Fixed Guideway Transit Outcomes on Rents, Jobs, and People and Housing

Arthur C. Nelson, Ph.D., ASCE, FAICP
Professor of Planning and Real Estate Development
University of Arizona
Changing Transportation Modes in 20th Century
Percent change 2003 to 2014 in population, vehicle miles traveled and FGT passenger miles annually
Theory

Transportation systems improve accessibility thereby reducing the friction of distance and increasing economic exchange.

But transportation systems (i.e. highways) can reduce economic development such as when beltways disperse to densities lower than their economic thresholds.

Adding new transportation modes in built-up urban areas can increase aggregate economic activity by making congested areas less congested.

Public transit should reduce production costs, increase income, raise property values, increase jobs, and raise the overall rate of return to real estate investments.

Scant research: We will help close this gap.
ASSOCIATION BETWEEN LOCATION IN 1/2 MILE AND 1/2 TO 1.0 MILE TRANSIT CORRIDORS AND ASKING RENTS FOR OFFICE, RETAIL AND APARTMENT SQUARE FOOT

THEORY

The real estate market values proximity to transit systems. This will be revealed as a rent premium per square foot for office, retail and apartment real estate with respect to location within the first one-half mile of a transit corridor and less so within the next one-half mile.

HYPOTHESES

$H_1$: There is no statistically significant association between rents per square foot of office, retail and apartment space with respect to location within one-half mile and between one-half and one mile of transit stations.

$H_2$: If $H_1$ is rejected, there is no difference in the magnitudes of coefficients between the distance bands.
TRANSIT STATIONS AND REAL ESTATE RENT VALUE-ADDED
Association between Location in 1/2 mile and 1/2 to 1.0 mile Transit Corridors and
Asking Rents for Office, Retail and Apartment Square Foot

METHOD
The theory can be tested through cross-section analysis such as
hedonic regression. It establishes associative relationships, not causal
ones. The “treatment” variables are whether a property is located
within one-half mile (1.0) or between one-half mile and one mile (1,0)
of a transit corridor. Control variables include building structure
features and metropolitan area location.

DATA
Rent data and building characteristic data for early 2015 are provided
by permission from CoStar.
### Association between Location in 1/2 mile and 1/2 to 1.0 mile Transit Corridors and Asking Rents for Office, Retail and Apartment Square Foot

<table>
<thead>
<tr>
<th>Corridor Width</th>
<th>Office</th>
<th>Retail</th>
<th>Apartment</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRT &lt;1/2 mile</td>
<td>-2.5%</td>
<td></td>
<td>3.0%</td>
</tr>
<tr>
<td>BRT 1/2-1.0 mile</td>
<td></td>
<td></td>
<td>1.7%</td>
</tr>
<tr>
<td>LRT &lt;1/2 mile</td>
<td>2.5%</td>
<td>4.5%</td>
<td></td>
</tr>
<tr>
<td>LRT 1/2-1.0 mile</td>
<td>2.3%</td>
<td>2.1%</td>
<td>2.5%</td>
</tr>
<tr>
<td>SCT &lt;1/2 mile</td>
<td>5.0%</td>
<td>6.3%</td>
<td>10.8%</td>
</tr>
<tr>
<td>SCT 1/2-1.0 mile</td>
<td>3.9%</td>
<td></td>
<td>9.0%</td>
</tr>
<tr>
<td>CRT &lt;1/2 mile</td>
<td>-2.2%</td>
<td>-3.5%</td>
<td></td>
</tr>
<tr>
<td>CRT 1/2-1.0 mile</td>
<td></td>
<td>-2.3%</td>
<td></td>
</tr>
</tbody>
</table>

BRT = Bus rapid transit  
LRT = Light rail transit  
SCT = Streetcar transit  
CRT = Commuter rail transit  

Only coefficients $p < 0.05$ reported
Association between Location in 1/2 mile and 1/2 to 1.0 mile Transit Corridors and Asking Rents for Office, Retail and Apartment Square Foot

FINDINGS

Light Rail Transit and Streetcar Transit systems have positive associations with respect to office, retail and apartment rents. Rents are highest in the closest corridor to transit lines. Residential has the highest percent association followed by retail and the office.

Bus Rapid Transit systems have no association with respect to office rents, a negative one with respect to retail rents in the closest corridor, but positive ones with respect to apartment location in both.

Commuter Rail Transit systems have negative associations with respect to office and retail land uses, and ambiguous associations with respect to apartments.

IMPLICATIONS

Light Rail Transit and Streetcar Transit systems have the most robust associations between transit corridor location and all land uses with the strongest influences on residential land uses.

