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Spatial spillover effects of transport infrastructure: evidence from Chinese regions

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ABSTRACT

This paper examines the possibility of spatial spillover effects of transport infrastructure in Chinese regions. We estimate the regional spillovers of the transport infrastructure stock by applying a spatial Durbin Model for the time-period 1978–2009, and also three sub-periods, 1978–1990, 1991–2000 and 2001–2009. The results indicate that positive spillovers exist in each period due to the connectivity characteristic of transport infrastructure at the national level. At the regional level, transport infrastructure spillover effects vary considerably over time among China's four macro-regions: the eastern region enjoyed positive spillovers all the time; the northeastern region had no significant spillover effects in 1978–1990, negative spillovers in 1991–2000, and positive spillovers in 2001–2009; the central region had negative spillovers for the three sub-periods; for the western region, negative spillovers can be observed after the 1990s. The analysis indicates that changes in spillovers among regions are closely associated with the migration of production factors in China during the last decades.

1. Introduction

Plenty of studies have been conducted on the impact of transport infrastructure development on regional economic growth over the last decades, mostly aiming to examine the economic returns of transport investments in order to find a reasonable investment pattern (Aschauer, 1989; Munnell, 1990; Ozbay et al., 2003; Canning and Bennathan, 2007). Even though the range of the measured economic growth effects varies widely among studies, the positive relationship between transport investment and economic development is now commonly accepted (Banister and Berechman, 2001; Berechman et al., 2006). However the finding that the impact of transport infrastructure at the regional level is generally lower than the results observed at the national level leads some researchers to conclude that there exist significant spillover effects across regions. Subsequent research has tried to confirm this (Munnell, 1992; Holtz-Eakin, 1994; Cohen and Paul, 2004; Cantos et al., 2005; Berechman et al., 2006; Ozbay et al., 2007). Attempts have been made to corroborate the claim that the positive benefits accruing from these investments derive not only from investments made by individual states, but that there are also positive externalities from network expenditures made by neighboring states (Lall, 2007). That is because some effects induced by transport infrastructure will extend outside the limits of this area, generating spillover effects (Munnell, 1992; Boarnet, 1995, 1996, 1998).

Only a few of studies have focused on ascertaining the possible existence of regional spillovers from transport capital, probably because it is difficult to find cases of countries in which its territory is divided in regions with substantial political power as the USA and Spain (Cantos et al., 2005). For the case of the USA, on the one hand, Munnell (1992) found that the impacts of highway capital became smaller as the geographic focus narrowed Thus she hypothesized that highway public capital can create positive cross-state spillovers because of productivity leakages (spillovers), since the transport infrastructure has network characteristics. But Holtz-Eakin and Schwartz (1995) rejected this argument after measuring the spillover effects separately. On the other hand, Boarnet (1995, 1996) hypothesized that public capital influences economic activity largely by shifting that activity from one location to another, and sees this claim confirmed in the case of the US street-and-highway capital. Considering these two arguments, Berechman et al. (2006) investigated the spillovers of transportation at the state, county and municipality levels of the USA respectively, and they concluded that the spillovers exist at the small geographic areas (at the municipality level) but that they cannot be found at the state and county levels. Ozbay et al. (2007) calculated the contribution of transport investments to county output using the data from the New York/New Jersey metropolitan area, and their results showed that the spillover effects decreased with distance from the

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investment location. For the case of Spain,[1] the empirical findings show the variance: Cantos et al. (2005) confirmed the existence of very substantial spillovers; Álvarez et al. (2006) did not find evidence of the existence of spillover effects of public infrastructure using a panel data set of the 47 mainland Spanish provinces; Moreno and Lopez-Bazo (2007) investigated the economic returns to local and transport infrastructure and found negative spillovers across Spanish regions in transport capital investments. This variance of the results is probably because of the difference between studies in the definition of public capital and the econometric models. What's worthy to note is that most empirical studies measure the spillover effects of transport infrastructure restricting attention to the first round neighbors for the purpose of a specification that is linear in the parameters (Boarnet, 1996; Berechman et al., 2006; Ozbay et al., 2007; Moreno and Lopez-Bazo, 2007). With the development of spatial econometric techniques (Anselin, 2001; LeSage and Pace, 2009), some advanced spatial models recently developed have been employed to capture the spatial externalities of infrastructure (including transport infrastructure) (Gomez-Antonio and Fingleton, 2009; Del Bo and Florio, 2012).

