LIGHT RAIL (DIS)PLACEMENT: NEIGHBOURHOOD CHOICE, TRANSIT AND LABOUR MARKET OUTCOMES

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1. Introduction

Ameliorating poor labour market outcomes in US cities is a perennial topic of acute policy interest. Labour market outcomes display strong spatial heterogeneity in US cities, with neighbourhoods of concentrated economic distress common in urban settings. Racial segregation interacts to ensure that these neighbourhoods contain a disproportionate share of a city's nonwhite population. Spatial mismatch theory proffers a cause for concentrated unemployment and poverty (Kain, 1968). The theory suggests that high unemployment, minority neighbourhoods are limited by their spatial access to employment opportunities. The expansion of access to labour market opportunities through improved transportation systems is a natural policy response to observed pockets of concentrated poverty. In recent years, the introduction of light rail transit (LRT) has been adopted by many US cities as a means to revitalize urban areas. It is not clear whether original residents are the ones benefiting from this place based revitalization. Consider –as one example– the rival opinions regarding the construction of a LRT line in the Minneapolis area.

> "We're trying to reconnect people, particularly people with high levels of unemployment, to the job market of today." – Peter McLaughlin, Hennepin County Commissioner, Minnesota
> "It wasn't really a transit system built to help folks in our community get from one place to the next." – Nathaniel Khaliq, Former NAACP President for St. Paul, Minnesota†

A common argument in favour of LRT construction is that LRT connects workers to firms. This study will search for evidence as to whether this contention is true. The first contribution of this paper will be to employ panel census tract data to estimate the neighbourhood change effects of LRT stations. The rapid proliferation of LRT construction and proposals in US cities inspire an urgency for such estimates. Analysis reveals that LRT stations are associated with significantly improved local labour market outcomes. The introduction of light rail also pushes up local home values and spurs the arrival of more affluent populations, accordant with gentrification concerns. The quasi-random introduction of LRT transit systems in three US cities over the 2000-2013 period is used to estimate causal neighbourhood effects.

Estimating unbiased neighbourhood effects provides little inference on individual level effects due to the fact that households may endogenously relocate. The ambition of this project is to apply a structural estimation model to disentangle the two elements that potentially contribute to LRT's positive effect on neighbourhood outcomes, namely: (1) The beneficial expansion of an individual's accessible labour market opportunities (overcoming spatial mismatch) and (2) Endogenous neighbourhood sorting in response to local transit infrastructure

2.1 Related Literature – Spatial Mismatch

This study will be concerned with identifying the local labour market consequences of spatial connectivity. The analysis of black populations in Chicago and Detroit in Kain (1968) provided early evidence that the spatial isolation of marginalized populations may be in part responsible for lagging labour market outcomes. Numerous subsequent studies have extended Kain's notion of spatial mismatch to explain spatial heterogeneity in urban labour market outcomes and particularly to explain the lagging outcomes of racial minorities and youth. A significant attempt at empirically estimating the effect of proximity to jobs was

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undertaken in Immergluck (1998). Results suggested a highly significant connection between household proximity to jobs and the local unemployment rate. Stoll (1999) provided evidence from Los Angeles that black and Hispanic workers undertook more extensive spatial job search than white residents. This behaviour appeared to be a compensating response to inferior locations relative to jobs among minority groups. Overall, the unemployed and poor tend to live in places that are isolated from relevant job opportunities (Holzer, 1991; Sanchez et al., 2004). However, observed correlations can not elucidate whether this pattern is the result of heterogeneous workers self-selecting into particular neighbourhoods, or if there is a causal effect of neighbourhood connectivity on individual employment outcomes. A thorough summary of the underlying theory of spatial mismatch and related theoretical works can be found in Gobillon et al. (2007).

