The Link between Transit Station Proximity and Mode Choice to Work, Working at Home, Vehicle Ownership, and Transportation Costs

with Implications for Transit and Land Use Planning

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ABSTRACT

One theorized benefit of proximity to such fixed route transit (FRT) systems such as light rail transit (LRT), bus rapid transit (BRT), and streetcar transit (SCT) is that residents will choose modes other than driving alone or carpooling to get to work. The extent to which FRT station areas themselves are also work destinations, people living near stations may also walk or bike to work. Moreover, proximity to transit enables those who work from home to access non-work destinations via transit or walking and biking if those destinations are near transit stations. In theory, these outcomes will also reduce household transportation costs. However, there is no literature that establishes the link between (a) FRT station proximity and mode choice to work, (b) an increase in share of people working at home, (c) reduced automobile ownership, and (d) transportation costs. This article helps address these limitations. Transit and land use planning implications are offered.

Fixed Route Transit Systems Used in Analysis *(26 metropolitan areas)*

Light Rail Transit	Year	Streetcar Transit	Year
Buffalo	1984	Atlanta	2014
Charlotte	2007	Dallas	2015
Cleveland	1980	Little Rock	2004
Dallas	1996	Portland	2001
Denver	1994	Salt Lake City	2013
Houston	2004	Seattle	2007
Minn.-St. Paul	2004	Tacoma	2003
Norfolk	2011	Tampa	2002
Phoenix	2008	Tucson	2014
Pittsburgh	1984		
Portland	1986	**Commuter Rail Transit**	**Year**
Sacramento	1987	Albuquerque	2006
Salt Lake City	1999	Austin	2010
San Diego	1981	Dallas-Fort Worth	1996
San Jose	1987	Miami Tri-Rail	1989
Seattle	2003	Minneapolis	1997
St. Louis	1993	Nashville	2006
		Orlando	2014
Bus Rapid Transit	**Year**	Portland	2009
Cleveland	2008	Salt Lake City	2008
Eugene-Springfield	2007	San Diego	1995
Kansas City	2005	San Jose-Stockton	1998
Las Vegas	2004	Seattle-Tacoma	2000
Nashville	2009		
Phoenix	2009		
Pittsburgh	1977		
Reno	2010		
Salt Lake City	2008		
San Antonio	2012		
San Diego	2014		
Seattle	2010		
Stockton	2007		

TRANSIT STATION PROXIMITY AND MODE CHOICE TO WORK, VEHICLE OWNERSHIP AND WORKING AT HOME

Research Question and Design

Relative to the counties within which FRT systems operate ("Transit Region"), are there shifts in the regional share over time of commuting mode choice with respect to FRT station proximity with respect to change in:

Driving alone and carpooling, transit, and walking and biking to work?

Workers working at home?

Household vehicle ownership?

The research question lends itself to pre-post quasi-experimental design.

Data

Census 2010
American Community Survey (ACS) 2016
Block groups (CBGs) using the 2010 geography
GIS used to assign CBGs to distance bands

Study Period

We evaluate shift in shares of demographic, housing, commuting and wage change over the period since the Great Recession (2008-2009), from 2010 through 2016.

Shift-share analysis as our analytic approach to estimate the shift in share of Mode Choice to Work, Working at Home, Vehicle Ownership over time, after the Great Recession.

Shift-share analysis assigns the change or shift in the share or concentration of jobs with respect to the region, other economic sectors, and the local area. The "region" can be any level of geography and is often the nation or the state. In our case, it is where we want to see whether there are intrametropolitan shifts in the share of demographic, housing, mode choice, and jobs by wage category changes with respect to transit station proximity. Our region is the "Transit Region" meaning those counties within which FRT systems operated during the entire study period. The "local" area is often a city or county or even state, but it can be any geographic unit that is smaller than the region. Our local areas are the FRT station areas within 0.125 (one-eighth) mile, 0.250 (one quarter) mile, 0.500 (one half) mile, 0.750 (three quarters) mile, and 1.000 mile of the nearest FRT station. As shifts in the share of activities may vary because of changes in demographic, housing, mode choice, and job by wage mixes, there is also an "industry mix" adjustment that we call "sector mix".

(1) $SS_i = TR_i + SM_i + FRT_i$

Where:

SS_i = Shift-Share
TR_i = Transit Region share
SM_i = Sector Mix
FRT_i = FRT Station Area shift

The equations for each component of the shift-share analysis are:

(2) $TR_i = [FRT\ Station\ Area^{t-1}_i \times TR^t_i / TR^{t-1}_i)$

(3) $SM_i = [(FRT\ Station\ Area^{t-1}_i \times TR^t_i / TR^{t-1}_i) - TR^t_i]$

(4) $FRT_i = [FRT\ Station\ Area^{t-1}_i \times (FRT\ Station\ Area^t_i / FRT\ Station\ Area^{t-1}_i - TR^t_i / TR^{t-1}_i)]$

Where:

$FRT\ Station\ Area^{t-1}_i$ = number of jobs in the FRT Station Area sector (i) at the beginning of the analysis period (t-1)

$FRT\ Station\ Area^t_i$ = number of jobs in the FRT Station Area in sector (i) at the end of the analysis period (t)

TR^{t-1}_i = total number of jobs in the Transit Region at the beginning of the analysis period (t-1)

TR^t_i = total number of jobs in the Transit Region at the end of the analysis period (t)

TR^{t-1}_i = number of jobs in the Transit Region in sector (i) at the beginning of the analysis period (t-1)

TR^t_i = number of jobs in the Transit Region in sector (i) at the end of the analysis period (t)

Findings

We find that the innermost (0.125-mile) distance band accounts for the largest shares of commuting activity, workers working at home, and vehicle ownership.

