Multilevel Approaches to Explore the Effect of Land Use on NHTS Commuting Outcomes

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Outline

Introduction

Review of the Literature

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Sprawl's Commuting-Related Impacts

Negative	Positive
More vehicle miles traveled	Shorter commuting times
More automobile trips	Automobile most efficient mode of transportation
Longer travel times	Less congestion

Source: Burchell et al. 1998

Review of the Literature

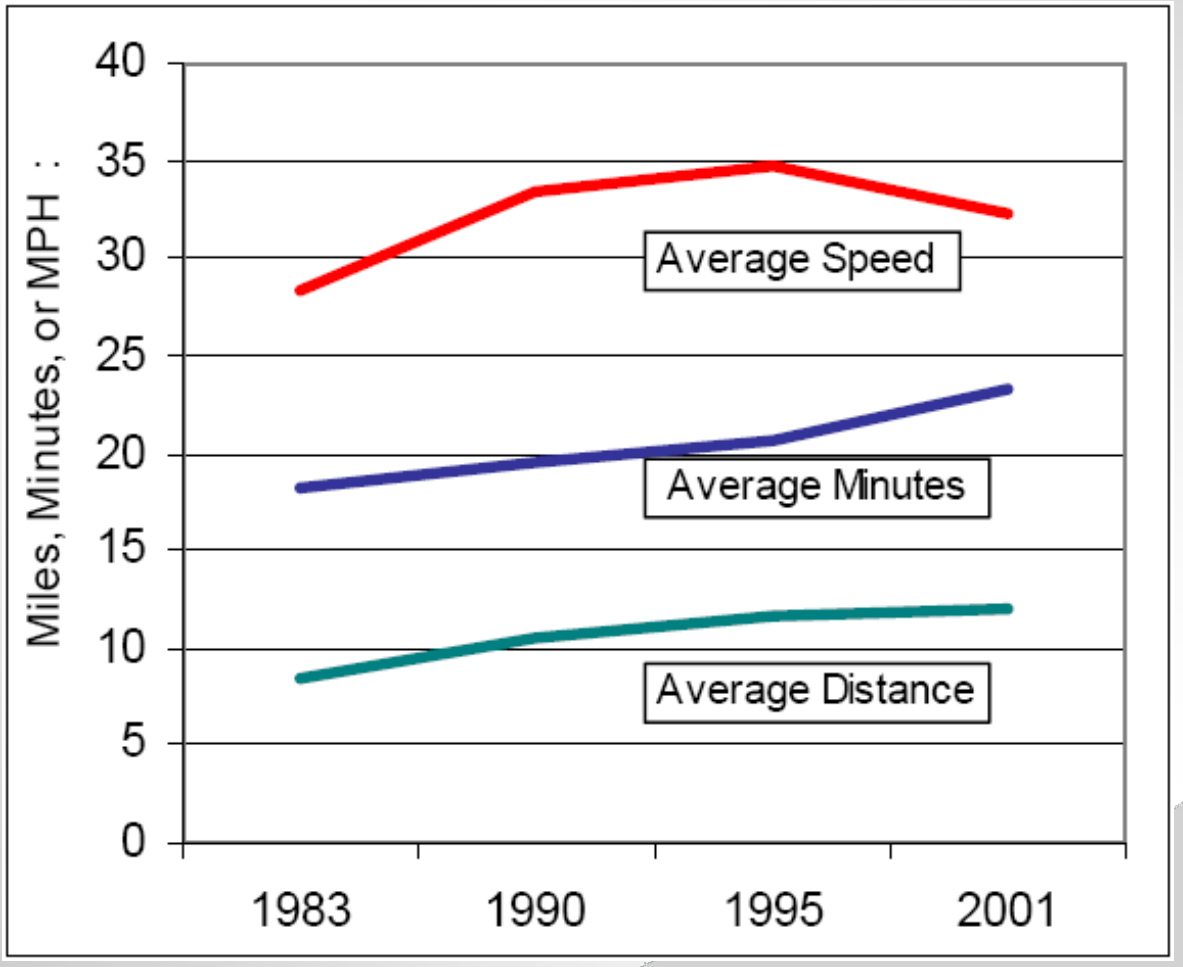
Commute times are stable…

Gordon et al. 1991
Pisarski, 1992
Gordon and Richardson, 1994
Levinson and Kumar, 1994

