Light Rail Transit and Economic Recovery: A Case of Resilience or Transformation?

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Abstract

In recent years, the ecological concept of "resilience" has been applied to social and economic systems in researchers' attempts to understand whether and the extent to which those systems recover after calamity. Resilience strictly speaking can mean little more than carrying on as usual after a period of recovery. It can also mean learning from calamity so that while most functions resume, systems have been hardened to prepare for the next, similar calamity. But transformation can also occur whereby systems are restructured, abandoning the most vulnerable pre-calamity elements while redirecting resources to new elements better able to withstand known and unknown future calamities. We apply the concepts of reliance and transformation to the seven light rail transit (LRT) systems operating in the U.S. before, during and after the Great Recession. Using shift-share analysis across groups of economic sectors, we trace the share and shift in the share of jobs in those sectors during each of the three time periods. We find some evidence that economic activity within 0.50-mile of light rail stations was more resilient to the economic downturn associated with the Great Recession than their metropolitan areas as a whole. But we found more: during recovery most of those metropolitan areas' economies appear to have been transformed such that jobs were shifting substantially to LRT corridors during recovery to a far greater degree than before. We offer implications for the role of LRT systems and by extension all fixed guideway transit systems in facilitating economic resiliency if not outright 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 continue with an application of our theory to the seven light rail transit (LRT) systems operating in the United States from 2004 or earlier through 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 (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, the new term *social-ecological resilience* emerged 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 global 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 to 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 here.

Transformability

Transformability and resilience are complementary 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 complementary, 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 et al., 2005, 2008; Zheng et al., 2010). Marshall is presently engaged in U.S. 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 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 sector 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 of jobs in the utilities, information and 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 et al. (2010) 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 measure 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 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 1.

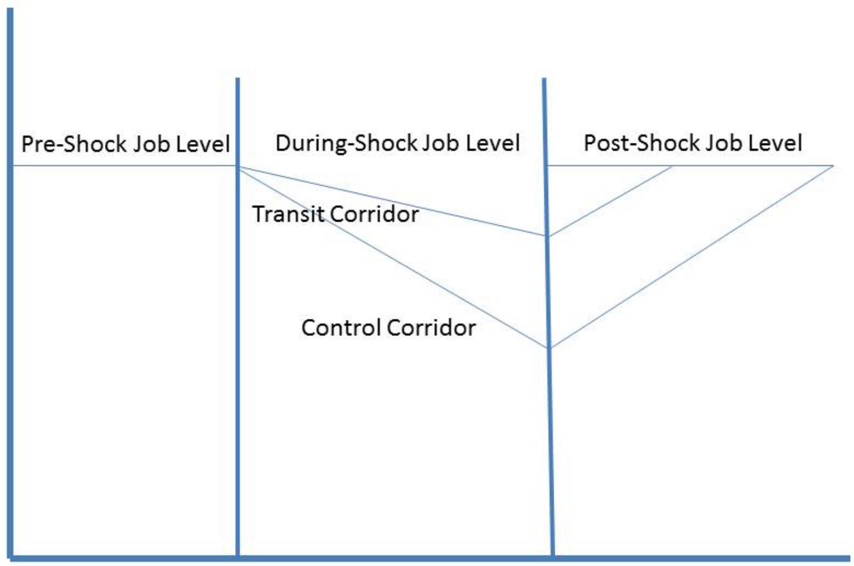

Figure 1
Pre-, During-, and Post-Shock Job Levels for Transit and Control Corridors

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 two-digit NAICS sectors that are within census blocks whose centroids are with 0.50 mile of LRT 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.

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.[1] For all LRT systems studied, two-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.

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

- 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 with more than seven million people. Newer systems were excluded because they were launched on 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 commenced operations is reported in Table 1. Similar to Belzer et al. (2011), we use the 0.50 mile corridor (1.0 mile total width) as our "treatment" unit of analysis compared to the metropolitan area as a whole excluding the corridors, our "control".

Table 1
Light Rail Systems used in Analysis

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. This is similar to the approach we used to evaluate shifts in shares of jobs around bus rapid transit stations in the Eugene-Springfield (Oregon) metropolitan area. We adapt analytic discussion to the present analysis (Nelson et al. 2013).

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 intrametropolitan shifts in the share of jobs by sector our region is 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 the LRT station areas within 0.50 mile of the nearest LRT station. We call this "LRT Stations". 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 that we call "sector mix". Using notations by the Carnegie Mellon Center for Economic Development (no date), the shift-share formula is:

$$SS_i = MA_i + SM_i + LRT_i$$

Where

SS_i = Shift-Share

MA_i = Metropolitan Area share

SM_i = Sector Mix

LRT_i = LRT Station Area shift

The Metropolitan Area (MA) share measures by how much total employment in a LRT station area changed because of change in the metropolitan area economy during the period of analysis. If metropolitan area employment grew by 10 percent during the analysis period, then employment in the LTR station area would have also grown by 10 percent. The Sector Mix (SM) identifies fast growing or slow growing economic sectors in a LRT station area based on the metropolitan area growth rates for the individual economic sectors. For instance, an LRT station area with an above-average share of the metropolitan area's high-growth sectors would have grown faster than an LRT station area with a high share of low-growth sectors. The LRT station area shift, also called the "competitive effect", is the most relevant component. It identifies a LRT station area's leading and lagging sectors. In particular, the competitive effect compares a LRT station area's growth rate in a given economic sector with the growth rate for that same sector at the metropolitan area. A leading sector is one where that sector's LRT station area growth rate is greater than its metropolitan area growth rate. A lagging sector is one where the sector's LRT station area growth rate is less than its metropolitan area growth rate.[2]

2 We have adapted the Carnegie Mellon Center for Economic Development's description of how shift-share works for our application.

