



Accounting for the impact of variety-seeking: Theory and application to HSR-air intermodality in China

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ARTICLE INFO

Keywords:

HSR-air intermodality
Stated choice
Variety-seeking
Mode choice
Latent variable
Discrete choice model

ABSTRACT

While variety-seeking has been analysed intensively in consumer marketing, little is known about its impact in the transport world where many novel travel services have emerged in recent years. In this paper, we investigate how variety-seeking could influence intercity travellers' mode choice decisions in the new context of HSR (high-speed rail)-air intermodality in China. The study is based on data collected in Shanghai, including responses to stated choice tasks and attitudinal statements on variety-seeking. An integrated choice and latent variable (ICLV) model is proposed with a view to provide us with a more behaviourally realistic explanation of respondents' choice decisions. The research findings suggest that variety-seeking has different impacts across modes, where variety seekers would be more likely to choose the newly-introduced integrated HSR-air option whereas variety avoiders have a higher propensity to choose car-air or traditional separate HSR-air alternative. Meanwhile, this study also examines the impact of various level-of-service attributes in mode choice behaviour, with results implying that long layover would heavily impair the attractiveness of integrated HSR-air service, and integrated luggage handling service is favourable to attract intermodal passengers while the effect of integrated ticketing system remains ambiguous.

1. Introduction

1.1. Research background

In recent years, a growing number of researchers and practitioners have moved away from merely analysing the competition between air and HSR (high-speed rail) to viewing the air-HSR relation from a perspective of intermodality featuring cooperation and complementarity. The European Union has long been promoting the complementarity between the air network and the rail network (European Commission's Directorate-General for Mobility and Transport, 2011) out of capacity, environmental and financial concerns, with an aim to not only alleviate the congestion at busy airports, but also improve the efficiency of the transport system as a whole. In Europe, while rail links (e.g. conventional rail, light rail, metro) at airports can be found relatively widely, HSR-air integration is mainly operationalised in airports with direct connection to a HSR network which requires a large amount of infrastructure investment and operating costs (Maffii et al., 2012), among which key examples are the cooperation between Thalys trains and Paris Charles-de-Gaulle Airport as well as between Deutsche Bahn trains and Lufthansa Airline on the Stuttgart-Frankfurt route (Chiambaretto and Decker, 2012; European Commission's Directorate-

General for Mobility and Transport, 2010a).

China has established the world's largest HSR network, with over 22,000 km in total by 2016 (Ministry of Transport of the People's Republic of China, 2017). An integrated HSR-air service, treating HSR travel as a feeder leg of long-distance air travel and allowing passengers to purchase HSR and flight services together, was first launched by China Eastern Airline in conjunction with the Shanghai Railway Bureau in 2011. HSR-air intermodality emerged in China mainly out of two different reasons. Firstly, HSR-air intermodality is expected to facilitate passengers from non-airport regions to access nearby airports where they can travel to/from a distant place. For example, passengers from many prefecture-level or county-level cities in the Yangtze river delta region can have access to airports in Shanghai through HSR. Secondly, HSR-air intermodality is considered capable of diverting passengers to/from a crowded hub airport to a nearby airport in order to decongest the busy hub airport. For example, passengers to/from Beijing Capital Airport - one of the world's busiest airport - are given the options to use the nearby Tianjin Binhai Airport and Shijiazhuang Zhengding Airport, which are about 150 km and 300 km away.

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1.2. Research questions

Although more cities begin to participate in HSR-air intermodality in China, the general public are not familiar with the integrated service as reflected by its relatively low passenger flow. Take Shanghai as an example, in 2015, about 8100 passengers chose China Eastern Airline's integrated HSR-air service which requires transferring at Shanghai (either HSR travel first or air travel first) every month while the monthly average volume of flight passengers, including both inbound and outbound, of two Shanghai airports is 8.27 million. The limited passenger demand might be potentially due to the relatively low level of integration of the current HSR-air intermodal service. To be specific, HSR-air intermodality products in China usually simply increase the time-window between the HSR segment and the air segment to diminish the possibility of fail-on-board due to service delay on either segment, making it less attractive to passengers (Li and Sheng, 2016). Besides, although passengers no longer need to purchase tickets twice for HSR journey and air journey, they are only offered with limited options in terms of airline, departure time, etc., and they are still required to collect train ticket and flight ticket separately. Moreover, as pointed out by a study on China's HSR-air intermodality (Givoni and Chen, 2017), though the benefit of realising integration between air and HSR has been recognised by China's policy makers and the integration infrastructure has been implemented in Shanghai, the actual integration level of the service is low, which can be attributed to 'the institutional (and cultural) division between air and rail transport and excessive importance attached to the competition between air and rail'.

