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**VACANT LAND VALUES:
A QUASI-EXPERIMENTAL STUDY OF PHOENIX METRO LIGHT RAIL STATIONS**

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30 **ABSTRACT**

31 This article pioneers a quasi-experimental methodology, assessing the development potential of
32 individual transit stations along a single route. The study investigates Phoenix METRO light rail
33 before and after the route was announced, until its opening December 2008. At 24 miles,
34 METRO was the nation's largest high capacity transit system starter line, traversing three
35 municipalities with radically different land use policies. Vacant land within a ½ mile of transit
36 stations is compared to two centrally located, mixed-use intersections that are not serviced by
37 high capacity transit. The first to use transit land values study using a quasi-experimental before-
38 after design, this study compares vacant land sales prices per square foot from 1990 to 1997
39 (before) and 1998 to 2008 (after) for each study area to predict where new mixed-use
40 development will occur after 2008. Net present values of vacant land sales before and after
41 transit's announcement shows that the City of Tempe's station areas increased in value the most.
42 Only the stations adjoining Tempe decreased in value. Additionally, a longitudinal view of total
43 square feet of land sold per year from 1990-2008 reveals triple the normal volume of sales for
44 those three years, signaling the existence of an investment cycle at high capacity transit stations.
45 Measurement and hedonic modeling of walkability, surrounding density, and local mix of uses
46 are required to pinpoint the reasons for the locational differences.

47

48 **INTRODUCTION**

49 This study investigates Phoenix METRO’s potential of achieving its goals: attracting
 50 development to municipal cores and creating regional accessibility (1). METRO’s challenge is
 51 twofold. METRO should attract new amenities to light rail stations and light rail expansions
 52 should improve accessibility to major destinations.

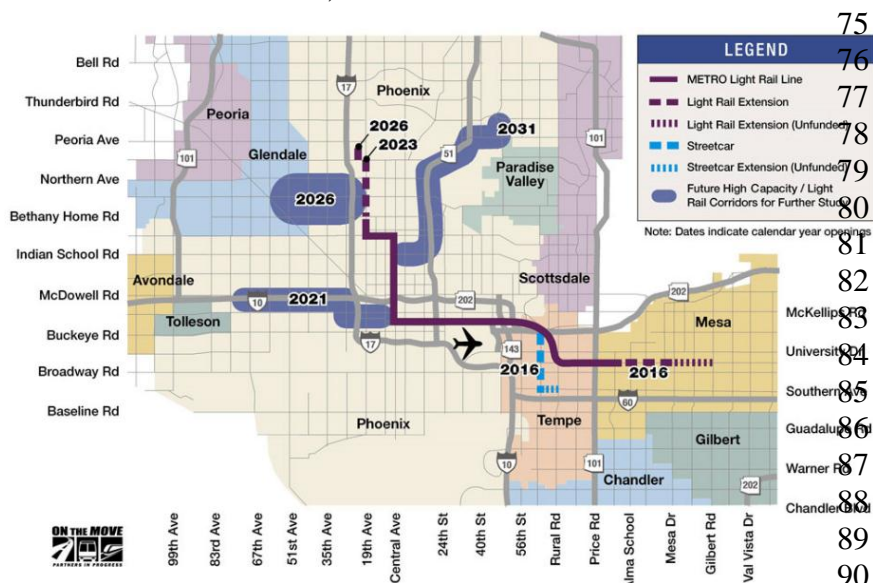
53 Phoenix is chosen as the case study because it is the last large city in the U.S. to
 54 reintroduce high capacity transit, and because it has an abundance of vacant land to study. In
 55 2000, Phoenix reported that 42.6 percent of its land was vacant, in sharp contrast to the 15.4
 56 percent average. Out of 83 cities, only Amarillo, 45 percent, and Fort Worth, 43.2 percent,
 57 reported more vacant land (2).

58 **METRO LIGHT RAIL HISTORY**

59 At its opening December 27, 2008, Phoenix METRO light rail was the nation’s largest modern
 60 light rail starter line, with 28 stations along 24 miles. In the first month of operation, ridership
 61 exceeded the projected 26,000 weekday riders by about 5,000 per day (3), with projected growth
 62 to 48,000 at maturity (4). Bus ridership was boosted by light rail, and total bus and light rail
 63 boardings increased 15 percent from fiscal year 2008 to 2009 (5).