Bus Rapid Transit systems do not appear to have strong influences on office rents, a minor and perhaps negative influence on retail rents, but positive though small influences on apartment rents.

Commuter Rail Systems are a disaster ... but no or bad planning may be the culprit.

Transit and land use planning may be guided by these market-based findings.
TRANSIT AND WAGES
The Association between Transit and Jobs by Wage Categories over Time within 1/2 Mile of Transit Stations

THEORY
Despite wishful thinking that transit will expand the supply of lower-wage jobs near transit stations, economic theory posits that transit will increase real estate values requiring investors to increase returns resulting in higher-wage jobs even to the extent of displacing lower-wage ones.

HYPOTHESIS
\(H_1\): There is no statistically significant association between the shift in the share of regional jobs by wage category between time periods with respect to location within a one-half mile distance band from the nearest transit station.
TRANSIT AND WAGES
The Association between Transit and Jobs by Wage Categories over Time within 1/2 Mile of Transit Stations

METHOD
Shift-share analysis can detect shifts in the share of jobs by wage category over time

- Regional shift = changes attributable to regional change
- Industry shift = changes attributable to sector change
- Station Area shift = changes attributable to location within 1/2 mile of transit stations (Station Area shift results are reported)

DATA
The Longitudinal Employment-Household Dynamics (LEHD) database is used for the period 2002 through 2011:

- Pre-Recession = 2002 (2004 in AZ) - 2007
- Recession/Recovery = 2007 - 2011
Wage Categories Defined

[Analysis does not use the LEHD wage categories]

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Description</th>
<th>Mean Annual Wages</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>Retail Trade</td>
<td>$25,779</td>
<td>Lower</td>
</tr>
<tr>
<td>71</td>
<td>Arts, Entertainment, and Recreation</td>
<td>$32,188</td>
<td>Lower</td>
</tr>
<tr>
<td>72</td>
<td>Accommodation and Food Services</td>
<td>$17,453</td>
<td>Lower</td>
</tr>
<tr>
<td>81</td>
<td>Other Services (except Public Administration)</td>
<td>$29,021</td>
<td>Lower</td>
</tr>
</tbody>
</table>

**Weighted Mean Wages and National Share of Jobs**

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Description</th>
<th>Mean Annual Wages</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>48</td>
<td>Transportation and Warehousing</td>
<td>$45,171</td>
<td>Middle</td>
</tr>
<tr>
<td>53</td>
<td>Real Estate and Rental and Leasing</td>
<td>$46,813</td>
<td>Middle</td>
</tr>
<tr>
<td>56</td>
<td>Administrative, Support, Waste Mgmt., Remediation</td>
<td>$35,931</td>
<td>Middle</td>
</tr>
<tr>
<td>61</td>
<td>Educational Services</td>
<td>$35,427</td>
<td>Middle</td>
</tr>
<tr>
<td>62</td>
<td>Health Care and Social Assistance</td>
<td>$44,751</td>
<td>Middle</td>
</tr>
</tbody>
</table>

**Weighted Mean Wages and National Share of Jobs**

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Description</th>
<th>Mean Annual Wages</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>22</td>
<td>Utilities</td>
<td>$94,239</td>
<td>Upper</td>
</tr>
<tr>
<td>31</td>
<td>Manufacturing</td>
<td>$54,258</td>
<td>Upper</td>
</tr>
<tr>
<td>42</td>
<td>Wholesale Trade</td>
<td>$65,385</td>
<td>Upper</td>
</tr>
<tr>
<td>51</td>
<td>Information</td>
<td>$83,677</td>
<td>Upper</td>
</tr>
<tr>
<td>52</td>
<td>Finance and Insurance</td>
<td>$88,677</td>
<td>Upper</td>
</tr>
<tr>
<td>54</td>
<td>Professional, Scientific, and Technical Services</td>
<td>$75,890</td>
<td>Upper</td>
</tr>
<tr>
<td>55</td>
<td>Management of Companies and Enterprises</td>
<td>$105,138</td>
<td>Upper</td>
</tr>
</tbody>
</table>

**Weighted Mean Wages and National Share of Jobs**

Source: Bureau of Economic Analysis
Shift in share of jobs by wage category within 1/2 mile of LIGHT RAIL stations

Shift in share of jobs by wage category within 1/2 mile of STREETCAR stations

Shift in share of jobs by wage category within 1/2 mile of BRT stations

Shift in share of jobs by wage category within 1/2 mile of COMMUTER RAIL stations
TRANSIT AND WAGES
The Association between Transit and Jobs by Wage Categories over Time within 1/2 Mile of Transit Stations

IMPLICATIONS
Serving downtowns/near-downtowns, Streetcar Transit systems experienced substantial gains in share of lower- and upper-wage jobs. These are in the retail, lodging and food service sectors that locate along downtown streetcar routes.