Commute times have increased…

Rosetti and Eversole, 1993
McGuckin and Srinivasan, 2003
Glaeser and Kohlhase, 2004
Reschovsky, 2004
Levinson and Wu, 2005

Changes in Daily Commutes, 1983-2001



Source: United States Department of Transportation, 2006

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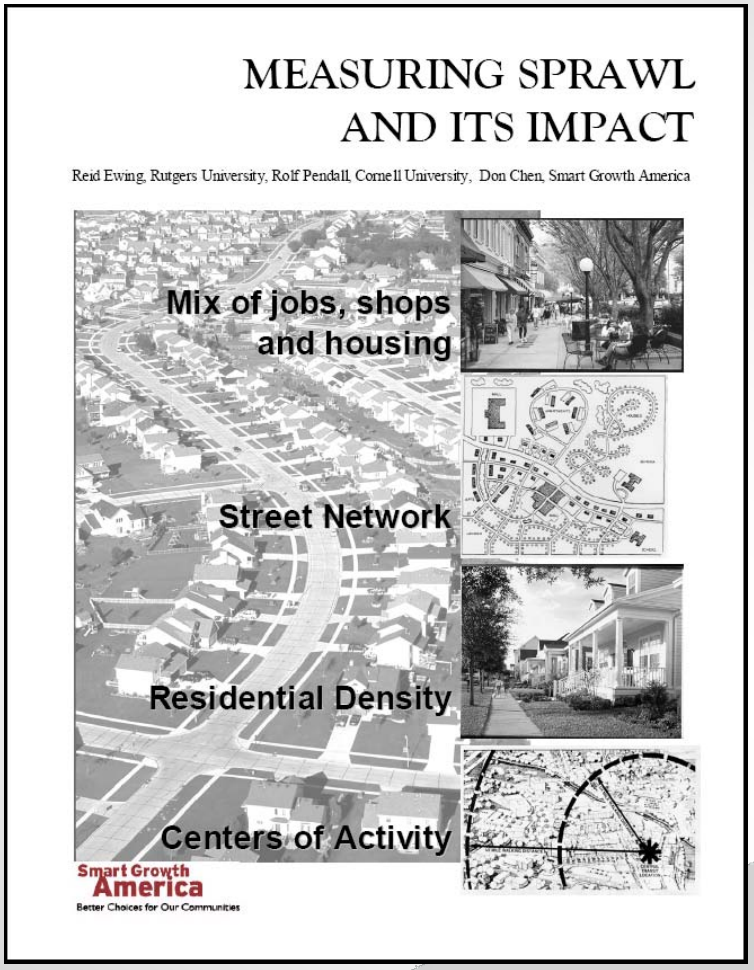
Research Questions

Do measures of sprawl decrease the duration of private-vehicle commutes in the United States urban system?

Do measures of sprawl increase the length of private-vehicle commutes in the United States urban system?

Measuring Sprawl and Its Impact



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Sprawl

Residential Density

Land Use Mix

Degree of Centering

Street Accessibility

Source: Ewing et al. 2003

Residential Density

The following variables were components of residential density:

- gross population density in persons per square mile;
- percentage of population living at densities less than 1,500 persons per square mile, a low suburban density;
- percentage of population living at densities greater than 12,500 persons per square mile, an urban density that begins to be transit supportive;
- estimated density at the center of the metropolitan area derived from a negative exponential density function;
- gross population density of urban lands;
- weighted average lot size in square feet for single-family dwellings; and
- weighted density of all population centers within a metropolitan area.

Source: Ewing et al. 2003

Land Use Mix

The following variables were components of land use mix:

- percentage of residents with businesses or institutions within one-half block of their homes;
- percentage of residents with satisfactory neighborhood shopping within one mile;
- percentage of residents with a public elementary school within one mile;
- job-resident balance;
- population-serving job-resident balance; and
- population-serving job mix (entropy).