64 High capacity transit is not new to Phoenix. Mule-driven streetcars were supplemented
 65 with a downtown trolley in the 1880’s, but by the 1940’s, all the trolleys and streetcars were
 66 decommissioned in favor of automobiles (6). In 1989, the first attempt to bring back high
 67 capacity transit failed by a three-to-two margin, defeating the plans for a 103-mile rapid train
 68 system (7-8). Success began in 1998, with a federally funded study that quickly resulted in
 69 funding for the initial line. Capital investment from Phoenix (\$402.1 million), Tempe (\$143.7
 70 million) and Mesa (\$20.5 million) were supplemented by Maricopa County sales tax (\$198.7
 71 million) and federal matching funds (\$646.9 million). Operating costs for the first five years
 72 were paid by fares (\$45 million), federal and regional funding (\$25 million), Phoenix (\$75
 73 million), Tempe (\$32 million) and Mesa (\$6.5 million), for a \$160 million total.

74 From west to east, the starter METRO transit corridor connected Spectrum Mall, a high-



75 density residential
 76 corridor, downtown
 77 Phoenix, Sky Harbor
 78 Airport, the main Arizona
 79 State University (ASU)
 80 campus in downtown
 81 Tempe and a major
 82 freeway. Lack of funding
 83 has plagued expansion
 84 plans. The major cultural
 85 and economic centers in
 86 nearby Mesa, Scottsdale
 87 and Glendale were not
 88 included in the starter line
 89 due to lack of funding.
 90 Some expansion is
 91 funded to the north and

FIGURE 1 METRO Starter Line and Extensions.

93 Metrocenter Mall by 2023 and downtown Mesa by 2016. As shown in Figure 1, Tempe streetcar

94 is funded to connect neighborhoods to the south by 2016. But in 2009, Arizona's sixth largest
95 city, Scottsdale, resigned their membership from Valley METRO, effectively eliminating the
96 potential for future connectivity and accessibility to its major commercial, residential and
97 entertainment hubs. In 2010, \$22 million in annual state transit funding was repealed to help
98 balance Arizona's weakening budget, further delaying expansion.

99 Light rail is not high speed. Its value is in connecting local destinations; the train travels
100 an average of 18 miles per hour, or 65 minutes to complete the entire route. Commuters require
101 higher speed high capacity transit to compete with faster automobile transportation. Despite the
102 significant size of the 24-mile starter line, the METRO system may not connect enough major
103 local destinations to bring the highest land premiums.

104 According to an Urban Land Institute report, the City of Phoenix has challenges to
105 overcome before the broader goals established for light rail can be achieved. Station area plans
106 that integrate sustainability goals and marketing plans for each station area are required, and they
107 should be integrated into the regional growth plan to insure that the regulatory framework allows
108 appropriate growth in the corridor. Priorities are needed if the growth pattern is to be influenced
109 (1). "Government interventions" described by Nelson (9-10), including incentives, zoning
110 overlays, private-public partnerships, and infrastructure may be required to attract mixed-use,
111 walkable development near transit stations. For example, Minneapolis station areas experienced
112 a new construction volume premium of 183 percent for the eight years following the
113 announcement of the line, and buildings were larger-scale than the comparison area. But the
114 Minneapolis study was not able to detect a significant change in land use diversity eight years
115 after the announcement of the station areas, so new zoning may not be enough to improve land
116 use patterns (11).

117 The starter transit line connects a business district, a major university and a few shopping
118 centers, covering a very limited, linear area with no grid or "spoke and wheel" connectivity (12).
119 Because the original line is so limited, station area premiums may increase well beyond the usual
120 five years if accessibility continues to grow.

121 **REVIEW OF LAND PREMIUM STUDIES**

122 Since the 1970's, over 50 studies have documented the property value impacts of high capacity
123 transit stations (13-14). These studies are being augmented with meta-studies that combine data
124 from individual transit system studies to roughly compare transit station premiums from city to
125 city (15-16). One recent study calculates the property value changes at rail station areas,
126 providing comparisons with a single methodology for 14 cities (17). These cross-sectional
127 studies compare one date before the transit investment and another after the investment, showing
128 the capitalization of transit investment into land values and measuring the transit investment's
129 economic utility.

130 Single family housing is the real estate asset type most studied, possibly because U.S.
131 zoning laws have insured that an abundant supply of homes similar in age, style and size are
132 available to study. County tax assessors provide significant data that is easy to use: public files
133 recording amenities and tax valuations for every home, a wealth of data for hedonic modeling.
134 Most land values studies rely on the hedonic modeling methodology to place statistically
135 relevant values on amenities that add to a total value for each property. For instance, a hedonic
136 model can tell how many dollars each foot of distance from a light rail station gives to properties
137 – useful data that is easy to understand and interpret.

