Bus Rapid Transit and Office Rents

Arthur C. Nelson
Professor of Planning and Real Estate Development
College of Architecture, Planning and Landscape Architecture
1040 N. Olive Road
University of Arizona
Tucson, AZ 85719
E: acnelson@email.arizona.edu
V: 520.621.4004

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Abstract

Bus rapid transit (BRT) systems may become a dominant form of fixed guide public transportation in the next few decades. From three lines serving one metropolitan area before 2000—Pittsburgh, by the end of 2015 nearly 100 lines were operating or planned serving nearly 30 more. Lower costs and greater design flexibility relative to rail transit options are a key reason for their growing popularity. But how does the real estate market respond to them? There are very few studies associating proximity to BRT systems with real estate premiums internationally. Only two studies in the US address this question in the context of residential property. There are no studies associating proximity to BRT systems with commercial property values. As a proxy for property value is rents, this study addresses the question in the context of asking office rent premiums with respect to location within one-half mile if BRT lines in Cleveland, Eugene-Springfield, Kansas City, Las Vegas, and Pittsburgh. Regression analysis using CoStar asking rent data for the first quarter of 2015 are used for analysis. In all cases, BRT proximity confers an office space asking rent premium ranging from $1.57 per square foot (Pittsburgh) to $4.81 per square foot (Las Vegas) representing 9 percent to 30 percent of the variation in asking rents, respectively. That all five real estate markets studied apparently capitalize BRT proximity into higher rents may lend support to efforts that expand existing systems and build new ones. Implications are offered.

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Overview

The United States has 17 heavy rail transit systems but the last system was deployed in Los Angeles in 1993. From the 1980s to 2011, nearly 20 metropolitan areas launched light rail systems but there have been none since. Modern streetcars are now operating in 10 metropolitan areas, mostly serving downtowns and nearby activity centers with nearly all systems initiated since 2010. From three bus rapid transit lines serving one metropolitan area before 2000—Pittsburgh, as of this writing, the U.S. had more than 60 lines serving more than 20 metropolitan areas, most installed since the late 2000s. There are another 30 BRT lines in various stages of planning and engineering serving up to 10 more metropolitan areas.

Clearly BRT systems are gaining traction as a fixed guideway transit investment. Why? A major attraction is that they are less expensive to install than rail systems. They can also be installed in existing rights-of-way. These two features make then more attractive fixed guideway transit investments than rail in smaller metropolitan areas with fewer resources and lower ridership markets, as well as submarkets in larger metropolitan where costs or ridership projections do not justify rail investments. While streetcars are also typically installed in existing rights-of-way, cost and design considerations usually limit them to high-density urban environments where in contrast BRT systems can serve entire metropolitan areas.

BRT systems are characterized as a form of bus service with advanced operational features distinct from other local bus services (Levinson et al., 2003). BRTs typically include separate priority lanes, faster passenger boarding, off-vehicle fare collection, and branding. Branding provides a BRT identity and style (GAO, 2012*;* Thole and Samus, 2009; Hook et.al, 2013; Urban Land Institute, 2011). Such features provide BRT a sense of permanence, which

fixed-rail investments typically signify (Polzin and Baltes, 2002; Graham, 2007; Cervero and Dai, 2014). In comparing BRT systems with conventional systems, Kittelson & Associates (2007) notes that BRT systems:

- Are physically separated, exclusive BRT-use lanes or roadways;
- Have distinctive operational lines with frequent, reliable service and regular headways at all daily hours;
- Include specially designed buses with large door-to-capacity ratios, low floors and/or high platforms;
- Enjoy signalized intersection priority; and
- Access intelligent transportation technology to maximize vehicle movements, passenger information, and fare collection.

Among many purposes (Nelson and Ganning 2015), BRT systems are expected to improve the value of property along their routes and at stations. As of this writing, there are only eight studies associating BRT proximity with property values, with only two in the U.S. Three studies of the BRT system in Bogotá, Columbia, find that (1) residential rents increased by 6.8 percent to 9.3 percent for every five minutes walking time to the nearest BRT station (Rodíguez and Targa, 2004); (2) the asking price of properties within BRT catchment areas were 7-14 percent higher than that in control areas (Rodríguez and Mojica, 2009); and (3) some price premium was found with respect to middle-income residential property and distance from the nearest BRT station, but not for low-income residential property (Munoz-Raskin, 2010).

