Relationships Between Land Use, Transportation, Household Expenditures, and Municipal Spending in Small Urban Areas: Executive Summary

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SURTC RESEARCH SUMMARY

Abstract

This study developed a number of models to estimate the relationships between land use, transit ridership, household expenditures, and municipal spending, with a focus on small urban areas. Transit ridership was found to increase with increases in density, while household transportation spending is greater in low-density areas. Among households living in single-family detached structures, those in older neighborhoods were found to spend less on transportation. Per capita municipal expenditures for a number of cost categories were also found to be higher for lower-density cities.

Introduction

Important relationships exist between land use, transportation, and household and municipal expenditures. Low-density, auto-oriented developments tend to promote auto dependency, as it is more difficult to make trips in these developments by walking, biking, or transit. Low-density, single-use developments result in longer distances between destinations, which leads to increased automobile use, increased vehicle miles traveled (VMT), and a reduction in trips made by alternative modes. While this has environmental implications – increased per capita VMT, pollutants, and greenhouse gas emissions – it also has economic implications. Households in low density, single-use, auto-oriented developments located far from city centers will likely need to spend more on transportation. They drive longer distances, take more trips by automobile, and do not have other reliable options. Therefore, they may own more vehicles than someone in a transit- or pedestrian-oriented neighborhood, and they may incur significantly greater transportation costs. The issue extends beyond households to municipalities as a whole. Lower-density, auto-oriented developments require more infrastructure per capita than do more compact developments. This can result in an increase in per capita infrastructure and maintenance costs for cities. The per capita costs of providing some services, such as fire and police protection, street maintenance, solid waste collection, and sewer and water, could also increase when the population is more spread out.

In this study, a number of models were developed to estimate the relationships between land use, transportation behavior, and household and municipal expenditures, with a focus on small urban areas, or cities with a population less than 200,000. The results are useful to planners in smaller communities evaluating the costs and benefits of different land use strategies or livability principles.

Density and Land Use Characteristics

Density is a commonly studied measure of land use. It can include the density of population, housing, employment, or some other activity. While density itself can have an impact on travel behavior, density is usually related to other land use characteristics, and the combined impact is much greater. Areas with greater density tend to have more land use mix, better accessibility, better transit services, shorter blocks, and better options for walking or biking.

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Dense areas will have more transit riders because there are more people and activities within walking distance of a transit stop. Furthermore, differences in density could imply other important differences. It may be more difficult to own and park automobiles in dense areas, and people in dense areas have less need to drive and may be less likely to own an automobile, because they can walk or bike to more places.

Land Use and Transit Ridership

This study developed two models of transit use in small urban areas that include land use, specifically density, as an explanatory variable. The first model used data from the National Transit Database (NTD) for a cross section of small urban areas. It estimated ridership as a function of service characteristics, service area demographics, economic conditions, land use, and characteristics of competing modes of transportation. The second model examined data from the American Community Survey (ACS) on the use of transit for commuting to work.

The results of both models showed a positive association between density and transit ridership. The first model estimated an elasticity of total transit ridership with respect to density of 0.09, which means that a 10% increase in density is associated with a 0.9% increase in ridership. Other factors, such as the level of transit service provided, fare levels, the unemployment rate, and rider demographics, were also shown to be important predictors of ridership.

The second model analyzed commute-to-work data at the Census block group level and again found positive correlations between density and use of transit. For example, block groups with no transit commuters had an average population density of 4,231 people per square mile, while block groups with at least one transit commuter had an average density of 7,897 people per square mile. Among Census block groups with at least one transit commuter, a 10% increase in density was found to be associated with a 1.5% increase in use of transit for commuting.

Both models also showed that the number of households without access to a vehicle is one of the most important determinants of transit use. College population was also found to have a positive impact on transit use.

Land Use and Household Transportation Expenditures

To demonstrate the impact that land use and neighborhood characteristics have on household transportation costs, the Center for Neighborhood Technology (CNT) developed the Housing and Transportation (H+T) Affordability Index, which estimates the cost of both housing and transportation at the neighborhood level. Data from the H+T Affordability Index were analyzed to show the relationship between land use and household expenditures in small urban areas of the Upper Great Plains and Midwest. Table 1 shows correlations between two measures of land use – resident density and gross household density – and estimates for transportation use and costs and greenhouse gas (GHG) emissions for 57 small or medium-sized cities (population 40,000 to 250,000) in the Midwest and Upper Great Plains, using H+T Index data.

Residential density and gross household density are shown to be negatively correlated with number of automobiles per household, annual vehicle miles traveled (VMT) per household, GHG emissions per household, and annual transportation cost for a typical household. Housing and transportation costs combined, as a percentage of income, is also negatively correlated with residential density. In

Table 1. Correlations between Density and Transportation Use and Cost for Small and Medium-Sized Midwest Cities, based on H+T Index Data

	Residential density	Gross household density
Autos per Household for the Regional Typical Household	-0.58	-0.39
Annual Vehicle Miles Traveled per Household for the Regional Typical Household	-0.75	-0.67
Annual GHG per Household	-0.72	-0.64
Annual Transportation Cost for the Regional Typical Household	-0.56	-0.37
Housing + Transportation Costs % Income for the Regional Typical Household	-0.35	-0.15

summary, household automobile ownership, VMT, GHG emissions, and total transportation costs are lower in higher-density cities, and even if higher-density cities have higher housing costs, it is more than offset by the lower transportation costs.

