12-2015

Do TODs Make a Difference?

Arthur C. Nelson
University of Utah

Matt Miller
University of Utah

Dejan Eskic
University of Utah

Keuntae Kim
University of Utah

Reid Ewing
University of Utah

See next page for additional authors

Recommended Citation

Nelson, A. C., Miller, M., Eskic, D., Kim, K., Ewing, R., Liu, J. H., ... & Mumuni, Z. (2015). Do TODs Make a Difference? NITC-RR-547/763. Portland, OR: Transportation Research and Education Center (TREC), 2015. http://dx.doi.org/10.15760/trec.7

Authors
Arthur C. Nelson, Matt Miller, Dejan Eskic, Keuntae Kim, Reid Ewing, Jenny H. Liu, Matt Berggren, and Zakari Mumuni

NITC

NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

FINAL REPORT

Do TODs make a difference?

NITC-RR-547/763 ■ *December 2015*

NITC is the U.S. Department of Transportation's national university transportation center for livable communities.

TREC

Transportation Insight for Vibrant Communities

DO TODs MAKE A DIFFERENCE?

Final Report

NITC-RR-547 and NITC-RR-763

by

Arthur C. Nelson
University of Utah and University of Arizona

Matt Miller
Dejan Eskic
Keuntae Kim
Joanna P. Ganning
Reid Ewing
University of Utah

Jenny Liu
Matt Berggren
Zakari Mumuni
Portland State University

for

National Institute for Transportation and Communities (NITC)
P.O. Box 751
Portland, OR 97207

NITC NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES

December 2015

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle

National Study of BRT Development Outcomes

5. Report Date

December 7, 2015

6. Performing Organization Code

7. Author(s)

Arthur C. Nelson, Matt Miller, Dejan Eskic, Keuntae Kim, Joanna P. Ganning, Reid Ewing, Jenny Liu, Matt Berggren, Zakari Mumuni

8. Performing Organization Report No.

9. Performing Organization Name and Address

Arthur C. Nelson
c/o Metropolitan Research Center
University of Utah
375 South 1530 East Room 235,
Salt Lake City, Utah 84112

10. Work Unit No. (TRAIS)

11. Contract or Grant No.

NITC-UU-14-650

12. Sponsoring Agency Name and Address

National Institute for Transportation and Communities (NITC)
P.O. Box 751
Portland, Oregon 97207

13. Type of Report and Period Covered

Final Report

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

In this report, we present research that measures the outcomes of TOD areas in relation to their metropolitan area controls with respect to (1) jobs by sector, (2) housing choice for household types based on key demographic characteristics, (3) housing affordability based on transportation costs, and (4) job-worker balance as a measure of accessibility. Prior literature has not systematically evaluated TOD outcomes in these respects with respect to light rail transit (LRT), commuter rail transit (CRT), bus rapid transit (BRT), and streetcar transit (SCT) systems. Our analysis helps close some of these gaps. We apply our analysis to 23 fixed guideway transit systems operating in 17 metropolitan areas in the South and West that have one or more of those systems. We find: (1) most TOD areas gained jobs in the office, knowledge, education, health care and entertainment sectors, adding more than $100 billion in wages capitalized over time; (2) in assessing economic resilience associated with LRT systems, jobs continued to shift away from TOD areas before the Great Recession, the pace slowed during the Recession, but reversed during recovery leading us to speculate that LRT TOD areas may have transformed metropolitan economies served by LRT systems; (3) rents for offices, retail stores and apartments were higher when closer to SCT systems, had mixed results with respect LRT systems, but were mostly lower with respect to CRT systems (our BRT sample was too small to evaluate); (4) SCT systems performed best in terms of increasing their TOD area shares of metropolitan population, households and householders by age, housing units, and renters with BRT systems performing less well while LRT and CRT systems experienced a much smaller shift in the share of growth; (5) household transportation costs as a share of budgets increase with respect to distance from LRT transit stations to seven miles suggesting the proximity to LRT stations reduces total household transportation costs; (6) emerging trends that may favor higher-wage jobs locating in transit TOD areas over time than lower or middle wage jobs perhaps because TOD areas attract more investment which requires more productive, higher-paid labor to justify the investment; and (7) the share of workers who commute 10 minutes or less to work increases nearly one-half of one percent for each half-mile their resident block group is to an LRT transit station, capping at a gain of 1.3 percent, which is not a trivial gain. Our report summarizes case studies of 23 transit systems and three journal articles based on our research.

17. Key Words

Transit Oriented Development, Light Rail Transit, Bus Rapid Transit, Commuter Rail Transit, Streetcar, Employment, NAICS, Industry, Sectors, Economic Development, Affordability, Household Income, HUD, Longitudinal-Household Employment Database, Employment Change, Transportation planning,

18. Distribution Statement

No restrictions. Copies available from NITC:
www.nitc.us

19. Security Classification (of this report)	20. Security Classification (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	237	

ACKNOWLEDGEMENTS

This research was funded by the National Institute for Transportation and Communities (NITC), in addition to the following partners: Utah Transit Authority, Salt Lake County, Wasatch Front Regional Council, Mountainlands Association of Governments, University of Utah, Portland State University, and University of Arizona.

Additionally, we acknowledge and thank the anonymous peer reviewers who provided immensely helpful insights and corrections to this report.

DISCLAIMER

The contents of this report reflect the views of the authors, who are solely responsible for the facts and the accuracy of the material and information presented herein. This document is disseminated under the sponsorship of the U.S. Department of Transportation University Transportation Centers Program and the partners mentioned above in the acknowledgements in the interest of information exchange. The U.S. Government and mentioned partners assumes no liability for the contents or use thereof. The contents do not necessarily reflect the official views of the U.S. Government or the other partners. This report does not constitute a standard, specification, or regulation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The United States is moving into a new era of metropolitan development and form. The demographic, economic, and finance drivers that made America a suburban nation may have run their course. America will see a shift toward infill and redevelopment. Facilitating this will be fixed-guideway transit systems and the transit oriented developments (TODs) they serve.

In this report, we present research that measures the outcomes of TOD areas in relation to their metropolitan area controls with respect to (1) jobs by sector, (2) housing choice for household types based on key demographic characteristics, (3) housing affordability based on transportation costs, and (4) job-worker balance as a measure of accessibility. Prior literature has not systematically evaluated TOD outcomes in these respects with respect to light rail transit (LRT), commuter rail transit (CRT), bus rapid transit (BRT), and streetcar transit (SCT) systems. Our analysis helps close some of these gaps. We apply our analysis to 23 fixed guideway transit systems operating in 17 metropolitan areas in the South and West that have one or more of those systems. We find:

> Most TOD areas gained jobs in the office, knowledge, education, health care and entertainment sectors, adding more than $100 billion in wages capitalized over time;
>
> In assessing economic resilience associated with LRT systems, jobs continued to shift away from TOD areas before the Great Recession, the pace slowed during the Recession, but reversed during recovery leading us to speculate that LRT TOD areas may have transformed metropolitan economies served by LRT systems;
>
> Rents for offices, retail stores and apartments were higher when closer to SCT systems, had mixed results with respect LRT systems, but were mostly lower with respect to CRT systems (our BRT sample was too small to evaluate);
>
> SCT systems performed best in terms of increasing their TOD area shares of metropolitan population, households and householders by age, housing units, and renters with BRT systems performing less well while LRT and CRT systems experienced a much smaller shift in the share of growth;
>
> Household transportation costs as a share of budgets increase with respect to distance from LRT transit stations to seven miles suggesting the proximity to LRT stations reduces total household transportation costs;
>
> Emerging trends that may favor higher-wage jobs locating in transit TOD areas over time than lower or middle wage jobs perhaps because TOD areas attract more investment which requires more productive, higher-paid labor to justify the investment; and
>
> The share of workers who commute 10 minutes or less to work increases nearly one-half of one percent for each half-mile their resident block group is to an LRT transit station, capping at a gain of 1.3 percent, which is not a trivial gain.

Our report summarizes case studies of 23 transit systems and three journal articles based on our research. It also poses transportation and land use planning policy implications.

INTRODUCTION

The United States is moving into a new era of metropolitan development and form. The demographic, economic, and finance drivers that made America a suburban nation may have run their course. America will see a shift toward infill and redevelopment. Facilitating this will be fixed-guideway transit systems and the transit oriented developments (TODs) they serve.

In this report, we present research that measures the outcomes of TOD areas in relation to their metropolitan area controls with respect to (1) jobs by sector, (2) housing choice for household types based on key demographic characteristics, (3) housing affordability based on transportation costs, and (4) job-worker balance as a measure of accessibility. Prior literature has not systematically evaluated TOD outcomes in these respects with respect to light rail transit (LRT), commuter rail transit (CRT), bus rapid transit (BRT), and streetcar transit (SCT) systems. Our analysis helps close some of these gaps. We apply our analysis to 23 fixed-guideway transit systems operating in metropolitan areas in the South and West that have one or more of those systems.

In **Chapter 1**, we evaluate the change in employment by clusters of jobs from 2002 or the year when each system opened (if after 2002). We find that TOD areas in most LRT, SCT and CRT transit systems experienced growth in the office, knowledge, education, health care and entertainment sectors. TOD areas in half of the BRT systems gained jobs in the office, education and health care sectors. We also estimated the economic gains from new jobs locating within TOD areas: Summed across all systems, we estimate that TOD areas gained more than $100 billion in wages capitalized over time. CRT TOD areas gained the most, followed by SCT, LRT and BRT TOD areas.

We use **Chapter 2** to pose a theory that fixed-guideway transit systems, such as light rail systems, may improve metropolitan-scale resilience and transformability during economic shocks. We tested our theory using the eight metropolitan areas with LRT systems operating since 2004. Between 2002 and 2007, these metropolitan areas experienced higher growth rates than nation as a whole. They also collectively saw eroding shares of employment within 0.50-mile LRT TOD areas relative to their metropolitan areas. The shift in share of jobs away from LRT stations slowed during the Great Recession. Afterwards, during recovery, however, LRT TOD areas gained share in the shift of metropolitan jobs. We see this shift as evidence of regional transformation associated with LRTs and their TOD areas.

Using CoStar asking-rent data for real estate within one-mile corridors of several LRT, BRT, SCT and CRT systems though not all, in **Chapter 3** we estimate the association between transit corridor proximity and rents. For the most part, SCT has the most important outcomes. This is notable because also, for the most part, economic outcomes to SCT systems are the least understood given their recent emergence. LRT systems expressed significant associations with respect to rent away from the center of the corridor. However, results for BRT are mixed with no statistically significant association with respect to office rent, a negative association with respect to the retail first distance band, but positive effects for rental apartments. Across all development types, proximity to CRT corridors either has an insignificant association or a negative one. We are not surprised given the freight-station nature of CRT systems.

Planners hope that TOD areas will attract people and housing. In **Chapter 4**, we observe that For the most part, there is very little research assessing whether TODs accomplish these objectives. We find that of the modes studied, streetcar transit systems performed best in terms of increasing their TOD area shares of metropolitan population, households and householders by age, housing units, and renters. LRT and CRT systems experienced a much smaller shift in the share of growth but they also serve many times more TOD areas with much larger geographic service areas. For the most part we do not find that BRT systems are associated with substantial shifts in population, household and housing unit location over time.

It seems assumed that transportation costs as a share of household income increase with respect to distance from downtowns, freeway interchanges, and—of key interest to us—light rail transit stations. Yet, there are no studies assessing this. To help close this gap in research, in **Chapter 5** we evaluate block group data for all 12 metropolitan areas with light rail transit stations operating in 2010. We use the Department of Housing and Urban Development Location Affordability Index database which estimates the share of household budgets consumed by transportation. We find that household transportation costs as a share of budgets increase with respect to distance from transit stations to seven miles.

We evaluate the potential role of transit systems to influence the distribution of jobs by lower, middle and upper wage categories in **Chapter 6**. While we find mixed results, we detect emerging trends that may favor higher-wage jobs locating in transit TOD areas over time than lower or middle wage jobs. We reason that as the real estate market values fixed-guideway transportation investments, firms needing transit-accessible locations also have higher-value labor needs with the effect that lower-wage jobs are displaced from TOD areas.

There is growing concern about increasing commuting trips and travel times with associated deterioration of individual quality of life. We theorize in **Chapter 7** that one benefit of transit and associated TOD areas is to shorten commute times for people living in or near them, and this may have important implications for personal well-being. We find that the share of workers who commute 10 minutes or less to work increases nearly one-half of one percent for each half-mile their resident block group is to a transit station, capping at a gain of 1.3 percent, which is not a trivial gain. Combined with other work, we sense that TOD areas may improve the well-being of those who can afford to live in them, presumably because their higher-wage jobs are nearby thereby reducing commuting time. This outcome would be consistent with emerging well-being literature.

A summary of three earlier works published by many members of our team are also reported in **Chapter 8** though details are reported elsewhere. A case study of the Eugene-Springfield bus rapid transit system found, for instance, that BRT stations attracted certain economic sectors to within about one-quarter mile, displaced other sectors to one-half mile or beyond, but that most of the changes in jobs occurred within the first quarter mile. On the other hand, a case study of apartment building values per square foot in Salt Lake County, Utah, with respect to distance from the nearest light rail transit station found positive value premiums out to 1.25 miles—a distance well beyond the conventional "half-mile circle". Another case study, this one of office asking rents in the Dallas, Texas, market found office rent premiums nearly two miles away from the nearest LRT station with roughly a quarter of the premium dissipating after one-half mile, half the premium dissipating at about a half mile, and three-quarters dissipating about one mile away—meaning nontrivial office rent premiums extend about a mile from the nearest LRT station in the Dallas market.

We use Chapter 9 to summarize our findings and suggest that work will inform decision-makers at all levels of government about whether and the extent to which TODs make a difference in economic development with respect to jobs generally and with respect to resiliency during recessions, expanding housing choice to specific household types, enhancing housing affordability, improving job-worker balance, and especially reconsidering the conventional half-mile circle for future TOD area planning.

Our analysis also includes 23 in-depth case studies of LRT, BRT, SCT and CRT systems. They are available through the National Institute for Transportation and Communities and are cited in the references and selected bibliography under Miller et al. (17 case studies) and Liu et al. (six case studies).

CHAPTER 1
Employment Change in LRT, BRT, SCT and CRT TOD Areas

In this opening chapter, we report change in by economic sector over time within transit oriented development (TOD) areas—measured as one-half mile distances from transit stations— for light rail transit (LRT), bus rapid transit (BRT), streetcar transit (SCT), and commuter rail transit (CRT) systems. We begin with an overview of the relationship between transit and the growth of urban areas. This is followed by sections on changes and shift-share assessments of change over time. The chapter concludes with implications for transit planning considering how economic sectors respond to individual types of systems.

Transit and the Rise of Urban Areas
Urban areas are formed and grow in large part by creating agglomeration economies (Glaeser 2011). Annas, Arnott and Small define the term as "the decline in average cost as more production occurs within a specified geographical area" (1998, p. 1427). As more firms in related sectors cluster together, costs of production fall as productivity increases. These economies can spill over into complementary sectors (Holmes 1999). Cities can become ever larger as economies of agglomeration are exploited (Ciccone and Hall 1996). Transportation improvements make it possible to reduce transportation times, increasing the size of market areas, increasing the effective size of industrial clusters. If cities get too large, however, transportation congestion may have a counter-productive force, encouraging the relocation of firms (Bogart 1998). Highway projects have been shown to induce this change in metropolitan form, and at a net cost to society (Boarnet 1997; Boarnet and Haughwout 2000). Because firm location follows residential relocation (Ganning and McCall 2012; Renkow and Hoover 2000), changes in firm location may not be temporally trackable to specific highway projects. If we presume the urban rent curve to be a proxy for accessibility, any transportation improvement having a metropolitan-area effect will shift the value surface of the land market. Thus, firm location in a metropolitan area is a sort of slow-motion equilibrium assignment process. In a static or stagnant economy, any transportation improvement will just shuffle jobs (and housing) around.

More recent research shows that the degree of suburbanization significantly varies within metropolitan regions, in accordance to both variation in the levels of population de-concentration drivers and due to sub-regional fixed effects (Ganning and McCall 2012). Thus, the preservation of and creation of new agglomeration economies within metropolitan regions varies tremendously and can be influenced by policy decisions.

A key role of transit is thus to mitigate transportation congestion effects of agglomeration. Voith (1998) characterizes public transit as essentially "noncongestible" and is best suited to sustaining agglomeration economies in downtowns and secondary activity centers, and along the corridors that connect them. Nonetheless, not all economic sectors benefit from agglomeration economies and/or density.

In part because of their role in facilitating agglomeration economies, there is a growing body of research showing that rail-based public transit enhances economic development (see Nelson et al. 2009). Transit improves accessibility between people and their destinations by reducing travel time relative to alternatives (Littman 2009). At the metropolitan scale, adding transit modes in built-up urban areas increases aggregate economic activity (Graham 2007). There is another aspect of agglomeration economies identified by Chapman and Noland (2011). Although transit systems can lead to higher density development by shifting new jobs and population to station areas, it could lead instead to the redistribution of existing development even in the absence of growth, as in the case of Detroit (Galster 2012).

Economic development can be measured in many ways. Our focus here is whether, and to what extent, there is a link between a specific form of transit and employment changes. We are specifically concerned with the changes both the numbers and concentration of jobs. Theoretically, areas proximate to commuter rail stations should have much better accessibility. Commuter Rail systems tend to run parallel to major freeway corridors, and the main impetus for their construction tends to be mitigation congestion along parallel freeway corridors. By reducing the effects of congestion, TODs should abet the preservation of existing agglomeration economies and the creation of new ones. Without the diseconomies of congestion, existing employment clusters should continue to grow, and the relative concentration of employment within clusters served by a TOD should continue to increase.

A necessary caveat for this phenomenon to occur is fixed amount of urbanized area. While most metropolitan areas with commuter rail system are characterized by geographical and regulatory constraints to their expansion, they cannot be considered fixed. Thus, employment concentration near transit stations may not always rise. In such cases, it is possible to assess the effect of proximity to a transit station by determining if employment near the station grew faster than would be expected on the basis of general metropolitan growth and industry mix.

Secondly, we are concerned about which industries in which total employment or employment concentration increase. We know from recent work that not all firms benefit from transit. In their recent study of employment within one-half mile of transit stations serving 34 transit systems, Belzer, Srivastava and Austin (2011) found that while jobs increase in the arts, entertainment, and recreation sector as well as the food and accommodation, and health care and social assistance sectors, they fell in the manufacturing sector. They also found that public administration had the greatest share of jobs found near transit stations. Several other sectors also concentrated around transit stations such as professional, scientific, and technical services, and retail. On the other hand, as a whole the station areas experienced declining shares of jobs relative to their regions, with the exception of jobs in the utilities, information, and the arts, entertainment, and recreation sectors. Belzer, Srivastava and Austin surmised that much of the metropolitan job growth continues to favor auto-oriented locations. Their study did not report results for individual systems or even types of systems. Also, with a study period from 2002 to 2008, it did not include the Great Recession. In sum, there is no research directly linking transit to economic development. The next section helps close this gap.

Employment Change within TODs of Transit Systems

The work reported by Belzer, Srivastava and Austin aggregated employment in one-half mile TOD areas for all transit systems from 2002 through 2008 regardless of mode and when systems actually opened. Our analysis:

- Differentiates by LRT, BRT, SCT and CRT mode;
- Analyzes change from 2002 (the earliest year for which data are available) or year of opening; and
- Extends past the Great Recession to 2011.

However, we did not include the 34 transit systems used in the Belzer, Srivastava and Austin study; they included heavy rail systems as well as systems in northeastern and Great Lakes areas that we did not.

Similar to Belzer, Srivastava and Austin, we used the Longitudinal Employment-Household Dynamics database produced by the Census for nearly all states (excluding Massachusetts) since 2002 (2004 for Arizona).

We exclude natural resources jobs from our analysis since our principal interest is whether and the extent to which TODs influences job distribution over time which likely applies to only non-resource jobs. We further combine jobs into roughly homogeneous economic sector categories thereby reducing from 17 non-resource jobs to the following categories. Table 1.1 reports our combination of economic sectors into groups of sectors for our analysis.

We note that our combinations are somewhat different from those used by Belzer, Srivastava and Austin. Our interest is mostly in land use demands associated with different clusters of economic sectors. For instance, they combined education and medical sectors which we separate, and they combined arts/entertainment/recreation with lodging and food service where we combined the latter sector with retail. (For details, see Belzer, Srivastava and Austin p. 14.)

Like Belzer, Srivastava and Austin, we report change in TOD area employment over time, though we calculate change during time periods more precisely aligned with system operations as well as differentiating by type of transit. These results are reported in tables 1.2 through 1.5 respectively for LRT, BRT, SCT and CRT systems. We illustrate changes in TOD area employment by sector in figures 1.1 through 1.4, respectively. Table 1.6 summarizes the number and percent of LRT, BRT, SCT and CRT systems that have positive employment growth TOD areas. It also shows combined results for all systems.

Before we review outcomes, let us review overall expectations of employment change over time with respect to different modes of transit with respect to our combinations of economic sectors.

Manufacturing is commonly perceived as a land-intensive activity and such one may expect manufacturing firms to seek locations where land prices are low—thus not in high-value urban areas such as within TODs. On the other hand, manufacturing processes that do not need much land but depend on high-quality labor may well find locations within TODs necessary to attract labor. Unfortunately, the LEHD database does not allow us to differentiate between land-extensive and TOD-attractive manufactures.

Nonmanufacturing industrial activities as we have grouped them are often land-extensive enterprises requiring inexpensive land, such as for warehousing and use of transportation equipment, probably away from high-value TOD areas.

Retail, lodging and food service activities would seem to generally locate generally where people or where lower-cost lodging services are attractive such as along freeway interchanges and suburban centers. We might not anticipate these activities being attractive to TOD areas.

Office, *knowledge*, *education* and *health care* activities might be attractive to TOD areas for the convenience of workers, students, and clients to take advantage of agglomeration economies associated with clustering at transit centers.

Arts, entertainment and recreation activities come in many forms among them museums as well as performing arts and sports venues. Certain activities lend themselves to TOD location.

We now review key findings for each system below. We report details of TOD-area employment by sector for each transit system in Appendix B (which also applies to Chapter 2).

Combinations of NAICS Sectors for Analysis

Table 1-1

NAICS	Sector Title
	Manufacturing
31-33	Manufacturing
	Nonmanufacturing Industrial (Non Man Ind.)
22	Utilities
42	Wholesale Trade
48-49	Transportation and Warehousing
	Retail & Lodging
44-45	Retail Trade
72	Accommodation and Food Services
	Office
52	Finance and Insurance
53	Real Estate and Rental and Leasing
55	Management of Companies and Enterprises
56	Administrative and Support and Waste Management and Remediation Services
81	Other Services (except Public Administration)
92	Public Administration
	Knowledge
51	Information
54	Professional, Scientific, and Technical Services
	Education
61	Educational Services
	Health
62	Health Care and Social Assistance
	Entertainment
71	Arts, Entertainment, and Recreation

Source: Adapted from the North American Industrial Classification System.

TOD area Total Employment Change by Sector for LRT Systems and Annual Average 2002-2011

Table 1-2

Sector	Charlotte Total 2007-2011	Dallas Total 2002-2011	Denver Total 2002-2011	Houston Total 2004-2011	Phoenix Total 2009-2011	Portland Total 2002-2011	Sacramento Total 2002-2011	Salt Lake City Total 2002-2011	San Diego Total 2002-2011	Twin Cities Total 2004-2011	Annual Average LRT TODs
Manufacturing	(817)	(1,846)	(789)	1,893	19	(135)	(25)	(190)	(2,856)	(828)	(692)
Non Man Ind.	266	(2,782)	(1,649)	(1,123)	61	(478)	382	(69)	(694)	3,340	(174)
Retail/Lodging	871	(208)	(2,008)	1,857	499	2,705	93	(415)	(907)	(4,082)	67
Office	37	8,210	3,393	6,484	(1,786)	(1,369)	1,830	(1,060)	(1,903)	3,336	1,530
Knowledge	239	(916)	1,217	(579)	189	1,439	163	(135)	3,162	(4)	619
Education	1,628	1,143	253	(20,630)	91	(6,383)	148	335	156	204	(2,949)
Health	1,532	3,263	486	382	(1,128)	961	101	53	4,278	2,828	1,293
Entertainment	891	(880)	1,606	98	(66)	(39)	2	(82)	46	1,225	451
Total	4,647	5,984	2,509	(11,618)	(2,121)	(3,299)	2,694	(1,563)	1,282	6,019	147

Note: Totals are total change from year of commencement to 2011 while annual average is the sum of total change divided by years of operation for each system.

TOD area Total Employment Change by Sector for BRT Systems and Annual Average 2002-2011

Table 1-3

Sector	Eugene-Springfield Total 2007-2011	Las Vegas Total 2004-2011	Phoenix Total 2009-2011	Salt Lake City Total 2008-2011	Annual Average
Manufacturing	(142)	59	(78)	132	(22)
Non Man Ind.	(77)	(406)	(81)	(201)	(185)
Retail/Lodging	8	(1,047)	(234)	(357)	(384)
Office	438	2,486	(829)	(395)	(82)
Knowledge	(208)	(225)	(87)	68	(105)
Education	149	(49)	(731)	107	(300)
Health	1,021	(145)	(210)	84	158
Entertainment	(101)	355	(7)	(64)	1
Total	1,088	1,028	(2,257)	(626)	(918)

Note: Totals are total change from year of commencement to 2011 while annual average is the sum of total change divided by years of operation for each system.

TOD area Total Employment Change by Sector for SCT Systems and Annual Average 2002-2011

Table 1-4

Sector	Portland Total 2002-2011	Seattle Total 2007-2011	Tacoma Total 2003-2011	Tampa Total 2002-2011	Annual Average
Manufacturing	(1,103)	(903)	(1,327)	2,311	(257)
Non Man Ind.	(2,133)	(1,485)	(437)	2,689	(364)
Retail/Lodging	1,547	(2,074)	(1,658)	3,787	(133)
Office	(3,718)	18,889	(11,310)	4,624	3,409
Knowledge	1,523	(3,057)	(549)	4,019	(217)
Education	(5,940)	388	(648)	3,306	(277)
Health	254	2,042	(755)	5,219	1,024
Entertainment	(313)	615	152	1,478	302
Total	(9,883)	14,415	(16,532)	27,433	3,487

Note: Totals are total change from year of commencement to 2011 while annual average is the sum of total change divided by years of operation for each system.

TOD area Total Employment Change by Sector for CRT Systems and Annual Average 2002-2011

Table 1-5

Sector	Albuquerque-Santa Fe Total 2002-2011	Miami-South Florida Total 2002-2011	Salt Lake City Total 2008-2011	San Diego Total 2002-2011	Seattle Total 2002-2011	Annual Average
Manufacturing	(169)	(3,331)	(1,207)	(1,094)	17	(911)
Non Man Ind.	(377)	(2,564)	341	264	608	(116)
Retail/Lodging	(836)	(1,739)	114	(656)	822	(230)
Office	2,555	2,932	8,003	3,389	253	3,682
Knowledge	(2,151)	642	731	(3,953)	1,000	(252)
Education	(1,893)	415	258	(998)	329	(153)
Health	1,868	2,127	477	546	237	690
Entertainment	(982)	135	297	(59)	71	6
Total	(1,985)	(1,383)	9,014	(2,561)	3,337	2,717

Note: Totals are total change from year of commencement to 2011 while annual average is the sum of total change divided by years of operation for each system.

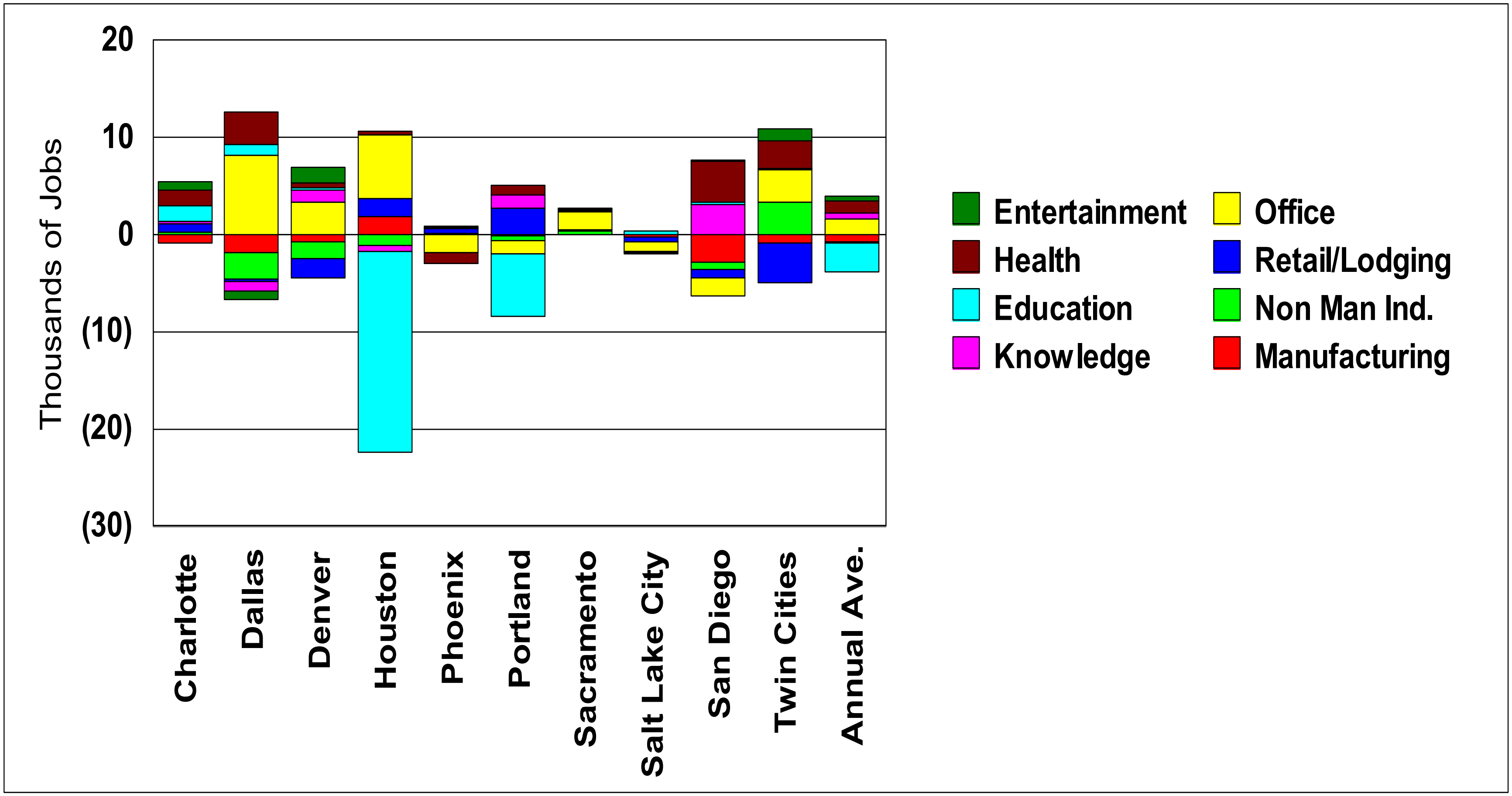

Figure 1-1

TOD area Employment Change by Sector for LRT Systems and Annual Average 2002-2011

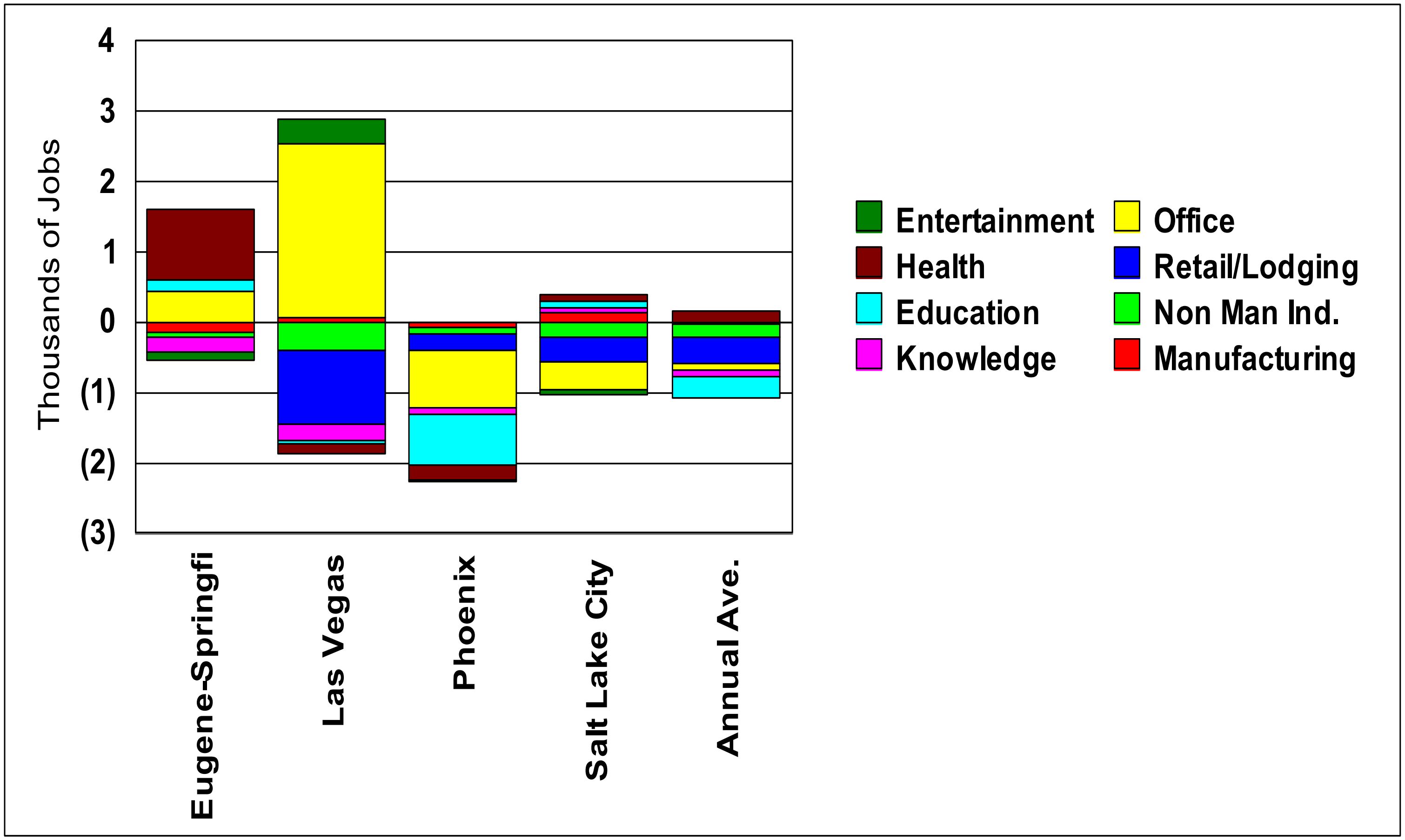

Figure 1-2
TOD area Employment Change by Sector for BRT Systems and Annual Average 2002-2011

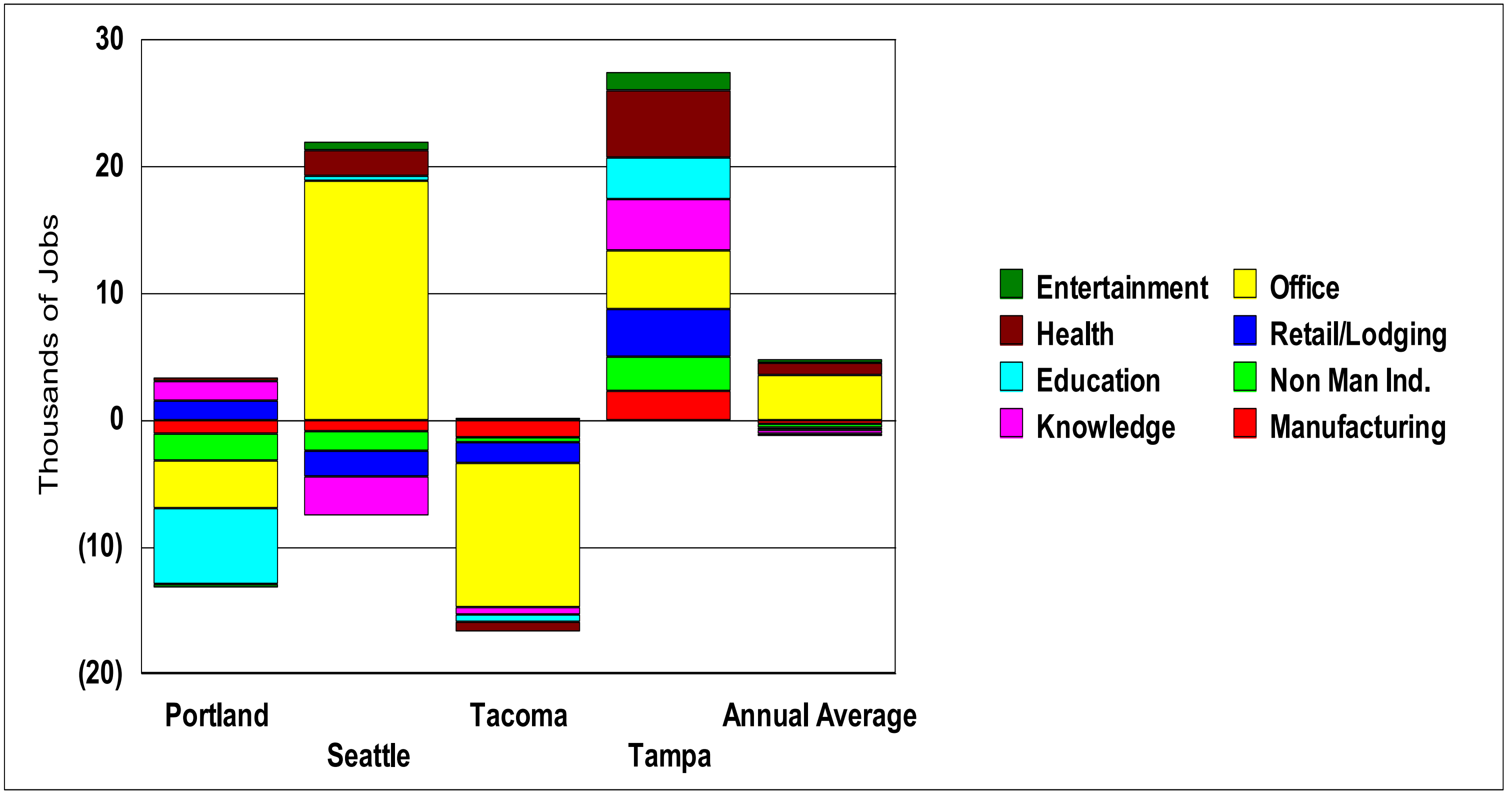

Figure 1-3
TOD area Employment Change by Sector for SCT Systems and Annual Average 2002-2011

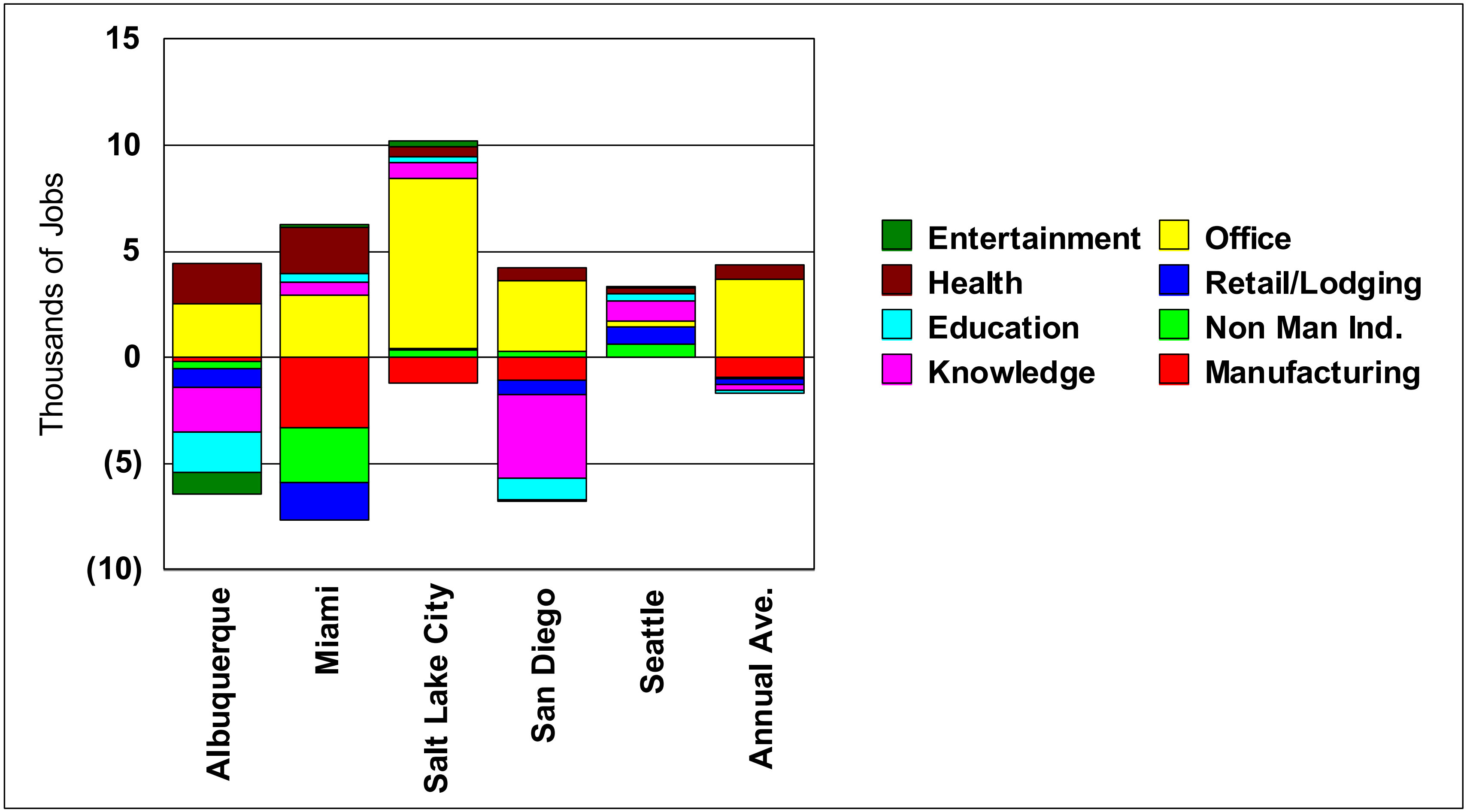

Figure 1-4
TOD area Employment Change by Sector for CRT Systems and Annual Average 2002-2011

Distribution of Positive Growth in TOD areas by Sector and by Transit System Type

Table 1-6

Sector	LRT Systems with Positive Growth in TOD Areas	BRT Systems with Positive Growth in TOD Areas	SCT Systems with Positive Growth in TOD Areas	CRT Systems with Positive Growth in TOD Areas	All Transit Systems with Positive Growth in TOD Areas
		Number of Systems			
Manufacturing	2	2	1	1	6
Non Man Ind.	4	0	1	3	8
Retail/Lodging	4	1	2	2	9
Office	6	2	2	5	15
Knowledge	8	1	2	3	14
Education	8	2	2	3	15
Health	9	2	3	4	18
Entertainment	6	1	3	3	12
		Percent of Systems			
Manufacturing	20%	50%	25%	20%	27%
Non Man Ind.	40%	0%	25%	60%	36%
Retail/Lodging	40%	25%	50%	40%	41%
Office	60%	50%	50%	100%	68%
Knowledge	80%	25%	50%	60%	64%
Education	80%	50%	50%	60%	68%
Health	90%	50%	75%	80%	82%
Entertainment	60%	25%	75%	60%	55%

Light Rail Transit Systems

We evaluated 10 LRT systems that began operating as early as 1981 (San Diego) and as late as 2009 (Phoenix). Table 1.2 reports change in jobs by clusters of economic sectors within TOD areas from either 2002 for those systems operating before that year or the year in which operations commenced. We note that six of the 10 LRT systems saw an overall increase in TOD-based jobs. On an average annual basis, we find that collectively LRT TODs gained jobs overall, though the amount was small at less than 150 jobs per year.

More interesting is the distribution of job change. This is summarized in Table 1.6. In terms of sectors that showed positive growth, we find mostly what we would expect: that TOD areas attract jobs especially in the knowledge, education, and health sectors and to a lesser but nonetheless important extent in the office and entertainment sectors.

We note that two metropolitan areas with LRT systems operating before 2002—Portland and Salt Lake City—actually saw an overall decline in TOD-based jobs. We further note that unlike other LRT systems such as Dallas and Denver, Portland did not expand its LRT system during our study period while the Salt Lake City metropolitan area has not been proactive in planning for development within most of its TODs. Finally, much of Portland's LRT system is sandwiched between freeways and other major highways reducing efficient access of pedestrians to stations.

For their part, Houston and Phoenix saw erosion in jobs within their TODs—which became operational during the middle to late 2000s—perhaps as a consequence of sustained sprawl in the case of Houston and remarkable jobs losses through the entire metropolitan area in the case of Phoenix.

For most metropolitan areas (Charlotte, Dallas, Denver, Sacramento, San Diego and Twin Cities), there were substantial TOD-based job gains.

Bus Rapid Transit Systems

As we evaluated only four BRT systems in this study, we direct readers to our more comprehensive NITC report, *National Study of BRT Development Outcomes*. Table 1.3 reports change in jobs by clusters of economic sectors within BRT TOD areas from the year in which operations commenced. We note that only the Eugene-Springfield and Las Vegas BRT systems saw an overall increase in TOD-based jobs.

Table 1.6 reports the distribution of job change by sector. We see one surprise in that half (two of four) of the BRT TOD areas saw increases in manufacturing employment since their opening but, from Table 1.3, we note these gains are small. For the most part, job growth in BRT TOD areas is as expected.

Streetcar Transit Systems

Modern streetcar systems seem to be gaining popularity nationally. We analyzed the four oldest systems—Portland, Seattle, Tacoma[1] and Tampa—but more research is needed over time as existing systems mature and new ones are added.

Table 1.4 reviews change in jobs by clusters of economic sectors within SCT TOD areas from 2002 for Portland and Tampa, and from 2007 for Seattle. We note very large differences in job change between the systems. Portland, the oldest, actually witnessed a very large decline in the number of total jobs between 2002 and 2011. Tacoma lost an even large number of jobs. On the other hand, as well will see in Chapter 4, both gained substantial increases in population, households, housing units and renters. It is as though people and housing displaced jobs.

Table 1.6 shows the distribution of job change by sector. As there are only four streetcar systems in the study our assessment is limited, only to suggest that streetcar and LRT TODs seem to have comparable associations with job growth in similar economic sector though with very wide variations in outcomes between systems.

[1] Sound Transit, which operates Tacoma Link, calls it a light rail system but at 1.6 miles serving only downtown with streetcar-like rolling stock navigating tight downtown turns, we believe it *functions* as a streetcar system.

Commuter Rail Transit Systems
In our view, CRT is the forgotten form of fixed-guideway public transit and it may warrant more specialized future study. To help close this gap, our study included all five CRT systems meetings criteria we presented in the Introduction.

Table 1.5 presents our calculation of the change in jobs by clusters of economic sectors within CRT TOD areas from 2002 for the Albuquerque, Miami, San Diego and Seattle metropolitan areas and since 2008 for the Salt Lake City metropolitan area. Only Salt Lake City and Seattle saw increases in jobs but they were substantial.

In Table 1.6, we note that like the other forms of fixed-guideway transit, manufacturing jobs have not growth within CRT TOD areas. We find it interesting, however, that all CRT TOD areas gained office jobs and most gained jobs in the same sectors as TODs of LRT and BRT systems.

Summary Assessment
We find important associations between fixed guideway transit investments and job growth. Notably, we find that TOD areas in a majority of LRT, SCT and CRT transit systems saw job growth in the office, knowledge, education, health care and entertainment sectors. TOD areas in half of the BRT systems gained jobs in the office, education and health care sectors.

Table 1.7 summarizes the change in jobs and wages in transit TOD areas for all systems. We report two sets of numbers. In the first, we report jobs for only economic sectors in TOD areas that grew. We estimate annual wages assuming $50,000 per job (which does not account for differences in jobs between sectors or regions) and then capitalizing total wages at five percent to estimate total wages over time. Using this calculation, we find more than $400 billion in the long term value of total wages in new jobs located in TOD areas. BRT TOD areas saw the smallest gain followed by SCT TOD areas. LRT areas have more than half the gains largely because their networks include many more times TOD areas.

The second approach is more conservative in considering on the net gain in job for each system and combined for all systems we studied. Using this approach, BRT TOD areas actually lost jobs and wages but in all cases the metropolitan areas also lost jobs during the periods in which BRT systems operated (the oldest being 2004 in the case of Las Vegas with all three others operating only since 2007, 2008 or 2009). Summed across all systems, this more conservative approach indicates TOD areas gained more than $100 billion in wages over time. Using this approach, CRT TOD areas gained the most overall.

In the next chapter, we will take a closer look at whether and the extent to which TOD areas in the transit systems we studied gained or lost shares of jobs by sector relative to their metropolitan areas, and whether changes in jobs were statistically significant. We do so in the context of assessing the role of transit in contributing to economic resilience, at least among the metropolitan areas we studied.

Annual and Capitalized Wages from Transit TOD Employment Change

Table 1-7

Metric	LRT TODs	BRT TODs	SCT TODs	CRT TODs	All Transit System TODs
		Sum of Positive Growth in TOD Areas			
Positive Job Growth	23,135	2,116	42,000	12,351	79,602
Annual Wages	$11,568	$1,058	$2,100	$6,176	$20,901
Capitalized Wages	$231,350	$21,160	$42,000	$123,510	$418,020
		Sum of Net Growth in TOD Areas			
Net Job Growth	4,534	-767	15,433	6,422	25,622
Annual Wages	$2,267	($384)	$772	$3,211	$5,866
Capitalized Wages	$45,340	($7,670)	$15,433	$64,220	$117,323

Note: In millions of dollars. Annual wages assume $50,000 per job, not adjusted for differences in wages between sectors or regions. Annual wages are capitalized at 5% to generate an estimate of total economic value of jobs over time.

CHAPTER 2
Transit: Economic Resilience or Transformation?

Overview
Do fixed-guideway transit systems facilitate resilience and transformation within metropolitan areas? There is little literature making this connection theoretically and none testing it empirically. This chapter offers a preliminary exploration into this relationship. In evaluating eight metropolitan areas with light rail transit systems operating fully before the Great Recession we find some evidence that economic activity within 0.50 mile of light rail stations was more resilient to the economic downtown associated with the Great Recession than their metropolitan areas as a whole. The transformation effect was especially evident after the recession. We offer implications for the role of these forms of fixed-guideway transit on economic resiliency and transformation.

Introduction
re·sil·ient adjective \ri-ˈzil-yənt\

a. capable of withstanding shock
b. tending to recover from or adjust easily to misfortunate or change

trans·for·ma·tion *noun* tran(t)sfərˈmāSH(ə)n/

a. thorough or dramatic change in form or appearance.
b. metamorphosis during the life cycle of an animal.
c. the induced or spontaneous change of one element into another by a nuclear process.

It seems an article of faith among transit proponents that transit systems, especially fixed-guideway ones, enable local economies to withstand economic shocks better than areas without these options. Alternatively, because transit systems induce economic development and investment in the region, they may transform it. Yet, there is scant literature making either of these connections theoretically and none testing it empirically. In this preliminary exploration, we start what should be a new literature connecting transit with economic resilience and transformation.

We begin with a review of resiliency and transformability as concepts, review recent literature applying the concepts to transit, and using economic resiliency and transformability literature we craft a theory of transit and economic resilience. We proceed with the application of our theory to all 10 light rail systems operating in the United States before and after the Great Recession. We offer implications for the role of these forms of fixed guideway transit on economic resiliency.

Resiliency

Pendall, et al. (2010) and Martin-Breen and Anderies (2011) offer sweeping views of resiliency as a concept from such disciplines as ecology, psychology, geography, political science and economics. Here, we focus on some of the key elements in the evolution of the concept as applied to urban policy.

The earliest applications of the concept emanate from the field of "ecological resilience" (Holling 1973). It was used to describe the biological capacity of an ecosystem to adapt and thrive under adverse environmental conditions. Specifically, resilience was described as "the persistence of relationships within a system; a measure of the ability of systems to absorb changes of state variables, driving variables, and parameters, and still persist" (Holling 1973). Since then, this definition of resilience has been expanded to similar fields that emphasize the link between social and environmental systems (Berkes et al. 2003; Folke 2006; Walker and Salt 2006), including urban planning (HUD 2012, Bristow 2010)

As appealing as the idea of resilience might be for urban planners and regional researchers, there is the distinct danger off "fuzziness" (Pendell et al. 2010). One reason for the popularity of the term resilience, and the subsequent fuzziness, is the term's malleability; it can mean different things to different people (Christopherson et al. 2010). For instance, to engineers, resiliency is "the ability to store strain energy and deflect elastically under a load without breaking or being deformed" (Gordon 1978). Psychologists adopted the term resilience to describe patients who were able to overcome adverse conditions (Masten et al. 1990). In economics, resilience has been defined in terms of return to a fixed and narrowly defined equilibrium following a shock (as measured by employment, for example). In the social sciences the term regional resilience is associated and almost synonymous with regional adaptation (Christopherson et al. 2010).

As a result, a new term emerged: Social-ecological resilience and is defined as the amount of disturbance a system can absorb and still remain within the same state; the degree to which the system is capable of self-organization; and the degree to which the system can cope with change (Wilkinson et al. 2010). This definition can be applied in an urban and regional planning context where the city, neighborhood, or metropolitan area is the system, and the disturbance may be any number of internal or external shocks.

The resilience approach to urban planning assumes that the future will include a major element of surprise, and that urban systems must be designed and operated in ways that accommodate sudden and unexpected changes (Sheltair Group 2003). This approach is understandably appealing to urban planners because they must make long term plans in the face of an uncertain future.

The discourse of resilience is also taking hold in discussions around desirable local and regional development activities and strategies (Hassink 2010). The global financial crises and the accompanying increase in livelihood insecurity has revealed the advantages of those local and regional economies that have greater 'resilience' by virtue of being less dependent upon globally activities. A resilience approach would draw parallels between healthy ecosystems and healthy economies: healthy ecosystems possess a high degree of functional diversity, and successful economic regions possess greater economic diversity, and/or have a determination to adapt and make significant structural changes (Ashby et al, 2009; Larkin and Cooper, 2009).

Similarly, resilience emerged in relation to emergency and disaster planning in cities. Wardekker et al. (2009) gathered urban planners from across Holland to operationalize resilience strategies to plan and prepare for the uncertain effects of climate change. Their "regional resilience" approach to disaster planning is rooted in the principles of resiliency; change will occur, unexpected shocks cannot be predicted, therefore cities must strengthen their capacity to withstand and rebound from shocks.

The challenge is for planners prepare and implement plans that will reduce the severity and negative aspects of an inevitable shock. We suggest that the location improvements induced by transit investments and transit allows cities to withstand shocks, as well as hasten the recovery from a shock. Across the U.S., transit development has enhanced urban travel corridors by triggering reinvestment and development in the area (Bartholomew and Ewing 2011). We see transit development as a metropolitan scale strategy to promote resilience and we test this hypothesis in this chapter.

Transformability
Transformability and resilience are complimentary concepts, yet there exist differences between resilience and transformability. Resilience describes the capacity of a particular system to respond to a shock, while transformability refers to fundamentally altering the nature of the system (Walker et al. 2004). We emphasize that resilience stresses that a system remains in "the same state", or retains the "same function". *Transformability* is the capacity to create a fundamentally new system when "ecological, economic, or social structures make the existing system untenable" (Walker et al. 2004). While resilience is the capacity to maintain a current state, transformation is the capacity to change to a new state. However, the two concepts remain complimentary, where resilient systems can and should transform. Resilience thinking suggests that a shock may open up opportunities for learning, novelty and innovation, possibly resulting in transformational change (Folke et al. 2010). A resilient system may not "recover" back to an original state, but rather resilience could facilitate transformation to a new state.

Transformability can also be characterized by the introduction of new characteristics, or the strengthening of latent characteristics (Folke et al. 2010). If a system's pre-shock characteristics were fundamentally inefficient (and perhaps contributed to the shock), then a shock to the system would stop further inefficient outcomes and reward more efficient ones. Transformations in resilient systems "make use of crises as windows of opportunity" to break down the resilience of the old, and build the resilience of the new (Folke et al. 2010 pg. 7).

Transit and Resiliency
According to Marshall (2012), the studies into transportation resilience have focused mostly on the ability of transportation systems to sustain target levels of service during a shock and/or the delay in returning to that service (see also Heaslip and Louisell 2009; 2010). There is a substantial and growing literature on transportation infrastructure resiliency with respect to climate change (see Cybulski 2013 for a review of the literature). Yet, there is no literature directly relating transit with economic resilience. When it comes to economic resiliency, Marshall's review of literature concludes that it has focused on spikes in gasoline prices (see also Briguglio, Cordina et al. 2005; Zheng, Garrick et al. 2010). Marshall is presently engaged in US DOT-sponsored research that explores "the varying impact of transit infrastructure and TODs on the ability of different households to be resilient to uncontrollable outside forces, such as rising gas prices." (Marshall 2012: 2)

A Theory of Transit and Economic Resilience

That there should be an association between transit and economic development has been established reasonably well in the literature. That there is may not yet be conclusive, though emerging evidence seems supportive. A key measure of economic effects is using the real estate market to estimate the premium the market is willing to pay for proximity to transit. Three recent papers have compiled literature providing a preponderance of evidence showing this for both residential and office development (Bartholomew and Ewing 2011; Petheram, Nelson et al. 2013; and Ko and Cao 2013).

