Transportation Research Part A 113 (2018) 410–420

Contents lists available at ScienceDirect

Transportation Research Part A

journal homepage: www.elsevier.com/locate/tra

The impact of governmental highway investments on local economic outcome in the post-highway era

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ABSTRACT

Interest in the role of governmental transportation investments in economic outcomes is on the rise, but empirical evidence on the linkage in the post-highway era is limited and the demonstration remains challenging. This study investigates the linkage at the county level using a mixed-effects model and a panel dataset of Texas from 1990 to 2012. It finds that highway investments have a positive but limited effect on county jobs after controlling for spillover, time lag, and other random effects. The empirical evidence with new data and a flexible modeling technique offer potential for future studies and policy debate.

1. Introduction

Economic impacts of governmental capital investments, especially the investments in transportation infrastructures, have been at the center of public spending policy debates since the 1980s. Interest in this issue is on the rise in recent years due to the global economic downturn and the public demand for more information about the return on investment for better decision making (Holtz-Eakin and Schwartz, 1995a; Sloboda and Yao, 2008; EDRG, 2013). The increasing demand for efficiency is evidenced in recent years as governments are required to do more with fewer resources. In addition, the public is demanding transparency and accountability of government decisions, especially expenditure decisions. This trend is also reflected in the recent surface transportation act: Public Law 112-141 – Moving Ahead for Progress in the 21st Century (MAP-21) and the subsequent Fixing America's Surface Transportation (FAST) Act (Pub. L. No. 114-94). As the federal transportation policy is moving towards a performance-based program, there is an increasing interest in research on the linkage between governmental transportation spending and economic outcomes.

Despite numerous studies, the effect of governmental transportation investments on economic outcomes remains debatable. This is especially the case in the era of post-highway development when transportation network has become a matured system with high accessibility and the marginal effect of transportation expenditure may be smaller (Black, 2003; Giuliano, 2004). The uncertainty is even higher at the regional and local levels as disaggregated data of private investment and capital stocks at these levels are limited from public accessible sources due to privacy concerns and other constraints.

We explore the impact of governmental investments in highway infrastructure on the local economic outcome in the post-highway era since 1990 – the fifth stage of Freeway Era as defined by Muller (2004). Using a multivariate linear mixed model (LMM) under a conventional production function framework, we analyze the investment and economic data of counties in the State of Texas from 1990 to 2012. We focus on the State of Texas mainly because of data availability, as well as its size, economic growth, geographic significance, and challenges of meeting high travel demand with limited resources. The State of Texas is also a new case that has not been studied. This study contributes to the state of the knowledge on the linkage between transportation and local

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https://doi.org/10.1016/j.tra.2018.04.023
Received 28 August 2016; Received in revised form 31 December 2017; Accepted 23 April 2018
0965-8564/

economy by focusing on the economic effect of highway investment in the post-highway era in a new geographic area. It provides new empirical evidence for the governmental fiscal policy debate. Moreover, it explores the application of a model that has not been widely used in this line of research, but is more flexible and can estimate both fixed and random effects in one analysis. The method can be applied using data of elsewhere. The exploration of using LMM in this line of research can stimulate discussions about new methods for efficient research in the future.

In the following, we first provide a brief review of the relevant studies in the U.S., then describe our research method and data, and present the results. We conclude the paper with a discussion on implications for transportation research, planning, and policy communities in the near future.

2. Studies of the economic impact of transportation investments

Economic impacts of transportation investments are often studied under the theoretical framework of production function and/or theories of spatial economics. Collectively, these theories suggest that transportation investments affect the economy through increasing accessibility, mobility, safety, and travel reliability. Transportation cost is a part of the inputs for economic production. A supportive transportation system with high accessibility, mobility, and reliability can reduce travel time and cost, increase travel safety, therefore reducing production costs and increasing the productivity of economic activities in a region. A well-connected and highly mobile and reliable transportation system can "shrink" space within a given time, therefore extending the market size, enlarging demand for goods and services, and increasing access to a larger labor pool. A supportive transportation infrastructure system can also magnetize businesses and increase the economy of agglomeration – the positive externalities/benefits obtained by firms when spatially clustering together, which further stimulate competition and innovation among firms and businesses, increase the economic competitiveness of a region, and attract foreign investments (Marshall, 1890, 1920; Hong, 2007; McCann, 2013).[1]

