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Should China further expand its high-speed rail network? Consider the low-cost carrier factor

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ABSTRACT

This paper examines China's large-scale high-speed rail (HSR) expansion, announced in July 2016, and the associated benefits assessment of the expansion program from the perspective of HSR-LCC (low-cost carriers) interactions. Our analysis suggests that in the highly populated and developed corridors the HSR expansion is likely to leave LCCs with little survival room, which is also shown by our case study on Spring Airlines. On the other hand, in the low-density corridors especially in the central and western China, LCCs might leave HSR with little survival room in the long run. By conducting a "propensity score matching" to pair HSR-linked city pairs in China to the counterfactual US airline routes, we find that most of these Chinese routes would be viable markets for LCCs to operate. The benefits of HSR expansion may thus be overestimated if not recognizing the LCCs' role as an alternative mode to serve these markets. In particular, for the routes to the central and western China with very small travel demand and high HSR construction cost, LCC service could be more cost efficient and operationally flexible than HSR. Our analysis calls for a more careful evaluation of the program and, more generally, a balanced and coordinated HSR and LCC development in China.

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1. Introduction

China has been the world's second largest airline market (behind the United States) since 2005, but its low-cost carrier (LCC) sector is far lagging other markets including the US, Europe, and Southeast Asia. Until 2010 there was only one LCC in China, namely, Spring Airlines, and LCCs together only accounted for 6.4% of domestic passengers carried in 2014 (CAAC, 2015a). They were underdeveloped in fleet size and the number of routes served (Fu et al., 2015a), while the state-owned full-service carriers (FSCs) still dominated Chinese airline market with air travel being concentrated at the three major hubs, namely, Beijing, Shanghai, and Guangzhou (Fu et al., 2015b). The underdevelopment of LCCs in China could be attributed to the legacy regulations and the lack of secondary airports in metropolitan areas as well as capacities at major airports (Zhang et al., 2008). For the last decade, China has been liberalizing its airline market (Fu et al., 2015a) and more airport capacities have been added, both of which should facilitate the growth of LCCs. However, the dramatic growth of high-speed rail (HSR), which is a recently emerged development in China, has imposed great competitive pressure on LCCs and will, as to be elaborated below, hinder the sector's future development.

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China's HSR program was elaborated in a National Development Plan in 2004, and was revised in later 2008 with additional injection of massive government funding to deal with the post-shock of the global financial crisis. By the end of 2015, the HSR network under operation in China reached 19,000 kilometer (km), a length that is greater than the rest of the world's HSR lines combined.¹ A network of four vertical (north-south) corridors and four horizontal (west-east) corridors (so-called the "4+4" network) is about to be formed. China's HSR lines, especially the ones with a design speed of 350 km/h, have significantly reduced intercity travel time, and they have imposed great challenges to airlines. The airlines were forced to cut prices and withdrew from several short-haul routes such as Wuhan-Nanjing, Nanjing-Shanghai, Zhengzhou-Xi'an (Fu et al., 2012; Jiang and Li, 2016).

Most recently in July 2016, China announced its latest "Mid-to-Long-Term Railway Network Plan" (MLTRNP) which sets out to further expand its HSR network to a total length of 38,000 km by 2025. Based on this plan, China will finally build eight vertical and eight horizontal corridors (to be referred to as the "8+8" network). Most of the cities to be linked by HSR in this latest plan are in the central and western China that are less economically developed and less populous than the current HSR-linked cities (which are largely in the coastal regions). Upon completion of the "8+8" network, all Chinese cities with more than half million population will have HSR linkage. Although the detailed investment plan of the "8+8 network" has not been announced, at least a yearly investment of 800 billion RMB (or roughly 115 billion USD) with current HSR construction cost is required from 2017 to 2025 to maintain the pace of HSR expansion as stated in the MLTRNP. This total investment from 2017 to 2025 can sum to about 7.2 trillion RMB (1.04 trillion USD), which is about 10% of Chinese GDP in 2016. Such a large-scale and ambitious HSR construction has never been seen anywhere in the world.

