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Does compact development increase or reduce traffic congestion?

Reid Ewing, Guang Tian*, Torrey Lyons

College of Architecture + Planning, 220 AAC, University of Utah, Salt Lake City, UT 84112, United States

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ABSTRACT

From years of research, we know that compact development that is dense, diverse, well-designed, etc. produces fewer vehicle miles traveled (VMT) than sprawling development. But compact development also concentrates origins and destinations. No one has yet determined, using credible urban form metrics and credible congestion data, the net effect of these countervailing forces on area-wide congestion. Using compactness/sprawl metrics developed for the National Institutes of Health, and congestion data from the Texas Transportation Institute's (TTI's) Urban Mobility Scorecard Annual Report database, this study seeks to determine which opposing point of view of sprawl and congestion is correct. It does so by (1) measuring compactness, congestion, and control variables using the best national data available for U.S. urbanized areas and (2) relating these variables to one another using multivariate methods to determine whether compactness is positively or negatively related to congestion. Our model (and earlier studies by the same authors) suggests that an increase in compactness reduces the amount of driving people do, but also concentrates the driving in smaller areas. The former effect is slightly larger than the latter. The relationship between compactness and congestion falls short of statistical significance at the conventional 0.05 level. This analysis does not support the idea that sprawl acts as a "traffic safety valve," as some have claimed. However, it also does not support the reverse idea that compact development offers a one-stop solution to congestion, as others have claimed. Developing in a more compact manner may help at the margin, but the greatest reduction in congestion appears to be achievable through expansion of surface streets and higher highway user fees.

1. Introduction

In 1958 William Whyte in his book *The Exploding Metropolis* referred to a new notion in planning, "suburban sprawl," and alerted Americans that their cities were becoming more sprawling. This began the debate over sprawl and its impacts. There is still little agreement on the definition of sprawl or its alternatives: compact development, pedestrian-friendly design, transit-oriented development, and the catch-all term "smart growth." There is also little consensus about how sprawl impacts everything from housing affordability to traffic congestion to air quality. Duany, Plater-Zyberk, and Speck (2001) use cultural, aesthetic and ecological reasons to reject suburban sprawl as human habitat. At the other end of the spectrum, Bruegmann (2006) describes suburban sprawl as a benign manifestation of the American Dream of a big house in the suburbs.

Fifteen years ago, Smart Growth America (SGA) and the U.S. Environmental Protection Agency (EPA) sought to raise the level of the debate over metropolitan sprawl, from purely subjective and qualitative to largely objective and quantitative (Ewing, Pendall, & Chen, 2002). They sponsored research to operationally define sprawl and study its relationship to quality-of-life outcomes. The resulting indices place sprawl at one end of a continuous scale and compactness at the other. These compactness/sprawl indices have been widely used in health and other research. The indices have been related to traffic fatalities, travel mode choices, physical inactivity, obesity, heart disease, cancer prevalence, air pollution, extreme heat events, residential energy use, social capital, emergency response times, teenage driving, private-vehicle commute distances and times, housing plus transportation costs, and economic and social mobility (Ewing & Hamidi, 2015). While most studies have linked sprawl to negative outcomes, there have been exceptions (see, in particular, Holcombe & Williams, 2012).

One area where the relative advantages of sprawl versus compact development have not been convincingly argued is in terms of traffic congestion. Limiting traffic congestion is one of the goals (if not the primary goal) of transportation agencies around the country. The Texas Transportation Institute (TTI) estimates that congestion costs the American commuter and taxpayer $160 billion in 2014 (TTI, 2015). Referring to congestion as a problem compels action, principally widening roads. Yet, as Litman says (Litman, 2009, p. 1–6): "Calling congestion a problem implies that it must be fixed, but describing it as a

* Corresponding author.
E-mail addresses: ewing@arch.utah.edu (R. Ewing), guang.tian@utah.edu (G. Tian).

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cost recognizes that a certain amount of congestion may be acceptable compared with the costs involved in eliminating it."

State departments of transportation and metropolitan planning organizations (MPOs) dole out billions annually for specific roadway construction projects to widen existing highways or build new corridors. Although billions of dollars have been spent on added capacity throughout the past few decades, each region in the country has experienced increased congestion over this period. For all but eight of the 101 urbanized areas in the TTI sample, annual delay per commuter more than doubled between 1982 (the first year in the series) and 2014 (the last year in the series). For all but one urbanized area, annual delay per commuter increased by > 40% over this same period.

For this reason and others, MPOs are increasingly resorting to land use scenario planning and land use strategies (through the local governments that comprise them) to create future growth patterns that are more compact than "trend" or "business as usual." In regional vision, scenario, and transportation plans, compact development mainly means developing a hierarchy of compact, mixed use, walkable, and transit served centers, and using transportation investments to channel growth into these centers. Think Portland, Oregon. Back in the 1990s, three scenarios were compared for their impacts on quality of life in the region: a "growing out" or sprawl scenario, a "growing up" or infill scenario, and a "neighboring cities" or polycentric scenario. The 2040 recommended alternative, adopted by the Metro Council in 1995, was a combination of scenarios two and three. The 2040 Growth Concept outperformed sprawl in terms of traffic congestion and many other outcome measures.

