Is high-speed rail socially exclusive? An evidence-based critical review

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Abstract

The extent to which high-speed rail (HSR) could be socially egalitarian has been disregarded, despite evidence that upper social-occupational groups are the primary users of high-speed trains (HSTs). In this context, this review aims to fill the gap by investigating the social attributes of HSR passengers based on worldwide, available ex post data derived from surveys at both national and corridor levels. The study's results converge to conclude that HSR passengers are predominantly male, higher income, highly educated and belonging to higher social-occupational groups. Key indicators of social inequalities (i.e. income, occupational group and education) show a much sharper differentiation in HSR use than gender and age. Social inequalities arguably shape the uneven use of HSR through available income compared to HSR fares; through income compared to total expenditure on non-business travel; and through travel purposes, considering the high share of business travel aboard HSTs. Our findings highlight "greener" transport means and policies may not be socially inclusive. They also raise the issue of facilities (co-)funded by taxpayers that do not benefit the masses.

1. Introduction: High-speed rail for everyone?

On September 22, 1981, recently elected President François Mitterrand opened the first high-speed line (HSL) in Europe, namely the first section of the Paris-Lyons line. As Figure 1 suggests, he understood the extent to which this was a critical step toward new long-distance mobilities as well as a reflection of his country's social, political and economic history. The French national railways (SNCF) initiated France's high-speed rail (HSR) project, branded TGV, which was formally adopted in the late 1970s by the then right-wing government (Fourniau, 1989; Klein, 2001a; Troin, 1995). The new socialist president at the time changed his negative attitude towards TGV and finally embraced it. The government's left-wing coalition included the Communist Party, of which one member served as Transport Secretary. With such a left coalition and the French attachment to public services and related egalitarian policies (a concern for equality instructed through the 1982 Domestic Transport Guidelines Act[1]), one could assume France's HSR would be open to most people, regardless of their social condition. This somewhat naïve assumption would later have been reinforced by the motto adopted by the SNCF (after Aristotle) in the early 1990s: "*Progress is worth nothing unless it is shared by all.*"[2]

[1] Loi d'Orientation sur les Transports Intérieurs (LOTI).

[2] Translated by the authors from "Le progrès ne vaut que s'il est partagé par tous".

Figure 1. President François Mitterrand posing on September 22, 1981, for the opening of France's first high-speed line.
Source: Institut François Mitterrand (reserved rights / IFM).

The reality is different. As soon as HSR services were launched in France and in various other countries, premium fares (e.g., traditional fares plus an extra, specific fare not connected to the distance or peak-time services any more) drew considerable opposition. As a result, a rail ticket purchased not long before departure could be fairly expensive. Delaplace and Dobruszkes (2015) found an HSR Paris-Marseille return ticket bought late was priced at between €134 and €226, which accounted for 10% to 18% of the population's median net salary at the time. In addition, the development of low-cost air and coach services over past decades in many markets also suggests not everyone can afford HSR travel. For example, the densest coach routes from/to Brussels, Belgium, match with the main HSR routes from/to these cities (that is, Paris, Amsterdam and London) (Vanhoestenberghe, 2015). Several empirical works have suggested that in various markets, cost-sensitive passengers tend to opt for cheaper coaches or flights (see, e.g., Román et al., 2014). Simply said, high-speed rail has moved railways away from common public services, as they were called and used by the (lower) middle-class in many countries.

These two diverging stories —progress for everyone on the one hand, fare-based barriers on the other hand— raise the following question: is HSR socially exclusive? Surprisingly, this has received little attention from scholars and public authorities. This paper aims to fill this gap in the literature at a time when trips made by high-speed trains accommodate around 30% of long-distance rail traffic in Europe (Amadeus, 2013).[3] To do so, this paper refers to the concept of transport justice, which has been increasingly considered as a lens to critically (re)assess transport systems and policies. Beyond its various acceptances, this concept embraces social, spatial and environmental justice (Pereira et al., 2017). The mainstream idea is whether transport-related benefits and adverse impacts are spread in a just way through all social groups (and possibly through all places). This usually leads to the operational concept of equity. The remaining parts of this paper will focus on the social dimension of transportation justice and thus social equity in HSR markets.

[3] 29% in passengers, 33% in passenger-km.

2. Social justice in the high-speed rail market: a review

Let first recall that beyond definition and measurement issues (see Mattioli and Adeel, 2021), strong social inequalities generally exist in long-distance travel. At the level of countries, airline passenger-km per capita is significantly correlated with GDP per capita, but even in high-income countries, the flying population is estimated to be only 40%; and even in the US, it is estimated that 53% of adults did not fly in 2018 (Gössling and Humpe, 2020). Turning to specific countries and detailed figures, all available evidence has shown the propensity to travel long distances is significantly affected by income, gender, age, social-occupational groups and education. Simply said, more long-distance travel is associated with higher income, masculinity, intermediate ages, higher social-occupational groups and higher diplomas (see, e.g., Hubert and Potier, 2003; Dargay and Clark, 2012; Longuar et al., 2010; Reichert and Rau, 2015; Rohr et al., 2013). Significantly, several of these factors shape long-distance mobilities more than local mobilities. Considering distances travelled per capita per year in France against income, for instance, local mobilities (less than 80 km) range from 6,036 km for the poorest sextile to 9,970 km for the richest sextile (a ratio of 1.8) while long-distance mobilities range from 3,134 to 12,565 km respectively, a ratio of 4.0. In addition, there is a spatial component in the fact that even having controlled for these social attributes, large cities' residents travel long distance proportionally more than those who live in smaller towns and in rural communities (see Czepkiewicz et al., 2018 for a review).

The question remains open whether similar social inequity prevails if one focuses on HSR travel. There are at least three reasons for raising this issue. First, in many countries, regional (and possibly long-distance) traditional rail services are associated with subsidised public services so travellers pay reasonable, out-of-market fares that are significantly cheaper than the real cost. Second, high-speed rail projects and the HSR system in general are often introduced as good for everyone, as evidenced by the aforementioned motto, "Progress is worth nothing unless it is shared by all." Third, the development of an HSR system is often (co-)funded by public authorities, and thus by taxpayers.

Despite this, most research interested in transport justice remains focused on urban mobilities (see, e.g., Church et al., 2000; McFarlane and Rutherford, 2008; Lucas, 2012; Gössling, 2016; Martens, 2017), to the detriment of long-distance travel, including high-speed rail. As a result, the social patterns of HSR and non-HSR users have mostly been disregarded (Pagliara and Biggiero, 2017) to the point that it is not possible to draw comprehensive conclusions about the inclusive or exclusive nature of HSR services based on inhabitants' social attributes. In practice, works interested in HSR-related social equity focus mostly on fares (see Cavallaro et al., 2020; Zhan et al., 2020). Even the scarce research works on the politics of HSR tend to neglect the social dimension of HSR use (e.g., Katz-Rosene, 2017; Minn, 2013). Actually, spatial equity issues raised by HSR have not received much more attention than social equity (see, for instance, Cascetta et al., 2020; Martínez Sánchez-Mateos and Givoni, 2012; Monzón et al., 2013; Shi and Zhou, 2013).

However, some interesting figures are implicitly presented in survey-based publications. Such figures usually suggest upper social-occupational groups are over-present in HSTs compared to the whole population (Delaplace, 2012; Pagliara et al., 2012; Dobruszkes et al., 2014; Banister, 2018). There is also evidence that the introduction of HSR can boost the share of these upper social-occupational groups among rail passengers for any travel purpose (namely, leisure, business and commuting) (Klein, 2001b: 62). A study by Pagliara et al. (2017) is a rare case of research that focuses explicitly on social exclusion and HSR. Here social exclusion encompasses several forms of exclusion, the most relevant of which are "geographical exclusion" (as discussed above under the term "spatial justice") and "economic exclusion" due

to the cost of travel (referred to here as "social justice"). Pagliara et al. (2017) also found that factors of exclusion differ between countries such as the UK, Italy and Spain. This suggests a review of evidence should be geographically comprehensive.

In a nutshell, HSR has been criticised mostly because of its investment cost compared to weak financial and/or social benefits[4] (Albalate et al., 2015; Betancor and Llobet, 2017). And most of the attention regarding winners and losers following the introduction of HSR actually focused on *places* rather than on *social groups* (e.g., Martínez Sánchez-Mateos and Givoni, 2012). The issue of social exclusion of/by HSR remains mostly unquestioned. The remaining parts of this paper will address this specific aspect.

3. Investigating HSR and social justice: Data and methods

To investigate whether HSR is socially inclusive or exclusive, our focus is on the social profile of the HSR passengers. This may appear straightforward, but the fact is that evidence is scarce, scattered and often unpublished, notably because most surveys conducted by HST operators are not publicly available. This is due to intermodal (and sometimes intra-modal) competition, which has made any data on passengers very sensitive. Both academic and grey literatures have been sought, and only ex post figures have been considered, since traffic forecasts are notoriously inaccurate (Preston and Wall, 2008; Crozet, 2013; Givoni and Dobruszkes, 2013). In this paper, "high-speed" refers to lines that operate at a cruising speed of at least 250 kph.