This study examines this large-scale HSR expansion and the associated benefits assessment of the expansion program from the perspective of HSR-LCC interactions (or the "LCC factor"). Examining the LCC impacts can be essential in that while China is still lagging the world in LCC development, LCCs have been proved to be an efficient intercity transport mode in the US, Europe, and Southeast Asia in terms of stimulating traffic and lowering prices (e.g., Whinston and Collins, 1992; Windle and Dresner, 1995, 1999; Morrison, 2001; Hofer et al., 2008; Donzelli, 2010). The potential preemption of LCCs by HSR will thus disable China to enjoy the associated benefits brought by LCCs as in the US, Europe, and Southeast Asia. As China is becoming increasingly liberalized in air transport policies and more airport capacities have been installed (Fu et al., 2015a; Zhang and Zhang, 2016), whether China can develop a prosperous LCC sector depends more on its survivability under the intensified HSR competition. On the other hand, the proven efficiency and operational flexibility of LCCs can impose a competitive challenge to HSR especially in smaller intercity travel markets. In other words, HSR may have little survival room for the routes to the central and western China with very small travel demand. Our assessment of China's HSR program is thus based on the two-way interactions between HSR and LCCs.

Surprisingly, despite the apparently more direct competition between LCCs and HSR, most of the existing studies only analyze interactions between HSR and FSCs (Albalade et al., 2015; Bergantino et al., 2015; Fu et al., 2012; González-Savignat, 2004; Takebayashi, 2014; Wan et al., 2016; Yang and Zhang, 2012; Zhang et al., 2017).² There are only a few exceptions: for example, Clewlow et al. (2014) analyze the differential impacts of HSR-LCC competition on air passenger traffic between the European short-haul domestic market and the medium-to-long haul intra-Europe market. Jiang and Li (2016) qualitatively compare the HSR and LCC sectors in Western Europe and Japan for their different interaction patterns. Wei et al. (2016) test whether there are different price reactions of FSCs and LCCs in response to the opening of Beijing-Shanghai HSR line and a fatal HSR accident in China. Overall, there has been no systematic research on a large-scale HSR network and its impact on air transport from an LCC perspective. Our study attempts to fill in this gap, focusing on China's HSR program.

Our second objective in writing this article is to evaluate the viability of LCCs, as an alternative to HSR, to serve Chinese intercity travels. One major rationale for the HSR expansion (from the "4+4" to "8+8" network) is to improve China's intercity mobility. However, due to the huge investment cost of HSR infrastructure, such expansion may face significant market risks and a high likelihood of economic loss (Zhao et al., 2015), while the LCC alternative could be more cost efficient and operationally flexible in facilitating intercity mobility (Levinson et al., 1997). Furthermore, as indicated above, empirical evidence in the US and Europe markets reveals the tremendous benefits of LCCs as an efficient intercity transport mode.

More specifically, we conduct a counterfactual analysis to benchmark the HSR-linked routes in China against the US airline routes. This can help us to better understand the role of LCCs as an alternative to the expanded HSR lines, if China could evolve to a US-like liberalized aviation market. Since the recent HSR expansion is intended to cover many secondary cities in the central and western China where the demand is likely to be small and the HSR construction cost is high, this understanding of the LCC viability to operate in these thin markets can have a major policy implication for a cautious and comprehensive evaluation of the ambitious HSR expansion plan.

The rest of the paper is organized as follows. Section 2 reviews the details of the large-scale HSR expansion and the LCC development in China. In Section 3, we conduct a counterfactual analysis to investigate LCC's viability in China through a propensity score matching (PSM) to the US airline market. In Section 4, we use Spring Airlines, the first and largest Chinese

¹ See the article available at http://english.gov.cn/news/top_news/2016/01/18/content_281475274283243.htm.

² As to be elaborated below, while both FSCs and LCCs can be adversely affected by the HSR expansion program, LCCs could be more vulnerable than FSCs. This is because LCCs and HSR offer more substitutable services (both target price sensitive passengers) as compared to the FSCs-HSR pair. Further, FSCs have advantages over LCCs in that FSCs can mitigate the competitive impact of HSR by developing air-HSR integration services, providing differentiated products, and leveraging on long-haul routes with their comprehensive network (e.g., Jiang and Zhang, 2014, 2016).

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