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Economic impacts of accessibility gains: Case study of the Yangtze River Delta

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ABSTRACT

Transport infrastructure development is generally perceived as catalyst for economic growth. This has been highlighted in previous literature, generally focusing on the economic impact of transport infrastructure investments. This paper contributes to spatial econometrics by examining the causal relationship between economic strength and accessibility gains due to the development of expressways and high-speed rail, taking the Yangtze River Delta as research object. Spatial regression models that accommodate for the influence of spatial autocorrelation and the newly defined variable "weighted mode's average travel time (WMATT)" and other explanatory variables are developed for quantitative analysis. Estimation results indicate that cities' gross domestic product increases significantly with population, passenger traffic, and foreign direct investment. Especially, all the estimated models indicate that WMATT is significantly and negatively associated with gross domestic product, revealing that inter-city accessibility gains (travel-time savings) can enhance economic strength. The robustness analysis on the estimators indicates that while the β-coefficient of WMATT generally increases with the share of expressways and high-speed rail in land transportation, its p-value increases and its effect may become insignificant if inter-city travel time becomes fast enough. Findings from this study highlight the travel-speed up measures such as open China's expressway freely and speed up the high-speed rail rather than blind development and endless investments can also play an important role in enhancing economic strength.

1. Introduction

Cities in major metropolitan areas are faced with enormous challenges in terms of growing population, greenhouse gas emissions, and sustaining the economic strength to stay competitive (Mittal & Kashyap, 2015). To position their metropolitan cities on a global scale and enhance their ability to compete with others, policy-makers have undertaken major investments in the form of large-scale projects (Kennedy, 2015). Given that the development of regional megaprojects such as expressways and high-speed rail (HSR) needs huge investments, the scientific and systematic study on their wider economic impacts is crucial to avoid the risk of implementing the wrong projects (Banister and Berechman, 2001).

The catalytic effect of transport infrastructure investments in economic growth has been discussed in previous literature (Banister and Berechman, 2001; Chen & Vickerman, 2016; Hall, 2013; Linneker & Spence, 1996; Rietveld, 1994). However, both claims and counterclaims exist about the economic contribution of megaproject investments. The debates focus on the actual outputs of the investment as well as the coupled relationship between investments and productivity (Banister and Berechman, 2001). In review of this, it is both necessary and urgent to reexamine the economic impact of transport infrastructure development from a new and direct perspective.

As a natural gift of transport systems and an intuitive benefit of transport investments, the concept of "accessibility", which at a general level is about the ease of passengers and goods can be transported from one location to others (Ahlström et al., 2011), may provide a more effective and direct perspective to reexamine the actual effects of new and improved transport forms on economy. Indeed, accessibility has been proved as one of major defining factors affecting public services (Cheng et al., 2016; Paul & Islam, 2015), housing prices (Jang & Kang, 2015), and urban life (Zhao, Lü, & Woltjer, 2009). Its potential effects on economic performance should also be explored and measured, thus shed light on

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the causality between transport development and economic growth as well as guide future transport investments. However, compared with the abundant studies on the accessibility impact of transport development (Bowen, 2000; Gutiérrez, 2001; Hou & Li, 2011; Cao, Liu, Wang, & Li, 2013; Maroto & Zofío, 2016; etc.), less attention has been paid to the influence of spatial accessibility gains on economic performance. This imparity may be partially due to the complexities of the impact mechanisms (Chen, Xue, Rose, & Haynes, 2016). Chen and Vickerman (2016) examined the impact of HSR on economic promotion in the Yangtze River Delta (YRD), China. Through detailed analysis, they found that HSR appeared to strengthen most HSR cities in the YRD, yet left the questions of whether and how such potential effects can be measured and included in any investment appraisal of new HSR lines.

This research aims to fill some of this research gap and enrich the existing studies with more findings on the potential benefits of accessibility gains due to transport infrastructure development, especially the entrance of expressways and HSR. We have collected the spatial data of the twenty-five cities in the major metropolitan region of the YRD. The data allow us to investigate the causal relationship between accessibility gains and economic performance not only on geographical perspective, but also on mode split consideration. By taking a region that has experienced very significant changes in accessibility over a relatively short period, this study presents an ideal test case and explores useful findings.

