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1 **RETAIL RENT WITH RESPECT TO DISTANCE FROM LIGHT RAIL TRANSIT**
2 **STATIONS IN DALLAS AND DENVER**

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46

47 **Abstract**

48 A growing body of recent research is challenging the assumptions underlying the half-mile-circle
49 in planning for development around transit stations. In this article we review this literature and
50 extend it to include retail land uses. We estimate the rent premium conferred on retail properties
51 in metropolitan Dallas and metropolitan Denver, both of which have extensive light rail transit
52 systems. We find that consistent with half-mile-circle assumptions, retail rent premiums extend
53 only to about 0.30 mile from transit stations with half the premium dissipating after a few
54 hundred feet and three quarters within the first 0.10 mile. We offer implications for planners and
55 public officials.

56

57 **Introduction**

58 Much has been written about the association between rail transit and residential property values
59 but less has been written about the association with respect to other property values and nearly
60 none about the association with respect to retail property values. We help close this gap. We
61 begin with a literature review. This is followed by our research design, study area and data which
62 we apply to metropolitan Dallas and Denver. After presenting our results we offer implications
63 for planning and public policy.

64

65 **Literature**

66 The basic theory of urban economics (1, 2) can be summed up as follows: as a location becomes
67 more central to economic activity in a region, demand for such location increases and through
68 the market bidding process land becomes more valuable and development becomes more intense.
69 Central business district (CBD) location is an obvious example of this. Assuming Von Thünen's
70 unfettered plain (3), land values and development intensity tend to fall at a declining rate from the
71 CBD. But areas outside CBDs can also enjoy accessibility advantages. This occurs when
72 transportation investments confer more efficient accessibility to non-CBD nodes than elsewhere
73 outside the CBD. The result should be more intensive development around those. Where those
74 investments are highways, congestion often follows thereby undermining efficiencies (4, 5).
75 Transit, as an "uncongestible" transportation option (6) can restore accessibility efficiencies,
76 leading to yet more intensive development.

77

78 But do all types of urban land uses react similarly transit station proximity? In an
79 important meta-analysis of studies through the middle 2000s, Debrezion, Pels and
80 Rietveld (7) identified variations between land uses. Like Bartholomew and Ewing (8),
81 they note that most studies of transit-station effects on property values address residential
82 property values and most of them address single family values – presumably because
83 data available for those properties are more plentiful than for other land uses. There were
84 about an equal number of studies on attached residential and office properties, but very
85 few for other land uses. We will not review the details of their findings except to observe
86 that, generally, the literature on industrial, hospitality (principally hotels), and retail
87 property value with respect to transit station proximity is small.

88

89 Generally, most prior studies have assume perhaps as an article of faith that urban land uses
90 will cluster mostly within the first one-quarter mile and a few out to about one-half mile.
91 Emerging research is challenging the half-mile-circle mantra. For instance, Petheram et al. (9)
92 found that apartments capitalized light rail transit station proximity to about 1.25 miles in Salt

93 Lake County, Utah. Ko and Cao (10) found office and industrial rent premiums with respect to
94 distance from the Hiawatha light rail transit stations in Hennepin County, Minnesota to extent
95 0.9 mile. For metropolitan Dallas and Denver, however, we (11) find the office rent premium to
96 extend about two miles from light rail transit stations though three-quarters of the premium
97 dissipates at about two-thirds mile.
98

99 We find only one relevant study estimating the rent premium on the association between
100 rail transit proximity and retail properties. Cervero and Duncan (12, 13) find that retail
101 land use value increases substantially within 200 feet of light and commuter rail transit
102 stations, perhaps 167 percent higher than distances beyond 200 feet in San Diego
103 County, California. Our study contributes to knowledge about whether and the extent to
104 which there is an association between retail land uses and, in particular, light rail transit
105 station proximity. We apply our inquiry to metropolitan Dallas and Denver.
106

107 **Research Design, Study Area, Model and Variables**

108 We extend work of others including Ko and Cao by evaluating the retail rent premium associated
109 with light rail transit station proximity in metropolitan Dallas and Denver. We chose those
110 systems for four reasons. First, they are among the oldest LRT systems in the US. The Dallas
111 Area Rapid Transit (DART) system began LRT service in 1996 while metropolitan Denver's
112 Regional Transportation District began operating its FasTracks LRT in 1994. Only Portland's
113 (1986), Sacramento's (1987) and San Diego's (1981) LRT systems are older.
114

