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High-speed rail in Taiwan: New experience and issues for future development

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ABSTRACT

This study aims to identify some possible issues and challenges for Taiwan's High Speed Rail (HSR) system, which was constructed and is operated under a Build–Operate–Transfer (BOT) model. The operational experiences in the initial stage for equivalent systems in Japan, France, Germany, and elsewhere are introduced herein. This study first presents Taiwan's HSR system development and conducts an ex post cost–benefit analysis of this transportation system. Second, unsatisfied ridership is examined to look for possible solutions to increase it. Third, the paper examines the impact of HSR on the intercity transportation market. Finally, the integration between HSR and various existing transportation modes is discussed. Several policy suggestions are included, which are useful for the decision makers of transportation systems' entrepreneurs, the central government, and the local authorities to derive a comprehensive post-HSR planning strategy for a more integrated transportation system.

1. Introduction

The High Speed Rail (HSR) system has been proven to be a safe, comfortable, and efficient transportation mode (Ardun and Ni, 2005). Due to its ability to carry large numbers of passengers and provide short travel times, HSR has become one of the major tools to alleviate the traffic burden of some main traffic corridors in Japan, France, Germany, Spain, and also recently in South Korea and Taiwan. The introduction of HSR is considered to have spatial and socio-economic impacts on regional development (Banister and Berechman, 2001; Bonnafous, 1987; Froidh, 2005; Vickerman, 1997). Such improved interregional accessibility leads to a widening of the regional labor market and the establishment of a new corridor economy (Blum et al., 1997).

1.1. A new finance model

The social–economic benefits of HSR, however, require substantial investments (Roll and Verbeke, 1998). The total amount of Taiwan's HSR project is valued at U$15 billion. Because, the government could not afford such a financial burden by itself, co-financing with the private sector was one of the solutions, resulting in the proposal and final approval of a Build–Operate–Transfer (BOT) model. Funding of the Taiwan High Speed Rail (THSR) came from two main sources: shareholder equity accounting for 20%, with the rest borrowed mostly from local banking groups. The government permits these local banks to buy back the system in case of the project's financial failure.

One of the key financial success factors for a BOT project lies in the satisfaction of its ridership. However, compared to THSR's real ridership, the forecasted traffic was far overestimated, because the forecasting period was based on Taiwan's social–economic situation before the 1997 Asian financial crisis. The overly optimistic traffic forecast has led to financial pressure in the form of a large interest burden on loans borrowed from local banks for the private company running the HSR. On the other hand, public financing by the government is needed to assure that the project keeps moving so as to protect the social–economic benefits generated by the HSR. Therefore, the present study aims to investigate ridership, which is strongly related to this system's revenue, in order to find some possible strategies to improve THSR's ridership.

1.2. Impacts on the intercity transportation market

The impacts from HSR on the existing transportation modes of the intercity transportation market seem unavoidable (Vickerman, 1997; Suh et al., 2005;Lopez-Pita and Robuste, 2005; Givoni, 2006). In terms of HSR's market scope in the intercity transportation market, there are typical time thresholds relating to the lower and upper bounds in which HSR has a clear advantage based on previous experiences in Japan, France, and Germany. These thresholds are of the order of 1–3 h by riding on the HSR, representing distances between 200–600 kilometers, and based on an average operating speed of 200 km/h. This distance could increase along with improved HSR technology, as the operating

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speed can attain 300 km/h and the high-speed threshold can be upgraded to at least 700 km (Paris–Marseille and Madrid–Barcelona are both over 600 km). At shorter distances, the flexibility and lower access-to-network times for cars make it difficult for HSR to compete, while at longer distances the faster speed of airplanes overcomes the higher access-to-network and inconvenience factors in air travel (Vickerman, 1997; Plassard, 1991). Therefore, HSR's competitive advantage over other travel modes on certain trip lengths is obvious.

The role of the existing transportation modes certainly needs to be changed. The relationships between some modes with HSR are not always that of competitors, as they appear more likely to be more complementary to each other after HSR joined the market (Givoni and Banister, 2006), because HSR could be the main line-haul transportation mode for passengers, while a conventional railway can play the role of regional passenger transportation (under 150 km) and freight transportation. In addition, HSR could cooperate with international air carriers to create more seamless transportation service for passengers flying outbound from and inbound to Taiwan. In terms of accessibility, most THSR stations (except the main ones) are located at peripheral locations with no direct rapid transit connection. Therefore, the current poor accessibility between some HSR stations and some cities' downtowns are an issue that needs to be resolved. Based on the aforementioned arguments, the integration issues between HSR and the other existing transportation modes need to be further examined.

