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The Impact of High-Speed Rail on Residents' Travel Behavior and Household Mobility: A Case Study of the Beijing-Shanghai Line, China

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Abstract: With the improvement of China's high-speed rail network, there have been many economic and social benefits for local residents. Based on a questionnaire conducted in stations on the Beijing-Shanghai line, and through an analysis of high-speed rail passenger travel behavior and family relocation, we explored the social effects of high-speed rail. The study found that high-speed rail passengers are mainly young, highly educated, and have a middle to high income. However, with the popularization of high-speed rail, such differences in the social stratum of high-speed rail passengers are expected to disappear. Through an analysis of passenger travel status, we found that the areas surrounding high-speed rail stations are very accessible to the main cities, and are well connected by other public transport. With the emergence of the "high mobility era" based on the high-speed rail network, the separation of workplace and residence and the number of "double city" households are increasing, primarily in the Beijing-Tianjin and Shanghai-Nanjing (especially in Suzhou-Kunshan-Shanghai) regions. In addition, high-speed rail introduces the possibility of household mobility, with 22.7% of the respondents in this study having relocated since the Beijing-Shanghai line opened. Household mobility is apparent primarily among big cities, with movement toward nearby cities. We also found that occupation, income, residence time, and schooling of children have a significant impact on households. With the improvement of high-speed rail networks, household mobility will become a common phenomenon and research on domestic mobility will continue to increase.

Keywords: high-speed rail; social effects; residents' travel behavior; household mobility; Beijing-Shanghai line

1. Introduction

Over the past few years, the Chinese government has vigorously promoted the development of high-speed railways (HSRs) in China [1]. Some researchers have found that in China the development of HSRs has resulted in dramatic time-space shrinkages between cities [2], and most cities have become more accessible [3]. The impact of HSRs on China's regional economy and space is becoming more apparent as the HSR network is further optimized. "HSR hot" (gao tie re) has expanded throughout the whole country and there are high expectations for the effectiveness of HSR. For the central government, HSR is an important economic driver [4]. Local governments expect HSRs to change the regional economic status of cities, and the construction of the new towns linked to the HSR network will

produce an enormous amount of revenue from the special land finance system (tu di cai zheng) [5]. For local people, HSRs are important public products that will improve travel convenience, promote economic development, and increase employment opportunities [3]. HSRs not only have a significant impact on regional economies [6] but also have a large impact on local social structure and family life [7,8]. As a consequence, an HSR construction boom has occurred in China. However, the impact of HSRs' construction on China's sustainable urban development has not been paid enough attention. In China, many HSR new towns (gao tie xin cheng) were built to capitalize on the high property value caused by HSR stations. These new towns in smaller cities have a lack of vitality and may become ghost towns. With the economy faltering, the inefficient investment of HSR new towns has a significant negative impact on the sustainable development of these cities. Therefore, it is necessary to do more research on the socio-economic effects of HSRs' construction in China.

The impact of HSR includes economic and social effects. The economic effect is based on the "time-space compression" of regions, produced by the construction of a local HSR. For example, Gutiérrez [9] used three indicators (weighted average travel times, economic potential, and daily accessibility) to measure the accessibility impact of the Madrid-Barcelona-French border high-speed line and found that there were polarizing effects at the national level and balancing effects along the travel corridor. For the cities along the HSR route, there were also "spatial spillovers" of transport infrastructure investment [10]. Sands [11] found that an HSR would increase regional population, employment growth rates, economic activities, and land value around the station. Wang et al. [12] found that with the development of the HSR network in China's Jiangsu province, accessibility levels across the province improved by 9.6% and the inequality of regional accessibility decreased by an average of 25.7%. Zhang et al. [13] found that HSRs in China not only generated a time-space contraction effect to the region from the station to the cities along the HSR line, but also strengthened interactions among different regions. Both in China and in the European Union, HSR is regarded as an instrument to promote economic integration by enhancing competitiveness and achieving greater economic cohesion. However, different countries have different attitudes to HSR. Although some countries are keen to invest in HSR, there are also concerns over the total investment costs and the real economic return of HSRs [14–16].

The social effect of HSR refers to the change in local people's behavior (such as travel behavior and household mobility) after an HSR station opens. Regional high-speed train services have a large impact on the travel market and on travel behavior [17]. Liu and Zhang [18] used a fuzzy clustering model to show that an HSR (between Beijing and Tianjin) created multiple travel activities (business trips, visiting relatives, etc.) and strengthened economic and social interactions. Based on the theory of planned behavior [19], Hsiaoa and Yang [20] found that in Taiwan high-speed train services are more attractive to people who previously traveled on traditional trains. In addition to the direct effect on people's behavior by changing the local economy and environment, HSRs have indirect effects on people's behavior. For example, HSR stations increase investment attractiveness, employment opportunities, and house prices [21,22]. Employment and housing opportunities increase the likelihood of residential relocation for many families [23,24].

