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

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[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   INSERT TABLE 2 ABOUT HERE
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

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			

264

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		

268

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			

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