2.2 Related Literature – The Role of Transit

The role of transit in neighbourhood sorting and neighbourhood change has been the subject of some prior work. LeRoy and Sonstelie (1983) provided a dynamic model of transportation induced urban change. LeRoy and Sonstelie (1983) noted that when the wealthy enjoy proprietary access to a rapid transportation technology they will optimally locate in the suburbs. However, when rich and poor residents have access to the same transportation technology, the rich will locate in the city center due to their increased time value of money. Glaeser et al. (2008) provided an analysis of why the poor concentrate in central cities. The presence of public transportation was examined as the likely culprit that holds poor residents in central cities. The current study extends analysis of heterogeneity in transport mode demand and its role in neighbourhood choice.

Baum-Snow and Kahn (2000) catalogue rail transit investment in five US cities during the 1980s. Results point towards increased home values and increased transit use. Baum-Snow and Kahn (2000) also demonstrated that rail investment during this era was preferentially directed towards affluent suburban areas. Kahn (2007) stressed the endogeneity of route and station site selection, finding new transit stations were resisted in affluent areas, and that stations were cited in tracts that were poorer and had higher black population shares. Home price results are somewhat disparate between cities in Kahn (2007). In general, new "walk and ride" stations were found to cause some gentrification in the area immediately surrounding the station, on average. Walk and ride stations were found to increase the share of the local population with a college degree by 5.1 percentage points, and increase local household income by 2%.

Tyndall (2017) made use of exogenous variation in transit access brought about by subway outages in New York City induced by a 2012 hurricane event. The sudden and spatially heterogeneous change in neighbourhood transit access provided an opportunity for identification. Results showed a rise in the local unemployment rate of 1.4 percentage points in neighbourhoods that lost subway access to the CBD. Results were robust to controlling for changes in observable neighbourhood demographics, though sorting on unobservables limited causal inference on the individual level.

2.3 Related Literature – Light Rail

A few studies have attempted to estimate the neighbourhood effects of LRT construction. Cao and Schoner (2014) implemented propensity score matching to study the ridership effects of a Minneapolis LRT line. Methodologically, Cao and Schoner (2014) discussed the importance of both spatially endogenous infrastructure investment and household location choice in estimating causal effects. Cao and Schoner (2014) found that residents moving towards new transit were no more likely to use transit than the residents they displaced; potentially because incoming residents were less dependent on transit. The possibility that rising rents will undercut LRT's provision of mobility to transit dependent populations will be central to the current study. Baker and Lee (2017) investigated LRT projects and related gentrification in fourteen US cities in the 1980s and 1990s. In contrast to the current study, the author's find no evidence of neighbourhood change in response to LRT construction.

This project will rely on a repeat sales index to estimate the effect of LRT on home prices. Chatman et al. (2012) undertook a repeat sales index analysis of the home price effect attributable to the construction of a LRT system in New Jersey and found little evidence of price appreciation. The LRT project analysed in Chatman et al. (2012) is somewhat unique in that it was built to facilitate intercity trips.

3. Light Rail Investment in US Cities

LRT transit has become a popular transportation and economic development strategy across the US. Figure 1 shows the national growth in LRT stations. Between 2000 and 2016 the number of LRT stations in the US grew by 60%. Station counts were obtained from the annual American Public Transportation Association Fact Book. The empirics of this study will focus on three metropolitan areas: Minneapolis, Minnesota; Salt Lake City, Utah; and Seattle, Washington. These three metropolitan areas all completed substantial LRT construction over the period of study. LRT construction in all cities included an extension to the regional airport.

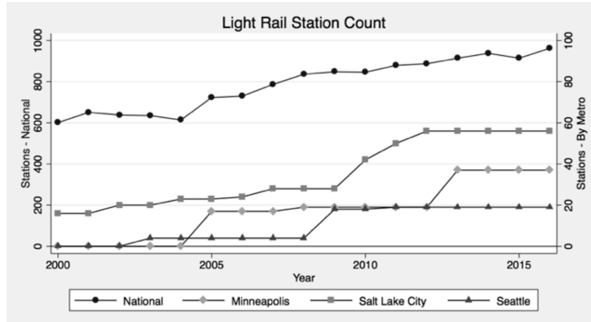


Figure 1: Proliferation of LRT Stations

4. Spatially Endogenous Transit Placement

Policy makers potentially direct rail investment towards neighbourhoods that have already achieved a reasonably high level of economic development, or are primed for future growth. Therefore, the comparison of neighbourhood change between tracts gaining and not gaining transit may yield biased results. This section proposes deriving quasi-randomness in rail investment by focussing on a common transit project type: lines connecting the CBD to the regional airport.