In the Chinese context, with high house prices and an imbalance of employment, some households have changed their living strategy. For example, in the integrated city region of Guangzhou-Foshan (Guang-Fo tong cheng hua), which is linked by intercity rail, there are many families that choose to live in Foshan city but work in Guangzhou city. In China, there is an increasing number of integrated city regions [25,26], such as Shanghai-Suzhou (Kunshan), Beijing-Tianjin, and Shenzhen-Huizhou. Like the super highway of America, which enabled American families to migrate to the suburbs [27], HSRs have also allowed Chinese families to adjust their living choices. The large HSR infrastructure has a significant impact on the living and mobility decisions of households.

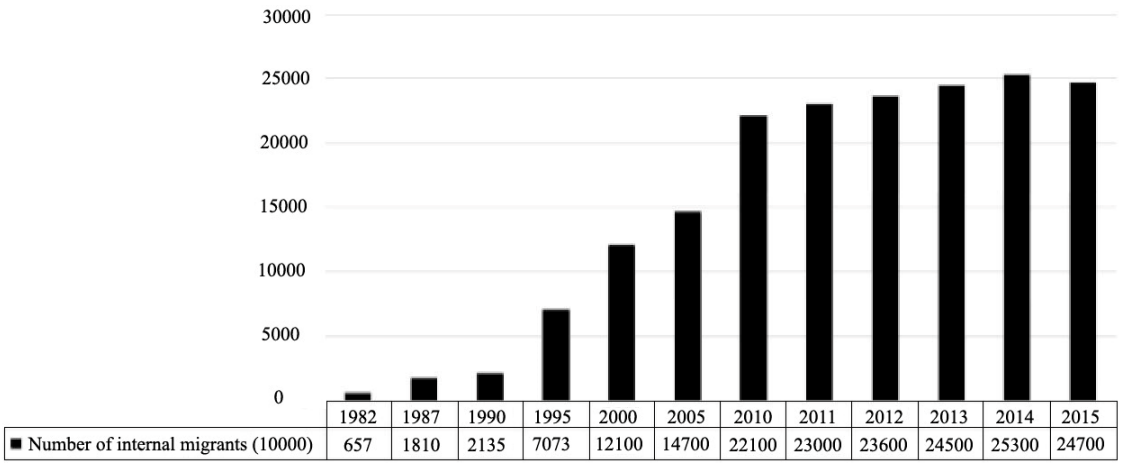
Most existing studies have focused on the travel behavior and environmental changes influenced by HSRs. There are few studies of the impact of China's HSR on the lifestyle of households and the willingness to relocate. We, therefore, restricted our study to the social impact of HSRs, by analyzing

the changes to the normal lives of urban residents due to the presence of an HSR. We analyzed the willingness to relocate due to the opening of an HSR station. In this paper, we considered the following questions: (1) "What are the socioeconomic characteristics of a typical HSR passenger?" and (2) "What are the main factors related to HSR that would promote a willingness to relocate?" By investigating the impact of HSRs, this paper contributes to the literature on the social impact of large infrastructure in China.

The remainder of this paper is organized as follows. The next section provides a brief review of China's population mobility and the construction of HSRs. Section 3 summarizes the data and methods used in the empirical analysis. We also provide a descriptive account of the socioeconomic status of the Beijing-Shanghai HSR passengers and their travel patterns. Section 5 analyzes the impact of HSR on urban households, with a particular focus on the willingness of families to relocate due to the availability of the HSR. Section 6 is a discussion and the final section provides the conclusion of the study.

2. Population Mobility and the Construction of HSRs in China

Since reform and opening-up, China has experienced large levels of population mobility. In the planned economy period, population flow was strictly limited [28,29]. It was unusual for rural people to migrate to urban areas, except for some political migrants, such as with the resettlement of ex-servicemen. In the urban areas, residents were arranged in danwei communities, in which family mobility was very low [30]. After the reform and opening-up policy was initiated, China's population mobility gradually increased. However, due to various factors (such as hukou [28] and employment opportunities), most of the rural population moved to nearby urban areas [31]. In addition to institutional and economic factors, the presence of infrastructure also has an important effect on migration. An immature transportation network decreases the likelihood of population mobility. From Figure 1, we can see that from 1982 to 1990 the number of migrants increased rapidly. From 1990 to 2010, the number of Chinese migrants begins to increase massively, while after 2010 the number of migrants was almost constant. From Table 1, we can see that the change in the number of migrants and the development of highways and rail networks was almost simultaneous. Although the population mobility has continued since 1978 [32], the development of transportation was an important requirement.