115 Second, unlike Portland, Sacramento and San Diego, DART and FasTracks serve metropolitan
116 areas that are largely sprawling metropolises undeterred by terrain (the Rocky Mountains are
117 tens of miles away from downtown Denver) and policy (neither explicitly contains urban
118 development).
119

120 Third, they are among the nation's largest LRT systems. In 2012, DART had 60 stations and
121 nearly 100,000 daily passengers while FasTracks had 46 stations and nearly 90,000 daily
122 passengers.
123

124 Fourth, their sheer size allow for sufficient data on office rents to undertake hedonic analysis (as
125 we discuss below). Indeed, our study area includes the central counties of Dallas and Denver as
126 well as Arapahoe and Jefferson counties in Colorado. It is thus the largest study area of any study
127 of its kind.
128

129 We employ the following hedonic model in our analysis:
130

$$131 R_i = f(B_i, S_i, C_i, L_i)$$

132
133 where:
134

135 R is the market rent per square foot for property *i*;

136
137 B is the set of building attributes of property *i*;
138

139 S is the set of socioeconomic characteristics of the vicinity of property *i*;

140

141 C is a composite measure of urban form of the vicinity of property *i*; and

142

143 L is a set of location attributes of property *i*.

144

145 Our dependent variable, **R** or rent per square foot, and independent variables comprising **B**,
146 building attributes, come from CoStar, with permission. Through proprietary access during fall
147 2012, we were able to collect an inventory of all retail structures within the study area including
148 their address, square feet, occupied and vacant space to derive the vacancy rate, stories, effective
149 age (by the later of the construction or renovation year), and weighted average contract rent per
150 square foot though we do not have lease terms for individual tenants. These variables include:

151

152 Socioeconomic data, **S**, come from either the 2010 census (for percent census tract population
153 that is not White non-Hispanic) or the 2012 5-year American Community Survey (for census
154 tract median household income).

155

156 **C** is a unique variable which measures urban form from most sprawled/diffused/disconnected to
157 most compact/integrated/connected at the level of the census tract. This index places urban
158 sprawl at one end of a continuous scale and compact development at the other. The original
159 index was developed in 2002 for metropolitan areas and counties (14, 15). In a recent study, the
160 compactness indices were refined and updated to 2010 for metropolitan areas, urbanized areas,
161 counties and census tracts and all are posted on a National Institutes of Health website (16).¹ For
162 census tract indices, Ewing and Hamidi used the same methodology and the same type of
163 variables as in larger area analyses. They extracted principal components from multiple
164 correlated variables using principal component analysis and transformed the first principal
165 component to an index with the mean of 100 and a standard deviation of 25. Because the number
166 of component variables is greater for street accessibility than land-use mix, and greater for land-
167 use mix than development density, the resulting index gives more weight to street accessibility
168 than mix, and to mix than density. This is not unintentional, since the built environment-travel
169 literature suggests that density is the least important of the three D variable types (17). Given that
170 retail land uses that depend especially on accessibility this is an appropriate composite variable
171 to include.

172

173 Finally, **L**, the set of location variables, measures the distance of the centroid of each parcel to
174 the center of central business district of Dallas or Denver, the nearest entrance onto a limited
175 access highway and its quadratic term, and distance to the nearest LRT station and its quadratic
176 term. Distances are measured in miles.

177

178 Although the CoStar retail building database is the most comprehensive available from any
179 source, only about a quarter of the retail properties include rent. The reason is that most firms
180 either own the buildings they use and do not rent space to other tenants, or tenants have long-
181 term exclusive tenancy agreements with property owners. Nonetheless, with more than 700 retail
182 properties comprising more than 36 million square feet, we believe our analysis will reveal
183 central tendencies helping to clarify whether and the extent to which LRT station proximity

¹ <http://gis.cancer.gov/tools/urban-sprawl> Accessed July 28, 2014.

184 confers rent premiums on retail property.

