

Improving Job Accessibility in Baltimore by Increasing Bike Commuting

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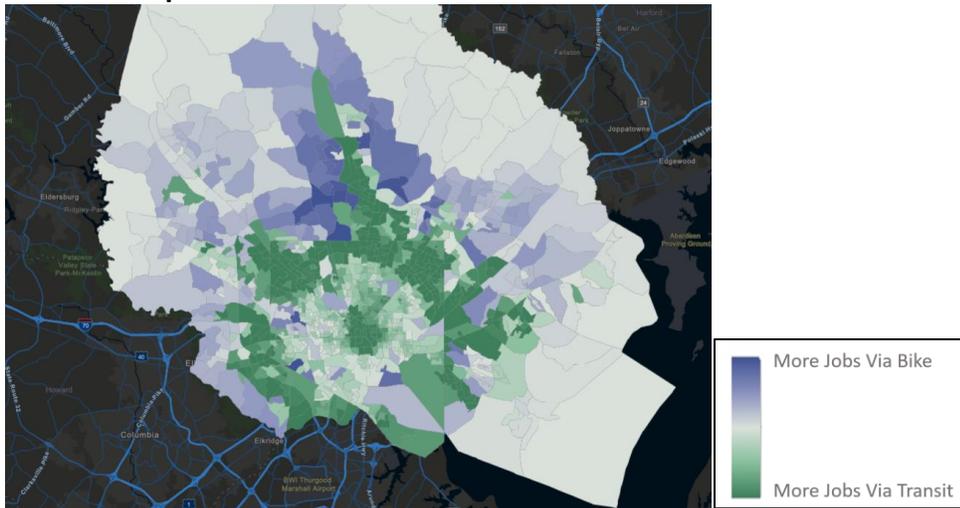
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1.0 Executive Summary

In May 2019, the Regional Economic Studies Institute (RESI) of Towson University released research on disparities across Maryland. These findings illustrated the widely different realities that residents experience from one neighborhood to the next. One of the most important factors for local disparities is transportation—many neighborhoods in Baltimore lack consistent access to a car, forcing workers to rely on alternative modes of transit. To gauge the effectiveness of bike commuting as a supplementary transit mode in the Baltimore region, RESI compared the number of jobs available to commuters via bike or public transportation.

Figure 1 illustrates whether a bike commute or a public transportation commute provides access to more jobs for Baltimore-area residents. Areas where more jobs are accessible by a bike commute are colored in shades of purple, whereas block groups with better accessibility via public transportation are colored in green.

Figure 1: Total Jobs Available by Biking in 30 Minutes Compared to Total Jobs Available by Public Transportation in 60 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

As seen above, transit generally outperforms biking in the core of downtown Baltimore and along the Baltimore City-County boundary. However, there is an “inner ring” of neighborhoods, shaded purple and light green, where biking and public transit provide similar levels of access.

Despite the potential for biking to increase job accessibility in Baltimore, relatively few commuters do so, generally due to safety concerns. Alleviating these worries by expanding bike infrastructure across Baltimore, especially in “inner ring” neighborhoods, will provide residents with a flexible alternative to public transit. Additionally, investments in bike infrastructure generate substantial short-term economic benefits as well. Within Baltimore City, investments in bike and pedestrian projects support nearly twice as many jobs per dollar spent as investment in road projects. Increasing equitable access to employment opportunities in Baltimore ensures that all residents can share in the region’s expanding prosperity.

2.0 Introduction

In May 2019, the Regional Economic Studies Institute (RESI) of Towson University released research on disparities in education, income, and life expectancy across Maryland. These findings illustrated the widely different realities that residents experience from one neighborhood to the next. The disparities in Maryland's workforce are the result of many interconnected factors. RESI convened roundtable discussions in fall 2019 to discuss four of these:

1. Education
2. Food insecurity
3. Access to employment
4. Transportation

During the transportation roundtable, participants established a clear link between easy, affordable access to transportation and economic disparity. Participants in the transportation roundtable discussion included representatives from local government and state agencies, transit-focused nonprofits and advocacy organizations, and institutions of higher education. The roundtable began by discussing the importance of public transportation as a way to connect with the state's economy. In some Baltimore City census tracts, as many as 80 percent of households lack access to a car.¹ For these neighborhoods, public transportation serves as the link between home, work, school, healthcare, grocery stores, and more.

In some Baltimore City census tracts, as many as 80 percent of households lack access to a car.

Despite its importance, public transportation is often one of the least flexible government services. Light rail and metro routes, such as those in the Baltimore area or the suburbs of Washington D.C., are essentially fixed in place upon construction. Bus routes have more flexibility to change, but large-scale redesigns of regional bus routes are relatively rare because they still require substantial investments. For example, Baltimore City's recent BaltimoreLink redesign cost \$135 million.² Roundtable participants noted that part of the high cost of transit programs comes from the lack of coordination between transit authorities and developers.

"No one bears the true cost of their commute."
-Roundtable Participant

Roundtable participants suggested that public transportation should be considered during all land use planning efforts. It is more difficult to design transit systems that link a patchwork of new development as opposed to having development fill in around a predesigned transit plan.

¹ U.S. Census Bureau, "Selected Housing Characteristics," accessed October 23, 2019, https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_DP04&prodType=table.

² Colin Campbell, "One year of BaltimoreLink bus system: Ridership bounces back, reliability still falls short," Baltimore Sun, June 15, 2018, accessed October 15, 2019, <https://www.baltimoresun.com/maryland/baltimore-city/bs-md-baltimorelink-one-year-20180608-story.html>.

Given the difficulties and costs associated with establishing new fixed rail lines and new bus routes, roundtable participants stressed the importance of emphasizing alternative means of

Bicycles and e-scooters are cheaper, require less road space, and are better able to address “first mile” and “last mile” gaps.

commuting, including bicycles and micromobility vehicles, such as e-scooters. When compared to buses and fixed rail, these forms of transportation are cheaper, require less road space, and are better able to address “first mile” and “last mile” gaps in existing transit networks.³ While micromobility vehicles are

relatively new, commuting by bicycle is not, offering users a flexible way to navigate the city. However, the relatively exposed nature of biking to elements and cars tends to limit the total number of bike commuters.