	1982	1987	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
■ Number of internal migrants (10000)	657	1810	2135	7073	12100	14700	22100	23000	23600	24500	25300	24700

Figure 1. The number of internal migrants in China from 1982 to 2015.

Compared with developed countries, the construction of China's HSR network started late. With financial assistance from the Chinese government, there has been a rapid development of HSRs. An HSR was officially proposed by the Chinese Ministry of Railways for the first time in 1990. By the end of 2015, the Chinese HSR network extended for more than 40,000 km. HSRs have played an

increasing role in China's economic and social development in recent years. The development of HSRs will promote coordinated regional development. The distribution of China's population and the HSR network are largely coincident, with both concentrated in eastern and southern China [3]. It is likely that HSRs will gradually change the way urban residents travel, and will alter the population and urban spatial structure [33]. During the period of normal transportation (1980–2010), China's population mobility was mainly from rural to urban areas, and from the west to the east [34]. During the period of HSR, China's population mobility has mainly occurred in the east and between urban areas. In the past, the strategy of China's rural households was "work in urban areas, live in rural areas" [35]. After entering the period of HSR, depending on the availability of HSR, households have been able to change their strategy to "work in one city and live in another city". This phenomenon is increasing in prevalence. For example, some urban residents work in Beijing but live in Tianjin, and commute by HSR. Because there are more job opportunities in Beijing than in Tianjin, house prices are much lower in Tianjin than in Beijing. A new division of city functions is emerging in China, and people's lives are changing.

Table 1. The development of China's highways and railway network.

The Type of Rail	Year	Important Event
Highway	1988	The first highway in China was built and opened to traffic, running from Shanghai to Jiading.
	1998	China increased the investment in highways to ward off the Asian financial crisis. The network of highways rapidly emerged.
	2002	The length of highways in China reached 25,000 km, the second longest highway network in the world.
Rail	1996	The Beijing to Kowloon line opened, which was regarded as a "Transportation Artery".
	2002	Shanghai became the world's first city to operate a commercial high-speed maglev train.
	2007	China implemented its sixth railway speed increase, with the speed of the "Hexie Hao" (the Harmony) train reaching 250 km/h.
	2008	Construction began on the Beijing-Shanghai HSR line.
	2016	China built the world's longest high-speed rail network [36,37].

3. Data and Methodology

This study sought to analyze the impact of China's HSRs on people's travel behavior and household relocation. Our analysis was based on a first-hand questionnaire survey, which was conducted in stations on the Beijing-Shanghai HSR line (Figure 2). We selected the 16 main stations (Langfang, Tianjin, Cangzhou, Ji'nan, Tai'an, Qufu, Zaozhuang, Xuzhou, Suzhou, Bengbu, Chuzhou, Zhenjiang, Changzhou, Wuxi, Suzhou, Kunshan) on the Beijing-Shanghai line to conduct a questionnaire survey between April and May 2015. During the survey, we adopted a random sampling technique to collect questionnaire responses in station waiting rooms. A total of 320 questionnaires were collected (20 questionnaires were collected at each station), of which 282 were valid, giving an effective return rate of 88.1%. The survey was conducted in a face-to-face manner. We collected questionnaires in different waiting areas of the station. In the sampling process, only one questionnaire was collected from each waiting group (people traveling together) to ensure that the questionnaires were from different groups. Compared to the massive passenger flow, our survey had a small sample size. However, although the sample size was relatively small, the data was representative and could reflect the social effect of HSR in China. As an exploratory study, it was still worth trying. We focused on the effects of HSR on the daily lives of users. Our questionnaire was divided into three parts: the first part assessed the respondents' socioeconomic status, the second part assessed the respondents' travel behavior, and the third part assessed the impact of the HSR on their family life (e.g., shopping, health care, schooling, and visiting relatives). Because Beijing and Shanghai are the largest cities in China and are very different from other cities along the line, we did not collect questionnaires in these two cities.

Beijing-Shanghai high-speed rail connects China's two largest cities, Beijing and Shanghai. The Construction of Beijing-Shanghai high-speed rail began in April 2008. The line opened to the public for commercial service in June 2011. The length of Beijing-Shanghai high-speed rail was 1318 km. At present, its speed is 300 km per hour. It takes 4 h and 48 min from Beijing to Shanghai at top speed and the fare is 553 yuan (the average monthly wage of employees is 7086 yuan in Beijing in 2015). In 2015, the Beijing-Shanghai high-speed rail carried 130 million passengers (a daily average of 347,000 passengers). This increase in mobility was remarkable. Table 2 shows the travel time and ticket price between each station of Beijing-Shanghai HSR line (300 km/h).