There are two studies of the BRT system operating in Seoul, South Korea. The first is by Cervero and Kang (2011), who find that within 300 meters of BRT stations residential land values increase from 5-10 percent, while within 150 meters non-residential land values increase

from 3-26 percent (Jun, 2012). A study of the Quebec City Métrobus by Dubé, Thériault and Dib (2011) found that proximity to the nearest BRT station increased housing prices from 2.9 percent to 6.9 percent.

Two studies of systems in the U.S. evaluated price premiums of residential and both residential and commercial properties with respect to BRT proximity in Pittsburgh and Los Angeles, respectively. In their study of the Pittsburgh East Line, Perk and Catalá (2009) found that a single-family residential property 100 feet away from a BRT station realized a premium of $9,745 compared to the same property located 1,000 feet away. The second study of the Los Angeles BRT line a year after it opened in 2000 by Cervero and Duncan (2002) found that the BRT system conferred a small negative premium on residential property, but a positive premium on commercial property. The researchers cautioned that the absence of dedicated travel lanes, the newness of service and underlying distress may have accounted for lower property value (see also Loukaitou-Sideris and Banerjee, 2000).

In sum, assessments of BRT-related value premiums are limited mostly to residential property and mostly outside the U.S. This article expands knowledge of property value effects by associating office space asking rents with BRT corridor proximity. The next section models the theoretical link between BRT corridor proximity and office space asking rents. Results and insights are then reported for each of the five metropolitan areas operating BRT systems before the Great Recession. The article concludes with implications for BRT policy and planning.

Modeling the Association between Office Rents and Proximity to BRT Corridors

Econometric analysis can be used to estimate the extent to which benefits of transit accessibility are capitalized by property. Usually, the observed sales price of property, or sometimes the

assessed value of property, is used for such analysis. Asking rents have also been used as they reflect current market conditions and thus do not suffer from the lag in reporting sales or appraisals. Where available, asking rents may be more efficiently assembled for cross-section analysis than using reported sales or appraisals of property (which can suffer from reporting inconsistencies between states and even among county assessors in the same state). As the interest is in understanding differences in capitalized values with respect to different BRT systems operating in different states, and given the availability of rents for privately-owned rental property reported by CoStar during the first quarter of 2015—for which permission was granted to use in this study, a quasi-experimental design is used based on hedonic regression analysis. At a snapshot in time (early 2015), the variation in asking rents is dependent on certain controlling variable and proximity to BRT corridors (the treatment variable). The modeling details follow.

The analysis considers only metropolitan areas with just BRT systems, with one exception. For instance, it excludes New York City's Bronx line, Chicago, Los Angeles, the San Francisco Bay Area, Phoenix and Salt Lake City because those metropolitan areas have multiple fixed guideway transit systems often intersecting with each other. The exception is Cleveland as its BRT system is the only fixed guideway system that connects downtown directly with the medical center northeast of downtown. Those systems included in the analysis include:

- Cleveland
- Eugene-Springfield
- Kansas City
- Las Vegas
- Pittsburgh

Moreover, to assure adequate time for the office market to respond to BRT systems, studies areas include those lines operating before 2010 or at least five years before the study period of early 2015. In all, the database is comprised of more than 1,500 office buildings with more than 200 million square feet of space in these metropolitan counties. The hedonic model applied to this research is the following.

$$\mathbf{R_i = f(S_i, SM_i, BRT_{i,})}$$

R is the asking rent per square foot for property *i* reported by CoStar in the first quarter of 2015 for all properties in the metropolitan counties used in the study. Asking rents are converted into logs. The linear model allows the coefficients of the independent variables to be interpreted as the dollar change in asking rent per square foot with respect to a one-unit change in the independent variable.

For **S**, CoStar provides data the following attributes of each property *i* including the predicted direction of association with respect to rent:

Class A and *Class B* buildings. Office buildings are usually classified by their overall level of quality from C (lowest) to A. Class C buildings are the reference against which Class A and B buildings are compared. As Class A buildings (binary variable where 1 if Class A and 0 if not) command the highest rent, the model should show them with then highest rents followed by Class B (also a binary variable).