The H+T Index data provide estimates of transportation costs based on estimated transportation use determined through regression modeling. Household transportation costs can be more directly estimated based on survey data from the Consumer Expenditure (CE) Surveys conducted by the U.S. Department of Labor's Bureau of Labor Statistics (BLS). The CE interview survey collects data on total household transportation expenditures.

Unfortunately, the CE data do not include any neighborhood or community land use information, and responses cannot be mapped to specific communities. However, the data can still provide some insight on how development types affect household expenditures on transportation. The survey collects information about the type of building in which the respondent resides, such as single-family home, duplex, garden apartment, high-rise apartment, etc. CE survey data were analyzed to estimate the relationship between housing type and household transportation expenditures.

Results showed that those living in single-family detached structures spend the most on transportation, and those in high rises spend the least, suggesting, again, a negative relationship between density and transportation spending. Those in single-family homes were found to spend 37% more on transportation than those living in high rises, after controlling for other factors. Other important predictors of transportation spending include income, family size, and age.

The data also showed that among those living in single-family homes, those living in older homes spend less on transportation, after controlling for other factors. Compared to those living in homes built after 1999, those in homes built before 1945 spend 22% less on transportation, those in homes built from 1945 to 1969 spend 17% less, and those in homes built from 1970 to 1999 spend 10% less. Older single-family homes tend to be in neighborhoods that are denser, closer to the city center, and more accessible by walking, biking, and transit, whereas newer neighborhoods, following suburban development patterns, tend to be more auto-dependent. The study showed that those living in the more urban, traditional neighborhoods spend less on transportation, and transportation costs have continued to increase over time for newly built houses, after controlling for income and other factors.

Land Use and Municipal Expenditures

A model was also developed to estimate the impacts of density and other factors on per capita municipal spending. The model was used to estimate spending for eight categories of expenditures that could be influenced by land use development. These included fire protection, streets and highways, libraries, parks and recreation, police, sewer, solid waste management, and water. Municipal expenditures can be influenced by both demand and cost factors. If there is a greater demand for services, expenditures may increase. Likewise, if costs to provide the service increase, expenditures would also likely increase. Land use can be considered a cost factor, because as densities decrease, it may become more costly for cities to provide services, as measured per capita. Municipal expenditure data from the U.S. Census Bureau's Annual Survey of State and Local Government Finances were analyzed to study the relationship between density and per capita expenditures.

Results showed that density has a significant effect for many spending categories. Density was shown to be negatively associated with per capita operational costs for fire protection, streets and highways, parks and recreation, sewer, solid waste management, and water. Density, on the other hand, was found to be positively related to police operational costs. A possible explanation for this positive effect is that denser areas may have higher crime rates due to increased interaction between people. With regard to construction costs, density was negatively related to cost for streets and highways, parks and recreation, sewer, and water. Density was also found be negatively related to land and existing facilities costs for police, sewer, and water. Overall, per capita costs were found to decrease for many spending categories as density increased. Estimated elasticities are shown in Table 2. These can be interpreted as the percentage change in costs following a 1% increase in density.

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Table 2. Estimated Elasticities of Per Capita Municipal Spending With Respect to Density

Cost Category	Operations	Construction	Land and Existing Facilities
Fire	-0.132		
Streets/highways	-0.266	-0.316	
Libraries			
Parks and recreation	-0.209	-0.259	
Police	0.090		-0.243
Sewer	-0.314	-0.544	
Solid Waste	-0.203		-0.557
Water	-0.141	-0.391	-0.542

Conclusions

In summary, results provide evidence that more densely populated areas result in increased transit ridership and reductions in household transportation spending and per capita municipal expenditures. Much of the analysis is based on population density because of data availability. This study focused on large-scale, city-level analyses of cities across the country, where data for other land use variables are lacking. These other variables, such as land use mix and accessibility, are also likely important. Density tends to be correlated with other land use characteristics, however. Areas with greater density tend to have more land use mix, better accessibility, better transit services, shorter blocks, and better options for walking or biking. Results from this study, therefore, are likely capturing the effects of not just density but also other characteristics that tend to be related.

Following from that, it is important to note that density alone cannot be assumed to result in increased transit ridership, reduced driving, and reduced expenditures for households and cities. Apartment complexes in suburban-style, auto-oriented developments may provide greater density, but if they are located in single-use neighborhoods with poor accessibility, the expected benefits will not be realized. Further, households in single family homes in older, traditional urban neighborhoods with grid street networks, proximity to downtown, and greater accessibility by walking, biking, or transit may be less likely to drive and more likely to use transit, and, as results suggest from this study, their transportation costs will be lower.

Projects such as infill development, downtown revitalization, mixed-use development, pedestrian improvements, multi-modal planning, and complete streets will increase density as well as create other land use changes that encourage walking and transit. Reduced dependency on the automobile will provide cost savings to households, and a more compact development pattern also yields per capita cost savings to cities.