



Assessing social equity in distance based transit fares using a model of travel behavior



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ABSTRACT

The goal of this study is to develop and apply a new method for assessing social equity impacts of distance-based public transit fares. Shifting to a distance-based fare structure can disproportionately favor or penalize different subgroups of a population based on variations in settlement patterns, travel needs, and most importantly, transit use. According to federal law, such disparities must be evaluated by the transit agency, but the area-based techniques identified by the Federal Transit Authority for assessing discrimination fail to account for disparities in distances travelled by transit users. This means that transit agencies currently lack guidelines for assessing the social equity impacts of replacing flat fare with distance-based fare structures. Our solution is to incorporate a joint ordinal/continuous model of trip generation and distance travelled into a GIS Decision Support System. The system enables a transit planner to visualize and compare distance travelled and transit-cost maps for different population profiles and fare structures. We apply the method to a case study in the Wasatch Front, Utah, where the Utah Transit Authority is exploring a switch to a distance-based fare structure. The analysis reveals that overall distance-based fares benefit low-income, elderly, and non-white populations. However, the effect is geographically uneven, and may be negative for members of these groups living on the urban fringe.

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Introduction

Transport policy is inherently spatial. In the particular case of public transportation, building new transit infrastructure, changing the level of service, or modifying transit fares differentially impacts the spatial distributions of costs and benefits associated with this form of mobility. Despite its importance, few tools exist to aid researchers and planners in analyzing *social equity*, the fairness of cost/benefit distributions over space and across different population groups. Given the increasing importance placed on sustainability principles, it becomes salient to the transportation sector to balance environmental and

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economic concerns with those that are social, such as justice and equity. Without the proper tools, social equity analyses have been systematically underrepresented in transportation planning research and practice, or at least performed in an inconsistent, ad hoc manner from region to region (Deka, 2004).

This research aims to address this gap by developing a Geographic Information System-based Decision Support System (GIS-DSS) for evaluating the social equity impacts of transit fare policy. GIS-DSSs assist users with evaluating the costs and benefits of hypothetical solutions to inherently spatial problems and they are recommended by the Federal Transit Administration for analyzing the equity impacts of proposed changes in transit route and fare structures (Federal Transit Administration, 2012). The work has been performed in consultation with the Utah Transit Authority (UTA), a transit agency currently in the midst of reforming its transit fare strategy; the agency is considering a shift from a flat-rate fare to a distance-based fare structure.

The Utah Transit Authority is a large state-authorized transit operator in the United States. It services a population of 1.8 million people with a fleet of busses, vanpools, and light and commuter rail locomotives. Similar to many transit agencies in the United States, the UTA currently charges a “local-service” flat-rate fare for one- and two-way trips irrespective of distance travelled on the transit system. Following a steep decline in UTA revenues during the recent economic downturn, UTA is considering a distance-based fare structure in an effort to generate higher levels of ridership (for shorter distance travelers) and greater levels of fare-box revenue overall.

In the United States, before a fare structure can be modified, there is a legal requirement for most transit agencies to conduct a differential impacts analysis, with the specific goal of determining whether the planned changes will have a disparate impact on the basis of race, color, or national origin. The most recent guidelines put forward by the Federal Transit Authority in FTA Circular 4702.1B do not contain specific instructions for investigating a transition to distance-based fares. Rather, the guidelines focus on disparities with respect to purchasing of different forms of fare media (single tickets, monthly passes, discount fares, etc.). Moreover, the types of distributional analyses recommended by the FTA cannot be meaningfully extended to the case of distance-based fares because there is no suggested guideline for examining disparities in travel behavior, specifically distance travelled, the fundamental underlying behavior that may result in inequalities in distance-based fares paid by different demographic groups.

This research aims to improve our understanding of transit fares and social equity. We evaluate the equity implications of UTA moving from a flat-rate fare to a distance-based fare strategy through the development of a “Fare Equity Analyzer GIS” (FEAGIS), a spatial database tool that meets the strategic planning needs of UTA while providing a platform for social equity research. The GIS enables us to investigate the fairness in distributions of transit fare costs across multiple geographic scales and socio-economic dimensions. To achieve this goal, we estimate a state-of-the-art spatial econometric joint model of trip-generation and distance-travelled. The model is then incorporated into a GIS so that fare strategies may be assessed for equity concerns in compliance with federal regulations across the United States.

Literature review

Research pertaining to socially sustainable transportation has evaluated the role of transportation in social exclusion, quality of life, and social equity (alternatively justice or fairness) at local and regional scales (Boschmann and Kwan, 2008; Litman and Brenman, 2011). The notion of social equity in transportation is summarized by Sanchez and Brenman (2007) as the distribution of “benefits and burdens from transportation projects equally across all income levels and communities” (p. 8). It follows that socially equitable transportation is concerned with fairness in the distribution of transport investments, internal and external costs, and benefits (Garrett and Taylor, 1999; Martens, 2009). The evaluation of costs may pertain to environmental justice (Lucas, 2004), public health externalities (Frumkin, 2002), or to fiduciary expenses such as tax burdens (Wachs, 2003; King, 2011), tolls and congestion pricing (Giuliano, 1994; Plotnick et al., 2011), and transit prices and fare structures (Cervero, 1990; Deb and Filippini, 2011; Fan and Huang, 2011).

The links between transportation and social justice have deep historic and political roots. In the United States, for instance, this history includes landmark Supreme Court decisions, bus boycotts, Freedom Riders, and the passage of federal legislation (e.g., Sanchez and Brenman, 2007; Bullard et al., 2004), including the Civil Rights Act of 1964. Title VI of that Act prohibits federally-funded transit providers such as UTA from administering programs in ways that would subject individuals to discrimination based on their race, color, or national origin. President Clinton’s 1994 Environmental Justice Executive Order similarly bars transit agencies from acting in ways that would have disproportionately high and adverse effects on low-income populations (Federal Transit Administration, 2012).

Equity can be examined from a variety of perspectives. Building on Litman (2002) theoretical structure, Bullard et al. (2004) identifies three types of equity: *horizontal equity*, which focuses on fairness between those of comparable wealth and ability, *vertical equity with regard to income and social class*, which looks at cost/benefit distributions between social and economic groups, and *vertical equity with regard to mobility need and ability*, which assesses “how well an individual’s transportation needs are met compared with other in their community” (p. 26). Taylor (2004) refines these concepts further, creating a three-by-three matrix that assesses three units of analysis (geographic, group, and individual) against three types of equity (market, opportunity, and outcome).

Various examinations of equity have been reported in the international literature, with the objective of assessing mainly vertical equity by comparing service availability to needs. In Melbourne, Australia, Currie (2010) combined information

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