

On the Road Again:

How Advances in Transportation are Shaping the Future of Real Estate



Introduction

The historical movement of people, industry, and goods has been heavily influenced by advances in transportation. The invention of the steam engine and the expansion of the railroads opened the Western United States to mass migration in the 19th century. Supplied with goods carried on those railroads, cities grew in all parts of the country. Many of them soon found density to be a challenge, especially when trying to travel from one part of the city to another. In order to alleviate this problem, public transit systems were introduced at the turn of the 20th century and they remain in heavy use today. Only a few decades later the mass production of the automobile democratized individual transportation and substantially improved the efficiency of local travel. Now, well into the 21st century, we believe we are on the verge of yet another advance of similar magnitude, one with the potential to have broad implications for the path and shape of real estate demand.

Unlike the advances of old, this one comes not from the advent of a single technology, but a combination of many. The introduction of ridesharing services, self-driving cars, and electric vehicles will all have significant individual impacts. Taken together though, their impact will likely be far greater. Ridesharing and ride hailing services will make public transportation more local than ever before, while self-driving cars and electrification will lower its cost and improve efficiency. These advances will impact renters, consumers, and businesses across the country and the globe, and affect what, how, and where we build.



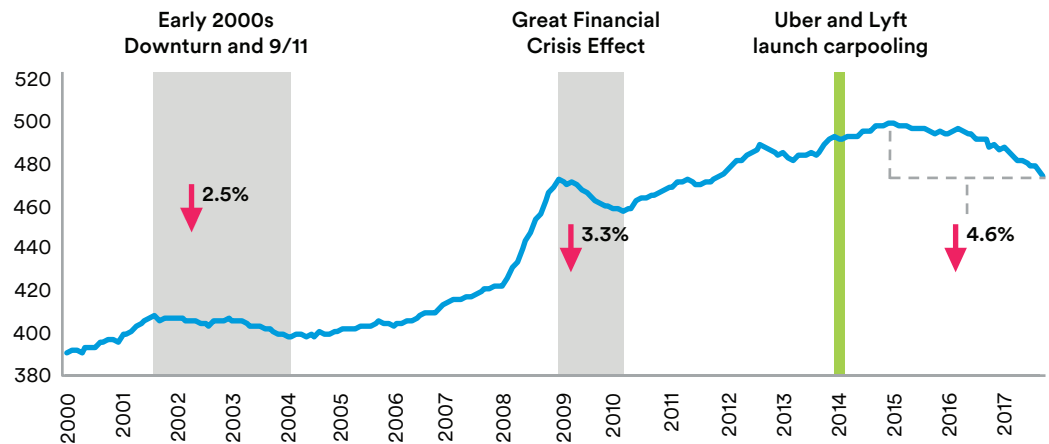
The Ridesharing Revolution

The pioneers of ridesharing and smart phone enabled pickup services, Uber and Lyft, first launched in 2011 and 2012, respectively. By managing pickup requests and fulfillments via smartphone, they improved on the traditional taxi model of cruising busy avenues in search of a fare. Primarily because of this added efficiency, Uber and Lyft rides are about 25% cheaper than a traditional taxi,¹ while drivers earn roughly the same wage.² As ridership grew, it allowed both companies to begin matching riders traveling in the same direction, leading to the launch of ridesharing services in 2014. Riders then had a choice between a direct route and a reduced-fare, carpooled route. As of 2018, we estimate that carpooled rides range from 30% to 80% cheaper than traditional taxi rides. Traditional taxis, however, have not been the only mode of transportation to see ridership declines since the entry of Uber and Lyft.

As ridesharing services have improved and gained greater acceptance, public transit ridership has declined. Ridership declines have historically only occurred during periods of economic contraction. The primary reason for this is contractions in the labor market. Commuters account for a large portion of public transit ridership, so when total employment declines, public transit ridership does as well. In recent years, however, something very different has occurred.

Beginning in January of 2015, little more than a year after the launch of Uber and Lyft's carpooling services, public transit ridership began to decline (Exhibit 1).³ Based on prior declines we could reasonably assume from this data that total employment had declined as well. In fact, total employment in the United States actually rose by 6.6 million from January of 2015 to September 2017, an increase of 4.7%.⁴ During the same time period, public transit ridership declined by 4.6%. We believe Uber and Lyft played a substantial role in this decline, not only through increased convenience, but also through reduced cost.