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

$MA = ({}_{i}\text{LRT Station Area}^{t-1} \times MA^{t}/MA^{t-1})$

$SM = [({}_{i}\text{LRT Station Area}^{t-1} \times {}_{i}MA^{t}/{}_{i}MA^{t-1}) - MA]$

$LRT = [{}_{i}\text{LRT Station Area}^{t-1} \times ({}_{i}\text{LRT Station Area}^{t}/{}_{i}\text{LRT Station Area}^{t-1} - {}_{i}MA^{t}/{}_{i}MA^{t-1})]$

Where:

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

${}_{i}\text{LRT Station Area}^{t}$ = number of jobs in the LRT Station Area in sector (i) at the end of the analysis period (t)

MA^{t-1} = total number of jobs in the Metropolitan Area at the beginning of the analysis period (t-1)

MA^{t} = total number of jobs in the Metropolitan Area at the end of the analysis period (t)

${}_{i}MA^{t-1}$ = number of jobs in the Metropolitan Area in sector (i) at the beginning of the analysis period (t-1)

${}_{i}MA^{t}$ = number of jobs in the Metropolitan Area in sector (i) at the end of the analysis period (t)

We analyze those jobs which normally occupy space in urban settings. This excludes the North American Industrial Classification System (NAICS) sectors of agriculture, forestry, mining, and construction. We further assemble other sectors into roughly comparable space-consuming land uses based on Nelson (2004) which are reported in Table 2. This allows us to detect differences in the nature of shifts in shares over time by comparable land use categories. As noted earlier, we evaluate employment performance within 0.50 mile of LRT stations.

Table 2
Conversion of NAICS Economic Sectors into Land Use Classifications for Analysis

Land-Use Classification	NAICS Sector	NAICS Label
Manufacturing	31-33	Manufacturing
Non-manufacturing Industrial	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
	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: NAICS information from Census.

Results

For brevity, Table 3 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. Table 4 summarizes outcomes for metropolitan areas, while Table 5 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. 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.

Table 3
Light Rail Transit TOD-Area Share of Change by Time Period

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 3
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

Table 4
Pre-Recession, Great Recession and Recovery Shift-Share TOD-Area Outcomes by Metropolitan Area

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

Table 5
Pre-Recession, Great Recession and Recovery Shift-Share TOD-Area Outcomes by Combined Economic Sector

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

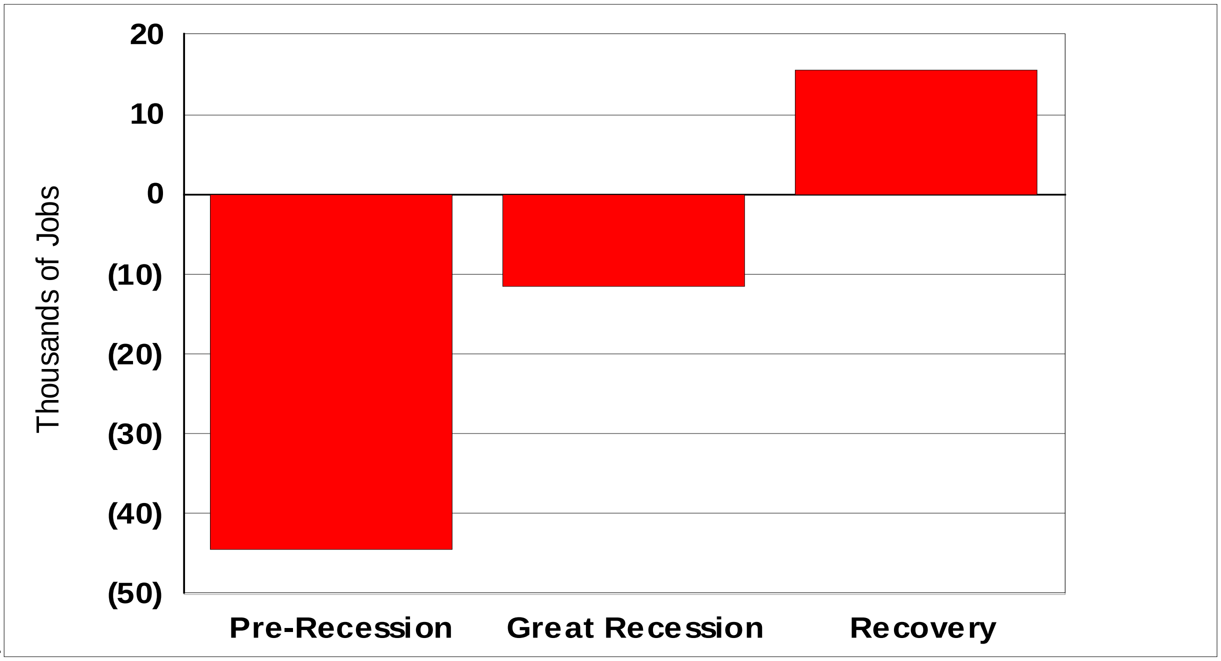

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Figure 2
Light Rail Corridor Composite Shift-Share Results for Pre-recession, Great Recession, and Post-Recession Time Periods

Implications

Our theory that fixed-guideway transit systems, such as light rail systems, may improve metropolitan-scale resilience and even advance transformability during economic shocks is substantially supported. Before the Great Recession, the eight metropolitan areas experiencing higher growth rates than the national average, which also had LRT 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 U.S. 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-quarter 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 caution that 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 a small body, 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 found evidence that LRT corridors may advance economic resilience if not transformability in American metropolitan areas.

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