To fully understand the potential for bicycling to serve as a supplementary commute mode, RESI analyzed the number of jobs available to commuters in the Baltimore region if the commuter chose bicycling or public transportation.

3.0 Job Accessibility Using Public Transit Versus Bicycle

To understand the number and types of jobs available using different commuting modes, RESI calculated the commute time between each block group in Baltimore City and Baltimore County, as well as every other block group in the region.⁴ Using detailed data from the Census, RESI then estimated the number of jobs commuters could reach within a given timeframe.

3.1 Job Accessibility Using Public Transit

When using public transportation, the time spent riding on a bus or light rail is only one piece of the commute. Walking from home to the first transit stop and from the last transit stop to work also takes time, as does waiting for the bus or rail and any required transfers. This means that for shorter door-to-door commute times, a smaller percentage of time is spent riding transit, and thus commuters can access fewer jobs.

For example, Figure 2 presents the total number of jobs accessible via public transportation within 30 minutes. On average, residents with access to public transportation can reach just over 60,000 jobs via public transportation within 30 minutes. As seen in Figure 2, the block groups where residents can access the most jobs using only public transportation during the morning rush hour are located in downtown Baltimore City. Only those commuters who already live near existing job centers are able to arrive within a half hour. In order for public transit lines to connect people to jobs outside of their immediate surroundings, the commute length via bus and rail needs to be increased.

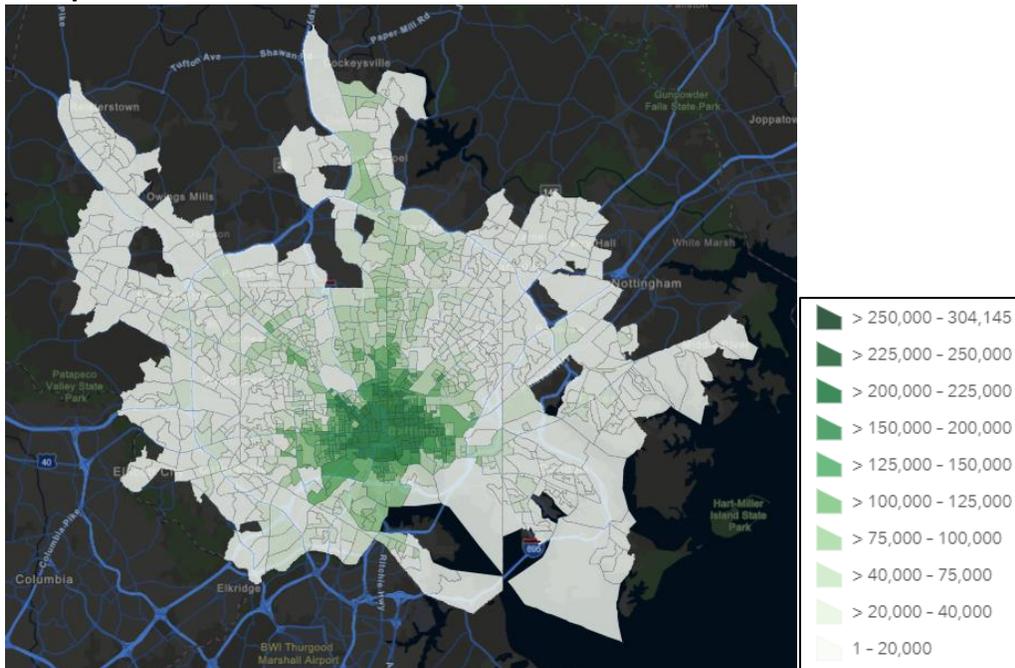
³ The terms “first-mile” and “last-mile” refer to the challenges associated with connecting commuters from their home to their first public transportation stop and from their final public transportation stop to their work/final destination.

⁴ A block group is an area with roughly 600 to 3,000 residents that is in between a block and a census tract in size.

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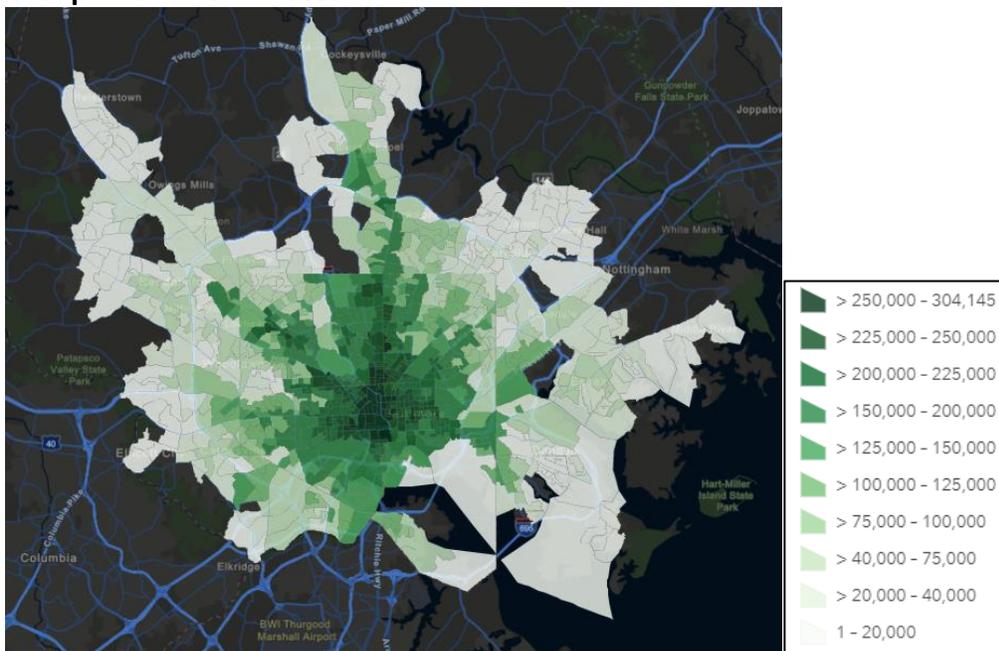
Figure 2: Total Jobs Accessible via Public Transportation from Each Baltimore Area Block Group Within 30 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

Figure 3 below illustrates how Baltimore’s public transit system connects workers to downtown when the commute time is increased to 45 minutes.