In 1975, of the 25 largest US metros, only the Boston area had a direct rail link from the CBD to the largest regional airport, today a majority of these metros have such a link. The economic development motivation for constructing rail links from city centres to airports is based on very little economic literature. Case studies have generally been unable to provide compelling arguments in favour of such projects (Stubbs and Jegede, 1998; Widmer and Hidber, 2000). Contrastingly, the political motivations for constructing such "mega-projects" appear to be strong. The origins of these large rail projects are often attributed to state or regional governments who are promoting broad economic development goals.

This study will use the rise in airport rail connections as a source of randomness in the spatial allocation of local rail infrastructure. The identifying assumption will be that neighbourhoods that happened to be en route to the airport were arbitrarily provided with rail service, while otherwise similar neighbourhoods in other areas of the city were not. Efforts will be taken to control for the possibility that being located on the way to the airport may have had additional time varying impacts on neighbourhood change.

5. Data

This study will use census tract level data from the 2000 US Decennial Census as well as the 2015 American Community Survey, five-year estimates. Census tract housing price data are obtained from the US Federal Housing Finance Agency (FHFA) Annual House Price Index (HPI). FHFA HPI estimates are derived from a repeat sales index constructed from multiple public and proprietary data sources on home sales.

Job flow data is obtained from the Longitudinal Employer-Household Dynamics, Origin-Destination Employment Statistics (LODES) data set. LODES provides linked workplace and residence data at the census block level. The data is compiled by the US Census Bureau. LEHD data coverage extends to 95% of wage and salary employment nationally, exceptions include self-employed individuals and US military personnel (Graham et al., 2014). 2013 data is used for post-treatment job locations, and 2002 data is used for pre-treatment job locations.

Estimating the accessibility impact of rail transit changes will be aided by detailed trip routing data from the Google Maps Application Programming Interface (API). The API provides estimated trip times between a matrix of origin-destination tracts. Step-by-step navigation instructions are gathered to identify origin-destination pairs that make use of the new LRT infrastructure.