Thanks to the diversity of authors involved in this paper, we were able to scrutinise data published in Chinese, Dutch, English, French, German, Italian, Japanese, Korean, and Spanish, which enabled us to consider nearly all HSR markets (Turkey and Morocco being the only cases where language remains a barrier). However, this does not mean we found data for all the markets investigated. Especially, we lack data related to Germany and international routes within North-West Europe. As for Germany, the National Travel Survey does not distinguish long-distance rail use between traditional and high-speed rail. No figures can be extracted from tickets sold because they are valid on both traditional (IC) and high-speed rail (ICE) services. Of course, this does not prevent the HSR operator from conducting surveys on HSTs. However, enquiries made to the national incumbent DB Fernverkehr or other parts of the DB holding company were not successful.

We have considered the "social" dimension according to a wide conception, since exclusion can be based on personal or household attributes other than income. Gender, age, income, social classes, occupational groups and education have thus been considered.

Of course, sociodemographic patterns diverge across markets. If HSR services are socially inclusive, a country with many people in their thirties would mean that many HSR passengers would be in their thirties too. As a result, HSR passengers' profiles have been compared to national figures as far as data were available. The HSR passengers/whole population ratio is known as a specificity index (SI). If an SI is lower (higher) than 1 for one specific social group, then this group is less (more) present on high-speed trains than in the whole society. However, we could not compute SIs extensively because, in many cases, data related to HSR passengers are not available in the same classes as national data. As a result, specificity indices are shown

[4] "Social benefits" means travel times saved (for HSR users) and lower environmental adverse impacts only.

in the main text while the whole data (including cases where SI could not be computed) will be found in the appendices.

4. Is high-speed rail socially exclusive or inclusive? A review of available evidence

4.1. HSR passengers' profile I – Gender and age

Figure 2 shows the split of HSR passengers per gender compared to national averages (see Appendix 1 for data in more detail). First, it is clear that in most HSR markets, there are significantly more men proportionately on board high-speed trains than there are within the whole population. The dominance of men ranges from slight inequality (specificity index close to 1 in the Beijing-Guangzhou (2016), Shenzhen-Xiamen (Spring 2016) and Taiwan (2015) markets) to significant imbalances, with specificity indices above 1.2 or even 1.4 in various markets, including the Yangtze River Delta region (2013) and Madrid-Barcelona (2009 and 2010); and even 1.6 on French Atlantic HSR (1993, commute purpose) as well as the Tokyo-Osaka and Osaka-Hakata HSTs (2017), although slightly less in first class. It is worth noting that figures change across the same country subject to the corridors considered, as shown by the case of China, where the men specificity index ranges from 1.00 to 1.57 subject to markets and surveys. Such a wide range of distinction may be due to regional demographic patterns (which would require further investigation of sub-national demographic figures), to the way surveys were conducted or other factors that deserve further investigation. More surprisingly, results also vary significantly from year to year in the case of Taiwan, where the share of women and men reversed suddenly between 2014 and 2015. Here again, survey designs may need to be interrogated. In addition, the split of gender per fare class, when available, suggests that masculinity is even higher in second class than in first class (see Appendix 1). This may suggest gender-based discrimination would be slightly lower among those travellers of higher social-occupation groups.

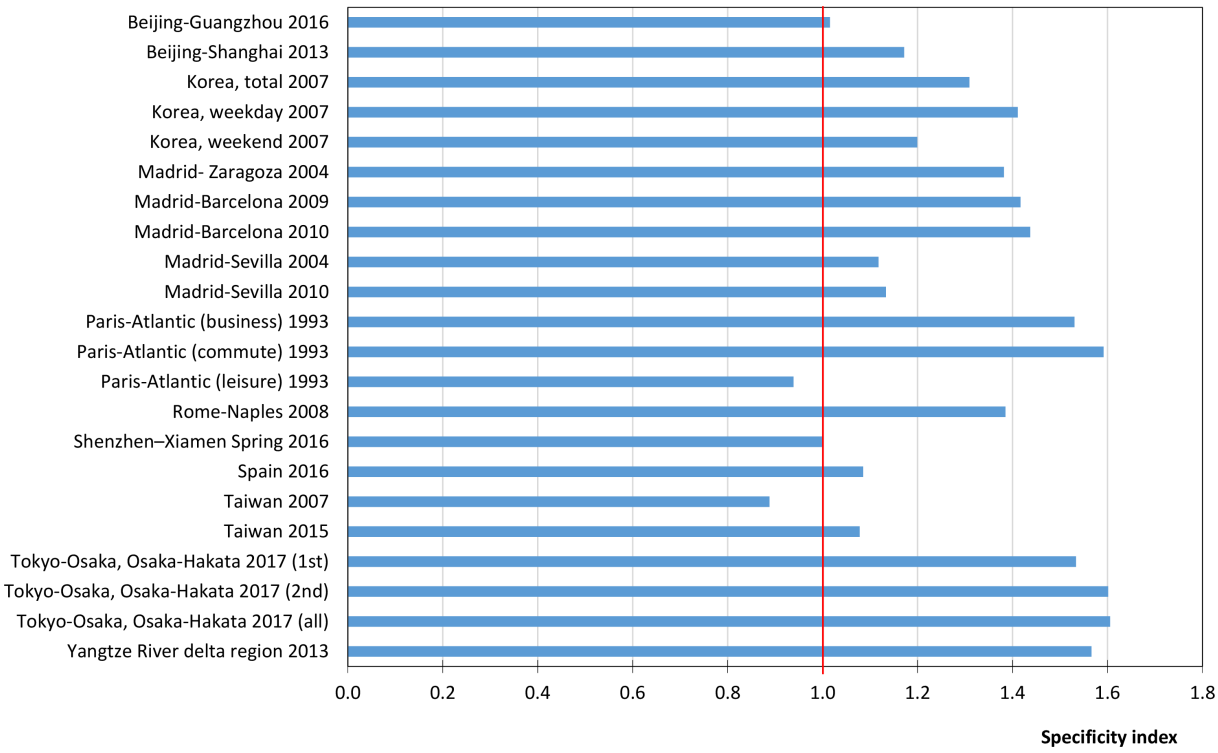


Figure 2. Men aboard HSTs compared to the whole population. Various sources (see Appendix 1) gathered by the authors.

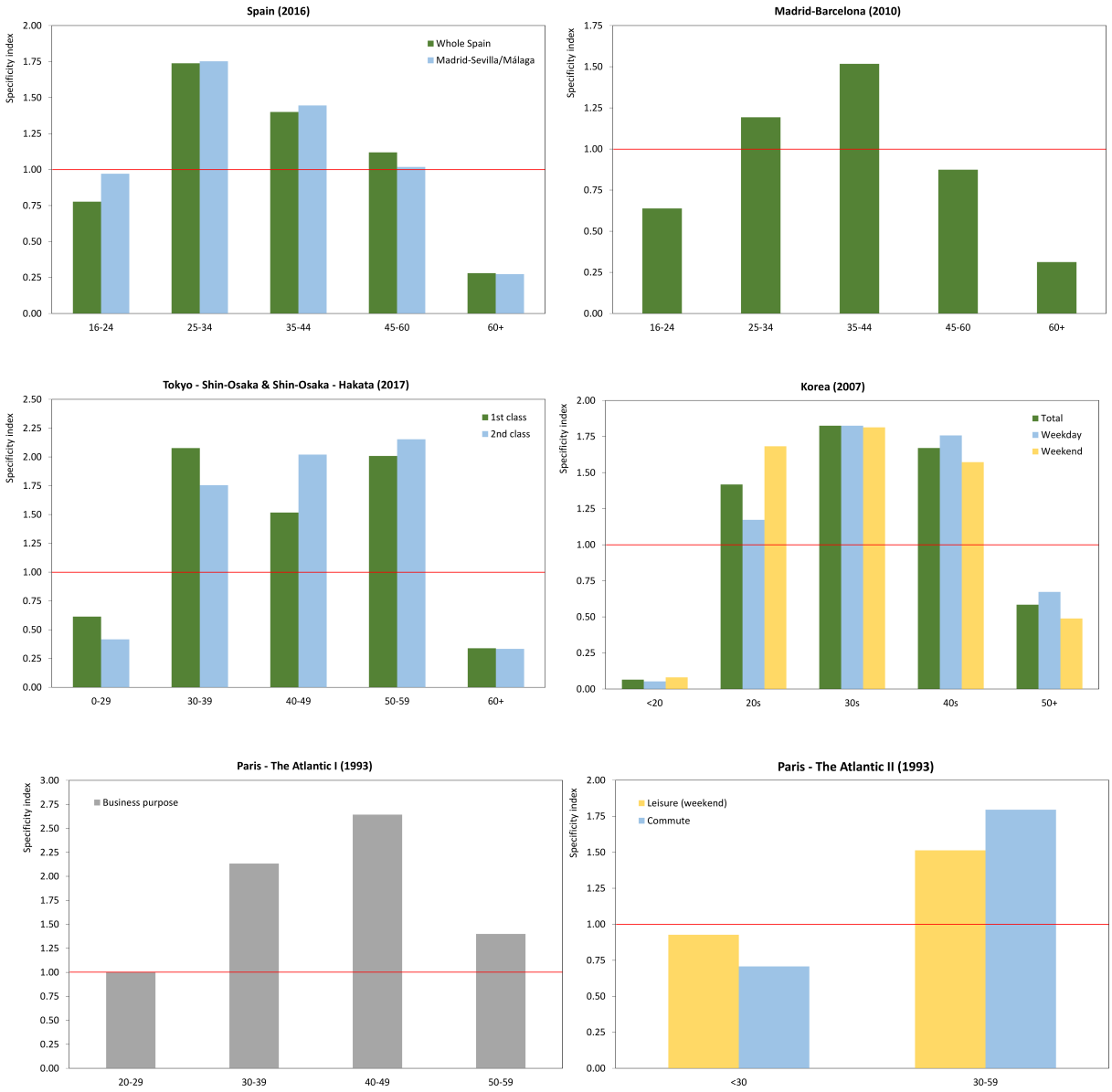


Figure 3. The age of HSR passengers compared to the whole population. Various sources (see Appendix 1) gathered by the authors.