Another key measure is how jobs are affected by transit investments. In their recent study of employment within 0.50 mile of transit stations serving 34 transit systems over the period 2002 through 2008, Belzer, Srivastava and Austin (2011) found that while jobs increase in the arts, entertainment, and recreation sector as well as the food and accommodation, and health care and social assistance sectors, they fell in the manufacturing sector. They also found that the public administration had the greatest share of jobs found near transit stations. Several other sectors also concentrated around transit stations such as professional, scientific, and technical services, and retail. On the other hand, as a whole the station areas experienced declining shares of jobs relative to their regions, with the exceptions jobs in the utilities, information, and the arts, entertainment, and recreation sectors. Indeed, data for 2008, the first full year of the Great Recession, indicated that most sectors within 0.50 mile of transit stations lost job share relative to their regions as a whole. They surmised that much of the metropolitan job growth continues to favor auto-oriented locations.

In short, while the relationship between transit and economic development measured in terms of value premiums is strong, the relationship with respect to jobs is not as clear. This paper will take a closer look at this nuance.

In measuring economic resilience, Pendall, Foster, and Cowell (2009) suggest two related approaches: "equilibrium analysis" which measures resilience as the time it takes to return to the level before a shock and "complex adaptation" adaptive systems which measures the ability of a system to adapt to stresses caused by the shock. Hill et al. (2012) refines measuring the first approach in terms of the time it takes to return to the rate of growth rate of output, employment, or population after a shock. For reasons noted below, we will focus on jobs as a key measure for resilience. On the other hand, while a quality location for warehousing may see employment recover to pre-recessionary levels, an increase in location quality might also result in that location transitioning to a higher-rent urban use.

While much of the literature on economic resilience focuses on measuring time-to-recovery, Briguglio et al. (2005; 2008) are more nuanced. To them, economic resilience refers to the ability to recover quickly from a shock and withstand the effect of a shock as it occurs (Briguglio et al. 2008: 4-5). In our view, their concepts can be reversed to measure the ability of an economy to withstand the shock as it occurs and then the amount of time it takes to recover from the shock.

Briguglio et al. also saw a role for public policy in facilitating resilience by ameliorating adverse effects of economic shocks. In our view, transit may be one such policy. In terms of transit and economic resilience, we thus theorize that transit will dampen adverse outcomes associated with an economic shock and facilitate a speedier recovery. One way in which to further measure these outcomes is to compare transit corridors with control corridors before, during and after an economic shock. This is illustrated in Figure 2.1.

A Theory of Transit and Economic Transformability

An alternative theory on how transit may affect a metropolitan area's resilience can be viewed through the lens of transformability. Rather than transit investments bolstering regional resilience by allowing a metropolitan area's economy to return to pre-shock conditions, transit may affect a *transformation* to new economic conditions. For example, if pre-shock land use patterns were fundamentally inefficient, (and perhaps contributed to the shock) then the shock would stop further inefficient outcomes and reward more efficient ones. In our context, the real estate market may favor transit accessibility over other locations both during a recession and especially afterward. Transit may not facilitate resilience in the sense of a "recovery" back to pre-recession sprawl, but rather resilience facilitates transformation of investment to locations that the private sector views as a hedge against future economic downturns. A shock would accelerate this transition.

We apply our theory to an empirical analysis as described next.

Research Question

Based on our theory, fixed-guideway transit corridors, such as light rail transit (LRT) should retain if not capture a higher share of jobs than their metropolitan areas as a whole during and shortly after economic shocks. Our research question is simple:

Do LRT TOD areas along corridors capture proportionately more jobs than their metropolitan areas as a whole during and shortly after economic shocks?

We mean the term "capture" as the share of total jobs and jobs within 2-digit NAICS sectors that are within census blocks whose centroids are with 0.50 mile of light rail transit stations as described in our data below.

We consider LRT systems because of all the modes we address in this study, LRT has the largest sample size and seems the most emblematic of modern fixed-guideway transportation.

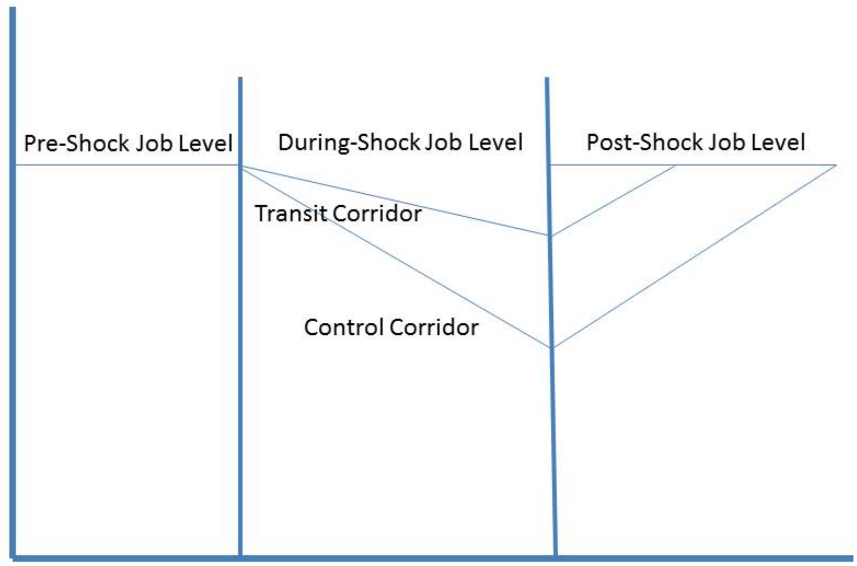

Figure 2-1
Pre-, during-, and post-shock job levels for transit and control corridors

Research Design
We use a pre-post design with an interrupted time period to address the research question.

Data
Because we evaluate the shift in share of jobs by economic sector over time, we use employment data. The source of data is the Longitudinal Employer-Household Dynamics (LEHD) program which is part of the Center for Economic Studies at the U.S. Census Bureau.[2] For all LRT systems studied, 2-digit NAICS data are available annually from 2002 through 2011 at the census block level.

Study Periods
We evaluate shift in shares of jobs over three discrete time periods extending from before the Great Recession of the late 2000s, through the Great Recession itself, and during recovery.

2002-2007 covers the period of relatively constant growth from the early 2000s to the end of 2007. This is the pre-test period.

2007-2009 covers the period of the Great Recession. This is the "shock" period. According to our theory, transit corridors should retain if not capture a higher rate of metropolitan jobs than their metropolitan areas as a whole. This is the interrupted period.

2009-2011 covers the period after the Great Recession, the recovery period. Based on our theory, transit corridors should capture a higher rate of jobs than their metropolitan areas as a whole. This is the post-test period.

Light Rail Transit Corridors
We evaluate seven LRT systems that were operational by 2004 in metropolitan areas outside of metropolitan areas of more than seven million people. Newer systems were excluded because they were launched in the heels of, or even during, the Great Recession: Houston (2006), Charlotte (2007), Phoenix (2008) and Seattle (2009). We also excluded systems serving metropolitan areas growing faster than the national average that included complex networks of multiple transit systems such as Los Angeles and the San Francisco Bay Area. The systems we evaluated and the year in which each they commenced operations is reported in Table 2.1.

[2] For details, see http://lehd.ces.census.gov/.

Light Rail Systems used in Analysis

Table 2-1

LRT System	Year
Dallas	1996
Denver	1994
Portland	1986
Sacramento	1987
Salt Lake City	1999
San Diego	1981
Twin Cities	2004

Analytic Approach

Given that change in employment share over time is our principal interest, we choose shift-share analysis as our analytic approach and apply it to combined economic sectors (see details in Chapter 1).

Results

Table 2.2 repots only the share of change attributable to locations within 0.50 mile of LRT stations, the TOD areas, for each of the seven metropolitan areas and the composite, for each of the three time periods. (Detailed tables for each are reported in Appendix B.) Table 2.3 summarizes outcomes for metropolitan areas while Table 2.4 summarizes outcomes for combined economic sectors. We offer the following observations:

1. During the period 2002 through 2007, TOD areas lost share of jobs in nearly all economic sectors and overall. As this was a period of extraordinary outward expansion of metropolitan areas (see Nelson 2013), we are not surprised to see TOD areas lose job share in most sectors and overall.

2. During the Great Recession, the change in share of jobs began to reverse. For most metropolitan areas and for most economic sectors, TOD areas gained share, though in some case it meant losing less job share than during the period 2002-2007.

3. During recovery, all TOD areas gained share of metropolitan area jobs in all combined economic sectors.

The composite performance for TOD areas is illustrated in Figure 2.2. It shows substantial loss of TOD area job share in the Pre-Recession period, less though still negative loss of job share during the Great Recession, and an increasing in job share during Recovery.

Light Rail Transit TOD Area Share of Change by Time Period

Table 2-2

Metro Area	Dallas	Denver	Portland	Sacramento	Salt Lake City	San Diego	Twin Cities	Composite
Sector			***Transit Station Shift-Share Results 2002-2007 Pre-Recession***					
Manufacturing	245	(331)	84	(107)	(415)	(1,448)	(224)	(2,196)
Non Man Ind.	(3,285)	(227)	(989)	(74)	(107)	(96)	(1,410)	(6,188)
Retail & Lodging	(652)	(2,045)	(68)	21	(427)	(1,142)	(2,457)	(6,770)
Office	(6,991)	2,895	(3,702)	218	(1,251)	(1,471)	(1,519)	(11,821)
Knowledge	(1,466)	727	(1,306)	(12)	(253)	1,977	(203)	(536)
Education	(1,776)	223	(10,770)	213	62	(157)	175	(12,030)
Health	(1,675)	(274)	(2,942)	(14)	(490)	70	1,682	(3,643)
Entertainment	(507)	(73)	(209)	(15)	(16)	(235)	(205)	(1,260)
Total	(16,107)	895	(19,902)	230	(2,897)	(2,502)	(4,161)	(44,444)
Sector			***Transit Station Shift-Share Results 2007-2009 Great Recession***					
Manufacturing	(1,098)	352	50	8	(170)	24	(252)	(1,086)
Non Man Ind.	216	(1,291)	111	4	(772)	49	3,616	1,933
Retail & Lodging	(1,778)	(709)	793	(66)	(937)	43	(2,253)	(4,907)
Office	(2,838)	(198)	2,907	33	(1,358)	(117)	857	(714)
Knowledge	(3,960)	(171)	131	174	(385)	(244)	615	(3,840)
Education	(1,162)	(1,390)	(33)	(20)	(267)	35	(305)	(3,142)
Health	(621)	156	(8)	(39)	260	(93)	201	(144)
Entertainment	55	1	77	3	(78)	123	213	394
Total	(11,186)	(3,250)	4,028	97	(3,707)	(180)	2,692	(11,506)

Table 2.2
Light Rail Transit TOD Area Share of Change by Time Period—continued

Metro Area	Dallas	Denver	Portland	Sacramento	Salt Lake City	San Diego	Twin Cities	Composite
Sector			***Transit Station Shift-Share Results 2009-2011Recovery***					
Manufacturing	235	65	(136)	116	69	(13)	(207)	129
Non Man Ind.	(959)	224	154	456	316	(80)	2,063	2,174
Retail & Lodging	512	(615)	385	76	(316)	79	1,212	1,333
Office	5,771	(109)	(3,485)	1,104	(1,322)	(791)	3,712	4,880
Knowledge	2,492	479	(491)	(57)	110	(218)	(693)	1,622
Education	50	1,576	998	(57)	362	(52)	(65)	2,812
Health	(876)	(125)	180	(23)	2,981	0	(1,089)	1,048
Entertainment	81	885	(136)	27	11	(76)	826	1,618
Total	7,306	2,380	(2,531)	1,642	2,211	(1,151)	5,759	15,616

Pre-Recession, Great Recession and Recovery Shift-Share TOD Area Outcomes by Metropolitan Area

Table 2-3

Metro Area	Pre-Recession LRT Shift	Great Recession LRT Shift	Outcome Pre-Recession through Recession	Recovery LRT Shift	Outcome Recession into Recovery	Outcome Pre-Recession into Recovery
Dallas	(16,108)	(11,187)	Gained	7,307	Gained	Gained
Denver	896	(3,250)	Lost	2,381	Gained	Gained
Portland	(19,901)	4,030	Gained	(2,530)	Lost	Gained
Sacramento	230	98	Lost	1,643	Gained	Gained
Salt Lake City	(2,897)	(3,707)	Lost	2,212	Gained	Gained
San Diego	(2,502)	(180)	Gained	(1,150)	Lost	Gained
Twin Cities	(4,162)	2,691	Gained	5,759	Gained	Gained
Composite	(44,444)	(11,506)	Gained	15,616	Gained	Gained

Pre-Recession, Great Recession and Recovery Shift-Share TOD Area Outcomes by Combined Economic Sector

Table 2-4

Sector	Pre-Recession LRT Shift	Great Recession LRT Shift	Outcome Pre-Recession through Recession	Recovery LRT Shift	Outcome Recession into Recovery	Outcome Pre-Recession into Recovery
Manufacturing	(2,196)	(1,086)	Gained	129	Gained	Gained
Non Man Ind.	(6,188)	1,933	Gained	2,174	Gained	Gained
Retail & Lodging	(6,770)	(4,907)	Gained	1,333	Gained	Gained
Office	(11,821)	(714)	Gained	4,880	Gained	Gained
Knowledge	(536)	(3,840)	Lost	1,622	Gained	Gained
Education	(12,030)	(3,142)	Gained	2,812	Gained	Gained
Health	(3,643)	(144)	Gained	1,048	Gained	Gained
Entertainment	(1,260)	394	Gained	1,618	Gained	Gained
Total	(44,444)	(11,506)	Gained	15,616	Gained	Gained

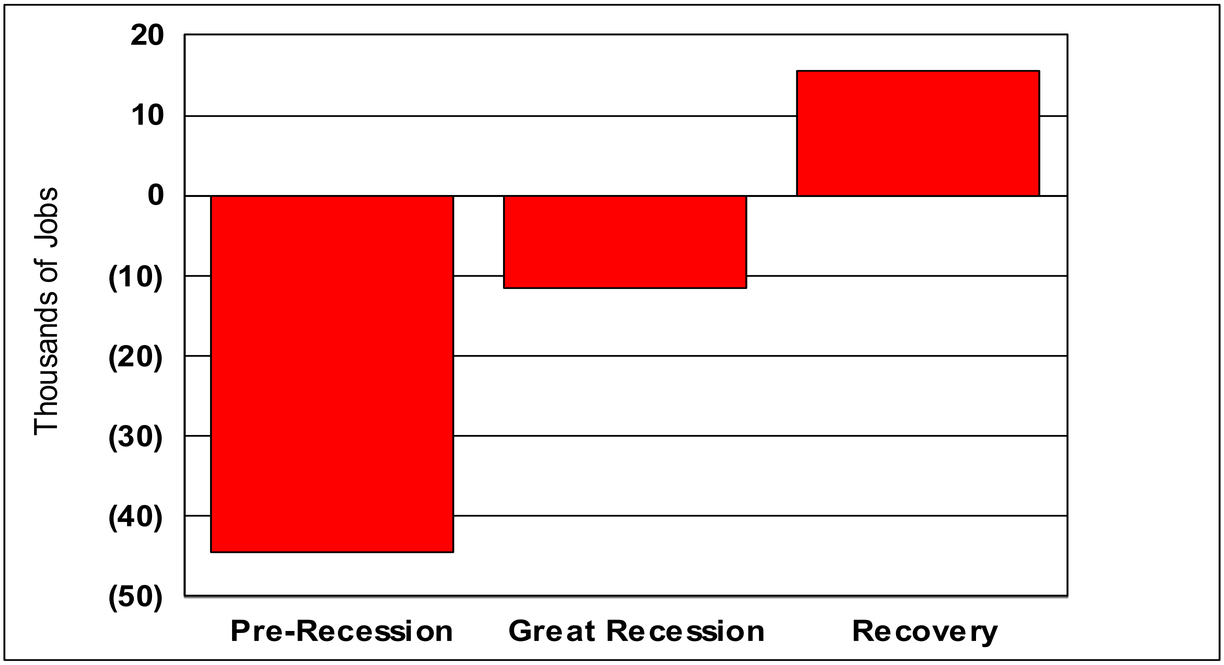

Figure 2-2
Light Rail Corridor Composite shift-share results for pre-recession, Great Recession, and post-recession time periods

Implications
Our theory that fixed-guideway transit systems, such as light rail systems, may improve metropolitan-scale resilience and transformability during economic shocks is substantially supported. Before the Great Recession, the eight metropolitan areas experiencing higher growth rates than national average which also had light rail transit systems collectively experienced eroding shares of employment within 0.50 mile of LRT stations relative to their metropolitan areas. The shift in share of jobs away from LRT TOD areas slowed during the Great Recession. Afterwards, during recovery, LRT TOD areas gained share in the shift of metropolitan jobs. We see this shift as evidence of regional transformation.

We do not know the reasons for this reversal but we can speculate. First, LRT TOD area planning has improved substantially since the 1980s when the US began to construct LRT systems. Many earlier LRT lines followed freeway corridors, even traversing along the median. LRT systems were thus just as disconnected with the existing urban fabric as freeways with the result that there was little economic interaction between LRT systems and the communities they served. Much has changed as modern LRT systems are built along surface collector and arterial streets and their stations are designed to serve one-quartet to one-mile catchment areas unimpeded by limited access highways.

Second, a substantial share of market demand for living and working near transit stations is slowly being met. Numerous surveys indicate that a quarter or more of American households want the opportunity to choose to live near fixed guideway transit stations but even if all new housing units were built within 0.50 mile of those stations between now and mid-century the demand may still not be met (Nelson 2013).

We view our analysis as only preliminary. For one thing, the concept of measuring economic resilience in terms of transit systems is new; ours may be among if not the first. Further, more rigorous analysis is needed. We compiled and evaluated data for entire LRT systems. Yet, the location and design of an individual station may have more to do with resilience than the haphazard planning and design of multiple stations. Station-specific analysis is needed. Moreover, longitudinal spatial econometrics is needed to tease out the important contributions that location attributes, growth patterns, demographics, economic restructuring and other effects have on LRT TOD area development not to mention altering metropolitan-scale development patterns.

Nonetheless, through this study, we have discovered evidence that light rail transit stations may advance economic resilience and transformability in American metropolitan areas. We explore this theme further in Chapter 6, relating to the location of jobs by lower, middle, and upper income categories.

CHAPTER 3
Transit and Real Estate Rents

Fixed-guideway transit systems include heavy or "fifth" rail, such as the New York subway; light rail, such as provided in Charlotte and San Diego; non-tourist-related streetcar, such as seen in Portland and Tampa; and bus rapid transit, such as operated in Pittsburgh which is the world's second oldest such system. Fixed-guideway systems reinvent the idea of agglomeration economies, which is a cornerstone of urban economic development. In this section, we review the role of agglomeration economies in economic development, assess how the advantages of agglomeration economies are undermined by automobile dependency, and summarize the role of fixed-guideway transit systems in recreating those economies.

Cities are formed and grow in large part by creating agglomeration economies (Glaeser 2011). Annas, Arnott, and Small (1998) define the term as "the decline in average cost as more production occurs within a specified geographical area" (p. 1427). They arise specific to certain economic sectors, however. As more firms in a related sector cluster together, costs of production fall as productivity increases. These economies can spill over into complementary sectors (Holmes 1999). Cities can become ever larger as economies of agglomeration are exploited (Ciccone and Hall 1996). If cities get too large, however, congestion occurs, which leads to diseconomies of scale. The result may be relocation of firms, but this can weaken economies of scale (Bogart 1998). Highways connecting the city to outlying areas can induce firms to relocate, thereby reducing agglomeration diseconomies of scale through sacrificing some economies, though overall economic improvement is debatable (Boarnet 1997). Cities thus spread out, and although the urban area may contain more people and jobs, the advantages of agglomeration economies are weakened.

One way to preserve agglomeration economies and reduce diseconomies is to improve transportation systems; this is a role of fixed-guideway transit systems. Within about 0.25 to 0.50 miles from transit stations accessing these systems, firms maximize the benefits of agglomeration economies (Cervero et al. 2004). Moreover, some firms can also benefit from expanded access to the labor force residing within walking distance of transit stations, wherever they are located (Belzer, Srivastava, and Austin 2011).

There is another aspect of agglomeration economies identified by Chapman and Noland (2011). Although transit systems can lead to higher-density development by shifting new jobs and population to station areas, it could lead, instead, to the redistribution of existing development even in the absence of growth.

In part because of their role in facilitating agglomeration economies, there is a growing body of research showing that rail-based public transit facilitates underlying agglomeration economies thereby enhances economic development (see Nelson et al. 2009). Those economies are facilitated when they improve accessibility between people and their destinations (Littman 2009) by reducing travel time and the risk of failing to arrive at a destination (Weisbrod and Reno 2009). At the metropolitan scale, adding transit corridors in built-up urban areas increases aggregate economic activity (Graham 2007).

With the exception of heavy-rail systems, empirical studies of fixed-guideway transit outcomes are surprisingly few. We divide the studies into market-value outcomes, physical development outcomes, and economic development outcomes.

Market-Value Outcomes

Economic development can be measured in many ways. One is by evaluating how the market responds to the presence of transportation investments, such as rail stations. Higher values closer to stations imply market capitalization of economic benefits, which can occur only when economic activity increases. Although there is a large literature assessing the association between fixed-guideway transit system proximity and market values (see Higgins and Kanaroglou 2015), the literature is small with respect to LRT systems, smaller still with respect to BRT systems, and non-existent with respect to SCT systems.

Light Rail Transit Property Value Effects

We count 14 hedonic studies of the association between LRT and property values though only one since 2002. The first of this genre was Al-Mosaind, Dueker and Strathman (1993) who found that single family homes increased 10.6 percent in value if they were within 500 meters of the Portland Eastside (MAX) LRT line. Two other studies of the same LRT line were later conducted by Chen, Rufflo and Dueker (1998) and Dueker and Bianco (1999). Using continuous distance, Chen, Ruffalo and Dueker found home values fall $32.20 per meter further from the nearest LRT station while Dueker and Bianco found that a house located at a station will decrease by 5 percent 400 feet away, 2 percent at 600 feet away, and 1 percent if 800 feet away from a station; in other words, the closer the home is to an LRT station the higher its value.

Voith (1993) found that home values rise 8 percent when they are within a census tract served by a light rail transit station in metropolitan Philadelphia. Weinstein and Clower (2002) as well find that assessed home values rose by 32 percent when within one-quarter mile of a Dallas DART station. Garrett's (2004) study of St. Louis MetroLink found home values fall 2.5 percent for every one-tenth mile away from the nearest LRT station. Similarly, Hess and Almeida (2007) found that median home values in Buffalo rise 2.5 percent if they are within 0.25 mile of MetroRail.

Applying similar data and methods to LRT systems in Sacramento, San Jose and San Diego, Landis, Guhathakurta and Zhang (1994) evaluated the association between LRT and single family residential property values. For Sacramento, they found no statistically significant effect while for San Jose they found values fall $1.97 for every meter closer to light rail (though they acknowledge this could be attributable to industrial and commercial uses that co-located near rail stations) and for San Diego values increase $2.72 for every meter closer to the San Diego Trolley. Cervero et al. (2004) observe land use change along the San Diego line has been substantially non-existent because of its alignment along freight rail tracks within an industrial corridor (see also Higgins, Mark R. Ferguson, Pavlos S. Kanaroglou (2014)).

Three studies by Cervero and Duncan used similar data and methods to evaluate the association between LRT distance and property values. In their study of San Diego (Cervero and Duncan 2002a) found that the value of multi-family homes rose 10 percent and 17 percent respectively when more than 0.25 mile away from the San Diego Trolley's East Line and South Line. They surmise nearby commercial uses created disamenity values perhaps because of the interaction with nearby freight rail service. In their study of San Jose, Cervero and Duncan (2002b) found that single family homes and apartments rose by 1 to 4 percent if within 0.25 mile of San Jose's VTA LRT stations but condominiums fell by 6 percent. They offered no explanation for this finding. Again using San Jose as their study area, Cervero and Duncan (2002c) found that commercial properties gained 23 percent in value if within 0.25 mile of an LRT station. The latter work is the first to report on nonresidential property value effects.

Nearly all of these studies assessed the relationship between LRT corridor or station proximity and residential property value mostly based on 0.25 and 0.50 distance bands. Petheram, Nelson, Ewing and Miller refined the distance band approach to assess value effects in 0.25 mile increments to 1.25 miles and beyond in Salt Lake County, Utah. When structural, neighborhood, and location characteristics were controlled for, they found a positive relationship between LRT station proximity and rental apartment building values in each 0.25 mile increment to 1.25 miles but not beyond. In other words, their work challenges the half-mile TOD planning assumption. However, as in all hedonic studies of the association between transit and property values, cause-and-effect outcomes are not claimed.

The most recent two works are of the association between LRT station distance and commercial property values. In the first, Ko and Cao (2013) evaluate combined office and industrial property values with respect to distance from the Minneapolis-St. Paul Hiawatha light rail line using a quadratic transformation of continuous distance. Their study area was one mile from light rail stations and used sales prices. Ko and Cao found that the light rail line confers significant price premiums for office and industrial properties to about 0.9 miles from light rail stations, or just about the full extent of their study area. They do not differentiate with respect to office or industrial properties. Moreover, being just one mile from rail stations, their study area design may actually mask the full spatial effect of light rail stations.

Nelson et al. (2015) evaluated the distance-decay function of office rents in metropolitan Dallas with respect to light rail transit (LRT) station distance. Using a quadratic transformation of distance applied to CoStar data they find that asking office rent premiums extend nearly two miles away from LRT stations with half the premium dissipating at about two-thirds on one mile and three quarters dissipating at nearly one mile. Figure 3.1 illustrates their findings.

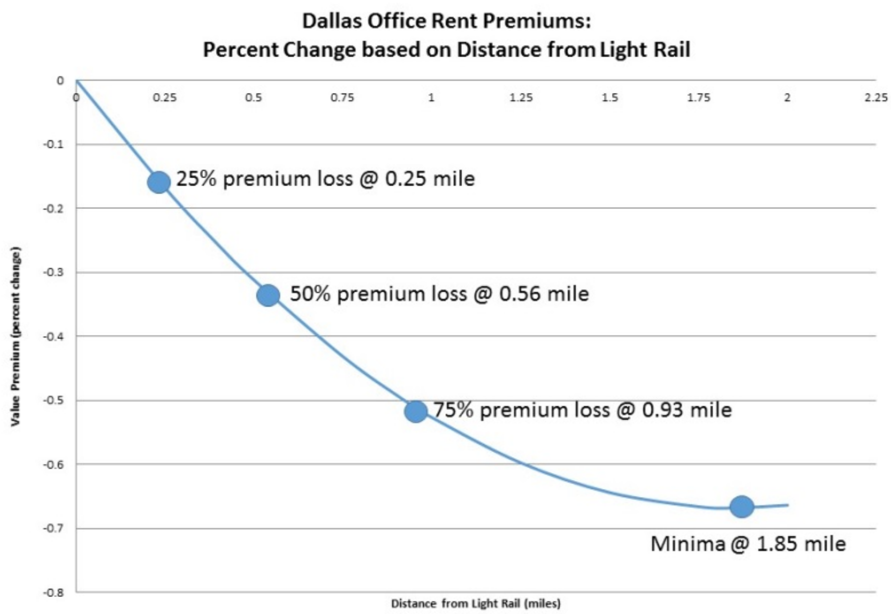

Figure 3-1
Dallas metropolitan area office rent premium with respect to distance from nearest light rail station

Studies of the relationship between LRT proximity and property values, or rents, have been limited to mostly residential, owner-occupied properties with only one study addressing apartments. Only three studies address office property, none address retail property, and only one partially addresses industrial property. This report helps close important gaps in LRT value premium research.

Bus Rapid Transit Property Value Effects

We find only 8 studies associating BRT proximity with property values with only two in the US. Three studies of the BRT system in Bogotá, Columbia, find that (1) residential rents increased by 6.8 percent to 9.3 percent for every 5 minutes walking time closer to the nearest BRT station (Rodíguez and Targa 2004); (2) the asking price of properties within 500 meter BRT catchment areas were 7 percent to and 14 percent higher than that in control areas (Rodríguez and Mojica 2009); and (3) some price premium was found with respect to middle income residential property and distance from the nearest BRT station but not for low-income residential property (Munoz-Raskin 2010).

There are two studies of the BRT system operating in Seoul, South Korea. The first is by Cervero and Kang (2011) who found that within 300 meters of BRT stations, residential land values increase from 5 to 10 percent while within a much smaller distance of150 meters non-residential land values increase from 3 percent at 150 meters away to 26 percent within 30 meters (see also Jun 2012). A study of the Quebec City Métrobus by Dubé, Thériault and Dib (2011) found that proximity to the nearest BRT station increased housing prices from 2.9 percent to 6.9 percent.

Two studies of systems in the US evaluated price premiums of residential and both residential and commercial properties with respect to BRT proximity in Pittsburgh and Los Angeles, respectively. In their study of the Pittsburgh East Line, Perk and Catalá (2009) found that a single family residential property 100 feet away from a BRT station realized a premium of $9,745 compared to the same property located 1,000 feet away. The second study of the Los Angeles Metro Rapid BRT lines (Wilshire-Whittier Boulevards and Ventura Boulevard) a year after they opened in 2000 by Cervero and Duncan (2002d) found that the BRT system conferred a small negative premium on residential property but a positive premium on commercial property. They reasoned that many BRT stops in lie within redevelopment districts which may dampen residential values until redevelopment occurs. Cervero and Duncan cautioned that the absence of dedicated travel lanes, the newness of service, and underlying distress may have accounted for lower property value (see also Loukaitou-Sideris and Banerjee 2000).

In sum, assessments of BRT-related value premiums are limited mostly to residential property and mostly outside the US.

Street Car Transit Property Value Effects

We note there are no studies into whether and the extent to which SCT systems confer any property value premium. Through new analysis, this report helps close the gap.

Commuter Rail Transit Property Value Effects

There are very few studies assessing the relationship between CRT and property values. An extensive review provided by Higgins (2015) indicate negative to weakly positive but mostly insignificant associations with respect to residential properties, and strongly negative and strongly positive associations with respect to commercial properties. All used distance bands for analysis. The number of studies is small, however, and those using hedonic pricing are limited to the San Francisco Bay Area, Los Angeles, and San Diego. Nonetheless, existing evidence suggest that CRT stations and lines on the whole may impose negative property value effects.

We help close many gaps in literature by estimating the association between asking rents (a proxy for property value) for office, retail and rental apartments and the presence of different types of transit (LRT, BRT, SCT, CRT) in one-half mile bands to one mile away from transit corridors. For this analysis we include 10 metropolitan counties with LRT systems, seven metropolitan areas with BRT systems (adding some from our national study of BRT outcomes for NITC (Nelson and Ganning 2015)), three SCT systems and five CRT systems.

Econometric analysis can be used to estimate the extent to which benefits of transit accessibility are capitalized by property. Usually, the observed sales price of property or sometimes the assessed value of property is used for these studies. Asking rents have also been used as they reflect current market conditions and thus do not suffer from the lag in reporting sales or appraisals. Where available, asking rents may be more efficiently assembled for cross-section analysis than using reported sales or appraisals of property (which can suffer from reporting inconsistencies between states and even among county assessors in the same state). As we are interested in understanding differences in capitalized values with respect to different transit systems in different states, and given data availability, we choose to employ hedonic analysis of asking rents for privately-owned rental property reported by CoStar during the first quarter of 2015.

By permission as it is used for research, we have access to CoStar's asking rent database for all the metropolitan counties noted earlier. To our knowledge, it is the largest database of its kind assembled to analyze the association between transit accessibility and market rents. In all, the database is comprised of more than 50,000 structures with more than three billion square feet of space in these metropolitan counties offered for rent in the first quarter of 2015.

From literature, the standard hedonic model is generalized as:

$R_i = f(S_i, SES_i, P_i, U_i, L_{i,})$

where:

> **R** is the asking rent per square foot for property *i*;
>
> **S** is the set of structural attributes of property *i* including its architecture, mass, height, age and effective age, interior amenities, flow efficiencies and so forth;
>
> **SES** is the set of socioeconomic characteristics of the vicinity of property *i* such as population features, income, education;
>
> **P** is a set of planning, zoning and other development restrictions applicable to property *i*;
>
> **U** is a set of measures of urban form of the vicinity of property *i* such as the nature of surrounding land uses, terrain, physical amenities (such as parks), street characteristics and related; and
>
> **L** is a set of location attributes of property *i* such as distance to downtown and other activity centers, distance to nearest major highways including freeway/expressway ramps, and distance to different public transit options.

Where these data can be assembled, ordinary least squares hedonic (regression) analysis can explain between one and three quarters of the variation in the observed rent for the properties in the sample. Because of resource constraints, our analysis necessarily excludes **SES**, **P** and **U** vectors, uses only indicators of **S** where reported in CoStar, and uses only some categorical measures of **L**. Nonetheless, an important feature of hedonic analysis is that despite missing attributes that could help explain more of the variation in market rents, the coefficients of reported variables used will nonetheless reveal an estimate of the willingness of the market to pay for them.

Our reduced model is comprised of these features:

R is the asking rent per square foot for property *i* reported by CoStar in the first quarter of 2015 for all properties in the metropolitan counties used in our study. By logging, our semi-log model allows for coefficients to be interpreted as percent changes in rent attributable to dependent factors.

For **S**, and depending on CoStar data availability, our attributes for property *i* include (with predicted sign of association with rent)

Year the structure was built (+)
If the property was renovated (+)
Number of floors (+)
Vacancy rate (- as the higher the rate the less attractive the property may be)
Some regressions for specific real estate types will have additional structure attributes.

L is comprised of three attributes indicating whether property *i* is within one-half mile of any of the BRT, LRT and SCT corridor centerlines in our study.

We also include a binary variable for each of the metropolitan counties to help account for a composite of attributes uniquely associated with those counties such as weather, terrain, region of the country, underlying economic structure, and so forth. As is customary, we do not predict the association between rent and location within these metropolitan county controls.

We note that our analysis is of the association between rents and properties within one-half mile bands of transit corridors to one mile, as opposed to discrete distance from transit stations. We will discuss the importance of this distinction later.

For the pooled metropolitan area analysis, we apply CoStar data to three major types of real estate it reports for all metropolitan counties in our analysis[3]: office, retail and rental apartments. In all, we estimate nine equations which are now presented. We will offer summary observations at the end.

Office Rent along Transit Corridors
Table 3.1 presents our hedonic analysis of office rents. In addition to the **S** attributes noted above, we add *Class A* and *Class B* attributes using Class C as the referent. For brevity, we dispense with reviewing structural control (the significant coefficients of which have the correct signs) and regional control variables (which have no a priori meaning).

We determine whether coefficients are significant as $p < 0.10$ based on the 2-tailed test. For all office properties in our analysis, we find the following asking rent associations between office property location within one-half and between one-half and one mile of transit systems by type.

[3] Normally, statistical analysis is applied to samples of a universe. In our case, we analyze the universe of all properties reported by CoStar. As CoStar data come from real estate brokerages participating in its network, the data exclude non-participating brokerages or entities and properties not for rent including those that that owner-occupied among others. However, as we do not have CoStar data for the Tacoma market its streetcar system is excluded.

Transit	Distance Band	Rent
BRT	<0.50 mile	ns
BRT	0.50-1.00 mile	ns
LRT	<0.50 mile	ns
LRT	0.50-1.00 mile	2.3%
CRT	<0.50 mile	-2.2%
CRT	0.50-1.00 mile	ns
SCT	<0.50 mile	5.0%
SCT	0.50-1.00 mile	3.9%

ns means not significant

BRT systems do not appear to have a statistically significant association with respect to location in either distance band. LRT systems do not seem to have a statistically significant rent association with respect to location in the closest half-mile band but have a small, positive association with respect to the next half mile. We observe, as others (see Cervero et al. 2004), that many LRT systems are built along existing freight rail rights of ways and have had little effect on development near them. Our analysis suggests LRT effects in the next half-mile band, however. Similar to some studies and consistent with our interpretation of them, we find a negative association between the first half-mile band from CRT transit lines and office rents but no significant association in the second band.

We find strong, positive associations between rents and both distance bands with respect to SCT systems, with the largest effect seen in the first half mile.

Office Rent along Transit Corridors

Table 3-1

Variable	**Beta**	**Std. Error**	**t-score**	**sig. p**
Constant	0.993	0.091	10.969	0.000
Structure Controls				
GLA	0.000	0.000	-1.081	0.280
Class A	0.175	0.004	42.301	***0.000***
Class B	0.068	0.002	28.493	***0.000***
Vacancy Rate	-0.001	0.000	-17.221	***0.000***
Stories	0.003	0.000	5.900	***0.000***
Year Built	0.000	0.000	2.268	***0.023***
Renovated	0.008	0.003	2.401	***0.016***
FAR	0.000	0.000	-0.974	0.330
City Center	0.020	0.004	4.812	***0.000***

Table 3.1
Office Rent along Transit Corridors—continued

Variable	Beta	Std. Error	t-score	sig. p
Regional Controls				
Allegheny	0.103	0.090	1.149	0.250
Arapahoe	0.127	0.090	1.414	0.158
Bernalillo	0.104	0.090	1.152	0.249
Broward	0.172	0.089	1.926	0.054
Clark	0.108	0.089	1.211	0.226
Collin	0.199	0.090	2.217	0.027
Cuyahoga	0.061	0.089	0.679	0.497
Dallas	0.112	0.089	1.249	0.212
Davis	0.067	0.090	0.742	0.458
Denver	0.185	0.090	2.062	0.039
Harris	0.157	0.089	1.754	0.080
Hennepin	0.040	0.089	0.445	0.656
Hillsborough	0.134	0.089	1.501	0.133
Jackson	0.067	0.090	0.749	0.454
King	0.218	0.089	2.432	0.015
Lane	0.125	0.091	1.373	0.170
Maricopa	0.177	0.089	1.980	0.048
Mecklenburg	0.157	0.089	1.759	0.079
Miami-Dade	0.291	0.089	3.249	0.001
Multnomah	0.166	0.090	1.846	0.065
Palm Beach	0.198	0.089	2.210	0.027
Pierce	0.142	0.090	1.586	0.113
Sacramento	0.188	0.089	2.105	0.035
Salt Lake	0.080	0.089	0.898	0.369
San Diego	0.265	0.089	2.969	0.003
Sandoval	0.077	0.093	0.824	0.410
Santa Fe	0.203	0.094	2.163	0.031
Tarrant	0.135	0.089	1.507	0.132
Weber	0.003	0.090	0.029	0.977
Transit Associations				
BRT<0.50	0.006	0.006	1.011	0.312
BRT0.50-1.00	0.004	0.009	0.397	0.691
LRT<0.50	0.005	0.005	1.000	0.317
LRT0.50-1.00	0.023	0.007	3.465	***0.001***
CRT<0.50	-0.022	0.006	-3.698	***0.000***
CRT0.50-1.00	0.007	0.006	1.188	0.235
SCT<0.50	0.050	0.011	4.462	***0.000***
SCT0.50-1.00	0.039	0.014	2.714	***0.007***

Table 3.1
Office Rent along Transit Corridors—continued

Model Performance	
n	15,909
Adjusted R^2	0.344
F-Ratio	182.36
F-Ratio sig.	0.000

Note: Significance level, p<0.10, based on two-tailed test.
Source: Data from CoStar.

Retail Property Rent along Transit Corridors
In Table 3.2, we present our hedonic analysis of the association between retail property rents and location within the two half-mile distance bands along fixed guideway transit corridors. We consider Strip Center, Power Center, Neighborhood and Community retail center categories with General Retail being the referent. (There were only five regional mall cases in our database which were automatically excluded from analysis by SPSS.)

As with the office rent analysis, we dispense with reviewing structural control (the significant coefficients of which have the correct signs) and regional control variables (which have no a priori meaning). We determine whether coefficients are significant as $p < 0.10$ based on the 2-tailed test. For all retail properties in our analysis, we find the following asking rent associations between retail property location within one-half and between one-half and one mile of transit systems by type.

Transit	**Distance Band**	**Rent**
BRT	<0.50 mile	-2.5%
BRT	0.50-1.00 mile	ns
LRT	<0.50 mile	2.5%
LRT	0.50-1.00 mile	2.1%
CRT	<0.50 mile	-3.5%
CRT	0.50-1.00 mile	-2.3%
SCT	<0.50 mile	6.3%
SCT	0.50-1.00 mile	ns

ns means not significant

Retail results are decidedly different than we found for office rents. Being within one-half mile of a BRT line reduces rents by 2.5% with no effect across the next half mile. Our perusal of BRT lines in Phoenix, Las Vegas, Eugene, Kansas City and Cleveland indicate BRT stops occur mostly at or near office centers with very little retail accessibility; nonetheless, more site specific analysis is needed to understand why.

In contrast to office results, we find a positive association between retail rent and location with the closest half mile, and slightly smaller association with respect to the next half mile. We observe that LRT systems often have stops near or in the heart of retail opportunities.

Consistent with office outcomes as well as with overall expectations, there is a negative association between CRT distance and retail rents.

Lastly, streetcar transit has the largest, positive association between rents and location within the closest half mile but no significant association beyond. As our data are limited mostly to three downtowns (Portland, Seattle and Tampa), these results may reflect the decision to locate SCT lines where high-value retail already exists.

Retail Rent along Transit Corridors

Table 3-2

Variable	Beta	Std. Error	t-score	sig. p
(Constant)	-1.150	0.134	-8.605	0.000
Structure Controls				
GLA	0.000	0.000	-1.754	***0.079***
Strip Center	0.000	0.029	-0.001	1.000
Power Center	0.162	0.070	2.302	***0.021***
Neighborhood	-0.030	0.029	-1.029	0.303
Community	0.030	0.040	0.758	0.449
Vacancy Rate	0.000	0.000	-7.537	***0.000***
Stories	0.010	0.002	4.615	***0.000***
Year Built	0.001	0.000	17.982	***0.000***
Renovated	-0.014	0.007	-2.062	***0.039***
FAR	-0.003	0.002	-1.374	0.170
City Center	0.066	0.007	9.130	***0.000***
Regional Controls				
Allegheny	0.098	0.063	1.565	0.118
Arapahoe	0.193	0.062	3.087	0.002
Bernalillo	0.147	0.063	2.340	0.019
Broward	0.277	0.061	4.536	0.000
Clark	0.187	0.061	3.069	0.002
Collin	0.235	0.062	3.800	0.000
Cuyahoga	0.069	0.062	1.115	0.265
Dallas	0.127	0.061	2.069	0.039
Davis	0.138	0.063	2.200	0.028
Denver	0.254	0.063	4.034	0.000
Harris	0.176	0.061	2.885	0.004
Hennepin	0.194	0.062	3.146	0.002
Hillsborough	0.164	0.062	2.660	0.008
Jackson	0.058	0.062	0.933	0.351
King	0.291	0.061	4.755	0.000
Lane	0.205	0.067	3.054	0.002
Maricopa	0.150	0.061	2.455	0.014
Mecklenburg	0.213	0.062	3.457	0.001
Miami-Dade	0.400	0.061	6.545	0.000
Multnomah	0.212	0.062	3.403	0.001
Palm Beach	0.301	0.061	4.920	0.000
Pierce	0.222	0.062	3.606	0.000
Sacramento	0.193	0.062	3.125	0.002
Salt Lake	0.154	0.062	2.499	0.012

Table 3.2
Retail Rent along Transit Corridors—continued

San Diego	0.332	0.061	5.422	0.000
Sandoval	0.201	0.080	2.524	0.012
Santa Fe	0.306	0.076	4.048	0.000
Tarrant	0.133	0.061	2.173	0.030
Weber	0.089	0.063	1.416	0.157
Transit Associations				
BRT<0.50	-0.025	0.009	-2.832	***0.005***
BRT0.50-1.00	-0.021	0.013	-1.540	0.124
LRT<0.50	0.025	0.011	2.382	***0.017***
LRT0.50-1.00	0.021	0.012	1.769	***0.077***
CRT<0.50	-0.035	0.011	-3.101	***0.002***
CRT0.50-1.00	-0.023	0.010	-2.198	***0.028***
SCT<0.50	0.063	0.024	2.658	***0.008***
SCT0.50-1.00	0.016	0.026	0.624	0.532
Model Performance				
n	12,861			
Adjusted R^2	0.203			
F-Ratio	69.137			
F-Ratio sig.	0.000			

Note: Significance level, p<0.10, based on two-tailed test.
Source: Data from CoStar.

Apartment Rents along Transit Corridors

Table 3.3 presents our hedonic analysis of the association between apartment rents and location within the two half-mile distance bands along fixed guideway transit corridors. We adjust our general model to include three broad categories of apartment building type: High Rise, Mid Rise and Low Rise with Garden Apartments as the referent. We also include whether apartments are subsidized (such as through HUD Section 8 vouchers) or restricted (such as to low-income households), and further restricted to seniors or students.

For brevity, we dispense with reviewing structural control (the significant coefficients of which have the correct signs) and regional control variables (which have no a priori meaning). We determine whether coefficients are significant as $p < 0.10$ based on the 2-tailed test. For all apartment rental property in our analysis, we find the following asking rent associations between apartment property location within one-half and between one-half and one mile of transit systems by type.

Transit	**Distance Band**	**Rent**
BRT	<0.50 mile	3.0%
BRT	0.50-1.00 mile	1.7%
LRT	<0.50 mile	4.5%
LRT	0.50-1.00 mile	2.5%
CRT	<0.50 mile	ns
CRT	0.50-1.00 mile	ns
SCT	<0.50 mile	10.8%
SCT	0.50-1.00 mile	9.0%

ns means not significant

Retail results are decidedly different than we found for office rents. Being within one-half mile of a BRT line reduces rents by 2.5% with no effect across the next half mile. Our perusal of BRT lines in Phoenix, Las Vegas, Eugene, Kansas City and Cleveland indicate BRT stops occur mostly at or near office centers with very little retail accessibility; nonetheless, more site specific analysis is needed to understand why.

In contrast to office results, we find a positive association between retail rent and location with the closest half mile, and slightly smaller association with respect to the next half mile. We observe that LRT systems often have stops near or in the heart of retail opportunities.

Consistent with office outcomes as well as with overall expectations, there is a negative association between CRT distance and retail rents.

Lastly, streetcar transit has the largest, positive association between rents and location within the closest half mile but no significant association beyond. As our data are limited mostly to three downtowns (Portland, Seattle and Tampa), these results may reflect the decision to locate SCT lines where high-value retail already exists.

Apartment Rents along Transit Corridors

Table 3-3

Variable	**Beta**	**Std. Error**	**t-score**	**sig. p**
Constant	-1.117	0.072	-15.415	0.000
Structure Controls				
Ave Unit Sq.Ft.	0.000	0.000	-39.455	***0.000***
High Rise	-0.002	0.016	-0.106	0.915
Low Rise	0.003	0.002	1.187	0.235
Mid Rise	0.075	0.004	19.354	***0.000***
Vacancy Rate	0.001	0.000	5.845	***0.000***
Stories	0.010	0.001	12.768	***0.000***
Acres	0.000	0.000	1.525	0.127
Subsidized	-0.036	0.004	-9.375	***0.000***
Restricted	-0.085	0.003	-26.926	***0.000***
Senior	0.003	0.005	0.570	0.569
Student	0.056	0.009	6.255	***0.000***
Year Built	0.001	0.000	17.626	***0.000***
Renovated	-0.007	0.006	-1.317	0.188
Regional Controls				
Allegheny	0.058	0.030	1.890	0.059
Arapahoe	0.139	0.030	4.621	0.000
Bernalillo	0.023	0.030	0.747	0.455
Broward	0.189	0.031	6.167	0.000
Clark	0.024	0.030	0.813	0.416
Collin	0.129	0.030	4.242	0.000
Cuyahoga	0.001	0.030	0.039	0.969
Dallas	0.086	0.030	2.886	0.004
Davis	0.043	0.032	1.366	0.172
Denver	0.188	0.030	6.279	0.000
Harris	0.084	0.030	2.826	0.005
Hennepin	0.123	0.030	4.119	0.000
Hillsborough	0.068	0.030	2.273	0.023
Jackson	-0.030	0.030	-0.988	0.323
King	0.231	0.030	7.739	0.000
Lane	0.049	0.031	1.589	0.112
Maricopa	0.029	0.030	0.976	0.329
Mecklenburg	0.042	0.030	1.392	0.164
Miami-Dade	0.126	0.030	4.135	0.000
Multnomah	0.105	0.030	3.522	0.000

Table 3.3
Apartment Rents along Transit Corridors—continued

Variable	Beta	Std. Error	t-score	sig. p
Palm Beach	0.176	0.030	5.875	0.000
Pierce	0.093	0.030	3.122	0.002
Sacramento	0.115	0.030	3.842	0.000
Salt Lake	0.061	0.030	2.025	0.043
San Diego	0.260	0.030	8.647	0.000
Sandoval	0.079	0.053	1.493	0.136
Santa Fe	0.102	0.034	2.972	0.003
Tarrant	0.056	0.030	1.880	0.060
Weber	-0.023	0.032	-0.721	0.471
Transit Associations				
BRT<0.50	0.030	0.005	6.125	***0.000***
BRT0.50-1.00	0.017	0.006	2.702	***0.007***
LRT<0.50	0.045	0.005	9.800	***0.000***
LRT0.50-1.00	0.025	0.004	6.248	***0.000***
CRT<0.50	-0.001	0.008	-0.076	0.940
CRT0.50-1.00	0.009	0.006	1.456	0.145
SCT<0.50	0.108	0.009	11.594	***0.000***
SCT0.50-1.00	0.090	0.009	9.524	***0.000***
Model Performance				
n	12,971			
Adjusted R2	0.510			
F-Ratio	270.982			
F-Ratio sig.	0.000			

Note: Significance level, $p<0.10$, based on two-tailed test.
Source: Data from CoStar.

Review and Implications

Table 3.4 synthesizes the significant coefficients for rent premium by transit mode for office, retail and rental apartment developments. For the most part, SCT has the most important outcomes. This is notable because also, for the most part, economic outcomes to SCT systems are the least understood given their recent emergence. But for the first distance band along LRT corridors, there is a positive association between rents for all development types and proximity to LRT corridors. Results for BRT are mixed with no statistically significant association with respect to office rent, a negative association with respect to the retail first distance band, but positive effects for rental apartments. However, across all development types, proximity to CRT corridors either has an insignificant association or a negative one. We are not surprised given the freight-station nature of CRT systems.

Significant Asking Rent Premium Coefficients by Real Estate Type

Table 3-4

Mode Distance Band	Office	Retail	Apartment
BRT<0.50	ns	-0.025	0.030
BRT0.50-1.00	ns	ns	0.017
LRT<0.50	ns	0.025	0.045
LRT0.50-1.00	0.023	0.021	0.025
CRT<0.50	-0.022	-0.035	ns
CRT0.50-1.00	ns	-0.023	ns
SCT<0.50	0.050	0.063	0.108
SCT0.50-1.00	0.039	ns	0.090

We have amassed a considerable amount of rent data that will be evaluated further. This includes assessing the association between each of the transit modes and rents for individual metropolitan areas as well as adding industrial and flex land uses. A sample of the kind of metropolitan area-specific analysis we anticipate undertaking is reported in Nelson et al. (2015).

CHAPTER 4
Influences of Light Rail Transit, Streetcar Transit, and Commuter Rail Transit on the Location of People and Housing

TODs have many promises. Of interest in this chapter is the extent to which LRT, SCT and CRT TOD areas attract people and housing consistent with expectations (Belzer et al., 2007; Belzer and Poticha, 2010; Belzer et al, 2011; Carrigan et al., 2013; Cervero et al., 2004; Dawkins and Buehler, 2010; Dawkins and Moeckel 2014).

For the most part, there is very little research assessing whether TODs accomplish these objectives. Analysis in the U.S. has been limited to case studies mostly of individual TOD areas but not of metropolitan areas as a whole (Cervero and Seskin, 1995; Cervero et al., 2004; Kolko, 2011). No studies analyze change in population and housing associated with LRT and SCT systems in the U.S. The only metropolitan-scale studies addressing the influence of BRT systems on population and housing are from outside the U.S. (Carrigan et al., 2013; Cervero, 2013).

Only one study addresses population and housing change for all TODs in the U.S.—the Center for Transit Oriented Development (2014). It does not differentiate by type of system nor does it provide detailed information for individual metropolitan areas. We adapt its language for our purposes in terms of population and households.

Population
Between 2000 and 2010, population increased both within transit sheds (areas within 0.50 mile of transit stations) and in their larger regions. In transit sheds, the rate of growth has not kept pace with the transit regions. The rate of growth varies depending on the size and growth of the transit systems themselves. Regions with extensive transit systems (located primarily in the Northeast) had more modest population growth in transit sheds than did regions with smaller expanding systems. For small to large transit systems, the population in the South, West, South and Sunbelt expanded between 4-16 percent while their transit sheds grew from 2-6 percent. (Adapted from Center for Transit Oriented Development: 9.)

Population growth in individual transit systems varied substantially. Newer, small systems in the Southeast such as Tampa and Charlotte saw their transit shed populations increase by more than 30 percent in their new station areas. Among the large systems, the transit sheds in Portland and Denver each grew approximately 20 percent. Extensive systems experienced more modest percentage gains but, in absolute numbers, recorded much larger growth. While New York's transit shed added nearly 200,000 residents, both Washington D.C. and San Francisco grew between 75,000 and 81,000. (Adapted from Center for Transit Oriented Development: 10.)

Some systems actually lost population. Cleveland, Baltimore, Detroit and Buffalo have seen declines in regional population for decades and are known for being weak market cities. Cook County in Chicago, where many of CTA's stations are located, also experienced population decline. Dallas County in Texas experienced slower growth than in the past, with only a 7 percent growth rate compared to at least 17 percent gains every decade since 1970. Finally, the population of Sacramento, CA, in transit zones declined while the region grew at almost 20 percent. Most of this growth appears to be in suburban areas and not near transit stations (Adapted from Center for Transit Oriented Development: 10).

Households
Transit sheds are attracting an increasing share of small households. The share of smaller one- and two-person households increased from 2000 to 2010 in both transit regions and sheds, while larger three-person or more households decreased. This shift was more pronounced within transit sheds. Shares of one- and two-person households grew about 6 and 3 percent, respectively, from 2000 to 2010 while households with three or more people declined by 8 percent. This trend may reflect the attraction of urban living for singles and couples near transit (Adapted from Center for Transit Oriented Development: 12.)

Research Question and Data
In this chapter, we address the following question:

> *Relative to the metropolitan area as a whole, is there an association between LRT, SCT and CRT TOD area change over time in population; households by householder age and household type; and housing by total supply, vacancy rates and tenure?*

Our study areas include the entire metropolitan statistical area as defined in 2010 for comparisons to change with one-half mile of census block-group centroids to LRT and SCT stations. While the largest share of influences likely occur within the first one-half mile, emerging literature indicates the full effect of transit systems is felt up to two miles away (see Nelson et al. 2015). Nonetheless, literature shows that the largest share of change occurs within the first one-half mile of fixed-guideway transit systems (see Center for Transit Oriented Development, 2014).

Our data are census data from the 2000 and 2010 censuses of population for persons and household types.

Analytic Scheme
Our analysis calculates the change in LTR, SCT and CRT TOD area outcomes between 2000 and 2010 compared to the change for the metropolitan area as a whole. We use the universe of block groups (BGs) whose centroids are within one-half mile of transit stations and compare the weighted sum of those BGs to the entire metropolitan area. As there is no sampling involved, we can use the direct comparisons for analytic purposes. (In other words, if the weighted average change in population of all BGs in the TOD study area was 14 percent the change and the metropolitan area grew by 13 percent, the TOD study area gained share of population relative to the metropolitan area.) We calculate ratios to make this comparison. If the ratio of population change among the BGs in our TOD study area compared to the population change of the metropolitan area as a whole is 1.01, we find that the TOD study area added more people proportionately than the metropolitan area. Conversely, if the ratio is 0.99, the BRT study area grew less proportionately than the metropolitan area.

We make a further observation. For the most part, new fixed-guideway transit systems are built where development already exists to maximize ridership to maximize revenues. In metropolitan areas prone to sprawl, new development is more likely to occur away from fixed-guideway transit systems than toward them. We might expect, a priori, change ratios of less than one in

growing metropolitan areas reflecting the ease of adding development away from transit than the potential problems associated with adding development where development already exists.
We developed three categories of performance measures: population change; change in households by householder age and type; and housing and tenure. The specific performance measures and how they are calculated are presented next.

Population Change

The key performance measure here is population change.

Population Change Ratio—The quotient of census 2010 and 2000 population for the TOD study area divided by the quotient of census 2010 and 2000 population, respectively.

Households by Householder Age and Type

Three performance measures are included in this category: three measure change in households by householder age (under 35, between 35 and 64, and 65 and over) while three measure change in households by household type (households with and without children, and single-person households.

HH <35 Share Ratio—The quotient of census 2010 and 2000 householders under 35 years of age and total households from the 2000 census for the TOD study area divided by the quotient of householders under 35 from the 2010 census for the metropolitan area, respectively.

HH 35-64 Share Ratio—The quotient of census 2010 and 2000 householders 35 to 64 years of age and total households from the 2000 census for the TOD study area divided by the quotient of householders 35 to 64 from the 2010 census for the metropolitan area, respectively. These tend to be households needing housing space to raise families and may also prefer detached homes on larger lots, so we would not be surprised if TOD study area shares fell relative to the metropolitan area.

HH 65+ Share Ratio—The quotient of census 2010 and 2000 householders 65 years of age and older and total households from the 2000 census for the TOD study area divided by the quotient of householders 65 years of age and older from the 2010 census for the metropolitan area, respectively. These tend to be downsizing households who are mostly empty-nesters and may prefer to relocate to smaller homes on smaller lots, or attached homes. We may expect an increasing share of these households living near transit stations relative to the metropolitan area.