Exhibit 1 | U.S. Public Transit Ridership (millions of rides per month, 12-mo trailing average, major metros)



Sources: MetLife Investment Management, American Public Transportation Association

Note: Major metros include Boston, Chicago, Los Angeles, New York City, San Francisco, and Washington D.C.

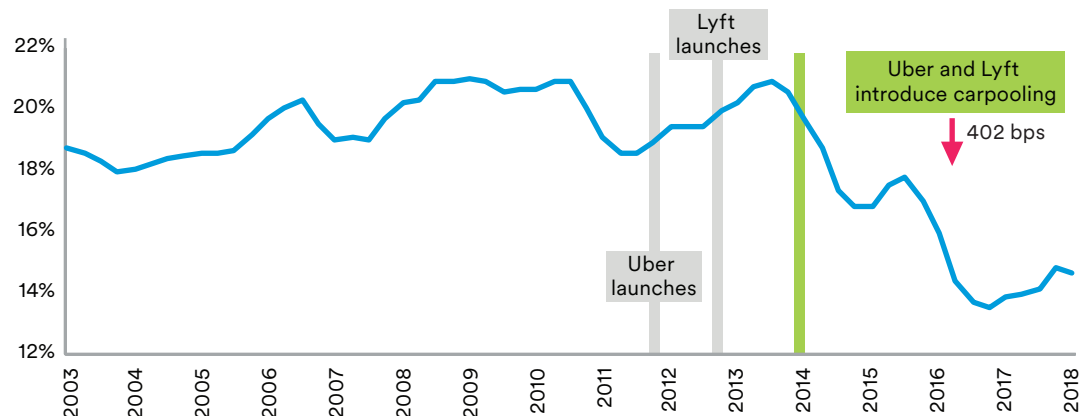
For most, the directness of a taxi ride is often preferable to public transit, but it comes at a cost. Uber and Lyft have managed to change that. To illustrate how much cheaper Uber and Lyft have made transportation in some areas, we compared the cost of a trip from a typical residential area in San Francisco's Lower Haight submarket to the Financial District. This ride costs about \$12.00 with a traditional taxi, \$2.75 via public transit, or \$3.25 using Uber or Lyft's carpooling service. Although carpooling is slightly more expensive than public transit, it remains far less expensive than the \$12.00 traditional taxi that was the only alternative a decade ago. Commuters have gradually taken notice of this changing dynamic, and we believe the preferences of renters are beginning to reflect it.

To test our belief that renters are increasingly viewing ridesharing services as a viable alternative to public transit, we compared demand for "on-transit" and "off-transit" apartments in San Francisco, the market where Uber and Lyft's services were first offered and where they have reached the greatest penetration and maturity. On-transit

apartments include those within a five minute walk of a transit stop, while off-transit includes everything else.

As conventional wisdom might suggest, on-transit apartments enjoy significantly higher rents than their off-transit counterparts (Exhibit 2). Some of this premium could theoretically be driven by newer or higher quality apartments located near transit stops, but the selection of San Francisco makes this somewhat less likely. Despite a national push towards transit oriented development, the high density of San Francisco and its strong zoning laws have heavily restricted apartment construction. We can therefore assume that transit accessibility is likely to play a greater role in determining the rent premium than in many other metros. For much of the last fifteen years, that premium hovered around 20%, but things began to change in the summer of 2013.

Exhibit 2 | Rent Premium for On-Transit Apartments in San Francisco



Sources: MetLife Investment Management, CoStar

San Francisco's on-transit apartments commanded a 21% higher asking rent in 2013 than those that were located off-transit, but shortly after reaching this level, and just two years after the launch of Uber, this premium began to decline. Once Uber and Lyft's carpooling services began in 2014 the decline accelerated, and the rent premium for on-transit apartments now sits at around 15%. There are a few potential takeaways from this. One is that commuters are increasingly using ridesharing as a substitute, a conclusion that would be supported by our earlier analysis of total public transit ridership. While we believe this to be the case, we don't believe it to be the entire story. Ridesharing, after all, can act as a complement to public transit as well as a substitute.

The data from our on-transit and off-transit analysis clearly shows that assets located close to transit stations continue to command a rental premium despite the growing acceptance of ridesharing and ride hailing services. We believe part of the reason for this is that ridesharing services are now acting as an intermediary transit system that is helping to bridge the walkability gap between on and off-transit locations. Renters may not be willing to pay \$300 more a month for a unit located right next to a transit station, but they may be willing save \$300 in rent while also spending \$100 more per month to cover short Uber and Lyft rides to and from the transit station. While this level of usage may occur largely on the margin, the ability of services like Uber and

Lyft to act as extended systems of public transit is one that could have a significant impact on how metropolitan areas grow and develop. We believe the magnitude of this change appears likely to accelerate in the near future as advances in autonomous vehicle technology and electrification lead to a substantial reduction in the cost of ridesharing and ride hailing services.



