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Transit and Economic Resilience

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1 **Transit and Economic Resilience**

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46 **Abstract**

47 Do fixed-guideway transit systems facilitate resilience with metropolitan areas? There is little
48 literature making this connection theoretically and none testing it empirically. Our paper helps
49 close this gap in both respects. In evaluating metropolitan areas with light rail transit systems we
50 find evidence that transit corridors on the whole performed better than control corridors during
51 the recovery period of two recessions: that of the early 2000s and the so-called Great Recession.
52 In particular, during the Great Recession transit corridors outperformed control corridors among
53 many economic sectors. Outcomes were more impressive during recoveries from both the
54 recession of the early 2000s and the Great Recession. We offer implications for the role of these
55 forms of fixed-guideway transit on economic resiliency.

56
57 **Introduction**

58
59 **re·sil·ient** *adjective* \ri-'zil-yənt\
60

61 a. capable of withstanding shock

62 b. tending to recover from or adjust easily to misfortunate or change

63 *Origin*

64 Latin *resilient-*, *resiliens*, present participle of *resilire* to jump back, recoil ...

65 First Known Use: 1674¹

66
67 There seems to be an article of faith among transit proponents that transit systems, especially
68 fixed-guideway ones, enable local economics to withstand economic shocks better than areas
69 without these options; such transit systems may make local economies more resilient to shocks.
70 Yet, there is scant literature making this connection theoretically and none testing it empirically.
71 This paper helps close the gap in the field of transit and economic resilience.

72
73 We start with an overall review of resiliency as a concept, review recent literature applying the
74 concept to transit, and adapting from the economic resiliency literature craft a theory of transit
75 and economic resilience. We proceed with the application of our theory to all the light rail
76 systems operating in the United States before and after the Great Recession, and in some cases
77 just after the recession of the early 2000s. We offer implications for the role of these forms of
78 fixed guideway transit on economic resiliency.

79
80 **Resiliency**

81 Martin-Breen and Anderies (2011) offer a sweeping review of the literature on the topic of
82 resiliency. Here, we focus on some of the key elements in the evolution of the concept as applied
83 to urban policy.

84
85 The earliest applications of the concept emanate from the field of “ecological resilience”
86 (Holling 1973). It was used to describe the biological capacity of an ecosystem to adapt and
87 thrive under adverse environmental conditions. Specifically, resilience was described as “the
88 persistence of relationships within a system; a measure of the ability of systems to absorb
89 changes of state variables, driving variables, and parameters, and still persist” (Holling 1973).
90 Since then, this definition of resilience has been expanded to similar fields that emphasize the
91 link between social and environmental systems (Berkes et al. 2003; Folke 2006; Walker and Salt

2006). 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 is appropriate in an urban planning context, where the city, neighborhood, or metropolitan area is the system, and the disturbance may be any number of internal or external shocks.

As appealing as the idea of resilience might be for urban planners and regional researchers, there is the distinct danger of “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).

For their part, Pendall, Foster and Colwell (2010) offer a sweeping view of resiliency as a concept from such disciplines as ecology, psychology, geography, political science and economics. Their review shows that while some literature characterizes resilience as a return to pre-shock conditions other literature offers a more complex approach wherein dynamic feedback loops make systems more or less resilient to stress.

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).

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

151
152 In short, while the relationship between transit and economic development measured in terms of
153 value premiums is strong, the relationship with respect to jobs is not as clear. This paper will
154 take a closer look at this nuance.

155
156 In measuring economic resilience, Pendall, Foster, and Cowell (2009) suggest two related
157 approaches: “equilibrium analysis” which measures resilience as the time it takes to return to the
158 level before a shock and “complex adaptation” adaptive systems which measures the ability of a
159 system to adapt to stresses caused by the shock. Hill et al. (2012) refines measuring the first
160 approach in terms of the time it takes to return to the rate of growth rate of output, employment,
161 or population after a shock. For reasons noted below, we will focus on jobs as a key measure for
162 resilience. On the other hand, while a quality location for warehousing may see employment
163 recover to pre-recessionary levels, an increase in location quality might also result in that
164 location transitioning to a higher-rent urban use.

