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Neighborhood design and vehicle type choice: Evidence from Northern California

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Abstract

Previous studies have found that suburban development is associated with the unbalanced choice of light duty trucks. The specific aspects of the built environment that influence vehicle choice, however, have not been well-established. Further, these studies have not shed much light on the underlying direction of causality: whether neighborhood designs themselves, as opposed to preferences for neighborhood characteristics or attitudes towards travel, more strongly influence individuals' decisions regarding vehicle type. Using a sample from Northern California, this study investigated the relationship between neighborhood design and vehicle type choice, controlling for residential self-selection. Correlation analyses showed that neighborhood design has a strong association with vehicle type choice. Specifically, traditional neighborhood designs are correlated with the choice of passenger cars, while suburban designs are associated with the choice of light duty trucks. The nested logit model suggests that sociodemographic and attitudinal factors play an important role, and that an outdoor spaciousness measure (based on perceptions of yard sizes and off-street parking availability) and commute distance also impact vehicle type choice after controlling for those other influences. This study, therefore, supports the premise that land use policies have at least some potential to reduce the choice of light duty trucks, thereby reducing emissions.

Keywords: Air quality; Land use; Nested logit model; Smart growth

1. Introduction

Air pollution, greenhouse gas emissions, and oil dependence are major concerns in the US. One factor is the increasing share of light-duty trucks (LDTs) in the passenger vehicle fleet, including minivans and pickup trucks as well as sport utility vehicles (SUVs), which contributes to these problems due to the differential fuel efficiency and emissions standards between passenger cars and LDTs. According to the 2004 Fuel Economy

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Guide (www.fueleconomy.gov), for example, on average a 2 wheel drive Ford F150 (a pickup truck) consumes 35% more gasoline per mile than a Ford Taurus (a passenger car), and produces 30% more greenhouse gases and 200% more air pollutants. Another factor is suburban development, widely criticized for its contribution to longer average trip lengths and excessive dependence on private vehicles at the expense of public transit and nonmotorized modes. Accordingly, a "smart growth" approach to planning has been proposed as a counter to urban sprawl. Previous studies have concluded that compact development and integration of land uses can lower auto ownership, reduce trip lengths, and increase the uses of alternative modes (e.g., Cervero and Radisch, 1996; Chu, 2002; Frank et al., 2000). The Environmental Protection Agency (EPA) now recognizes land-use policies as an effective tool for improving air quality and allows state and local communities to account for the air quality benefits of smart growth strategies in State Implementation Plans (SIPs) as a part of the Voluntary Mobile Source Emission Reduction Program (Environmental Protection Agency, 2001).

A few recent studies have found that suburban development is associated with the unbalanced choice of LDTs. For example, an analysis of the 1995 Nationwide Personal Transportation Survey (NPTS) showed that suburban residents own a disproportionate share of LDTs (Niemeier et al., 1999). After examining data from the San Francisco Bay Area, Bhat and Sen (2006) found that households living in denser areas are less inclined to drive SUVs and pickup trucks. However, these studies seldom reveal which specific characteristics of the built environment matter to vehicle type choice. Further, they have not shed much light on the underlying direction of causality: in particular, whether neighborhood designs themselves, as opposed to preferences for neighborhood characteristics or attitudes towards travel, more strongly influence individuals' decisions regarding vehicle type. The available evidence thus leaves unanswered questions: if policies encourage more compact development, will more people choose to drive passenger cars over LDTs, with a corresponding benefit to air quality?

The purpose of this study is to investigate the role of neighborhood design in vehicle type choice using a sample from Northern California. This paper addresses the following questions: What aspects of neighborhood design influence vehicle type choice? Controlling for sociodemographic traits, what is the role of residential preferences and travel attitudes in vehicle type choice? Answering these questions helps us answer the ultimate question of interest: Can land use policies contribute to air quality improvement by influencing vehicle type choice? The next section reviews the literature relevant to vehicle type choice. Section 3 describes the data and variables used in this study. Section 4 presents analysis of variance (ANOVA) results relating vehicle type choice to neighborhood design, attitudes, and sociodemographics. A nested logit model of vehicle type choice is discussed in Section 5. The final section recapitulates the key findings and discusses some policy implications of the results.

2. Literature review

A number of studies have investigated households' or individuals' vehicle type choices (e.g., Beggs and Cardell, 1980; Berkovec and Rust, 1985). Their main interests focused on vehicle attributes (such as purchasing and operating costs, horsepower, and scrappage) and household characteristics (such as household structure and income), to identify the factors that impact consumers' vehicle-purchasing or holding behavior. These studies highlighted that households' sociodemographics are primary determinants of their vehicle type choices. Further, it was found that vehicle type choice strongly depends on drivers' travel attitudes, personality, and lifestyle (Choo and Mokhtarian, 2004). Whether neighborhood design provides an incremental contribution to vehicle choice has, however, seldom been explored.

A few recent studies have pointed to this question. A correlational analysis found that the percentage of households with LDTs decreases as residential density increases in the 2001 National Household Transportation Survey (NHTS) data (Golob and Brownstone, 2005). However, this relationship may be confounded by sociodemographics. More affluent households, for example, may choose to live in large-lot houses in suburban neighborhoods and drive SUVs at the same time. Using the 1995 NPTS data, Kockelman and Zhao (2000) found that LDTs were more often driven by households living in lower density areas, after accounting for the influences of sociodemographics. On the surface, these findings seem to suggest that neighborhood design influences vehicle type choice, with traditional neighborhood residents favoring passenger cars and suburban residents favoring LDTs. Therefore, suburban development might be further blamed for its contribution to the disproportionate growth of low-efficiency and high-emission LDTs.