The Invisible Man Takes the Wheel

Although Uber and Lyft's fares are typically well below those of traditional taxis, they are still more expensive than public transportation. We believe that the introduction of autonomous vehicles will soon make this a thing of the past. The first self-driving cars available for public use, and without an operator or handler on board, are already operating in Phoenix. These vehicles are owned by Waymo, a subsidiary of Google parent Alphabet that has recently purchased 20,000 vehicles that they plan to upgrade into self-driving cars by 2020. Though in an earlier stage, Uber has also begun driverless car trials in Phoenix and Pittsburgh. In addition to the efforts of Waymo and Uber, auto manufacturers including Ford, GM, Daimler, BMW and Tesla have all announced plans to begin producing driverless vehicles within the next five years. Several manufacturers⁵ have also announced their intention to offer ridesharing services, and it seems likely that many of the others may also do the same.

Exhibit 3 | Estimated Cost of Uber/Lyft Ride

CURRENT MODEL (HUMAN DRIVER)	
Human Driver's Profit	\$5.80
Gas, Maintenance, and Depreciation	\$1.80
Uber/Lyft Fees	\$2.40
Total Fare	\$10.00
THEORIZED AUTONOMOUS VEHICLE	
Human Driver's Profit	↓ \$0.00
Gas, Maintenance, and Depreciation	\$1.80
Uber/Lyft Fees	↑ \$5.30
Total Fare	↓ \$7.10
THEORIZED AUTONOMOUS FLEETS	
Human Driver's Profit	\$0.00
Gas, Maintenance, and Depreciation	↓ \$1.44
Uber/Lyft Fees	\$5.30
Total Fare	↓ \$6.74

Sources: MIM, driver survey and other industry sources⁶

Although we believe driverless vehicles represent only a continuation of the improvement in transportation efficiency begun by the likes of Uber and Lyft, it's important to consider just how much more efficient, and how much less costly, transportation may become. Based on publicly available surveys of Uber/Lyft drivers, we were able to roughly estimate the cost breakdown of the fare (Exhibit 3). We estimate that as much as 58% of the cost of a fare goes to the driver, with Uber receiving 24%, and the remainder split between gas, maintenance, and depreciation. Removing the human driver from the equation theoretically cuts the cost of a ride by more than half. In practice, we suspect that will not immediately occur.

As autonomous vehicles are rolled out in coming years, we suspect ride hailing providers will capture a portion of the driverless savings. In a conservative scenario, where providers choose to retain 50% of the driver's profit, the cost of a \$10.00 ride would fall to only \$7.10. This analysis, however, fails to recognize the importance of scale. Uber, Lyft, and the manufacturers, after all, are not seeking just to build autonomous vehicles, but rather autonomous fleets.

Under the current ridesharing model, drivers own and maintain a single vehicle, bearing all the potential costs. We believe that in the future providers and manufacturers will own entire fleets, benefiting dramatically from the advantages of scale. Rather than paying retail prices at the pump, a portion of their fuel will likely be obtained at wholesale prices as vehicles refuel at company owned depots. Once there, their maintenance costs will likely be dramatically lowered through the employment of a full-time maintenance and repair staff with access to a large inventory of standardized parts obtained at bulk prices. The regularity and quality of this maintenance is also likely to improve the useful life of vehicles in the fleet, many of which are likely to have been built specifically for the task. Estimating the magnitude of the potential reduction in cost is a highly nebulous affair, but even if we assume it to be only 20%, the effects are significant. Combined with the cost savings of removing human drivers this additional decline would reduce our original \$10.00 fare to only \$6.74. To put that into perspective, we can return to our real life example of a trip from San Francisco's Lower Haight neighborhood to the Financial District. If reduced by the same rate its fare would decline to \$2.19, 56 cents below the \$2.75 cost of public transportation.

Even these estimates likely understate the full magnitude of cost reductions that fleets of vehicles will produce. Passengers in San Francisco, where Uber and Lyft's ridesharing services have been in service the longest, enjoy substantially higher discounts to traditional taxis than those in other markets where the service is comparatively young and the number of drivers is fewer. As ridesharing services grow the greater number of vehicles and passengers allows more efficient routing and pickup times, lowering costs to both the provider and the passenger. When fully autonomous fleets are introduced these benefits will only grow as mass data collections allow providers to estimate the ideal placement and routes for vehicles at different times of day and under different road conditions.

