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Urban Spatial Structure and Household Travel Time

Yes, traffic congestion is a problem in the Washington region. We all are spending too much time sitting in traffic getting to work and running errands, and not enough time with our families. The problem is not too few roads, but too much suburban sprawl and a lack of choice in transportation options in communities where we might want to live.

The Sierra Club¹

Chapter 1

Introduction

Statement of the Problem

In the past few years suburban “sprawl” development has emerged as a prominent issue on the American political scene. In recent elections many states’ ballots bore sprawl related referenda (Matuszeski, 1998). The Vice President (Haveman, 1998), several governors, congressmen (Goodman and Eggen, 1998; The Reinvention Report, 1999) state and federal agencies (2020 Panel Report, 1988), developers, banks (Bank of America, 1995; Hayward, 1996), environmental groups, and popular and academic press (Lincoln Institute for Land Policy, 1995; Moe, 1997; The American Enterprise, 1996; Pedersen, et al., 1999; Lacayo, 1999) have all joined the discussion of the alleged harms of sprawl. Although a unifying definition is notably missing from the debate about sprawl, consumption of land by the separation of the many destinations people wish to access is perhaps the most universal identifying characteristic of sprawl. In sprawling development homes, businesses, public facilities, commercial and cultural activities are all separated from one another. Sprawl is a suburban phenomenon. It is development outside of the city proper made up of low density settlements and the facilities needed to support those settlements and their residents (Sierra Club, 1999; Maurer, 1996; Moe, 1997; Bank of America, 1995; Ewing, 1997; Gordon and Richardson, 1997). As a consequence, many of the most prevalent and pervasive harms of

sprawl are thought to be related to the burden of added time needed to travel between these separated destinations. Additional transportation due to sprawl is said to disrupt family life, consume excessive resources and lead to greater air and water pollution (Bank of America, 1995; Cervero, 1986; Downs, 1992; Sierra Club, 1999). The added time required to travel in sprawling areas is thought to be a principal cause of these harms. In addition, if travel time is shown to be substantially larger in sprawling areas, it may provide a strong incentive for changing from a low density, disperse settlement form to a higher density form with more concentrated economic activity.

The goal of this research is to determine whether sprawl has caused increases in household travel time and whether any such increases are economically significant. If economically significant increases in household travel time do not result from sprawl then this new urban form may not be as harmful to the public good as purported by its opponents. There can be no doubt that the sprawling, low density, suburban settlements bring auto dependency. This auto dependency caused by the dispersal of housing, businesses and other activities is often said to increase travel times (Cervero, 1986; Downs, 1992). Auto travel, however, is faster than other modes. The dispersal of activity may reduce congestion found in areas of dense residential and economic activity. The dispersal of housing and economic activity also may reduce the distances between housing and that activity for many people. In a city with both a single concentration of economic activity and a large population residing in low density housing people will, by necessity, be removed from the activity found at the center. The dispersal of commercial, social and cultural activity from traditional city centers calls for an examination of the whether the separation found in suburban areas has in fact increased travel time for suburban residents. In addition to bringing into question the alleged travel costs of sprawl related to transportation, if suburban households do not bear additional travel burdens, a major incentive for those households to choose to live in alternative, denser settlement forms advocated by transportation experts and urban planners will be lost.

This research will test hypotheses about the relationship of household travel time and access to concentrations of economic activity. If travel time is unrelated to access to economic centers, the burden of increased travel time cited by those opposing sprawl is

¹ Besa and Oakes (1998).

perceived rather than real, and one must question arguments concerning transportation as a basis to the opposition to sprawling development.

The Creation of Sprawling Urban Forms

Households and businesses have both participated in and contributed to the dispersal of economic activity. They, however, have not acted alone. Public entities at all levels also have contributed to the dispersal of employment, goods and services traditionally found in city centers to the suburbs with the public facilities, services and infrastructure necessary to support sprawl development. Schools, parks, public buildings, such as municipal centers and post offices, are scattered throughout suburban areas. Most suburban development is supported with publicly funded fire protection, roads, sewers and water (Burchell and Listokin, 1995).

None of the entities involved in this settlement process - governments, businesses or residents - acts independently. Instead each influences the others. People moving to low density, suburban areas have created an incentive for business development to follow. Business and commercial development has brought the goods and services people desire to these areas allowing more people to move out from areas of concentrated economic activity. Likewise, people's desires to live in areas removed from density have influenced governmental entities to develop the facilities necessary to support these low density settlements and their residents.

Travel Costs , Travel Time

The interrelated, and apparently independent, choices of governmental entities, residents and businesses have led to low density settlement. Transportation costs are a measure of the influence of the dispersal of these suburbs on the welfare of their residents. In fact, the relationship between transportation costs and access to economic centers forms the foundation of central place theory in urban economics. Increasing transportation costs in areas removed from concentrations of economic activity determine rent (or price) gradients, which predict that house prices will decline as travel time to the city center rises. Declining population density gradients, which predict that population densities will decrease as the

cost of travel to economic centers rises, also follow from the assumption concerning increasing transportation costs.