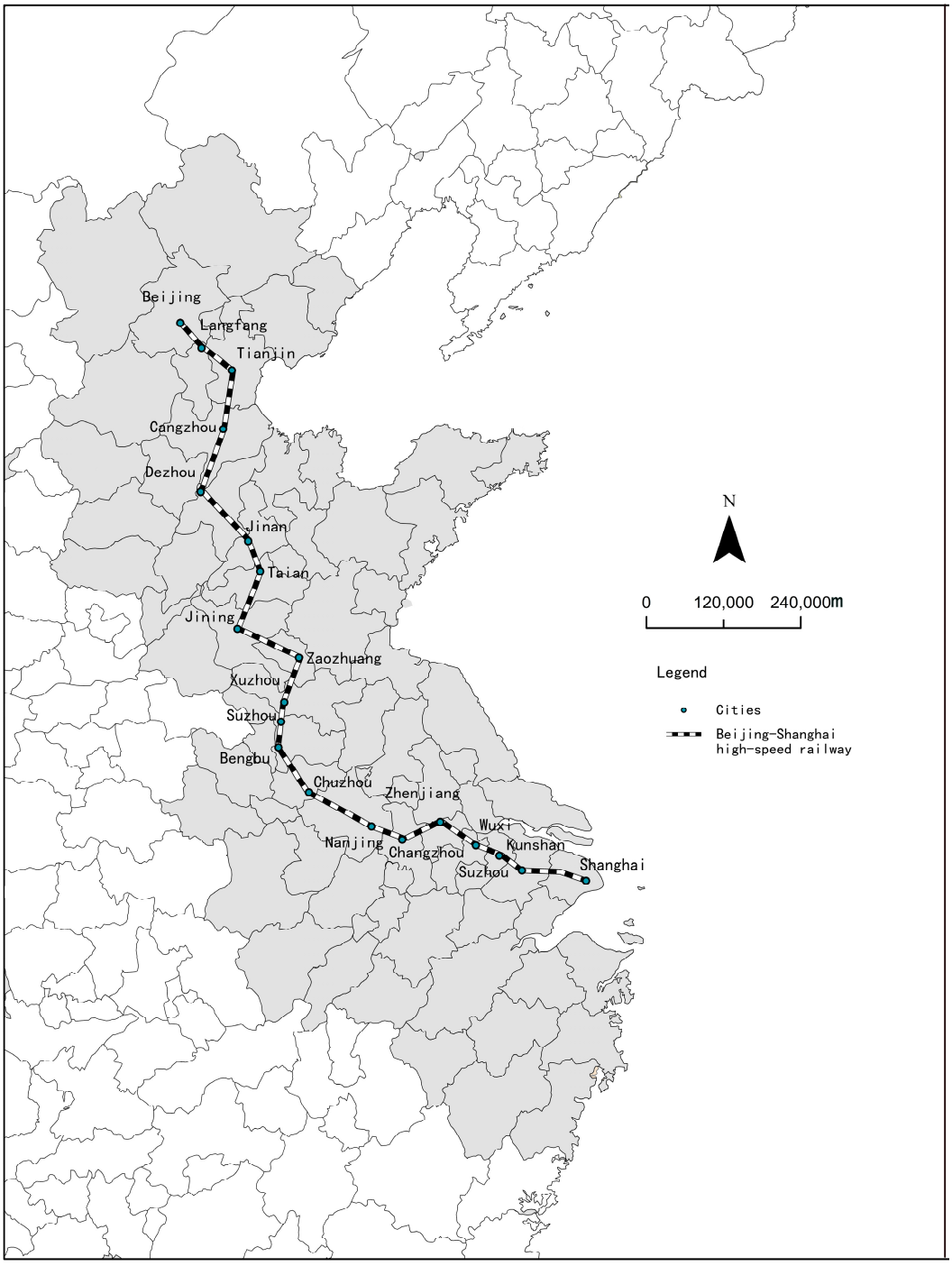


Figure 2. The Beijing-Shanghai HSR line and the cities along the line.

We used logistic regression analysis technology to test the impact of HSR on the willingness of respondents to relocate their families. This analytical method is effective and has been widely used in previous studies [38]. In the model of logistic regression of the willingness of a family to relocate, we selected "willingness of a family to relocate due to the opening of the Beijing-Shanghai HSR line" and 15 other related variables as dependent variables. The dependent variables were as follows.