Floors. Normally, higher floors are associated with higher rents than lower ones. One would expect that buildings with multiple floors should have higher mean rents per square foot per floor.

Year Built. Newer buildings are expected to command higher rents per square foot than older ones. This variable uses 2015 as the base to measure age.

Renovated. A binary variable (1 if renovated, 0 if not) denotes buildings that have been renovated are expected to command higher rents per square foot than ones that have not.

Vacancy Rate. Buildings with higher vacancy rates, perhaps because of excess supply relative to demand, should have lower rents per square foot than buildings with lower vacancy rates.

Acres. All office buildings occupy land and the larger the land area the more valuable the parcel. For one thing, this allows for more parking on the site, often free to the use though paid for by the tenant through rent. Thus, a positive association is expected between land area and asking rent per square foot.

SM is the metropolitan area submarket within which property *i* is located. CoStar reports data for discrete submarkets in many metropolitan areas. Those submarkets vary implicitly by the socioeconomic characteristics of the population living in them, land use planning designations, and historical role of the area in the development of the city or region among other factors. These are binary variables (1 if within a submarket and 0 if not). For BRT analysis, submarket data are available for Las Vegas and Pittsburgh. In each case, one submarket is excluded to be the referent against which the performance of other submarkets is compared. There is no *a priori* prediction of association.

BRT is the treatment variable. It is binary indicating whether property *i* is within one-half mile of a BRT corridor centerline (1) or outside (0). A positive association between it and asking rent per square foot is expected.

There are two reasons why the one-half mile distance is chosen. First of all, it seems to be the standard for TOD planning area analysis. Second, and most important, there is substantial empirical evidence that a very large share of transit ridership catchment areas extent to about

one-half mile from transit stations (Guerra, Cervero and Tischler 2011). Though the analysis study area is one-half mile from BRT corridor centerlines, it is assumed that a very large share of office buildings within the study area are also within one-half mile of a transit station. Future research can refine distance measurements.

Results are reported in the next section.

BRT Office Rent Results and Insights for Individual Metropolitan Areas

Because many metropolitan areas' BRT systems extend from downtown to suburban areas, the analysis is able to estimate market premiums with respect to the metropolitan area as a whole, downtown/near downtown areas, and outside of downtown. However, where a system just serves downtown—the case for downtown Kansas City, for instance, the analysis is limited to where service is provided. Results and insights for BRT systems are reported in alphabetical order.

Cleveland

At Silver, Cleveland's HealthLine BRT system is the nation's highest-rated BRT system according to the Institute for Transportation and Development Policy (2013). [1]The HealthLine connects downtown Cleveland to the medical centers to the east. Features of the HealthLine include more than two dozen hybrid-electric vehicles, doors on both sides, bike lanes, landscaping/hardscape treatment and integrated/stand-alone public art. The 36-station, 9.2-mile BRT corridor is operated by the Greater Cleveland Regional Transit Authority. Regression results for the Cleveland BRT system are

[1] The Institute for Transportation and Development Policy (2013) rates all BRT systems worldwide based on objective technically measured standards. Ratings include Gold (best), Silver, Bronze and Basic. Most systems in the United States are do not have objective scores warranting rating perhaps meaning, technically, that they could be little more than conventional bus service with a few BRT-like embellishments (see Nelson and Ganning 2015). Nearly all BRT systems in this study are rated, the exception being Kansas City.

reported in Table 1. Considering only statistically significant variables ($p < 0.10$ of the one-tailed test since the direction of association is predicted), Class A and B spaces enjoy asking rents of $6.44 and $2.86 per square foot more than Class C space while each additional floor along the corridor—Ohio's most densely developed office corridors—adds another $0.10 or $3.00 for a 30-floor buildings. All other structure-related variables have the expected signs though the coefficients are not statistically significant. With respect to BRT corridor location, results show a substantial and significant rent premium amounting to about $2.44 per square foot, or about 18 percent of the mean asking rental price.