165
166 While much of the literature on economic resilience focuses on measuring time-to-recovery,
167 Briguglio et al. (2005; 2008) are more nuanced. To them, economic resilience refers to the ability
168 to recover quickly from a shock and withstand the effect of a shock as it occurs (Briguglio et al.
169 2008: 4-5). In our view, their concepts can be reversed to measure the ability of an economy to
170 withstand the shock as it occurs and then the amount of time it takes to recover from the shock.

171
172 Briguglio et al. also saw a role for public policy in facilitating resilience by ameliorating adverse
173 effects of economic shocks. In our view, transit may be one such policy. In terms of transit and
174 economic resilience, we thus theorize that transit will dampen adverse outcomes associated with
175 an economic shock and facilitate a speedier recovery. One way in which to further measure these
176 outcomes is to compare transit corridors with control corridors before, during and after an
177 economic shock. This is illustrated in Figure 1.

178
179
180
181
182
183
INSERT FIGURE 1 ABOUT HERE

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

184 **Research Question**

185 Based on our theory, fixed-guideway transit corridors, such as light rail transit (LRT) should
186 retain if not capture a higher share of jobs than control corridors within the same metropolitan
187 area during and after economic shocks. Our research question is simple:

188
189 *Do LRT corridors capture proportionately more jobs than control corridors during and after*
190 *economic shocks?*

191
192 We mean the term “capture” to mean the share of total jobs and jobs within 2-digit NAICS
193 sectors that are within 0.25 and between 0.25 and 0.50 mile of transit or control corridors.

194
195 **Research Design**

196 We use a quasi-experimental, interrupted time series research design with treatment (transit) and
197 control (nontransit) corridors applied over several time periods and applied to LRT systems
198 operating within those time frames. Below we review our data, study periods, transit and control
199 corridors, and method.

200
201 **Data**

202 Our data come from the Longitudinal Employer-Household Dynamics (LEHD) program which is
203 part of the Center for Economic Studies at the U.S. Census Bureau.² For all LRT systems
204 studied, 2-digit NAICS data are available annually at the census block level.

205
206 **Study Periods**

207 We have three discrete time periods for analysis extending from the tail end of the early 2000s
208 recession through the recovery period of the Great Recession.

209
210 2002-2007 covers the period from the very end of the Dot Com recession of the early 2000s to
211 the year before the Great Recession of 2008-2009. This is the “first recovery” period. Based on
212 our theory, transit corridors should capture a higher rate of metropolitan jobs than control
213 corridors. The metropolitan areas with LRT systems operating during this period include Dallas,
214 Denver, Portland, Sacramento, Salt Lake City and San Diego.

215
216 2007-2009 covers the period of the Great Recession. This is the “shock” period. According to
217 our theory, transit corridors should retain if not capture a higher rate of metropolitan jobs than
218 control corridors. The metropolitan areas with LRT systems operating during this period include
219 all those noted above plus Charlotte, Houston and the Twin Cities.³

220
221 2009-2011 covers the period after the Great Recession. This is the “second recovery” period.
222 Based on our theory, transit corridors should capture a higher rate of metropolitan jobs than
223 control corridors. All LRT systems operating since 2007 area included in this analysis.

224
225 **Transit and Control Corridors Described**

226 This section describes the criteria for selecting existing transit and control corridors, and then
227 describes the corridor selected for analysis and its comparable corridor.

228

229 Many of the metropolitan areas analyzed have only as single light rail corridor, dictating the
230 selection. For metropolitan areas with more corridors, ones that began operation between 2002
231 and 2011 were preferred. When no such corridor was available, corridors between regional-scale
232 use such as airports were avoided as representing major confounders.