Due to its huge size, China is disaggregated into many small administrative units—provincial (or municipality) governments,[2] which have acquired substantial financial power after the Chinese fiscal decentralization, carried out in the early 1990s (Zhang et al., 2007). Each local government (provincial level) has the fiscal and political power to make decisions on the planning and investment of its transport construction, considering its individual interests. Hence, following fiscal decentralization, it is now possible to investigate for China whether regional transport infrastructure investment does have spillover effects – in terms of economic growth – on neighboring regions. In the case of China, only a small number of previous studies provide a separate analysis of spatial spillover endowments of transport infrastructures (Liu et al., 2007; Zhang, 2009; Liu, 2010; Hu and Liu, 2009). Liu et al. (2007) investigated the spillovers using the panel data for 11 cities of Zhejiang province and summarized that the highway infrastructure of other contiguous regions had positive spillover effects on local economic growth. Zhang (2009) estimated the spillover effects in the period 1993–2004 and confirmed the existence of spillovers at the national level. Liu (2010) examined the contributions of highway and waterway infrastructure for different geographic levels, including both direct effects and externalities and suggested that the Chinese government should take the spatial correlation of investment impacts into consideration in its policy making regarding transport investment. Hu and Liu (2009) investigated the external spillover effects of transportation on China's economic growth based on the spatial models and found the positive spillover with an elasticity of 0.06. These studies attempted to verify the existence of spillovers of transport facilities (or several types of transport infrastructure) in China and some of them indeed found empirical evidence of spillovers. However, most of these studies do not estimate spillover effects at the sub-national level, which would be more useful for the public decision making on the planning for large transport projects. This is why we propose this study, in order to obtain more detailed information of regional output productivity with respect to transport investment in a spatial framework, find changes in (the magnitude of) spillover effects over time, and try to interpret our findings in light of the actual situation in China.

[1] For the case of Spain, several studies on the topic of cross-border spillover effects recently emerged. However, these papers adopted a methodology based on the accessibility calculation in a Geographic Information System support, which was not very related to our paper. Thus, we did not review this literature here.

[2] The administrative hierarchy in China is: county–city–province (or municipality)–state. Since the financial reform in 1994, the provincial (and municipalities) governments have obtained the discretion over priority-setting in public investment.

Table 1
Transport system mileage in China. *Source*: The data is obtained from China Transportation Yearbook (1984–2010).

Year	Roads (×1000 km)	Railway (×1000 km)	Waterways (×1000 km)	Civil aviation (×1000 km)
1950	99.65	22.2	73.64	8.22
1970	636.74	43.79	148.42	42.50
1980	883.31	52.98	108.53	231.38
1990	1028.30	57.83	109.27	506.82
2000	1402.79	68.70	119.37	1529.14
2005	3345.71	75.48	123.31	1998.52
2009	3860.21	85.56	123.75	2345.19

Our study aims to test for the presence of regional spillovers of transport capital and to measure their magnitude both in the country as a whole and in specific parts of China. Of particular emphasis in this paper is the regional difference in the spatial effects of transport infrastructure on economic growth. The structure of the paper is as follows. The next section gives a brief descriptive analysis of the expansion of the transport infrastructure network and the regional distribution of transport facilities in China. Section 3 introduces the methodology and database to quantify spatial spillovers of transport investment in the Chinese regions, and it also presents the results. To improve our understanding of the regional differences in spillover, a deeper analysis of the changes in spillover effects of transport infrastructure among Chinese regions will be presented in Section 4. The paper ends with conclusions and policy implications.

2. Transport infrastructures in China: an overview

In the past decades, investment in transport infrastructure in China has seen remarkable growth in parallel with its booming economy. After 30 years of construction, all types of transport infrastructure have seen significant expansion as shown in Table 1.

In the past six decades the transport network in China has begun to take shape. The patterns of the current railway and highway networks in China in 2009 are presented in Fig. 1.

In 2009, the total length of the Chinese railway network reached 103.16 thousand kilometers. A government official from the Ministry of Railways, Mr. Liu Zhijun,[3] has stated that, in the long-term plan for Chinese railways, the total railway mileages will increase to 120 thousand kilometers, including 16 thousand kilometers of high-speed railways in 2015.

As to the highways, the investment in the highway construction was as high as RMB 623.11 billion yuan (about $93 billion dollars) in 2009 and kept a high growth rate from 1978, above 10% per year. The total mileage of expressways was 45 thousand kilometers in 2009, which was an 80% increase compared with the length in 2002.

The central government allocates its investment budget mostly to those transport facilities, the construction of which is likely to generate high economic returns, such as toll roads, ports and inter-city high-speed rail between high-density metropolitan areas. However, because regional Chinese administrative units have their own discretion with respect to the distribution of public investment, local governments make the investment decision in view of their individual economic growth and (often) neglect the (spillover) impact of their investments on the neighboring areas. As a result, there is considerable underinvestment in the connecting highways (State Roads and Provincial Roads) and rural roads, which have low economic returns but high social returns.

[3] Mr. Liu Zhijun was the head of Ministry of Railway Transportation in China during the period of 2003–2011, which is independent from the Ministry of Transportation.