Light Rail Transit and Streetcar Transit systems attract upper-wage firms. Those stations command rent premiums than can be afforded only through more productive labor and thus higher paying jobs.

Light Rail Transit systems outside downtowns are dispersed and there may not be the critical mass of economic activity that justifies lower-wage firms to move close to them.

Bus Rapid Transit systems are in heavily-trafficked corridors. BRT stations may attract firms that pay lower- and middle-wages categories.

Firms are not attracted to Commuter Rail Transit stations. Little proactive planning/investment to make CRT stations attractive to development.
TRANSIT STATION DISTANCE-RELATED JOB SHARE CHANGE
Change in Share of Jobs over Time with Respect to Light Rail, Streetcar and Bus Rapid Transit Station Distance Band

THEORY
    Fixed-guideway transit investments should change the regional distribution of jobs over time favoring station proximity.

HYPOTHESIS
    \( H_1 \): There is no statistically significant association between the change in regional share of jobs over time with respect to distance band from the nearest transit station.

METHOD
    Semi-log regression is used to test the association between transit accessibility and jobs by distance band from transit stations from 2004 through 2011. Independent variables are transit station distance band and metropolitan area binaries.

DATA
    The Longitudinal Employment-Household Dynamics (LEHD) database is used for the period 2002 through 2011.
Percent of transit county job share change with respect to distance band from LIGHT RAIL transit stations, 2004-2011

~75% change occurs in 1st 1/2 mile
Percent of transit county job share change with respect to distance band from STREETCAR transit stations, 2004-2011

Approximately 67% change occurs in the first 1/2 mile.
Percent of transit county job share change with respect to distance band from BUS RAPID TRANSIT stations, 2004-2011

~75% change occurs in 1st 1/8 mile
TRANSIT STATION DISTANCE-RELATED JOB SHARE CHANGE
Change in Share of Jobs over Time with Respect to Light Rail, Streetcar and Bus Rapid Transit Station Distance Band

IMPLICATIONS

Light Rail Transit TOD planning focus on the first 1/2 mile but there is non trivial attractiveness to 1.25 miles.

Streetcar Transit stations TOD planning focus up to 1/2 mile $\rightarrow$ Streetcars are in highly dense urban environments more conducive to walking. But there is non-trivial attractiveness to 1.25 miles.

Bus Rapid Transit TOD planning may focus on the first 1/8 mile and less-so between 1/8 mile and 1/4 mile. Similar to prior research.
THE EFFECT OF TRANSIT STATION PROXIMITY ON CHANGE IN JOBS BY ECONOMIC SECTOR, 2008-2011

THEORY
The Great Recession has helped restructure the economy favoring transit station proximity for many economic sectors.

HYPOTHESIS

$H_1$: There is no statistically significant association between the change in regional share of jobs by economic sector over time with respect to several distance bands from the nearest transit station.

METHOD
Shift-share analysis can detect shifts in the share of jobs by wage category over time
Regional shift = changes attributable to regional change
Industry shift = changes attributable to sector change

Station Area shift = changes attributable to location within 1/2 mile of transit stations (Station Area shift results are reported)

DATA
The Longitudinal Employment-Household Dynamics (LEHD) database is used for the period 2008 through 2011.
Comparisons of Economic Group Job Change by LIGHT RAIL Transit Station Distance Band, 2008-2011

<table>
<thead>
<tr>
<th>Industry</th>
<th>&lt;=1/8 Mile</th>
<th>&gt;1/8 to &lt;=1/4 Mile</th>
<th>&gt;1/4 to &lt;=1/2 Mile</th>
<th>&gt;1/2 to &lt;=1.0 Mile</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Industrial</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>200</td>
</tr>
<tr>
<td>Retail-Acc-Food</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Knowledge</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Office</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Education</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Health Care</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Arts-Ent-Rec</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td>80</td>
<td>120</td>
<td>160</td>
<td>400</td>
</tr>
</tbody>
</table>
Comparisons of Economic Group Job Change by STREETCAR Transit Station Distance Band, 2008-2011

Thousands of Jobs

- >1/2 to <=1.0 Mile
- >1/4 to <=1/2 Mile
- >1/8 to <=1/4 Mile
- <=1/8 Mile

<table>
<thead>
<tr>
<th>Economic Group</th>
<th>&gt;1/2 to &lt;=1.0 Mile</th>
<th>&gt;1/4 to &lt;=1/2 Mile</th>
<th>&gt;1/8 to &lt;=1/4 Mile</th>
<th>&lt;=1/8 Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail-Acc-Food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts-Ent-Rec</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(50) (40) (30) (20) (10) 0 10 20 30 40 50

