Linking Highway Improvements to Patterns of Regional Growth and Land Use with Quasi-Experimental Research Design

Richard G. Funderburg  
Graduate Program in Urban and Regional Planning  
The University of Iowa  
Iowa City, IA 52242-1316  
richard-funderburg@uiowa.edu

Hilary Nixon  
Department of Urban & Regional Planning  
San Jose State University  
San Jose, CA 95192-0185  
Hilary.Nixon@sjsu.edu

Marlon G. Boarnet  
Department of Planning, Policy, and Design  
University of California, Irvine  
Irvine, CA 92697-7075  
mgboarne@uci.edu

EXTENDED ABSTRACT

Understanding linkages of new highway construction or capacity expansion to regional growth patterns is crucial for transportation planners and policymakers. Particularly important will be the ability of new projects to avoid or sustain challenges to Environmental Impact Statements (EIS) based upon forecasts of regional growth. A legal precedent for such challenges was established in 1997 when a U.S. district court judge ruled that the EIS for a proposed Illinois toll road was deficient because the growth projections were the same in the build and no-build scenarios (Sierra Club vs. United States DOT 1997). Despite considerable research on the topic, a fundamental debate in urban and regional planning remains as to whether new highway infrastructure induces growth or whether the new infrastructure merely follows the path of development to service regions that would have grown with or without the new investment. In this study, we incorporate popular regional growth forecasting models into a quasi-experimental research design that directly relates new highway investments in Merced, Orange, and Santa Clara Counties to changes in population and employment location, while controlling for no-build historical counterfactuals. We study this mix of urban, small-town, and ex-urban highway projects to examine the possibility of differential effects.

Recent empirical studies confirm effects from transportation infrastructure improvements on intrametropolitan location choices of people and employers to be both statistically and economically significant. Baum-Snow’s (2007) examination of the suburbanization effects from the U.S. Interstate Highway System (IHS) estimates that building the first new highway through a central city reduces central city population growth by 17 percent, while increasing suburban population growth. Nationally, Baum-Snow (2007) estimates that building the IHS resulted in central city population growth that was 8 percent lower than what would have otherwise occurred, again shifting growth to the suburbs. In this study, we examine highway-related growth effects at a finer scale to address language and nuances posed by the National Environmental Protection Act regarding projections under “build” and “no build” scenarios and judicial decisions thereof. In short, given the recent evidence that the IHS contributed to the decentralization of U.S. metropolitan areas, what is the land use/growth impact of specific highway projects?

Our study cases (all from California) are in Orange County, where 51 new centerline miles of highway were added in a rapidly growing ex-urban area; Santa Clara County, where 19 new centerline miles of highway...

Proceedings of the 2009 Mid-Continent Transportation Research Symposium, Ames, Iowa, August 2009. © 2009 by Iowa State University. The contents of this paper reflect the views of the author(s), who are responsible for the facts and accuracy of the information presented herein.
were added in an urban area; and Merced County, where a 1.5 mile highway bypass was built in a rural community. All of the new highway investments opened in the early 1990s. We use census data from 1980, 1990, and 2000 for our empirical test. The research design is a “before and after” comparison, looking at population and employment changes from 1980 to 1990 (the before period) compared to population and employment changes from 1990 to 2000 (the after period).

Our basic approach involves identifying the group of treatment census tracts or other spatial units that gain access to a new highway, identifying the superset of geographic units from which to select the control group, implementing alternative matching methods, analyzing changes in population and employment growth as difference in differences (treatment from matched control and over time), and incorporating the selection of matched controls into models of simultaneous population and employment growth to examine temporal changes in growth before and after the investments. The selection of controls is designed to incorporate the appropriate no-build counterfactuals into the forecast model.

Propensity score matching is the quasi-experimental technique used to select, as controls, regions similar in every respect to those receiving (or in proximity to) transportation improvements, except that the controls lacked any similar sort of intervention. Quasi-experimental techniques have been used in a variety of settings to find and match the cases among the set of potential controls that are most similar in every respect to the treatment group, except that the control group did not experience the intervention, thus preserving the intent behind random assignment in experimental design (Cook and Campbell 1979; Rosenbaum and Rubin 1983; Dehejia and Wahba 1999 and 2002; Holzer, Quigley, and Raphael 2003; O’Keefe 2004; Smith and Todd 2005).

With the matched control areas, we implement simple difference-in-differences tests for the impact of the highway infrastructure on population and employment change. In addition, we use a simultaneous model of population and employment change as a second test (e.g., Steinnes and Fisher 1974; Carlino and Mills 1987; Boarnet 1992 and 1994). Building on the recent specification of the endogenous growth model in Boarnet, Chalermpong, and Geho (2005), our contribution is to directly incorporate a selection of controls into the system of simultaneous equations so as to devise natural experiments for each of the three study counties.

We build on the considerable amount of research that has been conducted on regional growth forecasting models to explore how transportation infrastructure improvements have led to changes in population and employment location. We estimate that, on average, 338 to 11,103 new Orange County jobs shifted to a typical census tract that gained highway access when compared to a nearly identical census tract that did not gain highway access. This employment gain for tracts near the new highways is statistically and economically significant as it represents upwards of an 18 percent addition from 1990 levels to these tracts on average. We estimate that a new highway bypass built outside the small town of Livingston in Merced County had an opposite effect and instead resulted in a statistically significant 12 to 83 job losses per square kilometer as a result of the new bypass, a loss upwards of 11 percent of new jobs that the town otherwise might expect if the bypass had not been built. We find no significant effects on population or employment growth that can be attributed to the new highway investment near the urban center of Santa Clara County. The differential effects from highway investments in the three contexts illustrate the importance of choosing appropriate comparison groups in forecasts of population and employment growth for build and no-build scenarios. Thus, the key finding of the study is that while improvements in surface transportation infrastructure tend to have large impacts on growth patterns, the nature of the effects is materially dependent on the context of the highway investment.

**Key words:** highways—land use—quasi-experimental design
ACKNOWLEDGMENTS

This research was funded by San Jose State University’s Mineta Transportation Institute, which receives funding from the U.S. and California Departments of Transportation. Gavin Ferguson and Allen Mulch provided valuable research assistance. William Fulton reviewed draft reports and provided insight into the planning process. We also thank the staff at the Mineta Institute for their support throughout.

REFERENCES