Table 1
Office Rent Results for Downtown Cleveland, Ohio

Variable	Beta	Error	t-score	1-tailed	p
Cleveland Downtown to Medical Center					
Constant	2.645	20.019	0.132	0.895	
Class A	6.438	1.534	4.196	0.000	*
Class B	2.860	0.753	3.799	0.000	*
Floors	0.101	0.049	2.082	0.020	*
Year Built	-0.003	0.010	-0.286	0.388	
Renovated	0.559	0.741	0.754	0.226	
Vacancy Rate	-0.009	0.011	-0.839	0.202	
Acres	0.183	0.198	0.921	0.180	
BRT <=0.50 mile	2.438	1.141	2.137	0.018	*
N	113				
R2 adjusted	0.473				
F-ratio	13.567				

*p <0.10

Eugene-Springfield

The Emerald Express (EmX) BRT system serving the Eugene-Springfield metropolitan area was put into service in 2007. The system is rated Bronze by the Institute for Transportation and Development Policy (2013). It connects downtown Springfield to downtown Eugene with stops at the University of Oregon. One unique feature affecting this metropolitan area is the presence of

an urban growth boundary designed to steer jobs away from lower-density areas into more central ones especially served by transit. EmX was extended in 2011 to connect northward from the east to the Gateway Mall and Sacred Heart Medical Center at RiverBend. Table 2 reports results for the Eugene-Springfield Emerald Express (EmX) BRT system. Contrary to expectations, asking rent per square foot for Class A and B spaces were negative though only those for Class B space were significant, in the wrong direction. This may be attributable to (a) the small number of cases (41), (b) the smaller still number of quality office spaces available for rent, and (c) that as a university town of a major research university the quality office spaces are occupied by institutional users that often occupy entire buildings they own or rent on a long-term basis. Though only speculative, the long term lease nature of the market may be giving an edge to Class C space that may be the principal source of short-term leases that command higher rents. More specialized and research into this market may be warranted. As expected, however, asking rents per square foot decrease with respect to the younger age of buildings (at $0.07 per square foot per year) but fall with respect to the building's vacancy rate (at $0.05 per square foot for each percentage point). Other structure-related variables have the correct sign though they are not significant. Regression analysis estimates that locations within one-half mile of a BRT corridor confers a positive rent premium of $1.93 per square foot, or about 12 percent of the mean office rent.

Table 2
Office Rent Results for Eugene, Oregon

Variable	Beta	Error	t-score	1-tailed	p
Constant	-111.501	50.253	-2.219	0.033	
Class A	-4.549	3.736	-1.218	0.116	
Class B	-4.607	2.414	-1.908	0.033	*
Year Built	-0.067	0.026	-2.595	0.007	*
Renovated	2.470	4.209	0.587	0.281	
Vacancy Rate	-0.047	0.023	-2.056	0.024	*
Acres	0.133	0.119	1.119	0.136	
BRT <=0.50 mile	1.928	1.355	1.423	0.082	*
N	41				
R2 adjusted	0.248				
F-ratio	2.883				

*p <0.10

Kansas City

Kansas City began operating its Main Street Line in 2005. It connects downtown to the Crown Center Plaza along a six-mile route, nearly four miles of which are dedicated lanes. However, it does not meet criteria to be rated by the Institute for Transportation and Development Policy (2013). It has proven to be moderately successful in attracting economic development within a slow-growing metropolitan area. The Kansas City Area Transportation Authority operates the system. Regression results, reported in Table 3, shows an office rent premium of $5.10 per square foot for Class B space relative to Class C space (the referent) and an additional $1.82 per square foot if the building was renovated. Almost all other variables have the expected signs, the exception being number of floors in a building and vacancy rate, though none are statistically significant. For the most part, downtown Kansas City is dominated by older mid- to high-rise office buildings. Location within the one-half mile BRT corridor commands an asking rent of $2.67 per square foot which is equivalent to about 18 percent of the mean office rent downtown.

Table 3
Office Rent Results for Downtown Kansas City, Missouri

Variable	Beta	Error	t-score	1-tailed	p
Kansas City Downtown					
Constant	-12.073	37.039	-0.326	0.745	
Class A	5.099	2.017	2.528	0.007	*
Class B	0.440	1.276	0.345	0.366	
Floors	-0.045	0.065	-0.690	0.247	
Year Built	-0.012	0.019	-0.616	0.270	
Renovated	1.828	1.087	1.681	0.049	*
Vacancy Rate	0.006	0.014	0.387	0.350	
Acres	0.000	0.177	0.002	0.499	
BRT <= 0.50 mile	2.669	1.728	1.544	0.064	*
N	79				
R2 adjusted	0.168				
F-ratio	2.97				