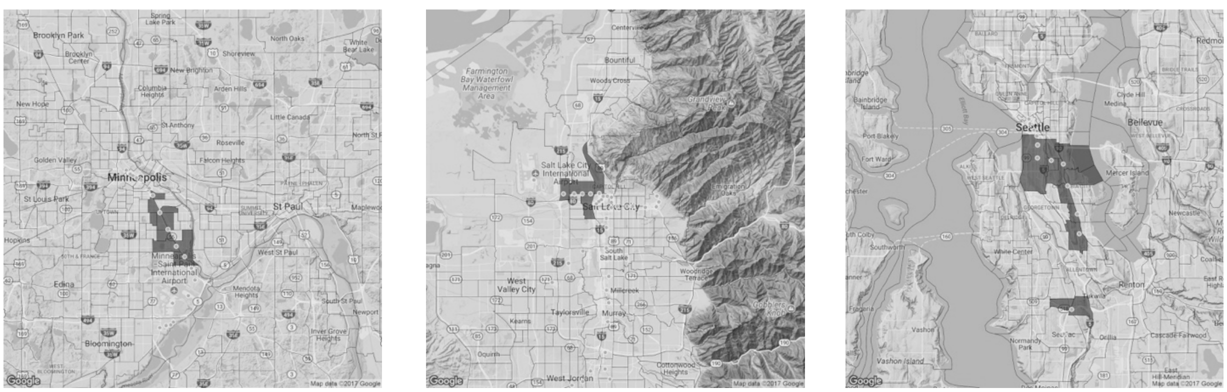
6.1 Propensity Score Matching

In order to identify the partial effect of gaining a local LRT station on neighbourhood level outcomes, this section will propose and implement a propensity score matching framework. A census tract will be considered to be "treated" by LRT if a new station was built within the tract, or within 1 km of the tract's centroid, between the pre and post treatment periods (2000-2013). Selection of treated neighbourhoods will be further limited by focusing on tracts that received LRT due to their location within an "airport corridor." As discussed in the previous section, the assignment of LRT to these tracts is plausibly exogenous to prior demographic levels or trends. Tracts within the CBD are excluded, proxied as any tract that has a centroid within 2 km of city hall. Tracts within a km of the airport are also excluded to avoid trends that might be specific to airports. There are 26 treatment tracts identified across the three metros. A control group is formed by matching each treated tract to a tract that is untreated, but had a similar probability of receiving treatment *ex ante*. Table 1 displays the matching variables selected. All matching variables are pre treatment (2000) values. Of the 10 matching variables displayed in Table 1, none are significantly different between the treatment and control groups, suggesting the propensity score matching method produced a valid control group. Figure 2 maps the location of all treated tracts used.

Table 1: Matching Balance Test

Variable	Treatment Group		Control Group		P-value
	Mean	Std. Dev.	Mean	Std. Dev.	
Public transit mode share	0.145	0.062	0.139	0.070	0.718
White pop share	0.511	0.229	0.519	0.267	0.906
College degree share	0.238	0.108	0.271	0.209	0.473
Employment	0.629	0.062	0.628	0.077	0.954
Unemployment	0.075	0.034	0.071	0.034	0.716
Median household income	38095	7996	41668	13035	0.239
Log distance to city hall	1.648	0.572	1.619	0.494	0.846
CBSA: Minneapolis	0.385	0.496	0.269	0.452	0.385
CBSA: Salt Lake City	0.154	0.368	0.231	0.430	0.491
CBSA: Seattle	0.462	0.508	0.500	0.510	0.787
N	26		26		

Figure 2: Propensity Score Matching, Treatment Tracts Highlighted



Minneapolis Salt Lake City Seattle

6.2 Neighbourhood Change Results

Matching estimates can provide information on how the average characteristics of neighbourhoods were changed as a result of new LRT amenities. All propensity score matching results correspond to the so-called average treatment effect (ATE). Standard errors are calculated according to the methodology proposed in Abadie and Imbens (2006). All estimates are executed in first differences to focus analysis on causal changes in neighbourhood characteristics.

A frequently stated policy goal of LRT transit investment is to increase the use of public transit and decrease reliance on privately owned vehicles. Table 2 estimates the partial effect of gaining a local station on the transportation mode share of local commuters. Column 1 indicates that the share of local commuters using public transit increased by 2.1 percentage points. The effect is not statistically significant. The effect is comparable to that estimated in Baum-Snow and Kahn (2000), that found a 1.42 percentage point increase in transit mode share when the closest rail station moved from 3 to 1 km away. The estimated effect of LRT on the share of commuters using a private vehicle is negative and significant. The introduction of LRT is found to reduce private vehicle mode share by 2.7 percentage points among commuters. The effect is small when compared to the average pre-treatment private vehicle mode share in treated tracts of 77.3%.

Table 2: Commuter Transportation Mode Effects

	Δ Public Transit	Δ Private Vehicle
	(1)	(2)
Gained Rail Access	.021 (.017)	-.027** (.007)
Mean 2000 value (treated obs)	.145	.773

Significance levels: * : 5% ** : 1%. Robust standard errors in parenthesis.

Table 3: Labour Market Effects

	Δ Employment Rate	Δ LF Participation Rate	Δ Unemployment Rate	Δ Median Income
	(1)	(2)	(3)	(4)
Gained Rail Access	.107** (.047)	.075** (.022)	-.051 (.039)	5930* (2814)
Mean 2000 value (treated obs)	.629	.681	.075	38095

Significance levels: * : 5% ** : 1%. Robust standard errors in parenthesis.