185

186 **Results**

187 Table 1 reports results of linear ordinary least squares regression separately for Dallas, Table 2
188 reports results for and Denver, and Table 3 reports combined results. For all models, the
189 coefficients of determination are modest but reasonable given overall performance including
190 expected outcomes with respect to the explanatory variables. The correlation matrices (not
191 reported for brevity) did not reveal problematic correlations, and autocorrelation was not
192 detected.

193

194 INSERT TABLE 1 ABOUT HERE

195

195 INSERT TABLE 2 ABOUT HERE

196

196 INSERT TABLE 3 ABOUT HERE

197

198 In all regressions, the building structure variables performed reasonably. The incremental size of
199 a building had no effect on rents suggesting no marginal advantage in larger over small size. The
200 floor area ratio was positive and significant indicating more intensely developed retail sites
201 conveyed higher premiums. It would seem that less parking generates higher rents. On the other
202 hand, the number of stories in a building may depress rent at the margin as floors above (or
203 below) main levels likely carry goods that sell at lower revenue volumes per square foot than the
204 main level. Increasing vacancy rates reduced mean rents while decreasing effective age increased
205 rents at the margins.

206

207 The socioeconomic variables for Dallas had expected results as increasing median household
208 incomes were associated with increasing while increasing shares of population that were not
209 White Non-Hispanic were associated with decreasing rents. Signs were reversed in Denver
210 though not significant for income. When both markets are pooled, signs are as expected with
211 acceptable levels of statistical significance.

212

213 The Compactness Index was also positive in all regression equations. While this is a composite
214 variable, it suggests that on the whole the market is willing to pay more for locations that are
215 more densely occupied by jobs and people, more integrated in terms of land use mix, and have
216 well-connected streets compared to other locations.

217

218 The CBD distance location variable performs as expected. In the individual Dallas and Denver
219 regressions, coefficients of the first order and quadratic transformations of the variable
220 measuring distance to the nearest limited access highway entrance had the correct signs though
221 in the pooled analysis both were negative but nonetheless consistent with distance-decay
222 expectations.

223

224 Of interest to us is the extent to which office rents are affected by proximity to LRT stations and
225 if so how far away. In the Dallas regression, the coefficients had the expected signs but they
226 were also just out of range of statistical significance at the 0.10 level of the 1-tailed t-test (since
227 directions of association are predicted). In the Denver equation, the LRT distance-decay
228 variables also had the expected signs but only the quadratic transformation was significant. In the
229 pooled regression both distance-decay terms had the expected signs and were significant at the

230 0.01 level of the 1-tailed t-test. Differentiating the coefficients and then setting for zero we solve
231 for the distance threshold. For the pooled markets we estimate the threshold extends about 0.30
232 or less than one-third mile.

233

234 **Implications**

235 Similar to Cervero and Duncan (12, 13), we find a much tighter distance-decay relationship
236 between LRT station proximity and retail rents compared to other land uses. For example, one of
237 our recent studies find that apartment land uses capitalize LRT distance up to 1.25 miles away
238 (9). We also find office rent premiums to extend in the range of two miles away (11). Ko and
239 Cao (10) find a combination of office and industrial rents to extent nearly a mile away. While we
240 estimated that half the office premium dissipated after one-half mile and three-quarters dissipated
241 after two-thirds mile, in this analysis we find that half the retail premium dissipates at about 0.06
242 mile while three-quarters of the premium dissipates at about 0.10 mile.

243

244 For decades, planners and public officials have assumed that the largest share of market
245 responsiveness to transit stations occurred within the first 0.25 mile and the rest out to about 0.50
246 mile. Emerging analysis is relaxing those narrow bands for apartments and office land uses, the
247 premiums for which can extend well beyond a mile with half or more of the premium found
248 within the first one-half mile. In contrast, this study finds a much tighter distance threshold with
249 respect to retail land uses, perhaps only within the first 0.10 mile.

250

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254 Front Regional Council, the Mountainland Association of Governments, and the University of
255 Arizona. We also give special acknowledgement to CoStar for allowing us to evaluate its
256 proprietary data on market rents for retail properties in the Dallas and Denver study areas. Our
257 views do not necessarily reflect those of our sponsors.