This suggests that the underlying benefits of HSR-air intermodality in China are still yet to be justified and explored, and also reveals the necessity to analyse passengers' preferences towards different level-of-service attributes of the HSR-air intermodality and to examine how they affect passengers' mode choice in the context of HSR-air intermodality. In particular, unlike traditional mode choice studies which treat each mono-mode as an alternative in choice set, transport planners need to examine how passengers would choose among several multi-modes alternatives where direct travel service between the origin and destination is unavailable.

Apart from observable level-of-service attributes, other unobserved factors might also influence passengers' mode choice behaviour. For example, Bennett et al. (1957) suggested that perception of some emotional experience may affect passengers' mode choice, such that air travel is considered to be associated with anxiety, while rail travel is associated with feelings like slowness, etc. In the current paper, we particularly examine the impact of the underlying variety-seeking tendency on mode choice behaviour in the new context of HSR-air intermodality. That the integrated HSR-air service could still be treated as a new option in the intercity market even though it has been in the market for around six years, is largely due to the unfamiliarity with the HSR-air intermodality of the general public in China as well as the relatively low integration level of the integrated HSR-air service at the moment. We conduct variety-seeking analysis with a view to explore whether variety seekers would have a higher propensity to choose the new integrated HSR-air alternative while variety avoiders would be more prone to stick to other long-existing traditional alternatives, such as car-air and air-air and separated HSR-air. It should be noted that this paper only addresses such short-run impact of variety-seeking, therefore neither the mode choice behaviour in the long term after the market becomes fully mature, nor the link between choice preference variability/stability and variety-seeking in stated-preference survey is discussed. To be specific, we explore the measurement of underlying variety-seeking and incorporate such information to the choice model in different ways to enhance the behavioural explanatory power of the model.

The main methodology utilised is an ICLV (integrated choice and latent variable) model based on the framework proposed by Ben-Akiva et al. (2002) as it has become the standard approach to understand the

impact of unobserved factors on people's decision-making. Our ICLV model has a random utility by the maximisation (RUM) kernel, where the utilities for the different modes are influenced not just by observable characteristics but also the latent construct of variety-seeking which is also used to explain the responses to a series of attitudinal statements.

In the remaining of the current paper, there are five sections. The next section summarises the studies of relevant literature, which is followed by a section that describes the experiment design and data collection work. The applied methodologies and model specifications are presented in section 4. Then in section 5, the estimation results are discussed. In the end, the conclusions drawn in the current research and the shortcomings and research potentials are summarised in section 6.

2. Literature review and research contribution

2.1. HSR-air intermodality analysis

Among the research into HSR-air intermodality, most of the studies focus on estimating the impact of initiating HSR-air intermodality on, for example, environmental benefits, fares, traffic volume and welfare (Albalade et al., 2015; Dobruszkes and Givoni, 2013; Jiang and Zhang, 2014; Xia and Zhang, 2016; Zanin et al., 2012; Jiang et al., 2017). Other studies identify factors that affect the service level of HSR-air intermodality, such as travel time, travel price, ease of transfer, ease of access/egress, baggage handling system, ticket integration, service reliability, check-in and security-check procedures (Costa, 2012; Vespermann and Wald, 2011). An earlier survey by the International Air Transport Association (2003) suggested that poor connection was considered by passengers as the main barrier to travel by HSR before or after flying.

However, analysis of mode choice behaviour is rather limited, among which the majority can be found in the Spanish context (Brida et al., 2017; Martín and Román, 2013; Román and Martín, 2014). The work of Román and Martín (2014) was based on a stated-choice survey which confronted passengers with choices between air-air alternative and the integrated HSR-air alternative if they needed to travel between the remote Island of Gran Canaria and different cities in mainland Spain. It illustrates through various discrete choice models that different travel time components (connection time in particular) and fare integration are highly valued by passengers while the impact of luggage integration is important only for individuals who check in luggage and travel for leisure purposes.

The first and the only comparable analysis conducted in China is by Li and Sheng (2016) which examined mode choice behaviour and made travel demand forecasts on the Beijing-Guangzhou corridor. Notwithstanding the enlightening and valuable findings, some shortcomings of this research can be identified: 1) attribute levels were fixed and respondents from a same group were faced with one same choice task, which might lead to the weakness of examining the trade-off between different attributes and the potential inaccuracy in modal share forecasting; 2) the choice scenario was specified as choosing from a choice set consisting of direct flight, direct HSR, and integrated HSR-air for a domestic intercity travel, whereas we argue that the trade-off between travel time and travel cost would dominate decision-making in such a scenario, making it difficult to detect the roles of other level of service attributes; 3) the authors acknowledged in that paper the necessity to analyse the impact of travel time reliability due to delay, but did not consider it to avoid survey complexity. Other attributes closely related to integration (e.g. luggage integration, ticket integration) were not accounted for in that paper as they were treated as being unimportant in passengers' decision-making, however our research results demonstrate that this is not necessarily the case. Since national and local governments in China are now putting even more effort to establish integrated HSR-air service in more cities, it is of vital importance to have a greater in-depth understanding on how travellers'

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