Table 3 estimates the change in neighbourhood level labour market outcomes. In general, the labour market outcomes at the neighbourhood level are found to respond very positively to the introduction of LRT. Table 3 reveals that the local employment rate rose by 10.7 percentage points, labour force participation rose by 7.5 percentage points and the unemployment rate fell by 5.1 percentage points. Furthermore, local median income is estimated to have risen by $5,900 on account of the introduction of local LRT service. Viewed as a type of place-based policy, LRT appears as a powerful tool to advance local labour market outcomes. These estimated effects represent causal effects at the neighbourhood level. However, the improvement of labour market outcomes amongst the neighbourhood's original residents is only one possible explanation for the finding. If local demographics were to shift such that residents with superior labour market abilities endogenously moved into the treated neighbourhoods, much of the observed labour market improvements might be explained by neighbourhood sorting.

Prior research has generally found transit amenities to have a positive effect on home values, with some work finding a negative effect directly adjacent to new stations. Propensity score matching is used to estimate the effect of treatment on the local HPI as reported in FHFA data, and median rents as reported by the US census (not shown). LRT significantly increased local home values by 8.5%. This estimate is in line with Kahn (2007) that found new "walk-and-ride" transit stations increased local home values by 5.4% 10 years after station construction and 10.8% after 20 years. Rents were found to increase by a large (but insignificant) $172, rising 28% from 2000 levels.

Table 4 and 5 present evidence of strong neighbourhood sorting in response to treatment. Increased home prices may reduce the appeal of a neighbourhood to lower income residents. However, higher valuation of public transit amongst low income residents suggests they may preferentially sort into LRT neighbourhoods. The effect of LRT on neighbourhood composition is therefore ambiguous in theory.

The issue of race has strong relevance to both spatial mismatch and gentrification concerns. Table 4 displays the estimated effect of obtaining a local rail station on neighbourhood racial composition. Estimates show that treatment increased the local white population share by 7.9 percentage points. Black, Asian and Hispanic population shares all decreased as a result of treatment.

Improved transportation may conceivably improve local educational outcomes by supplying better access to educational institutions for local residents. However, the magnitude of estimated effects appear far too large for such a mechanism, instead pointing towards strong neighbourhood sorting (Table 5). The introduction of LRT is estimated to increase the share of the local adult population with a high school diploma by a modest 3.0 percentage points (from a 2000 average of 76.2%). Contrastingly, post-secondary education rates rose markedly in treatment neighbourhoods. The share of the population with a

Table 4: Racial and Ethnic Composition Effects

	Δ White	Δ Black	Δ Asian	Δ Hispanic
	(1)	(2)	(3)	(4)
Gained Rail Access	.079* (.038)	-.024 (.033)	-.037** (.008)	-.008 (.016)
Mean 2000 value (treated obs)	.511	.130	.177	.150

Significance levels: * : 5% ** : 1%. Robust standard errors in parenthesis.

