

Advancing the Quantitative Assessment of Transportation Equity for Planning

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ABSTRACT

The passing of the Equity Executive Order by the US government in 2021 and the Equity Action Plan developed by the US Department of Transportation have made addressing equity a priority in transportation planning projects. The Equity Action Plan recognizes socio-economically disadvantaged (SED) and rural communities as overburdened and underserved in transportation services and highlights the need to provide basic equality of opportunities and a fair distribution of burdens in transportation. In response, several transportation planning agencies have proposed their own criteria, methods, metrics, and tools to quantify equity issues and use them in planning. However, transport equity is a multi-faceted phenomenon and its quantification faces challenges due to a lack of standards and a comprehensive assessment framework.

The first objective of this dissertation is to develop a nuanced understanding in three key aspects of transport equity – (i) accessibility to opportunities, (ii) environmental burden, and (iii) health outcomes – based on the concept of ‘compound disadvantage’. A detailed assessment of prominent accessibility measures reveals a substantial measurement bias in the current measures, which can result in inappropriate conclusions such as an overestimating accessibility to opportunities for SED neighborhoods on average by 16%. Despite this, spatial accessibility is found to be high for compact, urban areas which also tend to have higher concentration of SED communities. However, there are significant modal differences in accessibility that reveal a substantial lack of utilization of infrastructure for alternate modes of travel – public transit, walking, and bicycling.

Evaluation of inequalities in environmental and health outcomes shows substantial disadvantage faced by SED communities, particularly poor people and people of color. A proposed emission equity index shows that low-income and racial minority neighborhoods of Indiana’s largest cities disproportionately experience vehicular pollution from travelers residing in high-income, White-

majority areas passing through their neighborhoods. Similarly, essential workers living in low-income areas are observed to have experienced significantly worse COVID-19 infection rates than in high-income areas in Chicago and New York City, and this effect was mediated by their ‘mobility vulnerability’. Together, these results suggest a strong compounding of disadvantage by the current transportation systems for already disadvantaged communities despite their higher accessibility to opportunities owing to their predominantly urban residences.

The second objective of this dissertation is to integrate the equity measures in an interactive screening tool for identifying the vulnerable and priority areas for investment. ‘Indiana Equity Atlas’, an equity-screening dashboard tool, is developed to allow transportation planners and analysts to identify priority areas in terms of compound disadvantage of two selected indicators of socio-economic, accessibility, environmental burden, and health disadvantage. With this tool and the associated data and metrics, this work seeks to provide a comprehensive framework for identifying vulnerable regions to formally capture equity issues in transportation and urban planning and analysis.