138 Overall, cross-sectional research since the 1990's has shown that proximity to transit
139 stations adds value to single family home prices, averaging over 10 percent in Portland (18-19),

140 6.7 percent in Boston (20), up to 5 percent in Miami (21), 32 percent in Saint Louis (22), 20
141 percent in Chicago (23), 6.4 percent in Philadelphia (24), 6 percent in San Diego (25), 12.6
142 percent in Dallas (26), with homes increasing in value in Toronto (27) and Minneapolis (28). A
143 study of Miami showed insignificant impacts (19). A meta-analysis using 42 observations
144 showed an average single family home premium of 4.2 percent (13). Although these data show a
145 general consistency in property value premiums near transit stations, they tell us little or nothing
146 about the distribution of premiums among stations within transit lines, and this study begins to
147 fill that gap in the literature.

148 Multifamily residential access premiums are less extensively studied, but the available
149 statistics using cross-sectional hedonic models seem to show that condominiums and apartments
150 benefit more than single family residences: 17 percent in San Diego, 11 percent higher than
151 single family homes (25), with an additional 15 percent for condominiums in pedestrian-friendly
152 neighborhoods (29). In Phoenix, condominium accessibility premiums at more desirable light
153 rail stations was over 20 percent, compared to single family home premiums of 6 percent, with
154 less variation among stations (30). In Tampa, multifamily property values increased 117 percent
155 over a five-year period after a streetcar opening (11). Commuter rail, with faster speeds that
156 reduce commuting times, seems to bring higher premiums (31).

157 In one of the earliest studies of transit premiums, Nelson (9) demonstrated commercial
158 property value premiums near transit stations, and this finding is corroborated by nearly all of the
159 subsequent studies (29,32). Widely disparate ages, sizes and uses make comparing commercial
160 buildings inherently difficult, so methodologies vary substantially upon the rare occasions that
161 transit access studies include commercial real estate premium analysis. There is no accepted
162 methodology for valuing the underlying business use and neighborhood mix of services, which
163 have a great impact on building value. Despite the difficulties, a meta-study using 13 commercial
164 observations showed that the commercial premium was 12.2 percent higher than residential
165 within ¼ mile of stations (15). Premiums of 13.2 percent were reported in Dallas (26), 23 percent
166 in Santa Clara County (33), and 62 percent in Portland (11). In San Diego County, commercial
167 properties in prime central business district locations benefitted most from transit investment,
168 while competing commercial properties in less desirable locations experienced a price discount
169 (31). In cities with significant transit investment, new development clusters typically focus
170 around station areas to take advantage of increased accessibility (34). So far, studies have not
171 been able to show the time frame over which these premiums occur.

172 Not much is known about the impact on retail, other than transit stations seem to provide
173 a benefit (35-38). Proximity to retail shops increased condominium premiums near San Diego
174 transit stations (33). More studies are required to better understand what mix of retail stores is
175 effective at new transit stations, and how retail can increase walkability by sharing parking with
176 transit.

177 Vacant land may be the real estate type with the highest potential for premiums because
178 developers can incorporate the benefits of transit into new developments. In Tampa, commercial
179 vacant land had the highest premiums of any real estate type (11). The station area premium was
180 over 120 percent in Santa Clara County (33), and almost 150 percent for vacant land within ¼
181 mile of stations compared to ¼ to ½ mile from BART stations (39). The Seattle commercial
182 vacant land premium was more than 200 percent. Because single family residences are the least
183 compatible, they seem to have the lowest premiums. Existing multifamily residences and
184 commercial buildings are in the middle, because they have the greatest potential for
185 compatibility and high premiums when they have a high number of people and contain a mix of retail

186 and offices (11). This study measures vacant land premiums, likely to be the most volatile real
187 estate type at station areas.

188 Transit stations tend to attract both office and residential high-density development, but
189 this is not guaranteed. Duncan found that new condominium investments are attracted to transit
190 stations because of enhanced accessibility and the existing, complementary higher density,
191 walkable commercial and retail properties near stations. These Transit Oriented Developments
192 (TOD's) bring the most significant premiums for condominiums near transit (29). This study is
193 the first to differentiate station areas based on vacant land prices to assess TOD potential and
194 investigate the lifecycle of investment at transit.

195 **NEED FOR VACANT LAND STUDIES BY STATION AREA**

196 Vacant land is of interest because its constrained supply makes it possible, or even likely, for
197 appreciation to exceed that of buildings. Building value is largely limited to the cost of new
198 construction, especially when vacant land is available and municipalities encourage growth (40).
199 Vacant land is significantly more volatile than other property types (41). Studies tend to use the
200 values of buildings to infer an increase in the underlying land, presumably because of limited
201 nearby vacant land to analyze, but the prevalence of vacant land in Phoenix makes a direct study
202 of vacant land possible. In Minneapolis, within ¼ mile and ½ mile of stations, 92 percent and 95
203 percent of the land had already been developed by the announcement of the light rail alignment.
204 Vacant land at stations was further reduced at ¼ mile and ½ mile to less than 5 percent and about
205 4 percent (28).