233
234 For comparable corridors, the emphasis was placed on creating corridors viable as transit
235 corridors. This meant that corridors were contiguous and followed a continuous existing right-of-
236 way that was viable as a transit corridor. Availability of right-of-way was the primary concern,
237 and this dictated either existing major roads or existing railway right-of-way. For the former,
238 highways and major arterials were preferred. For the latter, this meant the majority of right-of-
239 way needed to follow an existing rail corridor.

240
241 For the Dallas DART system, the Red line was used as a transit corridor. The 29.3-mile light rail
242 corridor opened in 1996, and runs from Parker road in Plano to Westmoreland. The comparable
243 corridor follows an existing railroad corridor (one of the few not used for later DART lines).

244
245 For the Denver, the RTD light rail's Southwest Corridor was used as the transit corridor. It is a a
246 8.7 mile corridor stretching from downtown Denver to Littleton. For a comparable corridor, the
247 Northwest corridor, an existing rail corridor stretching from Denver Union station to Broomfield
248 was used.

249
250 For the Portland MAX system, the yellow line corridor was used, running between Expo center
251 and Portland State University. It is 5.8 miles long, and began operations in 2005. The
252 comparable corridor is a parallel path to the yellow line, on the east side of I-5, along Albina
253 Avenue, and then along Martin Luther King Boulevard for a similar length.

254
255 For the Sacramento Regional Transit light rail, the Southern extension to the Blue line was used.
256 The section is about 5.5 miles long, and began operations in 2003. The analysis portion runs
257 from the southern beltway to Meadowview Road. The comparable corridor was a Southern
258 Pacific railroad corridor running parallel to the line, characterized by similar types of land uses.

259
260 For the Salt Lake TRAX system, the 400 South University line was used, running from
261 downtown to the University of Utah. For a comparable corridor, 2100 South, a comparable
262 arterial that also links into the rest of the TRAX system was used.

263
264 For the San Diego Trolley, the Mission Valley East extension to the Green line was used. It
265 stretches from Mission San Diego to La Mesa, and began operations in 2005. It stretches 19.4
266 miles. As a comparable corridor, a corridor origination in Mission San Diego northward along I-
267 5, and then east to Mira Mesa was used. Both corridors run parallel to freeway corridors for
268 much of their length.

269
270 For the Charlotte Metro area LYNX light rail, running along the South Boulevard between I-485
271 and downtown Charlotte. It is a 9.6 mile corridor that began operations in 2007. For a
272 comparable corridor, the planned blue line extension It extends along an existing railroad
273 corridor from downtown Charlotte to UNC Charlotte.

274

275 For the Houston METRORail light rail line, the Red line, a 6.7 mile corridor stretching from the
276 University of Houston to the Reliant Park (Astrodome) in the south, along surface streets. For a
277 comparable corridor, a route running along existing arterial roads was used. It ran from the
278 Houston CBD to the Galleria, along Gray Street, Westheimer Road, and Post Oak Boulevard.
279

280 For the Minneapolis-St. Paul metropolitan area, 8.8 miles of the Hiawatha corridor (now part of
281 the METRO transit Blue line) from downtown Minneapolis to the Minneapolis-St. Paul
282 International Airport was used. The corridor began operations in 2004. The comparable corridor
283 follows a portion of the proposed Southwest Corridor light rail, originating in Minneapolis along
284 the existing railroad corridor toward St. Louis Park, then towards Hopkins, ending at Shady Oak
285 road.
286

287 *Method*

288 Given that the employment capture rate and change in rate over time is our principal concern we
289 choose descriptive and location quotient (LQ) analytic approaches. Descriptive statistics are used
290 to compare share of total jobs in transit and control corridors for 2002, 2007, 2009 and 2011, and
291 changes in shares between them between each successive year (2002 to 2007, 2007 to 2009, and
292 2009 to 2011). This provides us with an overall perspective of the extent to which transit
293 corridors perform as well as, better than, or worse than control corridors.
294