Housing and Tenure

Two measures are included in this set:

Unit Change Ratio—The quotient of census 2010 and 2000 housing units and total housing units from the 2000 census for the TOD study area divided by the quotient of housing units from the 2010 census for the metropolitan area, respectively. If TOD station areas attract new housing demand, there should be a shift in change in total housing units favoring the TOD study area.

Renter Change Ratio—The quotient of home rental rates in the TOD study area for 2010 and 2000 divided by the quotient of home rental rates for the metropolitan area for 2010 and 2000. If TOD study areas become more attractive to younger households and single-person households, we suspect there will be a greater change in the share of housing that is rented in the TOD study areas relative to the metropolitan area.

In review, the rows in the following tables and in Appendix C can be interpreted as follows:

2000 LRT/SCT/CRT is the TOD area baseline in 2000:
= Half-mile TOD area number in census year 2000

2000 Metro is the metropolitan area/combined area baseline in 2000:
= Metropolitan area number in census year 2000

2000 LRT/SCT/CRT/Metro is the share of TOD area to metropolitan area in 2000:
= (2000 LRT/SCT/CRT) / (2000 LRT/SCT/CRT Metro)

2010 LRT/SCT/CRT in the TOD area end year in 2010:
= Half-mile TOD area number in census year 2010

2010 Metro is the metropolitan area/combined area end-year in 2010:
= Metropolitan/Combined Metropolitan area number in census year 2010

2010 LRT/SCT/CRT/Metro is the share of TOD area to metropolitan area in 2010:
= (2010 LRT/SCT/CRT) / (2010 LRT/SCT/CRT Metro)

LRT/SCT/CRT/Metro 2010-2000 is the ratio of 2010 TOD area metro share to 2000 TOD area metro share:
= (2010 LRT/SCT/CRT/Metro) / (2000 LRT/SCT/CRT/Metro)

Metro Outcome is a categorical assessment of whether the TOD area gained share, held constant share, or lost share of metro area change:
= LRT/SCT/CRT/Metro 2010-2000 > 101% means TOD area Gained Share of metropolitan change
= LRT/SCT/CRT/Metro 2010-2000 = 99%- 101% means TOD area sustained a Constant Share of metropolitan change
= LRT/SCT/CRT/Metro 2010-2000 < 99% means TOD area Lost Share of metropolitan metric

LRT/SCT/CRT 2000-2010 is the TOD area change between 2000 and 2010:
= (2010 LRT/SCT/CRT) – (2000 LRT/SCT/CRT)

LRT/SCT/CRT Percent is the percent change between 2000 and 2010:
= [(2010 LRT/SCT/CRT) / (2000 LRT/SCT/CRT) – 1]

LRT/SCT/CRT Outcome is a categorical assessment of whether the TOD area gained or lost between 2000 and 2010:
= (2010 LRT/SCT/CRT) – (2000 LRT/SCT/CRT) > 0 means the TOD area gained
= (2010 LRT/SCT/CRT) – (2000 LRT/SCT/CRT) < 0 means the TOD area lost

Results

We now present our composite results for LRT, SCT and CRT systems. The first composite table reports results for all systems in the same mode combined. There are two key figures:

1. Whether TOD areas for all systems in a mode (a) gained share of metropolitan area population, households by age category, housing units, or renters (that is, the TOD area share of metro numbers in 2010 was 101% or more than the TOD area share of metro numbers in 2000), or held a constant share of these metrics between 2000 and 2010 (that is, the TOD share in 2010 was between 99% and 101% of the TOD share in 2000), or (c) lost share (that is, the TOD area share of metro metrics in 2010 was less than 99% of the TOD area share of the metro in 2000). This is the upper highlighted line in tables 4.1, 4.4 and 4.7 for all systems in all modes combined (LRT, SCT and CRT, respectively). Tables 4.3, 4,6 and 4.9 report summary ordinal results for each mode indicating whether the system gained share (gained), lost share (lost) or held a constant share (constant) of the respective metropolitan area's growth for each metric.

2. Whether TOD areas gained or lost population, households by age category, housing units, or renters between 2000 and 2010. This is the lower highlighted lines in tables 4.1, 4.4 and 4.7, and also reported for each system for each mode in tables 4.2, 4.5 and 4.7 for each mode (LRT, SCT and CRT, respectively).

Light Rail Transit Systems

As a whole, all TOD areas serving light rail transit systems gained population, households in all age categories, housing units, and renters between 2000 and 2010 as did nearly all TOD areas of each individual LRT system. Indeed, only the Dallas DART TOD areas saw a decline in population and households with householders under 35 years of age though they gained in all other metrics. However, as a whole LRT TOD areas lost share of most demographic and housing metrics compared to their metropolitan areas, the exceptions being households with householders under 35 and between 35 and 64 years of age.

As LRT systems have the largest geographic reaches and include many times more TOD areas than other modes, these results could be surprising. We reason that it is the very size of the area served and number of TOD areas that generates deceiving results. We know from literature that many LRT TOD areas served built-out areas, stations that do not connect easily to other land uses, or areas that remain underdeveloped because of market forces, planning barriers, or other factors.

Bus Rapid Transit Systems

As our analysis in this report would be otherwise limited to just four BRT systems we recommend readers to the much more extensive analysis in *National Study of BRT Development Outcomes* (Nelson and Ganning 2015).

Streetcar Transit Systems

Our research generated a big surprise for us: All four streetcar transit systems not only grew in all population, household and housing measures, they gained share of metropolitan change as well. We suspect two reasons. First, SCT systems serve the smallest and most built-out geographic areas—mostly downtowns and nearby areas—which in 2000 had very small shares of metropolitan population, households and housing shares. For instance, in 2000, our TOD study areas collectively accounted for barely more than one percent of the metropolitan area population. Mostly through redevelopment—such as Portland's Pearl District, and infill—such as seen along Tampa's downtown waterfront to Ybor City, the SCT TOD areas gained share across all metrics. At about 30,000 new residents, the share of SCT TOS area population rose from about one percent to about 1.5 percent over the period 2000 to 2010. While a very small share of total metropolitan area growth of nearly 1.5 million, the demographic and housing-related growth among SCT TOD areas is not trivial.

We also note that for Portland and Tacoma, gains in population, households, housing and renters may be offset by large reductions in jobs among their SCT TOD areas. In Portland's Pearl District, for instance, many thousands of jobs were displaced through redevelopment that transformed it from a low worker-intensity area into a high-density residential one. We anticipate conducting in-depth case studies of the Portland, Tacoma and Tampa with special emphasis on the extent to which residential infill and redevelopment displaced jobs.

Commuter Rail Transit Systems

There has not been much research about commuter rail systems so our findings are worth noting. Collectively, CRT TODs grew across all metrics though they gained share of metropolitan area/combined area metrics only with respect to households with householders under 35 and between 35 and 64 years of age—similar to our findings for LRT systems as a whole. Except for Miami-South Florida, nearly all other CRT systems grew across all metrics (Tacoma mostly held steady with the number of households with householders under 35 years of age.) For Miami-South Florida, only the number of households with households under 35 years of age increased. As we noted in Chapter 2, CRT systems may be an important long-term opportunity to connect development opportunities to this form of transit.

The CRT systems in Salt Lake City and San Diego are remarkable, however, in having gains across all metrics. We note from Chapter 1 that the San Diego CRT system did not perform well with respect to changing regional share of jobs to its TOD areas whereas the Salt Lake CRT system did. We also note that the Salt Lake CRT system is the subject of an ongoing study by the Metropolitan Research Center at the University of Utah to explore further why it seems to be associated with such positive development outcomes.

Summary Assessment

The tables reporting ordinal changes (4.3, 4.6, and 4.9) sum things up best. Streetcar transit systems performed best in terms of increasing their TOD area shares of metropolitan population, households and householders by age, housing units, and renters. For the most part, LRT and CRT systems are roughly comparable but they also serve many times more TOD areas with much larger geographic service areas. We note in a separate report on BRT systems (Nelson and Ganning 2015) that for the most part we do not find that BRT systems are associated with substantial shifts in population, household and housing unit location over time.

Composite Population, Households by Age, Housing Unit and Tenure Change for all LRT Systems, 2000-2010

Table 4-1

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	725,046	303,942	110,435	123,660	48,142	328,791	184,043
2000 Metro	24,409,717	8,922,431	2,359,753	5,166,415	1,396,263	9,281,877	3,269,980
2000 LRT/Metro	3.0%	3.4%	4.7%	2.4%	3.4%	3.5%	5.6%
2010 LRT	784,685	342,609	126,982	165,203	50,424	383,414	210,500
2010 Metro	29,084,117	10,617,393	2,457,313	6,338,446	1,821,634	11,807,490	3,912,428
2010 LRT/Metro	2.7%	3.2%	5.2%	2.6%	2.8%	3.2%	5.4%
LRT/Metro 2010-2000	91%	95%	110%	109%	80%	92%	96%
Metro Outcome	Lost Share	Lost Share	Gained Share	Gained Share	Lost Share	Lost Share	Lost Share
LRT 2000-2010	59,639	38,667	16,547	41,543	2,282	54,623	26,457
LRT Percent	8.2%	12.7%	15.0%	33.6%	4.7%	16.6%	14.4%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Percent Change in Population, Households by Age, Housing Unit and Tenure Change for Each LRT System, 2000-2010

Table 4-2

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
Charlotte	20.6%	22.3%	34.1%	19.4%	1.3%	32.1%	27.0%
Dallas	-4.5%	0.8%	-5.1%	178.7%	5.6%	4.9%	-2.2%
Denver	8.9%	17.1%	36.7%	10.3%	1.5%	20.3%	24.9%
Houston	30.2%	35.2%	41.3%	30.6%	27.6%	40.0%	31.6%
Portland	16.1%	20.1%	21.6%	21.4%	11.9%	21.6%	20.4%
Sacramento	2.3%	4.1%	-7.2%	9.9%	2.5%	7.1%	7.1%
Salt Lake City	19.8%	30.4%	29.8%	34.9%	20.7%	27.6%	30.6%
San Diego	9.7%	8.8%	9.8%	11.7%	0.2%	11.4%	15.0%
Twin Cities	8.9%	13.5%	14.6%	16.7%	0.9%	19.0%	13.6%

Ordinal Change of Share in Population, Households by Age, Housing Unit and Tenure Change for Each LRT System, 2000-2010

Table 4-3

Metric	Charlotte	Dallas	Denver	Houston	Portland	Sacramento	Salt Lake City	San Diego	Twin Cities
Population	Lost	Lost	Lost	Gained	Constant	Lost	Gained	Constant	Constant
Households	Lost	Lost	Constant	Gained	Gained	Lost	Gained	Constant	Gained
HHs <35	Gained	Lost	Gained	Gained	Gained	Lost	Gained	Gained	Gained
HHs 35-64	Lost	Lost	Lost	Gained	Gained	Lost	Gained	Constant	Gained
HHs 65+	Lost	Lost	Lost	Lost	Lost	Lost	Lost	Lost	Lost
Housing Units	Lost	Lost	Constant	Gained	Constant	Lost	Gained	Lost	Constant
Rental Units	Lost	Lost	Constant	Gained	Constant	Lost	Gained	Gained	Lost

Composite Population, Households by Age, Housing Unit and Tenure Change for all SCT Systems, 2000-2010

Table 4-4

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 SCT	119,791	69,370	28,251	30,003	10,321	75,532	53,281
2000 Metro	10,443,179	4,151,619	986,197	2,356,184	805,602	4,288,191	1,477,621
2000 SCT/Metro	1.1%	1.7%	2.9%	1.3%	1.3%	1.8%	3.6%
2010 SCT	152,899	87,766	36,900	38,681	12,185	102,570	65,132
2010 Metro	11,917,988	4,735,989	1,008,223	2,775,528	950,256	5,164,778	1,754,170
2010 SCT/Metro	1.3%	1.9%	3.7%	1.4%	1.3%	2.0%	3.7%
SCT/Metro 2010-2000	112%	111%	128%	109%	100%	113%	103%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Constant Share	Gained Share	Gained Share
SCT 2000-2010	33,108	18,396	8,649	8,678	1,864	27,038	11,851
SCT Percent	27.6%	26.5%	30.6%	28.9%	18.1%	35.8%	22.2%
SCT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Percent Change in Population, Households by Age, Housing Unit and Tenure Change for Each SCT System, 2000-2010

Table 4-5

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
Portland	28.5%	25.1%	21.1%	28.8%	26.4%	30.4%	17.2%
Seattle	23.7%	26.9%	28.1%	26.9%	22.2%	34.5%	23.6%
Tacoma	28.1%	31.2%	46.9%	27.5%	16.1%	33.9%	27.9%
Tampa	27.6%	26.5%	30.6%	28.9%	18.1%	35.8%	22.2%

Ordinal Change of Share in Population, Households by Age, Housing Unit and Tenure Change for Each SCT System, 2000-2010

Table 4-6

Metric	Portland	Seattle	Tacoma	Tampa
Population	Gained	Gained	Gained	Gained
Households	Gained	Gained	Gained	Gained
HHs <35	Gained	Gained	Gained	Gained
HHs 35-64	Gained	Gained	Gained	Gained
HHs 65+	Lost	Constant	Lost	Lost
Housing Units	Gained	Gained	Gained	Gained
Rental Units	Lost	Gained	Gained	Gained

Composite Population, Households by Age, Housing Unit and Tenure Change for all CRT Systems, 2000-2010

Table 4-7

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 CRT	473,235	181,927	44,792	96,392	40,743	201,550	83,706
2000 Metro	12,248,810	4,585,556	1,029,250	2,557,015	999,291	4,763,632	1,541,140
2000 CRT/Metro	3.9%	4.0%	4.4%	3.8%	4.1%	4.2%	5.4%
2010 CRT	490,612	191,182	63,607	104,254	40,985	221,816	93,125
2010 Metro	14,046,352	5,262,634	1,057,704	3,030,770	1,174,160	5,869,256	2,530,166
2010 CRT/Metro	3.5%	3.6%	6.0%	3.4%	3.5%	3.8%	3.7%
SCT/Metro 2010-2000	90%	92%	138%	91%	86%	89%	68%
Metro Outcome	Lost Share	Lost Share	Gained Share	Gained Share	Lost Share	Lost Share	Lost Share
CRT 2000-2010	17,377	9,255	18,815	7,862	242	20,266	9,419
CRT Percent	3.7%	5.1%	42.0%	8.2%	0.6%	10.1%	11.3%
CRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Percent Change in Population, Households by Age, Housing Unit and Tenure Change for Each CRT System, 2000-2010

Table 4-8

Metro/Combined Metro	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
Albuquerque-Santa Fe	11.3%	17.2%	98.7%	16.0%	36.4%	20.9%	13.9%
Miami-South Florida	-10.4%	-12.2%	53.0%	-6.5%	-19.4%	-5.7%	-2.6%
Salt Lake CSA	29.5%	38.3%	38.0%	37.9%	40.1%	39.2%	74.6%
San Diego	13.1%	18.0%	17.9%	19.7%	13.9%	24.3%	22.6%
Seattle-Tacoma	4.8%	6.2%	-0.6%	7.0%	12.9%	10.8%	8.2%

Ordinal Change of Share in Population, Households by Age, Housing Unit and Tenure Change for Each SCT System, 2000-2010

Table 4-9

Metric	Albuquerque-Santa Fe	Miami-South Florida	Salt Lake CSA	San Diego	Seattle-Tacoma
Population	Lost	Lost	Gained	Gained	Lost
Households	Lost	Lost	Gained	Gained	Lost
HHs <35	Gained	Gained	Gained	Gained	Gained
HHs 35-64	Lost	Lost	Gained	Gained	Lost
HHs 65+	Constant	Lost	Gained	Gained	Lost
Housing Units	Constant	Lost	Gained	Gained	Lost
Rental Units	Lost	Lost	Gained	Gained	Lost

CHAPTER 5
Household Transportation Cost Variation with Respect to Distance from Light Rail Transit Stations

Overview
It seems an article of faith that transportation costs as a share of household income increase with respect to distance from downtowns, freeway interchanges, and—of key interest to us—light rail transit stations. Considerable literature reports price effects of these points on residential property values but none measure explicitly differences in household transportation costs as a share of household budgets. Our study helps close this gap in literature.

In this chapter, we use ordinary least squares regression analysis to address this issue. We evaluate block group data for all 12 metropolitan areas with light rail transit stations operating in 2010. We use the Department of Housing and Urban Development Location Affordability Index database which estimates the share of household budgets consumed by transportation. In addition to control variables, we measure the distance of block group centroids to the center of central business districts, freeway interchanges, and light rail transit stations. We use the quadratic transformation of the distance variable to estimate the extent to which distance affects are found. We find that household transportation costs as a share of budgets increase with respect to distance from downtowns and transit stations to about 20 miles and seven miles respectively. We offer implications for planning and housing, as well as for future research.

Introduction
Conventional theory of location and land-use, especially residential location, in post-World War II, automobile dominant American metropolitan areas has household demand for location as a function of income, household size, and location costs – that is, the transportation costs associated with accessing work, shopping, services, recreation and other purposes from a prospective home. House and lot size increased the farther from centers one went. At some point, a household achieved equilibrium where preference for housing and neighborhood attributes were maximized given location costs. Conventional models of location and land-use decisions (see Alonso-Muth-Mills), however, did not consider lenders' underwriting standards which often capped principal-interest-taxes-insurance payments at 28 percent of the household's income available to service a mortgage.

By failing to consider location costs in the mortgage underwriting decision, lenders induce households to purchase homes farther away from centers than they may have chosen otherwise, resulting in more land-extensive development patterns across America's metropolitan landscapes. Combined with the ability to deduct mortgage interest against taxable income, the practice in most states to under-value owner-occupied homes for property tax assessment purposes, average-cost pricing of utility services resulting in high-cost areas paying less than their costs with low-cost areas paying more, and heavily subsidized highway investments among other actions (Blais 2010) led to inefficient land-use patterns. Some call it sprawl.

In recent years a growing body of literature has argued that housing and transportation costs need to be considered together when considering housing affordability.[4] Ewing and Hamidi (2015) note that HUD's definition of affordability—where no more than 30 percent of a household's income would be spent on housing—along with indexes of others are "structurally flawed in that they only consider costs directly related to housing, ignoring those related to utilities and transportation" (Ewing and Hamidi: 5). The 2013 Consumer Expenditure Survey, for instance, reports that total housing costs consume 33.6 percent of income[5] while transportation costs consume another 17.6 percent for a total H+T of 51.2 percent. If a household's transportation costs could be reduced by half, however, it would not able to acquire a home mortgage for a more expensive home in a more efficient location that capitalizes the savings even though it would not be economically worse off.

Conceptually, transportation cost savings are realized by locating in or near such places as downtowns, mixed-use developments, and transit stations. Studies only estimate these savings in two ways. First, a suite of studies based on work by the Center for Neighborhood Technology uses secondary data to estimate the share of trips by mode and household type at the block group, and then derive vehicle miles traveled through inferences based on other secondary data. The actual distance from block groups to such points as downtowns and transit is not estimated directly.[6] For several household types, CNT's studies estimate housing costs that are constant across large geographies such as counties while transportation costs vary by block group.

Another set of studies use hedonic regression analysis to estimate the variation in real estate values with respect to distance from such points as the downtown center and transit stations. Higgins' and Kanaroglou's (2015) review of 40 years of literature on market responsiveness to transit investment provide a thorough review of the models, methods, and outcomes using this technique. Transportation costs *per se* are not included in any of those studies.

We know of no research that estimates variation in transportation costs spatially.[7] Our study helps close this gap. Our particular interest is in knowing whether and the extent to which proximity to transit stations affects the share of transportation costs incurred by households. If

---

[4] We refer readers to HUD's Location Affordability Portal for literature and other materials on the concept of housing plus transportation ("H+T") costs (see http://www.locationaffordability.info/).

[5] These costs include "shelter" components such as rent and mortgage, utilities, insurance, maintenance and repairs, and several other expenditures. See http://www.bls.gov/cex/2013/combined/income.pdf.

[6] CNT has produced two significant generations of these studies. The first are reported in http://htaindex.cnt.org/map/ and the second in http://www.locationaffordability.info/default.aspx.

[7] Specifically, we do not know of any study that estimates the slope of change in the share of HH income consumed by transportation with respect to downtown or transit stations.

so, the finding may help explain part of the capitalization effect numerous studies find with respect to residential property values and rents. It may also add new information to the discussion on the relationship between housing affordability and transportation costs as a function of transit station proximity. In establishing this relationship, we will also explore similar relationships with respect to distance from downtown and freeway interchanges.

We begin with a discussion of our analytic approach, model, and data. We then report results and interpretations. We finish our article with implications for planning and housing policy, and future research.

Analytic Approach, Model and Data

As modeling depends on the availability and nature of data, we start with a general discussion of our data with details presented in the context of individual variables below.

Our aim is to measure the variation in household transportation costs with respect to distance from light rail transit (LRT) stations. Fortunately, HUD's Location Affordability Index (LAI) includes a block group-level database of all metropolitan counties in the U.S. It includes estimates of median household transportation costs for the year 2010 (for details, see http://www.locationaffordability.info/lai.aspx?url=user_guide.php). Among the several household types for which estimates are made, we use figures for the "regional typical" household. The methodology is transparent and consistently applied to all block groups. We use other data for 2010 as described below.

Because our main interest is the variability of transportation costs with respect to LRT stations, we apply our analysis to those 12 metropolitan areas having LRT systems in 2010. For each system, we construct a database geocoding all LRT stations and then measuring their distance to the centroids of the nearest block group. Our study area is 40 miles from the central business district (CBD) of each LRT system.

We use the standard-form ordinary least squares regression model adapted for our purposes:

Transportation Cost Share = ***f****(Income, Minority and Household Type, Tenure and Vacancy, Jobs-Housing Ratio, Metropolitan Controls, Location)*

Transportation Cost Share is the dependent variable. It is defined as the percent of median household income consumed by transportation costs for the regional typical household at the block group level in 2010.

Income, Minority Status and Household Type is a vector estimating transportation costs as a share of median household income, minority affiliation, and household type. Income is from the 5-year ACS for block groups. As ***Median HH Income*** increases the share of its income used for transportation falls (Center for Housing Policy 2006). We hypothesize a negative association between median household income and Transportation Costs.

We include percent block group households whose householders are other than White Non-Hispanic, calling them ***Minority Householder Share***. Data are from the 5-year ACS for block groups. We suspect that minority households will spend a higher share of income on transportation. The reason is that minority households are segregated away from key destinations such as work (see Galster and Cutsinger 2007).

In addition to income, transportation costs vary by household type. In assessing motivations to move, household satisfaction, mode journey-to-work and other factors, Emrath and Siniavskaia (2009) allocate households by married couples with and without children, single parents, single persons, and all others. We adapt their scheme to estimate the share of median household income consumed by transportation costs based on the share of block group households reported in the 5-year ACS for block groups that have children, have two or more adults without children, and single persons. Because it has the highest median household income, our model excludes two or more adult households without children (the referent). The operational variables are ***Percent HHs with Children*** and ***Percent Single Person HHs***. Compared to the referent household group, we expect households with children to spend more on transportation while single person households will spend less as a share of household income.

The **Tenure and Vacancy** vector relates to key measures of housing at the block group level. One measure is the ***Homeownership Rate*** and a second is the ***Residential Vacancy Rate***. In most metropolitan areas, the homeownership rate increases with respect to distance from downtowns but it also means transportation costs rise as well; we expect a positive association between the block group home ownership rate and share of median household income applied to transportation costs. Likewise, as vacancy rates for all residential units tend to increase with respect to distance from downtowns we expect a positive association between block group residential vacancy rates and share of median household income at the block group level consumed by transportation. We use block group data from the 5-year ACS for these variables.

In theory, the higher the ***Jobs-Housing Ratio*** the lower the transportation costs as a share of median household income at the block level (Stoker and Ewing 2014). The reasoning is that more plentiful job opportunities closer to home increases the chances of working closer to home. Also, some households will self-select to live closer to work if job and housing opportunities are proximate. We expect a negative association between share of income spent on transportation and the block group's jobs-housing ratio. For jobs, we use data from the Longitudinal Employment Dynamics (LED) database published by the Census Bureau at the block group level for 2010. Total jobs from the LED are the numerator and total occupied housing units from the 5-year ACS are the denominator.

As our analysis includes all 12 metropolitan areas with light rail systems operating in 2010, we need to include **Metropolitan Controls** to capture the unique contributions of each metropolitan area to our regression equation. We use the newest system, Seattle, as our referent. We have no *a priori* expectations of the direction of associations with respect to any given metropolitan area.

The experimental vector estimates the association between block group **Location** and share of median household income consumed by transportation based on three location measures. We measure the centroids of each block group to the center of the central business district (CBD), nearest freeway interchange, and nearest light rail transit station. In all cases, we expect a positive association between distance from these locations and share of median household income spent on transportation. That is, the farther away a block group is from these locations the higher the transportation costs as a share of income.

For the ***Distance from CBD*** and ***Distance from LRT Station*** variables, we include quadratic transformations of the distance measure. This allows us to estimate the distance from those points where transportation costs as a share of household income peak. Only the linear version of the ***Distance from Freeway*** variable provided a significant direction of association consistent with expectations.

Results and Interpretations
Table 4.1 reports our regression results. The model performs reasonably well as it explains 64 percent of the variation in transportation costs as a share of median household income among nearly 5,400 block groups across 12 metropolitan areas with LRT systems. Indeed, the coefficients for all variables are significant and in the correct directions. With a Durbin-Watson score of 1.85, there does not appears to be problematic spatial autocorrelation. Except for the metropolitan controls, we interpret the performance of variables within each of the other control vectors briefly. We then discuss outcomes of the experimental—Location—variables in some detail.

Our analysis indicates that the higher the median household income the lower the share of transportation costs incurred by the household. This is consistent with literature (for a recent review combined with analysis, see Fan and Huang 2012). We also find that even controlling for income and household composition (discussed in detail below), households with minority householders incur higher transportation costs as a share of income than non-minority households. This is consistent with our interpretation of Galster and Cutsinger (2007).

Compared to the block group share of households with two or more adults without children, single-person households spent a smaller share of their incomes on transportation while households with children spend more. This is consistent with other research. Emrath and Siniavskaia, for instance, find that married couples with children as well as single-parent households had longer commutes in terms of distance and time, and owned more cars than single-person households. Married couples without children had comparable commutes and cars as married couples with children but from the consumer expenditure survey we also know they earn higher incomes so their transportation cost shares would be lower. (See also Haas et al. 2008).

Our analysis confirms that home owners spend more on transportation as a share of their income than renters (see Reichenberger 2012). One reason may be America’s conventional home mortgage underwriting standards limit mortgages to about 28 percent of a household’s expenditures for the home but do not consider transportation costs. Economic savings attributable to location thus cannot be capitalized into higher home mortgages. The result is that households often “drive to qualify” (Gallagher 2014). But there is a downside to this: as total housing plus transportation costs are higher farther away from centers, the overall market for more distant housing weakens with the consequence that vacancy rates for all residential property tend to rise with respect to distance from centers.[8]

In addition to providing an updated literature review generally on the concept of jobs-housing balance, Stoker and Ewing (2014) use ACS journey-to-work data to determine that "more people live and work in the same commute shed if there is job–worker balance and income matching" (p. 485). While we did not control for income-matching, our analysis confirms their central findings. In this case, more jobs with respect to housing units in a block group is associated with lower shares of household income devoted to transportation costs presumably because more people can live near where they work. Indeed, Nelson et al. (2013) find that among households living within a mile of work, a third walked or biked to work in 2009 compared to a fifth in 1995.

Our analysis includes estimates of the association between three different metropolitan locations and the share of household income consumed by transportation. Those controls were distance from the CBD, distance from the nearest freeway interchange, and distance from the nearest light rail transit station.

It should not be necessary to assert that the farther one lives from a downtown the higher their transportation costs. This is the foundation of pioneering urban spatial economic theories (Alonso 1964; Mills 1967; Muth 1969). Redding and Turner (2014) update the key literature of this genre offering several insights based on empirical work such as "… highways cause the decentralization of economic activity … (and) … cause a dramatic increase in driving …" (p. 35). While we find what should be expected—that household transportation costs increase as a share of income the farther they live from downtowns, we also find something that is not often reported in literature: The distance-decay function extends about 20 miles based on the mean from our sample of 12 metropolitan areas. This is the utility of the quadratic transformation of the distance variable.

Similarly, we find that transportation costs as a share of income increases with respect to distance from freeway interchanges, though we could not find a significant association using the quadratic specification.

[8] Our data are used to confirm this through a bivariate regression where Vacancy Rate (VR) is a function of CBD distance: VR = 10.695 + CBD-Distance*-0.258, $p < 0.001$.

Household Transportation Cost Variation with Respect to Distance from Light Rail Transit Stations

Table 5-1

Variable	Beta	Error
Constant	11.971	0.301 *
Income, Minority and Household Type		
Median HH Income	-0.005	0.001 *
Minority Householder Share	0.004	0.001 *
Percent HHs with Children	0.004	0.003 **
Percent Single-Person HHs	-0.030	0.003 *
Tenure and Vacancy		
Home Ownership Rate	0.026	0.001 *
Residential Vacancy Rate	0.019	0.004 *
Jobs-Housing Ratio		
Jobs-Housing Ratio	-0.004	0.000 *
Metropolitan Controls		
Charlotte	3.674	0.221 *
Dallas	1.319	0.198 *
Denver	0.923	0.212 *
Houston	1.673	0.215 *
Minneapolis	-0.613	0.214 *
Phoenix	2.014	0.212 *
Portland	1.483	0.221 *
Sacramento	1.873	0.216 *
Salt Lake City	2.649	0.240 *
San Diego	1.255	0.212 *
Location		
Distance from CBD	0.278	0.013 *
Distance from CBD squared	-0.007	0.001 *
Distance from Freeway	0.100	0.026 *
Distance from LRT Station	0.356	0.046 *
Distance from LRT Station squared	-0.026	0.009 *

Table 5.1
Household Transportation Cost Variation with Respect to Distance from Light Rail Transit Stations—continued

Regression Summary	Figure
Dependent: Transportation Costs as Share of HH Income	
Analytic unit: Census block groups, 2010	
Number of observations	5,388
Adjusted R^2	0.642
F-ratio	440.826
F-significance	0.000
Durbin-Watson	1.845
* p < 0.01, one-tail	
** p < 0.10, one-tail	
Distance from CBD maxima	19.857
Distance from LRT Station maxima	6.846

Of central interest to us is whether and the extent to which transportation costs as a share of income increases with respect to distance from LRT stations. Over the years there have been numerous studies reporting that residential property values increase the closer they are to LRT stations, which is an implicit measure of transportation costs as savings that are presumably capitalized (see Higgins and Kanaroglou 2015). Based on the regression equation, we find that household transportation costs as a share of income increases with respect to distance from light rail transit stations to about seven miles away.

Implications for Planning and Housing Policy, and Future Research
That households' share of income devoted to transportation increases with respect to LRT stations to about seven miles elicits two important policy implications from us.

First, our findings may be used to relax early efforts to calibrate location-efficient mortgages (LEM). For the most part, the LEM calculations were weighted substantially toward the central business district. Considering just this limitation, research by Blackman and Krupnick (2001) conclude that LEMs do not raise mortgage default rates and should be weighed against anti-sprawl benefits they may offer. We suspect default rates will be lower the closer properties are to LRT stations. Further research may explore the relationship between proximity to LRT stations if not all fixed guideway transit stations and foreclosure rates.[9]

Second, assumptions about planning land uses around LRT stations if not all fixed guideway transit stations may need to be relaxed. The so-called half mile circle planning area has already

---

[9] We conducted an indirect test of this is using our data through a bivariate regression where Vacancy Rate (VR) as a proxy for foreclosure potential is a function of LRT station distance: VR = 10.344 + LRT-Station-Distance*-0.626, $p < 0.001$.

been challenged through a case study of the Salt Lake County LRT system, which finds that LRT stations confer a market value on apartments to more than one mile (Petheram et al. 2013). Some of us have also found that office rents capitalize proximity to LRT stations in metropolitan Dallas to nearly two miles (Nelson et al. 2015). Our empirical analysis suggests that LRT station planning protocols may need to extend many miles from stations. Not that station planning areas need to extend up to seven miles but station accessibility strategies might be reconsidered given the evidence suggesting that households realize important transportation cost savings within that distance.

The nation will add about 100 million people between now and mid-century. One of us (Nelson 2013) has estimated that about a quarter of American households want to live near fixed guideway transit opportunities though less than 10 percent have those options now. Perhaps one reason is that Americans understand the cost savings associated with living near transit stations. Yet, even if all new homes built between now and mid-century were located near existing or planned fixed-guideway transit stations the demand for living near those stations would still not be met.

CHAPTER 6
Fixed-Guideway Transit and Change in Jobs by Wage Categories

Introduction

Scholars and civil rights organizations assert that America's transportation policies perpetuate social and economic inequity. Sanchez and Brenman (2008), for instance, show that highway-ased transportation investments limit low-income and people-of-color access to education, jobs and 55 services. Echoing their concern is the Leadership Conference Education Fund (Leadership Conference Education Fund, 2011a; 2011b), a civil rights organization which asserts that low-wage jobs are inaccessible to those who are transit-dependent. Public transit is seen as one way to connect people to low-wage jobs, reduce poverty, increase employment, and help achieve social equity goals (Blumenberg and Manville, 2004; Sen, Metaxatos, Soot and Thakuriah, 1999).

In recent decades, such transit has included bus rapid transit (BRT) systems. A growing number of studies report a relationship between new rail transit investment and job growth (Nelson, M. Miller, Ganning, Stoker, Liu and Ewing, 2014). But do rail transit investments attract lower-wage jobs? To this question we add: do rail transit investments change the share of jobs in a region across multiple wage groups?

This chapter addresses this question. It begins with a review of literature on the relationship between BRT and change in jobs by wage level. We then evaluate the change in jobs by wage level between light rail transit (LRT), streetcar transit (SCT) and commuter rail transit (CRT) systems. Nelson and Ganning (2015) apply the question to 19 BRT lines serving 12 metropolitan areas.

In particular, our analysis assesses the change of jobs by broad income category (lower, middle and upper) from a baseline year to 2011, the most recent year for which data are available. Based on the lessons learned in Chapter 2—resilience—we assess changes in jobs by income category before the recession (2002-2007) and then during Great Recession and recovery (2007-2011).

Literature Review

Fan, Guthrie and Levinson (2010) provide an especially pertinent review of literature addressing our question. Citing Kain's (1968) pioneering work, they observe that the urban poor are harmed for want of affordable housing near job opportunities and reliable public transit to connect them to those jobs (Blumenberg, Ong and Mondschein, 2002; Sanchez, 2008).

A limiting factor in gaining access to lower-wage jobs is that the income from such jobs is often insufficient to buy and operate an automobile to access those jobs in the first place. Sanchez (1999) and Sanchez, Shen and Peng (2004) note that it is difficult for public transit to reduce the spatial mismatch between lower-income jobs and residential options for a number of reasons. One problem is that bus systems often do not provide sufficient service for the kinds of working hours that make low-skill/entry-level, temporary, and evening/weekend shift-work jobs feasible (Giuliano, 2005). Public transit, especially if it is more rapid and reliable than conventional buses—a feature of BRT systems, may be one way to connect lower-income urban workers from their lower-income neighborhoods to lower-wage jobs (Fan, Guthrie and Levinson, 2012).

Unfortunately, there are very few empirical studies showing whether and the extent to which LRT generates these outcomes. It seems that just as many studies show a positive outcome (Ong and Houston, 2002; Kawabata, 2002; Kawabata, 2003) as there which show small or ambiguous associations (Thakuriah and Metaxatos, 2000; Cervero, Sandoval and Landis, 2002; Bania, Leete and Coulton, 2008).

Two recent studies have further shown different results. In the first, McKenzie (2013) studies neighborhoods in Portland, OR, to identify differences in transit access for those neighborhoods. Using 2000 Census and five-year 2005–2009 American Community Survey data, McKenzie compares changes in levels of transit access across neighborhoods based on their concentrations of blacks, Latinos and poor households. The study found that neighborhoods with high Latino concentration have the poorest relative access to transit and that transit access declined for black and Latino-dominated neighborhoods. McKenzie did not evaluate job growth along transit lines serving or near those neighborhoods, however.

The other is the study by Fan, Guthrie and Levinson (2010). They find that residential proximity to light rail stations and bus stops offering direct connection to rail stations are associated with statistically significant gains in accessibility to low-wage jobs (Fan, Guthrie and Levinson, 2010). On the other hand, their analysis covered just a short number of years before the Great Recession: 2004 to 2007. The Center for Transportation Research at the University of Minnesota (Fan, 2010) goes further by reporting that between 2004, when the Hiawatha Line LRT line opened, and 2007, just before the Great Recession, low-wage jobs accessible within 30 minutes of transit within Hennepin County grew by 14,000, with another 4,000 where the LRT was accessed directly by bus.

In summary, there are very few studies showing the relationship between the provision of fixed-guideway transit systems and higher levels of lower-wage jobs, and none evaluate this association with respect to LRT, SCT and CRT systems. Our chapter helps close this gap in literature.

Research Design, Study Areas and Data

Our principal interest is measuring the change in share of lower-wage jobs before the Great Recession and during the recovery associated with BRT stations. Doing so will also require measuring the change in share of other wage categories such as middle- and upper-wage jobs. The analysis requires wage-related employment data at a reasonably small geographic scale. Both needs are met by the Longitudinal Employment-Household Dynamics (LEHD) database. We first convert the LEHD data into wage categories. As we wish to compare change of jobs between geographic units, those jobs should be stationary; that is, jobs should be based mostly at a single location in urbanized areas. We therefore exclude agriculture, mining and construction jobs. We also want to create categories of jobs based on wages. We estimate average annual wages per worker from the County Business Patterns (for 2013) and apportion the nation's jobs into roughly equal thirds, defined as lower-wage, middle-wage and upper-wage jobs by North American Industrial Classification System (NAICS) sector, excluding those noted above. Table 6.1 shows our allocation.

Table 6 -1 Allocation of Jobs by Lower-, Middle- and Upper-Wage Category

NAICS		Description
44		Retail Trade
71		Arts, Entertainment, and Recreation
72		Accommodation and Food Services
81		Other Services (except Public Administration)
		Weighted Mean Wages and National Share of Jobs
48		Transportation and Warehousing
53		Real Estate and Rental and Leasing
56		Administrative, Support, Waste Mgmt., Remedia
61		Educational Services
62		Health Care and Social Assistance
		Weighted Mean Wages and National Share of Jobs
22		Utilities
31		Manufacturing
42		Wholesale Trade
51		Information
52		Finance and Insurance
54		Professional, Scientific, and Technical Services
55		Management of Companies and Enterprises
		Weighted Mean Wages and National Share of Jobs

Source: County Business Patterns, 2013.

We then use shift-share analysis as our quasi-experimental method. 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, where we want to see whether there are intra-metropolitan shifts in the share of jobs by sector, our region is the central county of the metropolitan area. 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 block groups with centroids within 0.50 mile of the nearest LRT, SCT and CRT station; we call this these the TOD station areas. As shifts in the share of jobs may vary by sector over time because of changes in economic sector mixes, there is also an "industry mix" adjustment. Our "industries" in this context are the sector-based wage categories. Our analytic method is similar to that used by Nelson et al. (2013) and also described in Chapter 1.

We conduct two sets of analyses. First, we use shift-share analysis to estimate the shift in share of jobs by income level between the year a system opened (or 2000 whichever is earlier) to 2011 for each system by mode. We then use shift-share analysis to compare the shift in share of jobs for systems launched in 2004 or earlier for pre-recession (2002-2007) and recession-recovery (2007-2011) periods.

Results
For brevity, we report only the "industry shift" part of the shift-share analysis for each of the transit systems evaluated overall, and then during the recession and recovery. We call this the called ***TOD Share***. Appendix D includes the detailed tables for each system by mode.

Overall Results
Tables 6.2, 6.3 and 6.4 report overall results for each of the LRT, SCT and CRT systems evaluated, respectively.

LRT TOD Area Share of Job Shifts by Income Category

Table 6-2

LRT System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
Charlotte	1,519	1,721	244	3,485
Dallas	(4,364)	(9,000)	(5,017)	(18,381)
Denver	(464)	(727)	897	(294)
Houston	(11,076)	(32,419)	(11,074)	(54,569)
Phoenix	(1,361)	(2,418)	(1,239)	(5,018)
Portland	(1,579)	(15,775)	(182)	(17,537)
Sacramento	597	491	879	1,967
Salt Lake City	(1,612)	(670)	(1,351)	(3,632)
San Diego	(5,107)	1,962	(1,053)	(4,197)
Twin Cities	(948)	2,397	3,369	4,819
Composite	(22,612)	(51,679)	(10,367)	(84,658)

Note: Analysis extends from 2002 or when the system was commenced, whichever is the earlier, to 2011.

SCT TOD Area Share of Job Shifts by Income Category

Table 6-3

Streetcar System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
Portland	(4,092)	(14,963)	(3,057)	(22,111)
Seattle	7,057	3,967	(2,632)	8,392
Tacoma	(8,433)	(6,107)	(7,045)	(21,584)
Tampa	8,922	4,172	12,969	26,063
Composite	6,295	(11,194)	2,853	(2,046)

Note: Analysis extends from 2002 or when the system was commenced, whichever is the earlier, to 2011.

Table 6.3
CRT TOD Area Share of Job Shifts by Income Category

CRT System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
Albuquerque-Santa Fe	(2,114)	(2,328)	(401)	(4,842)
Miami-South Florida	(3,281)	1,075	(1,118)	(3,324)
Salt Lake City	3,917	2,004	1,407	7,329
San Diego	(2,399)	(1,409)	(3,102)	(6,911)
Seattle	(1,042)	(1,758)	(589)	(3,390)
Composite	(5,413)	(1,684)	(6,240)	(13,337)

Note: Analysis extends from 2002 or when the system was commenced, whichever is the earlier, to 2011.

With some exceptions, TOD areas in nearly all LRT and CRT transit systems lost share of jobs relative to their regions. Half the SCT systems also saw losses but Seattle and Tampa gained considerable share. For LRT systems as a whole, TOD areas lost the largest share of jobs in the middle income category, followed by lower-wage jobs. For SCT TOD areas, lower-income jobs increased share substantially followed by higher-income jobs. TOD areas served by CRT systems lost large shares of lower- and upper-income jobs.

Pre-Recession Compared to Recession-Recovery Shifts in Shares of Jobs by Income
Using the lessons from Chapter 2, this part of the analysis takes a closer look at the shift in share of jobs by income category for those systems operating since 2004 for LRT (Table 6.4), SCT (Table 6.5) and CRT (Table 6.6) systems. In review, analysis reported in Chapter 2 showed that before the Great Recession, LRT TOD areas lost share of job change for reasons we attribute to the forces that drove sprawling development patterns. LRT TOD areas continued to lose share of jobs during the recession though at a substantially smaller rate. After the recession, however, LRT TOD areas gained substantial shares of jobs. In this analysis, we compare the shift in share of jobs by income level before the recession (2002-2007) and during the recession and its recovery (2007-2011).

Table 6.4 reports the TOD share of job shifts by wage category for all LRT systems in our analysis operating since 2004. We also include a composite analysis which is the pooled shift-share analysis of all those systems. Before the recession, nearly all LRT systems lost share of jobs in nearly all wage categories. Overall, LRT systems lost a substantial share of jobs relative to their regions in the higher-wage category with roughly equal shares of losses in the lower- and middle-wage categories.

During the recession and into recovery, however, the situation reversed. LRT TOD areas gained shares of jobs overall with three of seven systems registering increases in shares for all wage categories. Indeed, we are impressed with the size of the share of jobs gained in the higher-wage category; the lower-wage category gained only slightly though the middle wage category also lost slightly. Results from Table 6.4 are illustrated in Figure 6.1.

LRT TOD Area Share of Job Shifts by Income Category before and after the Great Recession
Table 6-4

LRT System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
		Pre-Recession, 2002-2007		
Dallas	(2,402)	(4,973)	(7,965)	(15,340)
Denver	(1,245)	(114)	3,192	1,833
Portland	(628)	(169)	(16,821)	(17,618)
Sacramento	(11)	(103)	311	197
Salt Lake City	(562)	84	(2,630)	(3,108)
San Diego	(1,606)	2,882	(3,146)	(1,870)
Twin Cities	(2,760)	(3,698)	(6,255)	(12,714)
Composite	(10,084)	(9,587)	(34,513)	(54,183)
		Recession-Recovery, 2007-2011		
Dallas	(923)	637	(2,549)	(2,835)
Denver	(474)	(387)	(1,862)	(2,722)
Portland	1,153	(25)	1,407	2,535
Sacramento	73	358	1,414	1,844
Salt Lake City	(233)	(150)	(352)	(736)
San Diego	(1,547)	(605)	(686)	(2,837)
Twin Cities	315	2,244	5,780	8,338
Composite	2,722	(3,465)	45,643	44,900

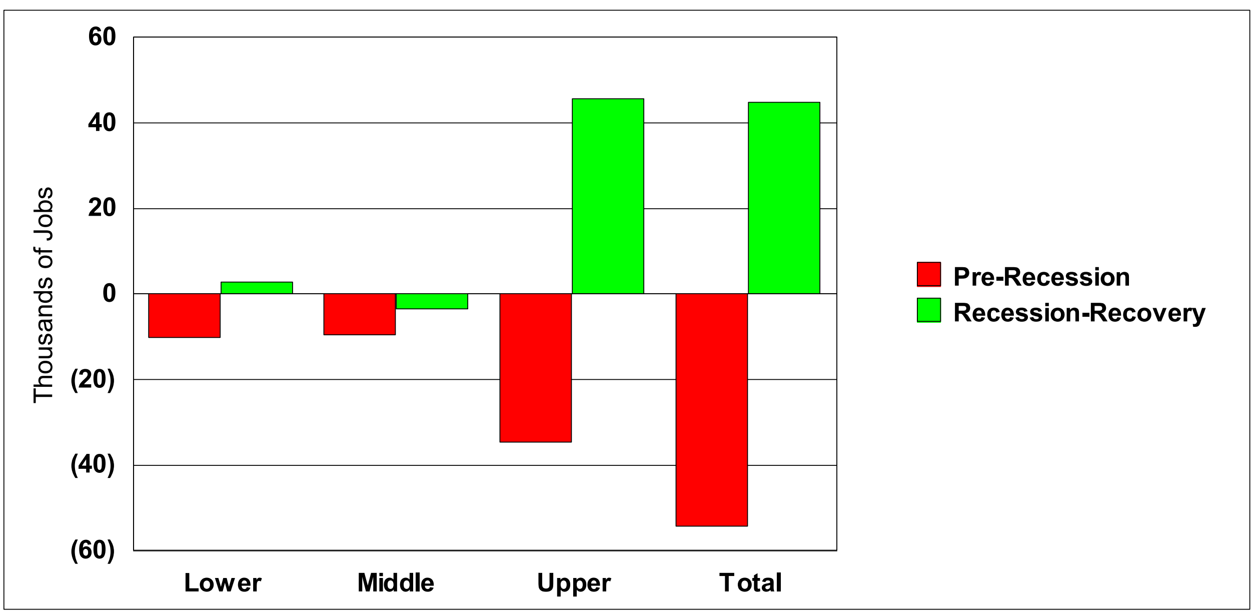

Figure 6-1
Change in Share of Jobs by Wage Category for LRT TOD Areas Compared to their Metropolitan Areas during Pre-Recession and Recession-Recovery Periods

Though SCT TOD areas saw roughly the same trends as those serving LRT systems there are interesting differences, as seen in Table 6.5. First of all, Portland streetcar TOD areas lost considerable share of jobs overall before the recession with by far the largest share occurring among the higher wage sectors. In contrast, the Tacoma and Tampa streetcar TODs gained overall with Tampa gaining share in all wage categories. We reason that a large share of Portland's job losses before the recession are attributable to the large-scale redevelopment of the Pearl District which displaced thousands of jobs and replacing them with thousands of new people and housing units (see Chapter 4).

During the recession and recovery periods, the magnitude of losses in share of jobs lessened in the Portland SCT TOD areas. However, the Tacoma TOD areas saw substantial losses in shares of jobs across all wage sectors relative to its county (Pierce). On the other hand, Tampa continued to gain share. The composite analysis—which estimates the shift in share of jobs by wage categories for all SCT TOD areas compared to the sum of their counties—shows TOD areas collectively gaining substantial shares of jobs overall with lower- and upper-wage jobs gaining about equal shares. Figure 6.2 illustrates this.

SCT LRT TOD Area Share of Job Shifts by Income Category before and after the Great Recession
Table 6-5

Streetcar System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
		Pre-Recession, 2002-2007		
Portland	(1,089)	(1,821)	(12,785)	(15,695)
Tacoma	(223)	(547)	1,053	283
Tampa	4,581	1,130	14,593	20,304
Composite	3,932	(1,862)	(271)	1,799
		Recession-Recovery, 2007-2011		
Portland	47	(841)	(4,554)	(5,348)
Tacoma	(3,546)	(503)	(7,488)	(11,537)
Tampa	578	2,759	8,697	12,033
Composite	17,400	882	14,247	32,530

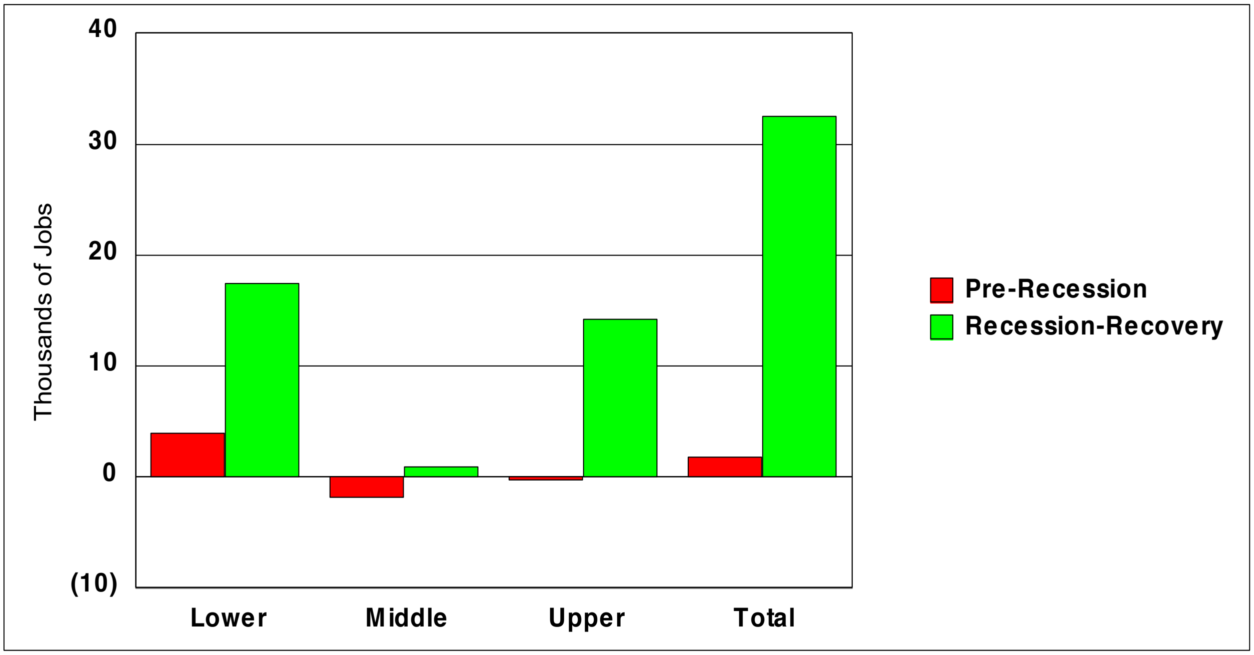

Figure 6-2
Change in Share of Jobs by Wage Category for SCT TOD Areas Compared to their Counties during Pre-Recession and Recession-Recovery Periods

As we have noted elsewhere, the role of CRT systems in influencing development patterns seems to have been underestimated in the literature. Indeed, we suspect the economic development opportunities associated the CRT TODs may have been woefully neglected. One result, seen in Table 6.6, may be that CRT systems have lost of share of metropolitan jobs before and since the recession when the opposite might have been possible. We note further that the pattern of shifts has changed. During the recession and recovery period, CRT GTODs lost substantial share of higher-wage jobs and a much smaller share of lower-wage jobs, though gaining a very small share in the shift of middle wage jobs. These trends are illustrated in Figure 6.3. We suspect that more pro-active planning efforts akin to those used by the Utah Transit Authority (see Chapter 1) could convert lagging CRT TOD areas into important economic development opportunities.

CRT LRT TOD Area Share of Job Shifts by Income Category before and after the Great Recession

Table 6-6

CRT System	TOD Share of Lower Wage Job Shift	TOD Share of Middle Wage Job Shift	TOD Share of Upper Wage Job Shift	TOD Share of Total Job Shifts
		Pre-Recession, 2002-2007		
Albuquerque-Santa Fe	(2,588)	(2,655)	(411)	(5,654)
Miami-South Florida	(2,922)	1,582	2,083	743
San Diego	(1,572)	(2,017)	21	(3,568)
Seattle	(259)	(1,165)	(1,739)	(3,163)
Composite	(7,130)	(3,673)	(993)	(11,796)
		Recession-Recovery, 2007-2011		
Albuquerque-Santa Fe	(5)	416	288	699
Miami-South Florida	(435)	(1,023)	(2,752)	(4,210)
San Diego	(671)	926	(3,596)	(3,341)
Seattle	327	278	(1,022)	(417)
Composite	(1,602)	654	(7,171)	(8,118)

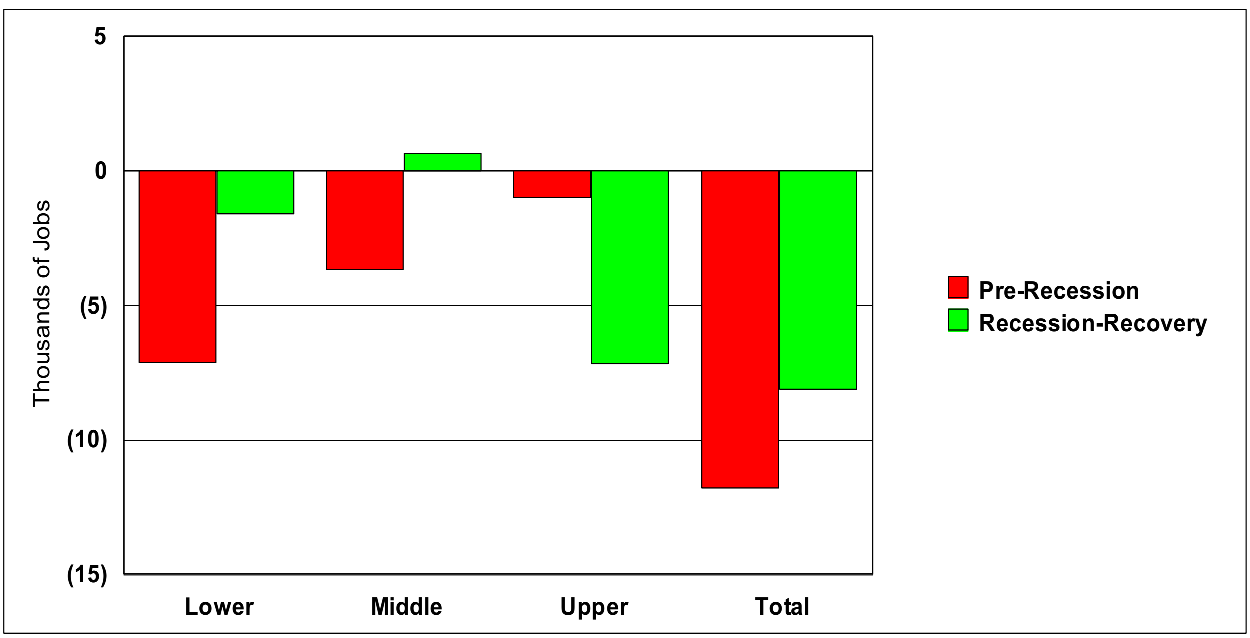

Figure 6-3
Change in Share of Jobs by Wage Category for CRT TOD Areas Compared to their Metropolitan Areas during Pre-Recession and Recession-Recovery Periods

Although we do not report results for the four BRT systems initially included in this study—instead referring readers to a much more extensive analysis of BRT development outcomes (see Nelson and Ganning 2015), we review overall trends here. Overall, we are impressed that there was such a rapid change in the share of jobs in BRT station areas across all wage categories during the recession and the recovery as illustrated in Figure 6.4. We suspect that BRT TOD areas may becoming more attractive to upper-wage jobs and less attractive to lower-wage ones.