In terms of age (Figure 3, see also Appendix 1 for more figures), younger people and the elderly tend to be under-present in HSTs compared to national age splits. In contrast, user groups in their thirties, forties and fifties to some extent are over-visible. These patterns can be understood if one considers that premium fares are affordable for those with higher incomes and specific professional positions. It could also be that younger adults travel more for leisure on long-distance routes than previous generations. Conversely, younger persons would be under-visible aboard HSTs because parents would travel less by HSR. For families with kids, the group size makes car travel usually cheaper than HSR.

It is worth noting that the Korean HSR appears particularly exclusive based on age, with under 20s being the least present aboard HSTs. However, this low representation could not be compared with other countries whose survey category does not usually include the passenger cohort under 20. Data from Korea and France also show that young adults in their twenties are

more over-present in HSR on weekends, which suggests social attributes should be crossed with travel purposes.

In addition, in Japanese cases, the over-presence of adults in their thirties is surprisingly higher in first class than in second. At first glance this is somewhat counterintuitive if one considers incomes tend to increase with age; however, it could be explained by specific commercial schemes. The so-called Express Club Service allows enrolled passengers to buy an upgrade to premium class for about 1,000 Japanese yen (about €8.1). It seems this scheme is quite popular among young adults.

4.2. HSR passengers' profile II – Incomes

Figure 4 shows the split of HSR passengers per income compared to the whole national population. We were able to compute specificity indices for two markets only, but Appendix 2 supplies significantly more figures. All available evidence converges to highlight that HSR passengers come mostly from groups with higher income than average. The gap with the least and most visible social groups aboard HSTs is much higher than that based on gender and age. Based on specificity indices (Figure 4), the highest incomes are around 8 and 17 times more present on Korean and Madrid-Barcelona HSTs than nationwide, respectively. Based on income split (Appendix 2), nearly all HSR passengers come from social groups with an income higher than the national average. In other words, social groups with lower and average incomes, which always dominate at the country level, are conversely under-present aboard HSTs.

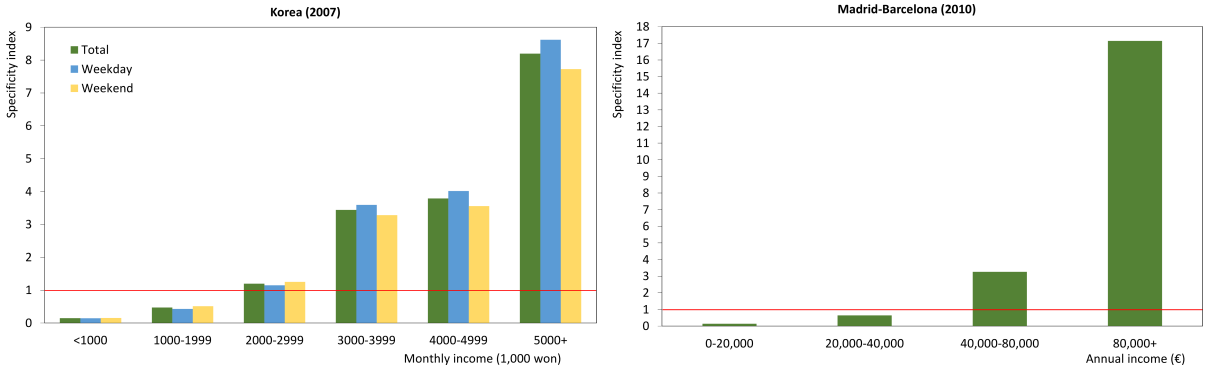


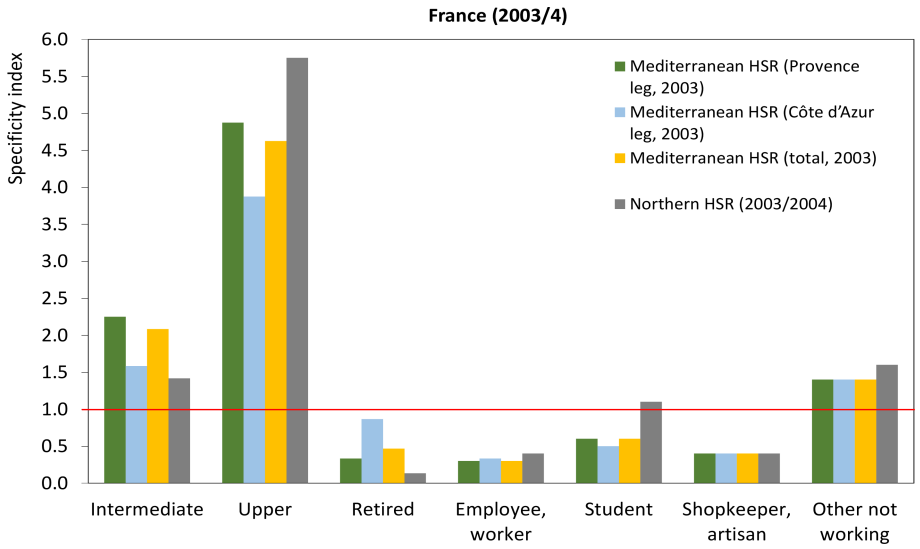
Figure 4. Incomes of HSR passengers compared to the whole population. Various sources (see Appendix 2) gathered by the authors.

4.3. HSR passengers' profile III – Social class and occupational groups

Concerning social class and occupational groups, Figure 5 unveils selected figures of occupational groups while Appendix 3 supplies extra data that covers social classes. It is manifest that upper occupational/social groups are over-represented among HSR passengers. In France and Spain, the various markets considered tend to show converging results. Data by comfort/fare class in Japan show significant gaps across occupational groups, especially through managers and medical staff favouring first class. In South Korea, the under-/overuse of HSR is rather similar at weekends compared to weekdays. The evidence related to the much higher specificity index for the user category "Unemployed Married Women" is noteworthy. HSR in South Korea has facilitated a strong decentralised development of firms and government institutes; many family members are thus living apart. The KTX (Korean HSR service) has shown a high percentage of visiting family (33.8% of total purpose trips, just after

business trips) (Lee, 2019). There could be two more reasons. First, these unemployed married women might have visited their husbands' dwellings at their workplaces during weekends. Second, unemployed married women in South Korea generally refers to full-time mothers who quit their jobs once they are married and have kids. Many Korean grandparents help their daughters (or daughters-in-law) by looking after their (grand) children over weekends, so these women have to travel by HSR to visit or collect their kids. This reflects a mixture of effects in sociocultural matters, family arrangements, and spatial-economic effects as a result of decentralised spatial development policies exploiting HSR networks.

The findings lead to a subsequent query about the spatial patterns of these occupational groups – i.e. where these upper social groups live and where these higher occupational jobs are located. From European experiences, it seems reasonable to assume people with higher occupational jobs tend to live in large urban areas (where their skills meet the needs of related employers), thus in areas that could be accessible by HSR services. The spatial patterns of social classes and occupational groups require further investigation because they could vary with planning approaches and contextual settings in each country and city. However, before delving further into the spatial patterns of occupational groups, it is important to consider the over-presence of higher social and occupation groups on board of HSTs. This over-presence arguably results from people's need to travel for professional reasons (with tickets paid by the employers) and the financial ability to travel for personal reasons over medium or long distances. This latter point relates to the growing phenomenon of long-distance work-related commuting by HSR, which is associated with travel purposes (section 4.5) and is worth investigating further.



