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Evaluating the coordinated development of economic, social and environmental benefits of urban public transportation infrastructure: Case study of four Chinese autonomous municipalities

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ABSTRACT

Urban public transportation infrastructure is a basic and necessary condition which ensures urban daily operation. The economic, social and environmental benefits of urban public transportation infrastructure are the positive impacts on urban economy, society and environment generated by the use of it respectively. Promoting their coordinated development is helpful to raise the level of urban public transportation infrastructure benefit. This paper evaluates the coordinated development of these three benefits taking four Chinese autonomous municipalities as examples. These four cities have large-scale urban public transportation infrastructure but its basic function has not been fully played. Whether these three benefits of urban public transportation infrastructure have been developed in harmony or not was unclear. We analyzed the coordinated development among three benefits by constructing coupling coordination degree model and studied the impacts of three benefits on their coordinated development level using panel regression model. The result showed that the coordinated development levels of three benefits of urban public transportation infrastructure were lower in these four cities and the impact of economic benefit on their coordinated development level was largest and social benefit insignificant. It was highly related with the development strategies and construction levels of urban public transportation infrastructure in these four cities. Three policy implications were put forward to the improvement of coordinated development level of three benefits of urban public transportation infrastructure.

1. Introduction

Urban public transportation infrastructure is a basic and necessary condition which ensures urban daily operation. It can promote the appreciation of the land of its surrounding areas (Efthymiou and Antoniou, 2013; Mathur and Ferrell, 2013) and change urban spatial distribution (Beyazit, 2015) which has important impact on urban economic development. At the same time, the construction of urban public transportation infrastructure changes urban living condition which is beneficial to quicken the flow of population, raise urbanization rate, increase urban employment, and promote urban social development and progress. In addition, urban public transportation infrastructure has been proven to be an effective way of tackling environmental problems which were brought by the expansion of urban scale and the use of private transport (Chester et al., 2013; Fan and Lei, 2016; Ercan et al., 2016).

As important public goods, urban public transportation infrastructure has important impact on urban economy, society and environment. The economic, social and environmental benefits of urban public transportation infrastructure are the positive impacts on urban economy, society and environment generated by the use of it respectively. Different benefits can affect each other. Increasing urban public transportation infrastructure economic benefit promotes the raise of urban living standard and attracts the inflow of external population which is helpful to raise the level of its social benefit. The increase of economic and social benefits of urban public transportation infrastructure is beneficial to add the investment on it and improve its technology level which has positive impact on urban natural environment protection. The raise of urban public transportation infrastructure environmental benefit helps to improve urban environment. It is conducive to attract the investment and raise the level of urbanization and public health which promotes the raise of economic and social benefits of urban public transportation infrastructure. Therefore, the economic, social and environmental benefits of

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urban public transportation infrastructure should be emphasized equally and develop in harmony. Their coordinated development is beneficial to realize the sustainable development of urban public transportation infrastructure.

In recent years, with the acceleration of urbanization process, China has highly emphasized the construction of urban public transportation infrastructure. The Chinese central government released the guidance on the priority development of urban public transportation in 2012. It pointed out that urban public transportation should fulfill its function of improving urban traffic condition and promoting the sustainable development of urban economy, society and environment. A number of Chinese cities have enlarged the construction of urban public transportation. The scales of many kinds of urban public transportation such as urban bus and rail transit have been expanded. By the end of 2015, the mileage of urban bus has exceeded 820,000 km in China which has grown by 29% compared to it in 2010 (Source: China Statistical Yearbook 2016). Twenty-five Chinese cities have opened urban rail transit line and the mileage of Chinese urban rail transit has more than 3200 km by the end of 2015 which was more than twice it in 2010 (Source: China Statistical Yearbook 2016). The annual passenger volume of Chinese urban public transportation infrastructure has reached 90 billion people from 2011 to 2015 which increased by one quarter compared to it in 2010 (Source: China Statistical Yearbook 2016). Although the operational scale of urban public transportation infrastructure has been increasing, several problems restricted the further promotion of its level. The construction of supporting facilities of urban public transportation infrastructure was relatively slow which prevents the raise of its service capacity. The main position of urban public transportation in urban transport system has not been established in China. It made Chinese urban public transportation infrastructure failed to play its role. Many Chinese cities have sought to expand the scale of urban public transportation infrastructure and emphasized its economic benefit but ignored its impact on urban society and environment. The total institution and policy concerning sustainable development of urban public transportation infrastructure has not been built. These problems were not only detrimental to the development of urban public transportation infrastructure, but also were not conducive to achieve the coordinated development of three benefits of urban public transportation infrastructure.

