**Measuring accessibility to public transportation services by low-income residents: the case of Washington DC**

**Introduction and background**

Research suggest that individuals and households who without private vehicles rely heavily on public transportation services (Martens et al., 2019; Taylor & Morris, 2015). Public transportation has a crucial role in the economic and social structure of metropolitan areas, particularly for low-income citizens who heavily rely on this service for their daily activities (Urena & Cinzia, 2016). Given the link between transportation and economic outcomes, limited access to transportation services in low-income areas perpetrates poverty to continually worsen socio-economic livelihood. Fletcher et al., (2015) identified transportation as major determinant of employment with private vehicle owners having a higher chance to be employed over individuals without the financial muscles for private vehicles. Federal agencies in the United States are mandated to strive for equitable access to resources for minority and low-income communities. Access to high-quality public transit is essential for the mobility of many of these populations. Assessing the allocation of transportation service among disadvantaged populations has the capacity to greatly improve policy analysis. Using cities in North America as case study, Kramer, (2018) finds that affordable housing technically does not exist around transit site. Thus, holding still other variables such as housing type, urban form, household characteristics, housing prices/cost increases as they move closer to the transit lines and especially where transit services are frequent. This implies denial of access to individuals or households who need it and are more likely to use transit services. Several studies indicate that transit services are generally more frequent and extensive in densely populated downtown districts (Kawabata & Shen, 2006), where property prices typically tend to be higher (Cervero, 2004; Immergluck, 2009). Many low-income households, who are unable to afford expensive housing and private vehicles, frequently must make difficult choices between spending on housing or transportation expenses.

In the United States, the federal government oversees certain affordable housing initiatives that focus on the supply side. These programs include the Multifamily Subsidized Housing (Multifamily), Low-Income Housing Tax Credits (LIHTC), and Public Housing (PH). The primary objective of housing schemes of this nature is to enhance the affordability of rent for households with low income. Nevertheless, the evaluation of transit accessibility is often overlooked when planning affordable housing units due to the absence of federal mandates and the lack of coordination between housing authorities and transit agencies (Zimmerman et al., 2022). Moreover, a recent study conducted by the Transit Cooperative Research Program has determined that numerous transit agencies frequently fail to provide special importance to providing communities with abundant affordable housing during their transit planning procedure (Blanchard & Waddell, 2017; Zimmerman et al., 2022).

**Research questions.**

Below are the questions the research seeks to answer.

* How do the spatial distribution and availability of public transportation services vary across different affordable units’ thresholds (30%, 50%, 80%, or 120% of AMI) in Washington DC?
* How do factors such as distance to transit stops, frequency of transit service, and transit mode availability affect accessibility for households with different income levels?
* Are there significant disparities in the quality of public transportation services (e.g., reliability, comfort, safety) experienced by households across different income levels?

**Methods**

The study will rely purely on secondary data on affordable housing projects in Washington DC that were started or completed in 2015 for the various AMI thresholds for analysis. The data will be manipulated with metro bus route and bus stops to access the distribution of routes and stops around the different AMI threshold projects. Geopanadas will be utilized to process and examine geospatial data, including the location of public transit stops, and routes in the various AMI categories. Network analysis in python will be utilized to calculate proximity and accessibility to the bus routes and stops. A comparative analysis will be done to assess proximity and accessibility among the different affordable AMI thresholds.

**Study Limitations**

The utilization of secondary will only limit the research findings to existing data which may be associated with errors such as counting. Ethically, the data that will be employed has limited metadata that describes the extent to which the data can be used. This undermines the credibility of the data for analysis. The distance and proximity analysis that will be utilized in this context is based on simplifying assumptions, such as Euclidean distance or constant travel speeds. These assumptions may not always adequately depict real-world conditions, particularly in intricate urban settings.

**References**

Blanchard, S. D., & Waddell, P. (2017). *UrbanAccess Generalized Methodology for Measuring Regional Accessibility with an Integrated Pedestrian and Transit Network*. *2653*, 35–44. https://doi.org/10.3141/2653-05

Cervero, R. (2004). *Transit-oriented development in the United States: Experiences, challenges, and prospects.*

Fletcher, C. N., Garasky, S. B., Jensen, H. H., & Nielsen, R. B. (2015). Transportation Access : A Key Employment Barrier for Rural Low- Income Families. *Journal of Poverty*, 37–41. https://doi.org/10.1080/10875541003711581

Immergluck, D. (2009). *Large Redevelopment Initiatives , Housing Values and Gentrification : The Case of the Atlanta Beltline*. *46*(July), 1723–1745. https://doi.org/10.1177/0042098009105500

Kawabata, M., & Shen, Q. (2006). *Job accessibility as an indicator of auto-oriented urban structure : a comparison of Boston and Los Angeles with Tokyo*. *33*, 115–131. https://doi.org/10.1068/b31144

Kramer, A. (2018). *The una ff ordable city : Housing and transit in North American cities*. *83*(June), 1–10. https://doi.org/10.1016/j.cities.2018.05.013

Martens, K., Bastiaanssen, J., & Lucas, K. (2019). *Measuring transport equity: Key components, framings and metrics*. Elsevier Inc. https://doi.org/10.1016/B978-0-12-814818-1.00002-0

Taylor, B. D., & Morris, E. A. (2015). *Public transportation objectives and rider demographics : are transit ’ s priorities poor public policy ?* 347–367. https://doi.org/10.1007/s11116-014-9547-0

Urena, N., & Cinzia, S. (2016). a policy analysis for the Washington D . C . metropolitan. *Public Transport*, *8*(1), 103–123. https://doi.org/10.1007/s12469-015-0119-2

Zimmerman, M. V, Posthumus, A., & Howell, K. (2022). *National Academies of Sciences Engineering and Medicine. Coordination of Public Transit Services and Investments with Affordable Housing Policies.*