295 Secondly, we use LQ analysis to decompose changes in shares of jobs between transit and
296 control corridors during the same time period. This has the advantage of identifying economic
297 sectors that are attracted to, or repelled by, transit corridors during economic shocks and
298 recovery.
299

300 LQs are calculated as the share of jobs in one economic sector compared to (divided by) all jobs
301 in that small area as the numerator, compared to (divided by) the share of all jobs in a larger area
302 compared to (divided by) all jobs in that area as the denominator.⁴ They are an efficient way to
303 assess concentrated a particular economic sector is in a region compared to other sectors, and
304 compared to other parts of the same region such as transit and control corridors in our study.
305

306 LQs for economic sectors quantifying how “concentrated” the sector is in the smaller area
307 compared to the larger one. Because they can be measured at any given point in time, changes in
308 LQs can identify emerging or lagging economic activity in a specific sector of a smaller area
309 relative the larger one, again in our case transit and control corridors compared to the
310 metropolitan area as a whole. As such, LQs can be considered a measure of the capture rate in a
311 given sector so that LQs >1.0 indicate local advantage in attracting jobs. Over time, as LQs rise
312 or fall, analysis can detect growing or declining attractiveness of the smaller area. In our case, if
313 transit corridor LQs rise in some sectors over time such would indicate growing attractiveness of
314 the corridor for new economic activity.
315

316 Also in our LQ analysis, we note whether the transit corridor LQ has increased between study
317 periods, indicating that jobs would be concentrating along the transit corridor relative to
318 metropolitan trends over time.
319

320 However, for our analysis, we compare the ratio of LQs between transit (numerator) and control
321 (denominator) corridors at the end-year of a study period to the begin-year of that period. This
322 generates a measure of relative strength or weakness of transit corridors in attracting growth with
323 specific sectors over each time period, relative to control corridors. LQ change ratios >1.0
324 indicate transit corridors are gaining share over control corridors while LQ change ratios <1.0
325 indicate the reverse.

326
327 Our LQ analysis is based on the 2-digit 20-sector NAICS sector definitions, aggregated to eight
328 larger sectors. The NAICS reports jobs some sectors (such as agriculture and mining) are not
329 relevant for our purposes while others (such as construction) is also excluded because it does not
330 have many workers occupying space on a permanent basis. We further still the relevant sectors to
331 eight groups as shown in Table 1.

332
333 For each study period we report results for the first 0.25 mile and then the second 0.25 mile from
334 the centerline of the transit or control corridor. That is, we compile job data for each census
335 block whose centroid falls within one or the other of those buffers.

336 337 **Results**

338 We report overall results for the descriptive comparisons first, followed by results from LQ
339 analysis.

340 341 *Descriptive Results*

342 Table 2 reports results from the descriptive analysis. Calculations are based on the ratio of job
343 change from an earlier period to a later period for transit corridors divided by the same for
344 control corridors. In effect, figures great than 1.0 indicate increasing share of metropolitan area
345 jobs in transit corridors relative to control corridors. From this table, we can see that within the
346 first 0.25 mile of the centerline of a corridor, transit corridors in half or more of all cases, and
347 weighted over all systems, shows transit corridors to have performed better than their controls.
348 Specifically of interest to us, transit corridors were decidedly more resilient in weathering the
349 economic shock of the Great Recession in nearly all the metropolitan areas as well as overall
350 within the first 0.25 mile, and in about half the metropolitan areas as well as overall over the next
351 0.25 mile. However, during the first and second recovery periods over the second 0.25 mile,
352 control corridors performed better.