Demographic and socioeconomic characteristics: Gender (male = 1, female = 0), age (continuous variable), level of education (reference = master's degree or higher, primary school or lower, junior high school, high school or technical secondary school, bachelor degree), occupation (reference = factory workers and others, managers, general workers), personal average annual income (reference = 150,000 yuan and higher, ≤30,000 yuan, 30,000–60,000 yuan, 60,000–100,000 yuan, 100,000–150,000 yuan).

Urban factors: Duration of residence in the city (continuous variable), employment-residence in the same city (ER in the different city = 1).

Traffic factor: Commuting time (from home to station, continuous variable), travel frequency (reference = more than 8 times per month, < once per month, 1–4 times per month, 5–8 times per month).

HSR factor: Frequency of contact with friends and relatives who live in other cities (increase = 1, not increase = 0), employment impact (have an effect = 1, no effect = 0), schooling impact (have an effect = 1, no effect = 0).

Table 2. The travel time and ticket price between each station of Beijing-Shanghai HSR Line.

Station	Travel Time between Stations (Minute)	Ticket Price between Stations (Yuan)	Distances between Stations (km)
Beijing	-	-	-
Langfang	21 (40)	29.5	59
Tianjin	18 (43)	29.5	72
Cangzhou	30 (124)	49.5	88
Ji'nan	69 (132)	99.5	200
Tai'an	17 (52)	24.5	43
Qufu	19 (90)	29.5	71
Zaozhuang	23 (149)	39.5	92
Xuzhou	18 (67)	29.5	63
Suzhou	18 (47)	29.5	79
Bengbu	23 (61)	39.5	77
Chuzhou	28 (101)	54.5	115
Zhenjiang	39 (-)	54.5	128
Changzhou	23 (52)	34.5	57
Wuxi	17 (27)	24.5	57
Suzhou	15 (28)	19.5	26
Kunshan	12 (24)	14.5	32
Shanghai	27 (40)	24.5	43

The ticket price between each station is second-class seat fare. The figures in parentheses are the travel times of the conventional rail.

4. Descriptive Statistics

Based on the 282 questionnaires, the status of HSR passengers and their travel was analyzed (see Tables 3 and 4). In terms of the gender and age structure, there was a predominance of men, accounting for 71.6% of the total, and young people (mainly in the age range 18–35 years old), accounting for 75.2% of the total respondents. In terms of education, HSR passengers were mainly people with a higher degree, with undergraduate level and higher qualifications accounting for 73% of the total. In terms of personal income and occupation, there was a predominance of middle- and upper-income users, with passengers having an annual income of 60–100,000 yuan accounting for 33.3% and those with an income of more than 100,000 yuan accounting for 29.8% of the total. In terms of the occupation structure, managers (government workers, executive groups) accounted for 16.7% of total passengers. General workers (public sector employees, corporate employees, self-employed, service employees, workers, and freelancers) accounted for 72.9%, while other occupations accounted for 10.4% of the total. Overall, the distribution of respondent occupations was relatively balanced.

In terms of residence time, more than five years accounted for 65.2%, while less than three years accounted for 24.5% of the total.

To travel within the city, the HSR passengers mainly used public transport, among which taxis, buses, and the subway accounted for 68.9% of all travel. Commuting time to HSR stations was classed as less than 30 min, 30 to 60 min, or more than 60 min, with each category accounting for 50.7%, 34.1%, and 15.2%, respectively. Commuting time was considered to be relatively reasonable. In terms of the passenger travel situation, transport cohesion and degree of accessibility of the areas surrounding stations on the Beijing-Shanghai HSR line and the main urban area were high. In terms of trip purposes, work trips accounted for 66.3% of the total, followed by tourism and visits to friends and relatives, accounting for 28.7% and 26.2%, respectively. This indicates that current HSR travel usage is mainly business travel, although the number of more conventional trips continues to increase. In terms of travel frequency, 50.7% of passengers used the service for more than one trip per month, which also reflects the above usage characteristics. It is noteworthy that 19.9% of users were employment–residence split families, which reflects the space–time compression effect of HSR, enabling families to work and live in different cities.

From the survey, it was apparent that the number of households with individuals who work in Kunshan, Beijing, Suzhou, Tianjin, and Ji'nan, while living in other cities, was larger than for other cities along the HSR line. The Ji'nan-Tianjin-Beijing and Suzhou-Kunshan-Shanghai segments of the line had more employment-residence split families. The employment-residence relationship of Suzhou-Kunshan-Shanghai was stronger than that of Ji'nan-Tianjin-Beijing, which reflects the close economic ties between these cities. Employment-residence split families mainly utilized cities that have close spatial and economic ties. Economic ties and spatial proximity are important foundations for the emergence of employment-residence split families, while the construction of HSRs increases the likelihood of maintaining this lifestyle.

Table 3. The socioeconomic status of high-speed rail passengers.