206 When properties near light rail stations are oversupplied, station areas compete with each
207 other for investment and the least desirable ones may experience a discount from the overall
208 market (11). Insufficient vacant land for new development may also reduce premiums. The key
209 is to "right size" the supply of development potential property so that pioneer TOD investors can
210 assemble redevelopment parcels into developable sites without raising prices so high that all
211 possible development plans become unprofitable. By limiting the number of developable sites,
212 municipalities increase the odds of these sites being fully developed as TOD's to maximize
213 premiums.

214 The accessibility premium may be affected by the value of the transit offered. Highest
215 premiums come from extensive transit systems that connect the major regional destinations (11,
216 29, 37-38, 42). For Philadelphia single family homes, the highest rail station accessibility
217 premiums were at the stations farthest from downtown, presumably because of a high value for
218 transportation to CBD destinations (43-44). Accessibility provided by the limited Phoenix
219 system may have limited value.

220 The long-term success of TOD's can be hindered by new parking lots used as park-and-
221 ride facilities that almost uniformly reduce the value of stations, sometimes even below the
222 accessibility premium created by the new transit option (17, 30, 42). In San Diego, the premium
223 for mixed use, walkable neighborhoods can exceed 15 percent in addition to the accessibility
224 premium (24). Several studies have shown that transit stations have the ability to attract new
225 development that values transit more highly, raising the property value premium at stations.

226 **NEED FOR LONGITUDINAL ANALYSIS**

227 The timing of studies could have an impact on the measurement of premiums. Studies commonly
228 use two points of reference. The first point is the year just after the route is announced and
229 finalized. The second point is a few years after the route is in service. Premiums are assumed to
230 grow the most between the announcement of new station areas and five years after service begins

231 (11), but a longitudinal study could test this assumption. Capitalization may continue for more
232 than a few years, and studies may be missing this additional premium (45-47). Distinct
233 investment phases may show significant premium changes over time. For example, in areas with
234 significant vacant land around announced transit station locations, land assembly and speculation
235 could create sharp property premium increases. Years later, premiums may increase again as a
236 response to additional public and private investment in walkable, mixed-use development.

237 Conversely, investors may perceive high levels of downside risk at this early stage of the
238 transit lifecycle. Vacant land prices could stay low until new development begins to transform
239 the neighborhood. Redevelopment efforts supported by rail can fail, as was arguably the case in
240 Miami, with dominant retail use at stations. Retail is an amenity that supports TOD in areas with
241 job density, but in Miami, retail required a high level of parking that displaced appropriate new
242 development (21, 42). Despite development bonuses and tax incentives, Sacramento TOD
243 arguably failed because the public associated high-density housing with overcrowding, low
244 income and crime (42). Longitudinal analysis may give new insight into investor perceptions of
245 value and the timing of land value premiums within the transit system lifecycle.

246 **METHODOLOGY**

247 The analysis pioneers a quasi-experimental study design also used by Cervero and Landis to
248 study commercial real estate premiums. A variety of measures of supply and demand are used to
249 compare subject areas near and away from rail stations (46). The design is called “an untreated
250 control group design with pretest and posttest samples” (48). The pretest and posttest percent
251 changes in values for each station are used to identify trends and compare with the comparative
252 intersections not “treated with transit.” Groups are not randomly established; there is no sample
253 as all sales are used for the subject areas within the study timeframe. The purpose of the study is
254 to measure demand by “counting” the land parcels that were selected for purchase, presumably
255 because they were the most desirable.

256 Like traditional financial analysis, the study looks at volume and at price. The first
257 analysis sums the square footage of vacant land sold within ½ mile of any station area along the
258 24 mile starter system, by year, to look for an indication of an investment cycle.