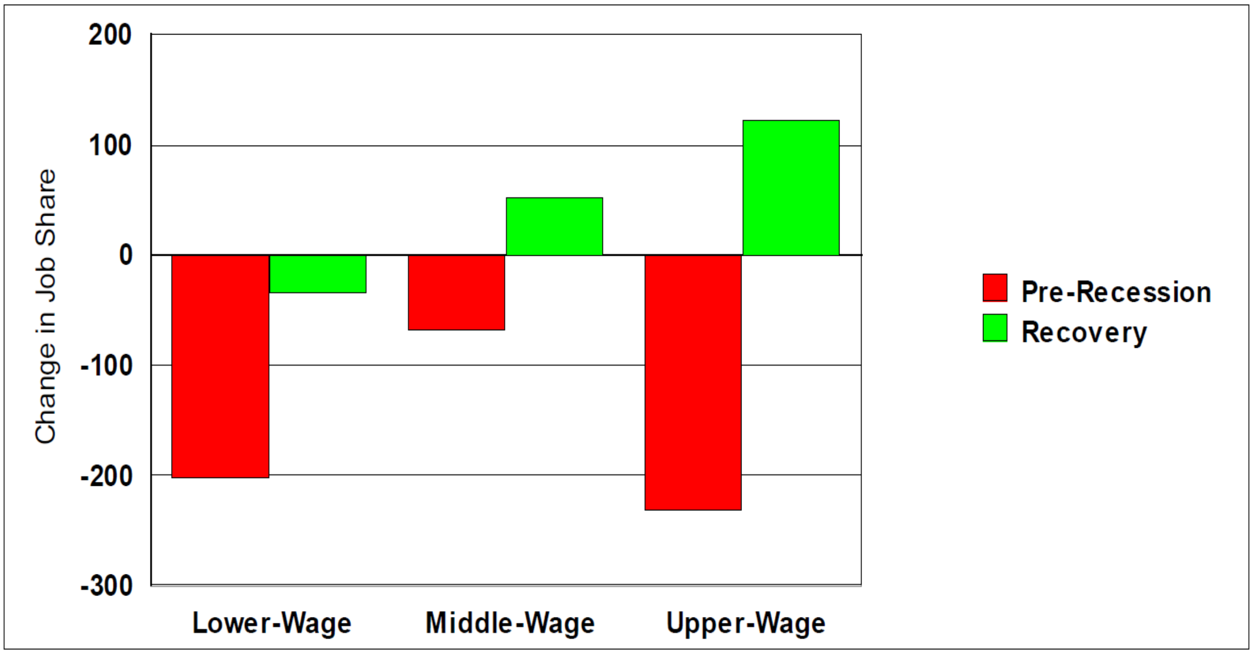

Figure 6-4
Change in Share of Jobs by Wage Category for BRT Station Areas Compared to their Central Counties during Pre-Recession and Recovery Periods

Summary and Implications
In this chapter, we evaluated the potential role of transit systems to influence the distribution of jobs by lower, middle and upper wage categories. While results seem mixed, we detect emerging trends that may favor higher-wage jobs locating in transit TOD areas over time than lower or middle wage jobs.

For one, the real estate market values permanence in transportation investments when deciding to make long-term development decisions (Nelson, 2014; Nelson, 2013). A key advantage of fixed-guideway transit is once the investment has been made, the real estate industry can usually rely on its permanence over the many decades it takes to maximize profits from high-density investments at or near stations.

If the real estate market does respond to fixed-guideway investments (see Higgins and Kanaroglou, 2015), land values will rise. To cover costs, developers will need to build more intensive projects and charge the rent needed to cover costs and assure a reasonable return on investment. In turn, this means workers need to be more productive so this lends itself to jobs paying higher wages. Though a certain number of lower- and middle-wage jobs would certainly

be generated, the greater share may be upper-wage jobs. Some evidence of this was found in a case study of the Eugene-Springfield Emerald Express BRT system (Nelson et al., 2013).
Real estate development along transit corridors can be expensive due to infrastructure upgrades or replacements, removing older buildings, and other high-cost renovations (especially historically significant buildings). While there are examples of transit systems stimulating redevelopment (Institute for Transportation and Development Policy, 2013), our observation is that new development is decidedly for upper-wage and perhaps some middle-wage jobs.
We cannot rule out that fixed-guideway transit may improve opportunities for lower-wage jobs, but emerging evidence based on our work indicates, with the possible exception of SCT systems, those investments may attract more upper-wage and perhaps middle-wage jobs than lower-wage jobs.

CHAPTER 7
Job-Worker Balance: An Assessment based on Commute Time with Reference to Transit, Walking and Biking to Work and TOD Distance

Overview

There is growing concern about increasing commuting trips and travel times with associated deterioration of individual quality of life. We theorize that one benefit of transit and associated TOD areas is to shorten commute times for people living in or near them, and this may have important implications for personal well-being. We find that the share of workers who commute 10 minutes or less to work increases nearly one-half of one percent for each half-mile their resident block group is to a transit station, capping at a gain of 1.3 percent, which is not a trivial gain. Combined with other work, we sense that TOD areas may improve the well-being of those who can afford to live in them, presumably because their higher-wage jobs are nearby thereby reducing commuting time. This outcome would be consistent with emerging well-being literature.

Literature Review

Over the past several decades, there is growing concern about increasing commuting trips and travel times with associated deterioration of individual quality of life. Weitz (2003) observes that the physical distance between where a worker lives and the location of jobs can be significant often because it is the only "realistic alternative for workers who cannot work from home is to commute by car to their job location".

In theory, when jobs and housing are located near each other, the need for long commutes—or any commute by motor vehicle— can be reduced. If jobs are close enough, workers may choose to use public transit, walk or bike to work instead of drive (Stoker and Ewing 2013). If all people who work also live in close proximity, this is called "job-worker balance."

Measuring job-worker balance—also known as "jobs-housing balance" among other terms, has proven elusive. Its definition depends on how the concept is to be applied. In this chapter, we contribute to the discussion. We begin with a brief literature review, relying on the most recent work in the area; we proceed with a theory and model; and we apply the model to light rail transit TOD areas using the 2010 census. We conclude with implications for planning and policy.

We derive much of this section from Stoker and Ewing (2013).[10]

For any given region or metropolitan area that is large enough, there will be a perfect balance between where workers live and their jobs. It is at the smaller, community scale however where there are often imbalances between where people live and where they work. In areas with an abundance of housing, residents who work may commute long distances to work outside the community. In areas with an abundance of jobs, workers will commute to fill them. However, even if a community has a mathematical balance between workers living there and available jobs, those jobs may require different skills than residents offer so resident workers would still commute out while others commute in.

[10] This study's principal investigator, Nelson, was PI for a HUD Sustainable Communities grant that led to the work developed and later published by Stoker and Ewing. This section paraphrases extensively their work.

This can lead to worsening congestion, increasing greenhouse gases, and lower quality of life. It can also lead to socioeconomic imbalances as lower-skilled workers incur high travels times and costs to access lower skilled jobs in high-value locations (Kain 1992). It is for this reason that the term "workforce housing balance" has gained popularity in recent years. It suggests the availability of housing affordable to households near where they work such as teachers and first-responders working in high-value communities.

The term "workforce housing" has its roots in "jobs-housing balance" literature. The term is often used in practice to mean a numerical balance between jobs and workers in a defined geographic area. For instance, if an area averages 1.5 workers per household, it should also have 1.5 jobs per households. As household sizes vary and thus the number of workers per household, the jobs-worker relationship is a more direct measure of balance.

Land-use planning, especially zoning, is seen as a key reason for reducing the job-worker housing balance (Weitz 2003). Exclusionary zoning—where lower income households are prevented from living in high-value areas—contribute especially to what Kain (1992) calls the "spatial mismatch" between lower-wage jobs in a community and the distance those workers travel to access them. (See also Giuliano and Small 1993, and Cervero 1989.)

From a planning perspective, a key goal of achieving job-worker balance is to reduce the single-occupant vehicle (SOV) mode in the commute to work, decrease travel distances and times, and increase the use of transit, walking, biking as alternatives to the SOV option (see Frank and Pivo 1994; Guiliano & Small 1993; Ewing 1996; Sultana 2002; Rodriguez 2004). Arguably, commuting stress could be reduced and workplace productivity increased (Armstrong and Sears 2001). Reducing motorized travel can also reduce greenhouse gas emissions

Several social goals may also be achieved through job-worker balance. Cervero (1989) implores that the "provision of affordable housing closer to suburban job centers would vastly increase the residential opportunities of America's working class and would help reduce housing discrimination". Improving job-worker balance can reduce the spatial mismatch thereby reducing unemployment especially among lower-skill workers (Kain 1992).

In recent years, the concept of the spatial mismatch has been broadened to include a "modal mismatch" whereby jobs are inaccessible to residents without cars (Fan 2012) and a "skill mismatch" whereby jobs are inaccessible to because nearby residents they do not have the necessary skills or education (Chapple 2001; Ong and Miller 2005; Grengs 2010; Fan 2012).

Cervero (1989) sums it best: "(M)any of the nation's most pressing and persistent metropolitan concerns- congestion, energy depletion, air pollution, sprawl, and class segregation-would be relieved by balancing job and housing growth."

There are many ways in which to measure job-worker balance. Stoker and Ewing note several conceptual issues as well as technical limitations in measuring distances and times between homes and jobs. Among researchers who have offered specific measures are from home to work are:

Levingston (1989) = 6-8 miles;
Deakin (1989) = 3-10 miles;
Cervero (1989) = 3 miles;
Pisarsky (1987) = 9 miles; and
Stoker and Ewing (2013) = 3 miles.

But we have a different view which will be presented next followed by our analytic model.

A Theory of the Appropriate Distance to Measure Job-Worker Balance

One view of measuring the appropriate job-worker balance area is not based on distance but rather travel time to work. We note that over the past several years, researchers have begun to correlate commuting time with quality of life. This literature indicates that people who incur long commuting times disproportionately suffer from stress and associated outcomes such as obesity and dissatisfaction with life (Lowrey 2011). It appears that the 10-minute commute, regardless of mode, could be considered ideal.

For instance, Robert Putnam in *Bowling Alone* (2001) notes that every 10 additional minutes engaged in commuting reduces "social connections"—which make people feel fulfilled and happy— by 10 percent. Lowrey also reports that the Gallop-Healthways Well-Being Index (Crabtree 2010) shows that a 90-minute commute stresses 40 percent of commuters but this falls to 28 percent—nearly a third— for those with "negligible" commutes of 10 minutes or less.

There is also an important aspect relating to personal health. Christian (2009) reports that each minute devoted to commuting is associated with "a 0.0257 minute exercise time reduction, a 0.0387 minute food preparation time reduction, and a 0.2205 minute sleep time reduction." Over a year with 200 work days, the difference between a 30-minute one-way commute and a 10-minute one is about 40 hours or the equivalent of a full work week; this is not trivial. Moreover, according to Lopez-Zetina, Lee and Friis (2006), vehicle-miles traveled—a proxy for commuting time— is more strongly correlated with obesity than any other factor.

From these perspectives, we suggest that another way to look at job-worker balance is to consider the well-being of the commuter from the perspective of travel time. We develop a model to evaluate this proposition next.

Alternative Model Assessing the Appropriate Job-Worker Balance

We are struck with the parallel between the possibility that a 10-minute commute to work advances personal well-being and the conventional TOD 10-minute walk between the station and a destination. We do not draw scientific comparisons, only the coincidence. Assuming there may be important well-being considerations associated with no more than a 10-minute commute, regardless of mode, we devise the following model to test the relationship between TOD areas and commute time. Since we use census block groups for analysis, we also operationalize it in terms of census data geographies.

Commute Time = ***f***(Urban Form + SES + MSA + Commute Choice + Location)

Where, for the 2010 Census:

Commute Time is the percent of workers whose journey to work is 10 minutes or less;

Urban Form is the Ewing-Hamidi (2014) urban sprawl score for the census tract within which a block group is nested (see Chapter 5)—because this index is a proxy for accessibility, we expect a positive association between urban form and the percent of workers commuting 10 minutes or less to work (See Ewing and Hamidi 2014);

SES is the percent of the population that is White, non-Hispanic and has at least a two-year post-secondary education degree, as well as the median household income all at the block group level—using Kain's body of work and those who followed, we expect a positive association between all these variables and the percent of workers commuting 10 minutes or less;

MSA is the metropolitan statistical area within which a block group is located—as these are controls there are no *a priori* assumptions of associations with the percent of workers commuting 10 minutes or less to work;

Commute Choice includes the percent of block group workers who commute via transit, walk, or bike (with the car, truck and other motor vehicles being the referent)—we expect a positive association between walking to work and commuting 10 or more minutes but a negative association between transit and biking to work and share of block group workers commuting 10 minutes or less to work; and

Location is the distance of the block group centroid to the central business district (CBD) and the nearest transit station (TOD) within two miles—we cannot posit an association with respect to CBD distance but we predict that proximity to transit stations increases the number of workers commuting 10 minutes or less.

Table 7.1 reports results of our regression equation. We report two models. The first model includes the continuous distance of the block group centroid to the nearest transit station, within two miles of those stations (the maximum we measured). The second includes binary variables for location within each successive one-half mile from the nest transit station—measured from the block group centroid—to two miles away with block groups beyond two miles serving as the referent.

Both models had modest coefficients of determination, 0.21 and 0.13, respectively, but all other performance indicators were reasonable. We tested for double-log and semi-log versions finding the linear transformation models worked best and produced clear interpretations.

In both equations, the higher the Urban Form Index score the higher the person of people living in the block group commuted to work in less than 10 minutes. Based on work by Ewing and Hamidi, we expected this.

Across all SES measures, the higher the income, the more the education, and the higher the percentage population that was White non-Hispanic, the higher the percent of workers who journey-to-work was 10 minutes or less. Put differently, the lower the income, the lower the education level, and the lower the rate of White non-Hispanics living in a block group, the lower the percent of workers commuting to work in 10 minutes or less.

Among the local controls, we noted that the farther away from a CBD the lower the share of the workers travel 10 minutes or less to work.

The variables for mode choice in the journey to work performed as expected. Relative to the vehicle option, the transit or biking modes to work are associated with lower shares of workers community to work in 10 minutes or less. But the reverse is found with respect to walking to work (see also Nelson et al. 2013).

The key variable of interest to us is distance from the transit station in a TOD area. For the first equation, we find that as continuous distance increases from the transit station out to two miles, the share of workers commuting to work in 10 minutes or less falls.

Results from the second equation are based on many times more cases because all block groups beyond two miles from the nearest transit stations but within 30 miles of the CBD are included. We are thus able to assign block groups in half-mile distance bands from the nearest station to two miles, with all block groups beyond two miles being the referent.

Regression Results Testing for the Association between working within 10 minutes of Home with respect to Light Rail Transit Station Distance

Table 7-1

Variable	Beta		Variable	Beta	
Constant	18.433		Constant	8.028	
Local Controls			***Local Controls***		
Urban Form Index	0.031	*	Urban Form Index	0.012	*
White non-Hispanic Percent	0.007	*	White non-Hispanic Percent	0.013	*
Two+ Year Degree Percent	0.028	*	Two+ Year Degree Percent	0.039	*
Median HH Income ($000)	1.367E-002	*	Median HH Income ($000)	-1.414E-002	*
CBD Distance (miles)	-0.693	*	CBD Distance	-0.100	
Metropolitan Controls[a]			***Metropolitan Controls***[a]		
Seattle	5.567		Seattle	0.322	
Salt Lake	8.448		Salt Lake	0.412	
Portland	1.565		Portland	0.262	
Twin Cities	-2.640		Twin Cities	-0.592	
Houston	-2.708		Houston	-0.933	
Denver	-1.986		Denver	-0.541	
Dallas	-4.319		Dallas	-3.596	
Commute Mode Controls[b]			***Commute Mode Controls***[b]		
Transit Commute Percent	-0.150	*	Transit Commute Percent	-0.151	*
Walk Commute Percent	0.359	*	Walk Commute Percent	0.417	*
Bike Commute Percent	-0.105		Bike Commute Percent	-0.043	*
Treatment			***Treatment***		
TOD Distance (miles)	-1.073	*	TOD <=0.5 mile[c]	1.310	*
			TOD 0.50-1.0 mile[c]	0.968	*
			TOD >1.0-1.5 mile[c]	0.472	*
		*	TOD >1.5-2.0 mile[c]	0.256	

a. Phoenix is the referent
b. Automobile is the referent
c. TOD beyond 2.0 miles is the referent
*p < 0.10, one-tailed test

Model Performance		
R2-adjusted	0.207	0.127
N	1,764	12,133
F-ratio	29.714	94.052
F significance	0.000	0.000

The second equation shows positive, significant coefficients in roughly equal increments from the 1.0-1.5 mile band toward the 0.5-mile band. The share of workers commuting to work in 10 minutes or less who live in the 1.0-1.5 mile band increases by nearly one-half percent, rising to nearly one percent in the 0.5.1.0 mile band and more than 1.3 percent in the closest band. These results are illustrated in Figure 7.1. (We include the coefficient for the 1.5-2.0 mile distance band even though it is barely insignificant.) To our knowledge, these are the first results to show a relationship between transit station distance and share of workers commuting 10 minutes or less.

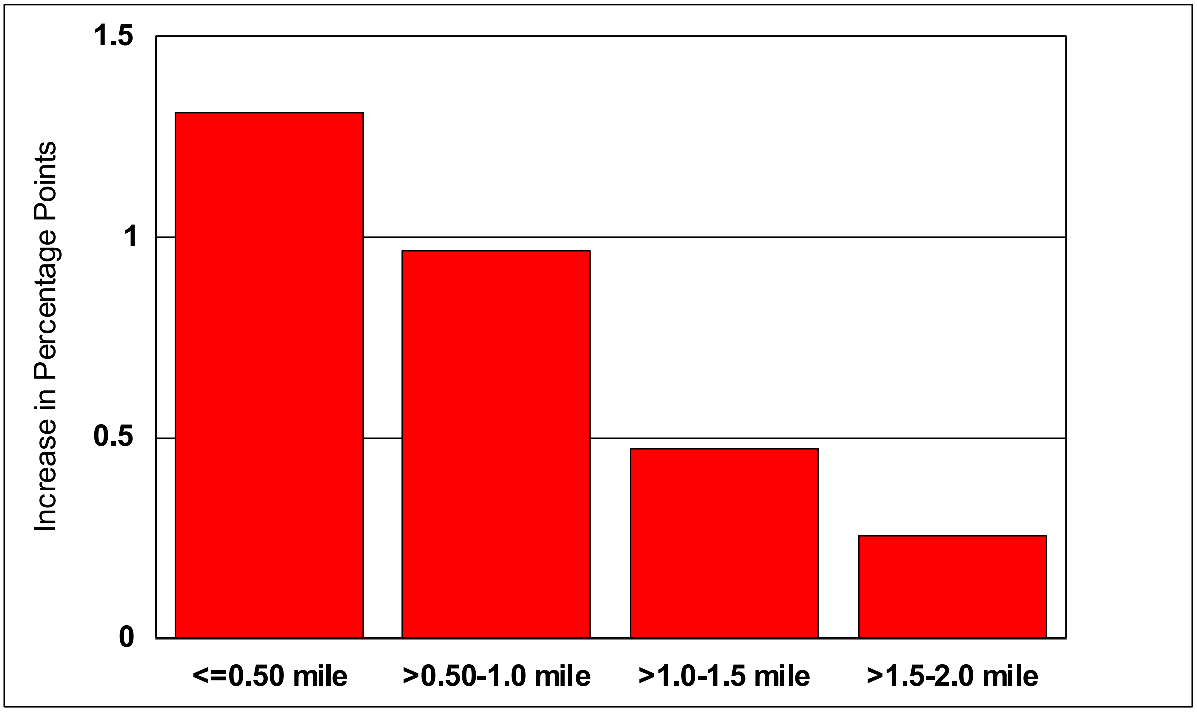

Figure 7-1
Percentage point increase by block group among workers commuting less than 10 minutes by distance band from nearest transit station

Implications
Our analysis indicates that the closer one lives to a LRT station the more likely one is also to commute 10 or fewer minutes to work. But that is not the whole story. We also find that people living in higher income households, with at least two years of post-secondary education, and who are White non-Hispanic are more likely to commute 10 or fewer minutes to work than others. In a sense, this confirms findings in Chapter 5 (where higher incomes are associated with lower total transportation costs with respect to distance from transit stations) and Chapter 6 (where higher-wage jobs are gravitating toward TIOD areas over time, apparently displacing lower-wage jobs.

We also sense that TOD areas may facilitate gentrification, evidenced by higher income households moving into them, many taking higher-wage jobs, and incurring lower commuting costs and time. Transportation cost savings of course are capitalized into higher residential values and rents, something which was shown in Chapter 3. While these outcomes on the whole may not bode well for lower wage households, the fact that higher wage jobs and higher income households are attracted to TOD areas suggests that those areas may improve job-worker balance.

Finally, we sense that TOD areas may improve the well-being of those who can afford to live in them, presumably because their higher-wage jobs are nearby thereby reducing commuting time. This outcome would be consistent with emerging well-being literature. We recommend this as a near area of research.

CHAPTER 8
SUMMARY OF THREE STUDIES

During the course of our analysis, many of us produced research that was published separate from this report. Support for those studies came from NITC. We use this chapter to summarize those works as they add important additional insights to the body of our NITC-supported investigation into *Do TODs Make a Difference?*

Bus Rapid Transit and Economic Development

In their article, *Bus Rapid Transit and Economic Development*, Nelson, Appleyard, Kannan, Ewing, Miller and Eskic (2013) assess the relationship between BRT systems and economic development. They note that BRT in the United States is relatively recent. Among its many promises is enhancing the economic development prospects of firms locating along the route. Another is to improve overall metropolitan economic performance. In their article, they evaluate this issue with respect to one of the nation's newest BRT systems that operates in a metropolitan area without rail transit: Eugene-Springfield, Oregon. They found that while the metropolitan area lost jobs between 2004 and 2010, jobs grew within 0.25 miles of BRT stations. Using shift-share analysis, they find that BRT stations are attractive to jobs in several economic sectors.

Nelson et al. identify economic sectors that seem especially attracted to, or even repelled by, BRT stations. Sectors that appear to be displaced include Construction, Manufacturing, and Wholesale Trade. This is consistent with findings of Belzer, Srivastava, and Austin (2011). Jobs in the Utilities sector appear to be displaced with 0.25 miles of BRT stations, but they seem to have shifted to areas between 0.25 and 0.50 miles. A number of other sectors appear to be attracted to BRT station areas as a whole, although especially within 0.25 miles of a station. These include Retail Trade, Transportation and Warehousing, Finance and Insurance, Real Estate and Rental & Leasing, and other services. This is also consistent with findings of Belzer, Srivastava, and Austin (2011).

An interesting finding is that certain sectors are attracted to the closest BRT locations but considerably less so up to 0.50 miles, and, in some cases, jobs are shifted away from the 0.25–0.50 mile band but into the closer band. For instance, the 0.25–0.50 mile band saw a negative shift in Information, Management of Companies and Enterprises, Administrative/Support/Waste Management/Remediation Services, and Accommodation and Food Service. In many instances, the positive shift into the 0.25 mile band was greater than the negative shift out of the 0.25– 0.50 mile band. While these are sectors that Belzer, Srivastava, and Austin (2011) expect to be attracted to station areas generally, the fact that their positive shift is so large toward the closer band suggests that, at least for BRT, the location advantage may not reach out as far as for rail modes.

There is also the reverse situation in which there is a negative shift in the closest band but a positive one in the 0.25–0.50 mile band. This is the case with Health Care and Social Assistance in which the shift away from the closer band was the largest of all shifts, while the shift to the 0.25–0.50 mile band was the largest there. Some of this may be explained by a major medical facility that opened in the late 2000s outside the BRT station areas.

Then there is the interesting case of Public Administration, which had the second largest shift away from the closest distance band and there does not appear to any offsetting shift in the 0.25–0.50 band. The explanation is likely severe local government budget cuts during the late 2000s that resulted in hundreds of jobs being cut that were near BRT stations.

There are two other observations. First, of the combined shift in jobs toward BRT station areas of 710 jobs, only 12 are in the 0.25–0.50 distance band. Thus, essentially, the entire overall shift in jobs favoring BRT station areas occurred within 0.25 miles of them. Second, the BRT system may have a resiliency effect. Where the Eugene-Springfield metropolitan area as a whole lost jobs between 2004 and 2010, jobs were actually added within 0.25 miles of BRTs stations.

Figure 8.1 illustrates their central findings.

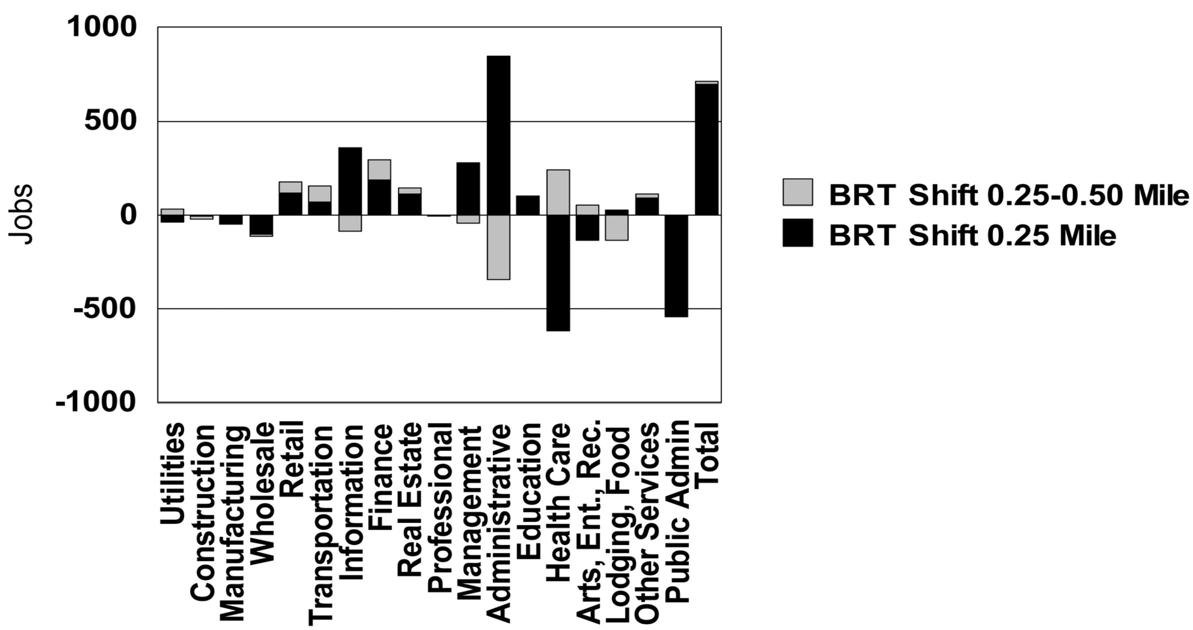

Figure 8-1

Shift-share distribution of employment change with respect to BRT station areas, Eugene-Springfield metropolitan area, 2004–2010

Establishing Light Rail Station Catchment Areas

Petheram, Nelson, Miller, and Ewing (2013) challenge the assumption that TODs should be planned for half-mile catchment areas around transit stations. Considerable literature reports the price effects of light rail transit accessibility on residential properties built principally for owner–occupants. Few studies show the relationship between light rail transit and rental apartment building values; those that have done so have evaluated outcomes within narrow bands of distance from light rail transit stations. The present study closes some of this gap in the research. The association between TRAX, the light rail system operated by the Utah Transit Authority serving Salt Lake County, Utah, and the value of rental apartment buildings in bands a distance from light rail stations of 0.25 mile out to 1.5 mile was estimated. When structural, neighborhood, and location characteristics were controlled for, a positive relationship between TRAX station and rental apartment building values was found to 1.25 mile but not beyond.

Of primary interest was finding the relationship between the distance from a TRAX station and rental apartment value. The coefficients showed a general pattern of declining value per square foot as the distance from the nearest TRAX station increased. As the mean value of apartment buildings in Salt Lake County is about $87/ft^2, the coefficients suggest value premiums of $7, $4, $5, $4, and $4/ft^2 for each 0.25-mile band outward from the nearest TRAX station. After about 1.25 mile, the effect of proximity became insignificant. This relationship is illustrated in Figure 8.2.

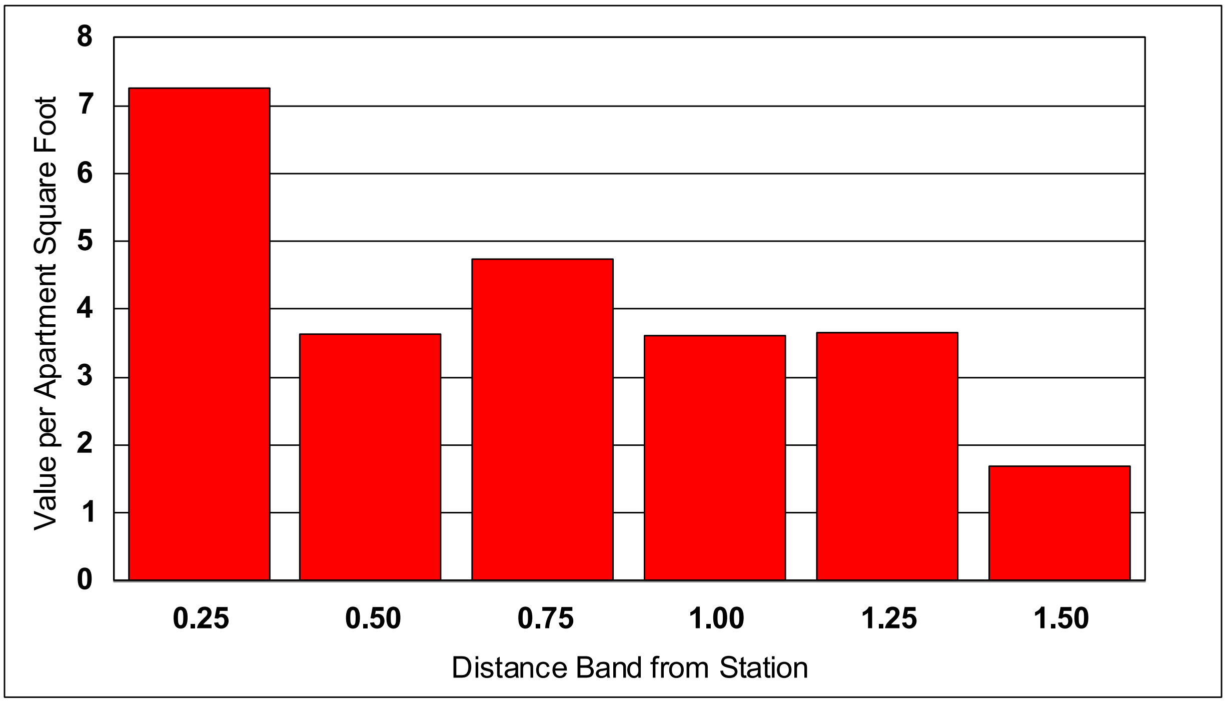

Figure 8-2
Incremental value per square foot of apartment buildings in Salt Lake County, Utah, with respect to distance from the nearest light rail transit station. (The value coefficient for the 1.50 mile band is not significant but shown for perspective.)

Office Rent Premiums with Respect to Distance from Light Rail Stations
Using CoStar office rent data for the Dallas metropolitan area, Nelson, Eskic, Ganning, Hamidi, Petheram, Liu and Ewing (2015) evaluated the association between asking rents for office space and distance to the nearest light rail transit station. Like Petheram, Nelson et al., they challenged conventional wisdom that real estate markets respond more favorably to location within one-half mile of transit stations, noting that planning and public decision-makers have thus drawn half-mile (or smaller) circles around rail transit stations assuming larger planning areas would not be supported by the evidence. They proceed to evaluate the distance-decay function of office rents in metropolitan Dallas with respect to LRT station distance. Using a quadratic transformation of distance, they find office rent premiums extending in the range of nearly two miles away from LRT stations with half the premium dissipating at about two-thirds on one mile and three quarters dissipating at about one mile. This is illustrated in Figure 8.3 (also reported in Chapter 3).

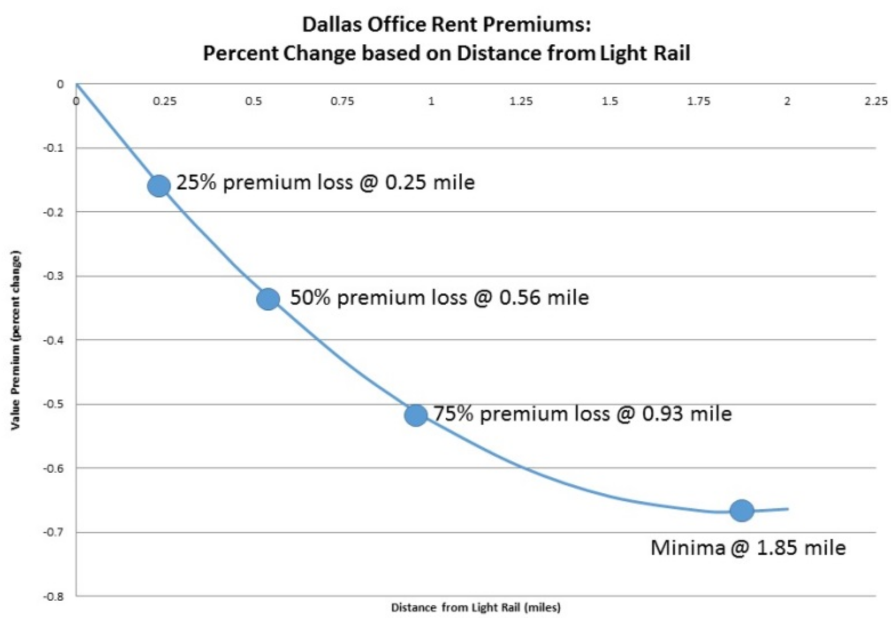

Figure 8-3
Dallas metropolitan area office rent premium with respect to distance from nearest light rail station

Nelson et al. argue that planners and public officials may need to rethink assumptions underlying the half-mile circle. They support Canepa (2007), who argued that combined with good urban design and multiple short-distance alternative modes (such as walking, biking, TOD-serving shuttles) there should be every reason to expect the market premium for land uses near rail transit stations to extend a mile and even well beyond a mile. That the office rent market capitalizes benefits of LRT station proximity so much farther away than previously thought should mean there are opportunities to maximize those benefits.

CHAPTER 9
Summary with Implications

Emerging evidence from surveys indicates that Americans want something different from their neighborhoods and communities (Nelson 2013). As demographic and economic trends are changing so are market preferences in ways we consider important to transit oriented development planning.

For instance, stated preference surveys gauge consumer demand given forced choices between clearly stated alternatives. In planning, such surveys can illustrate emerging preferences for communities, neighborhoods and housing. The National Association of Realtors recently commissioned a large national survey (Belden Russonello & Stewart 2011). From these suirveys, we estimate that nearly 40 percent of respondents, including half of those under 35 years of age and more than a third of all others, would choose to live in an attached home that was more accessible to destinations than detached homes—such as being within TOD areas. Yet attached homes comprise less than 30 percent of the housing supply.

Moreover, in choosing between small and large lot options, 60 percent of all respondents, and 56 percent of those 70 and over would choose a home on a smaller lot with a shorter commute rather than a home on a larger lot with a longer commute. Yet only 40 percent of the nation's detached housing stock is on smaller lots. As households without children will account for more than 80 percent of the demand for housing choices over the next few decades, and more than half of that demand will be comprised of singles, there would seem to be a substantial mismatch between emerging preferences and current housing supply.

These trends have us suspect that America is moving into a new era of metropolitan development and form. The demographic, economic, and finance drivers that made America a suburban nation may have run their course. The U.S. will see a shift toward infill and redevelopment. Facilitating this will be fixed-guideway transit systems and the transit oriented developments (TODs) they serve.

In this report, we have presented research that measures the outcomes of TOD areas in relation to their metropolitan area controls with respect to (1) jobs by sector, (2) housing choice for household types based on key demographic characteristics, (3) housing affordability based on transportation costs, and (4) job-worker balance as a measure of accessibility. Our analysis is based on studying 19 metropolitan areas in the South and West that have one or more of those systems. We highlight key findings here.

1. TOD areas in most LRT, SCT and CRT transit systems experienced growth in the office, knowledge, education, health care and entertainment sectors. TOD areas in half of the BRT systems gained jobs in the office, education and health care sectors. We also estimated the economic gains from new jobs locating within TOD areas: Summed across all systems, we estimate that TOD areas gained more than $100 billion in wages capitalized over time. CRT TOD areas gained the most, followed by SCT, LRT and BRT TOD areas (Chapter 1).

2. Between 2002 and 2007, the eight metropolitan areas with LRT systems operating in 2004 or earlier experienced higher growth rates than nation as a whole. They also collectively saw eroding shares of employment within 0.50-mile LRT TOD areas relative to their metropolitan areas. The shift in share of jobs away from LRT stations slowed during the Great Recession. Afterwards, during recovery, however, LRT TOD areas gained share in the shift of metropolitan jobs. We see this shift as evidence of regional transformation associated with LRTs and their TOD areas. (Chapter 2.)

3. In terms of office space asking rent within one-half mile of transit corridors, SCT systems revealed the highest rent premium outcomes. We find this notable because economic outcomes associated with SCT systems seem to be the least understood. LRT systems expressed significant associations with respect to rent away from the center of the corridor. However, results for BRT are mixed with no statistically significant association with respect to office rent, a negative association with respect to the retail first distance band, but positive effects for rental apartments. Across all development types, proximity to CRT corridors either has an insignificant association or a negative one. We are not surprised given the freight-station nature of CRT systems. (Chapter 3)

4. While planners may hope that TOD areas will attract certain kinds of people and housing opportunities, this is an area that is wanting in research. Our research finds that of the modes studied, streetcar transit systems performed best in terms of increasing their TOD area shares of metropolitan population, households and householders by age, housing units, and renters. LRT and CRT systems experienced a much smaller shift in the share of growth but they also serve many times more TOD areas with much larger geographic service areas. For the most part we do not find that BRT systems are associated with substantial shifts in population, household and housing unit location over time. (Chapter 4)

5. While is seems reasonable to assume that transportation costs as a share of household income increase with respect to distance from transit stations, there is no research on the proposition. We report research showing that household transportation costs as a share of budgets increase with respect to distance from light rail stations out to seven miles. (Chapter 5)

6. We detect emerging trends that may favor higher-wage jobs locating in transit TOD areas over time than lower or middle wage jobs. We reason that as the real estate market values fixed-guideway transportation investments, firms needing transit-accessible locations also have higher-value labor needs with the effect that lower-wage jobs are displaced from TOD areas. (Chapter 6)

7. As there is growing concern about increasing commuting trips and travel times with associated deterioration of individual quality of life, we theorize that one benefit of transit and associated TOD areas is to shorten commute times for people living in or near them, and this may have important implications for personal well-being. We find that the share of workers who commute 10 minutes or less to work increases nearly one-half of one percent for each half-mile their resident block group is to a transit station, capping at a gain of 1.3 percent, which is not a trivial gain. Combined with other work, we sense that TOD areas may improve the well-being of those who can afford to live in them, presumably because their higher-wage jobs are nearby thereby reducing commuting time. This outcome would be consistent with emerging well-being literature. (Chapter 7)

8. We conducted in-depth case study analysis of TOD areas serving 17 transit systems—creating comparable control areas for each. We applied pretest-posttest evaluation to jobs, housing choice, housing affordability, and occupation-housing balance. We also used interrupted time series analysis to conduct a natural experiment evaluating the differences in outcomes between treatment (TODs) and control areas with respect to the economic recession of 2008-2009. We find that in nearly all 17 case studies, transit systems softened economic losses during the recession and appeared better to facilitate recovery compared to control areas afterward. (Chapter 8)

9. A summary of three earlier works published supported by NITC found the following (Chapter 8):

   a) A case study of the Eugene-Springfield bus rapid transit system found, for instance, that BRT stations attracted certain economic sectors to within about one-quarter mile, displaced other sectors to one-half mile or beyond, but that most of the changes in jobs occurred within the first quarter mile.

   b) A case study of apartment building values per square foot in Salt Lake County, Utah, with respect to distance from the nearest light rail transit station found positive value premiums out to 1.25 miles—a distance well beyond the conventional "half-mile circle".

   c) Another case study of office asking rents in the Dallas, Texas, market found office rent premiums nearly two miles away from the nearest LRT station with roughly a quarter of the premium dissipating after one-half mile, half the premium dissipating at about a half mile, and three-quarters dissipating about one mile away.

We hope that our research will inform decision-makers at all levels of government about whether and the extent to which tods make a difference in economic development with respect to jobs generally and with respect to resiliency during recessions, expanding housing choice to specific household types, enhancing housing affordability, improving job-worker balance, and especially reconsidering the conventional half-mile circle for future TOD area planning.

REFERENCES AND SELECTED BIBLIOGRAPHY

Al-Mosaind, Musaad A., and Kenneth J. Dueker, and James G. Strathman (1993). Light-Rail Transit Stations and Property Values: A Hedonic Price Approach. *Transportation Research Record* 1400: 90–94

Alonso, William (1964). *Location and land use. Toward a general theory of land rent*. Cambridge, MA: Harvard University Press.

Anas, Alex, Richard Arnott, and Kenneth A. Small (1998). Urban spatial structure. *Journal of economic literature* 1426-1464.

American Public Transit Association (2009). *Defining Transit Areas of Influence*. APTA SUDS-UD-RP-001-09. American Public Transportation Association.

Armstrong, Michael, and Brett Sears (2001). *The New Economy and Jobs/Housing Balance in Southern California*. Los Angeles, CA: Southern California Association of Governments. Also available at http://www.scag.ca.gov/housing/jobhousing/balance.html.

Arrant, Tony (2012). *Planning and Growth Management*, Chapter 11 in Florida Association of Governments. *Florida County Government Guide*. Tallahassee, FL: Florida Association of Governments, pp 111-127.

Ashby, J., D, Cox. N and McInroy (2009). *An International Perspective of Local Government as Steward of Local Economic Resilience*. Report by the Centre for Local Economic Strategies: Manchester.

Baltes, Michael, Victoria Perk, Jennifer Perone, and Cheryl Thole (2003). *South Miami-Dade Busway System Summary*. National Bus Rapid Transit Institute, University of South Florida.

Bania, Neil, Laura Leete, and Claudia Coulton (2008). Job access, employment and earnings: Outcomes for welfare leavers in a US urban labour market. *Urban Studies* 45(11): 2179-2202.

Banister, David, and Yossi Berechman (2001). Transport investment and the promotion of economic growth. *Journal of transport geography* 9(3): 209-218.

Bartholomew K. and R. Ewing (2011) Hedonic price effects of pedestrian- and transit-oriented development. Journal of Planning Literature, 26(1): 18-34.

Belzer, Dena, Sujata Srivastava, and Mason Austin (2011). *Transit and Regional Economic Development*. Oakland, CA: Center for Transit-Oriented Development.

Belzer, Dena, Robert Hickey, Wells Lawson, Shelley Poticha, and Jeff Wood (2007). *The Case for Mixed-Income Transit-Oriented Development in the Denver Region*. Oakland, CA: Center for Transit-Oriented Development.

Belzer, Dana, and Shelley Poticha (2009). Understanding Transit-Oriented Development: Lessons Learned 1999–2009. *Fostering Equitable and Sustainable Transit-Orientated Development*: 4-11.

Berkes, F., J. Colding, et al., Eds. (2003). *Navigating socialecological systems: Building resilience for complexity and change*. Cambridge, UK: Cambridge University Press.

Blackman, Allen, and Alan Krupnick (2001). Location-Efficient Mortgages: Is the Rationale Sound? *Journal of Policy Analysis and Management* 20(4): 633-649.

Blais, Pamela (2011). *Perverse cities: hidden subsidies, wonky policy, and urban sprawl*. Vancouver, BC: University of British Columbia.

Blumenberg, Evelyn A., Paul M. Ong, and Andrew Mondschein (2002). *Uneven access to opportunities: Welfare recipients, jobs, and employment support services in Los Angeles.* University of California Transportation Center.

Blumenberg, Evelyn, and Michael Manville (2004). Beyond the spatial mismatch: welfare recipients and transportation policy. *Journal of Planning Literature* 19(2): 182-205.

Boarnet, Marlon (1997). Highways and economic productivity: Interpreting recent evidence. *Journal of Planning Literature* 11(4): 476–486.

Boarnet, Marlon G. and Andrew F. Haughwout. (2000). *Do Highways Matter? Evidence and Policy Implications of Highways Influence on Metropolitan Development*. Washington, DC: The Brookings Institution, Center on Urban and Metropolitan Policy.

Bogart, William T. (1998). *The Economics of Cities and Suburbs*. Upper Saddle River, NJ: Prentice Hall.

Bollinger, Christopher R., and Keith R. Ihlanfeldt (1997). The impact of rapid rail transit on economic development: The case of Atlanta's MARTA. *Journal of Urban Economics* 42(2): 179-204.

Briguglio, L., G. Cordina, N. Farrugia, and S. Vella. (2008) Economic Vulnerability and Resilience: Concepts and Measurements. New York, NY: United Nations University.

Briguglio L., G. Cordina, et al. (2005). Conceptualizing and Measuring Economic Resilience. Malta: University of Malta.

Bristow, G. (2010). Resilient Regions: re-'place'ing regional competitiveness. *Cambridge Journal of Regions, Economy and Society*, 3: 153-167

Brown, J. R., and G. L. Thompson (2009). *The influence of service planning decision on rail transit success or failure*. Mineta Transportation Institute, San Jose State University.

Canepa, Brian (2007). Bursting the Bubble: Determining the Transit-Oriented Development's Walkable Limits. Transportation Research Record: Journal of the Transportation Research Board, 1992: 28–34.

Carlino, Gerald, Satyajit Chatterjee, and Robert Hunt (2006), "Urban Density and the Rate of Invention," WP 06-14, http://www.philadelphiafed.org/research-and-data/regional-economy/regional-research/index.cfm?tab=3

Carnegie Mellon Center for Economic Development. Undated. *Methods of regional analysis: Shift-share*. Pittsburgh, PA: H. John Heinz School of Public Policy and Management, Carnegie Mellon University. Accessed from http://www.andrew.cmu.edu/user/jp87/URED/readings/Shift_Share.pdf.

Carrigan, Aileen, Robin King, Juan Miguel Velásquez, Nicolae Duduta and Matthew Raifman (2013). *Social, Environmental and Economic Impacts of Bus Rapid Transit.* Washington, DC: EMBARQ.

Center for Housing Policy (2012). *Paycheck to Paycheck*. Washington, DC: Center for Housing Policy, http://www.nhc.org/paycheck.

Cervero, Robert (1989). Jobs–housing balancing and regional mobility, *Journal of the American Planning Association* 55(2): 136–150.

Cervero, Rovert and Michael Duncan. (2002a). *Land Value Impacts of Rail Transit Services in San Diego County.* Washington, DC: Urban Land Institute.

Cervero, Robert and Michael Duncan(2002b). Benefits of Proximity to Rail on Housing Markets: Experiences in Santa Clara County. *Journal of Public Transportation:* 5: 1-18.

Cervero, Robert and Michael Duncan(2002c). Transit's Value-Added Effects: Light and Commuter Rail Services and Commercial Land Values. *Transportation Research Record*: 1805: 8-15.

Cervero, Robert and Michael Duncan (2002d). *Land Value Impacts of Rail Transit Services in Los Angeles County.* Washington, DC: National Association of Realtors and Urban Land Institute.

Cervero, Robert and Chang Deok Kang (2011). Bus rapid transit impacts on land uses and land values in Seoul, Korea. *Transport Policy* 18: 102–116

Cervero, R., S. Murphy, C. Ferrell, N. Goguts, Y. Tsai, G. B. Arrington, J. Boroski,

J. Smith-Heimer, R. Golem, P. Peninger, E. Nakajima, E. Chui, R. Dunphy, M. Myers, S. McKay, and N. Witsenstein. (2004). *Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects*. Washington, DC: Transportation Research Board.

Cervero, R. and Kang, C. D. (2011). Bus Rapid Transit Impacts on Land Uses and Land Values in Seoul, Korea, *Transport Policy* 18 (1): 102-116.

Cervero, Robert, and Samuel Seskin (1995). An evaluation of the relationships between transit and urban form. *TCRP Research Results Digest* 7.

Cervero, Robert, and John Landis (1997). Twenty years of the Bay Area Rapid Transit system: Land use and development impacts. *Transportation Research Part A: Policy and Practice* 31(4): 309-333.

Cervero, Robert, Onésimo Sandoval, and John Landis (2002). Transportation as a stimulus of welfare-to-work private versus public mobility. *Journal of Planning Education and Research* 22(1): 50-63.

Cervero, Robert B. (2013). Linking urban transport and land use in developing countries. *Journal of Transport and Land Use* 6(1): 7-24.

Cervero, Robert, and Danielle Dai (2014). BRT TOD: Leveraging transit oriented development with bus rapid transit investments. *Transport Policy* 36: 127-138.

Ciccone, Antonio, and Robert E. Hall. (1996). Productivity and the density of economic activity. *American Economic Review* 86: 54–70.

Chen, H., Rufolo, A., & Dueker, K. (1998). Measuring the Impact of Light Rail Systems on Single-Family Home Prices: A Hedonic Approach with GIS Applications. *77th Annual Meeting of the Transportation Research Board.* Washington, DC: Transportation Research Board.

Chapple, K. (2001). Time To Work: Job Search Strategies and Commute Time for Women on Welfare in San Francisco. *Journal of Urban Affairs* 23: 155–73.

Chapple, Karen and William T. Lester (2010.) The resilient regional labour market: The US case. *Cambridge Journal of Regions, Economy and Society*. 3(1): 85-104.

Chatman, Daniel G. and Robert B. Noland (2011). Do public transport improvements increase agglomeration economies? A review of literature and an agenda for research. *Transport Reviews* 31(6): 725-742.

Chatman, D. G., & Noland, R. B. (2014). Transit service, physical agglomeration and productivity in US Metropolitan Areas. *Urban Studies*, *51*(5), 917-937.

Cochrane, Steven, Sophia Koropeckyj, Aaron Smith, and Sean Ellis (2014). Central Cities and Metropolitan Areas: Manufacturing and Nonmanufacturing Employment as Drivers of Growth.

In *Revitalizing American Cities*, Susan M. Wachter and Kimberly A. Zeuli (Eds.). University of Pennsylvania Press, Philadelphia pp. 65-80.

Christopherson, S., Michie, J., Tyler, P. (2010). Regional resilience: theoretical and empirical perspectives. Cambridge Journal of Regions, Economy and Society 3, pp 3-10

Ciccone, Antonio and Robert E. Hall. (1996) "Productivity and the Density of Economic Activity." *American Economic Review*. 86(1): 54-70.

Crabtree, Steve (2010). *Wellbeing Lower Among Workers with Long Commutes*. Accessed December 5, 2015 from http://www.gallup.com/poll/142142/wellbeing-lower-among-workers-long-commutes.aspx.

Cybulski, J.D. (2013) Transportation Infrastructure Resiliency: A Review of Transportation Infrastructure Resiliency in Light of Future Impacts of Climate Change. Boston, MA: Volpe Center.

Dawkins, Casey, and Ralph Buehler (2010). Promoting Affordable Housing near Public Transit: The Role of Planning. *Policy Paper* 3.

Dawkins, Casey, and Rolf Moeckel (2014). "Transit-Induced Gentrification: Who Will Stay, and Who Will Go?.

De Bok, Michiel, and Michiel Bliemer (2006). Infrastructure and Firm Dynamics: Calibration of Microsimulation Model for Firms in the Netherlands. In *Transportation Research Record: Journal of the Transportation Research Board*, *No. 1977,* Transportation Research Board of the National Academies, Washington, D.C. pp. 132–144.

Diaz, R. B., M. Chang, G. Darido, M. Chang, E. Kim, D. Schneck, M. Hardy, J. Bunch, M. Baltes, D. Hinebaugh, L. Wnuk, F. Silver, and S. Zimmerman. (2004). *Characteristics of Bus Rapid Transit for Decision-Making*. Washington, DC: Federal Transit Administration, U.S. Department of Transportation.

Dubé, Jean, François Des Rosiers, Marius Thériault, and Patricia Dib (2011). Economic impact of a supply change in mass transit in urban areas: a Canadian example. *Transportation Research Part A: Policy and Practice* 45(1): 46-62.

Dueker, Kenneth J. and Martha J. Bianco. (1999). Light Rail Transit Impacts in Portland: The First Ten Years. Presented at Transportation Research Board, 78th Annual Meeting.

Dunn, James A. (2010) *Driving Forces: The Automobile, Its Enemies, and the Politics of Mobility*. Brookings Institution Press, Washington, D.C.

Emrath, Paul and Natalia Siniavskaia (2009). *Household Type, Housing Choice, and Commuting Behavior*. Washington, DC: National Association of Home Builders.

Ewing, Reid. (1996). *Best Development Practices: Doing the Right Thing and Making Money at the Same Time*. Chicago: Planners Press.

Ewing, Reid and Shima Hamidi (2015). *How Affordable is HUD Affordable Housing?* Portland, OR: Portland State University, National Institute for Transportation and Communities.

Ewing, Reid and Robert Cervero. (2010). Travel and the built environment: A meta-analysis. *Journal of the American Planning Association* 76(3): 265-294.

Fan, Yingling (2012). The Planners War against Spatial Mismatch: Lessons Learned and Ways Forward. *Journal of Planning Literature*. 27(2):153-169.

Fan, Yingling (2010). *How Light-Rail Transit Improves Job Access for Low-Wage Workers* (Research Brief). Report no. CTS Research Brief 2010-02. Minneapolis, MN: University of Minnesota, Center for Transportation Research.

Fan, Yingling, and Arthur Huang (2011). How affordable is transportation? A context-sensitive framework. Minneapolis, MN: University of Minnesota, Center for Transportation Research.

Fan, Yingling, Andrew Guthrie, and David Matthew Levinson (2010). Impact of light rail implementation on labor market accessibility: A transportation equity perspective. *Journal of Transport and Land Use* 5(3):

Fogarty, N., and M. Austin. (2011). *Rails to Real Estate: Development Patterns along Three New Transit Lines*. Washington, DC: Center for Transit-Oriented Development.

Folke, C. (2006). Resilience: The emergence of a perspective for social-ecological systems analyses. *Global Environmental Change-Human and Policy Dimensions* 163: 253-267.

Frank, Lawrence, and Gary Pivo. (1994). *Relationships between Land Use and Travel Behavior in the Puget Sound Region.* Seattle: Washington State Transportation Center.

Gallagher, Leigh (2013). *The end of the suburbs: Where the American Dream is moving*. New York, NY: Penguin.

Galster, George, and Jackie Cutsinger (2007). Racial settlement and metropolitan land-use patterns: Does sprawl abet black-white segregation? *Urban Geography* 28(6): 516-553.

Ganning, Joanna P. and Benjamin D. McCall. (2012). The Spatial Heterogeneity and Geographic Extent of Population Deconcentration: Measurement and Policy Implications. In *International Handbook of Rural Demography*, edited by Laszlo J. Kulcsar and Katherine J. Curtis, 319-332: Springer.

Garrett, T. (2004). *Light Rail Transit in America: Policy Issues and Prospects for Economic Development*. St. Louis: Federal Reserve Bank of St. Louis.

Glaeser, Edward L. Ed (2010). *Agglomeration Economics*. Chicago: University of Chicago Press.

Glaeser, Edward (2011). *Triumph of the City How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier*. New York: Penguin Books.

Glaeser, Edward L., Stuart S. Rosenthal, and William C. Strange (2010). Urban economics and entrepreneurship. *Journal of Urban Economics* 67(1): 1-14.

Golub, Aaron, Subhrajit Guhathakurta, and Bharath Sollapuram (2012). Spatial and temporal capitalization effects of light rail in phoenix from conception, planning, and construction to operation. *Journal of Planning Education and Research* 32(4): 415-429.

Gordon, J. (1978). *Structures*. Harmondsworth, UK: Penguin Books.

Graham, D. J. (2007). Agglomeration, productivity and transport investment. *Journal of Transport Economics and Policy* 41(3), September: 317–343. www.ingentaconnect.com/content/lse/jtep/2007/00000041/00000003/art00003. Summarized in OECD/ITF Discussion Paper 2007-11, www.internationaltransportforum.org/jtrc/DiscussionPapers/DiscussionPaper11.pdf.

Guerra, Erick, Robert Cervero, and Daniel Tischler (2012). Half-Mile Circle: Does It Best Represent Transit Station Catchments? *Transportation Research Record: Journal of the Transportation Research Board* 2276: 101-109.

Giuliano, G. (2005). Low income, public transit, and mobility. *Transportation Research Record: Journal of the Transportation Research Board*, 1927: 63-70.

Giuliano, G. (2004). Land use impacts of transportation investments: Highway and transit. In S. Hanson and G. Giuliano (Eds.), *The Geography of Urban Transportation*, 3rd Edition. New York: Guilford Press.

Giuliano, G. and Small, K. A. (1993) Is the journey to work explained by urban structure. *Urban Studies* 30(9): 1485–1500.

Grengs, J. (2010). Job Accessibility and the Modal Mismatch in Detroit. *Journal of Transport Geography* 18(1): 42–54.

Haas, Peter, Carrie Makarewicz, Albert Benedict, and Scott Bernstein. "Estimating transportation costs by characteristics of neighborhood and household." *Transportation Research Record: Journal of the Transportation Research Board* 2077 (2008): 62-70.

Harris, Timothy F. Harris and Yannis M. Ioannides. (2002), *Productivity and Metropolitan Density*. Boston, MA: Department of Economics, Tufts University.

Hassink, R. (2010). Regional resilience: a promising concept to explain differences in regional economic adaptability. *Cambridge Journal of Regions, Economy, and Society*, 3: 45-58.

Heaslip, K. and W. Louisell. (2010). A Sketch Level Method for Assessing Transportation Network Resiliency to Natural Disasters and Man-Made Events. Transportation Research Board, Washington, D.C.

Heaslip, K. and W. Louisell. (2009). *A Methodology to Evaluate Transportation Resiliency for Regional Networks*. Transportation Research Board, Washington, D.C.

Hess, D. B., & Almeida, T. M. (2007). Impact of Proximity to Light Rail Rapid Transit on Station-area Property Values in Buffalo, New York. *Urban Studies* 44 (5/6): 1041-1068.

Hess, D. B., & Lombardi, P. A. (2004). Policy Support for and Barriers to Transit-Oriented Development in the Inner City: Literature Review. *Transportation Research Record* 1887: 26-33.