Figure 3: Total Jobs Accessible via Public Transportation from Each Baltimore Area Block Group Within 45 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

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On average, commuters with access to public transportation can reach 138,000 jobs via public transportation within 45 minutes—more than double the average number of accessible jobs with a commute time of 30 minutes. Similar to the pattern seen in Figure 2, block groups with the most jobs available through public transportation are concentrated in downtown Baltimore.

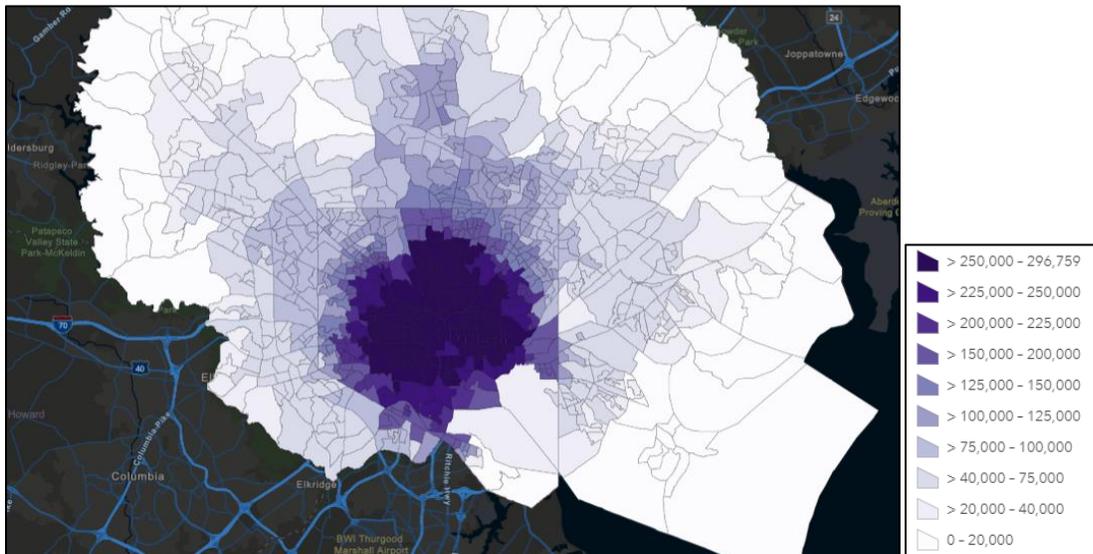
The presence of Baltimore’s hub and spoke model is easily seen, with higher levels of job accessibility present along the metro and light rail lines, as well as many of the major bus lines.⁵ However, the end points of the two major fixed rail lines (in Owings Mills and Hunt Valley) are not completely dark, signaling that even longer commutes are needed to bring nearby residents to major job centers.

Broadly, Figure 3 shows that the closer one lives to downtown, the more job options one has with a 45-minute commute due to the high number of converging transit routes into and out of the city. This means commuters can access not only those jobs that are located downtown, but also in outlying neighborhoods and suburbs.

3.2 Job Accessibility Using Bicycles

In contrast to public transportation, commuters using bicycles do not need to rely on as many fixed routes. Instead, as shown in Figure 4, the number of jobs bike commuters are able to access within 30 minutes is more uniformly distributed across the region.

Figure 4: Total Jobs Accessible via Biking from Each Baltimore Area Block Group Within 30 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

⁵ In a hub and spoke model, “spokes” are transit routes connecting points to a central “hub.”

As Figure 4 illustrates, Baltimore City and County residents are, on average, able to access over 161,000 jobs within a half hour with a bike commute. Biking provides the greatest level of access within Baltimore City, driven largely by the number of jobs available in downtown Baltimore and the number of options bicyclists from across the city have to commute downtown and to various block groups.

3.3 Biking Compared to Public Transportation

Both public transportation and biking offer Baltimore area residents, especially those without a car, the opportunity to access jobs across the metro area. However, as outlined in Figure 5, for a given commute time, biking provides residents with access to more jobs than public transportation.

Figure 5: Average Number of Jobs Accessible By Bicycle and Public Transportation for Different Commute Times

Average Number of Jobs Accessible Within:	Public Transportation	Biking	Percent Increase in Accessible Jobs By Biking
15 Minutes	9,724	46,682	380%
30 Minutes	60,156	161,621	169%
45 Minutes	138,031	308,706	124%
60 Minutes	237,518	449,246	89%

Sources: BLS, OpenTripPlanner, RESI, US Census

As an example of biking’s efficiency, for a half hour commute, Baltimore area residents are able to access 2.5 times as many jobs by biking than they are by taking bus or rail. This difference is not due to bikes being able to move faster than buses or rail. Instead, biking avoids the time spent walking to and from transit stops and waiting for buses and light rail to arrive. As shown in Figure 5, when commute times increase, this advantage of a bike commute diminishes.

Still, a commute by bike is very different from a commute by bus or rail. Commuters do not value a 30-minute commute by bike equally to a 30-minute commute by public transportation for a variety of reasons. Most notably, a commute by bicycle requires constant physical exertion. Additionally, a bike commuter is exposed to the elements more than a user of public transportation. Therefore, when evaluating differences in the number of jobs accessible by bike or public transportation, it is best to compare the outcomes from a bike commute that is shorter than a commute by public transit.