The Portland model has become the dominant regional planning paradigm in the United States, a paradigm which concentrates development in centers connected by high-quality transit. One of the advantages of this polycentric pattern over sprawl, it is argued, is reduced traffic congestion (Ewing & Bartholomew, 2017).

If the most convincing argument in favor of sprawl is that it acts as a "traffic safety valve," what if, in fact, this were not the case? Using the compactness/sprawl metrics methodology developed by Ewing and Hamidi (2014), and congestion data from TTI's Urban Mobility Scorecard Annual Report database, this study (1) measures compactness, congestion, and control variables using the best national data available for U.S. urbanized areas and (2) relates these variables to one another using structural equation models to determine whether compactness is positively or negatively related to area-wide congestion, or possibly unrelated due to the countervailing forces of dispersed origins and destinations with sprawl but also increased VMT with sprawl.

2. Literature review

In 1997, the *Journal of the American Planning Association* published a pair of point-counterpoint articles now listed by the American Planning Association as "classics" in the urban planning literature. In the first article, "Are Compact Cities Desirable?," Gordon and Richardson (1997) argued in favor of urban sprawl as a benign response to consumer preferences. In the counterpoint article, "Is Los Angeles-Style Sprawl Desirable?" Ewing (1997) argued for compact cities as an alternative to sprawl. They disagreed about nearly everything: the characteristics, causes, and costs of sprawl, and the cures for any costs associated with sprawl.

Gordon and Richardson said at the time and since that suburban sprawl acts as a "traffic safety valve, more of a solution than a problem." They go on to say: "Suburbanization has been the dominant and successful mechanism for reducing congestion. It has shifted road and highway demand to less congested routes and away from core areas. All of the available recent data from national surveys on self-reported trip lengths and/or durations corroborate this view." They note that most people live and work in the suburbs, and that most commuting is from suburb to suburb. A concept central to their claim is that as activities are spread across a greater area, and more roads are built to accommodate them, the resulting trips will also spread out, in turn, reducing congestion. Ewing took the opposite tack, arguing that sprawl, by definition, means spread out development where every trip is by automobile and many trips are long. He cited increases in average commute times from census to census. Neither article looked directly at congestion levels.

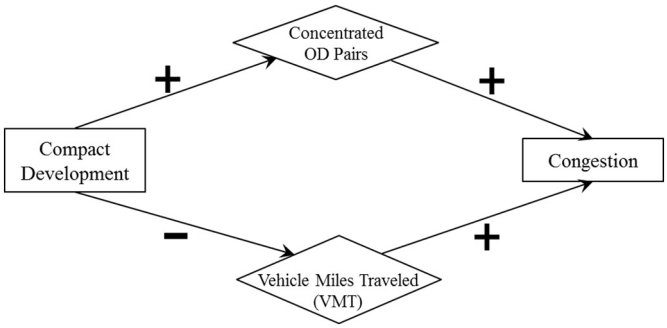

Fig. 1. Conceptual framework.

From the theoretical perspective, it is not obvious whose position is strongest. From years of research, we know that compact development that is dense, diverse, well-designed, etc. produces fewer vehicle miles traveled (VMT) than sprawling development. But compact development also concentrates origins and destinations, as shown in Fig. 1. Since VMT is positively related to congestion, a reduction in VMT with compact development would tend to reduce congestion. And since concentrated OD pairs are positively related to congestion, an increase in concentration with compact development would then to increase congestion. No one has yet determined, using credible urban form metrics and credible congestion data, the net effect of these countervailing forces on area-wide congestion.

At the time of the point-counterpoint, sprawl measures had not been developed. Now that they have been developed, we have more direct evidence on the relationship between sprawl and congestion. After controlling for population size and sociodemographic variables, Ewing et al. (2002) found no association between their overall metropolitan sprawl index and either mean journey-to-work time in minutes or annual traffic delay per capita. The individual dimensions of sprawl seem to neutralize each other. While VMT is higher in sprawling areas, so apparently are average travel speeds.

Other researchers have weighed in on this debate as well, with mixed results. Crane and Chatman (2003) looked into the relationship between commute times and employment location. They found that with increased suburbanization of employment (measured by the regional concentration of employment) there was an associated decrease in commute times. In this case, travel times were being used as a proxy for congestion.

In a more recent study, using aggregated commute data from the American Community Survey, Gordon and Lee (2013) also found that job dispersion rather than just density or population dispersion is the critical factor for congestion and travel time. "Given the population size and suburbanization, more decentralized and dispersed employment distribution was associated with shorter average commute time" (Gordon & Lee, 2013, p. 9).

Sarzynski, Wolman, Galster, and Hanson (2006) significantly advanced cross-sectional research on commuting by using more elaborate urban form variables and addressing potential endogeneity and time-lag effects between urban structure and congestion. Their regression analysis with a sample of 50 largest urban areas provided mixed results. They found that, controlling for prior levels of congestion and changes in an urban area's transport network and relevant demographics, density/contiguity and housing centrality were positively related to subsequent delay per capita, and housing–job proximity was inversely related to subsequent commute time. They concluded that only the last