Hickey, Robert, Jeffrey Lubell, Peter Haas, and Stephanie Morse (2012). *Losing ground: The struggle of moderate-income households to afford the rising costs of housing and transportation.* Washington, DC: Center for Housing Policy and Chicago, IL: Center for Neighborhood Technology.

Hill, E., T. St. Clair, H. Wial, H. Wolman, P. Atkins, P. Blumenthal, S. Ficenec, and A. Friedhoff (2012). Economic Shocks and Regional Economic Resilience. In N. Pindus, M. Weir, H. Wial and H. Wolman, eds. Building Resilient Regions: Urban and Regional Policy and Its Effects, volume 4. Washington, DC: Brookings Institution Press.

Higgins, Christopher D., Mark R. Ferguson, Pavlos S. Kanaroglou (2014). Light Rail and Land Use Change: Rail Transit's Role in Reshaping and Revitalizing Cities *Journal of Public Transportation* 17(2): 93-112.

Higgins, Christopher D. and Pavlos S. Kanaroglou (2015) *40 Years of Modelling Rail Transit's Land Value Uplift in North America: Diverse Methods, Differentiated Outcomes, Debatable Assumptions, and Future Directions*. Transportation Research Record (forthcoming).

Hoffman, A. (2008) *Advanced network planning for bus rapid transit: the "Quickway Model" as a modal alternative to "Light Rail Lite"*. Washington, DC: Department of Transportation, Federal Transit Administration.

Holling, C. S. (1973). Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*. 4(1): 1-23.

Holling, Walker, B., C. S., Carpenter, S. R., & Kinzig, A. (2004). Resilience, adaptability and transformability in social--ecological systems. *Ecology and society*, *9*(2): 5.

Hook, Walter, Stephanie Lotshaw, and Annie Weinstock (2013). *More Development for Your Transit Dollar: An Analysis of 21 North American Transit Corridors*. Washington, DC: Institute for Transportation and Development Policy.

Holmes, Thomas. (1999). How Industries Migrate when Agglomeration Economies are Important. *Journal of Urban Economics*. 45(2): 240-263.

Institute for Transportation & Development Policy. *The Scorecard.* https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/the-scorecard/

Institute for Transportation & Development Policy. *Best Practices 2013.* https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/best-practices-2013/

Jun, M. J. (2012). Redistributive effects of bus rapid transit (BRT) on development patterns and property values in Seoul, Korea, *Transport Policy* 19:85-92.

Kain, John F. (1968) Housing segregation, negro employment, and metropolitan decentralization. *The Quarterly Journal of Economics*: 175-197.

Kain, J., F. (1992). The Spatial Mismatch Hypothesis: Three Decades Later. *Housing Policy Debate* 3(2): 371-392.

Kang, Chang Deok (2010). The impact of bus rapid transit on location choice of creative industries and employment density in Seoul, Korea. *International Journal of Urban Sciences* 14(2): 123-151.

Kawabata, Mizuki (2002). *Job access and work among autoless adults in welfare in Los Angeles.* Working Paper Number 40. Los Angeles: The Ralph and Goldy Lewis Center for Regional Policy Studies.

Kawabata, Mizuki (2003). Job access and employment among low-skilled autoless workers in US metropolitan areas. *Environment and Planning A* 35(9): 1651-1668.

Kim, Keuntae (2015). Using ArcGIS to Identify Ten Comparable Points for Counter-Factual Analysis. Salt Lake City, UT: *Metropolitan Research Center*, University of Utah.

Kittelson & Associates (2007). *Bus rapid transit practitioner's guide*. TCRP Report 118. Washington, DC: Transportation Research Board, National Research Council.

Kittrell, K. (2012). Impacts of vacant land values: Comparison of metro light rail station areas in Phoenix, Arizona. *Transportation Research Record* 2276: 138-145.

Knight, R. L., and L. L. Trygg (1977). *Land Use Impacts of Rapid Transit: Implications of Recent Experience*. Office of the Secretary. Washington, DC: U.S. Department of Transportation.

Ko, K. and X. Cao. (2013). The Impact of Hiawatha Light Rail on Commercial and Industrial Property Values in Minneapolis. *Journal of Public Transportation*, 16(1): 47-66.

Kolko, Jed (2011). *Making the most of transit: Density, employment growth, and ridership around new stations*. San Francisco, CA: Public Policy Institute of California.

Landis, J., S. Guhathakurta and M. Zhang (1994). *Capitalization of Transit Investments into Single-Family Home Prices.* University of California Transportation Center.

Larkin, K. and M. Cooper (2009). *Into Recession: Vulnerability and Resilience in Leeds, Brighton and Bristol*. London: Centre for Cities.

Leadership Conference Education Fund (2011a). *Where we Need to Go: A Civil Rights Road Map for Transportation Equity*. Washington, DC: Leadership Conference Education Fund.

Leadership Conference Education Fund (2011b). *Getting to Work: Transportation Policy and Access to Work*. Washington, DC: Leadership Conference Education Fund.

Le Blanc, Gilles. (2000). *Regional Specialization, Local Externalities and Clustering in Information Technology Industries*. Paris: Centre D'économie Industrielle, Ecole Nationale Supérieure Des Mines De Paris.

Levinson, H., S. Zimmerman, J. Clinger, S. Rutherford, R. Smith, J. Cracknell, and R. Soberman. (2003). *Bus Rapid Transit Volume 1: Case Studies in Bus Rapid Transit*. Washington, DC: Transportation Research Board.

Lipman, Barbara J. (2006) *A heavy load: The combined housing and transportation burdens of working families*. Washington, DC: Center for Housing Policy.

Litman, Todd A. (2009). *Evaluating Transportation Economic Development Impacts*. Victoria, BC: Victoria Transportation Institute, http://www.vtpi.org/econ_dev.pdf.

Litman, Todd (2010). *Evaluating transportation economic development impacts*. Victoria, BC: Victoria Transport Policy Institute.

Litman, Todd A. (2011). *Rail transit in America: A comprehensive evaluation of benefits*. Victoria, BC: Transport Policy Institute.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Denver Light Rail Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Seattle Light Rail Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Seattle Commuter Rail Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Seattle Streetcar Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Portland Light Rail Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Liu, Jenny, Matt Berggren, Zakari Mumuni, Matt Miller, Arthur C. Nelson and Reid Ewing (2014). Portland Streetcar Transit Case Study. Report prepared for the National Institute of Transportation and Communities. Portland, Oregon: Portland State University.

Lobo, José, Luís M. A. Bettencourt, Deborah Strumsky, and Geoffrey B. West. (2011) *The Economic Productivity of Urban Areas: Disentangling General Scale Effects from Local Exceptionality*. SFI Working Paper: 2011-09-046. Santa Fe, NM: Santa Fe Institute.

Lopez-Zetina, Javier, Howard Lee and Robert Friis (2006). The link between obesity and the built environment. Evidence from an ecological analysis of obesity and vehicle miles of travel in California**.** Health and Place 12(4): 656–664.

Loukaitou-Sideris, A., and T. Banerjee (2000). The blue line blues: Why the vision of transit village may not materialize despite impressive growth in transit ridership. *Journal of Urban Design* 5(2): 101-125.

Lowrey, Annie (2011). Your Commute Is Killing You. *Slate* online May 26, 2011, accessed at http://www.slate.com/articles/business/moneybox/2011/05/your_commute_is_killing_you.html

Marshall, Alfred. (1920). *Principles of Economics*. London, UK: MacMillan and Co.

Marshall, W. (2012). Building a Framework for Transportation Resiliency and Evaluating the Resiliency Benefits of Light Rail Transit in Denver, Colorado. Mountain-Plains Consortium proposal number MPC-361. Denver, CO: University of Colorado.

Martin-Breen, P. and J. M. Anderies (2011). Resiliency: A Literature Review. New York, NY: Rockefeller Foundation.

Masten, A.S., K. Best, N. Garmezy. 1990. Resilience and development: contributions from the study of children who overcome adversity. Development and Psychopathology 2(4): 425-444.

McDonnell, Simon, and Josiah Madar (2011). New York City's Plans for Bus Rapid Transit as an Investment to Generate Economic Recovery. In *Transportation Research Board 90th Annual*

Meeting, Washington, D.C.: Transportation Research Board of the National Academies. no. 11-2772.

McKenzie, Brian S. "Neighborhood access to transit by race, ethnicity, and poverty in Portland, OR." *City & Community* 12, no. 2 (2013): 134-155.

Miami-Dade Government. " Regulatry and Economic Resources: Comprehensive Development Master Plan (CDMP) Adopted Components." Last Edited: Thu Aug 6, 2015**.** http://www.miamidade.gov/planning/cdmp-adopted.asp.

Miami-Dade Government. " Regulatry and Economic Resources: Small Area Plans & Ordinances." Last Edited: Thu May 1, 2014. http://www.miamidade.gov/zoning/small-area-plans.asp.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Charlotte Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Dallas Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Houston Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Phoenix Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Sacramento Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Salt Lake City Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Twin Cities Light Rail Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Charlotte Bus Rapid Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Eugene-Springfield Bus Rapid Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Las Vegas Bus Rapid Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Phoenix Bus Rapid Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Salt Lake City Bus Rapid Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *South Miami-Dade Busway Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Albuquerque-Santa Fe Commuter Rail Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Miami Commuter Rail Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Salt Lake City Commuter Rail Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Matt Miller, Arthur C. Nelson, Dejan Eskic, Reid Ewing and Joanna Ganning (2014). *Tampa Streetcar Transit Case Study*. Report prepared for the National Institute of Transportation and Communities. Salt Lake City, Utah: Metropolitan Research Center.

Mills, Edwin S. "An aggregative model of resource allocation in a metropolitan area." *The American Economic Review* (1967): 197-210.

Munoz-Raskin, Ramon (2010). Walking accessibility to bus rapid transit: Does it affect property values? The case of Bogotá, Colombia. *Transport Policy* 17(2): 72-84.

Muth, Richard F. (1969). *Cities and Housing*. Chicago: University of Chicago Press.

Nelson, Arthur C. (2014). *Foundations of Real Estate Development Finance: A Guide for Public-Private Partnerships*. Washington, DC: Island Press.

Nelson, Arthur C. (2013). *Reshaping metropolitan America: Development trends and opportunities to 2030*. Washington, DC: Island Press, 2013.

Nelson, Arthur C. (1999). Transit stations and commercial property values. *Journal of Public Transportation* 2(3): 77–96.

Nelson, Arthur C., Bruce Appleyard, Shyam Kannan, Reid Ewing, Matt Miller, Dejan Eskic (2013). Bus Rapid Transit and Economic Development: Case Study of the Eugene-Springfield BRT System. *Journal of Public Transportation* 16(3): 41-57.

Nelson, A. C., G. Anderson, R. Ewing, P. Perlich, T. W. Sanchez, and K. Bartholomew (2009). *The Best Stimulus for the Money: Briefing Papers on the Economics of Transportation Spending*. Salt Lake City: Metropolitan Research Center at the University of Utah for Smart Growth America. http://www.smartgrowthamerica.org/documents/thebeststimulus.pdf.

Nelson, Arthur C., Dejan Eskic, Shima Hamidi, Reid Ewing, Susan J. Petheram and Jenny H. Liu (2015). Office Rent Premiums with Respect to Light Rail Transit Stations: Case Study of Dallas with Implications for TOD Planning. *Transportation Research Record* (forthcoming).

Nelson, Arthur C. Nelson, Keuntae Kim, Dejan Eskic, and Joanna P. Ganning (2015). *Profiles in Bus Rapid Transit and Economic Development: Shift-Share Assessment of Pre- and Post-Recession Job Change with Planning and Policy Implications*. Salt Lake City, Utah: University of Utah, Metropolitan Research Center.

Nelson, Arthur C., Matt Miller, Joanna P. Ganning, Philip Stoker, Jenny H. Liu, and Reid Ewing. (2015). Transit and Economic Resilience. *Transportation Research Board 94th Annual Meeting*, no. 15-5474.

Nelson, Arthur C., Gail Meakins, Deanne Eeber, Shyam Kannan, Reid Ewing (2013). The Tragedy of the Unmet Demand for Walking and Biking. *The Urban Lawyer*. 45(3): 615-630.

Nikitas, Alexandros, and MariAnne Karlsson (2015). A Worldwide State-of-the-Art Analysis for Bus Rapid Transit: Looking for the Success Formula." *Journal of Public Transportation* 18(1): 1-33.

Olson, Kathy (2011). *Bending the market – using joint development as a catalyst*. Salt Lake City, UT: Utah Transit Authority.

O'Sullivan, Arthur. (2012). *Urban Economics* 8th ed. New York: McGrawHill-Irwin.

Ong, Paul M., and Douglas Houston (2002). Transit, Employment and Women on Welfare. *Urban Geography* 23(4): 344-364.

Ong, P., M. and D. Miller. (2005). Spatial and Transportation Mismatch in Los Angeles. *Journal of Planning Education and Research* 25(1): 43–56.

Pan, Q. (2013). The impacts of an urban light rail system on residential property values: A case study of the Houston METRORail Transit Line. *Transportation Planning and Technology* 36(2): 145-169.

Pendell, R. Foster, K. Cowell, M. (2010) Resilience and Regions: Building Understanding of the Metaphor.*Cambridge Journal of Regions, Economy, and Society*,3 (1): 71-84.

Perk, Victoria A., and Martin Catala (2009). Land use impacts of bus rapid transit: effects of BRT station proximity on property values along the Pittsburgh Martin Luther King, Jr. East Busway. *East Busway. Federal Transit Administration, Washington, DC http://www. nbrti. org/docs/pdf/Property% 20Value% 20Impacts% 20of% 20BRT_NBRTI. pdf* (2009).

Petheram, Susan J., Arthur C. Nelson, Matt Miller and Reid Ewing (2013). Use of the Real Estate Market to Establish Light Rail Station Catchment Areas: Case Study of Attached Residential Property Values in Salt Lake County, Utah, by Light Rail Station Distance. *Transportation Research Record* 2357: 95-99.

Polzin, Steven E. (1999). Transportation/land-use relationship: Public transit's impact on land use." *Journal of urban planning and development* 125(4): 135-151.

Polzin, Steven E., and Michael R. Baltes (2002). Bus Rapid Transit: A Viable Alternative? *Journal of Public Transportation*, 5(2): 47–69.
Puga, Diego. (2010). The Magnitude and Causes of Agglomeration Economies, Journal of Regional Science, 50(1): 203-219.

Putnam, Robert (2001). *Bowling Alone*. New York: Simon and Schuster.

Redding, Stephen J. and Matthew A. Turner (2014). *Transportation Costs and the Spatial Organization of Economic Activity*. National Bureau of Economic Research Work Paper 20235. Cambridge, MA: National Bureau of Economic Research.

Reichenberger, Adam (2012). A comparison of 25 years of consumer expenditures by homeowners and renters. *Beyond the Numbers* 1(15): 1-8
Renkow, Mitch and Dale Hoover (2000). "Commuting, Migration, and Rural-Urban Population Dynamics." *Journal of Regional Science* 40 (2): 261-287.

Rodríguez, Daniel A., and Felipe Targa (2004). Value of accessibility to Bogota's bus rapid transit system." *Transport Reviews* 24(5)): 587-610.

Rodríguez, Daniel A., and Carlos H. Mojica (2009). Capitalization of BRT network expansions effects into prices of non-expansion areas. *Transportation Research Part A: Policy and Practice* 43, no. 5 (2009): 560-571.

Rodríguez, D. A. and Mojica, C. H. (2009). Capitalization of BRT network expansions effects into prices of non-expansion areas, *Transportation Research Part A* 43: 560-571.

Ryan, Sherry. (1999). Property Values and transportation facilities: Finding the transportation-land use connection. *Journal of Planning Literature* 13(4): 412-427.

Sultana, S. (2002). Jobs/Housing Imbalance and Commuting Time in the Atlanta Metropolitan Area: Exploration of Causes of Longer Commuting Time. *Urban Geography* 23(8): 728-749.

Sanchez, Thomas W., Qing Shen, and Zhong-Ren Peng (2004). Transit mobility, jobs access and low-income labour participation in US metropolitan areas. *Urban Studies* 41(7): 1313-1331.

Sanchez, Thomas W. (2008) Poverty, policy, and public transportation." *Transportation Research Part A: Policy and Practice* 42(5): 833-841.

Sanchez, Thomas W. (1999). The connection between public transit and employment: the cases of Portland and Atlanta. *Journal of the American Planning Association* 65, no. 3 (1999): 284-296.

Sanchez, T. W. and M. Brenman (2008). *A Right to Transportation: Moving to Equity*. Chicago, IL: American Planning Association.

Sen, Ashish, Paul Metaxatos, Siim Sööt, and Vonu Thakuriah (1999). Welfare reform and spatial matching between clients and jobs. *Papers in Regional Science* 78(2): 195-211.

Sheltair Group (2003). *Climate Change Impacts and Adaptation Strategies for Urban Systems in Greater Vancouver*, Volume 1. Vancouver, BC: The Sheltair Group.

Southern California Association of Governments (2001). *The New Economy and Jobs-Housing Balance in Southern California.* Los Angeles, CA: Southern California Association of Governments.

Spectorsky, August (1955). The Exurbanites. Philadelphia, PA: Lippincott.

Stoker, Philip, and Reid Ewing (2014) Job–Worker Balance and Income Match in the United States. *Housing Policy Debate* 24(2): 485-497.

Tann, H. M., and D. Hinebaugh (2009). *Characteristics of Bus Rapid Transit for Decision-Making*. Washington, D.C.: Federal Transit Administration, U.S. Department of Transportation.

Thakuriah, Piyushimita, and Paul Metaxatos (2000). Effect of residential location and access to transportation on employment opportunities. *Transportation Research Record: Journal of the Transportation Research Board* 1726: 24-32.

Thole, Cheryl and Joseph Samus (2009). *Bus Rapid Transit and Development*. Report No: FTA-FL-26-7109.2009.5. Tampa, FL: University of South Florida, Center for Urban Transportation Research. National Bus Rapid Transit Institute and Federal Transit Administration.

Thole, C., A. Cain, and J. Flynn (2009). *The EMX Franklin Corridor BRT project evaluation*. Washington, D.C.: Federal Transit Administration, U.S. Department of Transportation.

Urban Land Institute (2011). *Developing the Next Frontier: Capitalizing on Bus Rapid Transit to Build Community*. Seattle, Washington: Urban Land Institute. pp 1-34.

United States Department of Housing and Urban Development (2015). Location Affordability Portal: Location Affordability Index.
http://www.locationaffordability.info/lai.aspx?url=user_guide.php

United States Government Accountability Office (2012). *Bus Rapid Transit: Projects Improve Transit Service and Can Contribute to Economic Development.* GAO-12-811. United States Government Accountability Office. (2012).

Valley Metro (2013). *Light rail economic development highlights*. Phoenix, AZ: Valley Metro.

Venables, A. (2007). Evaluating urban transport improvements: cost-benefit analysis in the presence of agglomeration and income taxation. *Journal of Transport Economics and Policy* 41(2), 173-188.

Voith, R. (1993). Changing Capitalization of CBD-Oriented Transportation Systems: Evidence from Philadelphia. *Journal of Urban Economics* 33 (3): 361-376.

Voith, Richard. (1998). Parking, Transit, and Employment in a Central Business District, *Journal of Urban Economics* 44(1): 43-48.

Vuchic, Vukan R., Richard M. Stanger and Eric C. Bruun (2012). “Bus Rapid Versus Light Rail Transit: Service Quality, Economic, Environmental and Planning Aspects”. In Zhang, Ming. ed (2012). Bus versus Rail: Implications for Transit-Oriented Development, pp. 1854-1889, In *Encyclopedia of Sustainability Science and Technology*. E. Meyers and A. Robert (eds). 1889-1908 New York: Springer. http://dx.doi.org/10.1007/978-1-4419-0851-3_327

Walker, B. Salt, D. (2006). Resilience Thinking: Sustaining Ecosystems and People in a Changing World. Island Press, New York.

Wardekker, J., A. de Jong, J. Knoop, J. van der Sluijs (2009). Operationalising a resilience approach to adapting an urban delta to uncertain climate changes. *Technological Forecasting and Social Change*, 77: 987-998.

Weinstein, B. L., & Clower, T. L. (2002). *An Assessment of the DART Light Rail Transit on Taxable Property Valuations and Transit-Oriented Development.* Center for Economic Development and Research. University of North Texas.

Weisbrod, G., and A. Reno (2009). *Economic impact of public transportation investment. American Public Transportation Association* Accessed December 5, 2015 from www.apta.com/resources/reportsandpublications/Documents/economic_impact_of_public_transportation_investment.pdf.

Weinstock, Annie, Walter Hook, Michael Replogle, and Ramon Cruz (2011). Recapturing global leadership in bus rapid transit. *Transportation Research Record: Journal of the Transportation Research Board* 165455: 7-17.

Wilkinson, C., Porter, L., Colding, J. (2010). Metropolitan Planning and Resilience Thinking: A Practitioner's Perspective. Critical Planning (Summer).

Wilkinson, K. N.D. TEDx Talk: The paradox of urban resilience. Accessed September 2011 at http://www.stockholmresilience.org/research/researchnews/theparadoxofurbanresilience.5.587b3d0a1 325af354a580007762.html

Zheng, J., N. W. Garrick, et al. (2010). Quantifying the Economic Domain of Transportation Sustainability. Washington, DC: Transportation Research Board.

APPENDIX A
TRANSIT SYSTEMS INCLUDED IN THE STUDY

In this appendix we review the general features of each kind of transit system mode studied and provide an overview of each individual transit system along with a route map.

Light Rail Transit Systems
Wikipedia offers a succinct characterization of light rail transit including definitions of key transportation organizations that we paraphrase extensively here:[11]

> The term *light rail* was coined in 1972 by the former U.S. Urban Mass Transportation Administration and now the Federal Transit Authority to describe new streetcar transformations that were taking place in Europe and the United States. *Light* means "intended for light loads and fast movement" rather than referring to physical weight. The infrastructure investment is also usually lighter than would be found for a heavy rail system.[12]

The Transportation Research Board defined "light rail" in 1977 as "a mode of urban transportation utilizing predominantly reserved but not necessarily grade-separated rights-of-way. Electrically propelled rail vehicles operate singly or in trains. LRT provides a wide range of passenger capabilities and performance characteristics at moderate costs."
The American Public Transportation Association (APTA), in its Glossary of Transit Terminology, defines light rail as: [13]

> ...a mode of transit service (also called streetcar, tramway, or trolley) operating passenger rail cars singly (or in short, usually two-car or three-car, trains) on fixed rails in right-of-way that is often separated from other traffic for part or much of the way. Light rail vehicles are typically driven electrically with power being drawn from an overhead electric line via a trolley [pole] or a pantograph; driven by an operator on board the vehicle; and may have either high platform loading or low level boarding using steps.

We evaluate 11 light rail transit systems constructed between 1981 and 2008 in the U.S. They include nearly all light rail systems built since 1980 outside of the Boston, Chicago, Los Angeles, New York and San Francisco metropolitan areas. As our study design aims to detect development effects associated substantially with light rail, we excluded those metropolitan areas because of their large networks of integrated transit systems. We also excluded the Seattle-Tacoma system which started with the 1.6 mile Tacoma Link in 2003 serving just downtown Tacoma and then the Central Link which opened in 2009 connecting downtown Seattle to the SeaTac airport. There is simply not enough data during our study period to reasonably assess

[11] See http://en.wikipedia.org/wiki/Light_rail.
[12] Gregory L. Thompson (2003), *Defining an Alternative Future: Birth of the Light Rail Movement in North America*, Transportation Research Board, http://trb.org/publications/circulars/ec058/03_01_Thompson.pdf
[13] *Fact Book Glossary - Mode of Service Definitions*. American Public Transportation Association. 2013. Retrieved 2013-11-12.

effects of this light rail system. The systems we evaluated include the following (along with the year services commenced):

Charlotte (2007)
Dallas (1996)
Denver (1994)
Houston (2004)
Phoenix (2008)
Portland (1986)
Sacramento (1987)
Salt Lake City (1999)
San Diego (1981)
Twin Cities (2004)

Key features of each system are provided in the following pages along with a route map.

Charlotte—Lynx Rapid Transit Services

LYNX Rapid Transit Services extends across 9.6-miles of light rail track and is operated by the Charlotte Area Transit System (CATS). The system was launched on November 24, 2007 and consists of 15 stations. Ridership averaged more than 16,000 passengers daily in 2014. The route map as of 2014 is illustrated in Figure A.1.

Figure A.1
LYNX light rail route map
Source: http://charmeck.org/city/charlotte/cats/lynx/Pages/default.aspx

DART—Dallas Metropolitan Area

The Dallas Area Rapid Transit (DART) light rail system consists of more than 90 miles of track along four lines: Red (opened 1996 and completed in 2002), Blue (opened in 1996 with completion in 2018), Green (opened in 2009 and completed in 2010) and Orange (opened in 2012 and completed 2014). Ridership was nearly 110,000 boardings daily in 2012. The route map is shown in Figure A.2.

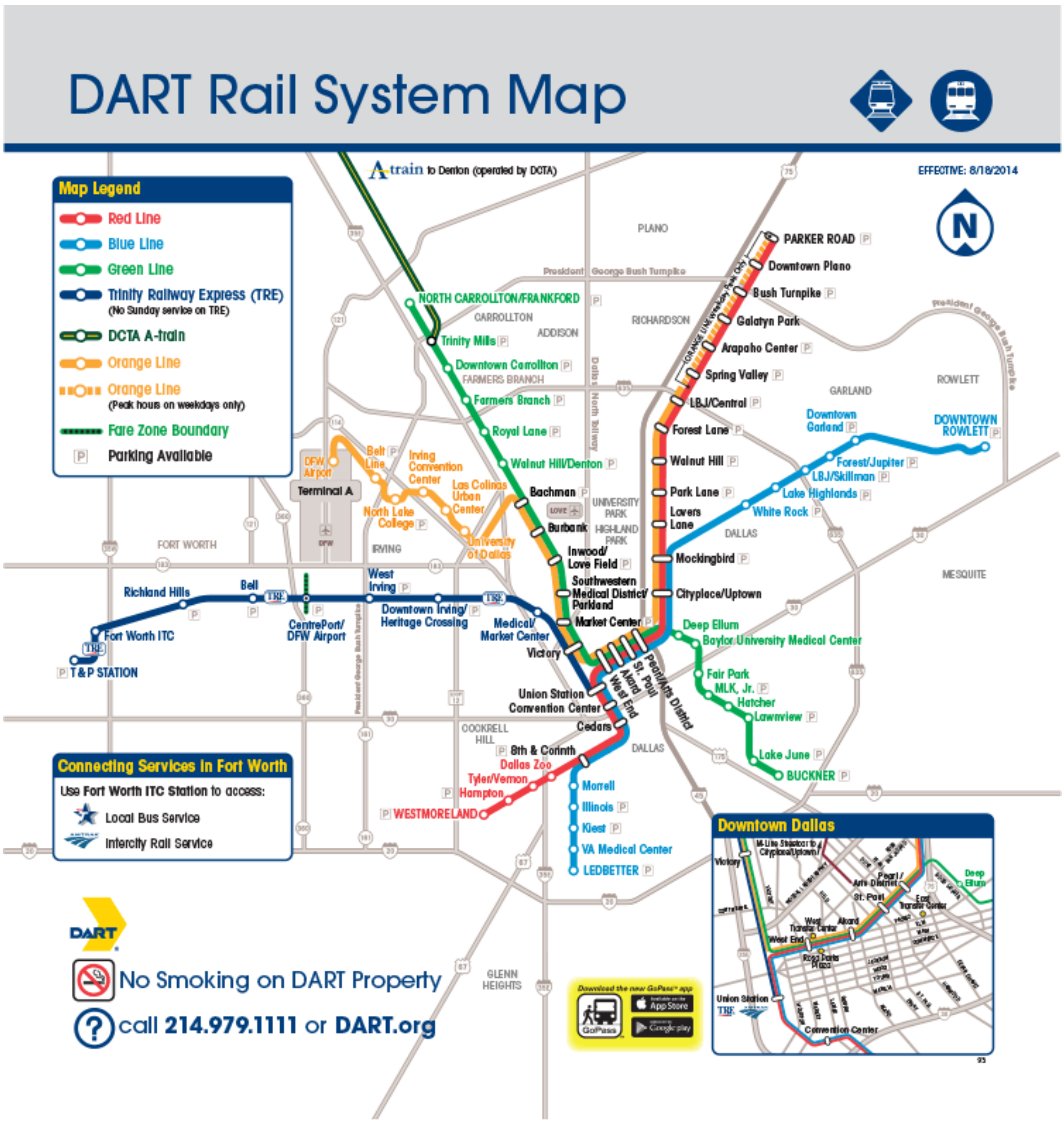

Figure A.2
DART light rail route map
Source: https://www.dart.org/maps/gifmaps/dartrailmapaug2014large.gif

Denver—Regional Transit District

In 1994, the RTD launched its first light rail line which extended 5.3 miles. It has since added five more lines. As of April 2013, the system ran of 47 miles of track serving about 90,000 riders daily. Figure A.3 shows the route map as of 2014.

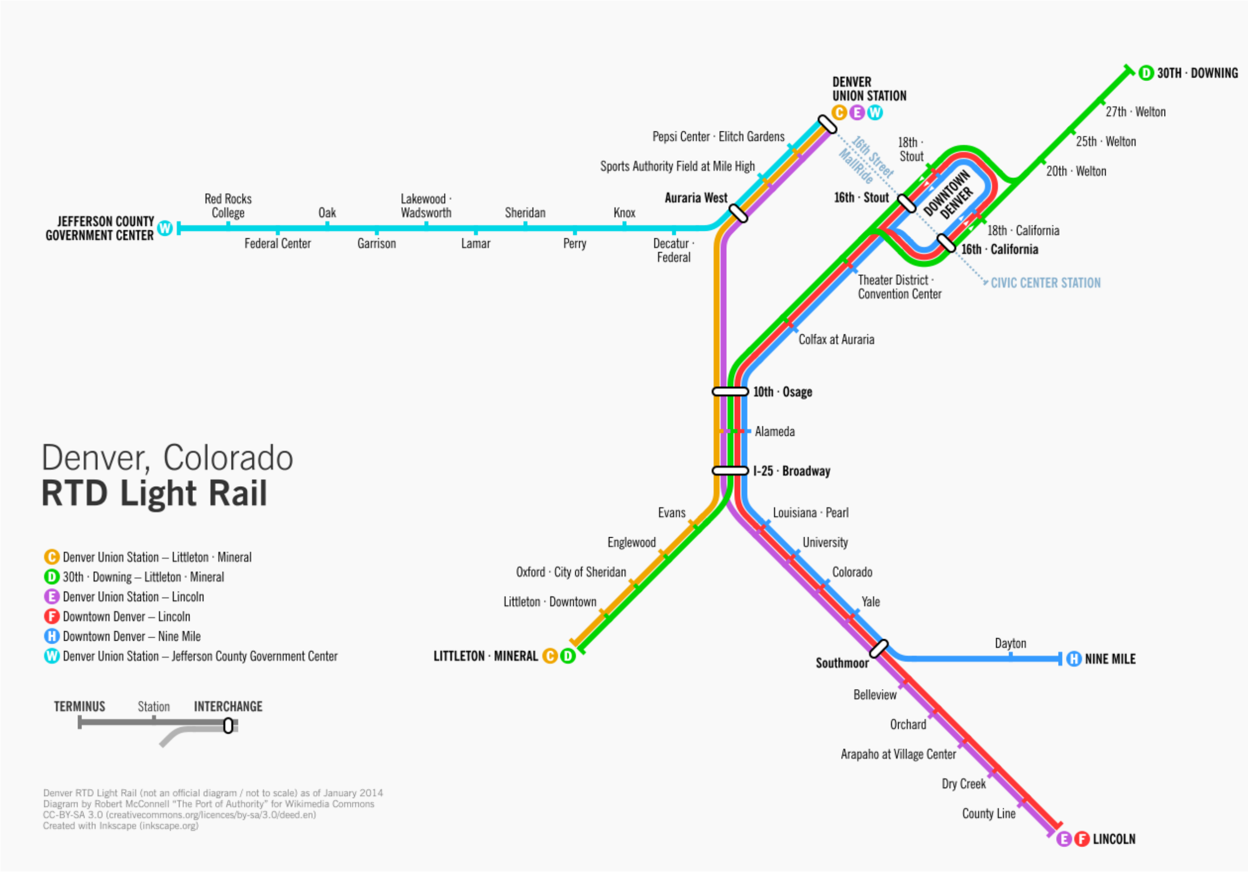

Figure A.3
Metropolitan Denver RTD light rail route map
Source:
http://en.wikipedia.org/wiki/RTD_Bus_%26_Light_Rail#mediaviewer/File:Denver_RTD_Light_Rail_Diagram.svg

Houston—METRORail
Houston's light rail system, METRORail, was inaugurated in 2004. By 2014 it operated on 12.8-mile of track and averaged about 10,000 passengers daily. Figure A.4 shows the route map.

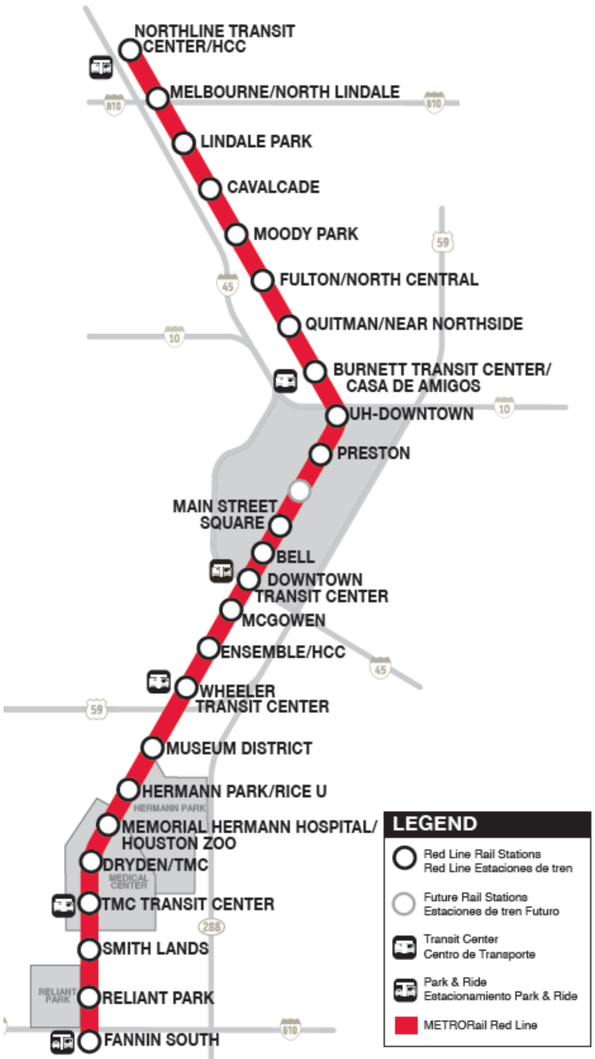

Figure A.4
Houston METRORail route map
Source: http://www.ridemetro.org/SchedulesMaps/Images/redline-map.png

Phoenix—METRO

The Phoenix METRO light rail system began operations on December 27, 2008 (which means for analytic purposes we use 2009 as the start year). It extends 20 moles from Mesa to uptown Phoenix. Daily ridership approached 50,000 passengers. The route map is shown in Figure A.5.

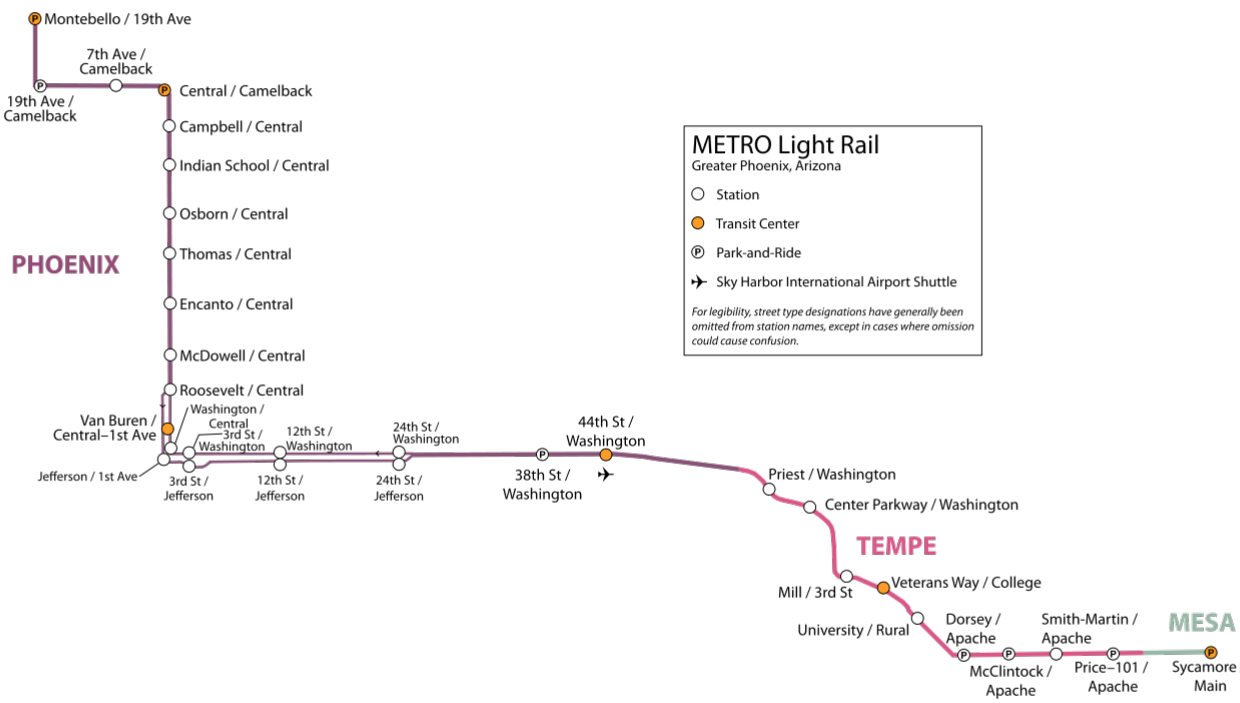

Figure A.5
Phoenix light rail system route map
Source:
http://upload.wikimedia.org/wikipedia/commons/thumb/f/f0/METRO_Light_Rail_%28Phoenix%29.svg/1247px-METRO_Light_Rail_%28Phoenix%29.svg.png

Portland—MAX

Metropolitan Portland, Oregon's Metropolitan Area Express or MAX, is a light rail system that includes four lines that operate on 54.2 miles of track. It is comprised of 87 stations with average daily ridership exceeding 130,000 passengers. Service began in 1986. The route map is shown in Figure A.6.

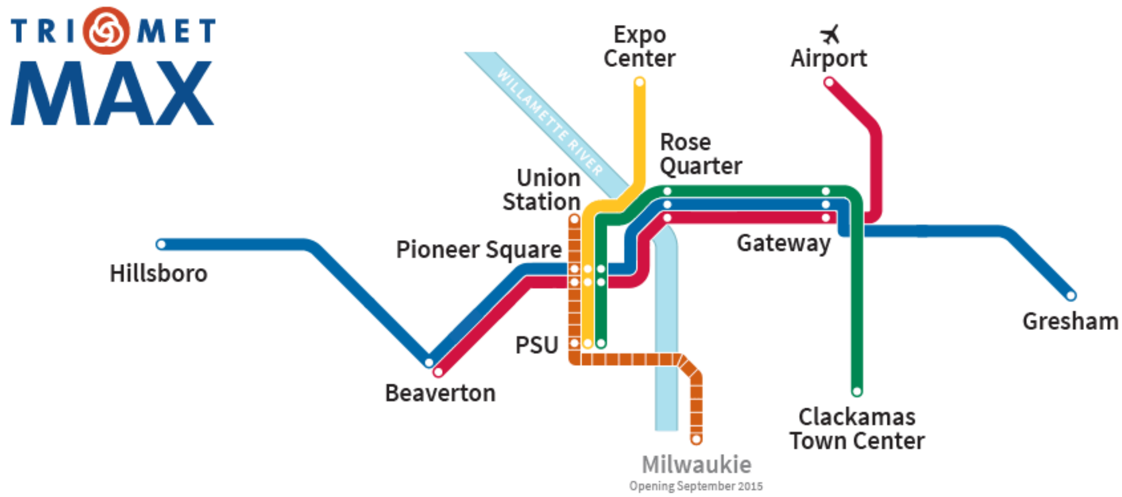

Figure A.6
Portland light rail system route map
Source: http://trimet.org/max/

Sacramento—SCRT

The Sacramento RT Light Rail system (SCRT) was initiated in 1987 and now includes 48 stations serving 38.6 miles of track along three lines. Ridership is about 50,000 passengers per day. Figure A.7 shows the route map.

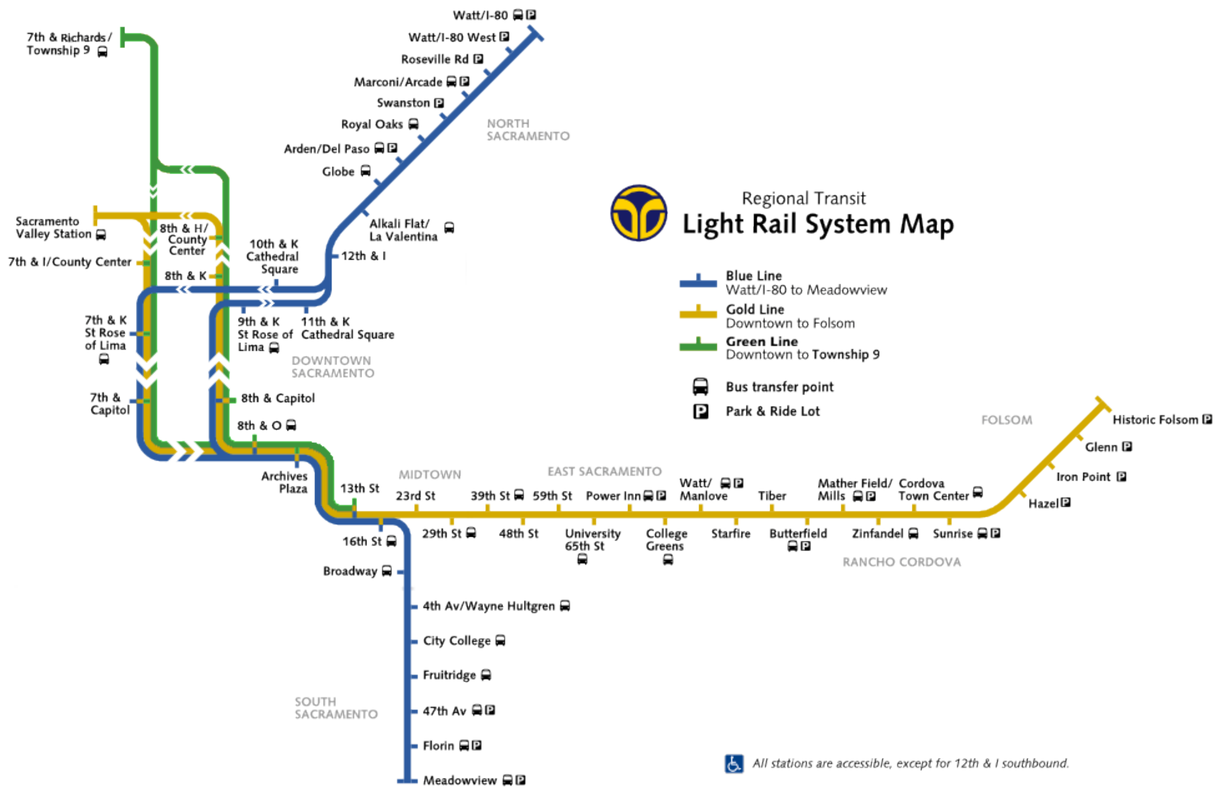

Figure A.7
Sacramento light rail system route map
Source:
http://upload.wikimedia.org/wikipedia/commons/7/74/Sacramento_RT_light_rail_map.png

Salt Lake City—TRAX

The Transit Express or TRAX light rail system serves the Salt Lake City metropolitan area. It began operations in 1999 and now includes 44.8 miles of track serving 50 stations. Daily ridership is about 70,000 passengers. The route map is illustrated in Figure A.8.

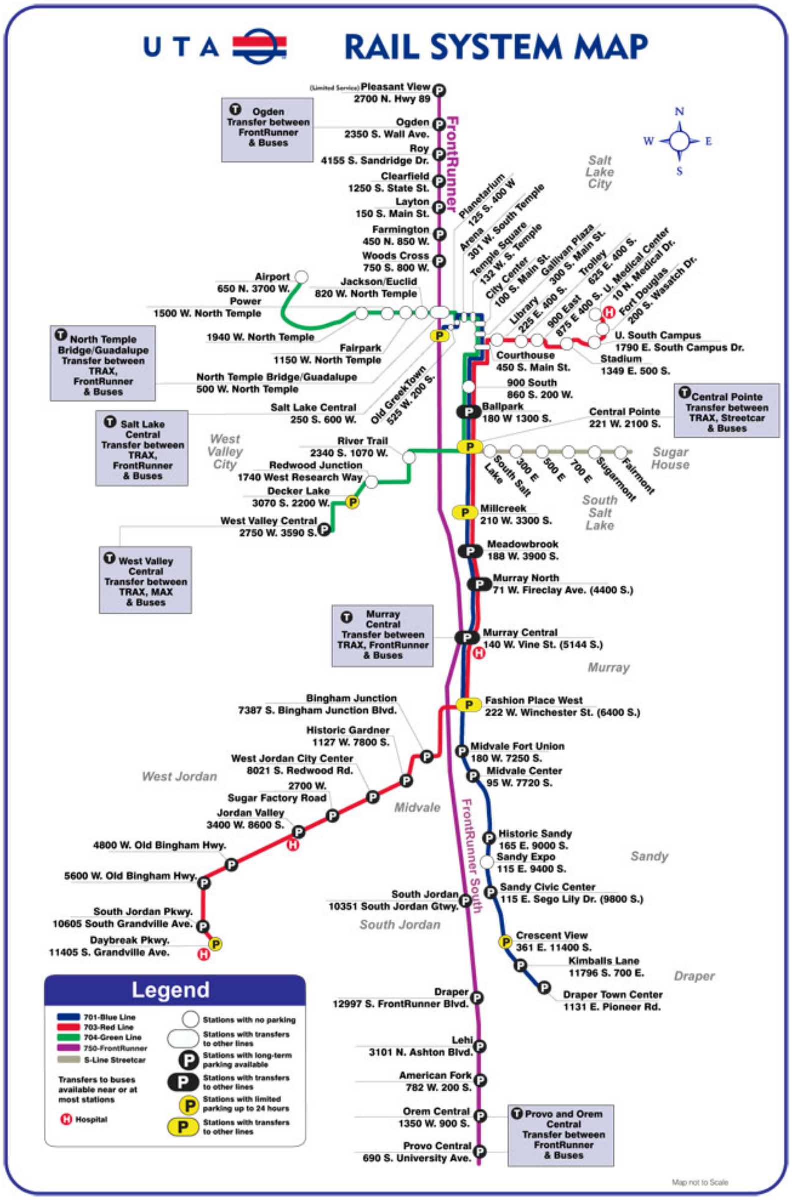

Figure A.8

Salt Lake City light rail system route map including commuter rail transit line

Source: http://www.rideuta.com/mc/?page=uta-home-trax

San Diego—Trolley

The San Diego Trolley began service on July 26, 1981, making it the first of the modern generation of light rail systems in the U.S. The system serves 53 stations across 53.5 miles of track. Ridership exceeds 120,000 daily passengers. Its route is shown in Figure A.9.

Figure A.9

San Diego light rail route map

Source:

http://en.wikipedia.org/wiki/San_Diego_Trolley#mediaviewer/File:San_Diego_Trolley_diagram.svg

Twin Cities—METRO

The Minneapolis-St. Paul, Twin Cities, launched the Hiawatha light rail line in 2004. It runs 12milesfrom downtown to Bloomington in Hennepin County. A second line (the Green Line) opened in 2014 connecting downtown St. Paul with downtown Minneapolis. For our purposes, we evaluate the Hiawatha Line, which since 2014 is known as the Blue Line. Notably, less than two years after opening, the line exceeded its 2020 weekday ridership goal, serving about 30,000 passengers daily. The Hiawatha (Blue) Line route is shown in Figure A.10

Figure A.10

Twin Cities Hiawatha (Blue) Line route

Source:

http://www.metrotransit.org/Data/Sites/1/media/metro/blueline/metro_blueline_map_101614_web.png

Modern Streetcar Transit Systems

Streetcars are returning as a key transit mode in many metropolitan areas. From the late 19th into the middle 20th centuries, streetcars (also known as trollies) were a principal source of urban transportation. They were usually powered through overhead electrified lines. Because they were mostly privately owned and operated, many streetcar lines failed during the Great Depression. After World War II, automobiles supplanted streetcars as the preferred mode of urban transportation. By the 1970s, most streetcars remaining were tourist novelties. Streetcars have been resurgent in the 21st century.

The "modern" streetcar vehicles are in many ways similar to light rail vehicles.[14] For one thing, the track gauge is the same so they can operate in both systems. The primary differences between these two kinds of vehicles are the scale of the infrastructure and the degree of integration into the urban street network. While both operate downtown within the street network, LRT usually extends many miles away from downtowns into suburban areas. It can also accommodate many more cars than the streetcar. Only if downtown service does not require tight turns can longer LRT trains navigate downtown. In contrast, streetcars usually serve downtown or nearby areas and are usually limited to two cars to ease negotiation of tight turns.

Study Areas

Among these "modern" streetcar systems are the following (along with the year of service commencement):

Portland (2001)
Seattle (2007)
Tacoma (2003)
Tampa (2002)

Key features of each system are provided in the following pages along with a route map.

[14] Much of this paragraph is adapted from http://www.modernstreetcar.org/.

Portland Streetcar

The Portland Streetcar opened in 2001. Its initial 3.9 mile route includes Portland State University to the south, downtown, the large-scale redevelopment area called the Pearl District to the north, and the Northwest Portland district to the northwest. This is the area included in our study. Between 2012 and 2015, the system was expanded across the Willamette River creating a 3.3 mile loop lack to Portland State University via a new pedestrian/bike/streetcar bridge called Tilikum Crossing. The two-route system serves some 20,000 daily riders. Figure A.11 shows its routes.

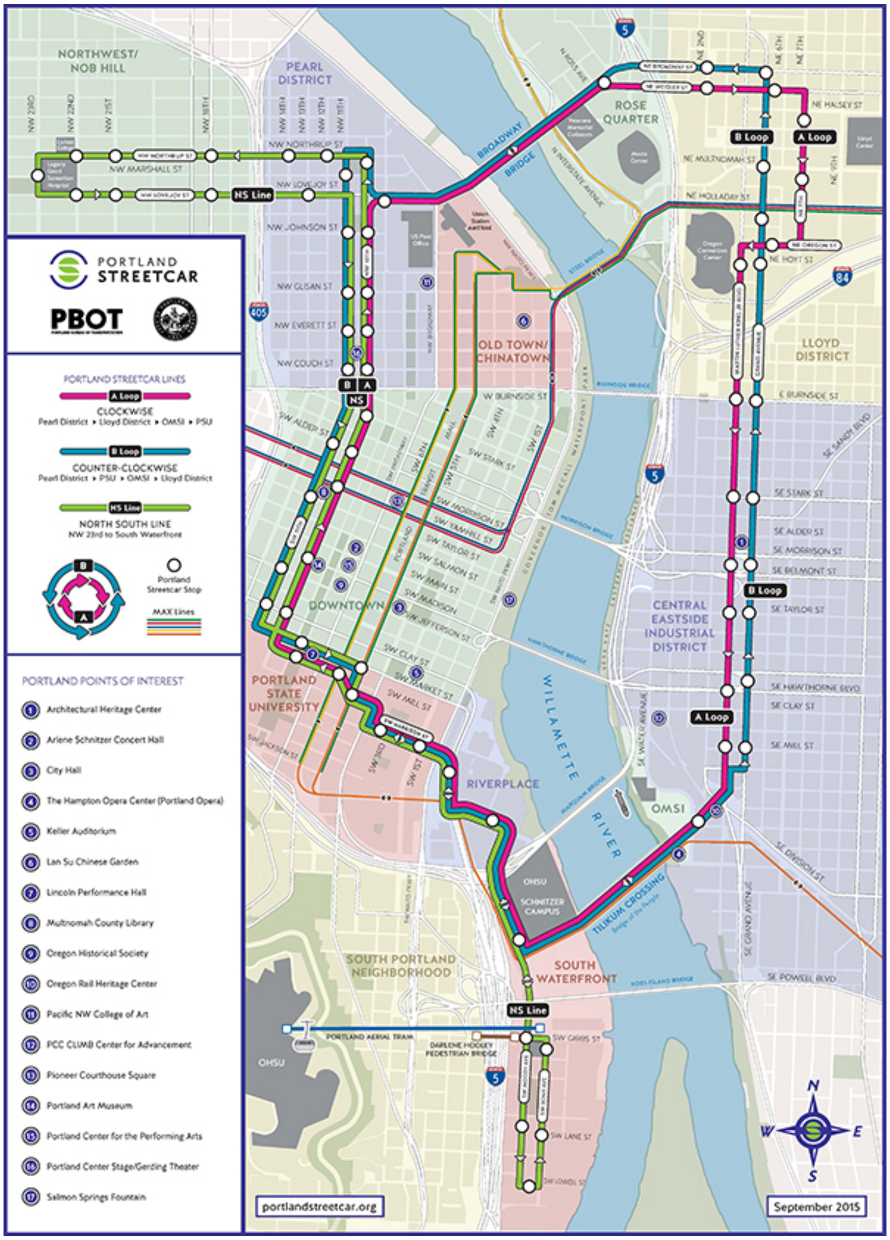

Figure A.11
Portland Streetcar map
http://www.portlandstreetcar.org/node/4

Seattle Streetcar
The Seattle Streetcar—South Lake Union Line extends just 1.3 miles (though the total two-way track is 2.6 miles) connecting the South Lake Union area to downtown (see Figure A.12). Service began in 2007. Although there are plans for an extensive streetcar network, this remains the only line.

Figure A.12
Seattle Streetcar—South Lake Union Line
http://www.railwaypreservation.com/vintagetrolley/SLU-Streetcar-Stops112007.gif

Tacoma Streetcar
Tacoma Link is a 1.6-mile streetcar located in Tacoma, Washington, that was completed in 2003. It connects the downtown core to the Tacoma Dome along with a combined parking garage and transit hub. The route serves downtown and the arts district as well. While we classify it as a streetcar, Sound Transit, which built and operates it, calls it a light rail system. While it may be *called* a light rail system, its limited, highly localized route, focus on connecting downtown to a sports stadium, and right street turns makes it *function* as a streetcar system for our analytic purposes. Figure A.13 illustrates its route.

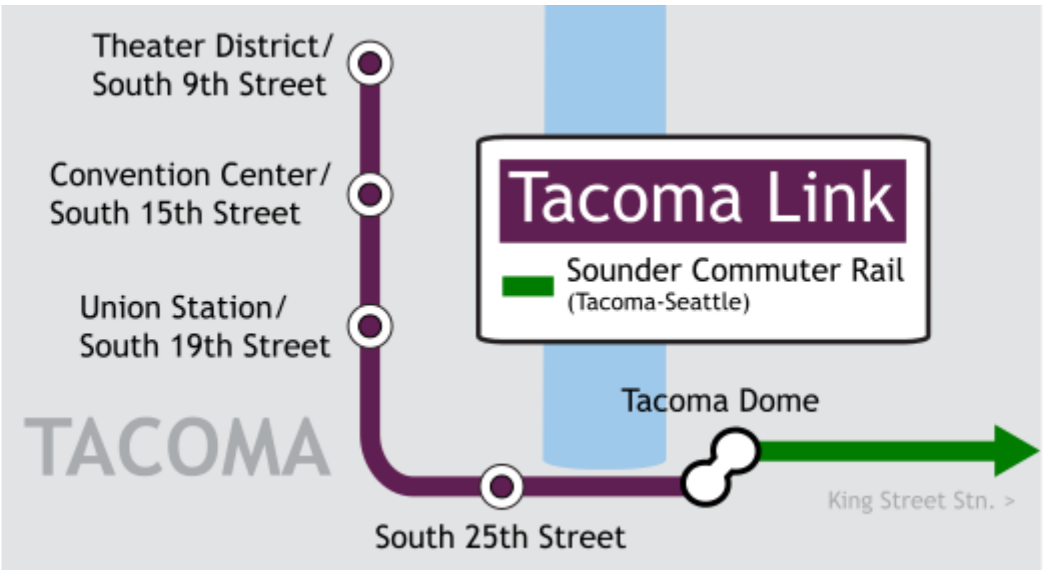

Figure A.13
Tacoma Link Route Map
Need citation

Tampa Streetcar

Tampa's TECO Line Streetcar System connects downtown and the Channelside area to the historic Ybor City district. There is also an "In-Town" trolley-replica bus system that connects downtown, Channelside, and Harbour Island. The line opened in 2002. In extends 2.7 miles and includes 11 stations. Figure A.14 shows its routes.