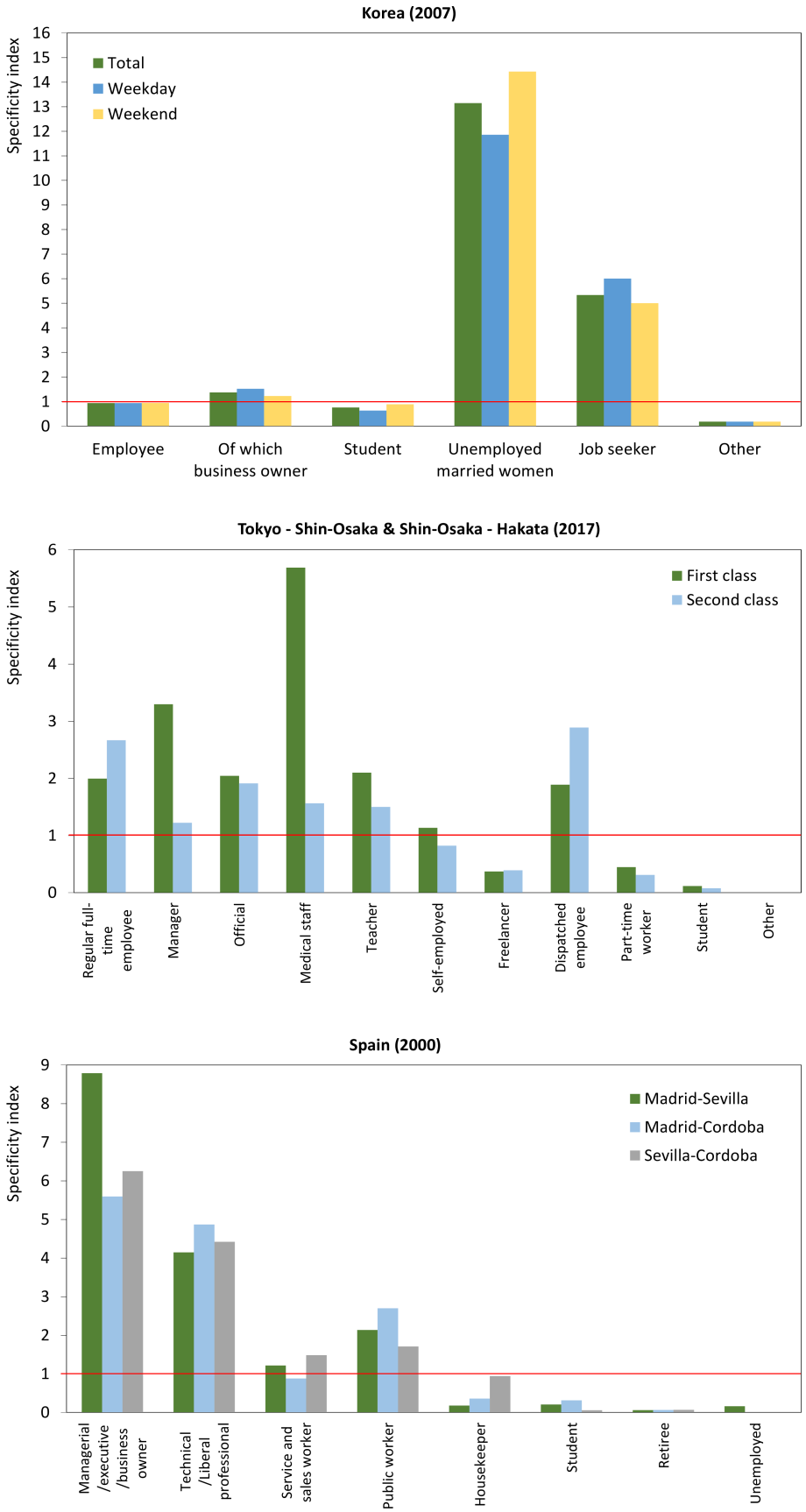


Figure 5. HSR passengers' occupation group compared to the whole population. Various sources (see Appendix 3) gathered by the authors.

4.4. HSR passengers' profile IV – Education

Based on education levels, Figure 6 and Appendix 4 also show a large gap between HSR users and the whole population. University graduates account for a high share of HSR passengers compared to the whole population, specificity indices commonly being above 5 and even above 20 in China. In the most extreme case (Beijing-Guangzhou), those with a master's degree account for 18% of passengers against 0.6% nationwide, so a ratio of 30. This is consistent with previous findings since, on average, graduates tend to get higher incomes and secure better professional positions.

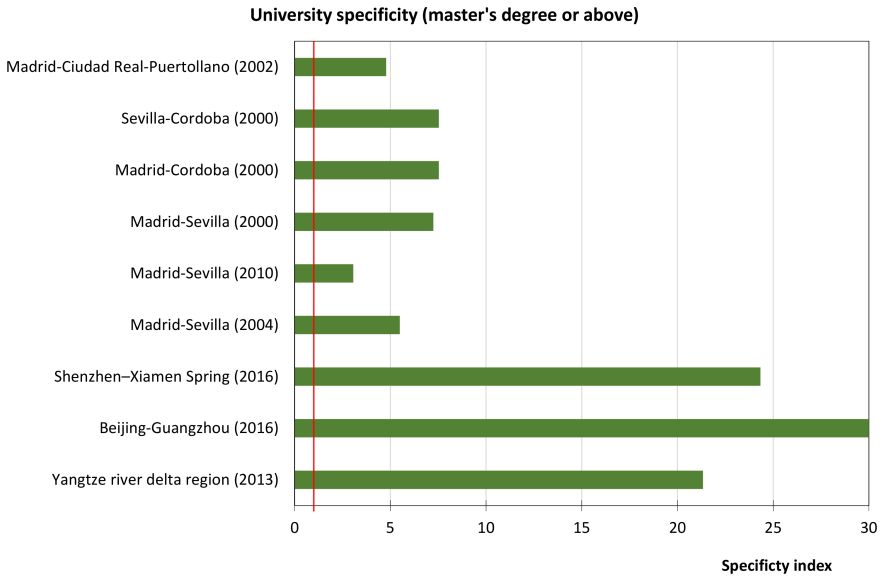


Figure 6. HSR passengers with a university master's degree or above compared to the whole population. Various sources (see Appendix 4) gathered by the authors.

In short, the traditional indicators of social inequalities, namely income, occupational groups and education, show much sharper gaps in HSR use than gender and age. The next section will discuss the most plausible factors for this scenario.

5. Why is high-speed rail overused by specific social groups?

5.1. A wide range of potential factors

While exclusion from transport is sometimes considered a consequence of income inequality only, the reality is more complex. As far as we know, there is no specific framework to capture the factors of exclusion from long-distance markets. However, nothing prevents us from starting from a more general framework to see whether the related factors make sense, as Pagliara et al. (2017a) have attempted. Here we combine three frameworks to obtain a comprehensive understanding of exclusion from HSR.

We first consider Church et al. (2000), who investigated the London case and identified seven potential factors of exclusion:

1. Physical exclusion: physical barriers, i.e. a lack of facilities for the disabled or insufficient timetable information, limiting accessibility to transport services.
2. Geographical exclusion prevents people from accessing transport services, especially those who live far away from transport services (e.g., in rural areas).
3. Exclusion from facilities, such as shops, schools, healthcare or leisure services because of poor access to them.

4. Economic exclusion represents the high monetary costs of travel. Such costs prevent or inhibit access to facilities or employment, and thus impact income.
5. Time-based exclusion refers to other demands on time, such as combined work, household and childcare duties that reduce the time available for travel.
6. Fear-based exclusion concerns fears about personal safety, which may preclude some people from using public spaces and/or transport services.
7. Space exclusion is security or space management (such as first-class waiting rooms at stations) that prevents people from having access to certain public spaces.

In addition, Cass et al. (2005) consider conditions for access in general. They highlight four dimensions: physical, organisational, financial and temporal, which all match with Church's classification (Figure 7). Obviously, these factors make sense, especially when compared to the persons' and households' sociodemographic and physical capacities, as well as the parties' aptitudes, aspirations, attitudes and perceptions. This leads us to Kaufmann et al.'s (2004) concept of motility. Motility *"can be defined as how an individual or group takes possession of the realm of possibilities for mobility and builds on it to develop personal projects. This potential is not necessarily transformed into travel"* (Flamm and Kaufmann, 2006). Motility is based on three groups of factors, namely *access* to mobility (i.e. transport services and their characteristics), the *competences* to recognise and make use of *access* (i.e. actors' skills and abilities, including physical ability, acquired skills and organisational skills) and *appropriation* (which refers to what actors do with access and competences based on needs, aspirations, values, habits, etc.[5]) (Kaufmann et al., 2004; Flamm and Kaufmann, 2006). Figure 7 proposes an integration of these three frameworks (factors of exclusion, dimensions of access and motility) to understand why individuals (do not) travel HSR. Obviously, these factors are nested to some extent; for instance, in a region not served at all by HSR services (geographical exclusion), the issue of economic exclusion from HSR use does not matter.

[5] The factors of each component of the appropriation dimension (long-distance travel propensity, habits, etc.) deserve more investigation but this is beyond the scope of this paper. Further research should try to disentangle the cultural and social dimensions of appropriation.