This study is thus organized to investigate the special features of THSR. The Section 1 describes some issues derived from THSR's revenue operation and the structure of this study. The Section 2 discusses some developed countries' HSR experiences such as Japan, France, Germany, Spain, and South Korea. The Section 3 includes THSR's system development and operational characteristics. The Section 4 includes an ex post cost-benefit analysis of THSR. The Section 5 looks at THSR's ridership, HSR's impact on the existing modes, and HSR's integration issues with other transport modes. The Section 6 offers possible policy suggestions to improve ridership and an integration between HSR and the existing transportation modes. Finally, conclusions and some managerial implications are provided.

2. The experience of other developed high-speed networks

With the exception of the United States and its main reliance on cars and airplanes, several developed countries have adopted HSR as an efficient transportation option for their intercity transportation market. Even in the US, the Obama administration plans to develop an HSR system so as to provide faster journeys, increased mobility, and better productivity. Japan and Europe have extremely effective HSR networks, and South Korea also boasts a new state-of-the-art system that opened in 2004. The following paragraphs discuss various HSR system developments during the initial stages of HSR operation (Table 1).

Table 1
Transportation impact of HSR in Japan, South Korea and Europe.
Source: Organized by author.

HSR system	Impacts after HSR operation	Referred literature
Japan Shinkansen	The traffic of Japan's Sanyo Shinkansen was diverted by (1) 23% from air (2) 16% from cars and buses (3) 6% induced demand	Givoni (2006)
France TGV	After the line of TGV Sud-Est, air traffic between Paris and Lyon decreased 50%. After the line of TGV Atlantique, air carrier traffic decreased 17%.	Vickerman (1997)
	The traffic of TGV Sud-Est from Paris to Lyon is derived from as follows: (1) 24% from air (2) 37% from cars and buses	Givoni (2006)
Germany ICE	About 12% of traffic transferred from air and roads.	Vickerman (1997)
Spain AVE	The demand (Madrid–Sevilla) for air carriers decreased 60%, and the demand diverted from the other modes is as follows: (1) transferred from air 32%, (2) transferred from buses 25%, (3) transferred from conventional railway 14%.	Vickerman (1997)
	The market share of domestic air carriers decreased from 89% to 36–47% (Madrid to Barcelona).	Lopez-Pita and Robuste (2005)
South Korea KTX	(1) 28% of air passengers preferred to travel by air after the opening of KTX. (2) Air traffic dropped by 20–30% after KTX operation and the traffic of the short-distance route (less than 100 km) increased about 20%.	Park and Ha (2006)

2.1. Shinkansen (Japan)

The Tokaido Shinkansen began revenue service on October 1, 1964 for the opening of the 1964 Olympics in Tokyo. In the initial stage of Shinkansen's operations, the maximum operating speed was 200 km/h, reducing the traveling time from Tokyo to Osaka to 2 h and 30 min. An extension of the Tokaido Shinkansen, the Sanyo Shinkansen from Shin-Osaka Station to Hakata Station in Fukuoka, was opened in March 1975. In Sanyo Shinkansen, 55% of traffic was diverted to the new line from the other rail lines, 23% from air, 16% from cars and buses, and 6% newly induced demand (Givoni, 2006).

2.2. TGV (France)

The first TGV line from Paris to Lyon was brought into operation service in 1981. The maximum speed permitted was 270 km/h and the journey time fell to 2 h for 450 km. Most of the diverted passengers came from air and half of increased TGV traffic came from newly generated trips (Bonnafous, 1987). In addition, the opening of TGV Atlantique in 1990 reduced journey times from Paris to Bordeaux to 3 h, leading to an immediate increase of around 50% in rail travel between 1989 and 1991 and a 17% reduction in air travel on the TGV Atlantique route as a whole (Vickerman, 1997).

2.3. ICE (Germany)

The origin of developing the HSR network was mainly aimed at overcoming particular bottlenecks in the existing network (Vickerman, 1997). In contrast with the French and Japanese HSR networks, ICE operated using the existing network in order to access major cities, because new construction would be difficult. ICE began its operation in 1992 and traffic accounted for 28% of long-distance passenger revenues in the first five years of operation. Deutsche Bahn (DB, German Rail) estimated that 12% of ICE traffic is transferred from road and air, and this diversion is significantly lower compared to the TGV network. The reason for the low rate of diversion to ICE, due to the higher ticket price of