While the economic impact of transportation is generally accepted in theory, there exists a challenge in linking theories with reality, and demonstrating the impact empirically (Weisbrod, 2008; Graham and van Dender, 2011). Empirical studies of such a relationship in the U.S. during the last several decades exhibit a wide array of findings. Some studies, especially those prior to the early 1990s, find that public capital investments, including transportation investments, have strong positive influence on economic outputs at the national or state level. The elasticity estimates by these studies range from .20 to .58, indicating a unit increase in public capital or transportation investments is associated with .20 to .58 unit increase in economic outputs (see, e.g., Costa et al., 1987; Aschauer, 1989; Munnell, 1990a,b; Lynde and Richmond, 1992; Garcia-Milà and McGuire, 1992). Others, especially studies in the late 1990s and at the turn of the century, are skeptical about the effect and argue that the effect may be smaller or non-productive after controlling for issues of nonstationarity and endogeneity in statistics. For instance, Garcia-Milà et al. (1996) use annual data of 48 contiguous states in the U.S. from 1969 to 1983 to study the impacts of public capital investment under a production function framework. Like the work by Garcia-Milà and McGuire (1992) and many previous studies, private capital investments are estimated following the apportioning approach by Munnell (1990a) due to the lack of data at the state and local levels. Public capital investments include highway, water and sewer, and other governmental expenditures. Labor input is measured by the number of employees. The economic impact is measured by gross state product. With a fixed-effects model specification, the coefficient of highway capital is .12. However, using the first-order specification for the same data, they find that the estimate for the highway capital, along with other public capital inputs, becomes negative and statistically insignificant. Such results confirm the findings of Holtz-Eakin (1994) and Holtz-Eakin and Schwartz (1995a).

Cross-country empirical studies, while diverse in method and data, are more in agreement with the positive effect of public infrastructure in general, transport in particular (Romp and Haan, 2007). A recent study by Calderón et al. (2015) finds that the contribution of infrastructure to the gross domestic product (GDP) ranges between .07 and .10. The study is based on a panel dataset of countries worldwide over the period of 1960–2000 and the pooled mean group (PMG) estimator. Infrastructure in the study includes telecommunications, power, and road transport capacities. The findings reinforce the results of many previous empirical studies (see, e.g. Sanchez-Robles, 1998; Ahmed and Miller, 2000).

Some scholars, mostly those after the turn of the century, argue that the role of governmental transportation investments cannot be assessed without considering the geographic spillover effect of transportation investments. Most studies construct the spatial weight using the simple adjacency/contiguity matrix approach. However, studies exploring the spillover effect also produce mixed results (see Table 1). For example, using data of 48 contiguous states in the U.S. from 1969 to 1986 that are similar to many studies in the 1980s and 1990s, Holtz-Eakin and Schwartz (1995b) examine spatial spillover effect of state highways under the vector autoregression (VAR) model specification. In addition to common input variables used by many previous studies, a spatial weight based on adjacency between states is created to capture the spillover effect from neighboring states sharing boundaries. The results indicate that neither highways within a state nor those in the neighboring states have statistically significant effects on state productivity.

However, the study by Sloboda and Yao (2008), which uses data of the 48 states from 1989 to 2002 and panel analysis techniques under a log linear production function, comes to a different conclusion. Like the aforementioned studies, they follow the apportioning approach suggested by Munnell (1990a) to create private capital variables, but construct the interstate spillovers based on cross-state commodity flows. They find negative but statistically significant effects of governmental transportation spending and spillovers on state gross domestic product (GDP). On the other hand, a study of Spain at the provincial level by Moreno and López-Bazo (2007) find

[1] Theory about the economic effects of transportation investments has been covered extensively in numerous studies and text books. See, for example, EDRG (2013) for a more recent and complete review of transportation impacts.