353 354 *Location Quotient Results*

355 The advantage of location quotient analysis is that it can detect economic development attraction
356 (and repelling) over time with respect to key factors such as transit systems. The advantage in
357 comparing the rate of change between LQs between transit and control corridors over our study
358 periods is that we can detect relative changes in the attractive of transit corridors over control
359 corridors. A ratio of change of LQs >1.0 indicates the transit corridor is performing better than
360 the control corridor for that specific sector. Table 3 reports change in LQs for transit compared to
361 control corridors for the first 0.25 mile for each of our study periods while Table 4 reports results
362 over the next 0.25 mile.

363
364 During the first recovery period, we find evidence of transit corridor resiliency with respect to
365 the control corridor and the overall metropolitan area, with the second 0.25 mile band actually

366 having more positive LQ (>1.0) changes for specific sectors that the first band, even though
367 share of total employment fared less well as seen in Table 2. Numerically, however, the number
368 of jobs affected is small. (Jobs are not reported for reasons of brevity.)
369

370 We find similar trends for the Great Recession and second recovery; that is, there is evidence
371 that transit corridors on the whole performed better than control corridors and the metropolitan
372 area as a whole. During the Great Recession, transit corridors over the first 0.25 mile band
373 outperformed control corridors in half the sectors (manufacturing, retail/lodging, office, and
374 education) and outperformed metropolitan areas in three of them (the same excluding
375 manufacturing). Outcomes were more impressive during the second recovery as transit corridors
376 were more resilient than control corridors in all but three sectors (nonmanufacturing industries,
377 office and health) and they were more resilient than metropolitan areas as a whole in all but two
378 sectors (nonmanufacturing industries and office). Over the next 0.25 mile results are less
379 impressive for transit corridors during the Great Recession as well as the second recovery.
380

381 **Implications**

382 We view our analysis as only preliminary. For one thing, the concept of measuring economic
383 resilience in terms of transit systems is new. Second, we measured entire transit corridors which,
384 while necessary for comparability with control corridors, could over-estimate resiliency
385 outcomes when restricted to just areas around transit stations. Though we also note that at least
386 one analyst (Canepa 2007) implicitly argues for transit corridor as opposed to transit station area
387 planning. Though ours may be the first work of its kind to attempt to measure and find some
388 evidence for a relationship between transit and economic resilience, we also call for more
389 rigorous research to improve measurement and expand the analysis across other transit modes.
390

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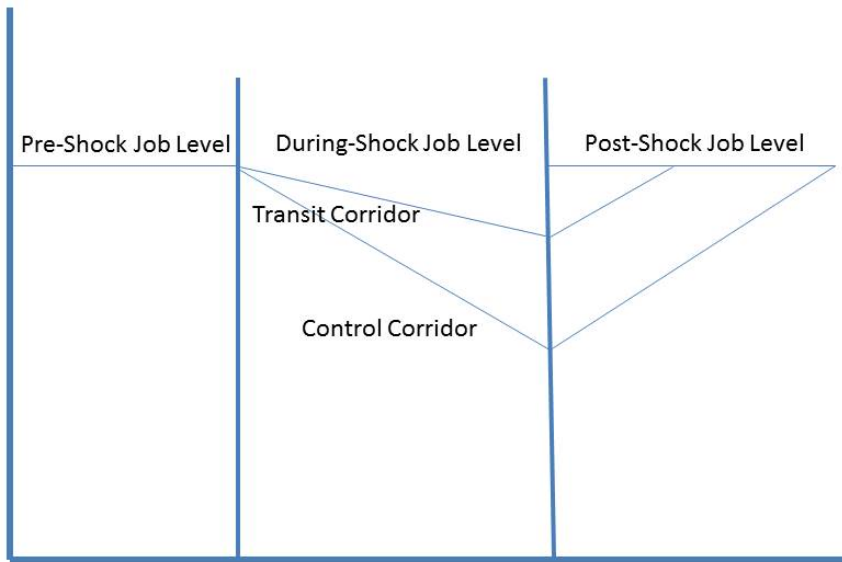
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469