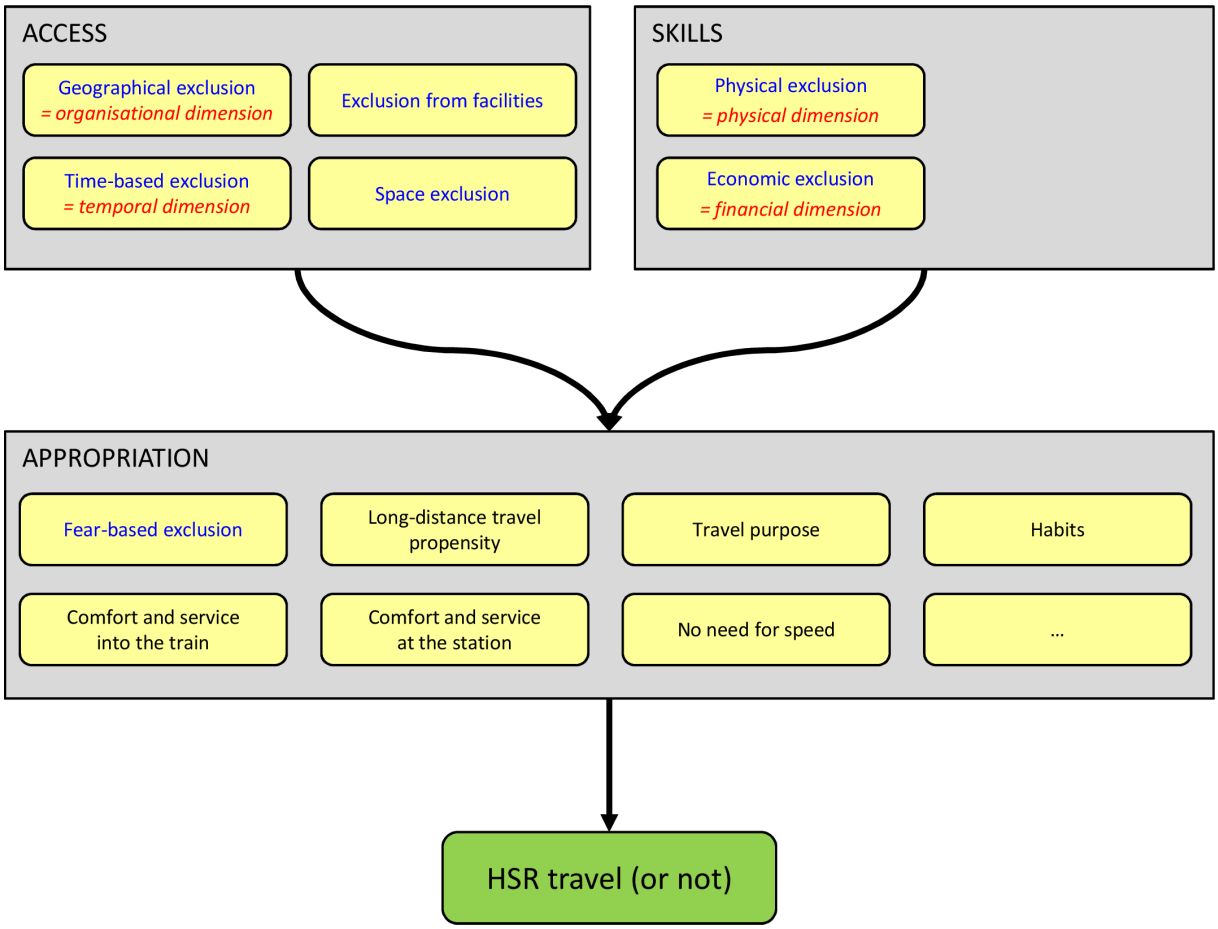


Figure 7. Conceptual framework to investigate exclusion from transport. In blue normal font: Church et al.'s (2000) factors of exclusion. In red italics: Cass et al.'s (2005) dimensions of access. In black normal font: extra factors deduced from the mobility concept. Grey boxes: Kaufmann et al.'s (2004) components of motility.

Based on Church et al.'s factors of exclusion, Pagliara et al. (2017a and 2017b) and Pagliara and Biggiero (2017) conducted Revealed Preference surveys among HSR users/non-users in Spain, the United Kingdom and Italy. Their framework considers Church et al.'s (2000) conceptual framework for social exclusion in transport. Table 2 compares the categories of exclusion among non-HSR users in the three aforementioned countries. Economic and geographical exclusion clearly dominate the reasons for not using HSR, ranging from 64% to 86% together. Having said that, the first reason for exclusion depends on the countries involved. Geographical exclusion dominates in Italy, while economic exclusion dominates in Spain and the UK. Of course, HSR does not serve the whole of Italy. But this is still somewhat intriguing if one considers that within the sample, the UK is the country in which high-speed lines the least developed. Although the only line qualified as high-speed in the UK, according to the definition of HSR adopted in this paper, is the Channel Tunnel Rail Link (aka High Speed 1), geographical exclusion is not found as the first factor. Two reasons could be suggested. First, HS1 has been exploited to provide faster regional high-speed services run by Southeastern with Javelin trains into the wider Kent County beyond Ashford and Ebbsfleet, including Canterbury, Margate, Ramsgate, Dover, Whitstable and Folkestone. Second, compared with other European counterparts, the expensive train tickets fares in the UK, largely based on the logic that the users rather than taxpayers bear the major share of fare, it is unsurprisingly that the major factor for exclusion is economic. The results in Spain are rather close to those of the UK, albeit with different factors. In this case, the large HSR network connecting most of the provinces' city

capitals diminishes the geographical exclusion, although there is a strong and generalised perception that HSR tickets are rather expensive compared to alternative transport modes. The third factor in the three cases is time-based exclusion. In addition, Ren et al. (2020) conducted a direct survey at three Chongqing rail stations, China, among non-HSR users (the city also being served by HSR). The reasons for travelling by traditional trains instead of HSR are shown in Table 3, which includes more factors than Table 2. Especially, not being in a hurry is without equivalent in Pagliara's surveys, but this appears to be a key factor along with economic and geographical exclusions.

	Case studies		
Categories of exclusion	Spain [%]	UK [%]	Italy [%]
Economic	39.85	48.73	27.20
Geographical	23.87	24.04	58.70
Time-based	10.59	11.07	6.30
Spatial	6.27	1.38	-
Fear-based	1.23	-	0.90
Physical	9.75	9.90	5.60
Facilities	8.44	4.88	0.30
Total	100.00	100.00	100.00

Table 2. Church et al.'s categories of social exclusion among non-HSR users. Source: Pagliara et al. (2017a)

Factors	**Matching to Figure 7's factors**	**%**
The fare is higher	Economic (CH)/Financial (CA)	38.18
Saving hotel costs	Economic (CH)/Financial (CA)	6.42
HSR catering is expensive	Economic (CH)/Financial (CA)	4.00
No HSR to the destination	Geographical (CH)/Organisational (CA)	33.85
Transfer is not convenient	Physical (CA & CH)	13.22
No smoking on HSR	Facilities (CH)	5.10
No night shift	Time-based (CH)/Temporal (CA)	8.20
Not in a hurry	No need for speed (KA)	31.86
Habit	Habit (KA)	8.43
More comfortable to take a sleeper	Comfort (KA)	14.38
Total		163.64

Table 3. Reasons for not travelling by high-speed rail among non-HSR users from Chongqing, China. Multiple reasons could be selected. (CA) means it fits with Cass et al.'s factors, (CH) with Church's factors and (KA) with Kaufmann's appropriation within the motility framework.
Source: Ren et al. (2020).

Finally, it is worth noting that categories of exclusion change if split by gender, income or travel purpose. In the surveys carried out in Italy by Pagliara et al. (2017b), they found that economic exclusion is higher for women than men, for low/medium incomes than high income and for other activities than commuting, holidays and study. Similar trends are found by Ren et al. (2020) based on gender and income. However, not being in a hurry is less cited when age, education level or income increases, which is counterintuitive but could simply means this factor is more subjective.

The following sub-sections will discuss the main causes of exclusion from HSR.

5.2. Income inequality: the fare issue and beyond

In most HSR countries, travelling by HSR has made rail travel more expensive than travel by traditional, slower trains. HSR operators have set specific fare grids, usually away from public service obligations and from distance travelled. Through yield management, fares often fluctuate, depending on the day and time of travel and how far in advance the booking is made. Discount fares exist for advance bookings, but not necessarily ad infinitum. As in planes or coaches, there could perhaps only be a limited share of seats, restricted to off-peak times and without flexibility. Table 4 illustrates this in the Brussels-Amsterdam market, where both traditional and high-speed services still coexist. In France, for instance, bookings are open four months in advance for most HSR services, and even nine months in advance for low-cost HSR. Between London and Paris or Brussels, bookings open six months in advance. As a result, and given the quotas of discounted seats, only early bookers usually get the discounted fares. And on Ouigo low-cost HSR, kids under 12 always get a flat discount fare. Similarly, in Spain, bookings are available three months in advance[6] and, since 2013, discounts are available for long-distance HSR services (up to 70% in some cases, compared to 'flexible' fares). These discounts are usually higher in proportion to the time the booking is made in advance, but not always, because these reduced fares depend on the demand of specific trains and schedules, and users could find slight fluctuations in ticket prices over time. It is also worth noting that in Germany, the emergence of bargain offers following the introduction of long-distance bus operators in 2013 led to an increased offer of so-called (super-)saver rail tickets by national incumbent DB Fernverkehr. Tickets at €19.90 (€14.90 if using the additional rail discount card BahnCard) made travelling affordable all over the country, regardless of HSR-usage or traditional long-distance rail, although subject to seat availability (Krämer, 2018).