Attributes		Proportion
Gender	Male	71.6%
	Female	28.4%
Age (year)	<18	0.7%
	18–35	75.2%
	35–65	23.7%
	>65	0.4%
Level of education	Primary school or lower	0.7%
	Junior high school	9.6%
	High school or technical secondary school	16.7%
	University or college	55.0%
	Above bachelor degree	18.0%
Duration of residence in the city (year)	<0.5	6.4%
	0.5–1	5.7%
	1–3	12.4%
	3–5	10.3%
	>5	65.2%
Annual income (yuan)	≤30,000	11.0%
	30,000–60,000	25.9%
	60,000–100,000	33.3%
	100,000–150,000	17.4%
	≥150,000	12.4%
Occupation	Government employee	4.3%
	Senior manager	12.4%
	Public sector employee	14.7%
	Enterprise staff	29.1%
	Self-employed	9.2%
	Service employee	4.6%
	Skilled worker	3.2%
	Liberal profession	12.1%
	Student	8.9%
	Farmer	0.4%
	Others	1.1%

Table 4. High-speed rail passengers' travel behavior.

Attributes		Proportion
Travel mode (from home to station)	Walk	1.7%
	Bicycle	0.4%
	Electro-mobile/motorcycle	1.1%
	Private car	28.0%
	Taxi	29.7%
	Bus	27.0%
	Subway	12.1%
Travel frequency (by HSR)	Less than once per month	49.3%
	1–4 times per month	34.8%
	4–8 times per month	9.9%
	More than 8 times per month	6.0%
Commuting time (from home to station) (minute)	<10	4.3%
	10–20	19.1%
	20–30	27.3%
	30–60	34.1%
	>60	15.2%
Trip purpose	Work	66.3%
	Tourism	28.7%
	Medical appointments	0.7%
	Visits to friends and relatives	26.2%
Employment-residence relationship	Employment-residence in the same city	80.1%
	Employment-residence in different cities	19.9%

Trip purpose in the table is multiple choice.

5. The Influence of HSR on the Willingness of a Family to Relocate

5.1. The Impact of HSR on Households

By asking which aspect of family life was most influenced by the HSR, we found that space-time compression effect of HSR was mainly reflected by the convenience of travel. The greatest impact on the families surveyed was in tourism, employment, and visits to relatives and friends, which accounted for 29.8%, 23.8%, and 19.5% of all travel, respectively. The impact that the HSR had on access to public services, such as schooling and medical appointments, was not obvious, and only accounted for 6.7% and 0.7% of all journeys, respectively. Among the respondents, 22.7% had relocated to other cities once the Beijing-Shanghai HSR began operating, which indicates that HSRs enable intercity family migration to some extent. When asked whether contact with relatives and friends had increased after the Beijing-Shanghai HSR opened, 45.4% of all respondents gave positive answers. It was clear that space-time compression effect of the HSR has strengthened contact with relatives and friends (Table 5).

Table 5. The impact of high-speed rail on the everyday life of urban households.

Impact Distribution		Proportion
Impact on the everyday life of urban households	Work	23.8%
	Schooling	6.7%
	Tourism	29.8%
	Medical appointments	0.7%
	Visits to friends and relatives	19.5%
	others	19.5%
Relocating or not	Yes	22.7%
	No	77.3%
Increasing contact with friends and family or not	Yes	45.4%
	No	54.6%

In summary, the construction of the HSR has had a significant impact on family travel behavior, family spatial structure (e.g., employment-residence, migration), and family ties. Respondents who indicated a willingness for intercity migration were asked for further details. We found that Suzhou, Shanghai, and Beijing were the three cities with the largest family immigration and emigration. Thus, the impact of the HSR on the willingness for intercity migration among families was mainly within the economically developed cities. With the growing popularity of HSRs, families will be able to settle in developed cities, while urban household migration will mainly occur between these developed cities. From the perspective of the socio-economic characteristics of residents who are willing to migrate (Table 6), the groups most influenced by HSRs were males, middle-aged, middle-income, highly educated workers, and business travelers. From the perspective of the spatial distribution or urban residents, residence-migration had a spatial proximity, with a tendency for migration to the nearest big city.

Table 6. Socio-economic characteristics of respondents who were willing to relocate.