470
471 **Figure 1**
472 **Pre-, during-, and post-shock job levels for transit and control corridors**
473
474

475 **Table 1**
 476 **Combinations of NAICS Sectors for Analysis**
 477

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

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Table 2
Ratio of Change of Transit to Control Corridor Jobs over Three Time Periods

Metropolitan Area	<0.25 mile	0.25-0.50 mile
<i>Ratio of Change of Transit to Control Corridor Jobs 2002-2007</i>		
Dallas	1.11	0.90
Denver	0.84	0.94
Portland	0.99	0.91
Sacramento	0.81	0.90
Salt Lake City	1.06	0.70
San Diego	1.03	1.10
Composite	1.02	0.95
<i>Ratio of Change of Transit to Control Corridor Jobs 2007-2009</i>		
Charlotte	1.04	0.90
Dallas	1.02	0.99
Denver	1.10	1.14
Houston	1.04	1.14
Portland	0.98	1.07
Sacramento	1.06	0.83
Salt Lake City	0.91	0.99
San Diego	1.00	1.00
Twin Cities	1.32	0.76
Composite	1.05	1.03
<i>Ratio of Change of Transit to Control Corridor Jobs 2009-2011</i>		
Charlotte	0.95	0.98
Dallas	1.03	0.96
Denver	1.03	0.87
Houston	0.97	1.51
Portland	0.97	0.99
Sacramento	1.30	0.84
Salt Lake City	0.98	1.05
San Diego	1.14	0.83
Twin Cities	0.98	0.84
Composite	1.04	0.88

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Table 3
Resilience Outcomes during First Recover, Great Recession, and Second Recovery, 2002-
2011, within 0.25 Mile of Transit and Control Corridor, and Compared to the Metropolitan
Area

MSA	Manufacturing	Nonman Industry	Retail Lodging	Office	Knowledge	Education	Health	Entertain
<i>Transit/Control = (Transit LQ 2007/Transit LQ 2002)/(Control LQ 2007/ Control LQ 2002)</i>								
<i>Transit/Metro = Transit LQ2007/Transit LQ 2002</i>								
Dallas								
Transit/Control		████████		████████		████████		
Transit/Metro			████████		████████		████████	
Denver								
Transit/Control		████████	████████				████████	
Transit/Metro		████████	████████	████████	████████		████████	
Portland								
Transit/Control		████████	████████		████████		████████	████████
Transit/Metro			████████	████████	████████			████████
Sacramento								
Transit/Control	████████	████████			████████			
Transit/Metro	████████	████████				████████	████████	
Salt Lake City								
Transit/Control				████████	████████		████████	
Transit/Metro				████████	████████	████████		
San Diego								
Transit/Control	████████	████████	████████			████████		████████
Transit/Metro	████████	████████	████████				████████	
Composite								
Transit/Control		████████	████████					
Transit/Metro		████████	████████		████████		████████	
<i>Transit/Control = (Transit LQ 2009/Transit LQ 2007)/(Control LQ 2009/ Control LQ 2007)</i>								
<i>Transit/Metro = Transit LQ2009/Transit LQ 2007</i>								
MSA								
Charlotte								
Transit/Control	████████		████████	████████	████████			
Transit/Metro				████████			████████	
Dallas								
Transit/Control			████████			████████		████████
Transit/Metro		████████	████████			████████	████████	████████
Denver								
Transit/Control		████████	████████	████████		████████		
Transit/Metro			████████	████████		████████		
Houston								
Transit/Control				████████		████████	████████	