Table 5: Education Attainment Effects

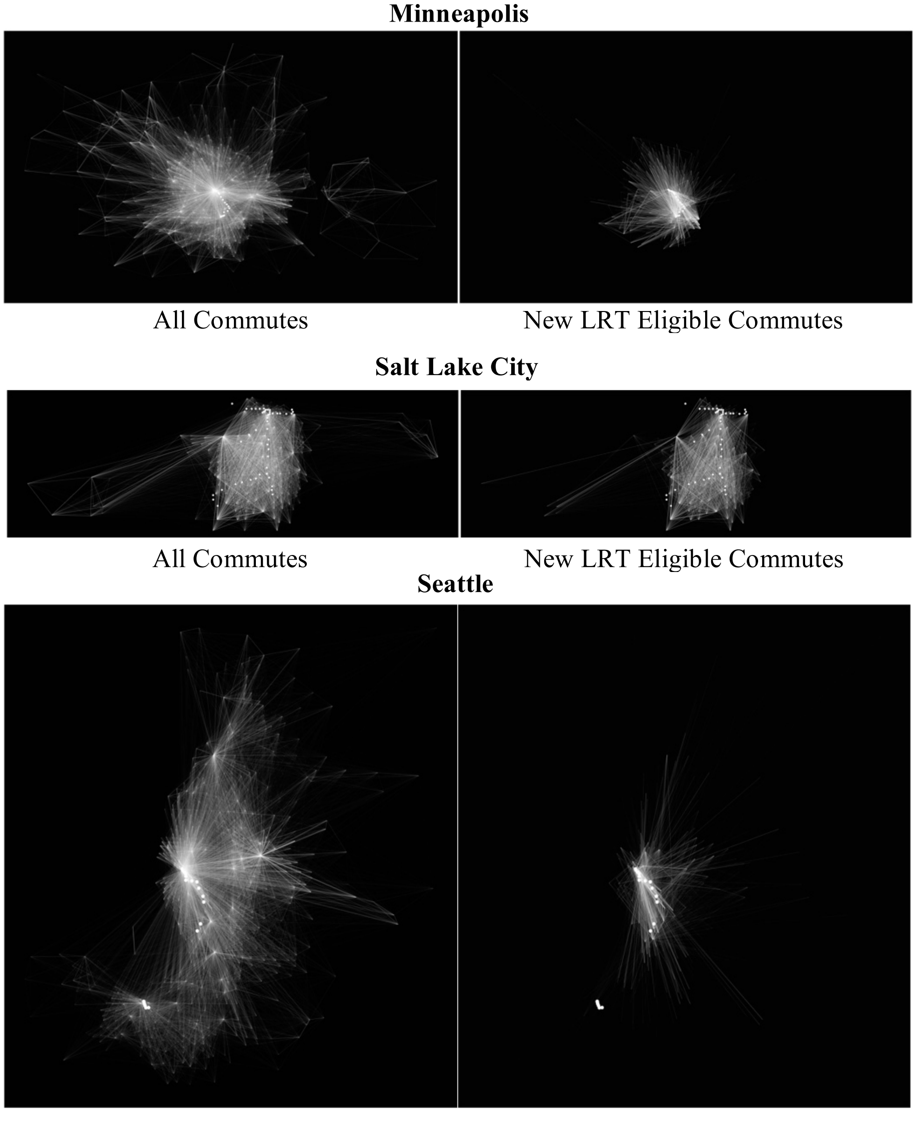
	Δ High School Diploma	Δ College Degree	Δ Graduate Degree
	(1)	(2)	(3)
Gained Rail Access	.030* (.013)	.138** (.013)	.063** (.006)
Mean 2000 value (treated obs)	.762	.234	.072

Significance levels: * : 5% ** : 1%. Robust standard errors in parenthesis.

college degree rose by 13.8 percentage points (from a baseline of 23.4%). The share of the local population with a graduate degree nearly doubled, rising 6.3 percentage points from a baseline of 7.2%.

Evidence of demographically heterogeneous neighbourhood sorting, coupled with property value increases suggests that a significant portion of the measured local labour market improvements could be attributable to the superior labour market abilities of workers who move into the neighbourhood after the arrival of LRT.

Figure 3: Mapping Commuter Flows



7. Effect of Light Rail on Job Flows

The prior section has demonstrated that neighbourhood level improvements in labour market outcomes can be causally related to the arrival of new LRT infrastructure. LRT may (or may not) have a causal effect on an individual resident's propensity to gain or maintain employment. If LRT projects are improving labour market outcomes through the expansion of employment access, it would be expected that once two neighbourhoods become better connected they would experience an increase in the number of commuters traversing between the neighbourhoods.

Google routing data is used to identify all home-work tract pairs for which the fastest transit route involves a segment of newly added LRT infrastructure. Of 1,171,521 possible home-work pairs, 62,054 (5.3%) were connected through new LRT infrastructure. Figure 3 maps the full set 2013 observed commute flows across the three cities. Commute routes that are populated by at least one commuter are captured on the map, with heavier lines indicating more commuters. In Salt Lake City, the large expansion of LRT resulted in 29.1% of home-work pairs now including LRT as a component of the quickest transit route. Relative to metro size, LRT construction in Minneapolis and Seattle were less expansive. In Minneapolis, 3.8% of routes involve new LRT infrastructure and in Seattle the figure is 4.5%.