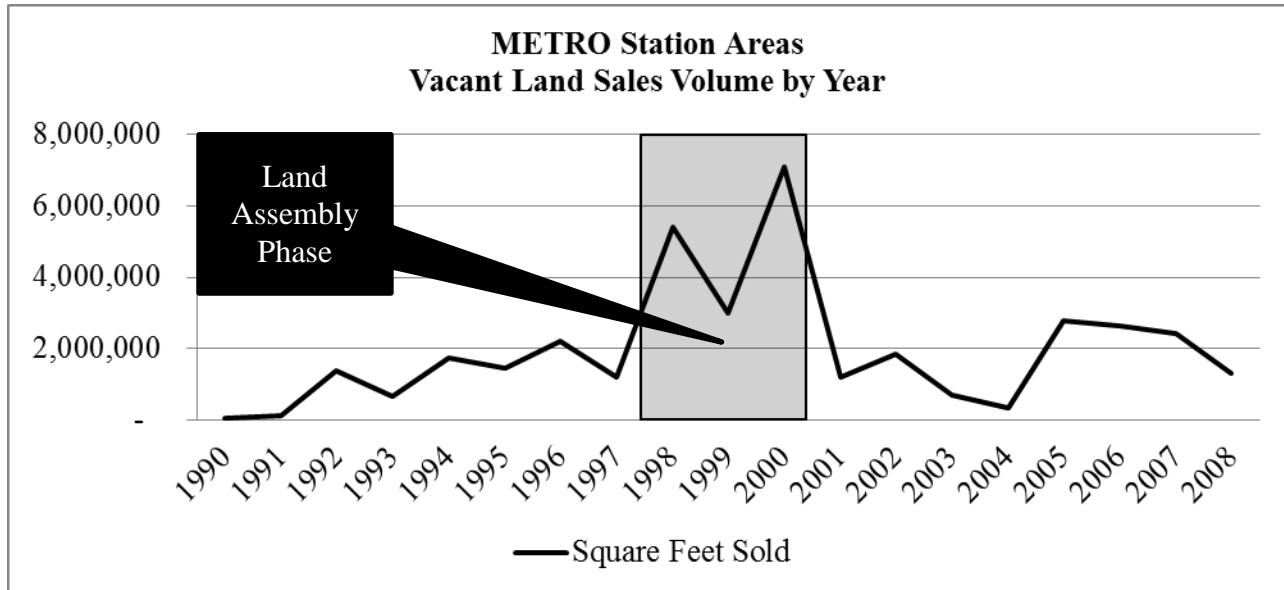
259 The second analysis looks at price. The net present value of vacant land sales from 1990
260 to 1997 (pretest) is compared to 1998 to 2008 (posttest), giving a percent change for each station
261 area and two comparative commercial intersections. Year end 1989 is chosen as the beginning of
262 the study because earlier data was not available. Year end 1997 is the separation between pretest
263 and posttest, because it approximates the announcement of the final alignment of the light rail
264 system. Year end 2008 is the end date because it marks the end of system construction and
265 beginning of light rail service.

266 In 2007, the Urban Land Institute identifies 10 Phoenix intersections to watch, and two of
267 them are centrally located but not served by high capacity transit, with the balance on transit, or
268 at the city periphery (49). The selection of these two intersections as the most successful
269 centrally located, dense, mixed-use areas in Phoenix and outside of the light rail service area is
270 unanimously confirmed through interviews of local developers, practitioners and academics.

271 All vacant land sales over \$250,000 from 1990 to 2008 from CoStar “COMPS” are
272 analyzed using quasi-experimental analyses, a total of 259 sales transactions for the light rail
273 stations, and 33 sales transactions for the two comparable intersections. All available vacant land
274 sales are used in the study.
275

276 **SALES VOLUME**

277 The total number of square feet of vacant land sold within ½ mile of any METRO light rail
 278 station by year is illustrated in Figure 1, where yearly land sales average 8.5 million square feet
 279 per year for the years 1998-2000 and then return to the normal average of about 3 million square
 280 feet per year. This indicates the possible existence of a three-year land assembly phase that
 281 begins at the announcement of the location of station areas.
 282



283
 284 **FIGURE 2 METRO station area vacant land sales volume by year.**

285 **SALES PRICES BY STATION AREA**

286 Table 1 shows the pretest and posttest median vacant land sales prices per square foot for each
 287 station area and the two comparison intersections. Median sales prices and appreciation rates
 288 vary widely by station. The highest appreciation is at Tempe stations, with an average
 289 appreciation of 429 percent between the pretest and posttest periods. Phoenix shows its diversity
 290 with station areas ranging from 250 to -5 percent appreciation. The worst performing stations,
 291 44th and Washington in Phoenix and Sycamore and Main in Mesa, actually lose value during the
 292 mid-2000's real estate boom. These are the two stations bordering Tempe.

293 Record prices for each study area show prices over \$100 per square foot in downtown
 294 Tempe and at both of the comparable intersections. The highest record prices, over \$300 per
 295 square foot, are in downtown Phoenix in 2006.

296 The highest number of acres sold in the posttest period, and the largest number of vacant
 297 acres left for development in 2011 are at 44th and Washington, the stop servicing Phoenix Sky
 298 Harbor Airport.