*p <0.10

Las Vegas

In 2004, the BRT system called MAX launched to operate on a northeasterly radial corridor (7.5 miles) between downtown Las Vegas and Nellis Air Force Base. The BRT service is intertwined with regular bus service. It is rated Basic by the Institute for Transportation and Development Policy (2013). Much of the BRT system serves areas already substantially developed as low to modest intensities, and is an important connector between the City of North Las Vegas and Nellis AFB. The line is owned by the Regional Transportation Commission of Southern Nevada and operated by Veolia Transportation. Table 4 reports regression results for the Clark County, the central county of the metropolitan area. All variables have the expected signs. Class A space commands an asking rent of $5.70 per square foot more than Class C space though the coefficient for Class B space is most small and insignificant. Each floor in a building adds $1.16 per square foot though most office buildings in Las Vegas are mid-rise with the skyline dominated by hotels and casinos. Older buildings command lower rents as well, at $0.10 per square foot per year, while each acre of land adds $0.08 per square foot. Variables for renovation

and vacancy rates were not available. Because of its central county scale, CoStar data also includes submarkets. The regression analysis thus shows the variation in asking price per squjare foot with respect to location in each of them, though none have statistically significant variation with respect to the referent. With respect to BRT, Table 4 shows a positive office rent premium of $4.82 per square foot with respect to being within one-half mile of a BRT corridor for the metropolitan area as a whole—about 30 percent of the mean rent.

Table 4
Office Rent Results for Las Vegas, Nevada

Variable	Beta	Error	t-score	1-tailed	p
Metropolitan Las Vegas					
Constant	-194.665	34.952	-5.569	0.000	
Class A	5.697	1.054	5.404	0.000	*
Class B	0.536	0.515	1.040	0.149	
Floors	1.160	0.144	8.082	0.000	*
Year Built	-0.104	0.018	-5.878	0.000	*
Acres	0.077	0.036	2.151	0.016	*
Central East	0.736	2.562	0.287	0.774	
North LV	-2.547	2.675	-0.952	0.341	
Northwest	2.233	2.582	0.865	0.387	
Outlying NE	-4.183	3.120	-1.341	0.180	
LV-Henderson	-0.572	2.645	-0.216	0.829	
South LV	0.484	2.575	0.188	0.851	
SW LV	1.183	2.585	0.458	0.647	
West LV	-0.004	2.577	-0.002	0.999	
Downtown	0.725	3.057	0.237	0.813	
BRT <= 0.50 mile	4.806	1.534	3.133	0.001	*
N	955				
R2 adjusted	0.304				
F-ratio	28.721				

Pittsburgh

Pittsburgh has the world's second-oldest BRT system, with Curitiba, Brazil, being the first. It includes three lines serving the south, east and west parts of Allegheny County. The Port Authority of Allegheny County operates the system. The South Line's 4.3 miles of exclusive bus lanes encompass previously underserved areas from the western suburbs to the downtown area. It is rated Basic by the Institute for Transportation and Development Policy (2013). By 1983, Pittsburgh started the East Line, rated Bronze, and runs 6.8 miles connecting eastern suburbs to downtown. In 2000, the West Line, rated Basic, was initiated. Table 5 reports results are reports for the central county as a while—Allegheny County, then for the central business district (CBD), and lastly for the entire system outside the CBD.

For Allegheny County as a whole, all structure-related variables have the expected signs and are significant. Notably, Class A and B asking rents are $8.36 and $3.38 per square foot higher than Class C rents; each floor in a building adds $0.05 per square foot to the rent; asking rent per square foot falls by $0.03 per year off a building's age being renovated adds $0.69 per square foot; for each percentage point of vacancy in the building, rents fall by $0.03 per square foot; and each acre land adds $0.07 per square foot. CoStar also divides Allegheny County into numerous submarkets, each of which have significant coefficients. In terms of BRT proximity, office space within one-half mile of a BRT line enjoys a premium of $1.57 per square foot or about 9 percent of the mean.