Table 6 regresses the change in number of commuters traversing a particular home-work pair against a dummy variable for new LRT infrastructure, as shown in equation 1. The dummy variable takes a value of one if the fastest transit route involves an LRT station constructed between 2000 and 2013. Both home tract and work tract fixed effects are employed to control for time invariant tract characteristics. Estimation in first difference nets out time invariant effects specific to any pair of tracts. Column 2 shows the fixed effects estimation of the effect of a LRT connection on the number of commuters. Results show no evidence of a significant overall effect of LRT on the frequency a particular commute is completed, the point estimate represents a 0.3% increase in commuters from the 2000 base. The relatively modest public transit use across the three cities (5.3% of commuters in 2013) is consistent with LRT having only a minor effect on overall commute flows.

$$\Delta Flow_{jk} = \beta_0 + \beta_1[New\ LRT]_{jk} + \Phi_j + \Psi_k + \varepsilon_{jk} \quad (1)$$

j indexes home tract. k indexes work tract. Φ_j indicates home location fixed effects. Ψ_k indicates work location fixed effects. β_1 is the parameter of interest.

However, limiting the analysis to populations who are more likely to be reliant on public transit yields results that are much larger, suggesting LRT may in fact be successfully expanding the labour market prospects of particular populations. Column 4 shows that the number of commuters under the age of 30 within a home-work cell is increased by a significant 0.12 jobs, a 5.5% increase over 2000 levels. Column 6 limits analysis to jobs that pay less than \$15,000 annually –likely capturing part time and low wage employment– showing an increase of 0.10 jobs, contributing to a rise of 4.7% from the 2000 baseline.

Table 6: Change in Commuter Flows

	Δ All Jobs		Δ Under 30		Δ Low Income	
	(1)	(2)	(3)	(4)	(5)	(6)
Gained Rail	.185**	.023	.001	.120**	.032**	.097**
Access	(.030)	(.034)	(.010)	(.013)	(.010)	(.013)
Home Tract FE?	N	Y	N	Y	N	Y
Work Tract FE?	N	Y	N	Y	N	Y
Mean 2000 Flow	7.732		2.127		2.055	

Significance levels: * : 5% ** : 1%. Robust standard errors in parenthesis. N = 1,171,521

8. Urban Structural Estimation in the Presence of Sorting

The practice of estimating structural neighbourhood choice models is becoming increasingly popular due to advances in methodology as well as increased ubiquity of computational power. Structural estimation provides an important advantage in its ability to recover the parameter estimates that account for complex and endogenous choice. In regards to the current research question, the ability of new rail infrastructure to advance neighbourhood development is of general interest. However, a more fundamental question is how these investments translate into societal welfare changes. Particularly, it is of interest if LRT improves the matching between workers and firms.

Building from works such as Epple and Sieg (1999), Bayer et al. (2004), Sieg et al. (2004), Ferreyra (2007) and Ahlfeldt et al. (2015), this project seeks to develop a model of spatial sorting among workers and firms. The common challenge shared by these papers and my own task is to estimate the benefits of a spatially delineated public good in the presence of sorting. The neighbourhood effects estimated in the initial stage of this project can be used to calibrate sorting simulations. By assigning workers a utility function, the observed changes in the location of LRT stations and the corresponding changes in the commute time matrix can be reconciled with individual decisions of labour force participation, neighbourhood choice and mode choice. The resultant parametrized model can answer whether LRT is successful in improving connections between workers and firms. Work on structural modelling and estimation is ongoing. Model details and results are forthcoming in future drafts.

9. Conclusion

This study analyses recent LRT transport investment in three US cities. The arrival of LRT infrastructure to a neighbourhood is found to improve local labour market outcomes, shift demographic composition towards more affluent residents, increase home prices, and reduce the share of workers commuting by private vehicle. Sorting patterns are consistent with new LRT stations causing local gentrification.

Novel use of commuter flow data combined with Google routing data allows for the estimation of LRT's effect of commute flows. Among young and low income populations, LRT is linked to an increase in the number of workers commuting along LRT routes.

The value of LRT as a progressive labour market intervention is undercut by accompanying gentrification. Future work seeks to decompose these effects structurally to provide a more nuanced picture of how LRT impacts local labour markets.