TABLE 1 Median Sales, Posttest Sq Ft Sales Rank, and 2011 Vacant Land

Station	Sales		% Chg	Record		Acres	Acres
	Sq Ft	Sq Ft		\$	Year	Sold	Vacant
	90-97	98-08				98-08	2011
Phoenix							
Campbell & Central Ave	\$8	\$28	250%	\$86	2007	47	23
12th St & Jefferson	\$6	\$18	208%	\$67	1999	11	7
Jefferson & 1st Ave	\$17	\$50	190%	\$372	2007	67	19
Indian School & Central	\$8	\$22	183%	\$80	2006	69	23
3rd St & Washington	\$18	\$50	182%	\$372	2006	26	18
Van Buren & 1st Ave	\$18	\$42	138%	\$372	2006	70	30
Roosevelt & Central	\$18	\$40	125%	\$258	2007	43	39
Encanto & Central	\$11	\$25	122%	\$106	2006	38	24
7th Ave & Camelback	\$12	\$25	107%	\$60	2006	132	8
Central & Camelback	\$14	\$28	105%	\$86	2007	24	21
McDowell & Central	\$14	\$26	85%	\$106	2006	37	32
Montebello & 19th Ave	\$3	\$6	78%	\$25	2007	119	17
Thomas & Central	\$18	\$32	75%	\$59	2005	18	16
Osborn & Central	\$15	\$25	62%	\$80	2006	43	18
24th St & Washington	\$6	\$10	54%	\$21	2007	6	10
38th St & Washington	\$8	\$11	44%	\$32	2002	75	38
19th Ave & Camelback	\$8	\$9	9%	\$46	1998	18	6
44th St & Washington	\$19	\$18	-5%	\$51	1999	136	72
Average	\$12	\$26	112%	\$127	2006	54	23
Tempe							
Veterans & College	\$5	\$86	1639%	\$179	2006	37	28
Mill & 3rd St	\$12	\$62	401%	\$179	2006	33	30
University & Rural	\$5	\$22	373%	\$82	2008	25	6
Smith-Martin & Apache	\$4	\$15	293%	\$36	2007	27	23
McClintock & Apache	\$4	\$11	194%	\$36	2007	50	17
Price-101 & Apache	\$3	\$5	74%	\$29	2007	35	1
Priest & Washington	\$7	\$9	28%	\$10	2000	15	3
Dorsey & Apache	N/A	\$61	N/A	\$82	2008	7	17
Center & Washington	N/A	\$48	N/A	\$40	1999	1	0
Average	\$6	\$35	429%	\$75	2007	26	14
Mesa							
Sycamore & Main	\$5	\$4	-12%	\$23	2002	11	42
Not on Light Rail							
24th St & Camelback	\$26	\$98	281%	\$117	1998	13	5
Scottsdale & Camelback	\$22	\$41	86%	\$119	2006	214	9

300 EXPLANATION OF PHOENIX LAND APPRECIATION BY STATION

301 The METRO starter line traverses three municipalities and many dissimilar neighborhoods.
302 Before the announcement of light rail, downtown Phoenix and Tempe were considered
303 redevelopment areas, linked by an industrial area with building supply warehouses and airport
304 parking. The two dominant, centrally located commercial areas were 24th Street and Camelback
305 Road, and Scottsdale and Camelback Road, north of the proposed light rail. Above market prices
306 paid for key assembly parcels to complete valuable redevelopment sites increased vacant land
307 prices in the neighborhood, and as a whole.

308 THE ROUTE: WEST TO EAST

309 Table 1 shows that land values changed very little at the westernmost station, 19th Avenue and
310 Camelback, the location of a lower income, redevelopment mall. Little or no redevelopment had
311 occurred near this station by 2008. Zoning may be a hindrance to redevelopment, with only 6
312 acres of vacant land at the station area (see Table 1), but a visual inspection shows a one-story
313 retail mall engulfed by underused asphalt parking lots, including a new park-and-ride. At the
314 light rail opening, security guards patrolled to insure separation of use for the big box retail,
315 mall, and light rail parking lots, encouraging transit riders to move their cars to the retail lots
316 before shopping and making walking to multiple destinations illegal. Existing retailers and
317 municipal policies hostile to TOD principles do not bode well for a future TOD or property
318 values in this neighborhood.

319 Land along the premier Phoenix residential and business corridor, Central Avenue, rose
320 from \$10-20 per square foot in the 1990's to \$50-\$100 at its 2006-2007 peak. Since the 1971
321 Central Phoenix Plan recommended unlimited building height on west side of Central, TOD
322 zoning expanded unlimited building height to the east side, spiking land prices, possibly above
323 the profitability threshold. Eight stations ½ mile apart, each with abundant undeveloped and
324 underdeveloped parcels, established an abundance of potential TOD sites that may not focus
325 development. In 2010, Central Avenue sported a mix of financially struggling, new and
326 refurbished condominium projects and amid a high volume of remaining vacant land still
327 awaiting development. The haphazard pattern of aging strip malls, office buildings surrounded
328 by grass, dusty vacant lots and asphalt surface parking among the starter seeds of mixed use
329 development may remain the landscape until the next real estate boom.