Transit/Metro									
Portland									
Transit/Control									
Transit/Metro									
Sacramento									
Transit/Control									
Transit/Metro									
Salt Lake City									
Transit/Control									
Transit/Metro									
San Diego									
Transit/Control									
Transit/Metro									
Twin Cities									
Transit/Control									
Transit/Metro									
Composite									
Transit/Control									
Transit/Metro									

$$\text{Transit/Control} = (\text{Transit LQ 2011}/\text{Transit LQ 2009})/(\text{Control LQ 2011}/\text{Control LQ 2009})$$

$$\text{Transit/Metro} = \text{Transit LQ2011}/\text{Transit LQ 2009}$$

MSA

Charlotte

Transit/Control									
Transit/Metro									

Dallas

Transit/Control									
Transit/Metro									

Denver

Transit/Control									
Transit/Metro									

Houston

Transit/Control									
Transit/Metro									

Portland

Transit/Control									
Transit/Metro									

Sacramento

Transit/Control									
Transit/Metro									

Salt Lake City

Transit/Control									
Transit/Metro									

San Diego

Transit/Control

[REDACTED]

Transit/Metro

[REDACTED]

Twin Cities

Transit/Control

[REDACTED]

Transit/Metro

[REDACTED]

Composite

Transit/Control

[REDACTED]

Transit/Metro

[REDACTED]

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501 **Table 4**
 502 **Resilience Outcomes during First Recover, Great Recession, and Second Recovery, 2002-**
 503 **2011, between 0.25 and 0.50 Mile of Transit and Control Corridor, and Compared to the**
 504 **Metropolitan Area**
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MSA	Manufact- uring	Nonman Industry	Retail Lodging	Office	Knowledge	Education	Health	Entertain
<i>Transit/Control = (Transit LQ 2007/Transit LQ 2002)/(Control LQ 2007/ Control LQ 2002)</i>								
<i>Transit/Metro = Transit LQ2007/Transit LQ 2002</i>								
Dallas								
Transit/Control				██████	██████		██████	██████
Transit/Metro				██████	██████		██████	██████
Denver								
Transit/Control				██████	██████		██████	██████
Transit/Metro	██████	██████	██████		██████	██████	██████	██████
Portland								
Transit/Control	██████		██████	██████	██████		██████	
Transit/Metro	██████	██████	██████	██████	██████		██████	██████
Sacramento								
Transit/Control	██████	██████			██████			
Transit/Metro	██████			██████	██████	██████		
Salt Lake City								
Transit/Control				██████	██████	██████		██████
Transit/Metro				██████	██████	██████		██████
San Diego								
Transit/Control			██████			██████	██████	
Transit/Metro		██████	██████			██████	██████	
Composite								
Transit/Control			██████		██████	██████	██████	
Transit/Metro		██████	██████		██████		██████	
<i>Transit/Control = (Transit LQ 2009/Transit LQ 2007)/(Control LQ 2009/ Control LQ 2007)</i>								
<i>Transit/Metro = Transit LQ2009/Transit LQ 2007</i>								
MSA								
Charlotte								
Transit/Control	██████	██████			██████		██████	
Transit/Metro		██████		██████		██████	██████	
Dallas								
Transit/Control	██████				██████	██████		██████
Transit/Metro	██████				██████			██████
Denver								
Transit/Control		██████				██████		██████
Transit/Metro		██████		██████				██████
Houston								
Transit/Control			██████		██████		██████	██████
Transit/Metro			██████		██████		██████	██████

Transit/Metro

[REDACTED]

Twin Cities

Transit/Control

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Transit/Metro

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

Composite

Transit/Control

[REDACTED]

[REDACTED]

[REDACTED]

Transit/Metro

[REDACTED]

[REDACTED]

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¹ Adapted from <http://www.merriam-webster.com/dictionary/resilient?show=0&t=1406213694>.

² For details, see <http://lehd.ces.census.gov/>.

³ Two LRT systems were launched after 2007: Phoenix and Seattle.

⁴ The formula is:

$$LQ = \frac{e_i/e}{E_i/E}$$

Where:

e_i = Local employment in industry i

e = Total local employment

E_i = Reference area employment in industry i

E = Total reference area employment