Sustainable development of urban public transportation infrastructure requires combining its own development with urban economic, social and environment systems equally. The construction of urban public transportation infrastructure not only needs to promote economic development but also asks to attach importance to realize social progress and the protection of natural environment. Therefore, the coordinated development of economic, social and environmental benefits of urban public transportation infrastructure is an issue worthy of in-depth study.

This paper takes four Chinese autonomous municipalities, which are Beijing, Tianjin, Shanghai and Chongqing, as examples to analyze the coordinated development among three benefits of urban public transportation infrastructure. They are the more developed regions in China and their construction scales of urban public transportation infrastructure are increasing year by year. As shown in Fig. 1, the per capita GDP levels of these four cities were far higher than its average level of China from 2006 to 2015 except Chongqing. The per capita GDP level of Chongqing was close to it of China, but it has exceeded Chinese per capita GDP level after 2014. Fig. 2 shows the construction scales of urban public transportation infrastructure of these four cities from 2006 to 2015. The mileages of urban public transportation infrastructure were also increasing in these four cities from 2006 to 2015. But whether economic, social and environmental benefits of urban public transportation infrastructure have been developed in harmony or not was unclear. Therefore, this paper tries to study the coordinated development among these three benefits of urban public transportation infrastructure in these four cities and analyze the impact of each benefit on their coordinated development. A comprehensive approach of evaluating the coordinated development among three benefits of urban public transportation infrastructure was put forward in this study. Coupling coordination degree model was applied to fully and objectively evaluate the coordinated development level among three benefits of urban public transportation infrastructure. Then the impact of each benefit on the coordinated development level of three benefits of urban public transportation infrastructure was studied using panel regression model.

The rest of this paper is organized as follows. In Section 2 we review the relevant literature. Section 3 constructs urban public transportation infrastructure benefit indicator system and introduces the empirical research methods used in this paper. The result of empirical analysis is revealed in section 4. Section 5 discusses the result of empirical analysis. And section 6 summarizes the main conclusions and provides the policy implications.

2. Literature review

The impact of transportation infrastructure on economy has been discussed many times in the past. Many scholars mainly paid attention to the relationship between transportation infrastructure and economic growth and applied different econometric methods to analyze it (Hong et al., 2011; Yu et al., 2012; Pradhan and Bagchi, 2013; Beyzatlar et al., 2014; Agbelie, 2014). Their research results indicated that there was an endogenous relationship between transportation infrastructure and GDP. The construction of urban public transportation infrastructure increases urban GDP which is helpful to raise the levels of fiscal revenue of urban government (Farhadi, 2015) and consumption expenditure of urban resident (Cruz and Katz-Gerro, 2016; Zailani et al., 2016). The well-conditioned urban public transportation infrastructure attracts investment by reducing transport cost (Hong, 2007; Donaubauer et al., 2016) which is beneficial to increase the profit of enterprise (Arvin et al., 2015) and raise urban productivity (Bougheas et al., 2000; Vijverberg et al., 2011). Urban public transportation infrastructure facilitates the circulation of commodity and raises its sale amount (Bowes and Ihlanfeldt, 2001; Cervero and Duncan, 2002). In addition, urban public transportation infrastructure provides the fundamental condition to the development of tourism industry (Albalate and Bel, 2010; Šťastná and Vaishar, 2017).

Urban public transportation infrastructure also has significant impact on urban social development. Developing transport industry promotes the development of other related industries through the interaction

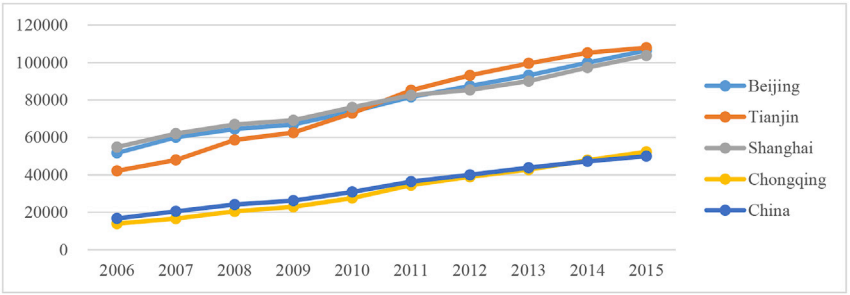

Fig. 1. Per capita GDP of China and its four autonomous municipalities: 2006–2015 (Unit: yuan). Source: Prepared by the authors with data from China Statistical Yearbook 2007–2016.