330 Significant newer public investment in arts venues, a convention center, two sports
331 complexes, a central library, numerous government offices and courthouses, and a new ASU
332 campus have supplemented light rail introduction and private investment to build downtown
333 Phoenix. Public-private partnerships aided by the Phoenix Downtown Alliance and high density
334 zoning have encouraged this development. With the introduction of the largest form-based code
335 zoning implementation to date in 2010, Phoenix demonstrates its interest in high-quality growth
336 for downtown.

337 The east side of Phoenix houses three out of four lowest-performing Phoenix stations,
338 bordering Tempe, north of Sky Harbor Airport. In 2008, most of the south side of Washington
339 from 24th Street to 44th Street remained reserved for airport parking and runway expansion.
340 Vacant land at the station offering the gateway to the airport, 44th Street, decreased in value
341 during the greatest real estate boom in Phoenix's history. At 72 acres, 44th Street and Washington
342 has the largest amount of available vacant land in the study. Dominated by one-story industrial
343 buildings and asphalt parking lots, this neighborhood did see a few new traditional office
344 buildings in the 2000's, but the developers opted out of new TOD zoning to use underlying
345 traditional zoning. The lack of clear airport plans may have overcome the new zoning incentives

346 near the airport, leaving extremely weak TOD potential in this neighborhood. Opportunities may
347 revive, however, if the airport expansion plan is interlaced with designated dense, walkable,
348 mixed-use areas: enough space for TOD but not an oversupply that fails to focus development.
349 The airport transit station, a museum, a community college, and a potentially scenic waterway
350 are nearby. Well-designed expansion plans that hide or relocate airport parking and tastefully
351 integrate airport features could create a future boom of parcel assembly, with skyrocketing land
352 prices and TOD opportunities.

353 East of Phoenix, Tempe was successful in attracting significant new investment during
354 this land assembly phase. Land worth about \$5 per square foot in the 1990's sold for over \$50
355 per square foot after light rail introduction (see Table 1). Tempe's highest priced parcels
356 exceeded land prices for all other study locations except downtown Phoenix. Tempe's lowest
357 TOD potential is at the stations bordering other cities: Priest and Washington adjoining Phoenix
358 and Price - 101 and Apache adjoining Mesa. Half of Tempe's stations had a greater median
359 percent increase than the highest Phoenix station area, highlighting Tempe's potential
360 effectiveness in directing new, higher density growth to the light rail line. Tempe is motivated to
361 support high density because, unlike other Arizona cities, it is landlocked and cannot expand its
362 boundaries so growth must come from increased density. Tempe completely rewrote its zoning
363 code in 2003 to introduce TOD, and city administration was reorganized to prioritize
364 development near the light rail route.

365 In addition to helpful municipal development policy, ASU helped with new policies to
366 encourage students to live closer to school, including a new requirement for freshmen to live on
367 campus. Student housing is largely recession-proof, so in the late 2000's, several developments
368 under construction were reconfigured for student housing, making some projects less profitable,
369 but still feasible, allowing their completion. One exception is the towering Centerpoint condo
370 project, with stalled construction because of a higher price-point that is less attainable for
371 students. Bankruptcy and resale at a lower price has enabled construction to ensue in 2011.
372 Development to the east along Apache is nowhere near buildout, so vacant land at many station
373 areas is awaiting the next market cycle for possible completion.

374 At Mesa's lone station, a park-and-ride, vacant land was still selling for about \$4 per
375 square foot in the 2000's, a slight decrease from prices before light rail was announced. Shortly
376 after the preliminary results of this study were announced, Mesa adopted TOD zoning and
377 approved a light rail extension through its downtown area. The failure of Mesa's station to attract
378 investors may have helped drive the city's decision to embrace light rail expansion through their
379 business and entertainment district and beyond.

380 New zoning may well enable redevelopment of Mesa's aging big box and strip mall retail,
381 industrial buildings, decrepit hotels, and massive asphalt parking lots along its light rail
382 expansion. Connecting the vibrant historic downtown, Mesa Arts Center, Mesa Convention
383 Center, Arizona Museum of Natural History, Arizona Museum for Youth, the Mormon Temple,
384 Mekong (shopping) Plaza and numerous thriving restaurants to nearby Tempe is a recipe for
385 future success. Mesa's new commitment to light rail adds connectivity and value to the entire
386 system, providing access to significant downtown destinations and new TOD zoning should
387 make redevelopment attractive during the next market cycle. Conversely, Scottsdale's rejection
388 of high capacity transit does not bode well for regional transit connectivity and accessibility.
389 Scottsdale's regional airport, major arts and entertainment district, retail centers, and office
390 complexes will not be accessible via the light rail system in the foreseeable future, limiting
391 potential for the overall system.