Table 5
Office Rent Results for Pittsburgh, Pennsylvania

Variable	Beta	Error	t-score	1-tailed	p
		Allegheny County			
Constant	-36.336	15.91	-2.284	0.023	
Class A	8.363	0.785	10.651	0.000	*
Class B	3.384	0.517	6.548	0.000	*
Floors	0.050	0.036	1.401	0.081	*
Year Built	-0.026	0.008	-3.216	0.001	*
Renovated	0.691	0.460	1.501	0.067	*
Vacancy Rate	-0.032	0.008	-4.033	0.000	*
Acres	0.072	0.052	1.379	0.085	*
CBD	-1.740	0.866	-2.008	0.045	*
Monroeville	-1.979	1.139	-1.737	0.083	*
North Pittsburgh	-2.527	0.807	-3.132	0.002	*
NE Pittsburgh	-3.838	1.031	-3.724	0.000	*
Parkway East	-3.156	0.759	-4.156	0.000	*
Parkway West	-1.854	0.832	-2.229	0.026	*
South Pittsburgh	-1.659	0.830	-1.997	0.046	*
West Pittsburgh	-2.641	1.060	-2.492	0.013	*
BRT <= 0.50 mile	1.571	0.736	2.135	0.017	*
N	423				
R2 adjusted	0.503				
F-ratio	27.657				

Review and Implications

Whether and the extent to which the office market responds to bus rapid transit system proximity is not known in the literature. Using quasi-experimental, cross-section hedonic regression applied to five metropolitan areas served by BRT systems operating before 2010 and meeting criteria noted above: Cleveland, Eugene-Springfield, Kansas City, Las Vegas, and Pittsburgh. Individual BRT analyses allowed for estimation of the association between asking office space rent and location within one-half mile on either side of BRT centerlines for downtowns and nearby centers (Cleveland, Eugene-Springfield, Kansas City and Pittsburgh), and central counties of metropolitan counties (Las Vegas and Pittsburgh). Table 6 reports outcomes.

Table 6
Summary of BRT Corridor Location and Office Rents

System	Downtown and Nearby Centers	Central County
Cleveland	$2.44	
Eugene-Springfield	$1.93	
Kansas City	$2.67	
Las Vegas		$4.81
Pittsburgh		$1.57

Asking office space rents for all three BRT systems serving principally downtowns and nearby centers are positive and significant, being $2.44, $1.93 and $2.67 per square foot equal to 18 percent, 12 percent and 18 percent of mean office space asking rents for Cleveland, Eugene-Springfield and Kansas City, respectively. For the Las Vegas and Pittsburgh BRT systems serving large portions of their central counties in addition to downtowns, office space asking rent premiums were $4.81 and $1.57 per square foot representing 30 percent and 9 percent of mean asking rents, respectively.

To be sure, the association between asking rents and location within BRT corridors may be attributable to installing BRT systems along corridors where rents were already at a premium because of their market accessibility. In an indirect test of this explanation, Nelson and Ganning (2015) tested for the association between job change over time with respect to location within one-half mile of BRT stations and a set of control locations that otherwise had the same location features before the BRT systems were installed, for those installed since 2000.[2] Not only was job growth positive and statistically significant within half-mile study areas of BRT stations but job growth was mostly negative or considerably smaller, and statistically significant within half-mile study areas of control locations. They surmised that BRT systems attract new regional jobs an d

[2] Their study used the Longitudinal Employment Household Dynamics (LEHD) database which reports employment data disaggregated to the census block annually since 2002. This allows for before-after and longitudinal comparisons of the change in job concentration for every BRT system installed in the USD since 2002, which means all of them except Pittsburgh.

maybe also result in the displacement of jobs elsewhere to BRT station areas. It would seem reasonable to conclude that if jobs are attracted to BRT station areas instead of roughly comparable areas that demand for office space near BRT stations would be internalized as higher asking rents. Nonetheless, future research should test this proposition.

Higher asking rents near BRT systems reflect the market's willingness to pay for those locations. Such market responsiveness can encourage investment in the expansion of existing BRT systems and in new ones. For smaller metropolitan areas where light rail transit systems may not be feasible, research reported in this article imply that BRT systems may be a suitable alternative based on market responsiveness. Moreover, capturing a share of the higher property value associated with BRT proximity can help finance BRT systems. It may also be the case that where light rail systems and perhaps streetcar systems may be nearing market saturation, BRT systems may be the next wave of public transit investment serving smaller metropolitan areas and providing additional transit service options for larger ones.

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