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Unbalanced development of inter-provincial high-grade highway in China: Decomposing the Gini coefficient

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ABSTRACT

This study discusses the unbalanced development of Chinese inter-provincial high-grade highway from 1997 to 2013. It does so from the viewpoint of the inter-provincial Gini coefficient based on per capita mileage of high-grade highway, which is decomposed according to such dimensions as the increment of the Gini coefficient, the Gini coefficient of different types of high-grade highway, and the Gini coefficient between and within inland and coastal areas. The Gini coefficient of China's per capita mileage of inter-provincial high-grade highway shows a declining trend year by year. According to the results from the decomposition of the contribution rate of different types of high-grade highway, the unbalanced development of inter-provincial high-grade highway is caused mainly by that of first- and second-grade highway. According to the results from the decomposition related to the increment of the Gini coefficient of China's per capita mileage of inter-provincial high-grade highway, the decrease of the Gini coefficient from 1997 to 2013 was mainly the result of balanced distribution of high-grade highway among regions in China. According to the results from the decomposition of the Gini coefficient between and within inland and coastal areas, the unbalanced development of inter-provincial high-grade highway in China from 1997 to 2013 was caused mainly by the unbalanced development of inter-provincial high-grade highway in inland areas. Therefore, the authors argue that the government should pay more attention to protecting the environment and providing a suitable scale of highway network, which could promote long-term sustainable development.

Introduction

There is a close connection between road transportation and economic development, wherein a solid economic foundation provides stable demand for road transportation and its development impacts economic development. Since the last century, the development of road infrastructure, represented by the expansion of high-grade highway, largely has accelerated the flow of all kinds of production factors, thus, maintaining China's rapid economic growth rate. In recent years, the IOT (Internet of things) has enjoyed rapid development, providing the country's transportation infrastructure with higher requirements than before. Logistics are becoming increasingly dependent on high-grade highways, especially expressways,

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owing to the special advantages of the highway transportation network over other transportation methods. In addition, the development of high-grade highways largely has shortened the physical distance between people, thus, providing people with more opportunities and better living standards.

High-grade highways in China are divided into three types, namely, expressways, first-grade highways, and second-grade highways. Expressways are the main component of the national highway trunk network, and their main functions are to connect politically, economically, and culturally important cities and regions. First-grade highways are arterial highways that mostly connect important political and economic centers and lead to key industrial and mining areas. Second-grade highways connect either suburban highways in busy transportation areas or arterial highways in political and economic centers and large industrial and mining areas. Third-grade highways and lower are not defined as high-grade highways, and essentially comprise all country highways and village highways. Although third-grade highways and lower have a relative larger mileage, this has tended to shrink in recent years.

According to data provided by the National Bureau of Statistics of the People's Republic of China (2014), only 200 km (km) of first-grade highways and 11,600 km of second-grade highways were in use in 1979. The construction of expressways began in 1988 when 100 km was completed. Since then, with the rapid development of the economy, highway transportation has experienced huge growth. By the end of 2013, the total mileage of China's highways reached 4,356,218 km, in which the mileage of expressways was 104,438 km, that of first-grade highways was 79,491 km, and that of second-grade highway was 340,466 km. Compared with highway mileage in 1997, these 2013 mileages were 2.5 times, 2.1 times, 4.4 times, and 2 times higher, respectively. According to the Twelfth Five-Year Plan of the Ministry of Transport of the People's Republic of China, during the five-year period from 2011 to 2015, the national highway network in China was established, covering 90% of each city and county in China with a population of more than 200,000 (Ministry of Transport of the People's Republic of China, 2011). With the rapid development of highway transportation, the scale of population flow and logistics has reached unprecedented numbers. During the "Spring Move" in 2008, 2 billion people used highway transportation and in 2014, this had grown to 3.2 billion. Express business volumes in 2008 were 1.51 billion, which grew to a global high of 14 billion in 2014, exceeding the express business of the United States for the first time in history (National Business Daily, 2015). The majority of the freight volumes and traffic volumes are carried by high-grade highways, which exert a large influence on the development of a nation's economy. Based on the abovementioned factors, we pay closer attention to research on high-grade highways.

Among all types of high-grade highway experiencing rapid development, the expressway in China has presented the most striking improvement. By the end of 2004, the Ministry of Transport of the People's Republic of China published a plan to establish a national highway network, targeting an expressway mileage of 85,000 km, equaling that of the United States in 2004. By the end of 2013, the total expressway mileage in China had reached 104,000 km, far exceeding the initial goal and representing a world first. By the end of 2014, this mileage had reached 112,000 km. The striking development of China's high-grade highway has triggered much research in the academic world.

Currently there are many studies on high-grade expressway, most of which have been carried out from the angle of engineering and related techniques. Substantial achievements have also been made by researchers studying the relationship between highway infrastructure, economics, and social development.

Much of the literature has proved that highway infrastructure can directly or indirectly promote economic growth. After conducting a series of research studies, Aschauer (1989) showed that economic growth was related strongly to government spending on infrastructure, like public transportation. In addition, he calculated the output elasticity of infrastructure to be 0.39. Terance (1993) concluded that the development of expressways could promote economic growth in areas with low economic output after studying the relationship between investment on expressways in the United States and regional economic development. Fan et al. (2002) conducted a series of analyses on provincial transportation infrastructure in China and pointed out that highways with different grades have different effects on economic growth and poverty relief.

Some studies, such as those conducted by Pereira and Roca-Sagalés (2003) and Cohen and Morrison (2004), showed that investments made by a regional government in infrastructure, like expressways, could not only promote economic development and increase economic output in the region, but also lower transportation and transaction costs, thus, generating positive spillover effects to neighboring regions in promoting economic development. Targa et al. (2005) studied the effects of the degree of transport convenience on economies using econometrics methods and found that complete transportation networks and services could provide solid foundations for conducting frequent and intense economic activities. Olamigoke and Emmanuel (2013) described the positive effects of highway infrastructure on Nigeria's economy and proposed related highway construction plans and management measures that could promote local economic growth. Weisbrod et al. (2014) considered that great economic benefits could be achieved through investment in transportation infrastructure and that such investment could both stimulate the economy and improve the rate of social output in the long run. Kim et al. (2014) concluded that expressway that opened in 2011 on South Korea's west coast improved traffic flow, stimulated economic development in neighboring regions, and had positive impacts on site selections of new factories. Lee and Munnich (2015), after exploring the relationship between transportation and competitive industry clusters, pointed out that transportation networks and related services supported the development of competitive industry clusters.

Other researchers have conducted their studies from the angle of the promotion of highway infrastructure for integration of the regional economy. For example, Dupuy and Stransky (1996) studied the combined development of highways and European cities and found that the development of highways could strengthen the connection among cities, specify the functions of each city, and promote the integration of the regional economy. Brenneman and Kerf (2002) studied the relationship

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