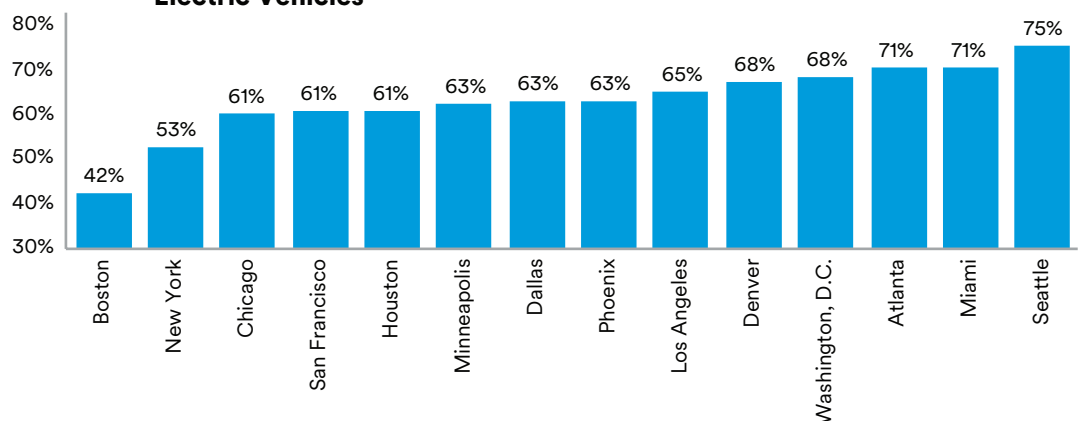


Lightning in a Lithium Ion Bottle

The widespread adoption of electric vehicles occupies the final spot in our trifecta of new transportation technologies. At present, many years of fuel savings are required to justify the high upfront cost of electric vehicles. In the near future though, advances in technology may alter that equation for private owners and service providers alike.

The clearest benefit of switching to electric vehicles is a reduction in per mile energy costs. According to the Department of Energy the average passenger vehicle achieves fuel economy of 23.4 miles per gallon. The average electric vehicle achieves the equivalent of better than 120.0 miles per gallon. Nearly all drivers would see a reduction in fuel costs by making the switch to electric, but due to regional differences in gasoline and electricity prices the magnitude of that reduction varies significantly by metro (Exhibit 4). In Seattle, where electricity is cheap and gasoline is expensive, the reduction in costs could amount to a whopping 75%. In Boston, where electricity costs are high and gasoline prices are low, it could still amount to as much as 42%. As impressive as these reductions are, the fact still remains that many drivers may not fully recover the higher upfront cost of an electric vehicle at today's prices.

Exhibit 4 | Reduction in Cost Per Mile, Switching from Gasoline Powered to Electric Vehicles



Sources: MetLife Investment Management, U.S. Bureau of Labor Statistics

Electric vehicles remain more expensive chiefly due to the cost of a single component, the battery. The current generation of electric vehicles runs on lithium ion batteries, but their successors will likely employ a new power source. Solid-state batteries, which hold the potential to be smaller, cheaper, and boost driving ranges by as much as 200%, are well under development. BMW, Honda, and Nissan have all targeted producing vehicles with solid-state batteries by the mid-2020s. These lower cost batteries will lead to dramatically lower vehicle costs, reducing the amount that needs to be amortized over the life of the car, and likely providing individual drivers and service providers alike with strong incentives to make the switch.

The expansion of ridesharing services and the adoption of autonomous, electric vehicles points to a future of highly accessible, highly efficient, and comparatively inexpensive transportation. Fleets of autonomous vehicles will partially substitute public transportation in some areas, complement it in others, and ultimately bring levels of transit access to far flung reaches where it was never present before. The real estate implications of these developments will be vast, and those who understand them will be well positioned to outperform.