References

Abadie, A. and Imbens, G. W. (2006). Large sample properties of matching estimators for average treatment effects. Econometrica, 74(1):235–267.

Ahlfeldt, G. M., Redding, S. J., Sturm, D. M., and Wolf, N. (2015). The economics of density: Evidence from the berlin wall. Econometrica, 83(6):2127–2189.

Baker, D. M. and Lee, B. (2017). How does light rail transit (LRT) impact gentrification? evidence from fourteen us urbanized areas. Journal of Planning Education and Research, DOI: 0739456X17713619.

Baum-Snow, N. and Kahn, M. E. (2000). The effects of new public projects to expand urban rail transit. Journal of Public Economics, 77(2):241–263.

Bayer, P., McMillan, R., and Rueben, K. (2004). An equilibrium model of sorting in an urban housing market. Technical report, National Bureau of Economic Research.

Cao, X. J. and Schoner, J. (2014). The influence of light rail transit on transit use: An exploration of station area residents along the Hiawatha line in Minneapolis. Transportation Research Part A: Policy and Practice, 59:134–143.

Chatman, D. G., Tulach, N. K., and Kim, K. (2012). Evaluating the economic impacts of light rail by measuring home appreciation: A first look at new jersey's river line. Urban Studies, 49(3):467–487.

Epple, D. and Sieg, H. (1999). Estimating equilibrium models of local jurisdictions. Journal of political economy, 107(4):645–681.

Ferreyra, M. M. (2007). Estimating the effects of private school vouchers in multidistrict economies. The American Economic Review, 97(3):789–817.

Glaeser, E. L., Kahn, M. E., and Rappaport, J. (2008). Why do the poor live in cities? the role of public transportation. Journal of urban Economics, 63(1):1–24.

Gobillon, L., Selod, H., and Zenou, Y. (2007). The mechanisms of spatial mismatch. Urban studies, 44(12):2401–2427.

Graham, M. R., Kutzbach, M. J., McKenzie, B., et al. (2014). Design comparison of lodes and ACS commuting data products. Technical report.

Holzer, H. J. (1991). The spatial mismatch hypothesis: What has the evidence shown? Urban Studies, 28(1):105–122.

Immergluck, D. (1998). Job proximity and the urban employment problem: do suitable nearby jobs improve neighbourhood employment rates? Urban Studies, 35(1):7–23.

Kahn, M. E. (2007). Gentrification trends in new transit-oriented communities: Evidence from 14 cities that expanded and built rail transit systems. Real Estate Economics, 35(2):155–182.

Kain, J. F. (1968). Housing segregation, negro employment, and metropolitan decentralization. The Quarterly Journal of Economics, 82(2):175–197.

LeRoy, S. F. and Sonstelie, J. (1983). Paradise lost and regained: Transportation innovation, income, and residential location. Journal of Urban Economics, 13(1):67–89.

Sanchez, T. W., Shen, Q., and Peng, Z.-R. (2004). Transit mobility, jobs access and low-income labour participation in us metropolitan areas. Urban Studies, 41(7):1313–1331.

Sieg, H., Smith, V. K., Banzhaf, H. S., and Walsh, R. (2004). Estimating the general equilibrium benefits of large changes in spatially delineated public goods. International Economic Review, 45(4):1047–1077.

Stoll, M. A. (1999). Spatial job search, spatial mismatch, and the employment and wages of racial and ethnic groups in Los Angeles. Journal of Urban Economics, 46(1):129–155.

Stubbs, J. and Jegede, F. (1998). The integration of rail and air transport in Britain. Journal of transport Geography, 6(1):53–67.

Tyndall, J. (2017). Waiting for the r train: Public transportation and employment. Urban Studies, 54(2):520–537.

Widmer, J.-P. and Hidber, C. (2000). Effects of rail stations at airports in Europe. Transportation Research Record: Journal of the Transportation Research Board, (1703):90–97.

†Quotes from *The Train Line That Brought the Twin Cities Back Together*, by E. Trickey, Politico Magazine, March 16, 2017.