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Using dynamic simultaneous-equation model to estimate the regional impacts of high-speed rail in Spain

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Abstract

The objective of this paper is to investigate the impacts of the HSR network on the regional development of the Spanish provinces from 1990 up to 2010, by applying a simultaneous-equation modeling approach. The proposed model possesses a systematic perspective, the relationships between HSR and the various aspects of the regional development interact with each other in a more realistic manner. The model intends to estimate the quantitative relationships between all the variables, where accessibilities by road and by HSR, employment, GDP, population and number of firms at province level are treated endogenously, and education level is the exogenous variable used to control for the impacts from education policies. The model estimates the reverse causality from the economic development to the investment in transport infrastructure, which is an issue not explicitly modeled in previous research. Besides, the model captures also dynamic effects, by the use of a lag-adjustment framework, implying that the initial levels of the variables are important in determining their subsequent changes. The empirical results concur that the investment in HSR together with education policies has positive impacts on stimulating GDP growth, establishing new firms, increasing employment levels and attracting population at provincial level in Spain.
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1. Introduction

Over the past three decades, substantial literature has focused on the role of public infrastructure in affecting economic growth, private sector productivity and location decisions of firms (Aschauer, 1989; Fujita and Thisse, 2002; Graham, 2007; Martin and Rogers, 1995; Munnell, 1990). Following this stream of literature, a fairly large amount of studies have focused on the economic impacts of transport infrastructure. Improvements in transport infrastructure are seen as a means of stimulating production and influencing the location decisions of firms, which then induce more employment and investment by expanding the existing businesses and attracting new economic activities (Button, 1998; Rietveld and Bruinsma, 1998; Rietveld and Nijkamp, 2000; SACTRA, 1999). It has been acknowledged that investment on transport infrastructure increases the accessibility to resources, goods and markets, and thus improves the competitiveness of a region (Dodgson, 1974) and enhances its economic integration (Blum, 1982; Rietveld, 1989). Reductions in travel time and travel costs can also give rise to productivity growth through reinforcing agglomeration benefits (Graham, 2007; Venables, 2007).

Adopting the traditional production function approach, Aschauer (1990, 1989) argued that core infrastructures have the strongest statistical significance in estimated productivity relations. Positive impacts of transport infrastructure on the production levels, in particular, were also found in several studies, e.g. Munnell (1990), Nijkamp (1986) and Andersson et al. (1990). The robustness of the empirical results from the studies of Aschauer (1989) and Munnell (1992) have raised various criticisms on its methodological drawbacks, firstly, the omitted variable bias. By refining the econometric structure using panel models incorporating state and time fixed- and random effects, some researchers found weakened and insignificant effects of public infrastructure investment on private productivity (Evans and Karras, 1994; Garcia-Mila et al., 1996; Holtz-Eakin, 1994; Holtz-Eakin and Schwartz, 1995). The criticisms relative to ignoring spillover effects of transport infrastructures have also been proven to be important. A municipality may not have the direct access to a transport infrastructure, such as a highway, but can still benefit from the one in an adjacent municipality (Pereira and Andraz, 2006). But the conclusions about the relevance and importance of spillover effects have been mixed, with studies arguing for positive and significant effects (Cohen and Paul, 2004; Dalenberg et al., 1998; Jiwattanakulpaisarn et al., 2012, 2011; Pereira and Andraz, 2006; Pereira and Roca-Sagalés, 2003; Rietveld and Wintershoven, 1998), and negative or insignificant ones spillover effects (Boarnet, 1998; Cohen and Paul, 2004; Holtz-Eakin and Schwartz, 1995b; Jiwattanakulpaisarn et al., 2009a; Kelejian and Robinson, 1993). Concerning the potential existence of a lagged response of economic and demographic aspects to the changes in the provision of transport infrastructure, a more dynamic panel formulation has been applied in the studies of Khadaroo and Seetanah (2008), Berechman et al. (2006), Ozbay et al. (2007), Jiwattanakulpaisarn et al. (2011), Jiwattanakulpaisarn et al. (2012), and Na et al. (2013) etc. Jiwattanakulpaisarn et al. (2009b) found that when the dynamic adjustment issue is properly modelled, the results show that improvements in highways have no discernible impact on employment. In another study by Jiwattanakulpaisarn et al., (2011), the same approach was used and they found that the effects of highway capital on the state output level are positive but fairly small.

Moreover, the potential endogeneity of transport infrastructure investment has been also the subject of dicussion. So far, the results have been mixed. Duffy-Deno and Eberts (1991), Thompson et al. (1993) and Rietveld and Boonstra (1995) provide evidence of a reverse link from economic development to public infrastructure including transport infrastructure. Jiwattanakulpaisarn et al. (2009a) revealed that increases in employment activity could lead to the expansion of roadway capacity, but it depends on the type of highways and the model specifications considered. Boarnet (1998), Bollinger and Ihlanfeldt (2003) found no evidence that changes in output or employment cause highway improvements. Other studies, such as Dalenberg et al. (1998) and Kemmerling and Stephan (2002) found that the feedback effects from economic development to public/transport infrastructure are negligible.

A major shortcoming of the single equation framework is that it tends to neglect the problem of endogeneity arising from the explanatory variables. Several studies use cross-sectional models to examine the impacts of transport infrastructure on population and employment in a simultaneous equations framework, considering that the location decisions of firms and households are simultaneous (Boarnet, 1994; Carlino and Mills, 1987; Clark and Murphy, 1996; Duffy-Deno, 1998; Luce, 1994). Besides the simultaneity between population and employment, more recently, a cross-sectional simultaneous equation model has been used by Yamaguchi (2007) to analyse the

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