	Traditional train (IC)		**HSR service (Thalys)**	
Scheme	**Mid Flex (up to one week before travel)**	**High Flex**	**Standard (non flexible)**	**Standard (flexible)**
Travel time	2:46		1:52	
Fare	€26	€49.40	€29	€44-82
Train choice	Any train on the selected day	Any train on the selected day	Specific train	Specific train
Cancellation	€5	For free	None	50% refundable
Exchange	None	For free	None	€15 + price difference

Table 4. Comparing fares and flexibility in the Brussels-Amsterdam rail market (one-way journey, 2nd class, adult traveller)

[6] This will be extended to one year in advance in 2020/2021

Several studies have highlighted trends in fares over time and/or by transport mode. For instance, Delaplace and Dobruszkes (2015) found that for a return trip between Paris and Marseilles during a long weekend in June 2014, HSR was first priced around €225 (which was even more expensive than Air France's flights), then around €275 over the last month (Air France being more expensive again over the last three weeks before the journey). It should also be highlighted that discount tickets may be available online only (for instance in France, in contrast to Germany). The digital divide between social groups may thus make the discount not available to everyone.

Obviously, the cost of HSR is not the sole economic factor for exclusion from HSTs. Transport is only one part of the total cost, since accommodation and other expenditures (such as restaurants and sights) need to be considered too. It could thus be that HSR fares alone do not explain the entire magnitude of economic exclusion from HSTs. It is well known that, on average, individuals or households with higher incomes tend to travel more often and on longer distances (see, for instance, Longuar et al., 2010, for France; Reichert and Holz-Rau, 2014, for Germany; National Travel Survey (DfT, 2019: Table 0705), for the UK).

However, there is significant evidence that fares are a barrier to using HSR services, at least for price-sensitive persons or households. For instance, Liu and Kesteloot (2015) surveyed Chinese peasants who moved to cities for off-farm work. These former peasants start to visit their home village during holidays or for key events such as birthday celebrations, and to arrange educational and health matters. This involves long-distance travel, including HSR options. Surveys in Qiya village show that most interviewees still use cheaper, traditional trains. One interviewee stated that the extra cost of HSR equals three days of his/her salary. Simply said, the less these domestic migrants spend on travel, the more money they send back to their families in their home villages. Quantitative analyses based on surveys conducted in Chongqing, China, confirm that higher HSR fares are a key reason for still using traditional trains services (see Table 3). Another relevant survey was carried out at Marne-la-Vallée Chessy HSR station, which is located besides a Disneyland theme park on the eastern side of Paris. Perrin (2019) surveyed passengers travelling for tourism purposes (Table 5). The place is especially interesting because the station is served by both traditional HSTs ("TGV") as well as low-cost HSTs ("OUIGO"). While gender and age converge, the comparison clearly shows diverging patterns for other attributes: low-cost HSR services show a lower proportion of executives and liberal professions as well as those with higher education, and a higher proportional share of passengers with lower incomes. Even though low-cost HSR passengers may account for a limited share of the whole population, they still enable less favoured persons to travel further away.

		TGV	OUIGO
Gender	Female	65%	68%
	Male	35%	32%
Age	18-24	12%	15%
	25-44	51%	55%
	45-64	32%	25%
	65+	5%	6%
Social-occupational group	Executive and liberal professions	29%	17%
	Retired	7%	9%
	Students	9%	8%
Incomes (household)	<€1500	10%	21%
	€1500-3500	52%	61%
	>€3500	37%	21%
Higher education		60%	44%

Table 5. The profile of HSR passengers at Marne-la-Vallée Chessy HSR station in March-April 2017 (travel purpose: tourism only). TGV is the traditional HSR service. OUIGO is the low-cost HSR service. Source: Perrin (2019)

5.3. Spatial inequalities: the network issue

In Europe, the fact that not all places are served by HSR services seems to be the second most important reason for not travelling by HSR (see Table 2 above). Simply said, many respondents are non-users because HSR does not serve itineraries they need or want to travel. Of course, the concept of being served or not is somewhat relative. Distance-based or time-based criteria are subjective, and depend on how potential passengers perceive access/egress journeys to/from HSR stations; hence, the rationale for considering the motility's "appropriation" component. It also could be the case that smaller or medium-sized cities nevertheless have not been served with frequent and rapid rail connections to/from major HSR stations.

Public authorities play a key role here. Since they usually (co-)fund the development of high-speed lines, the geography of HSR is a mix between geo-economic factors (which shape the geography of the demand) and political considerations (Dobruszkes and Moyano, 2021). In Spain, for instance, the most relevant corridor for developing HSR based on potential demand is Madrid-Barcelona, i.e., the country's two largest cities. Yet the government preferred to first build the Madrid-Seville high-speed line in the name of the forthcoming 1992 Universal Exposition in Seville and to boost the less-developed south of Spain[7]. In contrast, the Madrid-Barcelona high-speed line was opened more than a decade later. This case questions what spatial equity means: does it mean the geography of transport services (here HSR) should fit the geography of transport demand (first estimated through city size, for instance)? Or does spatial equity involve favouring less-developed and/or less-accessible regions? Obviously, there is no scientific answer to such questions, which is all about a political decision for the future. The answer also depends on how much land and transport planning is considered to follow dominant trends or to reverse them.

Having said that, the relationships between geographical exclusion and cities' social-spatial patterns remain unexplored. If favoured social groups specifically live more than the average in places served by HSTs, one could expect to find them having a higher-than-average presence aboard HSTs, all other things being equal. Conversely, if these favoured social groups are

[7] Also because of technical reasons, as there were previous capacity issues of rail lines reaching Andalusia, related mainly to topographical difficulties.

evenly spread across places served/not served by HSR, then the higher presence of these groups aboard HSTs would be even more significant. This arguably deserves further investigation. In the meantime, the impact of geographical exclusion on HSR passengers' profile (as investigated in Section 4) remains unknown.

5.4. Travel purposes

The purpose of travelling by HSR also shapes the social profile of HSR passengers. It is very clear from Appendix 5 that the dominant reason people travel by HSR is business, even though leisure and/or VFR (visits to friends and relatives) travel can dominate in certain markets. This clearly contrasts with air travel, where personal reasons outweigh business motivations (Dobruszkes et al., 2018).

Travelling for business purposes arguably filters the social groups aboard HSTs in favour of higher occupational groups, which also suggests higher incomes and higher education, on average. Indeed, those who travel long-distance for business tend to be high-skill workers and/or executives. They attend meetings and participate in strategic tasks related to the multi-located, globalised economy, mostly located in large cities, of which several are served by HSR. Government officials and senior civil servants also travel long distance (thus, typically by plane or by train), especially for meetings with authorities at other administrative levels. In contrast, clerks, workers and other civil servants have fewer reasons to travel for business.

Conversely, leisure travel usually involves travellers who are more sensitive to prices. Group size impacts modal choice in the sense that grouping several persons in a car lowers travel costs per head. For instance, Cascetta et al. (2011) built a mode choice model for the Naples–Rome HSR route. The main outcome was that travelling with two or more persons makes the alternative ''car" more attractive because of the possibility of sharing costs, while frequent travellers generally prefer train (dummy ONCEWEEK negative in alternative ''Car"). Moreover, younger travellers prefer cheap trains (2nd class IC), while managers prefer HSTs. Among them, employees who are reimbursed for their travel costs have a preference for travelling 1st class on HST. The computation of elasticities was carried out as well with the main outcome of the importance of ''investing" in train fare discounts (special discount for early booking, for a day trip departure/return, etc.), in access/egress facilities and, above all, in service frequencies in order to improve the use of the railway in general, and HSR services in particular.

6. Discussion and conclusion

Our analyses converge to demonstrate that in the various countries covered here, the profile of HSR passengers is anything but neutral. Evidently, these passengers simply do not represent the whole population. On the contrary, they come from specific social groups, such as men in their thirties to fifties, with higher incomes, higher occupational positions and higher education, who dominate on HSR. The three last attributes are even more significant than gender and age. This is a key result considering income, occupational position and education levels are key indicators of social inequality. It is thus reasonable to consider that HSR is socially exclusive rather than inclusive, even though further research will need to investigate HSR that has opened recently in intermediate or emerging countries such as Turkey and Morocco, where fare policies may be different (Delaplace, 2018). Interestingly, this contrasts with the profile of the dominant (everyday) group of urban or regional public transport users –women and younger/older persons, most of whom come from lower or middle social/occupational groups, and include students. In sum, long-distance, high-speed railways can clearly be distinguished from regional/suburban railways designed for the masses.