We find that as distances from transit stations decreased:

SOV/Carpooled use decreased;
Transit and walking increased (though biking stayed the same);
Combined transit-walk-bike-worked at home increased; and
Number of households owning vehicles decreased.

Shift in Share of Commuting Mode Choice, Workers Working at Home and Household Vehicle Ownership with Respect to LRT, BRT and SCT Station Proximity, 2010-2016

Commuting/Vehicles	Station Share 2010-2016 0.125	0.250	0.500	0.750	1.000
			Light Rail Transit		
Mode					
Total Workers	998,519	331,266	387,555	350,457	351,304
SOV/Carpooled	754,974	255,792	312,010	289,417	286,470
Transit-Bike-Walk-Home	230,024	70,471	70,206	49,859	59,703
Vehicles					
Vehicle(s) Present	677,061	225,736	267,607	242,090	239,195
No Vehicles	116,244	37,827	35,748	27,338	28,134
			Bus Rapid Transit		
Mode					
Total Workers	397,274	249,086	300,436	211,326	225,216
SOV/Carpooled	305,563	192,674	240,067	170,090	188,207
Transit-Bike-Walk-Home	86,035	52,492	56,351	35,162	33,390
Vehicles					
Vehicle(s) Present	273,460	173,857	205,976	145,330	156,257
No Vehicles	49,462	32,541	30,133	18,023	16,703
			Streetcar Transit		
Mode					
Total Workers	108,150	49,208	34,080	32,707	33,309
SOV/Carpooled	59,058	29,224	21,901	25,019	22,558
Transit-Bike-Walk-Home	47,276	19,201	11,467	6,172	10,246
Vehicles					
Vehicle(s) Present	71,576	34,387	23,369	23,353	23,483
No Vehicles	26,081	11,183	3,825	3,530	3,806

Note: Z-scores show these differences are statistically significant (p<0.01).

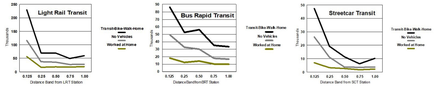

Illustration of commuting mode choice with respect to LRT, BRT and SCT station distance band

TRANSIT STATION PROXIMITY AND TRANSPORTATION COSTS

Do transportation costs as a share of median household incline decline with respect to FRT station proximity controlling for other factors?

General Model:

Regional Typical Household Transportation Cost Share = f(Location, Metropolitan Controls, FTR proximity)

Where:

Regional Typical Household Transportation Cost Share is the dependent variable. This is an index variable constructed by HUD for LAI version 2.0 and 2.1 databases. It is defined as the median household transportation cost divided by median household income at the census block group (CBG) or census tract (CT) for the 2012 5-year ACS or 2016 5-year ACS, respectively. Because "regional typical households" are themselves an index, they inherently include socioeconomic factors.

Location means distance to the central business district (***DCBD***), based on our Google map assessment of the highest value intersection, and distance to nearest freeway intersection (***DFreeway***).

The experimental variable is the ***distance from the nearest transit station*** to the CBG (2012 ACS) or CT (2016 ACS). We use **0.125**-mile distance bands to **2.00** miles; thus, all coefficients are interpreted in comparison to all cases beyond 2 miles.

To account for variation attributable to structural differences between metropolitan areas, we include ***Metropolitan Controls.***

Findings

For LRT systems, the typical regional households budget improved by an order of about one-half of one percent between 2012 and 2016 when considering transit station proximity.

But for BRT systems, the improvement was more than one percent (or roughly a 25% increase in savings).

In contrast, there was not no discernable change in savings associated with SCT station proximity between 2012 and 2016.

There was only a nominal change in the number of LRT and BRT systems between 2012 and 2016. The implication is that as systems mature and markets have time to respond to FRT systems, there may be some marginal shifting of residential development accordingly. This must not be over-stated however, as the household budget savings while not trivial are also not very large.

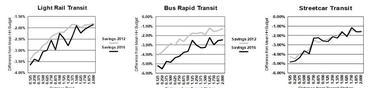

Illustration of the Association between Transit Station Proximity and Typical Regional Household Transportation Costs as a Percent of Regional Median Household Income by System Type
NOTE: Savings 2012 based on HUD LAI version 2.0 using block groups
Savings 2016 based on HUD LAI version 2.1 using census tracts

IMPLICATIONS FOR TRANSIT AND LAND USE PLANNING

Ours is the first study that links transit station proximity with differences in mode choice, working at home, vehicle ownership and household transportation costs. What are the lessons?

First, though subtle, transit station proximity makes a difference in mode choice to work. While the SOV/Carpool mode to work clearly dominates all modes, transit station proximity reduces auto use the closer a household lives to transit. Likewise, as households live closer to transit their use of transit increases as does walking to work, and working at home.

Second, proximity makes a difference with respect to vehicles owned by households; the closer a household lives to transit the fewer vehicles are owned on average.

Third, transit station proximity is associated with lower average household transportation costs.

Our findings rekindle the role of mortgage instruments such as location-efficient mortgages (LEM) are calibrated. Earlier versions may not have calibrated savings adequately.