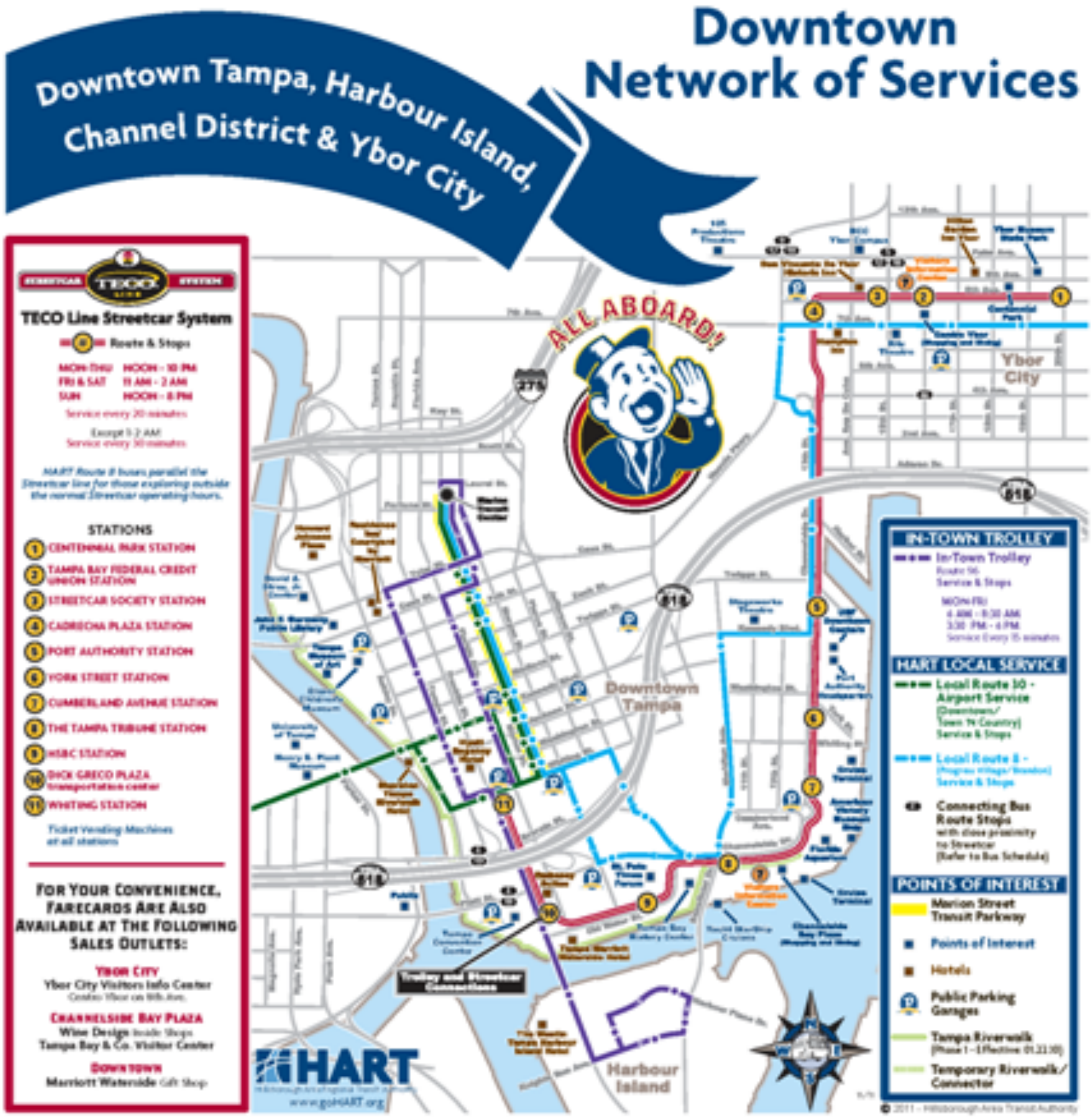

Figure A.14
Tampa TECO Streetcar (red line and orange stops)
http://www.tecolinestreetcar.org/about/maps/

Commuter Rail Transit Systems
There is scant empirical analysis of whether and the extent to which commuter rail transit is associated with economic development. Historically, commuter rail service connected distant suburbs with downtowns in the northeast and Great Lakes regions, serving mostly affluent business people working in downtowns. In recent years, commuter rail service has opened outside these older metropolitan areas. One implicit purpose of these systems is to generate economic development especially around commuter rail stations. In this paper we explore this connection for five commuter rail systems.

Commuter rail transit (CRT) is a form of rail passenger service connecting downtowns and other major activity centers with suburban commuter towns and beyond. CRT systems are passenger rail that occupies a niche between intercity rail and heavy rail metro systems. They serve lower-density suburbs by connecting them to downtowns, city centers, and other major activity centers. CRT systems usually have less frequent of service than heavy rail metro systems, often hourly, or just during peak commuting hours. Their service areas extend 10 to 100 miles from downtown, traveling at speeds from about 30 to more than 100 miles per hour. Due to these longer travel distances and travel times, they provide more seating options than light rail. They are typically not electrified, although portions may be. Although the use of tunnels is not unknown, they are typically not grade separated. They typically make use of existing railroad rights-of-way, and often share track with freight or intercity rail lines.

A number of privately-operated railroads have long provided commuter services. In *The Exurbanites*, August Spectorsky (1955) chronicled the lifestyles of families who lived in Bucks County, Pennsylvania but whose breadwinners commuted daily to work through New Jersey into midtown or downtown Manhattan via privately operated railroads. Amtrak now provides these longer-distance commuter services, notably between Boston and Washington, DC.

The nation's first public commuter rail service was launched in 1834. It was the Metropolitan Transit Authority's Long Island Rail Road connecting Long Island with Manhattan Island, New York. Nearly 70 years later, the nation's second public commuter rail service started (in 1903) connecting South Bend, Indiana with Chicago. It took nearly another 70 years (1973) before the nation's third public commuter rail service was launched, connecting Boston with its suburbs. Since 1983, another 22 public CRT systems have been initiated. Table 1 shows key features of all public systems in place as of 2013.

CRT is part of the family of fixed guide-way transit systems, which includes both rail and bus rapid transit. Unlike regular buses, streetcars, or mixed traffic light rail, CRT belongs which is formally 'rapid' transit, which has exclusive right of way. Rapid transit systems only stop at stations. This family includes metro (subway) systems, elevated systems, and other third-rail systems. While there is extensive literature on the economic development effects of other fixed guide-way transit modes, there is little research on the effects of CRT systems.

Aside from making it more convenient for middle and high income earners to work downtown while keeping their families in the suburbs, CRT systems play a significant role in urban economic development by mitigating the one of the dis-economies of urban aggregation, namely transportation congestion. Yet the existing literature provides no explicit assessment of the role of CRT stations in economic development.

We selected all five CRT systems that were in the South and West, not in one of the top 10 largest combined statistical areas, and having more than one million riders in 2013. They include for following systems (with their first year of operations):

Albuquerque-Santa Fe (2006)
Miami-South Florida (1984)
Salt Lake City (2008)
San Diego (1995)
Seattle (2000)

Key characteristics of each system are provided in the following pages along with route maps.

Rail Runner—Albuquerque-Santa Fe Metropolitan Areas
The Rail Runner runs along a 97 mile corridor from Santa Fe to Albuquerque and south to Belen (see Figure A.15). It began with 3 stations in 2006 and was expanded to 13 stations by 2013. It was developed as part of an ongoing project to connect Albuquerque with Santa Fe and relieve congestion along I-25, and almost more of a regional rail system than a commuter rail, requiring over two hours of travel from one end to the other. It makes use of existing freight rail right of way, and consists largely of single track with passing sidings.

Figure A. 15
Rail Runner System Map
http://riometro.org/maps/rail-runner-system-map

Tri-Rail—Miami-Ft. Lauderdale-Palm Beach Metropolitan Areas

This study examines Miami-Dade commuter rail system, Tri-Rail, a heavy rail rapid transit system. Opened in 1984, it had 70 miles of track along a freight rail corridor with 19 park and ride stations. The corridor was intended as congestion relief for the parallel I-95 corridor. It has gradually added several additional stations over the past few years. As a commuter rail system, its length is extensive as it connects multiple metropolitan areas running along the narrow strip of land between the Atlantic Ocean and Lake Okeechobee (see Figure A.16).

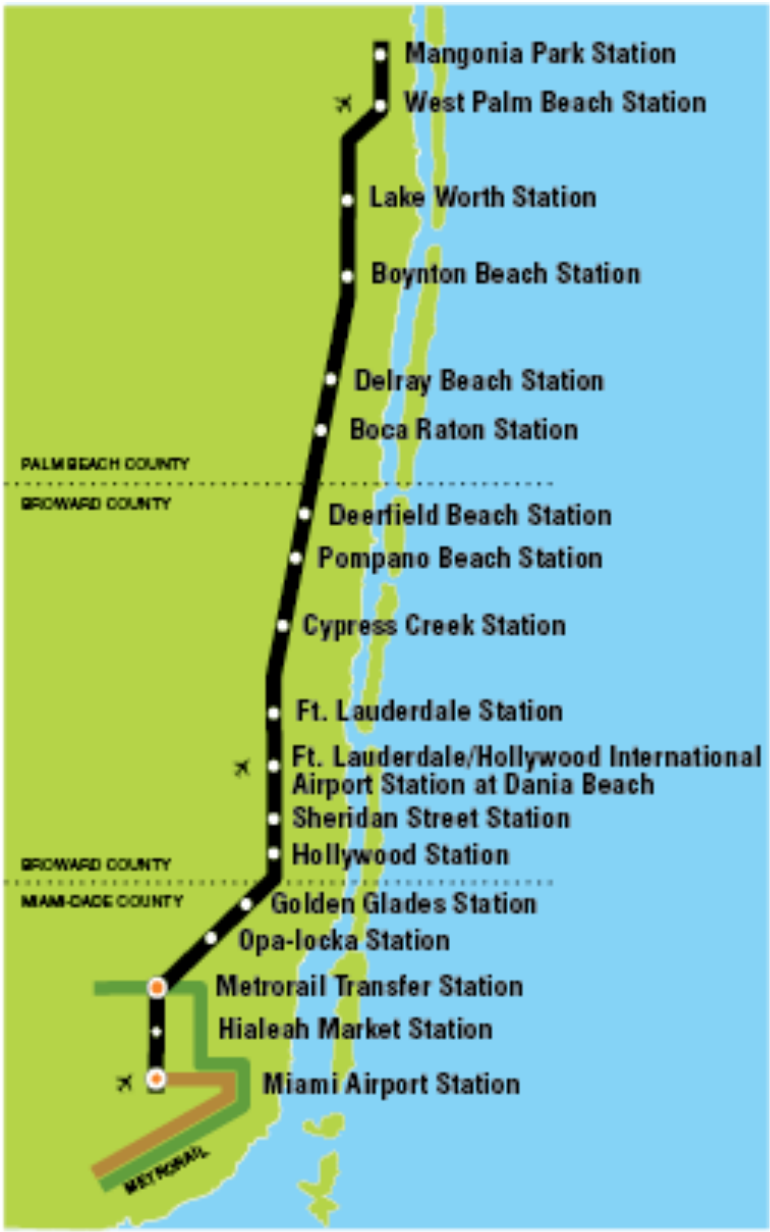

Figure A. 16
Tri-Rail System Map
http://www.tri-rail.com/images/250x400-map.png

FrontRunner—Salt Lake City-Provo Metropolitan Areas

The Utah Transit Authority's Front Runner commuter rail system started operations in 2008. It has since been extended to almost double its length. Only the initial segment between downtown Ogden and downtown Salt Lake City is used in our analysis. The study corridor has 8 stations along 42 miles of track. The corridor was intended as congestion relief for the parallel I-15 corridor. As seen in Figure A.17, the FrontRunner runs down the spine of two long, narrow metropolitan areas.

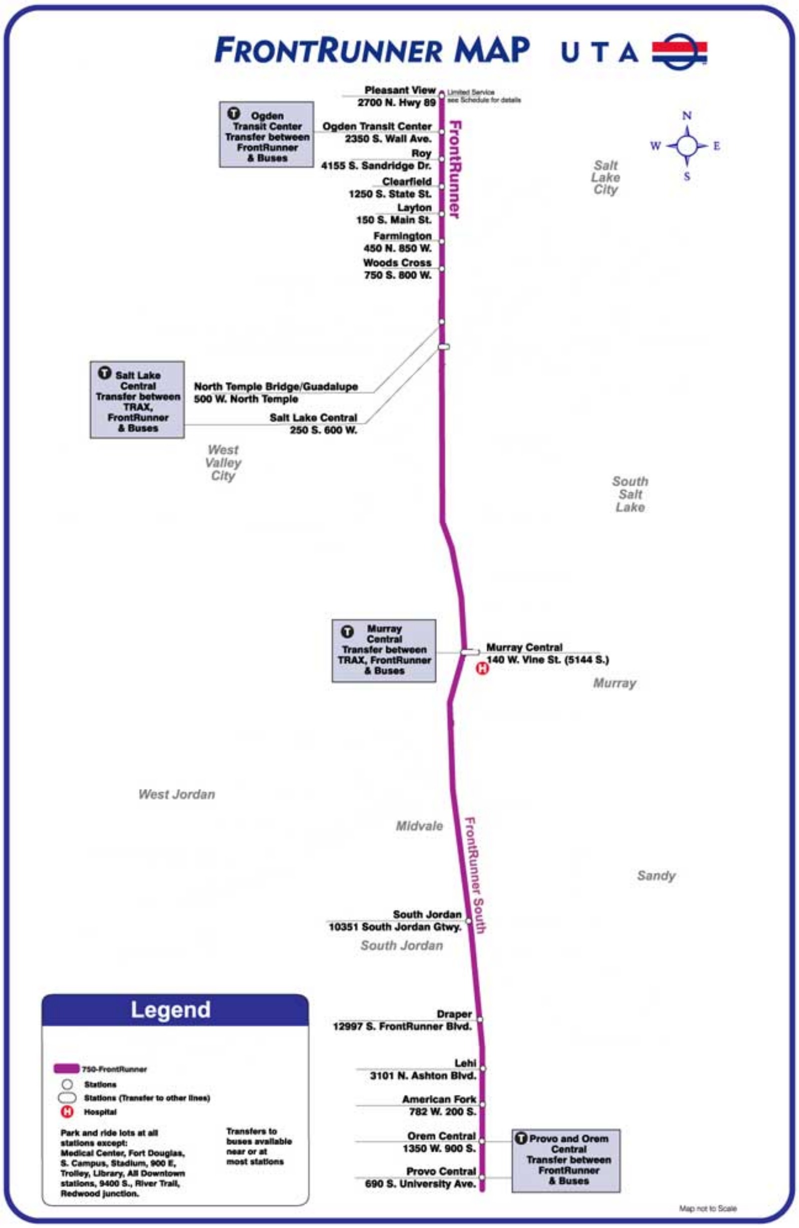

Figure A. 17
FrontRunner System Map
http://40.media.tumblr.com/7cc4cd6d5b4b3eddb8537361e056deed/tumblr_mlczfqedvs1r54c4oo2_1280.jpg

Coaster—San Diego Metropolitan Area

The Coaster is a commuter rail service that since 1995 provides service to the central and northern coastal regions of San Diego County, California. The service is operated by TransitAmerica Services through a contract with North County Transit District (NCTD). The Coaster has 8 stations along 41 miles of track. Its route is shown in Figure A.18.

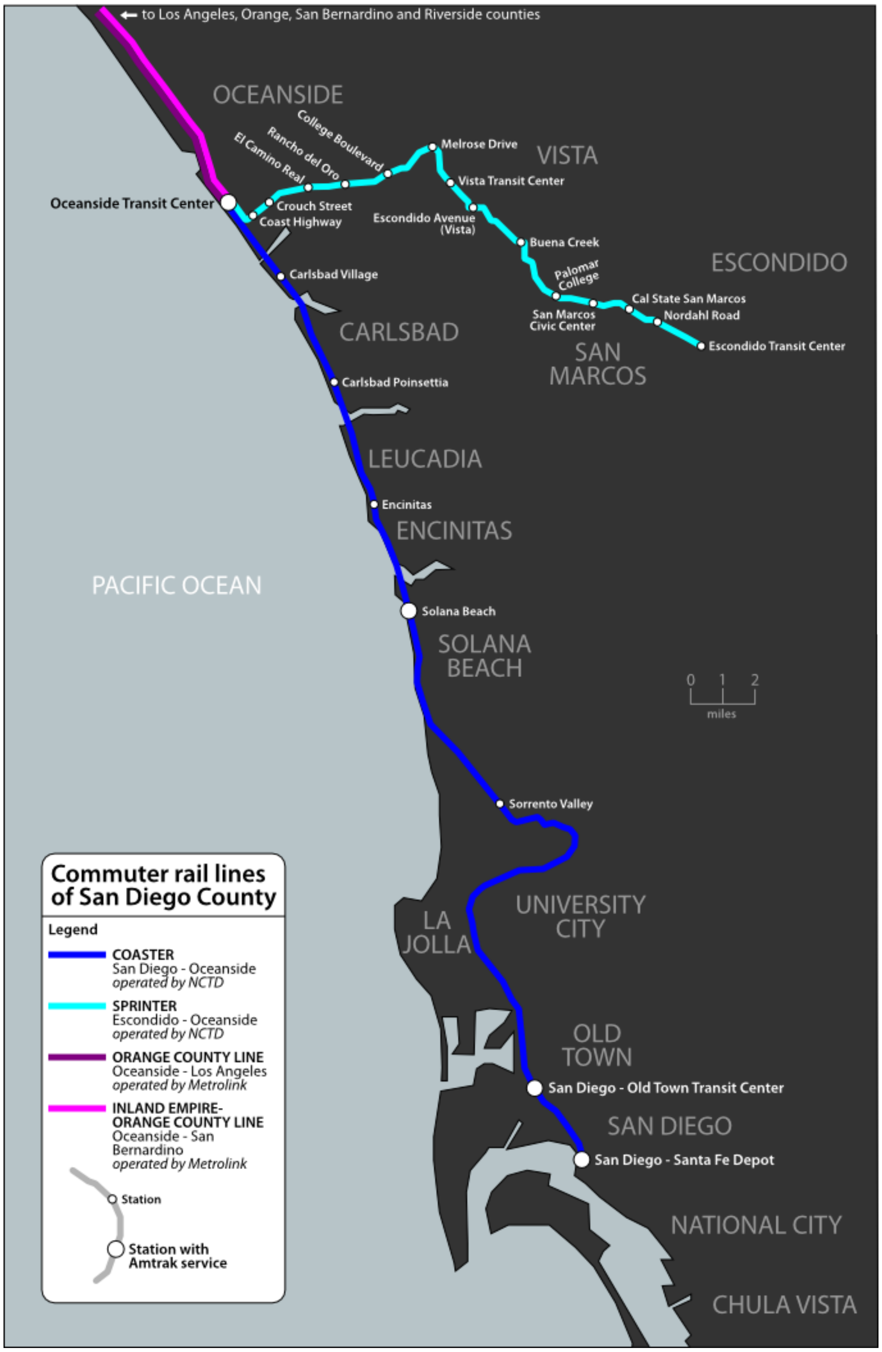

Figure A. 18
Coaster System Map
http://www.sandiegoasap.com/gfx/san-diego-commuter-rail-map.png

Sounder—Seattle Metropolitan Area

Sounder commuter rail is a regional rail service operated by the Burlington Northern-Santa Fe Railroad on behalf of Sound Transit serving the greater Seattle metropolitan area. Service began in 2000 and by 2013 it had 9 stations along 80 miles of track. The corridor was intended as congestion relief for the parallel I-5 corridor between Everett and Seattle. Its service area runs the narrow urbanized land area is between the Cascade Mountains and Puget Sound, as seen in Figure A.19.

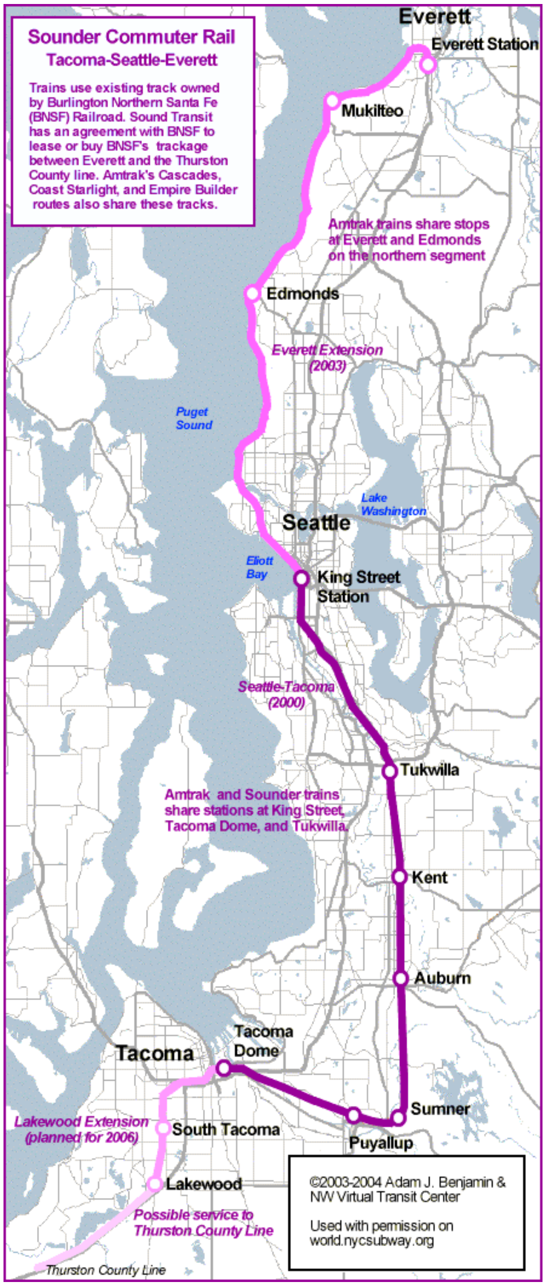

Figure A. 19
Sounder Route Map
http://nycsubway.org.s3.amazonaws.com/images/maps/soundermap.gif

Bus Rapid Transit Systems

Bus rapid transit (BRT) is the newest version of fixed guideway public transit. Unlike light rail transit, commuter rail transit and street car transit, BRT is wheel-based. "A true BRT system generally has specialized design, services and infrastructure to improve system quality and remove the typical causes of delay. Sometimes described as a "surface subway", BRT aims to combine the capacity and speed of light rail or metro with the flexibility, lower cost and simplicity of a bus system.

"To be considered BRT, buses should operate for a significant part of their journey within a fully dedicated right of way (busway) to avoid traffic congestion. In addition, a true BRT system will have most of the following elements:

- Alignment in the centre of the road (to avoid typical curb-side delays)
- Stations with off-board fare collection (to reduce boarding and alighting delay related to paying the driver)
- Station platforms level with the bus floor (to reduce boarding and alighting delay caused by steps)
- Bus priority at intersections (to avoid intersection signal delay)" [15]

We evaluate four bus rapid transit systems constructed between 2004 and 2009, all located in the western region of the US, including the following (along with the year operations commenced):

Eugene-Springfield (2007)
Las Vegas (2004)
Phoenix (2009)
Salt Lake City (2008)

A much more detailed report, National Study of BRT Outcomes (Nelson and Ganning 2015) provides more information about 19 BRT lines operating in 12 metropolitan areas across the US. Key features of each study area used for this study are described below. This is followed by tables that provide more detail than reported in the main report. The tables are organized by chapter and section.

[15] http://en.wikipedia.org/wiki/Bus_rapid_transit

Eugene-Springfield— EmX

The Emerald Express (EmX) is a bus rapid transit (BRT) system serving the Eugene-Springfield metropolitan area that is operated by the Lane Transit District. The first route (Franklin) opened in early 2007 and an extension (Gateway) was opened in early 2011. The route map as of 2014 is illustrated in Figure A.20.

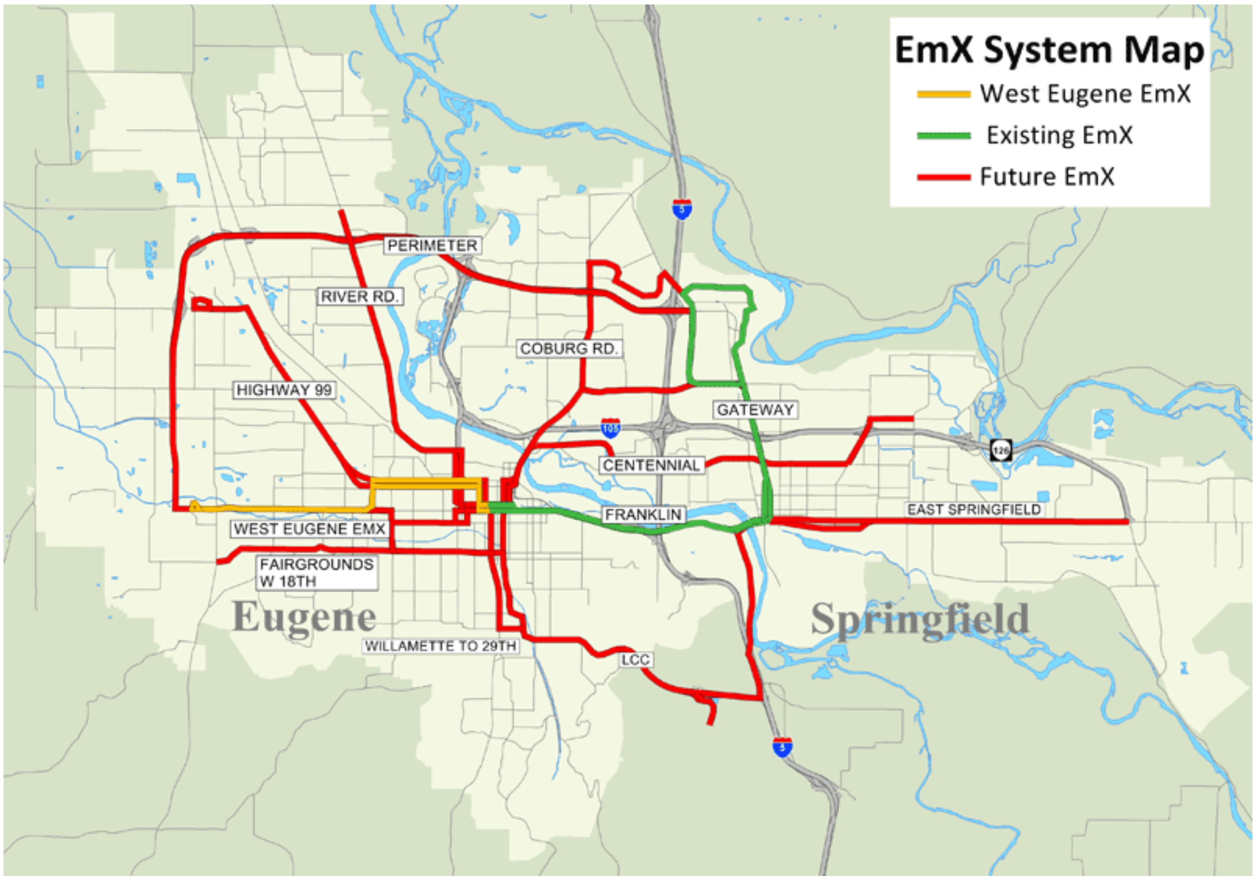

Figure A.20

EmX bus rapid transit route map

Source:

https://www.ltd.org/search/showresult.html?versionthread=033d2f811f5cf856f7be33ce7a4b4dc3

Las Vegas Metropolitan Area—MAX

The Metropolitan Area Express, or MAX, is owned by the Regional Transportation Commission of Southern Nevada and operated by Veolia Transportation. MAX launched operations on June 30, 2004. It currently provides service between downtown and North Las Vegas. The route map is shown in Figure A.21.

Figure A.21

MAX bus rapid transit route map

Source:

http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0CDAQFjAC&url=http%3A%2F%2Fwww.nbrti.org%2Fmedia%2Fevaluations%2FLas_vegas_final_report.pdf&ei=Fb2qVPzUCo60ogTj5YGIAw&usg=AFQjCNES-on-eliBu1XaGmjeLCp3tLPg9Q

Valley Metro (Phoenix) Transit—- RAPID

In 1994, the RTD launched its first light rail line which extended 5.3 miles. It has since added five more lines. As of April 2013, the system ran of 47 miles of track serving about 90,000 riders daily. Figure A.22 shows the route map as of 2014.

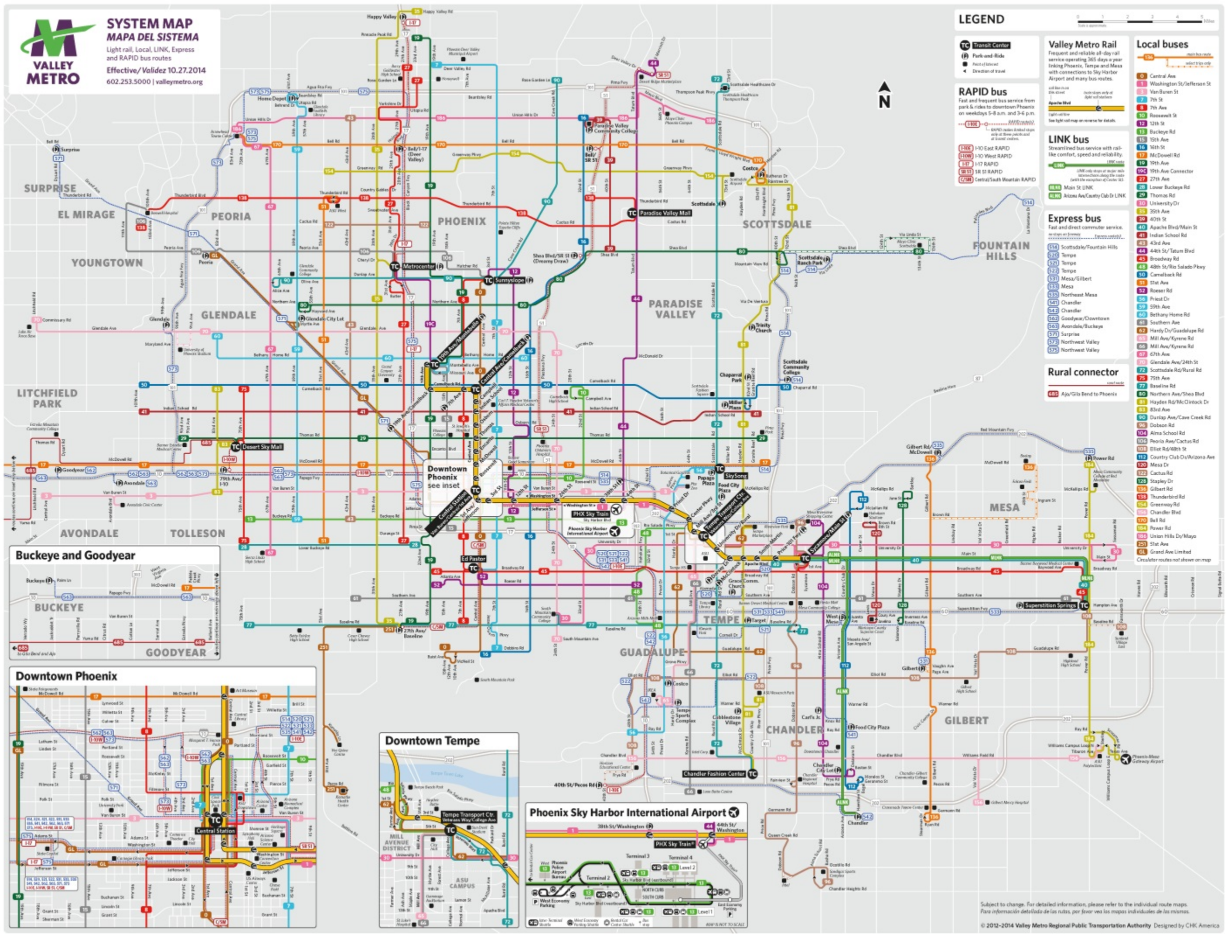

Figure A.22

Metropolitan Phoenix transit service map including bus rapid transit (in broad green color, lower right quadrant)

Source: http://www.valleymetro.org/planning_your_trip/system_map

Salt Lake City—MAX

The Utah Transit Authority operates the bus rapid transit service in Salt Lake County known as MAX. As of 2014 there is only one line in service are planned for Salt Lake and Utah counties. The route map is shown in the larger con text of other planned routes in Figure A.23.

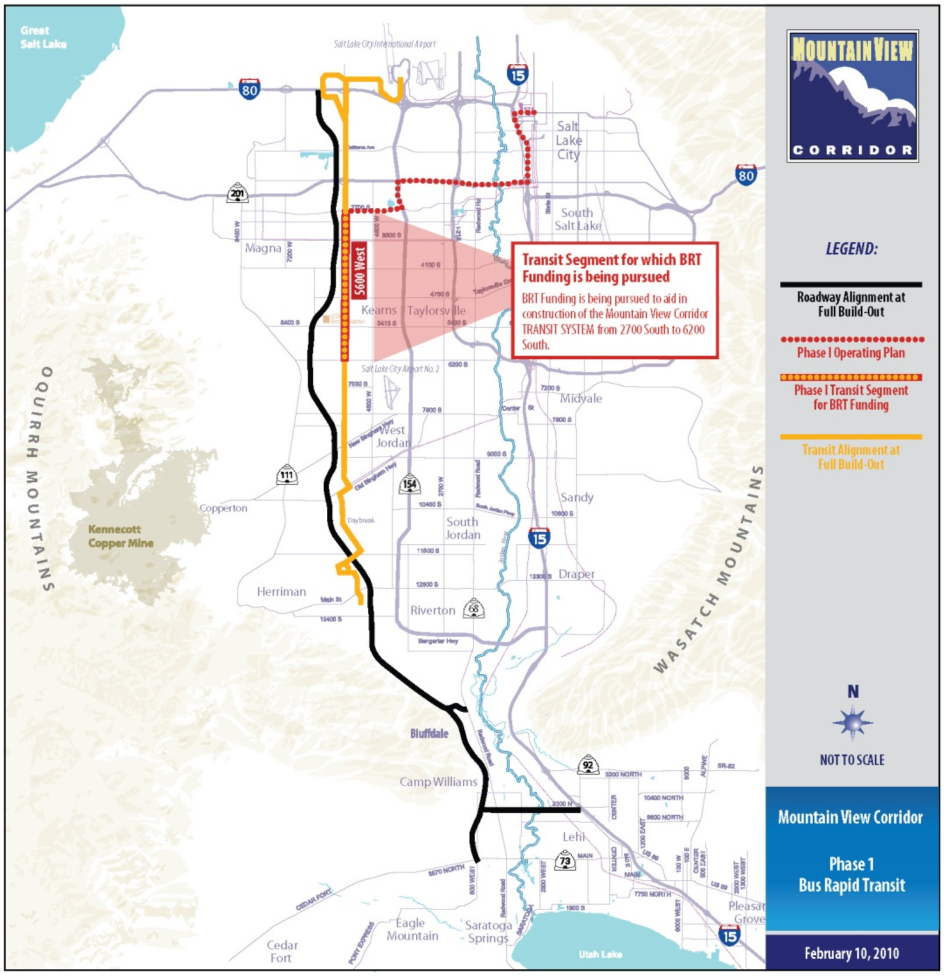

Figure A.23

Salt Lake City MAX route map (see "5600 West" route for current operations)

Source: http://www.rideuta.com/mc/?page=Projects-5600WestBRT

APPENDIX B
TRANSIT SYSTEM ECONOMIC ANALYSIS TABLES

This appendix presents detailed economic analysis tables for all transit systems used on this study. In review, those systems (and the year in which they commenced operations) include:

<u>Light Rail Transit Systems</u>
Charlotte (2007)
Dallas (1996)
Denver (1994)
Houston (2004)
Phoenix (2008)
Portland (1986)
Sacramento (1987)
Salt Lake City (1999)
San Diego (1981)
Twin Cities (2004)

<u>Streetcar Transit Systems</u>
Portland (2001)
Seattle (2007)
Tacoma (2003)
Tampa (2002)

<u>Commuter Rail Transit Systems</u>
Albuquerque-Santa Fe (2006)
Miami-South Florida (1984)
Salt Lake City (2008)
San Diego (1995)
Seattle (2000)

<u>Bus Rapid Transit Systems</u>
Eugene-Springfield (2007)
Las Vegas (2004)
Phoenix (2009)
Salt Lake City (2008)

Our separate report, National Study of BRT Outcomes (Nelson and Ganning 2015) published by NITC adds many more addresses bus rapid transit systems.

The tables are organized as follows:

1. Change in jobs by combined sector (see Chapter 1 for details) from the first year of system operation through 2011, the latest year for which data were available for analysis.

2. Change in location quotients (LQs) for combined economic sectors with respect to metropolitan employment from the first year of system operation through 2011.

3. Shift-Share results (see Chapter 1 for calculation details) for combined economic sectors with respect to metropolitan employment from the first year of system operation through 2011.

4. Shift-share results for combined economic sectors from 2002 (or 2004 in the case of Phoenix) to 2007—the baseline "Pre-Recession" period regardless of when the LRT system started, 2007-2009—the period of the Great Recession (which started in late 2007 and ended in the middle of 2009), and 2009-2011—Recovery.

Chapter 1, on economic development, combines the first three sets of tables to provide an overview of overall economic development trends with respect to these transit systems. Chapter 2, on economic resilience, combines the fourth set of tables to show the extent to which these systems may be resilient to economic shocks if not facilitate transformation of a metropolitan areas economy.

In all tables, figures in *italics* indicate Z-scores below the 0.05 level of significant using the two-tailed test. We find that nearly all TOD area-based changes over time are significantly different.

Charlotte—Lynx Rapid Transit Services

Table B.1
Charlotte LRT Change in Jobs by Combined Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	2,280	981	(1,299)	-57%
Non Man Ind.	*2,475*	*2,503*	*28*	*1%*
Retail/Lodging	6,703	8,665	1,962	29%
Office	19,040	21,923	2,883	15%
Knowledge	8,001	7,977	(24)	-0%
Education	3,564	1,760	(1,804)	-51%
Health	1,851	4,255	2,404	130%
Entertainment	804	1,932	1,128	140%
Total	44,718	49,996	5,278	12%

Table B.2
Charlotte LRT Change in Location Quotients by Combined Economic Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	0.34	0.22	-0.12	-35%
Non Man Ind.	0.42	0.45	0.03	7%
Retail/Lodging	0.79	0.86	0.07	9%
Office	1.81	1.63	-0.18	-10%
Knowledge	1.87	1.67	-0.20	-11%
Education	0.06	0.44	0.38	694%
Health	0.51	0.66	0.15	30%
Entertainment	1.26	1.70	0.44	34%

Table B.3
Shift-Share Results for Charlotte LRT, 2007-2011

Sector	2007 LRT	2011 LRT	2007 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,798	981	180,458	143,562	1,727	(296)	(449)
Non Man Ind.	2,237	2,503	181,314	178,656	2,148	56	299
Retail/Lodging	7,794	8,665	333,296	321,940	7,485	43	1,137
Office	21,886	21,923	411,028	431,758	21,020	1,970	(1,067)
Knowledge	7,738	7,977	140,586	153,290	7,432	1,006	(460)
Education	132	1,760	81,160	128,776	127	83	1,551
Health	2,723	4,255	182,006	206,770	2,615	478	1,162
Entertainment	1,041	1,932	27,948	36,428	1,000	357	575
Total	45,349	49,996	1,537,796	1,601,180	43,554	3,696	2,746

Table B.4
Pre-Recession (pre Light Rail), Great Recession and Recovery Shift-Share Analysis, Charlotte LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	2,280	1,798	218,944	180,458	2,118	(238)	(81)
Non Man Ind.	2,475	2,237	180,926	181,314	2,299	182	(243)
Retail/Lodging	6,703	7,794	277,770	333,296	6,225	1,818	(249)
Office	19,040	21,886	353,386	411,028	17,683	4,463	(260)
Knowledge	8,001	7,738	127,940	140,586	7,431	1,361	(1,054)
Education	3,564	132	99,772	81,160	3,310	(411)	(2,767)
Health	1,851	2,723	145,018	182,006	1,719	604	400
Entertainment	804	1,041	24,454	27,948	747	172	122
Total	44,718	45,349	1,428,210	1,537,796	41,531	7,950	(4,132)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,798	950	180,458	148,252	1,889	(411)	(527)
Non Man Ind.	2,237	2,417	181,314	170,452	2,350	(247)	314
Retail/Lodging	7,794	7,299	333,296	310,198	8,187	(933)	45
Office	21,886	25,578	411,028	370,546	22,989	(3,258)	5,848
Knowledge	7,738	7,657	140,586	143,612	8,128	(223)	(248)
Education	132	270	81,160	97,606	139	20	111
Health	2,723	3,482	182,006	189,980	2,860	(18)	640
Entertainment	1,041	1,683	27,948	33,378	1,093	150	440
Total	45,349	49,336	1,537,796	1,464,024	47,634	(4,921)	6,623

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	950	981	148,252	143,562	869	51	61
Non Man Ind.	2,417	2,503	170,452	178,656	2,210	323	(30)
Retail/Lodging	7,299	8,665	310,198	321,940	6,674	902	1,090
Office	25,578	21,923	370,546	431,758	23,387	6,416	(7,880)
Knowledge	7,657	7,977	143,612	153,290	7,001	1,172	(196)
Education	270	1,760	97,606	128,776	247	109	1,404
Health	3,482	4,255	189,980	206,770	3,184	606	465
Entertainment	1,683	1,932	33,378	36,428	1,539	298	95
Total	49,336	49,996	1,464,024	1,601,180	45,110	9,878	(4,992)

DART—Dallas Metropolitan Area

Table B.5
Dallas LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	8,979	7,133	(1,846)	-21%
Non Man Ind.	19,198	16,416	(2,782)	-14%
Retail/Lodging	17,100	16,892	(208)	-1%
Office	46,491	54,701	8,210	18%
Knowledge	26,863	25,947	(916)	-3%
Education	11,380	12,523	1,143	10%
Health	14,539	17,802	3,263	22%
Entertainment	3,699	2,819	(880)	-24%
Total	148,249	154,233	5,984	4%

Table B.6
Dallas LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.47	0.48	0.01	3%
Non Man Ind.	0.99	0.89	-0.10	-10%
Retail/Lodging	0.53	0.53	0.00	0%
Office	1.42	1.45	0.03	2%
Knowledge	1.62	1.62	0.00	0%
Education	0.95	0.84	-0.10	-11%
Health	1.03	0.96	-0.07	-7%
Entertainment	1.71	1.20	-0.51	-30%

Table B.7
Shift-Share Results for Dallas LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	8,979	7,133	626,744	541,458	7,711	46	(624)
Non Man Ind.	19,198	16,416	627,936	669,000	16,487	3,967	(4,037)
Retail/Lodging	17,100	16,892	1,043,352	1,151,960	14,685	4,195	(1,988)
Office	46,491	54,701	1,063,884	1,368,474	39,925	19,876	(5,100)
Knowledge	26,863	25,947	540,264	583,618	23,069	5,949	(3,072)
Education	11,380	12,523	391,000	541,042	9,773	5,974	(3,224)
Health	14,539	17,802	456,808	672,274	12,486	8,911	(3,595)
Entertainment	3,699	2,819	70,316	85,172	3,177	1,304	(1,662)
Total	148,249	154,233	4,820,304	5,612,998	127,313	50,222	(23,302)

Table B.8
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Dallas LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	8,979	9,120	626,744	619,460	8,168	706	245
Non Man Ind.	19,198	17,083	627,936	666,212	17,465	2,903	(3,285)
Retail/Lodging	17,100	17,557	1,043,352	1,111,008	15,556	2,653	(652)
Office	46,491	46,986	1,063,884	1,235,194	42,294	11,684	(6,991)
Knowledge	26,863	26,261	540,264	557,638	24,438	3,289	(1,466)
Education	11,380	12,097	391,000	476,668	10,353	3,521	(1,776)
Health	14,539	15,911	456,808	552,556	13,226	4,360	(1,675)
Entertainment	3,699	2,517	70,316	79,956	3,365	841	(1,689)
Total	148,249	147,532	4,820,304	5,298,692	134,864	29,957	(17,290)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	9,120	7,055	619,460	553,782	9,039	(886)	(1,098)
Non Man Ind.	17,083	17,068	666,212	657,188	16,931	(79)	216
Retail/Lodging	17,557	15,964	1,111,008	1,122,728	17,401	342	(1,778)
Office	46,986	44,421	1,235,194	1,242,374	46,567	692	(2,838)
Knowledge	26,261	23,052	557,638	573,590	26,027	985	(3,960)
Education	12,097	11,533	476,668	500,250	11,989	706	(1,162)
Health	15,911	17,043	552,556	613,436	15,769	1,895	(621)
Entertainment	2,517	2,667	79,956	82,970	2,495	117	55
Total	147,532	138,803	5,298,692	5,346,318	146,218	3,772	(11,187)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	7,055	7,133	553,782	541,458	6,720	178	235
Non Man Ind.	17,068	16,416	657,188	669,000	16,257	1,118	(959)
Retail/Lodging	15,964	16,892	1,122,728	1,151,960	15,206	1,174	512
Office	44,421	54,701	1,242,374	1,368,474	42,311	6,619	5,771
Knowledge	23,052	25,947	573,590	583,618	21,957	1,498	2,492
Education	11,533	12,523	500,250	541,042	10,985	1,488	50
Health	17,043	17,802	613,436	672,274	16,233	2,444	(876)
Entertainment	2,667	2,819	82,970	85,172	2,540	197	81
Total	138,803	154,233	5,346,318	5,612,998	132,208	14,718	7,307

Denver—Regional Transit District

Table B.9
Denver LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	*3,353*	*2,564*	*(789)*	*-24%*
Non Man Ind.	8,050	6,401	(1,649)	-20%
Retail/Lodging	13,938	11,930	(2,008)	-14%
Office	8,800	12,193	3,393	39%
Knowledge	6,093	7,310	1,217	20%
Education	2,282	2,535	253	11%
Health	2,031	2,517	486	24%
Entertainment	578	2,184	1,606	278%
Total	45,125	47,634	2,509	6%

Table B.10
Denver LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.98	1.05	0.06	6%
Non Man Ind.	1.57	1.35	-0.23	-14%
Retail/Lodging	1.55	1.23	-0.32	-21%
Office	0.73	0.96	0.22	31%
Knowledge	0.93	1.10	0.18	19%
Education	0.62	0.59	-0.03	-5%
Health	0.45	0.41	-0.04	-9%
Entertainment	0.71	2.43	1.72	242%

Table B.11
Shift-Share Results for Denver LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,353	2,564	163,038	119,332	3,121	(667)	110
Non Man Ind.	8,050	6,401	244,608	231,360	7,493	121	(1,213)
Retail/Lodging	13,938	11,930	430,890	473,564	12,973	2,345	(3,388)
Office	8,800	12,193	574,942	620,794	8,191	1,311	2,691
Knowledge	6,093	7,310	314,012	322,266	5,671	582	1,057
Education	2,282	2,535	175,418	208,766	2,124	592	(181)
Health	2,031	2,517	217,074	299,694	1,890	914	(287)
Entertainment	578	2,184	39,028	43,840	538	111	1,535
Total	45,125	47,634	2,159,010	2,319,616	42,001	5,310	323

Table B.12
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Denver LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,353	2,680	163,038	146,388	3,214	(203)	(331)
Non Man Ind.	8,050	8,121	244,608	253,652	7,715	632	(227)
Retail/Lodging	13,938	13,212	430,890	471,670	13,358	1,899	(2,045)
Office	8,800	12,036	574,942	597,206	8,434	707	2,895
Knowledge	6,093	6,768	314,012	311,324	5,840	201	727
Education	2,282	2,606	175,418	183,158	2,187	196	223
Health	2,031	2,021	217,074	245,342	1,947	349	(274)
Entertainment	578	1,301	39,028	43,940	554	97	650
Total	45,125	48,745	2,159,010	2,252,680	43,249	3,877	1,619

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	2,680	2,802	146,388	133,824	2,740	(290)	352
Non Man Ind.	8,121	6,484	253,652	242,848	8,304	(529)	(1,291)
Retail/Lodging	13,212	12,351	471,670	466,256	13,510	(450)	(709)
Office	12,036	11,649	597,206	587,828	12,308	(461)	(198)
Knowledge	6,768	6,660	311,324	314,206	6,921	(90)	(171)
Education	2,606	663	183,158	144,290	2,665	(612)	(1,390)
Health	2,021	2,386	245,342	270,698	2,067	163	156
Entertainment	1,301	1,275	43,940	43,028	1,330	(56)	1
Total	48,745	44,270	2,252,680	2,202,978	49,845	(2,325)	(3,250)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	2,802	2,564	133,824	119,332	2,661	(163)	65
Non Man Ind.	6,484	6,401	242,848	231,360	6,158	19	224
Retail/Lodging	12,351	11,930	466,256	473,564	11,730	815	(615)
Office	11,649	12,193	587,828	620,794	11,063	1,239	(109)
Knowledge	6,660	7,310	314,206	322,266	6,325	506	479
Education	663	2,535	144,290	208,766	630	330	1,576
Health	2,386	2,517	270,698	299,694	2,266	376	(125)
Entertainment	1,275	2,184	43,028	43,840	1,211	88	885
Total	44,270	47,634	2,202,978	2,319,616	42,044	3,210	2,381

Houston—METRORail

Table B.13
Houston LRT Change in Jobs by Combined Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	7,310	9,203	1,893	26%
Non Man Ind.	24,096	22,973	(1,123)	-5%
Retail/Lodging	32,566	34,423	1,857	6%
Office	85,242	91,726	6,484	8%
Knowledge	33,985	33,406	(579)	-2%
Education	26,501	5,871	(20,630)	-78%
Health	9,877	10,259	382	4%
Entertainment	*3,344*	*3,442*	*98*	*3%*
Total	222,921	211,303	(11,618)	-5%

Table B.14
Houston LRT Change in Location Quotients by Combined Economic Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	0.31	0.44	0.13	41%
Non Man Ind.	0.87	0.91	0.04	4%
Retail/Lodging	0.69	0.76	0.07	10%
Office	1.82	2.03	0.22	12%
Knowledge	1.56	1.66	0.10	6%
Education	0.97	0.24	-0.73	-75%
Health	0.39	0.38	-0.01	-2%
Entertainment	1.08	1.29	0.21	19%

Table B.15
Shift-Share Results for Houston LRT, 2004-2011

Sector	2004 LRT	2011 LRT	2004 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	7,310	9,203	412,826	465,646	6,120	2,125	958
Non Man Ind.	24,096	22,973	491,228	565,028	20,174	7,542	(4,743)
Retail/Lodging	32,566	34,423	833,222	1,010,900	27,266	12,245	(5,087)
Office	85,242	91,726	831,006	1,006,538	71,368	31,879	(11,522)
Knowledge	33,985	33,406	386,134	450,318	28,454	11,180	(6,228)
Education	26,501	5,871	485,216	550,368	22,188	7,872	(24,188)
Health	9,877	10,259	453,550	607,178	8,269	4,953	(2,964)
Entertainment	3,344	3,442	54,894	59,588	2,800	830	(188)
Total	222,921	211,303	3,948,076	4,715,564	186,639	78,626	(53,962)

Table B.16
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Houston LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	7,000	10,635	438,796	464,386	6,399	1,009	3,227
Non Man Ind.	28,501	23,258	500,468	544,948	26,054	4,980	(7,776)
Retail/Lodging	32,234	33,700	816,496	904,114	29,467	6,226	(1,993)
Office	85,655	84,518	827,678	913,286	78,302	16,212	(9,996)
Knowledge	36,837	36,489	395,474	443,408	33,675	7,627	(4,813)
Education	30,284	29,014	474,046	488,724	27,684	3,537	(2,208)
Health	12,132	10,148	425,622	485,136	11,091	2,738	(3,680)
Entertainment	3,032	3,723	51,682	55,322	2,772	474	477
Total	235,675	231,485	3,930,262	4,299,324	215,444	42,803	(26,762)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	10,635	10,909	464,386	464,268	10,366	266	277
Non Man Ind.	23,258	26,021	544,948	544,512	22,669	570	2,782
Retail/Lodging	33,700	32,515	904,114	918,682	32,847	1,396	(1,728)
Office	84,518	92,737	913,286	928,436	82,379	3,541	6,817
Knowledge	36,489	35,916	443,408	448,670	35,566	1,356	(1,006)
Education	29,014	24,878	488,724	501,876	28,280	1,515	(4,917)
Health	10,148	10,682	485,136	544,990	9,891	1,509	(718)
Entertainment	3,723	3,591	55,322	59,524	3,629	377	(415)
Total	231,485	237,249	4,299,324	4,410,958	225,627	10,531	1,092

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	10,909	9,203	464,268	465,646	10,204	737	(1,738)
Non Man Ind.	26,021	22,973	544,512	565,028	24,340	2,661	(4,028)
Retail/Lodging	32,515	34,423	918,682	1,010,900	30,415	5,364	(1,356)
Office	92,737	91,726	928,436	1,006,538	86,747	13,792	(8,812)
Knowledge	35,916	33,406	448,670	450,318	33,596	2,452	(2,642)
Education	24,878	5,871	501,876	550,368	23,271	4,011	(21,411)
Health	10,682	10,259	544,990	607,178	9,992	1,909	(1,642)
Entertainment	3,591	3,442	59,524	59,588	3,359	236	(153)
Total	237,249	211,303	4,410,958	4,715,564	221,924	31,162	(41,782)

Phoenix—METRO

Table B.17
Phoenix LRT Change in Jobs by Combined Sector, 2009-2011

Sector	2009	2011	Change	Percent Change
Manufacturing	3,125	3,144	19	1%
Non Man Ind.	4,264	4,325	61	1%
Retail/Lodging	*11,666*	*12,165*	*499*	*4%*
Office	54,933	53,147	(1,786)	-3%
Knowledge	6,065	6,254	189	3%
Education	2,918	3,009	91	3%
Health	8,984	7,856	(1,128)	-13%
Entertainment	3,484	3,418	(66)	-2%
Total	95,439	93,318	(2,121)	-2%

Table B.18
Phoenix LRT Change in Location Quotients by Combined Economic Sector, 2009-2011

Sector	2009	2011	Change	Percent Change
Manufacturing	0.47	0.46	-0.01	-1%
Non Man Ind.	0.49	0.48	-0.00	-1%
Retail/Lodging	0.55	0.59	0.04	7%
Office	1.99	2.01	0.02	1%
Knowledge	0.77	0.85	0.08	10%
Education	0.31	0.35	0.04	12%
Health	0.76	0.63	-0.13	-17%
Entertainment	1.69	1.66	-0.03	-2%

Table B.19
Shift-Share Results for Phoenix LRT, 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,125	3,144	218,192	234,282	3,029	326	(211)
Non Man Ind.	4,264	4,325	287,762	309,632	4,134	455	(263)
Retail/Lodging	11,666	12,165	699,902	716,842	11,309	639	217
Office	54,933	53,147	904,646	915,066	53,252	2,314	(2,419)
Knowledge	6,065	6,254	257,384	253,674	5,879	98	276
Education	2,918	3,009	304,516	296,352	2,829	11	169
Health	8,984	7,856	389,900	431,600	8,709	1,236	(2,089)
Entertainment	3,484	3,418	67,732	71,378	3,377	294	(254)
Total	95,439	93,318	3,130,034	3,228,826	92,519	5,372	(4,573)

Table B.20
Pre-Recession (pre Light Rail), Great Recession and Recovery Shift-Share Analysis, Phoenix LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,339	3,174	264,610	290,094	2,991	669	(487)
Non Man Ind.	3,767	4,831	284,412	327,078	3,375	958	499
Retail/Lodging	14,160	14,363	682,912	772,636	12,685	3,336	(1,657)
Office	58,418	62,489	878,034	998,720	52,332	14,116	(3,959)
Knowledge	6,938	7,168	247,946	271,406	6,215	1,379	(426)
Education	2,952	2,330	241,718	250,326	2,644	413	(727)
Health	7,342	7,791	301,810	326,578	6,577	1,367	(154)
Entertainment	4,696	5,073	64,244	73,758	4,207	1,185	(318)
Total	101,612	107,219	2,965,686	3,310,596	91,026	23,422	(7,229)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,174	3,125	290,094	218,192	3,357	(970)	738
Non Man Ind.	4,831	4,264	327,078	287,762	5,110	(859)	14
Retail/Lodging	14,363	11,666	772,636	699,902	15,192	(2,181)	(1,345)
Office	62,489	54,933	998,720	904,646	66,094	(9,491)	(1,670)
Knowledge	7,168	6,065	271,406	257,384	7,581	(784)	(733)
Education	2,330	2,918	250,326	304,516	2,464	370	84
Health	7,791	8,984	326,578	389,900	8,240	1,061	(318)
Entertainment	5,073	3,484	73,758	67,732	5,366	(707)	(1,175)
Total	107,219	95,439	3,310,596	3,130,034	113,404	(13,561)	(4,405)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,125	3,144	218,192	234,282	3,029	326	(211)
Non Man Ind.	4,264	4,325	287,762	309,632	4,134	455	(263)
Retail/Lodging	11,666	12,165	699,902	716,842	11,309	639	217
Office	54,933	53,147	904,646	915,066	53,252	2,314	(2,419)
Knowledge	6,065	6,254	257,384	253,674	5,879	98	276
Education	2,918	3,009	304,516	296,352	2,829	11	169
Health	8,984	7,856	389,900	431,600	8,709	1,236	(2,089)
Entertainment	3,484	3,418	67,732	71,378	3,377	294	(254)
Total	95,439	93,318	3,130,034	3,228,826	92,519	5,372	(4,573)

Portland—MAX

Table B.21
Portland LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	*1,295*	*1,160*	*(135)*	*-10%*
Non Man Ind.	5,423	4,945	(478)	-9%
Retail/Lodging	17,047	19,752	2,705	16%
Office	46,725	45,356	(1,369)	-3%
Knowledge	21,038	22,477	1,439	7%
Education	15,834	9,451	(6,383)	-40%
Health	11,744	12,705	961	8%
Entertainment	1,934	1,895	(39)	-2%
Total	121,040	117,741	(3,299)	-3%