Figure 6 illustrates whether a bike commute of 30 minutes or a public transportation commute of 60 minutes provides access to more jobs for residents of the Baltimore area.⁶

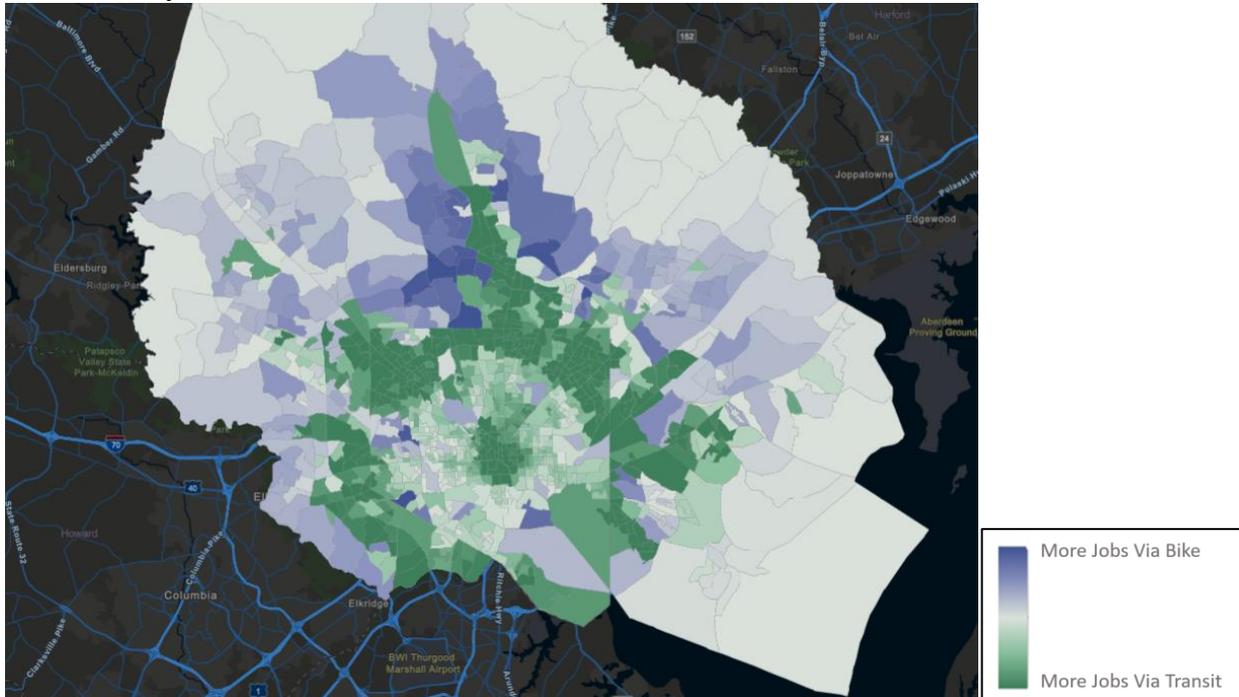
⁶ These commute lengths were chosen as they roughly match the average commute by each mode.

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Census block groups where more jobs are accessible by a 30-minute bike commute than a 60-minute bus or rail commute are colored in shades of purple. Census block groups where more jobs are accessible by a 60-minute commute using public transportation than a 30-minute bike commute are colored in green. Census block groups colored in lighter shades represent those areas where the number of jobs available by a 30-minute bike commute and 60-minute transit commute are relatively equal.

Figure 6: Total Jobs Available by Biking in 30 Minutes Compared to Total Jobs Available by Public Transportation in 60 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

There are a number of key takeaways from Figure 6. Firstly, when controlling for commuter preferences for shorter bike commutes relative to public transportation, the vast majority of block groups within Baltimore City provide greater access to jobs with a bus or rail commute of 60 minutes as opposed to a bike commute of 30 minutes. This is evident by the light green to dark green shades within Baltimore City.

Secondly, public transportation significantly outperforms biking in two main locations: downtown Baltimore City and along the Baltimore City-Baltimore County border boundary. Downtown, this pattern is generally due to the number of overlapping bus and rail lines that residents are able to use for accessing jobs downtown and in outlying neighborhoods. Biking is less effective along the Baltimore City-Baltimore County border mostly due to limitations in how far a commuter can bike in a half hour.

Notably, between downtown and the Baltimore City-Baltimore County border, there is a clear “inner ring” of neighborhoods where biking is roughly as efficient as, and in some cases slightly more efficient than, bus and rail.

These neighborhoods are those shaded purple or a very light green, and represent prime targets for additional support for bike commuters. In these areas of Baltimore City, commuters can access a roughly equivalent number of jobs within a half hour bike commute or an hour commute by public transit.

The “inner ring” neighborhoods represent prime targets for improved bike infrastructure to increase access to employment in Baltimore City.

Improving bike infrastructure and access within these neighborhoods may lead to increased access to employment opportunities by giving residents an alternative to public transit.

An additional area where biking stands out relative to commuting by bus or rail is in northern Baltimore County. Here, transit is more efficient in connecting workers to employment along the light rail line and on York Road—as evidenced by the dark green shading. However, for residents just off York Road, biking provides them with more efficient access to the job opportunities than solely using public transportation.

4.0 What Challenges Exist in Increasing Bike Commuting?

As discussed earlier, bicycling frequently allows Baltimore City residents the ability to access more jobs than if they relied solely on public transportation. However, only one percent of Baltimore City residents commute to work by bike. Given how efficient bicycling can be in connecting Baltimore area residents to employment, why aren’t more residents taking advantage of this commute mode? The decision to cycle versus using an alternate means of transportation is a complex function of many different factors. While not intended to be exhaustive, this section discusses some major reasons.

4.1 Safety

One of the main barriers to increased bike commuting is safety. A survey of residents in Philadelphia, Chicago, and Brooklyn identified safety as the number one concern across racial groups and income levels.⁷ The main issue residents had was traffic, with 48 percent of respondents indicating concern. Respondents of color, especially those with lower income, also cited personal safety concerns relating to biking. Although 22 percent of lower-income respondents of color cited personal safety (either as a victim of a crime or from unwanted police activity) as a concern, only 7 percent of higher-income white respondents said so.