Source: Ewing et al. 2003

Degree of Centering

The following variables were components of degree of centering:

- coefficient of variation of population density across census tracts (standard deviation divided by mean density);
- density gradient (rate of decline of density with distance from the center of the metropolitan area);
- percentage of metropolitan employment less than three miles from the CBD;
- percentage of metropolitan employment more than ten miles from the CBD;
- percentage of metropolitan population relating to centers of subcenters within the same MSA or PMSA; and
- ratio of weighted density of population centers within the same MSA or PMSA to the highest density center to which a metropolitan area relates.

Source: Ewing et al. 2003

Street Accessibility

The following variables were components of street accessibility:

- approximate average block length in the urbanized portion of the metropolitan area;
- average block size in square miles; and
- percentage of small block.

Source: Ewing et al. 2003

Multilevel Model

Metropolitan Statistical Area

$$\pi_{0m} = \beta_{00} + \beta_{01}X_{1m} + \beta_{02}X_{2m} + \ldots + \beta_{0q}X_{qm} + r_{0m}$$

Household

$$Y_{hm} = \pi_{0m} + \pi_{1m}a_{1hm} + \pi_{2m}a_{2hm} + \ldots + \pi_{Pm}a_{Phm} + e_{hm}$$

Data

Household (n = 2,943)
Commute Distance
Commute Time
Age
Ethnicity
Income
Life Cycle
Occupation
Sex
Workers to Vehicles
Vehicle Age
Fuel Price
Fuel Efficiency
Vehicle Type

Metropolitan Statistical Area (n = 44)
Congestion
Region
Sprawl
Subway

Household-Level

Y-intercept and regression coefficient estimates for households (n = 2,943).

Level	Variable	Category	Distance (Miles)	Time (Minutes)
Household				
	Age			
		35 to 44	Referent	Referent
		55 to 64	−1.14** (0.54)	
	Income			
		$25,000 to $49,999	Referent	Referent
		$50,000 to $74,999	+1.10*** (0.60)	
		$75,000 to $99,999	+1.86* (0.66)	+2.71* (0.87)
		Greater than or Equal to $100,000	+2.16** (0.87)	+3.04** (1.38)
	Occupation			
		Sales/Service	−1.27** (0.55)	−2.63* (0.79)
		Professional/Managerial/Technical	Referent	Referent
	Sex			
		Male	+3.04* (0.39)	+3.66* (0.56)
		Female	Referent	Referent
	Workers to Vehicles		−3.60* (0.60)	−3.62* (0.67)
	Vehicle Age (Years)		−0.13* (0.04)	−0.19* (0.06)
	Fuel Efficiency (Miles per Gallon)		+0.29* (0.06)	+0.31* (0.08)
	Vehicle Type			
		Car	Referent	Referent
		Van	+2.15** (0.89)	
		SUV	+1.46** (0.59)	

*, **, and *** indicate significance at 99%, 95%, and 90% confidence levels, respectively. Standard errors appear in parentheses.

Metropolitan Statistical Area-Level

Regression coefficient estimates for MSAs.

Level	Variable	Category	Distance (Miles)	Time (Minutes)
MSA				
	Y-Intercept		+10.69* (0.96)	+19.49* (1.48)
	Sprawl			
		Residential Density	+0.04* (0.01)	
		Degree of Centering	−0.03* (0.01)	−0.03** (0.01)
		Street Accessibility	−0.03** (0.01)	
	Subway			
		Yes		+3.71* (0.68)
		No	Referent	Referent

* and ** indicate significance at 99% and 95%, confidence levels, respectively. Standard errors appear in parentheses.

Conclusions

Contrary to Ewing et al. (2003) the effect of residential density on commute times was positive and significant.

The effect of centering is negative and significant.

Congestion did not have a significant effect on commute times or distances.

Policy Implications

- Several measures of sprawl have a statistically significant effect on commuting outcomes, but the magnitudes of their effects are small.

- Mitigating congestion at the regional scale will not affect commuting outcomes.

Acknowledgment

Thanks to Arjun Sheoran for help in gathering data for this study.