These results are in line with Pooley's (2016) findings, according to which *"although it is now possible to travel more quickly and easily than ever before, transport-related social exclusion is more likely than it was in the past"*. Pooley also highlights how much thinking away from the neoclassical, sustainable mobility and new mobilities approaches helps to unveil what the dominant paradigms in transportation research do not address, namely that transport modes that may help achieve greener mobility can actually be socially exclusive. In other words, "greener" transport mode and "greener" transport policies are not *per se* socially inclusive. In this sense, our conclusions are in line with critical views (e.g., Reigner and Brenac, 2019) and similar findings found in the context of urban mobilities, including shared bicycle systems (Médard de Chardon, 2019), night-time public transport supply (McArthur et al., 2019), tramways (in)accessible to disabled persons (Lope and Dolgun, 2020) and ICT-based multimodal schemes (Groth, 2019). This paper has completed these findings on long-distance travel, suggesting that the actual terms of HSR products prevent the (lower) middle-class from achieving greener mobilities if travelling long distances, probably to the benefit of low-cost airlines. Of course, things could be totally different if public authorities decided that HSR services should be operated as affordable and accessible public services instead of market-based schemes.

The data we have gathered does not make it possible to say how much the social profile of HSR passengers simply reflects the social profile of long-distance travel passengers, or whether HSR would be socially somewhat less, or more, selective than other transport modes. Our results nevertheless raise some overlooked political questions. First, should costly and supposedly "greener" HSR systems used by a social minority be (co)funded by public authorities, and thus by all taxpayers? The contradiction is reinforced by the fact that in various markets, HSR has cannibalised traditional services to the point that rail passengers can only travel high-speed or have to use regional services because traditional services have been reduced partly due to the diversion of demand from traditional to HSR[8]. Second, do those social groups excluded from HSTs at least enjoy new jobs created by the economic boost possibly induced by HSR systems, notably for its wider economic impacts such as agglomeration economies and regional growth? The wider economic impacts of HSR are highly debated, which raise methodological difficulties (see Chen and Vickerman, 2017, for an overview). What is more, the social benefits are never split by social groups, so there is currently no answer to this. Finally, are premium HSR fares an obstacle to higher traffic density on high-speed lines? The question is not neutral because the environmental cost of building high-speed lines is high and can be offset only in the case of large volumes of passengers. In other words, the socially exclusive nature of HSR may contribute to jeopardise its environmental benefits.

This paper also paves the way for further research. First, one needs to keep in mind the recent development of low-cost HSR services in France (OUIGO), between Paris and Brussels (IZY), as well as forthcoming low-cost offerings in Spain. Along with new fares policies in Spain (with more fare discounts), they deserve more attention. Our data are usually not recent enough to capture their potential impacts on users' social profile, beyond the evidence shown in Table 4. Note that these low-cost HSR services could also affect the degree of geographical inclusion/exclusion. In Paris and Lyons (France), for example, many OUIGO services call at HSR peripheral (if not "greenfield") stations built on the HSL instead of central terminals. In spatial terms, this means a better-balanced supply. In Spain, however, a forthcoming low-cost

[8] In 2002 for instance, several traditional long-distance train lines were abandoned in Germany due to the introduction of the HSR-line Köln-Frankfurt am Main.

HSR service would first only serve main corridors and would bypass smaller en-route cities, which would involve more spatial disparities.

In addition, the case of Germany should be investigated if data eventually become available. In contrast with most other HSR markets, HSR (ICE) travel in Germany is priced and is as flexible as traditional intercity (IC) services (including the fact that booking a seat is not mandatory, except with specific discount fares). IC and ICE services are well integrated in terms of operations, fares and passenger use. HSR in Germany could thus not be socially more or less exclusive than traditional long-distance rail services. Furthermore, the recent introduction of HSR in intermediate or emerging countries, including Turkey and Morocco, call for extra investigations once data are available.

Finally, the extent to which our results convey a genuine social exclusion process by HSR services remains unclear and certainly deserves further research. It is also not clear whether social groups under-presented in HSTs travel less long distance in any case (let us recall the "appropriation" dimension within the motility framework). If the latter is true, then HSR would not have added more inequalities, but simply reproduced incumbent inequalities. However, it should not be forgotten that traditional long-distance trains, including overnight services, used to be accessed by a wider social basis, as evidenced by the former success of night trains (Steer Davies Gleave/Politecnico di Milano, 2017). In the meantime, with all due respect to Aristotle and French railways, progress is not shared by all.

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8. References

Albalate, D., Bel, G., & Fageda, X. (2015). When supply travels far beyond demand: Causes of oversupply in Spain's transport infrastructure, *Transport Policy* 41, 80–89.

Amadeus (2013). *The Rail Journey to 2020*. Amadeus IT Group SA, doc DMA 0344.

Banister, D. (2018). *Inequality in Transport*. Marcham: Alexandrine Press.

Betancor, O. & Llobet, G. (2017). Financial and Social Profitability of HSR in Spain. In D. Albalate and G. Bel (Eds). *Evaluating High-Speed Rail: Interdisciplinary perspectives*, New York: Routledge, pp. 23–45.

Cascetta, E., Papola, A., Pagliara, F., & Marzano, V. (2011). Analysis of mobility impacts of the high speed Rome-Naples rail link using withinday dynamic mode service choice models. *Journal of Transport Geography* 19 (4), 635–643.

Cascetta, E., Cartenì, A., Henke, I., Pagliara, F. (2020). Economic growth, transport accessibility and regional equity impacts of high-speed railways in Italy: ten years ex post evaluation and future perspectives. Transportation Research Part A 139, 412–428.

Cass, N., Shove, E., & Urry, J. (2005). Social exclusion, mobility and access. *The Sociological Review* 53(3), 539–555.

Cavallaro, F., Bruzzone, F., & Nocera, S. (2020). Spatial and social equity implications for High-Speed Railway lines in Northern Italy. *Transportation Research Part A* 135, 327–340.

Chang, J. & Lee, J.-H. (2008). Accessibility analysis of Korean high-speed rail: a case study of the Seoul metropolitan area. *Transport Reviews* 28 (1), 87–103.

Chen, C.-L. & Vickerman, R. (2017). Can transport infrastructure change regions' economic fortunes? Some evidence from Europe and China. *Regional Studies* 51(1), 144–160. Chen, Z. (2015). Culture Constraints of High-Speed Rail in the United States: A Perspective from American Exceptionalism. *Transfers* 5(3), 129–135.

Church, A., Frost, M. & Sullivan, K. (2000). Transport and social exclusion in London, *Transport Policy* 7, 195–205.

Crozet, Y. (2013). High Speed Rail Performance in France: From Appraisal Methodologies to Ex-post Evaluation, International Transport Forum, Discussion Paper No. 2013-26.

Czepkiewicz, M., Heinonen, J., Ottelin, J. (2018). Why do urbanites travel more than do others? A review of associations between urban form and long-distance leisure travel. Environmental Research Letters 13 (7), 073001

Dargay, J., Clark, S. (2012). The determinants of long distance travel in Great Britain. Transportation Research Part A 46 (2012), 576–587.

de Rus, G. & Nombela, G. (2007). Is the investment in high-speed rail socially profitable? *Journal of Transport Economics and Policy* 41, 3–23.

Delaplace, M. (2012). Pourquoi les « effets » TGV sont-ils différents selon les territoires ? L'hétérogénéité au cœur du triptyque « Innovations, Territoires et Stratégies », Recherche Transports et Sécurité 28, 290–302.

Delaplace, M. (2018). High-speed rail in developing countries and potential inequalities of use: the case of Morocco. 360.revista de Alta Velocidad 6, 37–59.

Delaplace, M. & Dobruszkes, F. (2015). From low-cost airlines to low-cost high-speed rail? The French case. *Transport Policy* 38, 73–85.

DfT (2019). National Travel Survey 2019. London: Department for Transport.

Dobruszkes, F., Dehon, C. & Givoni, M. (2014). Does European high-speed rail affect the current level of air services? An EU-wide analysis. *Transportation Research Part A: Policy and Practice* 69, 461–475.

Dobruszkes F., Moyano A. (2021), The Geography of Rail Transport, in Roger Vickerman (Eds), International Encyclopedia of Transportation, vol. 5, pp. 427-436. UK: Elsevier Ltd, http://dx.doi.org/10.1016/B978-0-08-102671-7.10462-2

Dobruszkes, F., Ramos-Pérez D., & Decroly, J.-M. (2018). Reasons for Flying. In Graham A., Dobruszkes F. (Eds), Air Transport – A Tourism Perspective, Elsevier (forthcoming).

Flamm, M., & Kaufmann, V. (2006). Operationalising the Concept of Motility: A Qualitative Study. *Mobilities* 1(2), 167–189.

Fourniau, J-M. (1989). La genèse du TGV Sud-Est. Innovation et adaptation à la concurrence, *Culture Technique*, 19, 85–94

Givoni, M. & Dobruszkes, F. (2013). A review of ex-post evidence for mode substitution and induced demand following the introduction of High-Speed rail. *Transport Reviews* 33(6), 720–742.