⁷ Transportation Research and Education Center, “Breaking Barriers to Bike Share,” accessed October 8, 2019, https://ppms.trec.pdx.edu/media/project_files/TREC_BreakingBarriersSummaryReport_emQeiBA.pdf

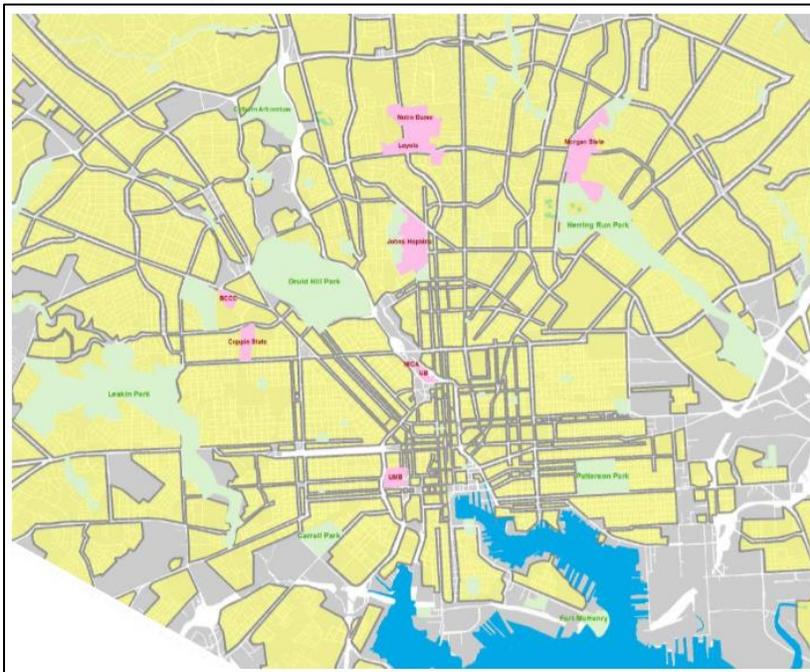
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As an example of the traffic safety concerns facing bike commuters in Baltimore City, Figure 7 (produced by the Baltimore Department of Transportation) illustrates the main obstacles to safe commuting via bike. Areas in yellow are classified as “low stress bike zones,” which are areas where bicyclists have limited interactions with fast moving traffic. In contrast, the roads in white are those with high-speed traffic that bicyclists may feel unsafe riding along or crossing.

As Figure 7 shows, Baltimore City contains a number of busy streets that disincentivize biking of any distance. This is especially true for commuters hoping to access jobs in downtown Baltimore, where the highest density of roads classified as barriers is found. Figure 6 in Section 4 illustrated the “inner ring” neighborhoods that would most benefit from an increase in bike lanes and other targeted efforts. Prioritizing infrastructure in the inner ring along the roads outlined in Figure 7 will help increase the employment opportunities to residents.

Figure 7: Low Stress Bike Zones (in Yellow) and Barriers to Enhanced Connectivity (in White) in Baltimore City



Source: Baltimore City Department of Transportation

4.2 Cost

In the survey of residents in Philadelphia, Chicago, and Brooklyn, the number one barrier to biking more for lower-income respondents of color was the lack of a bike or other gear.⁸ The upfront cost to purchase a bicycle can be prohibitive lack access to capital. Paying \$3.80 per day to take the bus or light rail is often more financially feasible when living paycheck-to-paycheck.

⁸ Transportation Research and Education Center, “Breaking Barriers to Bike Share.”

However, as reported in a national survey, those who make less than \$20k per year and do not currently own a bicycle are also the most likely to want to bike, with 40 percent reporting that they would like to ride more.⁹

4.3 Other Concerns

The default thinking in many parts of the United States is that a car is needed to get from point A to point B. In fact, people often overestimate the amount of time required to get to a destination by biking or walking compared to using a car.¹⁰ Furthermore, in low-income communities, owning a car is often symbolic of success, while owning a bicycle can carry a stigma of being poor.¹¹ Still, as mentioned above, many low-income residents still have a desire to use bicycles as a means for commuting.

For many residents of Baltimore City, there are also a number of practical reasons someone may not bike to work. For example, it is difficult to ride with children, and if a commuter needs to drop children off at daycare or school, a bike can be a more burdensome vehicle. Additionally, there may not be a safe place to park or store a bicycle at work or home.

5.0 Increasing Job Accessibility by Increasing Bike Infrastructure

The challenges outlined in Section 4 are numerous and no single solution can address all of them. However, as discussed in Section 4, the main concern across potential bicyclists is safety. In fact, over 64 percent of would-be cyclists say that they would be more likely to bike if lanes were physically separated by a barrier.¹² Having a series of bike lanes separated from the flow of car traffic increases the likelihood that commuters will use bike lanes and thereby increase their access to jobs.

Across the country, cities are overhauling their road networks to be more inclusive of other modes of transportation, such as electric scooters, electric bicycles, electric skateboards, and Mopeds. These initiatives are termed “Complete Streets” to designate that roads should be shared by all users, regardless of their chosen mode of travel, and have the potential to generate substantial economic gains. For example, Lancaster, CA invested \$10 million to configure nine blocks, resulting in 50 newly created businesses and generating over 800 jobs.¹³

⁹ Michael Andersen, “Here's What Keeps People from Riding a Bike,” Greater Greater Washington, March 16, 2015, <https://gqwash.org/view/37584/heres-what-keeps-people-from-riding-a-bike>.

¹⁰ “Misestimating Travel Times May Stop People from Walking or Biking to Work,” ScienceDaily, March 28, 2018, <https://www.sciencedaily.com/releases/2018/03/180328120058.htm>.

¹¹ PeopleForBikes and Alliance for Biking & Walking, “Building Equity. Race, ethnicity, class, and protected bike lanes: An idea book for fairer cities,” 2015, accessed October 10, 2019, <https://peopleforbikes.org/wp-content/uploads/2017/07/EquityReport2015.pdf>.

¹² Michael Andersen, “Here's What Keeps People from Riding a Bike,” Greater Greater Washington, March 16, 2015, <https://gqwash.org/view/37584/heres-what-keeps-people-from-riding-a-bike>.

¹³ “The Many Benefits of Complete Streets,” Smart Growth America, March 2015, accessed October 23, 2019, <http://old.smartgrowthamerica.org/documents/cs/resources/cs-benefits.pptx>.