The remainder of the paper is organized as follows. Section 2 reviews the related literature on the topic and provides a background for this research. Section 3 introduces the study area and data obtaining approaches. Analytical models are presented in Section 4. Section 5 presents the analysis results and research findings. Section 6 concludes the findings and proposes future research directions.

2. Lecture review

With regard to the potential benefits of transport infrastructure development, three major groups of studies related to this paper can be identified. The first stream of studies investigate the impacts of transport infrastructure investments on economic growth. Using panel data from a sample of various provinces in China, researchers found that transport infrastructure investments have significantly positive impact on economic growth (Demurger, 2001; Hong, Chu, & Wang, 2011; Yu, De Jong, Storm, & Mi, 2012; Chen et al., 2016). Meersman and Nazemzadeh (2017) found the investments in port infrastructure, and the length of motorways and rail network have positive impact on the annual GDP per capita of Belgium. A comprehensive study of the long-run economic impact of transport infrastructure investments in the OECD countries indicated a significant and positive relationship between the investments in stock of transport infrastructure and labour productivity (Farhadi, 2015).

The first group of studies acknowledged the economic benefits of transport infrastructure investments. These studies have several common limitations. First, the decoupling argument on investment and productivity (Banister and Berechman, 2001): the more advanced the economy usually the more investments can be budgeted. Second, most previous studies generally focused on the national level, ignoring the huge spatial inequality. For instance, as one of the regional economic engines in China, the YRD is in the forefront of regional integration, sectoral specialization, and transport infrastructure development (Table 1). Neglecting the huge spatial inequality may lead to inaccurate estimations. Another limitation is that the national/provincial data may not be as accurate as the city level data (Li, Huang, Yang, Chuai, & Wu, 2017).

The second set of studies established a strong correlation between transport development and accessibility gains (Bowen, 2000; Cao et al., 2013; Gutiérrez, 2001; Holl, 2007; Hou & Li, 2011; Jiao, Wang, Jin, & Dunford, 2014; Maroto & Zofío, 2016; Wang et al., 2016).These studies highlighted the potentials of transport infrastructure investments on and development of expressway and high-speed rail in travel-time reductions, which in return, promoting convergence between cities (Graham, 2007), affecting human activities (Tenkanen, Salonen, Lattu, & Toivonen, 2015), leading to greater specialization (Chen & Vickerman, 2016), as well as opening up markets and creating conditions (Lakshmanan, 2011). Most of these studies assumed that all passengers/freight choose the shortest travel paths/time regardless of whichever travel modes related. This hypothesis does not take account of a range of alternative opportunities for travels, thus may exaggerate the actual effect of new and modern transport forms should have.

Compared with the abundant studies of the first and second groups, the third group of research on the actual impacts of advanced transport forms on economy is relatively less. Chen and Hall (2012) examined the wider spatial-economic impacts of HSR in Manchester, Lille, and their sub-regions. The case study indicated that HSR affects knowledge economic in both the regions but the impacts vary obviously. Cheng, Loo, and Vickerman (2015) found the economic impacts of HSR differ widely in both China and European. Hernández and Jiménez (2014) examined the impact of HSR on local budgets, finding that HSR has significant effect on both local revenues and local fiscal gap.

These studies shed light on potential relationship between transport development and economic performance, without establishing causality analysis framework by examining spatial autocorrelation and the share of new transport forms in passengers and goods. Due to the development of statistical methods, various spatial regression models have been suggested and further developed by Pinkse (1999), Kelejian and Prucha (2001), Anselin (2005), Baltagi and Bresson (2011) and Su and Yang (2015). Given that accessibility rather than infrastructure investments is a more direct and accurate indicator in reflecting the actual transport investments and user-benefits, a spatially causal analysis between accessibility gains and economic strength may provide some more detailed findings. This study is proposed to achieve this objective,

Table 1
Total length (km) and density (km/1000km2) of expressway and HSR in the YRD and comparison with national level.

Year	Expressway				HSR			
	YRD		China		YRD		China	
	Length	Density	Length	Density	Length	Density	Length	Density
2000	1830	8.7	16,300	1.7	0	0	0	0
2010	8217	39.0	74,113	7.7	950	4.5	8300	0.9
2020	11,300[a]	53.6	118,000[b]	12.3	3900[a]	18.5	30,000[c]	3.1

[a] Data from NDRC (2010).
[b] Data from NDRC (2013).
[c] Data from NDRC (2016).