Attributes		Proportion
Gender	Male	71.9%
	Female	28.1%
Annual income (yuan)	≤30,000	17.2%
	30,000–60,000	18.8%
	60,000–100,000	34.4%
	100,000–150,000	23.4%
	≥150,000	6.2%
Level of education	Primary school or lower	1.6%
	Junior high school	7.8%
	High school or technical secondary school	14.1%
	Bachelor degree	60.9%
	Master degree and above	15.6%
Age (year)	<18	1.6%
	18–35	71.9%
	35–65	26.6%
Occupation	Government employee	1.6%
	Senior manager	9.4%
	Public sector employee	15.6%
	Enterprise staff	23.4%
	Self-employed	7.8%
	Service employees	7.8%
	Factory worker	4.7%
	Liberal profession	12.5%
	Student	15.6%
	Farmer	1.6%

5.2. Logistic Regression Analysis

Logistic regression analysis was used to explore the impact that the HSR had on urban households (Table 7). The willingness of a family to relocate was set as the dependent variable in the regression model, with demographic and socioeconomic characteristics, urban factors, traffic factors, the HSR, and other influential factors all considered. The individual and family factors were gender, age, level of education, occupation, and annual income. The urban factors were residence time and employment-residence in the same city. The traffic factors were commuting time and travel frequency. The impacts of the HSR were on visits to friends and relatives, employment, schooling, and others.

Table 7. Logistic regression analysis of the willingness of a family to relocate.

Dependent Variables (Willing to Relocate = 1, Not Willing to Relocate = 0)		B	S.E.	Exp (B)
Demographic and socioeconomic characteristics	Gender (ref: male)	−0.372	0.385	0.689
	Age	0.618	0.384	1.856
	Level of education (ref: master degree and above)			
	Primary school and less	0.668	2.013	1.950
	Junior high school	−0.127	0.696	0.880
	High school or technical secondary school	−0.034	0.582	0.967
	Bachelor degree	0.665	0.473	1.945
	Occupation (ref: factory workers and others)			
	Manager	2.471 ***	0.723	11.834
	General staff	0.691	0.526	1.996
	Personal average yearly income (ref: 150,000 yuan and higher)			
	≤30,000 yuan	1.933 *	0.771	6.909
	30,000–60,000 yuan	0.388	0.686	1.473
	60,000–100,000 yuan	1.144	0.652	3.138
	100,000–150,000 yuan	1.438 *	0.667	4.212
Urban factors	Duration of residence in the city	−0.424 ***	0.130	0.655
	Employment-residence in different city (ref: ER in the same city)	0.154	0.425	1.166
Traffic factor	Commuting time (from home to station)	−0.130	0.152	0.878
	Travel frequency (ref: >8 times per month)			
	<once per month	0.000	0.726	1.000
	1–4 times per month	0.710	0.727	2.035
	5–8 times per month	1.282	0.829	3.605
HSR factor	Frequency of contact with friends and relatives in other cities (ref: no increase)	−0.610	0.335	0.543
	Employment impact (ref: have no effect)	0.499	0.399	1.648
	Schooling impact (ref: have no effect)	1.685 **	0.793	5.393
	Constant	−4.688 **	1.867	0.009
	Chi-square			44.479 ***
	−2 Log likelihood			257.579
	Percentage correct (%)			81.9
	Sample size			282
	df			21

* $p < 0.10$, ** $p < 0.05$, and *** $p < 0.01$. B is the regression coefficient. S.E. is the standard error of the regression coefficient. Exp (B) is the occurrence ratio.

From the model, the value of the −2 Log likelihood was 257.579, which accounted for a degree of explanation of 81.9%. The main factors in the model were occupation, income, residence, and schooling, all of which were statistically significant. From the occurrence ratio (Exp (B)), the willingness of managers to relocate was 11.834 times greater than that of migrant workers, which indicates that occupation has a clear impact on family relocation. Managers with more human capital and more extensive social relations have access to more employment and market information, and the construction of an HSR is more likely to encourage their relocation for career development. Therefore, the construction of an HSR will weaken local talent and enhance mobility. It was found that the willingness of workers earning <30,000 yuan and 100,000–150,000 yuan to relocate was 6.909 and 4.212 times greater, respectively, than those earning above 150,000 yuan. One possible explanation for this is that low-income residents are more likely to migrate to search for better job opportunities with a higher income. In contrast, middle- and upper-income residents, along with their accumulation

of wealth, are likely to have consolidated their urban housing, home, school, and other requirements to achieve a satisfactory family life. Residence time in a city had a negative correlation with the willingness of a family to relocate—i.e., the longer a family had settled in a city, the less likely they were to relocate—which reflects the fact that HSRs enhance migrant mobility. One possible explanation for the impact of schooling is that HSRs shorten the space-time distance between cities and strengthen family ties, which increases the potential for off-site study.