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Complete Streets Initiatives also have the capacity to reduce crime, increase public health levels, and other impacts that are difficult to monetarily quantify.^{14,15}

At the end of 2018, Baltimore City passed its own Complete Streets Ordinance.¹⁶ Additionally, Baltimore has implemented several bike master plans, including its most recent update in 2017, which identified a number of targeted routes to improve commuting via bike.¹⁷ However, Baltimore has been relatively slow to fund both bike lane infrastructure projects compatible with either the Complete Street Ordinance or the city's master plans.¹⁸ In doing so, not only is Baltimore limiting residents' ability to move across the City, they are potentially leaving on the table millions in state and federal funds that have been set aside to match city investment.¹⁹ Baltimore could therefore benefit from aggressively implementing its Complete Streets Initiative.

Baltimore could benefit from aggressively pursuing its Complete Streets Initiative.

In addition to providing access to jobs, healthcare, schools, and more, investments in bike lanes help stimulate the local economy. According to a report by PERI of the University of Massachusetts, for each \$1 million spent on bicycle and pedestrian infrastructure, Baltimore creates 13 jobs—the highest among the 11 cities analyzed in the report.²⁰ Furthermore, according to the report, investments in bicycle and pedestrian infrastructure in the city support nearly twice as many jobs per dollar spent as road improvement projects do.

Investments in bike and pedestrian projects support nearly twice as many jobs per dollar spent as road improvement projects.

¹⁴ "The Many Benefits of Complete Streets," Smart Growth America.

¹⁵ Taylor Young, "Effect of Complete Streets Infrastructure and Design on Street Life," Academic Commons, June 2017, accessed October 23, 2019, <https://academiccommons.columbia.edu/doi/10.7916/D8MG80XK>.

¹⁶ <https://www.baltimorecompletestreets.com/thebill>.

¹⁷ Kittelson Associates, "Baltimore City Separated Bike Lane Network: Addendum to 2015 Master Plan Update," prepared March 2017, accessed October 23, 2019, http://transportation.baltimorecity.gov/sites/default/files/FINAL_HighRes_Separated%20Bike%20Lane%20Network_4_7%20compressed.pdf

¹⁸ Emily Ransom, "What's Going On With Baltimore's Bike Master Plan,?" Greater Greater Washington, January 24, 2019, accessed October 16, 2019, <https://ggwash.org/view/70604/baltimores-bicycle-plan-lacks-ambition-and-funding>.

¹⁹ Ethan McLeod, "As DOT Proceeds to Alter Another Bike Lane, Delegate Worries Baltimore is Risking Federal, State Dollars", May 30, 2019, accessed October 22, 2019, <https://baltimorefishbowl.com/stories/as-dot-proceeds-to-alter-another-bike-lane-delegate-worries-baltimore-is-risking-federal-state-dollars/>.

²⁰ Heidi Garrett-Peltier, "Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts," PERI, accessed October 23, 2019, <https://www.peri.umass.edu/publication/item/427-pedestrian-and-bicycle-infrastructure-a-national-study-of-employment-impacts>.

According to the Maryland Department of Transportation, Baltimore City has over \$19 million in federal earmark projects related to bicycle and pedestrian infrastructure.²¹ This is enough to sustain hundreds of jobs, while also being able to connect more residents to employment opportunities across the city in the long run.

Of note, it is critically important that any new investments in bike infrastructure be made in collaboration with city residents, especially those in “inner ring” neighborhoods. Residents of these neighborhoods need to feel included in the process and can offer better locations for workable transit routes than modeling.

7.0 Conclusion

While expanding bicycle infrastructure and encouraging cycling should not be viewed as a replacement for large public transportation projects, it can serve as an important intermediate step during the planning process. As laid out in this policy brief, investments in many Baltimore City neighborhoods would provide residents with an alternative means to find employment.

Currently, there are no new large infrastructure projects proposed for the Baltimore area.²² Because major projects (e.g., rail infrastructure) can take around 12 years before construction even begins, early planning is critical. For each year there are no planned major public transportation projects, the region continues to push back development by over a decade. This comes at a critical juncture where cities are competing nationally to attract businesses, as well as to build up a qualified workforce.

By aggressively pursuing evidence-based policies that enable the most efficient ways of connecting people with opportunities, the region can become a leader in sustainable growth. On the other hand, by assuming the same policies of the past will work for the future, the region risks falling further behind.

²¹ Maryland Department of Transportation, “Consolidated Transportation Program: FY2020 – FY2025. Draft 2020 State Report on Transportation,” accessed October 23, 2019, http://www.mdot.maryland.gov/newMDOT/Planning/CTP/CTP_20_25/Draft_Documents/MDOT%202020-2025%20Draft%20CTP.pdf.

