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## The socio-economics of travel behavior and environmental burdens: A Detroit, Michigan regional context

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### ABSTRACT

The transportation industry—particularly light-duty vehicles—is a significant contributor of greenhouse gasses, accounting for about one-third of overall emissions in the U.S. Research to date has studied various factors that impact travel behavior of residents with varying socio-economic characteristics. However, research on the socio-economic characteristics of residents and their impact on *environmental burdens* within a single urban region, as measured by fuel consumption and vehicular emissions, is recognized as under-represented in the U.S. planning and transportation literature. This study focuses on the Detroit region, Michigan, a unique case study due to the scale of suburbanization and urban decline, yet representative of many mid-western cities. The article explores how socio-economic characteristics impact travel patterns and environmental burdens within six Detroit region neighborhoods. Data on individual travel behavior and personal vehicle characteristics gathered from a mail survey enabled an analysis into how associated environmental burdens varied with socio-economic composition. The analysis explores contributions to environmental burdens between poorer urban and wealthier suburban populations.

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### Introduction

There is no dearth of research on transportation issues, with the work ranging from micro-scale dimensions, focused on streetscape design, to broader global issues, such as travel demand and transportation related greenhouse gas emissions. Transportation is the fastest growing contributor of greenhouse gasses, accounting for approximately one-third of overall emissions in the U.S. (Fitzgerald, 2010; Meyer, 2010). About 79% of the transportation emissions are from on-road vehicles (U.S. Department of Transportation [USDOT], 2010). Within this on-road vehicle segment, light duty vehicles (which include passenger cars and light duty trucks) contribute the largest share (about 63%) of greenhouse gas emissions (USDOT, 2010).

The existing research has shown links between the built environment (including density, land use mix and connectivity) and emissions from light duty vehicles (Fitzgerald, 2010; Lankao et al., 2009; Stone, 2008; Stone et al., 2007). In general, studies have shown that higher-densities, a greater land use mix and increased street connectivity lead to lower levels of personal car use and shorter driving distances, thereby lowering emissions.

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With the emphasis on socio-ecological conditions, the study focuses on travel within six neighborhoods—organized into three neighborhood typologies—selected based on socio-demographic composition and built environment characteristics. The analysis into travel, and resulting environmental impacts, centers on neighborhoods of wealth and neighborhoods of disadvantage. This allows for an exploration into the socio-economic dimension of gasoline consumption and pollutant emissions within different neighborhood types in the Detroit area; a study into the class dimension of environmental burdens within a single urban region.

The notion of environmental burdens appeared in the Brundtland Commission's *Our Common Future* (WCED, 1987). The commission recognized that roughly one-quarter of the world's population, mostly from wealthy countries, consumed about three-quarters of the world resources and produced the majority of wastes. More recent research continues to show that it is a small subset of the global population—some 25% of the world wealthiest and largely living in cities—who are almost exclusively responsible for all environmental burdens (Crutzen, 2002; McGranahan and Satterthwaite, 2002; Rees, 1992; Vojnovic, 2014). The existing research generally emphasizes distinctions in environmental burdens between urban regions or nations, but quantitative analysis focusing on differences of environmental burdens within a single urban region is limited. Within this context, this study focuses on one human activity pattern, travel, in exploring the resulting class dimensions of environmental burdens within the Detroit region, Michigan.

There has been over two decades of research analyzing the environmental impacts of travel, but this research has generally been on coarse spatial scales, focused mainly on inter-urban comparisons (Dahl and Sterner, 1991; Newman and Kenworthy, 1989; Su, 2011; Karathodorou et al., 2010). There has also been extensive research exploring the relationship between the urban built environment and travel—including at fine spatial scales—with the studies controlling socio-economic and built environment characteristics (Brownstone and Golob, 2009; Cao et al., 2010; Ewing, 1997; Ewing and Handy, 2009; Frank and Pivo, 1995; Frank et al., 2008; Shay and Khattak, 2012; Owens, 1993; Southworth, 1997). These studies, however, have not explored the class dimensions of intra-urban environmental burden variations associated with travel. With the focus explicitly on the socio-economic and travel behavior relationship, and exploring how differences in travel result in different environmental impacts by population subgroups within an urban region, this study takes a different approach to the traditional built environment and travel research. With the explicit purpose of controlling for the built environment, instead of including built environment characteristics as control variables in the regression, a unique built environment-controlling data collection and analysis strategy is employed in the study. To control for the built environment, data is collected and analyzed at the neighborhood scale, within three neighborhood typologies. In addition, in order to capture the unique condition of travel in underclass neighborhoods, one neighborhood typology explored includes communities experiencing extreme disinvestment and decline.

Three neighborhood typologies, structured around six neighborhoods in the Detroit region, are selected for the intra-neighborhood analyses: high-density urban (HDU), high-density suburban (HDS) and low-density suburban (LDS). Again, this is a unique approach to the exploration of the socio-economics of travel and allows for the rare analysis into environmental burdens within a single urban region, including in communities experiencing severe disinvestment.

## Review of literature

### *The urban built environment and travel patterns*

Research has consistently shown that access to destinations has an important impact on travel behavior, with accessibility having a positive association with non-motorized travel and a negative association with travel distances. For instance, Liu and Shen (2011) find that amongst various urban form characteristics, accessibility is the only characteristic that has a significant negative impact on annual household vehicle miles traveled (VMT). Accessibility itself is shaped by three built environment characteristics—density (residential and employment), land use mix, and street connectivity.

Research on density, taken alone or combined with other built environment characteristics, has been shown to impact travel behavior (Cao and Fan, 2012; Cervero and Murakami, 2010; Ewing and Cervero, 2010; Holtzclaw et al., 2002; Kahn, 2006; Su, 2010). Research has shown that commute times and distances have increased in the late 20th century as a result of low density urban decentralization (McGuckin and Srinivasan, 2003; Reschovsky, 2004; Rossetti and Eversole, 1993). The increase in VMT is shown to be related to increasing land consumption, energy consumption, and local and global pollutant emissions (Cervero and Murakami, 2010). Research has also shown that compact development promoting higher-densities could reduce vehicle miles traveled in the next four decades by about 17% (Bartholomew and Ewing, 2008).

Bento et al. (2005) found that urban sprawl measures and public transit supply individually have marginal effects on changing travel demand, however, taken together, these measures have a considerable impact on travel. In essence, they caution against policy measures that only focus on one variable (like density) to influence VMT. In addition, the presence of a balanced mix of varied land uses within small areas, by reducing distance, creates possible destinations for people to access by walking and non-motorized travel in general (Boarnet, 2011; Ewing, 1997; Ewing and Handy, 2009; Frank and Pivo, 1995; Kemperman and Timmermans, 2014; Southworth, 1997). In the current U.S. urban context, the importance of having daily destinations close to residential areas—ensuring walkable access to stores, restaurants and leisure destinations—is deemed critical in encouraging alternative travel modes to the automobile.

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