Travel time and travel costs are not synonymous. The cost of travel – which includes both the opportunity cost of time and out-of-pocket expenditures– is, however, closely correlated with travel time. This correlation, among other factors, justifies the use of travel time as a proxy for travel cost in this study. Out of pocket expenditures are a function of transportation mode. Opportunity cost of time is a function of income. Including variables to control for these influences, such as the number of vehicles owned by a household, household usage of public transportation and household income, allows the comparison of travel times in this study. Household travel time is also influenced by a variety of other factors, such as the number of working adults, number of nonworking adults and number of children. These factors are also controlled for to determine the affect of access to economic centers on household travel time.²

Auto Use, Travel Time and Joined Trips

Despite differences in travel costs with mode choice the use of travel time as the measure for this study also is justified since auto use is often adopted by preference rather than in an attempt to minimize costs. Auto use provides greater flexibility, convenience and privacy than any other mode. These features of auto use are likely to lead to a preference for the car over other modes.

The flexibility of auto use influences household travel times as people can more effectively join trips with a car. When joining a trip a person accesses more than one destination on a single trip. In areas of disperse facilities with less congestion than dense areas close to concentrations of economic activity joining trips may lead to substantial savings in travel time. This study will also examine whether the use of joined trips by households increases with travel time to concentrations of economic activity. The use of more joined trips by households with less access to economic centers would suggest that households that choose locations with less access to economic centers are able to join trips

² Studies that rely on travel time as a proxy for travel cost in the central place theory literature include Hamilton, 1982; Hamilton, 1989; Dubin, 1991; Small and Song, 1992 and; Giuliano and Small, 1991.

to reduce household travel time. The use of joined trips may explain, in part, a lack of a relationship between household travel time and travel time to economic centers.

Household Travel Times and the Rent Gradient

Rent gradients are the estimated relationship between housing prices and travel time to economic centers. Housing prices are expected to decrease as travel times to centers increase. The justification for rent gradients is the supposed increases in household travel times that occur with increases in travel times to economic centers. To examine the soundness of the assumed relationship between household travel times and housing prices, a rent gradient will be estimated for the portion of the study area for which housing price data is available. The results of this estimation will then be compared with the results of the estimated changes in household travel times with travel times to economic centers. This analysis should provide a basis for understanding whether the rent gradient can be justified by the variation in household travel times. The influence of demographic factors and the transportation infrastructure on the relationship between the rent gradient and household travel times will also be examined.

Conclusion

Expansive, low density, auto dependent suburban development in this country has received criticism from a variety of sources. Among the major criticisms of these sprawling developments is that their disperse form forces residents to spend too much time in travel. The assumption underlying this notion is that the goods and services that suburban residents desire are located in the central business district or other economic centers distant from their homes. In recent years, however, businesses and governmental entities have located facilities of all types in the suburbs so that many of the goods, services and activities that suburban residents desire are closer than economic centers. This research will examine whether total household travel time to all destinations increases with travel time to identifiable economic centers (including the central business district). If it is found that total travel times are not related to the access to centers, part of the criticism of the suburban development form is misguided. In this event we should question efforts to curtail suburban development to the extent they are directed at reducing travel burdens of suburban residents.

A second effect is that travel time savings will not be an incentive for residents (and potential residents) of suburban developments to choose housing in other developments.

Objectives

1. To determine the relationship between urban spatial form and household travel time, controlling for other influences on household travel time.
2. To determine whether the use of joined trips reduces household travel time
3. To determine the relationship between household travel time and the price of housing.
4. To synthesize the findings of objectives 1, 2 and 3 above, to determine whether low density suburban development, commonly known as sprawl, has contributed to a rise in household travel time.

Methods

The remainder of this work proceeds as follows. In chapter 2 a conceptual framework is developed for this research using the urban economic theory of central place. The chapter provides an understanding of how this research relates to previous empirical and theoretical research and the void that this study attempts to fill. Chapter 3 is a brief description of pertinent characteristics of the study area, the Washington, D.C. metropolitan area. Economic centers in the study area are identified in that chapter and the reader will be familiarized with the region to help understand the location of economic centers and other possible influences on household travel time. Chapter 4 introduces the data and their sources that are used to test the relationship between household travel time and access to economic centers. In chapter 5 a theoretical model is developed that using the traditional central place theory. The model is formulated to show the relationship between household travel time and access to economic centers that forms the foundation of the traditional theory. In chapter 6 an empirical model is developed from the theoretical model of Chapter 5. This is the model used to test whether household travel time rises with access to economic centers. Chapter 7 presents the results of the estimation of household travel time and access to economic centers. Graphical presentations of the results are examined to clarify the extent of the relationship. In chapter 8 the relationship between access to economic centers and joined trips is tested to determine whether joined trips influence the

relationship between household travel time and access to those centers. Chapter 9 is an estimation of the rent gradient in the portion of the study area for which housing price data was available. The rent gradient is compared to the household travel time estimation to determine whether household travel times explain the rent gradient as assumed by central place theory. Chapter 10 is a discussion of the implications of the findings in the previous chapters. The findings of the different empirical analyses are synthesized, reconciled and explained using economic theory and the demographic and transportation information set out in chapter 3. Chapter 11 summarizes the most critical findings and their implications for urban spatial form. Areas for further research are also suggested.