Table B.22
Portland LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.08	0.08	0.01	13%
Non Man Ind.	0.40	0.40	-0.00	-0%
Retail/Lodging	0.71	0.86	0.15	21%
Office	1.59	1.66	0.07	4%
Knowledge	2.01	2.13	0.12	6%
Education	1.48	0.77	-0.71	-48%
Health	0.86	0.77	-0.09	-10%
Entertainment	0.96	0.90	-0.05	-5%

Table B.23
Shift-Share Results for Portland LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,295	1,160	243,736	220,360	1,169	1	(11)
Non Man Ind.	5,423	4,945	190,436	197,986	4,897	741	(693)
Retail/Lodging	17,047	19,752	339,522	370,804	15,393	3,224	1,134
Office	46,725	45,356	415,698	439,732	42,192	7,234	(4,070)
Knowledge	21,038	22,477	147,680	169,876	18,997	5,203	(1,723)
Education	15,834	9,451	151,388	197,200	14,298	6,328	(11,175)
Health	11,744	12,705	192,772	263,830	10,605	5,468	(3,368)
Entertainment	1,934	1,895	28,552	33,686	1,746	535	(387)
Total	121,040	117,741	1,709,784	1,893,474	109,298	28,736	(20,292)

Table B.24
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Portland LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,295	1,403	243,736	248,170	1,187	131	84
Non Man Ind.	5,423	4,816	190,436	203,840	4,972	833	(989)
Retail/Lodging	17,047	19,025	339,522	380,270	15,628	3,465	(68)
Office	46,725	46,332	415,698	445,136	42,835	7,199	(3,702)
Knowledge	21,038	21,730	147,680	161,706	19,287	3,750	(1,306)
Education	15,834	7,529	151,388	174,954	14,516	3,783	(10,770)
Health	11,744	10,420	192,772	219,336	10,766	2,596	(2,942)
Entertainment	1,934	1,831	28,552	31,638	1,773	370	(312)
Total	121,040	113,086	1,709,784	1,865,050	110,963	22,127	(20,004)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,403	1,298	248,170	220,668	1,445	(198)	50
Non Man Ind.	4,816	4,701	203,840	194,270	4,961	(371)	111
Retail/Lodging	19,025	18,837	380,270	360,662	19,599	(1,555)	793
Office	46,332	46,234	445,136	416,262	47,729	(4,403)	2,907
Knowledge	21,730	21,575	161,706	159,574	22,385	(942)	131
Education	7,529	8,237	174,954	192,166	7,756	514	(33)
Health	10,420	11,143	219,336	234,718	10,734	417	(8)
Entertainment	1,831	1,937	31,638	32,134	1,886	(27)	77
Total	113,086	113,962	1,865,050	1,810,454	116,496	(6,564)	4,030

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,298	1,160	220,668	220,360	1,241	55	(136)
Non Man Ind.	4,701	4,945	194,270	197,986	4,495	296	154
Retail/Lodging	18,837	19,752	360,662	370,804	18,011	1,356	385
Office	46,234	45,356	416,262	439,732	44,207	4,634	(3,485)
Knowledge	21,575	22,477	159,574	169,876	20,629	2,339	(491)
Education	8,237	9,451	192,166	197,200	7,876	577	998
Health	11,143	12,705	234,718	263,830	10,654	1,871	180
Entertainment	1,937	1,895	32,134	33,686	1,852	178	(136)
Total	113,962	117,741	1,810,454	1,893,474	108,965	11,306	(2,530)

Sacramento—SCRT

Table B.25
Sacramento LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	217	192	(25)	-12%
Non Man Ind.	222	604	382	172%
Retail/Lodging	*1,320*	*1,413*	*93*	*7%*
Office	675	2,505	1,830	271%
Knowledge	215	378	163	76%
Education	156	304	148	95%
Health	368	469	101	27%
Entertainment	*168*	*170*	*2*	*1%*
Total	3,341	6,035	2,694	81%

Table B.26
Sacramento LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.92	0.77	-0.14	-16%
Non Man Ind.	0.79	1.49	0.71	90%
Retail/Lodging	1.79	1.23	-0.56	-31%
Office	0.71	1.16	0.46	65%
Knowledge	0.69	0.70	0.01	2%
Education	0.39	0.47	0.08	20%
Health	1.09	0.62	-0.47	-43%
Entertainment	2.00	1.21	-0.79	-40%

Table B.27
Shift-Share Results for Sacramento LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	217	192	93,976	66,444	178	(25)	39
Non Man Ind.	222	604	112,172	108,142	183	32	390
Retail/Lodging	1,320	1,413	292,530	306,600	1,085	298	30
Office	675	2,505	379,136	575,592	555	470	1,480
Knowledge	215	378	123,682	144,184	177	74	127
Education	156	304	156,788	171,982	128	43	133
Health	368	469	134,192	202,158	303	252	(85)
Entertainment	168	170	33,268	37,556	138	52	(20)
Total	3,341	6,035	1,325,744	1,612,658	2,747	1,195	2,094

Table B.28
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Sacramento LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	217	86	93,976	83,410	202	(10)	(107)
Non Man Ind.	222	155	112,172	115,916	207	22	(74)
Retail/Lodging	1,320	1,492	292,530	325,908	1,231	240	21
Office	675	903	379,136	384,660	629	55	218
Knowledge	215	225	123,682	136,138	200	36	(12)
Education	156	388	156,788	176,294	145	30	213
Health	368	433	134,192	163,180	343	104	(14)
Entertainment	168	135	33,268	36,186	157	26	(48)
Total	3,341	3,817	1,325,744	1,421,692	3,116	504	197

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	86	83	83,410	72,440	87	(12)	8
Non Man Ind.	155	146	115,916	106,516	157	(15)	4
Retail/Lodging	1,492	1,309	325,908	300,256	1,511	(136)	(66)
Office	903	947	384,660	389,164	914	(1)	33
Knowledge	225	384	136,138	127,288	228	(17)	174
Education	388	398	176,294	189,704	393	25	(20)
Health	433	429	163,180	176,392	438	30	(39)
Entertainment	135	161	36,186	42,242	137	21	3
Total	3,817	3,857	1,421,692	1,404,002	3,865	(106)	98

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	83	192	72,440	66,444	72	4	116
Non Man Ind.	146	604	106,516	108,142	127	21	456
Retail/Lodging	1,309	1,413	300,256	306,600	1,140	197	76
Office	947	2,505	389,164	575,592	824	576	1,104
Knowledge	384	378	127,288	144,184	334	101	(57)
Education	398	304	189,704	171,982	347	14	(57)
Health	429	469	176,392	202,158	373	118	(23)
Entertainment	161	170	42,242	37,556	140	3	27
Total	3,857	6,035	1,404,002	1,612,658	3,358	1,034	1,643

Salt Lake City—TRAX

Table B.29
Salt Lake City LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	1,640	1,450	(190)	-12%
Non Man Ind.	952	883	(69)	-7%
Retail/Lodging	3,794	3,379	(415)	-11%
Office	9,437	8,377	(1,060)	-11%
Knowledge	1,045	910	(135)	-13%
Education	637	972	335	53%
Health	1,069	1,122	53	5%
Entertainment	194	112	(82)	-42%
Total	18,768	17,205	(1,563)	-8%

Table B.30
Salt Lake City LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.86	0.91	0.05	6%
Non Man Ind.	0.46	0.48	0.01	3%
Retail/Lodging	0.94	0.97	0.03	4%
Office	1.83	1.80	-0.02	-1%
Knowledge	0.60	0.53	-0.07	-12%
Education	0.39	0.63	0.24	62%
Health	0.61	0.56	-0.04	-7%
Entertainment	0.45	0.30	-0.14	-32%

Table B.31
Shift-Share Results for Salt Lake City LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,640	1,450	103,652	105,984	1,464	213	(227)
Non Man Ind.	952	883	112,902	124,008	850	196	(163)
Retail/Lodging	3,794	3,379	221,192	232,162	3,387	596	(603)
Office	9,437	8,377	282,490	310,398	8,424	1,946	(1,992)
Knowledge	1,045	910	95,180	114,926	933	329	(352)
Education	637	972	90,132	103,430	569	162	241
Health	1,069	1,122	96,534	133,560	954	525	(357)
Entertainment	194	112	23,786	24,800	173	29	(90)
Total	18,768	17,205	1,025,868	1,149,268	16,753	3,995	(3,543)

Table B.32
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Salt Lake City LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,640	1,333	103,652	110,452	1,488	259	(415)
Non Man Ind.	952	932	112,902	123,210	864	175	(107)
Retail/Lodging	3,794	3,665	221,192	238,538	3,443	648	(427)
Office	9,437	9,016	282,490	307,334	8,564	1,703	(1,251)
Knowledge	1,045	975	95,180	111,878	948	280	(253)
Education	637	761	90,132	98,934	578	121	62
Health	1,069	775	96,534	114,258	970	295	(490)
Entertainment	194	137	23,786	25,806	176	34	(73)
Total	18,768	17,594	1,025,868	1,130,410	17,032	3,516	(2,954)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,333	1,556	110,452	105,484	1,365	(91)	283
Non Man Ind.	932	811	123,210	121,416	954	(36)	(107)
Retail/Lodging	3,665	3,777	238,538	231,898	3,752	(189)	214
Office	9,016	8,717	307,334	296,604	9,229	(528)	16
Knowledge	975	1,009	111,878	111,618	998	(25)	36
Education	761	842	98,934	85,802	779	(119)	182
Health	775	654	114,258	125,322	793	57	(196)
Entertainment	137	106	25,806	26,156	140	(1)	(33)
Total	17,594	17,472	1,130,410	1,104,300	18,010	(933)	395

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	1,556	1,450	105,484	105,984	1,495	68	(113)
Non Man Ind.	811	883	121,416	124,008	779	49	55
Retail/Lodging	3,777	3,379	231,898	232,162	3,629	152	(402)
Office	8,717	8,377	296,604	310,398	8,376	746	(745)
Knowledge	1,009	910	111,618	114,926	970	69	(129)
Education	842	972	85,802	103,430	809	206	(43)
Health	654	1,122	125,322	133,560	628	69	425
Entertainment	106	112	26,156	24,800	102	(1)	11
Total	17,472	17,205	1,104,300	1,149,268	16,788	1,358	(942)

San Diego—Trolley

Table B.33
San Diego LRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	8,075	5,219	(2,856)	-35%
Non Man Ind.	6,914	6,220	(694)	-10%
Retail/Lodging	18,929	18,022	(907)	-5%
Office	20,474	18,571	(1,903)	-9%
Knowledge	12,883	16,045	3,162	25%
Education	*2,080*	*2,236*	*156*	*8%*
Health	2,963	7,241	4,278	144%
Entertainment	817	863	46	6%
Total	73,135	74,417	1,282	2%

Table B.34
San Diego LRT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	1.03	0.86	-0.17	-16%
Non Man Ind.	1.36	1.32	-0.03	-3%
Retail/Lodging	1.17	1.10	-0.07	-6%
Office	1.21	1.05	-0.16	-13%
Knowledge	1.33	1.61	0.28	21%
Education	0.26	0.27	0.01	4%
Health	0.40	0.81	0.40	99%
Entertainment	0.42	0.37	-0.05	-13%

Table B.35
Shift-Share Results for San Diego LRT, 2002-2011

Sector	2002 LRT	2011 LRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	8,075	5,219	231,914	192,290	7,399	(703)	(1,476)
Non Man Ind.	6,914	6,220	151,194	149,666	6,335	509	(624)
Retail/Lodging	18,929	18,022	481,908	521,520	17,343	3,141	(2,463)
Office	20,474	18,571	503,228	563,604	18,759	4,171	(4,359)
Knowledge	12,883	16,045	287,698	316,852	11,804	2,385	1,856
Education	2,080	2,236	238,866	263,712	1,906	391	(60)
Health	2,963	7,241	217,490	285,916	2,715	1,180	3,346
Entertainment	817	863	57,050	74,106	749	313	(198)
Total	73,135	74,417	2,169,348	2,367,666	67,009	11,387	(3,979)

Table B.36
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, San Diego LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	8,075	5,589	231,914	202,096	7,727	(690)	(1,448)
Non Man Ind.	6,914	6,569	151,194	145,740	6,616	49	(96)
Retail/Lodging	18,929	19,388	481,908	522,668	18,112	2,418	(1,142)
Office	20,474	20,578	503,228	541,948	19,590	2,459	(1,471)
Knowledge	12,883	15,057	287,698	292,104	12,327	753	1,977
Education	2,080	2,035	238,866	251,678	1,990	201	(157)
Health	2,963	3,305	217,490	237,470	2,835	400	70
Entertainment	817	924	57,050	73,480	782	271	(128)
Total	73,135	73,445	2,169,348	2,267,184	69,979	5,861	(2,395)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	5,589	5,212	202,096	194,608	5,652	(270)	(170)
Non Man Ind.	6,569	5,408	145,740	137,104	6,643	(464)	(772)
Retail/Lodging	19,388	17,067	522,668	485,364	19,608	(1,604)	(937)
Office	20,578	17,929	541,948	507,952	20,811	(1,524)	(1,358)
Knowledge	15,057	15,416	292,104	306,532	15,228	573	(385)
Education	2,035	1,938	251,678	272,748	2,058	147	(267)
Health	3,305	3,953	237,470	265,332	3,342	350	260
Entertainment	924	829	73,480	72,124	934	(28)	(78)
Total	73,445	67,752	2,267,184	2,241,764	74,278	(2,819)	(3,707)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	5,212	5,219	194,608	192,290	4,935	215	69
Non Man Ind.	5,408	6,220	137,104	149,666	5,120	783	316
Retail/Lodging	17,067	18,022	485,364	521,520	16,159	2,179	(316)
Office	17,929	18,571	507,952	563,604	16,976	2,918	(1,322)
Knowledge	15,416	16,045	306,532	316,852	14,596	1,339	110
Education	1,938	2,236	272,748	263,712	1,835	39	362
Health	3,953	7,241	265,332	285,916	3,743	517	2,981
Entertainment	829	863	72,124	74,106	785	67	11
Total	67,752	74,417	2,241,764	2,367,666	64,149	8,056	2,212

Twin Cities—METRO

Table B.37
Twin Cities LRT Change in Jobs by Combined Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	3,873	3,045	(828)	-21%
Non Man Ind.	8,053	11,393	3,340	41%
Retail/Lodging	16,447	12,365	(4,082)	-25%
Office	16,170	19,506	3,336	21%
Knowledge	12,191	12,187	(4)	-0%
Education	3,074	3,278	204	7%
Health	7,139	9,967	2,828	40%
Entertainment	1,617	2,842	1,225	76%
Total	68,564	74,583	6,019	9%

Table B.38
Twin Cities LRT Change in Location Quotients by Combined Economic Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	0.47	0.37	-0.11	-23%
Non Man Ind.	1.17	1.75	0.58	50%
Retail/Lodging	1.24	0.92	-0.33	-26%
Office	0.88	0.98	0.10	12%
Knowledge	1.94	1.79	-0.15	-8%
Education	0.52	0.46	-0.06	-11%
Health	0.84	0.89	0.05	6%
Entertainment	1.48	2.25	0.77	52%

Table B.39
Shift-Share Results for Twin Cities LRT, 2004-2011

Sector	2004 LRT	2011 LRT	2004 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,873	3,045	380,400	364,884	3,770	(55)	(670)
Non Man Ind.	8,053	11,393	321,062	286,156	7,839	(662)	4,216
Retail/Lodging	16,447	12,365	616,188	593,068	16,010	(180)	(3,465)
Office	16,170	19,506	858,384	874,934	15,740	741	3,024
Knowledge	12,191	12,187	291,720	298,256	11,867	597	(277)
Education	3,074	3,278	275,368	311,130	2,992	481	(195)
Health	7,139	9,967	393,606	490,544	6,949	1,948	1,070
Entertainment	1,617	2,842	50,768	55,512	1,574	194	1,074
Total	68,564	74,583	3,187,496	3,274,484	66,743	3,064	4,776

Table B.40
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Twin Cities LRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 LRT	2007 LRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	4,897	3,832	410,194	398,410	4,676	80	(924)
Non Man Ind.	15,373	6,672	331,602	322,212	14,679	258	(8,266)
Retail/Lodging	15,910	13,887	576,616	612,324	15,192	1,703	(3,008)
Office	15,797	14,826	835,644	867,662	15,084	1,318	(1,576)
Knowledge	12,867	12,816	302,662	311,540	12,286	958	(428)
Education	2,985	3,512	269,118	298,934	2,850	465	196
Health	6,616	9,393	357,994	425,166	6,317	1,540	1,536
Entertainment	1,251	1,448	50,042	45,722	1,195	(52)	305
Total	75,696	66,386	3,133,872	3,281,970	72,280	6,272	(12,166)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 LRT	2009 LRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,832	3,180	398,410	356,796	3,892	(460)	(252)
Non Man Ind.	6,672	9,909	322,212	303,908	6,776	(483)	3,616
Retail/Lodging	13,887	10,939	612,324	581,682	14,103	(911)	(2,253)
Office	14,826	16,039	867,662	888,504	15,057	125	857
Knowledge	12,816	12,964	311,540	300,194	13,015	(666)	615
Education	3,512	3,270	298,934	304,332	3,567	9	(305)
Health	9,393	10,148	425,166	450,264	9,539	408	201
Entertainment	1,448	1,670	45,722	45,994	1,471	(14)	213
Total	66,386	68,119	3,281,970	3,231,674	67,419	(1,992)	2,691

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 LRT	2011 LRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Manufacturing	3,180	3,045	356,796	364,884	3,138	114	(207)
Non Man Ind.	9,909	11,393	303,908	286,156	9,779	(449)	2,063
Retail/Lodging	10,939	12,365	581,682	593,068	10,796	357	1,212
Office	16,039	19,506	888,504	874,934	15,829	(35)	3,712
Knowledge	12,964	12,187	300,194	298,256	12,795	86	(693)
Education	3,270	3,278	304,332	311,130	3,227	116	(65)
Health	10,148	9,967	450,264	490,544	10,015	1,040	(1,089)
Entertainment	1,670	2,842	45,994	55,512	1,648	367	826
Total	68,119	74,583	3,231,674	3,274,484	67,228	1,596	5,759

Portland Streetcar

Table B.41
Portland SCT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	2,652	1,549	(1,103)	-42%
Non Man Ind.	4,989	2,856	(2,133)	-43%
Retail/Lodging	17,061	18,608	1,547	9%
Office	44,028	40,310	(3,718)	-8%
Knowledge	23,307	24,830	1,523	7%
Education	13,038	7,098	(5,940)	-46%
Health	7,658	7,912	254	3%
Entertainment	2,146	1,833	(313)	-15%
Total	114,879	104,996	(9,883)	-9%

Table B.42
Portland SCT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.16	0.13	-0.04	-22%
Non Man Ind.	0.39	0.26	-0.13	-33%
Retail/Lodging	0.75	0.90	0.16	21%
Office	1.58	1.65	0.08	5%
Knowledge	2.35	2.64	0.29	12%
Education	1.28	0.65	-0.63	-49%
Health	0.59	0.54	-0.05	-9%
Entertainment	1.12	0.98	-0.14	-12%

Table B.43
Shift-Share Results for Portland SCT, 2002-2011

Sector	SCT 2002	SCT 2011	MSA 2002	MSA 2011	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	2,652	1,549	121,868	110,180	2,395	3	(849)
Non Man Ind.	4,989	2,856	95,218	98,993	4,505	682	(2,331)
Retail/Lodging	17,061	18,608	169,761	185,402	*15,406*	*3,227*	*(25)*
Office	44,028	40,310	207,849	219,866	39,757	6,817	(6,264)
Knowledge	23,307	24,830	73,840	84,938	21,046	5,764	(1,980)
Education	13,038	7,098	75,694	98,600	11,773	5,210	(9,885)
Health	7,658	7,912	96,386	131,915	6,915	3,566	(2,569)
Entertainment	2,146	1,833	14,276	16,843	1,938	594	(699)
Total	114,879	104,996	854,892	946,737	103,734	25,863	(24,601)

Table B.44
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Portland SCT, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	SCT 2002	SCT 2007	MSA 2002	MSA 2007	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	2,652	2,060	121,868	124,085	2,431	269	(640)
Non Man Ind.	4,989	3,860	95,218	101,920	4,574	766	(1,480)
Retail/Lodging	17,061	18,598	169,761	190,135	15,641	3,468	(511)
Office	44,028	43,785	207,849	222,568	40,363	6,783	(3,361)
Knowledge	23,307	24,563	73,840	80,853	21,367	4,154	(958)
Education	13,038	5,811	75,694	87,477	11,953	3,115	(9,257)
Health	7,658	7,332	96,386	109,668	7,020	1,693	(1,381)
Entertainment	2,146	2,026	14,276	15,819	1,967	411	(352)
Total	114,879	108,035	854,892	932,525	105,315	20,659	(17,939)

Great Recession Shift-Share Analysis 2007-2009

Sector	SCT 2007	SCT 2009	MSA 2007	MSA 2009	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	2,060	1,634	124,085	110,334	2,122	(290)	(198)
Non Man Ind.	*3,860*	*3,684*	*101,920*	*97,135*	*3,976*	*(298)*	*5*
Retail/Lodging	18,598	18,509	190,135	180,331	19,159	(1,520)	870
Office	43,785	43,300	222,568	208,131	45,105	(4,161)	2,355
Knowledge	*24,563*	*24,104*	*80,853*	*79,787*	*25,304*	*(1,065)*	*(135)*
Education	5,811	6,133	87,477	96,083	5,986	396	(250)
Health	7,332	7,397	109,668	117,359	7,553	293	(449)
Entertainment	2,026	1,944	15,819	16,067	2,087	(29)	(114)
Total	108,035	106,705	932,525	905,227	111,293	(6,673)	2,085

Post-Recession Shift-Share Analysis 2009-2011

Sector	SCT 2009	SCT 2011	MSA 2009	MSA 2011	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	*1,634*	*1,549*	*110,334*	*110,180*	*1,562*	*69*	*(83)*
Non Man Ind.	3,684	2,856	97,135	98,993	3,522	232	(898)
Retail/Lodging	18,509	18,608	180,331	185,402	17,697	1,332	(421)
Office	43,300	40,310	208,131	219,866	41,401	4,340	(5,431)
Knowledge	24,104	24,830	79,787	84,938	23,047	2,613	(830)
Education	6,133	7,098	96,083	98,600	5,864	430	804
Health	7,397	7,912	117,359	131,915	7,073	1,242	(402)
Entertainment	1,944	1,833	16,067	16,843	1,859	179	(205)
Total	106,705	104,996	905,227	946,737	102,026	10,437	(7,467)

Seattle Streetcar

Table B.45
Seattle SCT Change in Jobs by Combined Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	3,110	2,207	(903)	-29%
Non Man Ind.	9,259	7,774	(1,485)	-16%
Retail/Lodging	22,066	19,992	(2,074)	-9%
Office	48,006	66,895	18,889	39%
Knowledge	35,358	32,301	(3,057)	-9%
Education	1,300	1,688	388	30%
Health	6,878	8,920	2,042	30%
Entertainment	2,532	3,147	615	24%
Total	128,509	142,924	14,415	11%

Table B.46
Seattle SCT Change in Location Quotients by Combined Economic Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	0.21	0.15	-0.06	-28%
Non Man Ind.	0.67	0.55	-0.12	-18%
Retail/Lodging	0.87	0.76	-0.11	-13%
Office	1.62	2.00	0.38	23%
Knowledge	2.30	1.64	-0.67	-29%
Education	0.12	0.14	0.02	18%
Health	0.45	0.48	0.02	5%
Entertainment	0.85	0.93	0.08	10%

Table B.47
Shift-Share Results for Seattle SCT, 2002-2011

Sector	SCT 2007	SCT 2011	MSA 2007	MSA 2011	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	3,110	2,207	176,238	164,497	2,953	(51)	(696)
Non Man Ind.	9,259	7,774	160,784	156,693	8,793	231	(1,249)
Retail/Lodging	22,066	19,992	296,345	291,370	20,955	741	(1,704)
Office	48,006	66,895	344,714	368,808	45,589	5,773	15,534
Knowledge	35,358	32,301	178,854	217,655	33,578	9,451	(10,728)
Education	1,300	1,688	127,360	132,744	1,235	120	333
Health	6,878	8,920	177,329	206,653	6,532	1,484	905
Entertainment	2,532	3,147	34,606	37,147	2,405	313	429
Total	128,509	142,924	1,496,230	1,575,567	122,038	18,062	2,824

Table B.48
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Seattle SCT, 2002-2011

			Pre-Recession Shift-Share Analysis 2002-2007				
Sector	**SCT 2002**	**SCT 2007**	**MSA 2002**	**MSA 2007**	**Metropolitan Area Share**	**Sector Mix Share**	**SCT Station Share**
Manufacturing	4,962	3,110	164,002	176,238	4,606	726	(2,222)
Non Man Ind.	10,568	9,259	147,347	160,784	9,809	1,722	(2,273)
Retail/Lodging	19,839	22,066	274,172	296,345	18,415	3,029	623
Office	48,516	48,006	319,526	344,714	45,033	7,307	(4,334)
Knowledge	30,928	35,358	173,544	178,854	28,708	3,166	3,484
Education	*1,301*	*1,300*	*122,407*	*127,360*	*1,208*	*146*	*(54)*
Health	6,432	6,878	157,801	177,329	5,970	1,258	(350)
Entertainment	1,991	2,532	30,025	34,606	1,848	447	237
Total	124,537	128,509	1,388,824	1,496,230	115,597	17,801	(4,890)
			Great Recession Shift-Share Analysis 2007-2009				
Sector	**SCT 2007**	**SCT 2009**	**MSA 2007**	**MSA 2009**	**Metropolitan Area Share**	**Sector Mix Share**	**SCT Station Share**
Manufacturing	3,110	2,823	176,238	166,699	3,065	(123)	(119)
Non Man Ind.	*9,259*	*9,032*	*160,784*	*154,445*	*9,126*	*(232)*	*138*
Retail/Lodging	22,066	20,783	296,345	283,800	21,748	(616)	(349)
Office	48,006	61,173	344,714	345,690	47,314	828	13,031
Knowledge	35,358	33,799	178,854	207,776	34,848	6,227	(7,277)
Education	1,300	1,464	127,360	131,436	1,281	60	122
Health	*6,878*	*7,519*	*177,329*	*192,150*	*6,779*	*674*	*66*
Entertainment	2,532	2,344	34,606	36,119	2,495	147	(299)
Total	128,509	138,937	1,496,230	1,518,115	126,656	6,966	5,315
			Post-Recession Shift-Share Analysis 2009-2011				
Sector	**SCT 2009**	**SCT 2011**	**MSA 2009**	**MSA 2011**	**Metropolitan Area Share**	**Sector Mix Share**	**SCT Station Share**
Manufacturing	2,823	2,207	166,699	164,497	2,720	66	(579)
Non Man Ind.	9,032	7,774	154,445	156,693	8,703	461	(1,389)
Retail/Lodging	20,783	19,992	283,800	291,370	20,025	1,312	(1,345)
Office	61,173	66,895	345,690	368,808	58,942	6,322	1,631
Knowledge	33,799	32,301	207,776	217,655	32,567	2,839	(3,105)
Education	1,464	1,688	131,436	132,744	1,411	68	209
Health	7,519	8,920	192,150	206,653	7,245	842	833
Entertainment	2,344	3,147	36,119	37,147	2,259	152	736
Total	138,937	142,924	1,518,115	1,575,567	133,871	12,062	(3,008)

Tacoma Link

Table B. 49
Tacoma SCT Change in Jobs by Combined Sector, 2003-2011

Sector	2003	2011	Change	Percent Change
Manufacturing	2,316	989	(1,327)	-57%
Non Man Ind.	1,060	623	(437)	-41%
Retail/Lodging	3,455	1,797	(1,658)	-48%
Office	24,746	13,436	(11,310)	-46%
Knowledge	2,730	2,181	(549)	-20%
Education	6,616	5,968	(648)	-10%
Health	6,273	5,518	(755)	-12%
Entertainment	341	493	152	45%
Total	47,537	31,005	(16,532)	-35%

Table B.50
Tacoma SCT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2003	2011	Change	Percent Change
Manufacturing	0.74	0.55	-0.19	-26%
Non Man Ind.	0.29	0.24	-0.05	-17%
Retail/Lodging	0.35	0.29	-0.05	-16%
Office	1.27	1.04	-0.23	-18%
Knowledge	0.97	1.12	0.16	16%
Education	6.26	8.46	2.21	35%
Health	0.99	1.30	0.31	32%
Entertainment	0.30	0.68	0.37	122%

Table B.51
Shift-Share Results for Tacoma SCT, 2004-2011

Sector	2003 SCT	2011 SCT	2003 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	2,316	989	18,929	18,383	2,104	145	(1,260)
Non Man Ind.	1,060	623	21,885	26,238	963	308	(648)
Retail/Lodging	3,455	1,797	60,056	62,444	3,138	454	(1,795)
Office	24,746	13,436	117,993	131,691	22,479	5,140	(14,183)
Knowledge	2,730	2,181	17,092	19,851	2,480	691	(990)
Education	6,616	5,968	6,398	7,201	6,010	1,437	(1,478)
Health	6,273	5,518	38,435	43,326	5,698	1,373	(1,553)
Entertainment	341	493	6,780	7,442	310	65	119
Total	47,537	31,005	287,568	316,576	43,181	9,613	(21,789)

Table B.52
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Tacoma SCT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 SCT	2007 SCT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	1663	1553	19,989	20,656	1,451	267	(165)
Non Man Ind.	804	602	20,920	26,864	702	331	(430)
Retail/Lodging	1737	2211	58,812	67,922	1,516	490	205
Office	13415	14487	115,591	132,515	11,706	3,673	(892)
Knowledge	2081	2060	17,002	21,135	1,816	771	(527)
Education	6354	5874	6,068	6,970	5,544	1,754	(1,425)
Health	4518	5326	37,437	40,696	3,942	969	415
Entertainment	*338*	*342*	*6,796*	*7,120*	*295*	*59*	*(12)*
Total	30910	32455	282,615	323,878	26,972	8,315	(2,832)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 SCT	2009 SCT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	1,553	953	20,656	18,971	1,579	(153)	(473)
Non Man Ind.	*602*	*547*	*26,864*	*25,396*	*612*	*(43)*	*(22)*
Retail/Lodging	2,211	1174	67,922	63,111	2,248	(194)	(880)
Office	14,487	8631	132,515	132,636	14,733	(232)	(5,869)
Knowledge	*2,060*	*1979*	*21,135*	*20,680*	*2,095*	*(79)*	*(37)*
Education	5,874	5640	6,970	7,073	5,974	(13)	(321)
Health	5,326	4076	40,696	43,175	5,416	234	(1,574)
Entertainment	342	318	7,120	7,436	348	9	(39)
Total	32,455	23318	323,878	318,478	33,005	(471)	(9,216)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 SCT	2011 SCT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	953	989	18971	18,383	959	(35)	66
Non Man Ind.	547	623	25396	26,238	550	15	58
Retail/Lodging	1174	1,797	63111	62,444	1,181	(19)	635
Office	8631	13,436	132636	131,691	8,683	(113)	4,866
Knowledge	1979	2,181	20680	19,851	1,991	(91)	281
Education	5640	5,968	7073	7,201	5,674	68	226
Health	4076	5,518	43175	43,326	4,100	(10)	1,428
Entertainment	318	493	7436	7,442	320	(2)	175
Total	23318	31,005	318478	316,576	23,458	(188)	7,735

Tampa TECO Streetcar

Table B. 53
Tampa SCT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	467	2,778	2,311	495%
Non Man Ind.	4,683	7,372	2,689	57%
Retail/Lodging	5,025	8,812	3,787	75%
Office	29,930	34,554	4,624	15%
Knowledge	10,219	14,238	4,019	39%
Education	27,107	30,413	3,306	12%
Health	5,826	11,045	5,219	90%
Entertainment	437	1,915	1,478	338%
Total	83,694	111,127	27,433	33%

Table B.54
Tampa SCT Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.08	0.43	0.35	429%
Non Man Ind.	0.66	0.90	0.24	36%
Retail/Lodging	0.30	0.36	0.06	20%
Office	1.03	1.16	0.13	13%
Knowledge	1.23	1.23	-0.00	-0%
Education	5.65	3.12	-2.54	-45%
Health	0.56	0.61	0.05	9%
Entertainment	0.29	0.71	0.42	145%

Table B.55
Shift-Share Results for Tampa SCT, 2002-2011

Sector	SCT 2002	SCT 2011	MSA 2002	MSA 2011	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	467	2,778	74,545	61,096	483	(100)	2,395
Non Man Ind.	4,683	7,372	91,323	76,994	4,838	(890)	3,424
Retail/Lodging	5,025	8,812	217,453	231,229	5,192	152	3,469
Office	29,930	34,554	376,785	281,306	30,924	(8,578)	12,208
Knowledge	10,219	14,238	107,404	109,507	10,558	(139)	3,819
Education	27,107	30,413	62,132	92,177	28,007	12,208	(9,802)
Health	5,826	11,045	135,409	171,934	6,019	1,378	3,648
Entertainment	437	1,915	19,516	25,479	452	119	1,344
Total	83,694	111,127	1,084,567	1,049,722	86,472	4,150	20,505

Table B.56
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Tampa SCT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	SCT 2002	SCT 2007	MSA 2002	MSA 2007	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	467	3,787	74,545	76,280	448	30	3,309
Non Man Ind.	4,683	8,340	91,323	85,556	4,491	(104)	3,953
Retail/Lodging	5,025	8,924	217,453	230,433	4,819	506	3,599
Office	29,930	31,232	376,785	354,202	28,705	(569)	3,096
Knowledge	10,219	14,808	107,404	119,034	9,801	1,525	3,482
Education	27,107	28,955	62,132	87,535	25,998	12,192	(9,235)
Health	5,826	9,442	135,409	150,975	5,588	908	2,946
Entertainment	437	1,575	19,516	26,822	419	181	974
Total	83,694	107,063	1,084,567	1,130,837	80,270	14,668	12,125

Great Recession Shift-Share Analysis 2007-2009

Sector	SCT 2007	SCT 2009	MSA 2007	MSA 2009	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	*3,787*	*3,235*	*76,280*	*64,087*	*4,213*	*(1,031)*	*53*
Non Man Ind.	8,340	7,880	85,556	76,163	9,278	(1,854)	456
Retail/Lodging	8,924	8,449	230,433	223,640	9,928	(1,267)	(212)
Office	31,232	32,775	354,202	271,874	34,746	(10,773)	8,802
Knowledge	14,808	12,952	119,034	109,175	16,474	(2,892)	(630)
Education	*28,955*	*29,336*	*87,535*	*88,442*	*32,213*	*(2,958)*	*81*
Health	9,442	10,566	150,975	157,989	10,504	(624)	685
Entertainment	1,575	1,705	26,822	25,109	1,752	(278)	231
Total	107,063	106,898	1,130,837	1,016,479	119,108	(21,677)	9,467

Post-Recession Shift-Share Analysis 2009-2011

Sector	SCT 2009	SCT 2011	MSA 2009	MSA 2011	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Manufacturing	3,235	2,778	64,087	61,096	3,133	(49)	(306)
Non Man Ind.	7,880	7,372	76,163	76,994	7,630	336	(594)
Retail/Lodging	*8,449*	*8,812*	*223,640*	*231,229*	*8,181*	*554*	*76*
Office	32,775	34,554	271,874	281,306	31,737	2,175	642
Knowledge	12,952	14,238	109,175	109,507	12,542	450	1,247
Education	*29,336*	*30,413*	*88,442*	*92,177*	*28,407*	*2,168*	*(162)*
Health	10,566	11,045	157,989	171,934	10,231	1,267	(454)
Entertainment	1,705	1,915	25,109	25,479	1,651	79	185
Total	106,898	111,127	1,016,479	1,049,722	103,513	6,980	634

Albuquerque-Santa Fe Rail Runner

Table B.57
Albuquerque-Santa Fe CRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	*576*	*407*	*(169)*	*-29%*
Non Man Ind.	*2,854*	*2,477*	*(377)*	*-13%*
Retail/Lodging	7,070	6,234	(836)	-12%
Office	15,171	17,726	2,555	17%
Knowledge	6,018	3,867	(2,151)	-36%
Education	3,024	1,131	(1,893)	-63%
Health	2,144	4,012	1,868	87%
Entertainment	2,066	1,084	(982)	-48%
Total	38,923	36,938	(1,985)	-5%

Table B.58
Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.22	0.23	0.01	5%
Non Man Ind.	0.53	0.58	0.05	8%
Retail/Lodging	0.80	0.73	-0.07	-9%
Office	1.75	2.11	0.36	20%
Knowledge	1.34	1.20	-0.14	-10%
Education	0.85	0.31	-0.55	-64%
Health	0.48	0.65	0.17	34%
Entertainment	2.11	1.29	-0.82	-39%
Total	39,632	36,938	(2,694)	-7%

Table B-59
Shift-Share Results for Albuquerque-Santa Fe CRT, 2002-2011

Sector	2002 CRT	2011 CRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	576	407	26,189	20,189	532	(88)	(37)
Non Man Ind.	2,854	2,477	54,296	49,580	2,636	(30)	(129)
Retail/Lodging	7,070	6,234	89,852	98,901	6,529	1,253	(1,548)
Office	15,171	17,726	87,854	97,211	14,011	2,776	939
Knowledge	6,018	3,867	45,701	37,417	5,558	(631)	(1,060)
Education	3,024	1,131	35,895	42,897	2,793	821	(2,483)
Health	2,144	4,012	45,017	71,501	1,980	1,425	607
Entertainment	2,066	1,084	9,910	9,700	1,908	114	(938)
Total	38,923	36,938	394,714	427,396	35,947	5,641	(4,650)

Table B.60
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Albuquerque CRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 CRT	2007 CRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	576	411	26,189	26,766	517	72	(178)
Non Man Ind.	2,854	2,877	54,296	64,422	2,561	825	(509)
Retail/Lodging	7,070	6,289	89,852	98,573	6,345	1,412	(1,467)
Office	15,171	16,082	87,854	94,076	13,615	2,631	(163)
Knowledge	6,018	4,395	45,701	49,167	5,401	1,074	(2,079)
Education	3,024	3,813	35,895	40,703	2,714	715	384
Health	2,144	2,415	45,017	55,104	1,924	700	(209)
Entertainment	2,066	1,177	9,910	11,025	1,854	444	(1,121)
Total	38,923	37,459	394,714	439,836	34,930	7,873	(5,344)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 CRT	2009 CRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	411	210	26,766	20,415	436	(122)	(103)
Non Man Ind.	2,877	2,435	64,422	53,540	3,051	(660)	44
Retail/Lodging	6,289	5,654	98,573	95,660	6,669	(566)	(449)
Office	16,082	16,050	94,076	89,935	17,054	(1,680)	676
Knowledge	4,395	3,910	49,167	48,525	4,661	(323)	(428)
Education	3,813	2,162	40,703	36,805	4,043	(596)	(1,286)
Health	2,415	3,821	55,104	61,051	2,561	115	1,145
Entertainment	1,177	1,106	11,025	8,841	1,248	(304)	162
Total	37,459	35,348	439,836	414,772	39,723	(4,136)	(239)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 CRT	2011 CRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	210	407	20,415	20,189	204	4	199
Non Man Ind.	2,435	2,477	53,540	49,580	2,363	(108)	222
Retail/Lodging	5,654	6,234	95,660	98,901	5,487	359	388
Office	16,050	17,726	89,935	97,211	15,576	1,773	378
Knowledge	3,910	3,867	48,525	37,417	3,795	(780)	852
Education	2,162	1,131	36,805	42,897	2,098	422	(1,389)
Health	3,821	4,012	61,051	71,501	3,708	767	(463)
Entertainment	1,106	1,084	8,841	9,700	1,073	140	(129)
Total	35,348	36,938	414,772	427,396	34,304	2,576	58

Miami-South Florida Tri-Rail

Table B.61
Miami-Dade CRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	7,948	4,617	(3,331)	-42%
Non Man Ind.	14,496	11,932	(2,564)	-18%
Retail/Lodging	9,973	8,234	(1,739)	-17%
Office	22,452	25,384	2,932	13%
Knowledge	7,855	8,497	642	8%
Education	236	651	415	176%
Health	4,596	6,723	2,127	46%
Entertainment	*932*	*1,067*	*135*	*14%*
Total	68,488	67,105	(1,383)	-2%

Table B.62
Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	2.10	1.99	-0.11	-5%
Non Man Ind.	1.34	1.33	-0.02	-1%
Retail/Lodging	0.69	0.51	-0.18	-26%
Office	1.29	1.49	0.20	15%
Knowledge	1.18	1.39	0.21	18%
Education	0.04	0.12	0.07	187%
Health	0.56	0.71	0.15	26%
Entertainment	0.71	0.82	0.11	15%

Table B.63
Shift-Share Results for Miami CRT, 2002-2011

Sector	2002 CRT	2011 CRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	7,948	4,617	116,900	77,390	7,527	(2,265)	(645)
Non Man Ind.	14,496	11,932	333,526	299,815	13,728	(697)	(1,099)
Retail/Lodging	9,973	8,234	448,922	538,136	9,444	2,511	(3,721)
Office	22,452	25,384	536,089	567,244	21,262	2,495	1,627
Knowledge	7,855	8,497	205,680	203,725	7,439	342	717
Education	236	651	181,973	188,476	223	21	407
Health	4,596	6,723	253,427	317,431	4,352	1,404	966
Entertainment	932	1,067	40,789	43,596	883	114	71
Total	68,488	67,105	2,117,306	2,235,813	64,858	3,924	(1,677)

Table B.64
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Miami CRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 CRT	2007 CRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	7,948	6,639	116,900	103,507	7,407	(370)	(398)
Non Man Ind.	14,496	12,944	333,526	379,245	13,510	2,973	(3,539)
Retail/Lodging	9,973	7,461	448,922	482,941	9,295	1,434	(3,268)
Office	22,452	32,025	536,089	585,689	20,925	3,605	7,496
Knowledge	7,855	7,832	205,680	204,058	7,321	472	39
Education	236	263	181,973	191,915	220	29	14
Health	4,596	5,865	253,427	279,957	4,283	794	788
Entertainment	932	981	40,789	44,543	869	149	(37)
Total	68,488	74,010	2,117,306	2,271,855	63,829	9,086	1,095

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 CRT	2009 CRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	6,639	4,994	103,507	81,291	7,216	(2,002)	(220)
Non Man Ind.	12,944	10,712	379,245	305,320	14,069	(3,648)	291
Retail/Lodging	7,461	7,782	482,941	466,099	8,110	(909)	581
Office	32,025	22,763	585,689	525,163	34,809	(6,094)	(5,952)
Knowledge	7,832	7,932	204,058	188,602	8,513	(1,274)	693
Education	263	798	191,915	184,888	286	(32)	545
Health	5,865	4,577	279,957	296,601	6,375	(161)	(1,637)
Entertainment	981	1,022	44,543	42,178	1,066	(137)	93
Total	74,010	60,580	2,271,855	2,090,142	80,444	(14,258)	(5,606)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 CRT	2011 CRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	4,994	4,617	81,291	77,390	4,669	86	(137)
Non Man Ind.	10,712	11,932	305,320	299,815	10,014	505	1,413
Retail/Lodging	7,782	8,234	466,099	538,136	7,275	1,710	(751)
Office	22,763	25,384	525,163	567,244	21,280	3,307	797
Knowledge	7,932	8,497	188,602	203,725	7,415	1,153	(71)
Education	798	651	184,888	188,476	746	67	(162)
Health	4,577	6,723	296,601	317,431	4,279	620	1,825
Entertainment	1,022	1,067	42,178	43,596	955	101	11
Total	60,580	67,105	2,090,142	2,235,813	56,633	7,548	2,924

Salt Lake FrontRunner

Table B.65
Salt Lake CRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	2,295	1,088	(1,207)	-53%
Non Man Ind.	1,882	2,223	341	18%
Retail/Lodging	*2,742*	*2,856*	*114*	*4%*
Office	2,684	10,687	8,003	298%
Knowledge	*2,552*	*3,283*	*731*	*29%*
Education	146	404	258	177%
Health	618	1,095	477	77%
Entertainment	641	938	297	46%
Total	13,560	22,574	9,014	66%

Table B.66
Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	1.50	0.49	-1.01	-67%
Non Man Ind.	0.94	0.71	-0.23	-24%
Retail/Lodging	0.97	0.64	-0.33	-34%
Office	0.86	2.03	1.17	135%
Knowledge	2.16	1.50	-0.66	-30%
Education	0.11	0.18	0.07	65%
Health	0.49	0.42	-0.07	-14%
Entertainment	2.17	2.03	-0.15	-7%

Table B.67
Shift-Share Results for Salt Lake CRT, 2002-2011

Sector	2002 CRT	2011 CRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	2,295	1,088	93,384	92,489	2,009	264	(1,185)
Non Man Ind.	1,882	2,223	122,196	131,150	1,647	372	203
Retail/Lodging	2,742	2,856	173,091	186,468	2,400	554	(98)
Office	2,684	10,687	190,164	220,660	2,349	765	7,573
Knowledge	2,552	3,283	71,951	91,363	2,234	1,007	42
Education	146	404	81,094	93,544	128	41	236
Health	618	1,095	77,414	110,036	541	337	217
Entertainment	641	938	18,018	19,390	561	129	248
Total	13,560	22,574	827,312	945,100	11,870	3,468	7,236

Table B.68
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Salt Lake CRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 CRT	2007 CRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	2,295	1,808	93,384	98,845	2,003	427	(621)
Non Man Ind.	1,882	2,362	122,196	158,725	1,642	802	(83)
Retail/Lodging	2,742	3,457	173,091	191,453	2,393	640	424
Office	2,684	3,117	190,164	214,729	2,342	689	86
Knowledge	2,552	1,993	71,951	86,843	2,227	853	(1,087)
Education	146	207	81,094	84,376	127	25	55
Health	618	664	77,414	93,920	539	211	(86)
Entertainment	641	778	18,018	19,251	559	126	93
Total	13,560	14,386	827,312	948,142	11,832	3,772	(1,218)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 CRT	2009 CRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,808	1,382	98,845	91,171	1,878	(210)	(286)
Non Man Ind.	2,362	2,297	158,725	133,797	2,453	(462)	306
Retail/Lodging	3,457	3,451	191,453	186,248	3,590	(227)	88
Office	3,117	3,460	214,729	204,739	3,237	(265)	488
Knowledge	1,993	2,033	86,843	88,100	2,070	(48)	11
Education	207	391	84,376	86,502	215	(3)	179
Health	664	771	93,920	102,500	690	35	46
Entertainment	778	745	19,251	19,920	808	(3)	(60)
Total	14,386	14,530	948,142	912,977	14,940	(1,183)	773

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 CRT	2011 CRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,382	1,088	91,171	92,489	1,335	67	(314)
Non Man Ind.	2,297	2,223	133,797	131,150	2,219	33	(29)
Retail/Lodging	3,451	2,856	186,248	186,468	3,334	121	(599)
Office	3,460	10,687	204,739	220,660	3,342	387	6,958
Knowledge	2,033	3,283	88,100	91,363	1,964	144	1,175
Education	391	404	86,502	93,544	378	45	(19)
Health	771	1,095	102,500	110,036	745	83	267
Entertainment	745	938	19,920	19,390	720	6	213
Total	14,530	22,574	912,977	945,100	14,036	886	7,652

San Diego Coaster

Table B.69
San Diego CRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	1,860	766	(1,094)	-59%
Non Man Ind.	5,183	5,447	264	5%
Retail/Lodging	13,078	12,422	(656)	-5%
Office	32,640	36,029	3,389	10%
Knowledge	13,657	9,704	(3,953)	-29%
Education	1,793	795	(998)	-56%
Health	*1,582*	*2,128*	*546*	*35%*
Entertainment	1,353	1,294	(59)	-4%
Total	71,146	68,585	(2,561)	-4%

Table B.70
Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.26	0.14	-0.12	-45%
Non Man Ind.	0.59	0.80	0.21	35%
Retail/Lodging	0.88	0.86	-0.02	-3%
Office	2.10	2.30	0.20	9%
Knowledge	1.54	1.10	-0.44	-28%
Education	0.24	0.11	-0.13	-55%
Health	0.24	0.27	0.03	14%
Entertainment	0.77	0.63	-0.14	-18%

Table B.71
Shift-Share Results for San Diego CRT, 2002-2011

Sector	2002 CRT	2011 CRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,860	766	115,957	96,145	1,739	(197)	(776)
Non Man Ind.	5,183	5,447	142,502	122,668	4,846	(384)	985
Retail/Lodging	13,078	12,422	240,954	260,760	12,228	1,925	(1,731)
Office	32,640	36,029	251,614	281,802	30,518	6,038	(527)
Knowledge	13,657	9,704	143,849	158,426	12,769	2,272	(5,337)
Education	1,793	795	119,433	131,856	1,676	303	(1,185)
Health	1,582	2,128	108,745	142,958	1,479	601	48
Entertainment	1,353	1,294	28,525	37,053	1,265	492	(464)
Total	71,146	68,585	1,151,579	1,231,668	66,520	11,051	(8,986)

Table B.72
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, San Diego CRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 CRT	2007 CRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,860	729	115,957	101,048	1,763	(142)	(892)
Non Man Ind.	5,183	6,044	142,502	154,119	4,913	692	438
Retail/Lodging	13,078	13,006	240,954	261,334	12,397	1,787	(1,178)
Office	32,640	31,484	251,614	270,974	30,940	4,211	(3,667)
Knowledge	13,657	13,780	143,849	146,052	12,946	920	(86)
Education	1,793	1,686	119,433	125,839	1,700	190	(203)
Health	1,582	1,954	108,745	118,735	1,500	228	227
Entertainment	1,353	1,594	28,525	36,740	1,283	460	(149)
Total	71,146	70,277	1,151,579	1,214,841	67,441	8,346	(5,510)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 CRT	2009 CRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	729	631	101,048	97,304	752	(50)	(71)
Non Man Ind.	6,044	4,927	154,119	125,696	6,233	(1,304)	(2)
Retail/Lodging	13,006	11,460	261,334	242,682	13,412	(1,335)	(618)
Office	31,484	31,147	270,974	253,976	32,468	(2,959)	1,638
Knowledge	13,780	17,143	146,052	153,266	14,211	250	2,682
Education	1,686	1,716	125,839	136,374	1,739	88	(111)
Health	1,954	2,093	118,735	132,666	2,015	168	(90)
Entertainment	1,594	1,401	36,740	36,062	1,644	(79)	(164)
Total	70,277	70,518	1,214,841	1,178,026	72,473	(5,220)	3,264

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 CRT	2011 CRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	631	766	97,304	96,145	604	20	143
Non Man Ind.	4,927	5,447	125,696	122,668	4,712	96	639
Retail/Lodging	11,460	12,422	242,682	260,760	10,961	1,353	108
Office	31,147	36,029	253,976	281,802	29,790	4,769	1,469
Knowledge	17,143	9,704	153,266	158,426	16,396	1,324	(8,016)
Education	1,716	795	136,374	131,856	1,641	18	(864)
Health	2,093	2,128	132,666	142,958	2,002	254	(127)
Entertainment	1,401	1,294	36,062	37,053	1,340	100	(146)
Total	70,518	68,585	1,178,026	1,231,668	67,447	7,932	(6,794)

Seattle Sounder

Table B. 73
Seattle CRT Change in Jobs by Combined Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	*2,149*	*2,166*	*17*	*1%*
Non Man Ind.	5,796	6,404	608	10%
Retail/Lodging	6,568	7,390	822	13%
Office	23,545	23,798	253	1%
Knowledge	8,103	9,103	1,000	12%
Education	*4,350*	*4,679*	*329*	*8%*
Health	4,379	4,616	237	5%
Entertainment	1,671	1,742	71	4%
Total	56,561	59,898	3,337	6%

Table B.74
Change in Location Quotients by Combined Economic Sector, 2002-2011

Sector	2002	2011	Change	Percent Change
Manufacturing	0.35	0.37	0.02	7%
Non Man Ind.	0.70	0.81	0.11	16%
Retail/Lodging	0.62	0.69	0.07	11%
Office	1.81	1.71	-0.10	-6%
Knowledge	1.25	1.18	-0.07	-5%
Education	0.90	0.94	0.05	5%
Health	0.72	0.61	-0.11	-15%
Entertainment	1.43	1.26	-0.17	-12%

Table B.75
Shift-Share Results for Seattle CRT, 2002-2011

Sector	2002 CRT	2011 CRT	2002 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	2,149	2,166	167,680	167,626	1,919	229	18
Non Man Ind.	5,796	6,404	226,220	228,556	5,176	679	548
Retail/Lodging	6,568	7,390	289,050	308,906	5,866	1,153	371
Office	23,545	23,798	354,774	401,918	21,028	5,646	(2,876)
Knowledge	8,103	9,103	177,427	222,907	7,237	2,943	(1,077)
Education	4,350	4,679	132,488	143,112	3,885	814	(20)
Health	4,379	4,616	166,546	218,300	3,911	1,829	(1,124)
Entertainment	1,671	1,742	31,887	39,805	1,492	594	(344)
Total	56,561	59,898	1,546,072	1,731,130	50,515	13,887	(4,504)

Table B.76
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Seattle CRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2002 CRT	2007 CRT	2002 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	2,149	1,982	167,680	179,599	1,966	336	(320)
Non Man Ind.	5,796	5,982	226,220	274,378	5,301	1,729	(1,048)
Retail/Lodging	6,568	7,651	289,050	313,481	6,007	1,116	528
Office	23,545	23,911	354,774	376,262	21,535	3,436	(1,060)
Knowledge	8,103	9,055	177,427	183,974	7,411	991	653
Education	4,350	4,698	132,488	138,129	3,979	557	163
Health	4,379	4,153	166,546	187,444	4,005	923	(775)
Entertainment	1,671	1,165	31,887	37,126	1,528	417	(781)
Total	56,561	58,597	1,546,072	1,690,393	51,732	9,505	(2,640)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 CRT	2009 CRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,982	1,507	179,599	170,019	1,977	(100)	(369)
Non Man Ind.	5,982	5,971	274,378	242,149	5,966	(686)	692
Retail/Lodging	7,651	7,204	313,481	301,663	7,630	(268)	(159)
Office	23,911	24,883	376,262	383,126	23,846	501	536
Knowledge	9,055	9,141	183,974	212,793	9,030	1,443	(1,332)
Education	4,698	4,833	138,129	142,026	4,685	145	2
Health	4,153	4,187	187,444	204,368	4,142	386	(341)
Entertainment	1,165	1,132	37,126	38,849	1,162	57	(87)
Total	58,597	58,858	1,690,393	1,694,993	58,438	1,478	(1,058)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 CRT	2011 CRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Manufacturing	1,507	2,166	170,019	167,626	1,476	10	680
Non Man Ind.	5,971	6,404	242,149	228,556	5,846	(211)	768
Retail/Lodging	7,204	7,390	301,663	308,906	7,054	323	13
Office	24,883	23,798	383,126	401,918	24,364	1,740	(2,305)
Knowledge	9,141	9,103	212,793	222,907	8,950	625	(472)
Education	4,833	4,679	142,026	143,112	4,732	138	(191)
Health	4,187	4,616	204,368	218,300	4,100	373	144
Entertainment	1,132	1,742	38,849	39,805	1,108	51	582
Total	58,858	59,898	1,694,993	1,731,130	57,629	3,050	(782)

Eugene-Springfield Emerald Express—EmX

Table B.77
Eugene-Springfield BRT Change in Jobs by Combined Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	578	436	(142)	-25%
Non Man Ind.	1,171	1,094	(77)	-7%
Retail/Lodging	*3,847*	*3,855*	*8*	*0%*
Office	8,149	8,587	438	5%
Knowledge	*3,682*	*3,474*	*(208)*	*-6%*
Education	*1,124*	*1,273*	*149*	*13%*
Health	8,328	9,349	1,021	12%
Entertainment	910	809	(101)	-11%
Total	27,789	28,877	1,088	4%

Table B.78
Eugene-Springfield BRT Change in LQs by Combined Economic Sector, 2007-2011

Sector	2007	2011	Change	Percent Change
Manufacturing	0.16	0.16	0.01	4%
Non Man Ind.	0.34	0.37	0.03	8%
Retail/Lodging	0.65	0.60	-0.05	-8%
Office	1.49	1.52	0.04	2%
Knowledge	2.03	1.80	-0.23	-11%
Education	0.37	0.34	-0.03	-7%
Health	2.17	1.88	-0.29	-13%
Entertainment	1.64	1.60	-0.04	-3%
Total	1.00	0.00	-0.57	-57%

Table B.79
Shift-Share Results for Dallas-Springfield BRT, 2007-2011

Sector	2007 BRT	2011 BRT	2007 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	578	436	19,385	12,482	628	(256)	64
Non Man Ind.	1,171	1,094	18,344	14,004	1,272	(379)	200
Retail/Lodging	3,847	3,855	30,995	29,931	4,180	(465)	140
Office	8,149	8,587	28,937	26,380	8,855	(1,426)	1,158
Knowledge	3,682	3,474	9,570	9,035	4,001	(525)	(2)
Education	1,124	1,273	16,197	17,469	1,221	(9)	61
Health	8,328	9,349	20,270	23,267	9,050	510	(210)
Entertainment	910	809	2,925	2,363	989	(254)	74
Total	27,789	28,877	146,623	134,931	30,197	(2,804)	1,484

Table B.80
Pre-Recession (pre Light Rail), Great Recession and Recovery Shift-Share Analysis, Eugene-Springfield BRT System, 2004-2011

Pre-Recession Shift-Share Analysis 2004-2007

Sector	2004 BRT	2007 BRT	2004 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	678	578	19,796	19,385	629	34	(86)
Non Man Ind.	1,065	1,171	16,207	18,344	989	217	(34)
Retail/Lodging	3,434	3,847	28,532	30,995	3,188	542	117
Office	6,795	8,149	26,897	28,937	6,308	1,002	839
Knowledge	3,329	3,682	9,111	9,570	3,091	406	185
Education	980	1,124	15,256	16,197	910	131	84
Health	7,744	8,328	18,034	20,270	7,189	1,515	(376)
Entertainment	752	910	2,290	2,925	698	262	(51)
Total	24,777	27,789	136,123	146,623	23,003	4,109	677