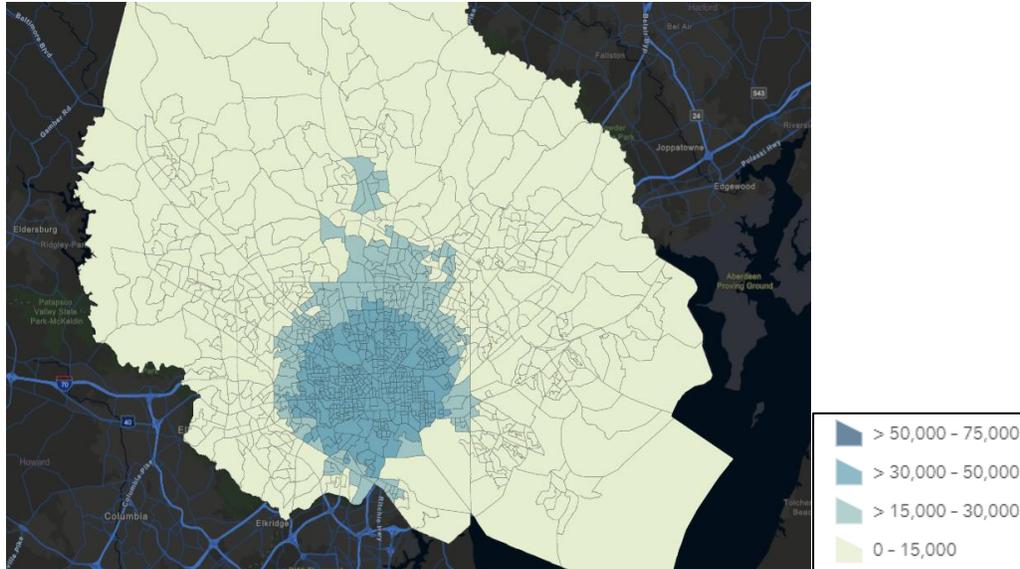
²² Ibid

8.0 References

- Andersen, Michael. "Here's What Keeps People from Riding a Bike." Greater Greater Washington, March 16, 2015. <https://ggwash.org/view/37584/heres-what-keeps-people-from-riding-a-bike>.
- Arata, Nicole, and Philip Reed. "What Is the Total Cost of Owning a Car?" NerdWallet, June 28, 2019. <https://www.nerdwallet.com/blog/loans/total-cost-owning-car>.
- "Bike Rack Request Form." Baltimore City Department of Transportation, September 26, 2019. <https://transportation.baltimorecity.gov/bikerackrequestform>.
- "Building Equity. Race, ethnicity, class, and protected bike lanes: An idea book for fairer cities." PeopleForBikes and Alliance for Biking & Walking. 2015. <https://peopleforbikes.org/wp-content/uploads/2017/07/EquityReport2015.pdf>.
- Campbell, Colin. "One year of BaltimoreLink bus system: Ridership bounces back, reliability still falls short." Baltimore Sun. June 15, 2018. Accessed October 15, 2019 at <https://www.baltimoresun.com/maryland/baltimore-city/bs-md-baltimorelink-one-year-20180608-story.html>.
- Garrett-Peltier, Heidi. "Pedestrian and Bicycle Infrastructure: A National Study of Employment Impacts." PERI. Accessed October 23, 2019. <https://www.peri.umass.edu/publication/item/427-pedestrian-and-bicycle-infrastructure-a-national-study-of-employment-impacts>.
- "The Many Benefits of Complete Streets." Smart Growth America. March 2015. Accessed October 23, 2019. <http://old.smartgrowthamerica.org/documents/cs/resources/cs-benefits.pptx>.
- Maryland Department of Transportation. "Consolidated Transportation Program: FY2020 – FY2025. Draft 2020 State Report on Transportation." Accessed October 23, 2019. http://www.mdot.maryland.gov/newMDOT/Planning/CTP/CTP_20_25/Draft_Documents/MDOT%202020-2025%20Draft%20CTP.pdf.
- McLeod, Ethan. "As DOT Proceeds to Alter Another Bike Lane, Delegate Worries Baltimore is Risking Federal, State Dollars." May 30, 2019. Accessed October 22, 2019. <https://baltimorefishbowl.com/stories/as-dot-proceeds-to-alter-another-bike-lane-delegate-worries-baltimore-is-risking-federal-state-dollars/>.
- "Misestimating Travel Times May Stop People from Walking or Biking to Work." ScienceDaily. March 28, 2018. <https://www.sciencedaily.com/releases/2018/03/180328120058.htm>.
- Ransom, Emily, "What's Going On With Baltimore's Bike Master Plan?", January 24, 2019, accessed October 16, 2019, <https://ggwash.org/view/70604/baltimores-bicycle-plan-lacks-ambition-and-funding>.
- Smart, Michael and Nicholas Klein. "A Longitudinal Analysis of Cars, Transit, and Employment Outcomes." MNTRC Report 12-49. September, 2015. http://scholarworks.sjsu.edu/cgi/viewcontent.cgi?article=1198&context=mti_publications.
- U.S. Census Bureau, 2017 American Community Survey 5-Year Estimates. "Selected Housing Characteristics." Accessed October 23, 2019. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_17_5YR_DP04&prodType=table.
- Young, Taylor. "Effect of Complete Streets Infrastructure and Design on Street Life." Academic Commons. June 2017. Accessed October 23, 2019. <https://academiccommons.columbia.edu/doi/10.7916/D8MG80XK>.

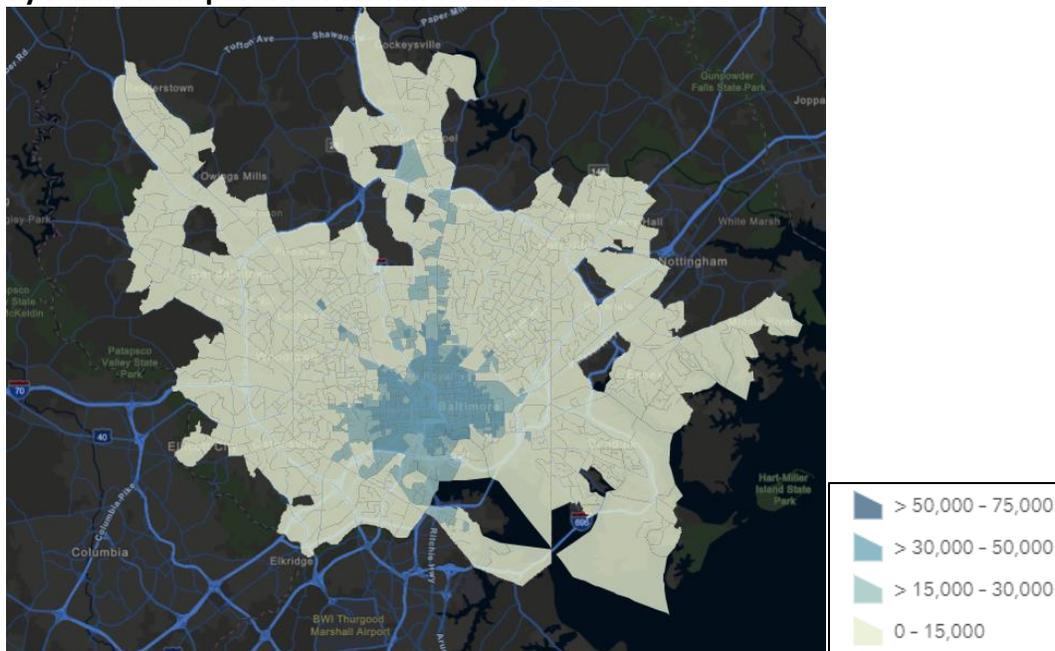
Appendix A—Additional Data

Figure 8: Total Number of Accessible Jobs for Workers with High School Education Accessible by Bicycle Within 30 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