392 POLICY IMPACTS AND FUTURE STUDY

393 The Phoenix market has been one of the most volatile in the nation. In the 2000's, rising prices
394 increased investment risk, and the potential for the cost basis of the newly assembled sites to rise
395 above the market price of already successful commercial neighborhoods. For the METRO station
396 areas, sales volume more than doubled for the first three years after the alignment and station
397 areas were announced, and then returned to normal, signaling a possible land assembly phase.

398 To support land assembly, businesses often relocate so that buildings can be razed to
399 clear land, sometimes at a price above the profitable development threshold. When the
400 profitability threshold is exceeded, developers are priced out of the market, leaving land
401 investors to incur losses, default on loans or declare bankruptcy. The newly cleared land may
402 remain vacant until the next investment cycle, or longer. Demolition of underused and obsolete
403 buildings that were not immediately replaced undermined the formation of TOD's in
404 Minneapolis (28). Municipal planners may need a better understanding of the effects of market
405 cycles on investment so that government participation is an option during critical project phases,
406 especially during an economic downturn. Without government participation, it may not be
407 possible to assemble the land and capital necessary to complete a large TOD project during a
408 typical market cycle. Public private partnerships may substantially reduce the risk of partially-
409 completed development that does not meet the needs of the developer or the citizenry. Case
410 studies about successful TOD neighborhoods can enlighten planning departments about the
411 lifecycle of investment so that they are aware of the tools available and the project stages, to
412 keep projects on track.

413 METRO should evaluate expansion plans to more clearly define the purpose of each new
414 transit stop. In addition to monetary cost, the new stops are costly in terms of transportation time
415 performance and competition with existing stops for new development. Phoenix has not
416 completed detailed plans for each station area. Adding more land to an already bloated TOD
417 market without specific station area plans, and investors ready to build, undermines the success
418 of the entire system. Until the existing stops are built out, only new transit stops that enhance
419 connectivity by serving regional destinations should be built. Because transit stations, especially
420 park-and-rides, have the potential to decrease single family home prices, new transit stops should
421 not be placed in single family home neighborhoods.

422 A comparison of net present values of land pre-test (1990-1997) and post-test (1998-
423 2008) shows that the City of Tempe's station areas increased in value the most, and that the
424 stations adjoining Tempe were the only ones that decreased in value. Tempe seems to have been
425 the most successful of the three municipalities in attracting new investment, aided by recession-
426 resistant ASU and more clearly defined TOD policies. The diverse Phoenix neighborhoods have
427 had a mixed response to light rail. Westernmost Spectrum Mall has yet to see a substantial
428 impact. Central Avenue represents some missed opportunities, as stations 1/2 mile apart reduce
429 the speed and the transportation value of the light rail system and have the potential of opening
430 too much land to development. The eastern Phoenix route is marked with uncertainty about
431 airport expansion plans. Parcel-level hedonic modeling using measurements of walkability,
432 density, neighborhood mix of land uses and proximity to specific amenities may uncover specific
433 land use components that lead to successful new TOD's.

434 With a consensus that investment in transit benefits property values overall in nearly
435 every market, the value of studying a single investment type for a single transit system is limited.
436 New national databases make it possible to compare data from multiple cities to describe the
437 property and neighborhood characteristics that produce the greatest benefits. New findings can

438 come from multi-regional hedonic models that measure levels of transportation value,
439 walkability, and neighborhood mix of uses for individual land parcels, possibly showing the right
440 size, right land use mix, or right number of TOD's.

441 Further analysis of the planning process used to build these neighborhoods should yield
442 strategies that can work for other cities. Public private partnerships can yield tremendous benefits
443 to cities if they can learn how to aid development during crucial investment stages. For example,
444 by gaining control of vacant land prices at station areas, cities can eliminate the potential of land
445 prices spiking above the profitability threshold and eliminating TOD potential. Higher vacant
446 land tax rates could also have a positive impact that might be confirmed or denied in a national
447 study.

448 The METRO light rail system continues to compete with surrounding cities for
449 development. Scottsdale continues to infill further north on its main artery, Scottsdale Road, with
450 Scottsdale and Camelback approaching buildout in 2011 (see Table 1). These projects seem to be
451 more successful than METRO light rail station areas in attracting development, which sometimes
452 mimics the walkability and density of TOD, minus the transit. The trend of significant
453 development projects far from transit continued with new Scottsdale and Glendale sports
454 stadiums far from light rail in 2011. As municipalities continue to subsidize development that
455 disregards transit, achievement of transit's goals, increasing regional accessibility and attracting
456 development to urban cores, seems more distant than ever.

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462

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