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Evaluation of large-scale transnational high-speed railway construction priority in the belt and road region

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ABSTRACT

This study deals with the large-scale transnational high-speed railway construction evaluation problem, which is a major issue in implementing the Belt and Road (B&R) initiative. We proposed a method for the selection of the most urgent need for transnational high-speed railway construction in the B&R region, which was tested on massive experimental data. The results show that 18 sections in the B&R region have priority conditions to build high-speed railways in current situations, which to a great extent coincide with those road sections covered by high-speed railway projects under construction or to be put into construction in the B&R region.

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1. Introduction

In December 2013, the Chinese government made the important decision of implementing the Belt and Road initiative (B&R), the purpose of which is “to speed up the construction of infrastructure interconnectivity with neighboring countries and regions, to promote the construction of the Silk Road Economic Belt and the 21st-Century Maritime Silk Road, and to form a new pattern of all-round opening” (Ze, 2014; Swaine, 2015; Brant, 2015; Godement and Kratz, 2015). The proposed initiative is of great significance, which means that the B&R construction will become an important foothold and starting point of a new system of open economy for China. As the largest developing country in the world, China has been severely hindered, and even marginalized in the international competition. In the situation of increasingly fierce international competition, if dealing with external pressures through new models of regional cooperation, such as the trans-Pacific Partnership (TPP) and the Transatlantic Trade and Investment Partnership (TTIP) (Rahman and Ara, 2015), China will create new opportunities for its own development. The implementation of the B&R initiative will build a full range of foreign development patterns and international collaborations within the new framework, through more effective foreign policies; it can promote the economic development of the country, as well as be of great significance in the construction of infrastructure to neighboring countries, in energy cooperation, and in other aspects of the real economy. It is well known that the construction of infrastructure and the manufacturing industry are key elements for the economic development of a country. In the sphere of influence of the B&R initiative, India and other South Asian countries, Indonesia and other Southeast Asian countries, and

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Kazakhstan and other Central Asian countries, the infrastructure construction and the manufacturing industry are facing several problems, such as lack of funds and technology (Dong et al., 2016; Zhu, 2016; Ghouri, 2016; Palit, 2017). China has strong capabilities in exporting technology as a great exporter of technology. For example, China offers leading technical solutions on a global level and has extensive construction experience in high-speed railways, which can effectively compensate for the lack of funds and the technical shortages of neighboring countries in the process of railway construction (Chen and Zhang, 2015; Wang and Huang, 2017).

Chinese President Xi Jinping has declared that the B&R construction should comply with five major goals, namely the policy coordination, facilities connectivity, unimpeded trade, financial integration, and the people-to-people bonds (Ze, 2014). It is clear that China hopes to achieve international, economic and trade, cultural and political communication with neighboring countries through trade agreements. At the same time, China hopes to make full use of the existing infrastructure of its surrounding countries. Through the construction of a high-speed railway, the connectivity of the logistics channel, as well as the capacity and efficiency of transport would be improved, thus promoting China to form a community of shared interests along with various countries and regions (Álvarez-Sanjaime et al., 2016). As a staunch supporter of global trade and investment, China has been actively promoting and participating in the multilateral trading system and regional trade cooperation. It is foreseeable that relying on the B&R construction, China will play a leading role in regional economic cooperation, which is not only conducive to the economic development of the countries along the Silk Road, but is also of great importance for the promotion of the international division of labor, international cooperation, and integration of regional economy.

Transportation is the main driving force for shaping and leading the economic space pattern; the construction process of a transportation system is the prerequisite and a significant foundation for the implementation of the B&R strategy. The construction of railways is represented by the strategy of “land-power,” which means that all railways will become the predominant means of transportation across the continents of Europe and Asia through Central Asia, South Asia, the Middle East, and West Europe. These railways will increase the mobility of the procreative factor in the countries and integrate them. Simultaneously, changing the definition and perspective of the countries along the Silk Road will lay a foundation for regional economic integration. By constructing high-speed railway as key “sally ports” and opening the international logistics tunnel (Chen and Zhang, 2015; Li and Schmöcker, 2016), China can promote road connections with the Middle Asian nations and strengthen the Maritime Silk Road construction, which is an important measure for the rapid implementation of the B&R project (Dong et al., 2016). Meanwhile, technology export can also increase the amount of the invested capital and improve the efficiency of investments. For example, the Pan-Asia high-speed railway, the Middle-Asia high-speed railway, the Eurasian high-speed railway, and the high-speed railway of the China-Russia plus America line are of the highest level in the world, the engineering scale and investment scale of which is immense. However, the profits are exactly considerable after the completion of the constructions. There are four key points to be considered in the entire B&R project, which are the European Union (EU), Russia, India, and China; the high-speed railway technology is the most crucial means for their connection. Many scholars conducted several studies and achieved a series of results (Jiao et al., 2014; Perl and Goetz, 2015; Chen and Zhang, 2015; Li and Schmöcker, 2016). However, the four cross-border high-speed railways are under planning for the time being, and present enormous difficulties in the full implementation of the construction. Although China can export the high-speed railway construction technology and partial capital, China considers it difficult to build such world-class lines. Owing to the immense capital demand, any individual country or district would not be able to afford it alone (Lim et al., 2016). To draw a conclusion, although an agreement on constructing high-speed railways in the B&R region has been reached at present, owing to several restricting factors, railway construction must develop gradually. That is to say, we should first construct the most important line, and then determine the next step of construction projects according to the development of new situations. The construction of large-scale transnational high-speed railways becomes a major issue in implementing the B&R initiative (Kaczmarski, 2015; Djankov and Miner, 2016).

There is ample literature on the construction technology or the impact assessment of high-speed railways; however, most of them are confined to one country or region. The study of high-speed rail networks across multiple countries is still relatively limited. In the present work, we deal with the large-scale transnational high-speed railway construction evaluation problem (LT-HSRCEP) in the B&R region and develop an evaluation method of the high-speed railway construction priority, in the hopes to find an accurate strategy to assess which road sections are the most suitable for the construction of high-speed railways. Since several road sections in the B&R region are transnational, their construction, operation and management would be very complex. Owing to the political relations among countries, the stability and economic status, and the geographic position of a country, whether the desired conditions exist for high-speed railway linking two countries need to be considered from a broader perspective. Fully considering the cost factors of the import and export logistics, while combining the characteristics of countries or regions, we have made efforts to discover the importance index of various sections of the road network in the main part of the city road network in the B&R region. After obtaining the optimal paths from domestic port cities in China to port cities in Asia, Europe, and Africa, we will determine the partial betweenness of all port city vertices and road sections in the B&R region by summing the number of times they are traversed through all optimal paths. Finally, we will calculate the priority construction of the road sections between the port cities, and we will then determine the priority order of high-speed railway construction.

To assess the accuracy of the LT-HSRCEP, a thorough experimental analysis is proposed. The basic experimental data come from literature (The Belt and Road Initiative Big Data Center at the State Information Center of China, 2016) and from official websites of Chinese State Council, such as the Ministry of Commerce (<http://www.mofcom.gov.cn/>), the General

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