25
Comparisons of Economic Group Job Change by BRT Station Distance Band, 2008-2011

Thousands of Jobs

- >1/2 to <=1.0 Mile
- >1/4 to <=1/2 Mile
- >1/8 to <=1/4 Mile
- <=1/8 Mile

<table>
<thead>
<tr>
<th>Group</th>
<th>&gt;1/2 to &lt;=1.0 Mile</th>
<th>&gt;1/4 to &lt;=1/2 Mile</th>
<th>&gt;1/8 to &lt;=1/4 Mile</th>
<th>&lt;=1/8 Mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Retail-Acc-Food</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health Care</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts-Ent-Rec</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
THE EFFECT OF TRANSIT STATION PROXIMITY ON CHANGE IN JOBS BY ECONOMIC SECTOR, 2008-2011

IMPLICATIONS

First: Land-extensive industrial group firms in warehousing, wholesaling and utilities may be outbid for transit-accessible locations by more land-intensive economic groups.

Second: Considering only the economic groups that lost jobs, nearly all of them lost jobs at a faster pace within one mile of transit stations than the transit county as a whole. They may be outbid by other firms.

Third: For a given transit mode and within a given distance from a transit station, economic development planners may consider attracting firms in target economic groups.

Caveat → Another analysis found BRT attractive to manufacturing but closer examination showed micro-brewery attraction with synergistic/co-location restaurant outcomes.

Fourth: The distribution of change in jobs for any given economic group may be influenced by residential development that is attracted to transit stations.

In downtowns with streetcars, residential development may be outbidding nonresidential development for locations up to one-quarter mile away from SCT stations.
TRANSIT’S INFLUENCE ON DEMOGRAPHIC AND HOUSING CHANGE, 2000-2010

THEORY

Transit will influence demographic and housing patterns leading to population and housing growth near transit stations. As the benefits of transit may confer a premium on station proximity, higher income and by implication mostly White households may be attracted. As stations are associated with non-family externalities, mostly younger households without children will be attracted to locations near stations. To the extent the market capitalizes on location efficiencies, housing supply should increase.

COMPOSITE HYPOTHESIS

$H_1$: There is no statistically significant difference over the period 2000 to 2010 between change in the selected demographic features and housing within several distance bands from transit stations compared to the central county as a whole in terms of: (1) population; (2) White population; (3) minority population; (4) households; (5) households by type; (6) householders by age; (7) median household income; (8) housing units; and (9) housing tenure.

METHOD

This is a pre-post difference test using $Z$-scores at $p < 0.01$ to assess whether there are significant differences in demographic and housing outcomes between 2000 and 2010.

DATA

Decennial census for 2000 and mostly for 2010, and the ACS 5-year data for household income for 2010. The analysis is applied to all Light Rail Transit, Streetcar Transit and Bus Rapid Transit systems operating no later than 2005.
Householder age and tenure change within distance bands from LIGHT RAIL transit stations

![Graph showing householder age and tenure change](image)

- **65 and over**
- **35 to 64**
- **Under 35**

![Graph showing Thousands of Households](image)

- **Renter**
- **Owner**

![Graph showing Thousands of Households](image)
Householder age and tenure change within distance bands from STREETCAR transit stations

(1)

Thousands of Householders

65 and over
35 to 64
Under 35

Households by Tenure

Renter
Owner

(2)
Householder age and tenure change within distance bands from BRT stations

- Households 65 and over
- Households 35 to 64
- Households Under 35

Distance bands:
- 1/8 mile
- 1/4 mile
- 1/2 mile
- 3/4 mile
- 1 mile

- Renters
- Owners
IMPLICATIONS

Light Rail Transit and Streetcar Transit systems are associated with considerable demographic and housing change changes within the first 1/8 mile of transit stations and then from 1/4 to 1/2 mile.

• There appears to be a hollowing-out effect between 1/8 and 1/4 mile. Why?

Bus Rapid Transit systems have little effect on demographic and housing or tenure change in the first 1/8 mile but have important effects from 1/8 to 3/4 mile.

• Jobs clearly attracted to first 1/8 mile and may be displacing residential demand to the next bands.
Next Steps

- Update LEHD data to 2014, input into our analytic templates, and be able to assess true recovery outcomes.

- Expand rent analysis to include socioeconomic variables and submarkets of individual systems to generate local market outcomes.

- Drill down to station area or small area analysis ➔ our work has been at the 10k foot level but we have the data and tools to undertake small area analysis.