6. Discussion

6.1. The Socioeconomic Characteristics and Travel Behavior of a Typical HSR Passenger

Based on investigations in the main stations along the Beijing-Shanghai HSR, this study found that passengers were mainly young, highly educated, and had a high income. With the further promotion of HSR networks, the social characteristics of HSR passengers (occupation, social stratum, etc.) will gradually become more mixed. In terms of the passenger travel situation, the transport cohesion and degree of accessibility of the areas surrounding stations on the Beijing-Shanghai HSR line and the main urban area were high. HSR passengers mainly use public transport for travel, and the commuting time to stations is considered reasonable. In terms of the purpose of travel, work trips accounted for 66.3% of the total, followed by tourism and visits to friends and relatives, which accounted for 28.7% and 26.2%, respectively. This indicates that HSR travel is currently mainly used for business travel, although the amount of more conventional travel continues to increase. In addition, it is noteworthy that employment-residence split families account for 19.9% of all travel. This reflects the space-time compression effect of HSR, which has enabled families to work and live in different cities, with the number of such families still increasing. The Ji'nan-Tianjin-Beijing and Suzhou-Kunshan-Shanghai segments of the HSR have produced more employment-residence split families. Among which, the employment-residence relationships of Suzhou-Kunshan-Shanghai are stronger than those of Ji'nan-Tianjin-Beijing. It is mainly related to the intensity of urban economic ties and urban attractiveness. Beijing is the capital of China. It has a strong attraction to industries, capital, and talents, which limits the division of functions between cities in this region and also has a negative impact on the development of surrounding cities. The development gap between different cities in Nanjing-Shanghai region (Sunan) is small. The level of urban development in Nanjing-Shanghai (Sunan) region is relatively balanced, which reduces the thresholds for household inter-regional relocation.

6.2. The Impact of HSR on Family Relocation

The construction of the HSR has had a significant impact on family travel behavior, family spatial structure (such as employment-residence and migration), and family ties. The impact that the HSR has had on family migration willingness was most obvious in economically developed cities. With the growing popularity of HSRs, families will be able to settle in developed cities, while urban household migration will mainly occur between these developed cities. In terms of the impact of HSRs on urban households, occupation, income, residence time in the city, and schooling all had an obvious impact on family relocation. With a high degree of mobility, households can better support family developments through a more appropriate combination of family space, i.e., low-income residents can migrate to search for better job opportunities. Middle- and upper-income residents, along with their accumulation of wealth, are likely to have consolidated their urban housing, home, school, and other requirements to achieve a satisfactory family life. Through the development of HSRs, residents can strengthen family ties and consider the possibility of off-site study as an alternative to traditional schooling. The current prices for high-speed rail tickets are acceptable to middle-income households. Especially for shorter trips, compared with other forms of transportation, the price of a high-speed rail ticket is not high. Therefore, the construction of high-speed rail can effectively promote population/household mobility between cities. Distance is also an important factor affecting

population/household mobility. Because the distance between Suzhou-Kunshan-Shanghai is shorter than the distance between Beijing-Tianjin, the population mobility between Shanghai and Suzhou is greater than that between Beijing and Tianjin. Family relocation is one of the important effects of urban integration caused by HSR. HSR becomes a common means of transport for urban households, which allows people to better enjoy the public services in different cities. It should be noted that China's current urban integration is deeply affected by housing prices. Compared with the high housing prices in big cities, the travel time and economic costs of HSR are acceptable for many households.

6.3. Future Research Directions

The construction of the HSR has improved the liquidity of the family, weakened the traditional characteristics of the family, and made families more likely to move to cities with better development opportunities and living environments (such as better public services and a better natural environment). To this end, we recommend further strengthening cooperation among cities connected by HSRs, integrating public service resources, and promoting regional economic integration, in addition to accelerating social integration. With the improvement of China's HSR network, economic and social benefits will continue to emerge. HSR phenomena, such as metro, new towns, and networks, are still worthy of further study. This study has explored the social effects produced by an HSR. Due to the limited survey sample size, there is still insufficient information regarding the social effects of HSR. In future work, a partial section of an HSR (such as the Shanghai-Nanjing line or the Suzhou-Shanghai section) will be studied.

7. Conclusions

The construction of high-speed railway has a huge impact on China's economy and society. This study found that the Beijing-Shanghai HSR line changed residents' travel behaviors and the households' urban spatial structure. For these households, they can re-arrange their own family life and work, such as working in a city and living in another city. The opening of HSR also increases the willingness of household migration. Moreover, the construction of HSR makes the cities more closely linked, especially between the big cities, such as Beijing-Tianjin and Suzhou-Kunshan-Shanghai. However, we should note that the impact of HSR on different cities is different. Especially the small and medium-sized cities (low economic development), they may be subject to some negative impact. Population and important development resources are continuously concentrated in major big cities (the "siphon effect"), which is detrimental to the sustainable development of small cities. In short, there will be both a challenge and opportunity for small cities.

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