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 BRT	2009 BRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	578	389	19,385	12,713	634	(255)	10
Non Man Ind.	1,171	986	18,344	14,973	1,284	(328)	30
Retail/Lodging	3,847	3,690	30,995	29,416	4,218	(567)	39
Office	8,149	8,078	28,937	25,739	8,935	(1,686)	830
Knowledge	3,682	3,653	9,570	9,021	4,037	(566)	182
Education	1,124	1,274	16,197	17,141	1,232	(43)	84
Health	8,328	9,052	20,270	22,098	9,131	(52)	(27)
Entertainment	910	808	2,925	2,631	998	(179)	(11)
Total	27,789	27,930	146,623	133,732	30,468	(3,676)	1,138

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 BRT	2011 BRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	389	436	12,713	12,482	386	(4)	54
Non Man Ind.	986	1,094	14,973	14,004	977	(55)	172
Retail/Lodging	3,690	3,855	29,416	29,931	3,657	97	100
Office	8,078	8,587	25,739	26,380	8,006	273	308
Knowledge	3,653	3,474	9,021	9,035	3,621	38	(185)
Education	1,274	1,273	17,141	17,469	1,263	36	(25)
Health	9,052	9,349	22,098	23,267	8,972	559	(182)
Entertainment	808	809	2,631	2,363	801	(75)	83
Total	27,930	28,877	133,732	134,931	27,682	870	326

Las Vegas Metropolitan Area—MAX

Table B.81
Las Vegas BRT Change in Jobs by Combined Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	47	106	59	126%
Non Man Ind.	552	146	(406)	-74%
Retail/Lodging	8,546	7,499	(1,047)	-12%
Office	6,861	9,347	2,486	36%
Knowledge	522	297	(225)	-43%
Education	79	30	(49)	-62%
Health	572	427	(145)	-25%
Entertainment	1,019	1,374	355	35%
Total	18,198	19,226	1,028	6%

Table B.82
Las Vegas BRT Change in Location Quotients by Combined Economic Sector, 2004-2011

Sector	2004	2011	Change	Percent Change
Manufacturing	0.09	0.23	0.14	166%
Non Man Ind.	0.18	0.07	-0.11	-63%
Retail/Lodging	1.19	0.93	-0.26	-22%
Office	1.88	2.35	0.47	25%
Knowledge	0.50	0.27	-0.22	-45%
Education	0.08	0.02	-0.05	-71%
Health	0.45	0.25	-0.20	-45%
Entertainment	2.43	3.38	0.95	39%

Table B.83
Shift-Share Results for Las Vegas BRT, 2004-2011

Sector	2004 BRT	2011 BRT	2004 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	47	106	23,723	19,854	45	(6)	67
Non Man Ind.	552	146	130,375	91,358	529	(143)	(241)
Retail/Lodging	8,546	7,499	307,568	341,308	8,196	1,288	(1,984)
Office	6,861	9,347	156,838	168,474	6,580	790	1,977
Knowledge	522	297	45,096	46,223	501	34	(238)
Education	79	30	44,853	57,323	76	25	(71)
Health	572	427	54,864	72,939	549	212	(333)
Entertainment	1,019	1,374	18,009	17,245	977	(1)	398
Total	18,198	19,226	781,326	814,724	17,452	2,200	(426)

Table B.84
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Law Vegas BRT System, 2004-2011

Pre-Recession Shift-Share Analysis 2004-2007

Sector	2004 BRT	2007 BRT	2004 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	47	254	23,723	27,351	40	14	200
Non Man Ind.	552	218	130,375	161,827	472	213	(467)
Retail/Lodging	8,546	8,219	307,568	351,561	7,313	2,455	(1,549)
Office	6,861	7,506	156,838	179,772	5,872	1,993	(358)
Knowledge	522	287	45,096	53,839	447	176	(336)
Education	79	17	44,853	55,956	68	31	(82)
Health	572	455	54,864	63,180	490	169	(204)
Entertainment	1,019	1,030	18,009	19,513	872	232	(74)
Total	18,198	17,986	781,326	912,999	15,573	5,283	(2,871)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 BRT	2009 BRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	254	234	27,351	21,913	283	(80)	31
Non Man Ind.	218	119	161,827	122,151	243	(79)	(46)
Retail/Lodging	8,219	7,129	351,561	323,506	9,170	(1,607)	(434)
Office	7,506	8,206	179,772	163,669	8,374	(1,541)	1,372
Knowledge	287	320	53,839	47,291	320	(68)	68
Education	17	24	55,956	57,104	19	(2)	7
Health	455	438	63,180	66,978	508	(25)	(44)
Entertainment	1,030	827	19,513	15,731	1,149	(319)	(3)
Total	17,986	17,297	912,999	818,343	20,066	(3,719)	950

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 BRT	2011 BRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	234	106	21,913	19,854	235	(23)	(106)
Non Man Ind.	119	146	122,151	91,358	120	(31)	57
Retail/Lodging	7,129	7,499	323,506	341,308	7,161	361	(22)
Office	8,206	9,347	163,669	168,474	8,242	204	900
Knowledge	320	297	47,291	46,223	321	(9)	(16)
Education	24	30	57,104	57,323	24	(0)	6
Health	438	427	66,978	72,939	440	37	(50)
Entertainment	827	1,374	15,731	17,245	831	76	467
Total	17,297	19,226	818,343	814,724	17,374	616	1,236

Valley Metro (Phoenix) Transit—- RAPID

Table B.85
Phoenix BRT Change in Jobs by Combined Sector, 2009-2011

Sector	2009	2011	Change	Percent Change
Manufacturing	259	181	(78)	-30%
Non Man Ind.	547	466	(81)	-15%
Retail/Lodging	3,072	2,838	(234)	-8%
Office	4,421	3,592	(829)	-19%
Knowledge	476	389	(87)	-18%
Education	12,557	11,826	(731)	-6%
Health	1,860	1,650	(210)	-11%
Entertainment	*19*	*12*	*(7)*	*-37%*
Total	23,211	20,954	(2,257)	-10%

Table B.86
Phoenix BRT Change in Location Quotients by Combined Economic Sector, 2009-2011

Sector	2009	2011	Change	Percent Change
Manufacturing	0.17	0.12	-0.04	-26%
Non Man Ind.	0.17	0.17	-0.00	-1%
Retail/Lodging	0.62	0.64	0.01	2%
Office	0.69	0.63	-0.06	-9%
Knowledge	0.26	0.25	-0.02	-6%
Education	5.86	6.41	0.55	9%
Health	0.68	0.61	-0.06	-9%
Entertainment	0.04	0.03	-0.01	-32%

Table B.87
Shift-Share Results for Phoenix BRT, 2009-2011

Sector	2009 BRT	2011 BRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	259	181	109,096	117,141	254	24	(97)
Non Man Ind.	547	466	227,616	222,356	536	(2)	(68)
Retail/Lodging	3,072	2,838	349,951	358,421	3,011	135	(308)
Office	4,421	3,592	452,323	457,533	4,334	138	(880)
Knowledge	476	389	128,692	126,837	467	3	(80)
Education	12,557	11,826	152,258	148,176	12,309	(89)	(394)
Health	1,860	1,650	194,950	215,800	1,823	236	(409)
Entertainment	19	12	33,866	35,689	19	1	(8)
Total	23,211	20,954	1,648,752	1,681,953	22,753	446	(2,245)

Table B.88
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Phoenix BRT System, 2004-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2004 BRT	2007 BRT	2004 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	101	217	132,305	145,047	89	22	106
Non Man Ind.	1,159	1,093	262,894	325,382	1,023	412	(341)
Retail/Lodging	4,957	4,571	341,456	386,318	4,374	1,234	(1,037)
Office	3,769	3,529	439,017	499,360	3,326	961	(758)
Knowledge	721	616	123,973	135,703	636	153	(173)
Education	10,322	13,118	120,859	125,163	9,109	1,581	2,428
Health	1,080	1,581	150,905	163,289	953	216	412
Entertainment	64	22	32,122	36,879	56	17	(51)
Total	22,173	24,747	1,603,531	1,817,141	19,567	4,595	586

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 BRT	2009 BRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	217	259	145,047	109,096	239	(76)	96
Non Man Ind.	1,093	547	325,382	227,616	1,205	(440)	(218)
Retail/Lodging	4,571	3,072	386,318	349,951	5,038	(897)	(1,069)
Office	3,529	4,421	499,360	452,323	3,889	(693)	1,224
Knowledge	616	476	135,703	128,692	679	(95)	(108)
Education	13,118	12,557	125,163	152,258	14,458	1,500	(3,401)
Health	1,581	1,860	163,289	194,950	1,742	145	(28)
Entertainment	22	19	36,879	33,866	24	(4)	(1)
Total	24,747	23,211	1,817,141	1,648,752	27,274	(560)	(3,504)

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 BRT	2011 BRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	259	181	109,096	117,141	254	24	(97)
Non Man Ind.	547	466	227,616	222,356	536	(2)	(68)
Retail/Lodging	3,072	2,838	349,951	358,421	3,011	135	(308)
Office	4,421	3,592	452,323	457,533	4,334	138	(880)
Knowledge	476	389	128,692	126,837	467	3	(80)
Education	12,557	11,826	152,258	148,176	12,309	(89)	(394)
Health	1,860	1,650	194,950	215,800	1,823	236	(409)
Entertainment	19	12	33,866	35,689	19	1	(8)
Total	23,211	20,954	1,648,752	1,681,953	22,753	446	(2,245)

Salt Lake City—MAX

Table B.89
Salt Lake City BRT Change in Jobs by Combined Sector, 2008-2011

Sector	2008	2011	Change	Percent Change
Manufacturing	496	628	132	27%
Non Man Ind.	1,042	841	(201)	-19%
Retail/Lodging	3,814	3,457	(357)	-9%
Office	2,187	1,792	(395)	-18%
Knowledge	*255*	*323*	*68*	*27%*
Education	378	485	107	28%
Health	*455*	*539*	*84*	*18%*
Entertainment	118	54	(64)	-54%
Total	8,745	8,119	(626)	-7%

Table B.90
Salt Lake City BRT Change in LQs by Combined Economic Sector, 2008-2011

Sector	2008	2011	Change	Percent Change
Manufacturing	0.61	0.88	0.27	44%
Non Man Ind.	0.73	0.71	-0.02	-3%
Retail/Lodging	2.17	2.20	0.03	1%
Office	0.99	0.85	-0.13	-14%
Knowledge	0.31	0.42	0.11	34%
Education	0.53	0.69	0.16	31%
Health	0.55	0.60	0.04	8%
Entertainment	0.66	0.32	-0.34	-52%

Table B.91
Shift-Share Results for Salt Lake City BRT, 2008-2011

Sector	2008 BRT	2011 BRT	2008 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	496	628	57,330	52,992	507	(49)	170
Non Man Ind.	1,042	841	100,389	88,206	1,066	(150)	(75)
Retail/Lodging	3,814	3,457	123,291	116,081	3,902	(311)	(134)
Office	2,187	1,792	155,430	155,199	2,237	(54)	(392)
Knowledge	255	323	57,937	57,463	261	(8)	70
Education	378	485	50,024	51,715	387	4	94
Health	455	539	57,778	66,780	465	60	13
Entertainment	118	54	12,472	12,400	121	(3)	(63)
Total	8,745	8,119	614,651	600,836	8,946	(510)	(317)

Table B.92
Pre-Recession, Great Recession and Recovery Shift-Share Analysis, Salt Lake City BRT System, 2002-2011

Pre-Recession Shift-Share Analysis 2002-2007

Sector	2004 BRT	2007 BRT	2004 MSA	2007 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	663	500	51,010	55,226	590	128	(218)
Non Man Ind.	720	1,040	80,023	102,386	641	281	119
Retail/Lodging	4,183	3,732	110,031	119,269	3,721	813	(802)
Office	2,322	2,679	141,316	153,667	2,066	459	154
Knowledge	225	251	47,314	55,939	200	66	(15)
Education	354	337	46,769	49,467	315	59	(37)
Health	316	479	52,143	57,129	281	65	133
Entertainment	78	48	10,496	12,903	69	26	(48)
Total	8,861	9,066	539,102	605,986	7,883	1,898	(715)

Great Recession Shift-Share Analysis 2007-2009

Sector	2007 BRT	2009 BRT	2007 MSA	2009 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	500	1,367	55,226	52,742	522	(44)	889
Non Man Ind.	1,040	1,148	102,386	89,422	1,085	(177)	240
Retail/Lodging	3,732	3,400	119,269	115,949	3,893	(265)	(228)
Office	2,679	1,906	153,667	148,302	2,795	(209)	(679)
Knowledge	251	274	55,939	55,809	262	(11)	24
Education	337	410	49,467	42,901	352	(59)	118
Health	479	513	57,129	62,661	500	26	(12)
Entertainment	48	145	12,903	13,078	50	(1)	96
Total	9,066	9,163	605,986	580,864	9,458	(742)	447

Post-Recession Shift-Share Analysis 2009-2011

Sector	2009 BRT	2011 BRT	2009 MSA	2011 MSA	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Manufacturing	1,367	628	52,742	52,992	1,322	52	(745)
Non Man Ind.	1,148	841	89,422	88,206	1,110	23	(291)
Retail/Lodging	3,400	3,457	115,949	116,081	3,287	117	53
Office	1,906	1,792	148,302	155,199	1,843	152	(203)
Knowledge	274	323	55,809	57,463	265	17	41
Education	410	485	42,901	51,715	396	98	(9)
Health	513	539	62,661	66,780	496	51	(8)
Entertainment	145	54	13,078	12,400	140	(3)	(83)
Total	9,163	8,119	580,864	600,836	8,858	507	(1,246)

APPENDIX C
DETAILED TABLES FOR LRT, SCT AND CRT SYSTEMS WITH RESPECT TO THE LOCATION OF PEOPLE AND HOUSING

Light Rail Transit Systems

These tables exclude LRT systems for Phoenix, which for practical purposes started operations in 2009, and Seattle, which also started in 2009.

Table C.1
Charlotte LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	48,874	21,623	8,117	10,328	3,178	23,239	12,896
2000 Metro	1,728,616	658,711	171,703	374,892	112,116	686,580	202,076
2000 LRT/Metro	2.8%	3.3%	4.7%	2.8%	2.8%	3.4%	6.4%
2010 LRT	58,931	26,438	10,888	12,332	3,218	30,702	16,376
2010 Metro	2,223,635	848,745	184,327	510,352	154,066	961,206	272,837
2010 LRT/Metro	2.7%	3.1%	5.9%	2.4%	2.1%	3.2%	6.0%
LRT/Metro 2010-2000	94%	95%	125%	88%	74%	94%	94%
Metro Outcome	Lost Share	Lost Share	Gained Share	Lost Share	Lost Share	Lost Share	Lost Share
LRT 2000-2010	10,057	4,815	2,771	2,004	40	7,463	3,480
LRT Percent	20.6%	22.3%	34.1%	19.4%	1.3%	32.1%	27.0%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.2
Dallas LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	195,019	75,659	31,078	13,058	9,818	82,402	51,247
2000 Metro	5,235,385	1,897,576	548,932	1,092,939	255,705	1,991,236	752,247
2000 LRT/Metro	3.7%	4.0%	5.7%	1.2%	3.8%	4.1%	6.8%
2010 LRT	186,277	76,257	29,496	36,397	10,364	86,408	50,124
2010 Metro	6,452,758	2,320,283	561,234	1,401,772	357,277	2,592,495	888,393
2010 LRT/Metro	2.9%	3.3%	5.3%	2.6%	2.9%	3.3%	5.6%
LRT/Metro 2010-2000	77%	82%	93%	217%	76%	81%	83%
Metro Outcome	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share
LRT 2000-2010	(8,742)	598	(1,582)	23,339	546	4,006	(1,123)
LRT Percent	-4.5%	0.8%	-5.1%	178.7%	5.6%	4.9%	-2.2%
LRT Outcome	Lost	Gained	Lost	Gained	Gained	Gained	Lost

Table C.3
Denver LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	83,413	38,093	12,154	19,184	6,755	41,088	21,173
2000 Metro	2,171,140	844,017	223,849	496,590	123,578	869,600	279,389
2000 LRT/Metro	3.8%	4.5%	5.4%	3.9%	5.5%	4.7%	7.6%
2010 LRT	90,804	44,625	16,611	21,159	6,855	49,439	26,448
2010 Metro	2,521,640	983,282	234,418	586,210	162,654	1,059,571	352,249
2010 LRT/Metro	3.6%	4.5%	7.1%	3.6%	4.2%	4.7%	7.5%
LRT/Metro 2010-2000	94%	101%	131%	93%	77%	99%	99%
Metro Outcome	Lost Share	Constant Share	Gained Share	Lost Share	Lost Share	Constant Share	Constant Share
LRT 2000-2010	7,391	6,532	4,457	1,975	100	8,351	5,275
LRT Percent	8.9%	17.1%	36.7%	10.3%	1.5%	20.3%	24.9%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.4
Houston LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	54,979	22,165	10,114	10,004	2,047	25,592	16,224
2000 Metro	4,717,507	1,648,148	438,359	984,715	225,074	1,761,454	647,047
2000 LRT/Metro	1.2%	1.3%	2.3%	1.0%	0.9%	1.5%	2.5%
2010 LRT	71,558	29,964	14,292	13,061	2,611	35,818	21,345
2010 Metro	5,948,689	2,062,529	488,378	1,261,183	312,968	2,349,122	776,106
2010 LRT/Metro	1.2%	1.5%	2.9%	1.0%	0.8%	1.5%	2.8%
LRT/Metro 2010-2000	103%	108%	127%	102%	92%	105%	110%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Lost Share	Gained Share	Gained Share
LRT 2000-2010	16,579	7,799	4,178	3,057	564	10,226	5,121
LRT Percent	30.2%	35.2%	41.3%	30.6%	27.6%	40.0%	31.6%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.5
Portland LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	57,753	28,952	10,251	14,262	4,439	31,997	18,269
2000 Metro	1,934,792	745,531	188,345	430,823	126,363	779,438	276,375
2000 LRT/Metro	3.0%	3.9%	5.4%	3.3%	3.5%	4.1%	6.6%
2010 LRT	67,026	34,757	12,468	17,320	4,969	38,915	22,003
2010 Metro	2,232,177	867,794	191,159	513,515	163,120	935,123	332,361
2010 LRT/Metro	3.0%	4.0%	6.5%	3.4%	3.0%	4.2%	6.6%
LRT/Metro 2010-2000	101%	103%	120%	102%	87%	101%	100%
Metro Outcome	Constant Share	Gained Share	Gained Share	Gained Share	Lost Share	Constant Share	Constant Share
LRT 2000-2010	9,273	5,805	2,217	3,058	530	6,918	3,734
LRT Percent	16.1%	20.1%	21.6%	21.4%	11.9%	21.6%	20.4%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.7
Sacramento LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	57,333	20,436	5,139	11,116	4,181	21,775	9,875
2000 Metro	1,807,949	665,298	154,947	384,104	126,247	683,452	257,582

2000 LRT/Metro	3.2%	3.1%	3.3%	2.9%	3.3%	3.2%	3.8%
2010 LRT	58,652	21,269	4,771	12,211	4,287	23,330	10,578
2010 Metro	2,154,417	787,667	164,371	461,646	161,650	915,892	309,155
2010 LRT/Metro	2.7%	2.7%	2.9%	2.6%	2.7%	2.5%	3.4%
LRT/Metro 2010-2000	86%	88%	88%	91%	80%	80%	89%
Metro Outcome	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share	Lost Share
LRT 2000-2010	1,319	833	(368)	1,095	106	1,555	703
LRT Percent	2.3%	4.1%	-7.2%	9.9%	2.5%	7.1%	7.1%
LRT Outcome	Gained	Gained	Lost	Gained	Gained	Gained	Gained

Table C.8
Salt Lake City LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	22,613	10,948	5,284	4,082	1,582	12,539	8,611
2000 Metro	942,537	307,818	91,705	168,200	47,913	317,845	94,288
2000 LRT/Metro	2.4%	3.6%	5.8%	2.4%	3.3%	3.9%	9.1%
2010 LRT	27,091	14,275	6,860	5,505	1,910	15,995	11,244
2010 Metro	1,091,452	360,593	97,968	202,773	59,852	385,249	116,301
2010 LRT/Metro	2.5%	4.0%	7.0%	2.7%	3.2%	4.2%	9.7%
LRT/Metro 2010-2000	103%	111%	122%	112%	97%	105%	106%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Lost Share	Gained Share	Gained Share
LRT 2000-2010	4,478	3,327	1,576	1,423	328	3,456	2,633
LRT Percent	19.8%	30.4%	29.8%	34.9%	20.7%	27.6%	30.6%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.9
San Diego LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	133,140	56,837	17,620	27,575	11,642	59,499	28,912
2000 Metro	2,827,366	994,677	248,025	555,463	191,189	1,017,032	443,216
2000 LRT/Metro	4.7%	5.7%	7.1%	5.0%	6.1%	5.9%	6.5%
2010 LRT	146,042	61,840	19,354	30,815	11,671	66,307	33,252
2010 Metro	3,104,182	1,086,865	247,785	624,016	215,064	1,214,374	495,840

2010 LRT/Metro	4.7%	5.7%	7.8%	4.9%	5.4%	5.5%	6.7%
LRT/Metro 2010-2000	100%	100%	110%	99%	89%	93%	103%
Metro Outcome	Constant Share	Constant Share	Gained Share	Constant Share	Lost Share	Lost Share	Gained Share
LRT 2000-2010	12,902	5,003	1,734	3,240	29	6,808	4,340
LRT Percent	9.7%	8.8%	9.8%	11.7%	0.2%	11.4%	15.0%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.10
Twin Cities LRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	71,922	29,229	10,678	14,051	4,500	30,660	16,836
2000 Metro	3,044,425	1,160,655	293,888	678,689	188,078	1,175,240	317,760
2000 LRT/Metro	2.4%	2.5%	3.6%	2.1%	2.4%	2.6%	5.3%
2010 LRT	78,304	33,184	12,242	16,403	4,539	36,500	19,130
2010 Metro	3,355,167	1,299,635	287,673	776,979	234,983	1,394,458	369,186
2010 LRT/Metro	2.3%	2.6%	4.3%	2.1%	1.9%	2.6%	5.2%
LRT/Metro 2010-2000	99%	101%	117%	102%	81%	100%	98%
Metro Outcome	Constant Share	Gained Share	Gained Share	Gained Share	Lost Share	Constant Share	Lost Share
LRT 2000-2010	6,382	3,955	1,564	2,352	39	5,840	2,294
LRT Percent	8.9%	13.5%	14.6%	16.7%	0.9%	19.0%	13.6%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Streetcar Transit Systems

Table C.10
Portland SCT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 SCT	46,399	28,033	12,061	12,058	3,914	30,651	21,665
2000 Metro	1,934,792	745,531	188,345	430,823	126,363	779,438	276,375
2000 SCT/Metro	2.4%	3.8%	6.4%	2.8%	3.1%	3.9%	7.8%
2010 SCT	59,637	35,074	14,601	15,526	4,947	39,955	25,400

2010 Metro	2,232,177	867,794	191,159	513,515	163,120	935,123	332,361
2010 SCT/Metro	2.7%	4.0%	7.6%	3.0%	3.0%	4.3%	7.6%
SCT/Metro 2010-2000	111%	107%	119%	108%	98%	109%	97%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Lost Share	Gained Share	Lost Share
SCT 2000-2010	13,238	7,041	2,540	3,468	1,033	9,304	3,735
SCT Percent	28.5%	25.1%	21.1%	28.8%	26.4%	30.4%	17.2%
SCT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.11
Seattle SCT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 SCT	40,222	26,225	12,269	10,798	3,158	28,791	21,023
2000 Metro	3,052,187	1,196,568	302,483	700,342	193,743	1,228,430	453,152
2000 SCT/Metro	1.3%	2.2%	4.1%	1.5%	1.6%	2.3%	4.6%
2010 SCT	49,764	33,277	15,716	13,701	3,860	38,712	25,991
2010 Metro	3,448,425	1,357,475	307,929	811,681	237,865	1,488,459	521,918
2010 SCT/Metro	1.4%	2.5%	5.1%	1.7%	1.6%	2.6%	5.0%
SCT/Metro 2010-2000	110%	112%	126%	109%	100%	111%	107%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Constant Share	Gained Share	Gained Share
SCT 2000-2010	9,542	7,052	3,447	2,903	702	9,921	4,968
SCT Percent	23.7%	26.9%	28.1%	26.9%	22.2%	34.5%	23.6%
SCT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.12
Tacoma SCT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 LRT	16,161	7,265	2,186	3,703	1,376	8,243	5,787
2000 Metro	3,052,187	1,196,568	302,483	700,342	193,743	1,228,430	453,152
2000 LRT/Metro	0.5%	0.6%	0.7%	0.5%	0.7%	0.7%	1.3%
2010 LRT	20,706	9,529	3,212	4,720	1,597	11,036	7,399
2010 Metro	3,448,425	1,357,475	307,929	811,681	237,865	1,488,459	521,918
2010 LRT/Metro	0.6%	0.7%	1.0%	0.6%	0.7%	0.7%	1.4%
LRT/Metro 2010-2000	113%	116%	144%	110%	95%	110%	111%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Lost Share	Gained Share	Gained Share
LRT 2000-2010	4,545	2,264	1,026	1,017	221	2,793	1,612
LRT Percent	28.1%	31.2%	46.9%	27.5%	16.1%	33.9%	27.9%
LRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.13
Tampa SCT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 SCT	17,009	7,847	1,735	3,444	1,873	7,847	4,806
2000 Metro	2,404,013	1,012,952	192,886	524,677	291,753	1,051,893	294,942
2000 SCT/Metro	0.7%	0.8%	0.9%	0.7%	0.6%	0.7%	1.6%
2010 SCT	22,792	9,886	3,371	4,734	1,781	12,867	6,342
2010 Metro	2,788,961	1,153,245	201,206	638,651	311,406	1,252,737	377,973
2010 SCT/Metro	0.8%	0.9%	1.7%	0.7%	0.6%	1.0%	1.7%
SCT/Metro 2010-2000	116%	111%	186%	113%	89%	138%	103%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Lost Share	Gained Share	Gained Share
SCT 2000-2010	5,783	2,039	1,636	1,290	(92)	5,020	1,536
SCT Percent	34.0%	26.0%	94.3%	37.5%	-4.9%	64.0%	32.0%
SCT Outcome	Gained	Gained	Gained	Gained	Lost	Gained	Gained

Commuter Rail Transit Systems

Table C.14
Albuquerque-Santa Fe CRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Uni
2000 CRT	67,633	26,092	5,650	15,374	5,068	28,2
2000 Metro	977,080	375,536	85,050	220,519	69,967	406,6
2000 CRT/Metro	6.9%	6.9%	6.6%	7.0%	7.2%	6.9
2010 CRT	75,251	30,581	11,229	17,829	6,913	34,1
2010 Metro	1,149,160	453,598	93,096	263,721	96,781	489,8
2010 CRT/Metro	6.5%	6.7%	12.1%	6.8%	7.1%	7.0
SCT/Metro 2010-2000	95%	97%	182%	97%	99%	100
Metro Outcome	Lost Share	Lost Share	Gained Share	Lost Share	Constant Share	Constant Sha
CRT 2000-2010	7,618	4,489	5,579	2,455	1,845	5,9
CRT Percent	11.3%	17.2%	98.7%	16.0%	36.4%	20.9
CRT Outcome	Gained	Gained	Gained	Gained	Gained	Gain

Table C.15
Miami-South Florida CRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units
2000 CRT	210,663	80,716	17,640	41,374	21,702	90,851
2000 Metro	5,495,950	2,099,345	389,727	1,134,897	574,721	2,186,967
2000 CRT/Metro	3.8%	3.8%	4.5%	3.6%	3.8%	4.2%
2010 CRT	188,720	70,883	26,983	38,684	17,490	85,675
2010 Metro	6,185,040	2,344,237	373,522	1,341,055	629,660	2,698,402
2010 CRT/Metro	3.1%	3.0%	7.2%	2.9%	2.8%	3.2%
SCT/Metro 2010-2000	80%	79%	160%	79%	74%	76%
Metro Outcome	Lost Share	Lost Share	Gained Share	Lost Share	Lost Share	Lost Share
CRT 2000-2010	(21,943)	(9,833)	9,343	(2,690)	(4,212)	(5,176)
CRT Percent	-10.4%	-12.2%	53.0%	-6.5%	-19.4%	-5.7%
CRT Outcome	Lost	Lost	Gained	Lost	Lost	Lost

Table C.16
Salt Lake Combined Metro CRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Uni
2000 CRT	67,404	19,945	6,517	10,679	2,749	21,2
2000 Metro	1,855,910	577,375	176,568	309,655	91,152	595,6
2000 CRT/Metro	3.6%	3.5%	3.7%	3.4%	3.0%	3.6
2010 CRT	87,264	27,574	8,992	14,730	3,852	29,5
2010 Metro	2,281,080	715,736	203,041	393,788	118,907	764,6
2010 CRT/Metro	3.8%	3.9%	4.4%	3.7%	3.2%	3.9
SCT/Metro 2010-2000	105%	112%	120%	108%	107%	108
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Gained Share	Gained Sha
CRT 2000-2010	19,860	7,629	2,475	4,051	1,103	8,3
CRT Percent	29.5%	38.3%	38.0%	37.9%	40.1%	39.2
CRT Outcome	Gained	Gained	Gained	Gained	Gained	Gain

Table C.17
San Diego CRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 CRT	68,242	30,037	8,148	15,935	5,954	34,135	17,454
2000 Metro	133,140	56,837	17,620	27,575	11,642	59,499	28,912
2000 CRT/Metro	51.3%	52.8%	46.2%	57.8%	51.1%	57.4%	60.4%
2010 CRT	77,214	35,458	9,605	19,074	6,779	42,418	21,404
2010 Metro	146,042	61,840	19,354	30,815	11,671	66,307	33,252

2010 CRT/Metro	52.9%	57.3%	49.6%	61.9%	58.1%	64.0%	64.4%
SCT/Metro 2010-2000	103%	108%	107%	107%	114%	112%	107%
Metro Outcome	Gained Share	Gained Share	Gained Share	Gained Share	Gained Share	Gained Share	Gained Share
CRT 2000-2010	8,972	5,421	1,457	3,139	825	8,283	3,950
CRT Percent	13.1%	18.0%	17.9%	19.7%	13.9%	24.3%	22.6%
CRT Outcome	Gained	Gained	Gained	Gained	Gained	Gained	Gained

Table C.18
Seattle-Tacoma CRT Outcomes With Respect to the Location of People and Housing

Year	Population	Households	HHs <35	HHs 35-64	HHs 65+	Housing Units	Rental Units
2000 CRT	59,293	25,137	6,837	13,030	5,270	27,054	15,971
2000 Metro	3,786,730	1,476,463	360,285	864,369	251,809	1,514,846	540,123
2000 CRT/Metro	1.6%	1.7%	1.9%	1.5%	2.1%	1.8%	3.0%
2010 CRT	62,163	26,686	6,798	13,937	5,951	29,973	17,274
2010 Metro	4,285,030	1,687,223	368,691	1,001,391	317,141	1,850,025	624,718
2010 CRT/Metro	1.5%	1.6%	1.8%	1.4%	1.9%	1.6%	2.8%
SCT/Metro 2010-2000	93%	93%	97%	92%	90%	91%	94%
Metro Outcome	Lost Share	Lost Share	Gained Share	Lost Share	Lost Share	Lost Share	Lost Share
CRT 2000-2010	2,870	1,549	(39)	907	681	2,919	1,303
CRT Percent	4.8%	6.2%	-0.6%	7.0%	12.9%	10.8%	8.2%
CRT Outcome	Gained	Gained	Lost	Gained	Gained	Gained	Gained

APPENDIX D
DETAILED TABLES FOR LRT, BRT, SCT AND CRT SYSTEMS WITH RESPECT TO CHANGE IN LOWER, MIDDLE AND UPPER INCOME JOBS IN TOD AREAS

Table D.1
Change in Lower, Middle and Upper Income Jobs in LRT TOD Areas

CHARLOTTE

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	19,778	21,559	566,758	574,247	9%	1%	20,483	(443)	1,519
Middle	7,791	11,025	390,700	466,562	42%	19%	8,069	1,235	1,721
Upper	17,780	17,412	580,338	560,371	-2%	-3%	18,413	(1,245)	244
Total	45,349	49,996	1,537,796	1,601,180	10%	4%	46,965	(453)	3,485

DALLAS

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	44,045	47,062	1,645,610	1,921,369	7%	17%	42,310	9,115	1,519
Middle	40,017	45,369	1,217,569	1,654,261	13%	36%	38,441	15,928	(9,000)
Upper	64,188	61,802	1,957,125	2,037,368	-4%	4%	61,660	5,160	(5,017)
Total	148,249	154,233	4,820,304	5,612,998	4%	16%	142,410	30,204	(12,498)

DENVER

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	18,916	20,211	757,389	827,801	7%	9%	19,663	1,012	1,519
Middle	8,086	9,091	568,632	690,459	12%	21%	8,405	1,413	(727)
Upper	18,124	18,333	832,989	801,356	1%	-4%	18,839	(1,404)	897
Total	45,125	47,634	2,159,010	2,319,616	6%	7%	46,906	1,021	1,690

Table D.1
Change in Lower, Middle and Upper Income Jobs in LRT TOD Areas—continued

HOUSTON

Income Category	2004 LRT	2011 LRT	2004 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	78,531	83,728	1,303,619	1,573,757	7%	21%	67,767	27,037	1,519
Middle	59,450	40,218	1,227,774	1,500,111	-32%	22%	51,302	21,335	(32,419)
Upper	84,940	87,357	1,416,683	1,641,696	3%	16%	73,298	25,133	(11,074)
Total	222,921	211,303	3,948,076	4,715,564	-5%	19%	192,367	73,505	(41,974)

PHOENIX

Income Category	2009 LRT	2011 LRT	2009 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	42,617	42,157	1,219,957	1,245,753	-1%	2%	41,249	2,268	1,519
Middle	23,955	22,576	947,286	988,373	-6%	4%	23,186	1,807	(2,418)
Upper	28,868	28,586	962,791	994,700	-1%	3%	27,942	1,883	(1,239)
Total	95,439	93,318	3,130,034	3,228,826	-2%	3%	92,377	5,958	(2,138)

PORTLAND

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	42,344	44,325	575,923	624,356	5%	8%	41,605	4,299	1,519
Middle	38,279	32,463	474,909	598,473	-15%	26%	37,611	10,627	(15,775)
Upper	40,418	40,953	658,952	670,645	1%	2%	39,713	1,422	(182)
Total	121,040	117,741	1,709,784	1,893,474	-3%	11%	118,930	16,348	(14,438)

Table D.1
Change in Lower, Middle and Upper Income Jobs in LRT TOD Areas—continued

SACRAMENTO

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	1,826	2,836	515,366	631,952	55%	23%	1,633	605	1,519
Middle	715	1,425	394,850	516,294	99%	31%	639	295	491

Upper	801	1,775	415,528	464,412	122%	12%	717	179	879
Total	3,341	6,035	1,325,744	1,612,658	81%	22%	2,989	1,079	2,889

SALT LAKE CITY

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	8,707	7,680	386,223	412,161	-12%	7%	7,877	1,414	1,519
Middle	3,831	3,990	271,390	330,072	4%	22%	3,466	1,193	(670)
Upper	6,230	5,535	368,256	407,035	-11%	11%	5,637	1,250	(1,351)
Total	18,768	17,205	1,025,868	1,149,268	-8%	12%	16,980	3,857	(501)

SAN DIEGO

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	29,983	28,171	790,572	877,428	-6%	11%	29,737	3,541	1,519
Middle	10,866	14,746	594,800	699,765	36%	18%	10,777	2,007	1,962
Upper	32,286	31,500	783,976	790,473	-2%	1%	32,020	533	(1,053)
Total	73,135	74,417	2,169,348	2,367,666	2%	9%	72,534	6,080	2,429

Table D.1
Change in Lower, Middle and Upper Income Jobs in LRT TOD Areas—continued

TWIN CITIES

Income Category	2002 LRT	2011 LRT	2002 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	26,149	24,960	1,096,148	1,086,047	-5%	-1%	26,841	(933)	1,519
Middle	15,460	19,994	920,916	1,048,200	29%	14%	15,870	1,727	2,397
Upper	26,955	29,629	1,170,432	1,140,237	10%	-3%	27,669	(1,409)	3,369
Total	68,564	74,583	3,187,496	3,274,484	9%	3%	70,380	(615)	7,286

Table D.2
Change in Lower, Middle and Upper Income Jobs in BRT TOD Areas

EUGENE-SPRINGFIELD

Income Category	2007 BRT	2011 BRT	2007 MSA	2011 MSA	BRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Lower	8,832	8,958	48,389	45,484	1%	-6%	11,366	(3,065)	1,519
Middle	11,375	12,613	46,840	49,513	11%	6%	14,639	(2,615)	589
Upper	7,583	7,307	51,394	39,934	-4%	-22%	9,759	(3,867)	1,415
Total	27,789	28,877	146,623	134,931	4%	-8%	35,764	(9,547)	3,523

LAS VEGAS

Income Category	2004 BRT	2011 BRT	2004 MSA	2011 MSA	BRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Lower	12,996	13,547	403,996	442,790	4%	10%	14,997	(754)	1,519
Middle	2,161	2,363	163,678	186,796	9%	14%	2,494	(28)	(104)
Upper	3,041	3,317	213,652	185,138	9%	-13%	3,510	(874)	681
Total	18,198	19,226	781,326	814,724	6%	4%	21,001	(1,656)	2,097

PHOENIX

Income Category	2009 BRT	2011 BRT	2009 MSA	2011 MSA	BRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Lower	5,302	4,646	609,979	622,877	-12%	2%	5,265	149	1,519
Middle	15,438	14,311	494,577	511,072	-7%	3%	15,331	622	(1,642)
Upper	2,472	1,997	544,197	548,005	-19%	1%	2,454	34	(492)
Total	23,211	20,954	1,648,752	1,681,953	-10%	2%	23,050	806	(615)

Table D.2
Change in Lower, Middle and Upper Income Jobs in BRT TOD Areas—continued

SALT LAKE CITY

Income Category	2008 BRT	2011 BRT	2008 MSA	2011 MSA	BRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	BRT Station Share
Lower	5,026	4,407	213,478	206,081	-12%	-3%	5,341	(490)	1,519
Middle	1,531	1,593	163,985	171,586	4%	5%	1,627	(25)	(9)
Upper	2,189	2,119	237,188	223,169	-3%	-6%	2,326	(267)	60
Total	8,745	8,119	614,651	600,836	-7%	-2%	9,294	(782)	1,570

Table D.3
Change in Lower, Middle and Upper Income Jobs in CRT TOD Areas

ALBUQUERQUE-SANTA FE

Income Category	2002 CRT	2011 CRT	2002 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	16,722	16,181	143,689	157,207	-3%	9%	18,747	(452)	1,519
Middle	8,916	9,307	112,057	146,235	4%	31%	9,996	1,639	(2,328)
Upper	13,286	11,450	138,968	123,954	-14%	-11%	14,895	(3,045)	(401)
Total	38,923	36,938	394,714	427,396	-5%	8%	43,638	(1,857)	(1,209)

MIAMI-SOUTH FLORIDA

Income Category	2002 CRT	2011 CRT	2002 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	22,131	21,993	757,756	865,354	-1%	14%	24,010	1,264	1,519
Middle	12,946	15,434	625,999	694,310	19%	11%	14,045	314	1,075
Upper	33,411	29,678	733,551	676,149	-11%	-8%	36,247	(5,451)	(1,118)
Total	68,488	67,105	2,117,306	2,235,813	-2%	6%	74,302	(3,873)	1,476

SALT LAKE CITY

Income Category	2008 CRT	2011 CRT	2008 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	4,725	9,138	286,191	316,188	93%	10%	4,259	962	1,519
Middle	1,771	4,192	227,090	280,500	137%	24%	1,597	591	2,004
Upper	7,064	9,244	314,031	348,413	31%	11%	6,367	1,470	1,407
Total	13,560	22,574	827,312	945,100	66%	14%	12,222	3,023	4,931

Table D.3
Change in Lower, Middle and Upper Income Jobs in CRT TOD Areas—continued

SAN DIEGO

Income Category	2002 CRT	2011 CRT	2002 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	30,751	31,731	395,286	438,714	3%	11%	28,723	5,406	1,519
Middle	31,210	32,522	812,450	911,511	4%	12%	29,152	5,864	(2,494)
Upper	44,083	41,020	868,711	930,047	-7%	7%	41,176	6,020	(6,176)
Total	106,045	105,272	2,076,447	2,280,273	-1%	10%	99,051	17,290	(7,151)

SEATTLE

Income Category	2002 CRT	2011 CRT	2002 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	20,012	21,031	498,324	549,670	5%	10%	18,214	3,860	1,519
Middle	14,887	15,656	426,544	498,935	5%	17%	13,549	3,864	(1,758)
Upper	21,663	23,211	621,204	682,525	7%	10%	19,716	4,085	(589)
Total	56,561	59,898	1,546,072	1,731,130	6%	12%	51,479	11,809	(828)

Table D.4
Change in Lower, Middle and Upper Income Jobs in SCT TOD Areas

PORTLAND

Income Category	2002 SCT	2011 SCT	2002 MSA	2011 MSA	SCT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Lower	41,221	40,596	287,962	312,178	-2%	8%	40,502	4,185	1,519
Middle	30,749	23,786	237,454	299,236	-23%	26%	30,213	8,537	(14,963)
Upper	42,909	40,614	329,476	335,323	-5%	2%	42,161	1,510	(3,057)
Total	114,879	104,996	854,892	946,737	-9%	11%	112,876	14,231	(16,501)

SEATTLE

Income Category	2007 SCT	2011 SCT	2007 MSA	2011 MSA	SCT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Lower	48,601	56,587	503,308	512,921	16%	2%	46,115	3,414	1,519
Middle	20,094	25,931	413,828	452,332	29%	9%	19,066	2,897	3,967
Upper	59,814	60,407	579,094	610,314	1%	5%	56,754	6,284	(2,632)
Total	128,509	142,924	1,496,230	1,575,567	11%	5%	121,935	12,596	2,854

TACOMA

Income Category	2003 SCT	2011 SCT	2003 MSA	2011 MSA	SCT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Lower	16,169	9,008	125,833	135,732	-44%	8%	14,578	2,863	1,519
Middle	18,103	14,329	73,903	83,425	-21%	13%	16,322	4,114	(6,107)
Upper	13,265	7,668	87,833	97,420	-42%	11%	11,959	2,753	(7,045)
Total	47,537	31,005	287,568	316,576	-35%	10%	42,859	9,730	(11,632)

Table D.4
Change in Lower, Middle and Upper Income Jobs in SCT TOD Areas—continued

TAMPA

Income Category	2002 SCT	2011 SCT	2002 MSA	2011 MSA	SCT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	SCT Station Share
Lower	20,427	28,004	425,362	397,361	37%	-7%	23,741	(4,659)	1,519
Middle	40,090	50,212	295,729	339,621	25%	15%	46,594	(554)	4,172
Upper	23,177	32,911	363,477	312,740	42%	-14%	26,937	(6,995)	12,969
Total	83,694	111,127	1,084,567	1,049,722	33%	-3%	97,272	(12,208)	18,660

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery

DALLAS

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 LRT	2007 LRT	2002 MSA	2007 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	23,124	22,423	1,166,862	1,252,724	-3%	7%	21,550	3,275	(2,402)
Middle	42,106	43,993	1,398,985	1,626,908	4%	16%	39,241	9,725	(4,973)
Upper	83,020	81,116	2,254,457	2,419,061	-2%	7%	77,371	11,711	(7,965)
Total	148,249	147,532	4,820,304	5,298,692	-0%	10%	138,161	24,710	(15,340)

Recession and Recovery, 2007-2011

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	22,423	22,446	1,252,724	1,305,556	0%	4%	20,445	2,924	(923)
Middle	43,993	45,369	1,626,908	1,654,261	3%	2%	40,111	4,622	637
Upper	81,116	86,418	2,419,061	2,653,182	7%	10%	73,958	15,008	(2,549)
Total	147,532	154,233	5,298,692	5,612,998	5%	6%	134,514	22,554	(2,835)

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

DENVER

					Pre-Recession Shift-Share Analysis 2002-2007		
Income Category	**2002 LRT**	**2007 LRT**	**2002 MSA**	**2007 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	14,956	15,115	498,665	545,470	1%	9%	15,54
Middle	8,400	9,489	604,640	691,314	13%	14%	8,72
Upper	21,770	24,141	1,055,705	1,015,896	11%	-4%	22,62
Total	45,125	48,745	2,159,010	2,252,680	8%	4%	46,89
					Recession and Recovery, 2007-2011		
Income Category	**2007 LRT**	**2011 LRT**	**2007 MSA**	**2011 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	15,115	14,724	545,470	548,444	-3%	1%	14,20
Middle	9,489	9,091	691,314	690,459	-4%	-0%	8,92
Upper	24,141	23,820	1,015,896	1,080,714	-1%	6%	22,69
Total	48,745	47,634	2,252,680	2,319,616	-2%	3%	45,82

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

PORTLAND

					Pre-Recession Shift-Share Analysis 2002-2007		
Income Category	**2002 LRT**	**2007 LRT**	**2002 MSA**	**2007 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	21,317	23,173	388,859	434,165	9%	12%	20,44
Middle	28,650	32,626	525,039	601,017	14%	14%	27,47
Upper	71,073	57,287	795,887	829,868	-19%	4%	68,16
Total	121,040	113,086	1,709,784	1,865,050	-7%	9%	116,08

					Recession and Recovery, 2007-2011		
Income Category	**2007 LRT**	**2011 LRT**	**2007 MSA**	**2011 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	23,173	23,915	434,165	426,477	3%	-2%	22,14
Middle	32,626	32,463	601,017	598,473	-0%	-0%	31,17
Upper	57,287	61,363	829,868	868,525	7%	5%	54,73
Total	113,086	117,741	1,865,050	1,893,474	4%	2%	108,05

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

SACRAMENTO

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 LRT	2007 LRT	2002 MSA	2007 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	1,522	1,672	344,755	381,327	10%	11%	1,460	223	(11)
Middle	1,012	992	443,344	480,051	-2%	8%	971	125	(103)
Upper	808	1,153	537,645	560,314	43%	4%	775	67	311
Total	3,341	3,817	1,325,744	1,421,692	14%	7%	3,206	414	197

Recession and Recovery, 2007-2011

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	1,672	1,708	381,327	372,936	2%	-2%	1,295	340	73
Middle	992	1,425	480,051	516,294	44%	8%	769	299	358
Upper	1,153	2,902	560,314	723,429	152%	29%	893	595	1,414
Total	3,817	6,035	1,421,692	1,612,658	58%	13%	2,956	1,234	1,844

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

SALT LAKE CITY

				Pre-Recession Shift-Share Analysis 2002-2007			
Income Category	**2002 LRT**	**2007 LRT**	**2002 MSA**	**2007 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	4,460	4,253	259,103	279,711	-5%	8%	4,01
Middle	3,661	4,130	297,916	329,259	13%	11%	3,29
Upper	10,647	9,211	468,850	521,440	-13%	11%	9,57
Total	18,768	17,594	1,025,868	1,130,410	-6%	10%	16,87
				Recession and Recovery, 2007-2011			
Income Category	**2007 LRT**	**2011 LRT**	**2007 MSA**	**2011 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	4,253	3,910	279,711	272,482	-8%	-3%	4,05
Middle	4,130	3,990	329,259	330,072	-3%	0%	3,93
Upper	9,211	9,305	521,440	546,715	1%	5%	8,78
Total	17,594	17,205	1,130,410	1,149,268	-2%	2%	16,78

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

SAN DIEGO

				Pre-Recession Shift-Share Analysis 2002-2007			
Income Category	**2002 LRT**	**2007 LRT**	**2002 MSA**	**2007 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	20,770	21,341	564,119	623,245	3%	10%	21,38
Middle	11,163	15,235	627,592	694,453	36%	11%	11,49
Upper	41,202	36,869	977,637	949,486	-11%	-3%	42,42
Total	73,135	73,445	2,169,348	2,267,184	0%	5%	75,30
				Recession and Recovery, 2007-2011			
Income Category	**2007 LRT**	**2011 LRT**	**2007 MSA**	**2011 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	21,341	19,814	623,245	623,806	-7%	0%	19,40
Middle	15,235	14,746	694,453	699,765	-3%	1%	13,85
Upper	36,869	39,857	949,486	1,044,095	8%	10%	33,52
Total	73,445	74,417	2,267,184	2,367,666	1%	4%	66,79

Table D. 5
Change in Share of Jobs by Wage Category in LRT TOD Areas before Recession and During Recession-Recovery—continued

TWIN CITIES

				Pre-Recession Shift-Share Analysis 2002-2007			
Income Category	**2002 LRT**	**2007 LRT**	**2002 MSA**	**2007 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	17,951	16,076	668,440	701,429	-10%	5%	17,55
Middle	19,908	17,878	974,129	1,055,759	-10%	8%	19,47
Upper	37,838	32,432	1,491,303	1,524,782	-14%	2%	37,00
Total	75,696	66,386	3,133,872	3,281,970	-12%	5%	74,03
				Recession and Recovery, 2007-2011			
Income Category	**2007 LRT**	**2011 LRT**	**2007 MSA**	**2011 MSA**	**LRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	16,076	16,182	701,429	692,327	1%	-1%	15,98
Middle	17,878	19,994	1,055,759	1,048,200	12%	-1%	17,77
Upper	32,432	38,406	1,524,782	1,533,958	18%	1%	32,23
Total	66,386	74,583	3,281,970	3,274,484	12%	-0%	65,98

Table D. 6
Change in Share of Jobs by Wage Category in CRT TOD Areas before Recession and During Recession-Recovery

ALBUQUERQUE-SANTA FE

				Pre-Recession Shift-Share Analysis 2002-2007			
Income Category	**2002 CRT**	**2007 CRT**	**2002 MSA**	**2007 MSA**	**CRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	9,895	8,270	104,155	114,302	-16%	10%	9,18
Middle	9,976	9,079	126,952	149,319	-9%	18%	9,26
Upper	19,053	20,110	163,608	176,216	6%	8%	17,69
Total	38,923	37,459	394,714	439,836	-4%	11%	36,13
				Recession and Recovery, 2007-2011			
Income Category	**2007 CRT**	**2011 CRT**	**2007 MSA**	**2011 MSA**	**CRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	8,270	8,204	114,302	113,462	-1%	-1%	8,69
Middle	9,079	9,307	149,319	146,235	3%	-2%	9,54
Upper	20,110	19,426	176,216	167,699	-3%	-5%	21,13
Total	37,459	36,938	439,836	427,396	-1%	-3%	39,36

Table D. 6
Change in Share of Jobs by Wage Category in CRT TOD Areas before Recession and During Recession-Recovery—continued

MIAMI-SOUTH FLORIDA

				Pre-Recession Shift-Share Analysis 2002-2007			
Income Category	**2002 CRT**	**2007 CRT**	**2002 MSA**	**2007 MSA**	**CRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	12,028	10,043	516,515	556,768	-16%	8%	11,31
Middle	14,242	17,015	662,471	717,856	19%	8%	13,40
Upper	42,218	46,952	938,319	997,231	11%	6%	39,72
Total	68,488	74,010	2,117,306	2,271,855	8%	7%	64,44
				Recession and Recovery, 2007-2011			
Income Category	**2007 CRT**	**2011 CRT**	**2007 MSA**	**2011 MSA**	**CRT Change**	**MSA Change**	**Metropolita Area Shar**
Lower	10,043	10,570	556,768	610,094	5%	10%	10,75
Middle	17,015	15,434	717,856	694,310	-9%	-3%	18,21
Upper	46,952	41,101	997,231	931,409	-12%	-7%	50,27
Total	74,010	67,105	2,271,855	2,235,813	-9%	-2%	79,24

Table D. 6
Change in Share of Jobs by Wage Category in CRT TOD Areas before Recession and During Recession-Recovery—continued

SAN DIEGO

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 CRT	2007 CRT	2002 MSA	2007 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	16,063	16,174	282,060	311,623	1%	10%	16,162	1,584	(1,572)
Middle	11,464	10,731	330,522	367,539	-6%	11%	11,535	1,213	(2,017)
Upper	43,619	43,372	538,997	535,680	-1%	-1%	43,889	(539)	21
Total	71,146	70,277	1,151,579	1,214,841	-1%	5%	71,587	2,258	(3,568)

Recession and Recovery, 2007-2011

Income Category	2007 CRT	2011 CRT	2007 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	16,174	15,517	311,623	311,903	-4%	0%	15,529	659	(671)
Middle	10,731	11,491	367,539	361,841	7%	-2%	10,303	261	926
Upper	43,372	41,577	535,680	557,924	-4%	4%	41,643	3,530	(3,596)
Total	70,277	68,585	1,214,841	1,231,668	-2%	1%	67,475	4,451	(3,341)

Table D. 6
Change in Share of Jobs by Wage Category in CRT TOD Areas before Recession and During Recession-Recovery—continued

SEATTLE

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 CRT	2007 CRT	2002 MSA	2007 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	9,416	10,012	338,676	369,420	6%	9%	8,707	1,564	(259)
Middle	15,009	15,573	453,083	505,259	4%	12%	13,879	2,858	(1,165)
Upper	32,136	33,013	754,314	815,714	3%	8%	29,717	5,035	(1,739)
Total	56,561	58,597	1,546,072	1,690,393	4%	9%	52,304	9,456	(3,163)

Recession and Recovery, 2007-2011

Income Category	2007 CRT	2011 CRT	2007 MSA	2011 MSA	CRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	CRT Station Share
Lower	10,012	10,322	369,420	368,807	3%	-0%	9,459	536	327
Middle	15,573	15,656	505,259	498,935	1%	-1%	14,713	665	278
Upper	33,013	33,921	815,714	863,389	3%	6%	31,190	3,752	(1,022)
Total	58,597	59,898	1,690,393	1,731,130	2%	2%	55,361	4,953	(417)

Table D. 7
Change in Share of Jobs by Wage Category in SCT TOD Areas before Recession and During Recession-Recovery

PORTLAND

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 LRT	2007 LRT	2002 MSA	2007 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	21,408	22,813	194,429	217,082	7%	12%	20,532	3,371	(1,089)
Middle	23,196	24,732	262,519	300,509	7%	14%	22,246	4,307	(1,821)
Upper	70,275	60,490	397,943	414,934	-14%	4%	67,397	5,878	(12,785)
Total	114,879	108,035	854,892	932,525	-6%	9%	110,175	13,556	(15,695)

Recession and Recovery, 2007-2011

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	22,813	22,457	217,082	213,238	-2%	-2%	21,798	611	47
Middle	24,732	23,786	300,509	299,236	-4%	-0%	23,631	996	(841)
Upper	60,490	58,754	414,934	434,262	-3%	5%	57,797	5,510	(4,554)
Total	108,035	104,996	932,525	946,737	-3%	2%	103,227	7,117	(5,348)

Table D. 7
Change in Share of Jobs by Wage Category in SCT TOD Areas before Recession and During Recession-Recovery—continued

TACOMA

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 LRT	2007 LRT	2002 MSA	2007 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	5,409	6,039	61,298	70,956	12%	16%	4,832	1,429	(223)
Middle	11,963	12,316	64,426	69,275	3%	8%	10,688	2,175	(547)
Upper	(17,034)	(18,013)	(118,927)	(133,112)	6%	12%	(15,219)	(3,847)	1,053
Total	338	342	6,796	7,120	1%	5%	302	(243)	283

Recession and Recovery, 2007-2011

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	6,039	2,962	70,956	76,471	-51%	8%	(5,130)	11,638	(3,546)
Middle	12,316	14,329	69,275	83,425	16%	20%	(10,464)	25,296	(503)
Upper	(18,013)	13,714	(133,112)	156,681	-176%	-218%	15,303	5,899	(7,488)
Total	342	31,005	7,120	316,576	8966%	4346%	(291)	42,833	(11,537)

Table D. 7
Change in Share of Jobs by Wage Category in SCT TOD Areas before Recession and During Recession-Recovery—continued

TAMPA

Pre-Recession Shift-Share Analysis 2002-2007

Income Category	2002 LRT	2007 LRT	2002 MSA	2007 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	6,959	12,061	255,808	274,965	73%	7%	6,744	736	4,581
Middle	47,059	49,789	344,619	356,340	6%	3%	45,609	3,051	1,130
Upper	29,677	45,213	484,140	499,532	52%	3%	28,762	1,858	14,593
Total	83,694	107,063	1,084,567	1,130,837	28%	4%	81,115	5,644	20,304

Recession and Recovery, 2007-2011

Income Category	2007 LRT	2011 LRT	2007 MSA	2011 MSA	LRT Change	MSA Change	Metropolitan Area Share	Sector Mix Share	LRT Station Share
Lower	12,061	12,455	274,965	270,773	3%	-2%	13,713	(1,837)	578
Middle	49,789	50,212	356,340	339,621	1%	-5%	56,612	(9,159)	2,759
Upper	45,213	48,461	499,532	439,328	7%	-12%	51,409	(11,645)	8,697
Total	107,063	111,127	1,130,837	1,049,722	4%	-7%	121,734	(22,641)	12,033

NITC
NATIONAL INSTITUTE for TRANSPORTATION and COMMUNITIES
Transportation Research and Education Center
Portland State University
1900 S.W. Fourth Ave., Suite 175
Portland, OR 97201