Real Estate Implications

The design and location of future commercial real estate projects will be heavily impacted by the advances in transportation we have outlined. One of the first major impacts, coming largely as a result of the greater acceptance and efficiency of ridesharing, will be the increased value of development sites with good access to uncongested roadways, but limited access to public transportation. In our 2016 paper on the multifamily sector, *Echoing the Boom: Millennials, Myths, and the Future of Multifamily*, we argued that changing demographics would lead to a resurgence in real estate demand in the suburbs by the mid-2020s. We further noted that though many Millennials would leave their city homes, they would be reluctant to abandon the amenities those cities offered, and would desire to retain access to them by clustering around nodes of public transit. We believe the advances we have noted strengthen this argument by showing how future suburban residents can enhance the reach of existing public transit systems and allow for greater density by reducing one of its limiting factors, the need for parking.

Parking demand has been softening in recent years,⁷ and this trend is likely to accelerate as autonomous vehicles begin to populate the road. One of the major challenges of development is the need to meet parking requirements today, while keeping in mind that as the need for vehicle ownership declines, so too should the need for parking. This could lead to greater construction levels as the increase in potential development sites leads to a decline in land prices, but it is also possible that developers will instead repurpose these lots as amenity spaces or alternate uses that could breathe new life into otherwise tired developments. While these changes may pay dividends in the office sector, the largest changes are likely to occur in the apartment and retail sectors.

As we discussed earlier, the premium renters are willing to pay to live within walking distance to transit access may already be declining, but in retail, we suspect a different trend may take hold. Part of the cost of urban shopping and dining is the cost of parking, which can be significant in terms of time, money, or both. With this cost reduced the appeal of urban style high street retail is likely to increase, to the benefit of landlords in cities and suburbs alike.

Congestion and Other Caveats

As we peer into the near future to a world of increased transportation efficiency, and the impacts it will have on real estate demand, it's important to remember that the timeline of events remains in flux. This uncertainty comes not only from the new vehicles that will be soon be traversing the nation's roads, but from the state of the roads themselves. As it stands today, much of the nation's infrastructure, particularly in dense areas, may be unable to recognize the full benefits of the technological advances we have outlined for some time. The New York metro area provides an instructive example.

Long dependent on an extensive public transportation system, the metro's roadways seem ill-prepared for large increases in vehicles operating at peak traffic hours. According to estimates provided by Google Maps, a typical morning commute from suburban Morristown, New Jersey into Manhattan can take upwards of 90 minutes from 8 – 9 a.m., more than twice the time it takes during low traffic periods. This substantial increase occurs even though only 7 percent of the 1.6 million workers who commute to Manhattan do so by car.⁸ Were this percentage to double, an easily possible scenario if increases in ride hailing are not matched by increases in ridesharing, the ensuing congestion could quickly overwhelm existing roadways.

Manhattan may be an extreme example of the limits of existing roadway infrastructure, but it should be an instructive one in reminding us that though the changes we have predicted are perhaps as inevitable as they are far-reaching, they may also occur gradually.

While these changes are occurring there are methods local governments can employ in combating congestion. For one, governments may choose to increase tolls and toll roads. This would have the dual effect of encouraging some drivers to take public transit and others to switch to ridesharing. Increased investment in the nation's roadways could also better prepare them for the specialized traffic ridesharing and autonomous vehicles may usher in. Carpool lanes are common in some parts of the country, but not in others. Lanes dedicated to autonomous vehicles, likely separated by barriers, could also allow for higher driving speeds than are legal today.

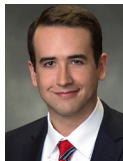
Conclusion

Advances in transportation have shaped the form, pace, and direction of real estate demand throughout the nation's history. We believe that the advent of ridesharing services and the widespread adoption of autonomous, electric vehicles will do so once again. Though the changes these advances will bring are likely to occur gradually due to the limitations of existing infrastructure, we believe some are already well underway. On-transit urban locations may see rent premiums continue to decline, the nation's suburbs should see their own access to an effectively extended system of public transit increase, and parking lots in many locations may be repurposed or redeveloped. Shrewd real estate investors conscious of these future changes will be well positioned to retain value in their existing portfolios and capitalize on the host of new opportunities that are sure to emerge.

Endnotes

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- 6 MIM estimates based on NBER Working Paper No. 22843 (2015), The Economist: "Autonomous vehicles are just around the corner" (2018), MIT CEEPR working paper: "The Economics of Ride-Hailing" (Feb. 2018 & Mar. 2018 revision), BuzzFeed: "Methodology For Estimating Uber Drivers' Hourly Net Earnings" (2016), therideshareguy.com surveys, and RideGuru surveys.
- 7 "Yes, Uber Really Is Killing the Parking Business," Fortune, February 2018.
- 8 U.S. Census Bureau, March 2013, Release Number CB13-R. 17.

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