258

259

260 **Table 1**
 261 **Hedonic Regression Results for Retail Rent Premium with Respect to LRT Station**
 262 **Distance, Dallas**
 263

Variable	Coefficient	Std Err of Coef.	t-score p
Constant	-191.242	30.092	-6.355 .01
Gross Leasable Square Feet	0.000	0.000	0.365
Floor Area Ratio	1.945	0.793	2.452 .01
Stories	-1.018	0.598	-1.704 .05
Vacancy Rate	-0.036	0.009	-3.983 .01
Effective Year Built	0.105	0.015	6.825 .01
Median Household Tract Income	0.054	0.012	4.417 .01
Percent Not White Non-Hispanic	-0.032	0.015	-2.076 .05
Compactness Index	3.798	0.615	6.173 .01
Distance from CBD, miles	-0.144	0.077	-1.876 .05
Distance from Interchange, miles	-3.264	1.02	-3.201 .01
Square Distance from Interchange	0.873	0.372	2.347 .01
Distance LRT Station, miles	-1.266	0.687	0.277
Squared Distance LRT Station	1.161	0.138	0.031
R Square	0.289		
Adjusted R Square	0.272		
Std. Error of the Estimate	5.170		
F	17.096		
Sig. F	0.000		
Observations	562		
Degrees of Freedom	548		
Durbin-Watson	1.884		

265 **Table 2**
 266 **Hedonic Regression Results for Retail Rent Premium with Respect to LRT Station**
 267 **Distance, Denver**

Variable	Coefficient	Std Err of Coef.	t-score p
Constant	-242.017	55.035	-4.398 .01
Gross Building Square Feet	0	0	-0.206
Floor Area Ratio	0.427	0.493	0.865
Stories	0.492	1.219	0.404
Vacancy Rate	-0.052	0.016	-3.198 .01
Effective Year Built	0.126	0.028	4.506 .01
Median Household Income	0.009	0.025	0.347
Percent Not White Non-Hispanic	0.236	0.086	2.737 .01
Compactness Index	-1.319	1.176	-1.122
Distance from CBD, miles	0.353	0.202	1.746 .05
Distance from Interchange, miles	0.534	0.508	1.052
Square Distance from Interchange	-0.167	0.069	-2.425 .01
Distance from Nearest LRT Station	-0.608	0.508	-1.199
Squared Distance from Nearest LRT	0.071	0.048	1.471 .05
R Square	0.298		
Adjusted R Square	0.242		
Std. Error of the Estimate	4.671		
F	5.263		
sig. F	0.000		
Observations	175		
Degrees of Freedom	161		
Durbin-Watson	1.750		

269 **Table 3**
 270 **Hedonic Regression Results for Retail Rent Premium with Respect to LRT Station**
 271 **Distance, Dallas and Denver**
 272

Variable	Coefficient	Std Err of Coef.	t-score p
Constant	-184.1570	26.4120	-6.9720 .01
Gross Leasable Square Feet	0.0000	0.0000	-0.0650
Floor Area Ratio	1.3320	0.4350	3.0650 .01
Stories	-0.2860	0.5240	-0.5460
Vacancy Rate	-0.0360	0.0080	-4.6040 .01
Effective Year Built	0.1000	0.0130	7.4600 .01
Median Household Tract Income	0.0550	0.0110	5.0730 .01
Percent Not White Non-Hispanic	-0.0310	0.0140	-2.1100 .05
Compactness Index	2.6520	0.5200	5.0960 .01
Denver	-1.8540	0.7010	-2.6450 .01
Distance from CBD, miles	-0.0690	0.0700	-0.9850
Distance from Interchange, miles	-0.5120	0.3330	-1.5370 .10
Squared Distance from Interchange	-0.1050	0.0580	-1.8240 .01
Distance LRT Station	-0.7930	0.2700	-2.9380 .01
Squared Distance LRT Station	0.1200	0.0320	3.7960 .01
R Square	0.2450		
Adjusted R Square	0.2310		
Std. Error of the Estimate	5.1720		
F	16.1720		
Sig. F	0.0000		
Observations	737		
Degrees of Freedom	722		
Durbin-Watson	1.807		

273
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