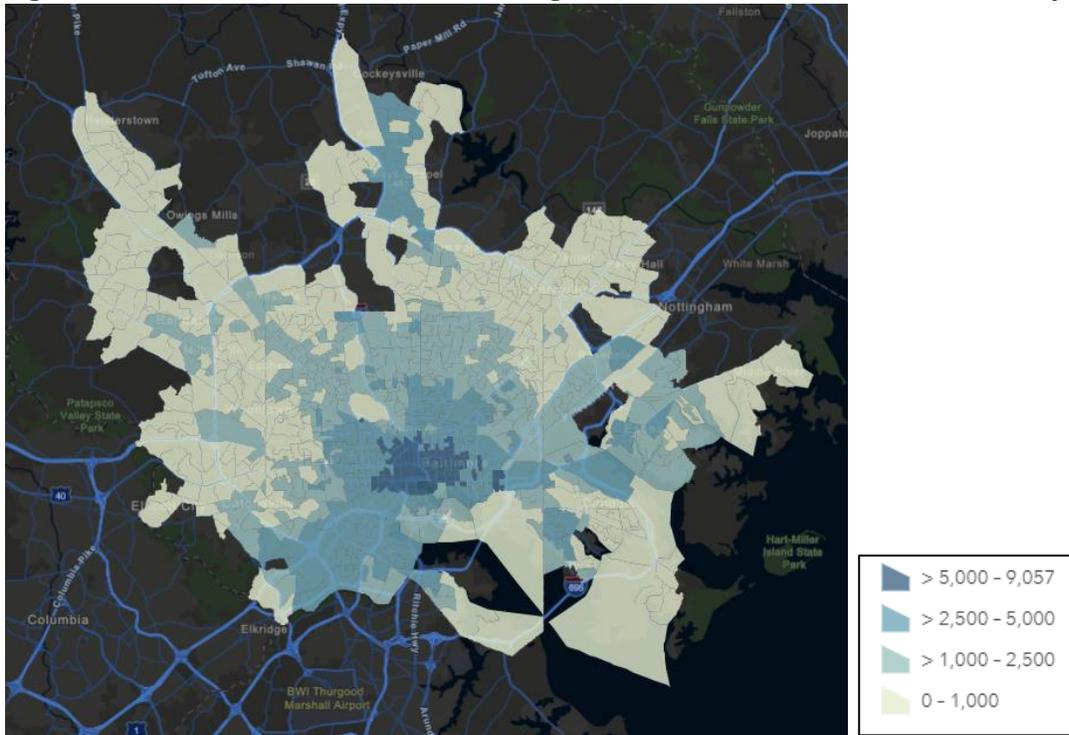
Figure 9: Total Number of Accessible Jobs for Workers with High School Education Accessible by Public Transportation Within 30 Minutes



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

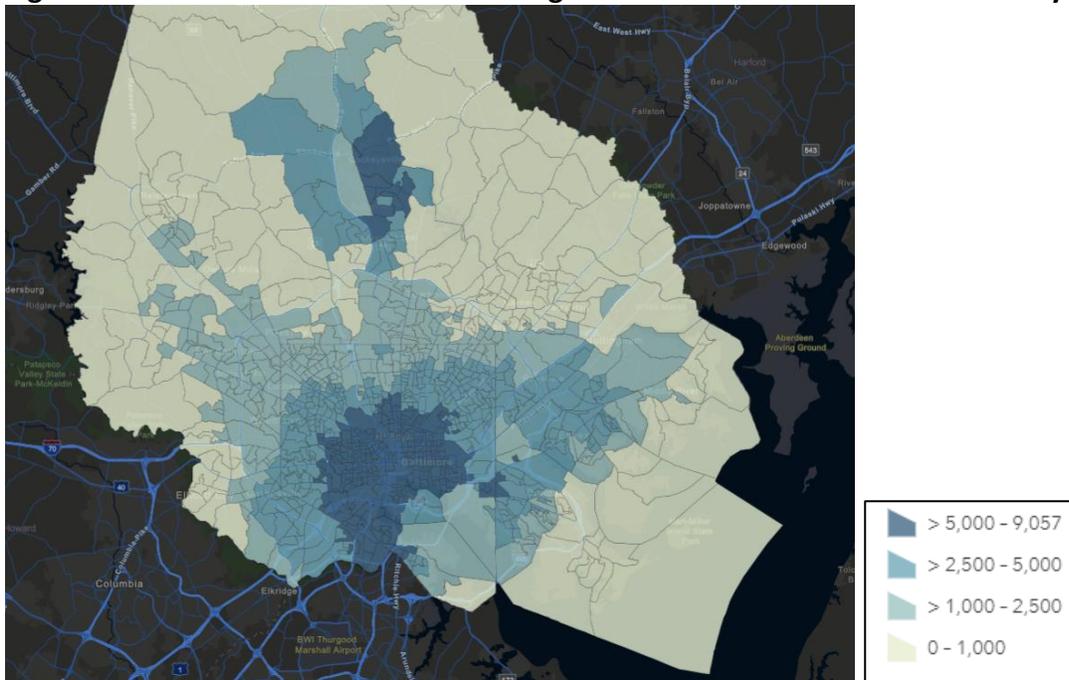
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Figure 10: Total Number of Manufacturing Jobs Accessible Within 45 Minutes by Transit



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

Figure 11: Total Number of Manufacturing Jobs Accessible Within 30 Minutes by Bike



Sources: BLS, Esri ArcGIS, OpenTripPlanner, RESI, US Census

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