Gössling, S. (2016). Urban transport justice. *Journal of Transport Geography* 54, 1–9, https://doi.org/10.1016/j.jtrangeo.2016.05.002

Gössling S., Humpe A. (2020), The global scale, distribution and growth of aviation: Implications for climate change, Global Environmental Change 65, 102194, https://doi.org/10.1016/j.gloenvcha.2020.102194

Groth, S. (2019). Multimodal divide: Reproduction of transport poverty in smart mobility trends. *Transportation Research Part A: Policy and Practice* 125, 56-71.

Hubert, J.-P., Potier, F. (2003). What is known. In K. W. Axhaussen, J.-L. Madre, J. W. Polak, P. Toint (Eds.), Capturing Long Distance Travel, 45–70, Baldock: Research Studies Press.

Katz-Rosene, R. (2017). To build or not to build? Competing narratives of high-speed rail development in Canada. *Mobilities* 12(5), 758–777.

Kaufmann, V., Bergman, M. M., & Joye, D. (2004). Motility: Mobility as Capital. *International Journal of Urban and Regional Research* 28(4), 745–756.

Kaufmann, V. (2011). *Rethinking the city: Urban Dynamics and motility*. Lausanne, EPFL Press.

Klein, O. (2001a). La genèse du TGV, une innovation contemporaine de l'épuisement du fordisme, Innovations. *Cahiers d'économie de l'innovation* 13(1), 111–132

Klein, O. (2001b). Les horizons de la grande vitesse : Le TGV, une innovation lue à travers les mutations de son époque. Thèse pour le doctorat en Sciences Economiques, Université Lumière Lyon 2.

Krämer, A. (2018). Die Mobilisierung von preissensibler Nachfrage in einer digitalisierten Welt - Die Entstehung von vier Quasi-Monopolen im deutschen Fernverkehrsmarkt. *Internationales Verkehrswesen* 70(1), 16–20.

Lee, J.-Y. (2019). 15 years of KTX Operation: Impacts and Future Direction. Paper presented in the *8th International Public Transport Forum* (co-hosted by International Transport Forum, Ministry of Land, Infrastructure and Transport, and The Korean Transport Institute). Leipzig, Germany, May 12, 2019.

Longuar Z., Nicolas J.-P., Verry D. (2010), Chaque Français émet en moyenne deux tonnes de CO2 par an pour effectuer ses déplacements, La Revue, Commissariat général au développement durable – Service de l'observation et des statistiques, 163-176.

Lope, D. J. & Dolgun, A. (2020). Measuring the inequality of accessible trams in Melbourne. *Journal of Transport Geography* 83, 102657.

Loukaitou-Sideris, A., Higgins, H., Piven, M., & Wei, W. (2013). Tracks to change or mixed signals? A review of the Anglo-Saxon literature on the economic and spatial impacts of high-speed rail. *Transport Reviews* 33(6), 617–633.

Lucas, K. (2012). Transport and social exclusion: Where are we now? *Transport policy* 20, 105-113.

Mattioli, G., Adeel, M. (2021), Long-Distance Travel, In: Vickerman, Roger (Eds.) International Encyclopedia of Transportation. vol. 6, pp. 272-277. UK: Elsevier.

Martens, K. (2017). *Transport Justice: Designing Fair Transportation Systems*. New York, London: Routledge.

Martínez Sánchez-Mateos, H. S. & Givoni, M. (2012). The accessibility impact of a new High-Speed Rail line in the UK – a preliminary analysis of winners and losers. *Journal of Transport Geography* 25, 105–114.

McArthur, J., Robin, E., & Smeds, E. (2019). Socio-spatial and temporal dimensions of transport equity for London's night time economy. *Transportation Research Part A: Policy and Practice* 121, 433-443.

McFarlane, C., & Rutherford, J. (2008). Political Infrastructures: Governing and Experiencing the Fabric of the City. *International Journal of Urban and Regional Research* 32(2), 363–374.

Médard de Chardon, C. (2019). The contradictions of bike-share benefits, purposes and outcomes. *Transportation Research Part A: Policy and Practice* 121, 401-419.

Minn, M. (2013). The Political Economy of High Speed Rail in the United States. *Mobilities* 8(2), 185–200.

Monzón, A, Ortega, E., López, E. (2013). Efficiency and spatial equity impacts of high-speed rail extensions in urban areas. *Cities* 30, pp. 18-30.

Pagliara, F. & Biggiero, L. (2017). Some evidence on the relationship between social exclusion and high speed rail systems, *HKIE Transactions* 24(1), 17–23.

Pagliara, F., Biggiero, L. & Menicocci, F. (2017a). Social Exclusion and High-Speed Rail: some evidence from three European countries. Proceedings of the AIIT International Congress on Transport Infrastructure and Systems (TIS 2017), Rom2, 10th-12th April. In Transport Infrastructure and Systems Dell'Acqua G. and Wegman F. (Eds). pp. 579-585.

Pagliara, F., De Pompeis, V., & Preston, J. (2017b). Travel cost: not always the most important element of social exclusion, *The Open Transportation Journal* 11, 110–119.

Pagliara, F., Vassallo, J. M., & Román, C. (2012). High-Speed Rail Versus Air Transportation. Case Study of Madrid–Barcelona, Spain, *Transportation Research Record: Journal of the Transportation Research Board* 2289, 10–17.

Pereira, R., Schwanen, T., & Banister, D. (2017). Distributive justice and equity in transportation. *Transport Reviews* 37(2), 170–191.

Perrin, J. (2019). La territorialisation des gares franciliennes de la grande vitesse ferroviaire face aux mutations du modèle TGV. Une analyse par la desserte du cas de Marne-la-Vallée Chessy. PhD dissertation, Université Paris-Est, unpublished.

Pooley, C. (2016). Mobility, Transport and Social Inclusion: Lessons from History. *Social Inclusion* 4(3), 100–109.

Preston, J. & Wall, G. (2008). The Ex-ante and Ex-post Economic and Social Impacts of the Introduction of High-speed Trains in South East England. *Planning, Practice & Research*, 23(3), 403–422.

Reichert, A., & Holz-Rau, C. (2014). Verkehrsmittelnutzung im Fernverkehr. In : Proff, H. (ed.), Radikale Innovationen in der Mobilität, Wiesbaden: Springer, pp. 429–444.

Reichert, A., Holz-Rau, C. (2015). Mode use in long-distance travel 8(2), 87–105.

Reigner, H., Brenac, T. (2019). Safe, sustainable… but depoliticized and uneven – A critical view of urban transport policies in France. *Transportation Research Part A: Policy and Practice* 121, 218-234.

Ren, X., Chen, X., Wang, F., Dan, T., Wang, W., Guo, X., Liu, C. (2020). Impact of high-speed rail on social equity in China: Evidence from a mode choice survey. Transportation Research Part A 138, 422–441.

Rohr, C., Fox, J., Daly, A., Patruni, B., Patil, S., Tsang, F. (2013). Modelling long-distance travel in the UK, Transportation Research Record 2013, 2344(1), 144–151, doi:10.3141/2344-16

Román, C., Martín, J. C., Espino, R., Cherchi, E., Ortúzar, J. de D., Rizzi, L. I., González, R. M., & Amador, F. J. (2014). Valuation of travel time savings for intercity travel: The Madrid-Barcelona corridor. *Transport Policy* 36, 105–117.

Shi, J. & Zhou, N. (2013). How Cities Influenced by High Speed Rail Development: A Case Study in China, *Journal of Transportation Technologies* 3, 7–16.

Steer Davies Gleave, Politecnico di Milano (2017), Research for TRAN Committee – Passenger night trains in Europe: the end of the line? Brussels: European Parliament, Policy Department for Structural and Cohesion Policies. Available at https://op.europa.eu/en/publication-detail/-/publication/0c15bc8e-3f64-11e7-a08e-01aa75ed71a1/language-en/format-PDF (retrieved 31/07/2020).

Troin, J.-F. (1995). *Rail et aménagement du territoire: Des héritages aux nouveaux défis*. Aix-en-Provence, France: Edisud.

Vanhoestenberghe, E. (2015). Le transport en car régulier et longue distance. Géographie du réseau à partir de Bruxelles et caractérisation des pratiques des utilisateurs. Master dissertation, Brussels: ULB (unpublished).

Zhan, S., Wong S. C., Lo S. M. (2020). Social equity-based timetabling and ticket pricing for high-speed railways. Transportation Research Part A 137, 165–186.

9. Appendices

Please see Supplementary Material.

Is high-speed rail socially exclusive? An evidence-based critical review

Paper to be submitted to TBS

Supplementary material

Appendix 1: HSR passengers by gender and age

Source	Market	Method	Findings (between brackets: national average, not always with same thresholds)
Xie (2017)	China, Beijing-Guangzhou line, 2016 (National Bureau of Statistics of China, 2016)	Questionnaires Sample: 160 Valid: 150	Gender Structure (Jinghu-HSR) **52% of males (51.2% of males)** 48% of females (48.8% of females) Age Structure (Jinghu-HSR) (most HSR passengers are 25-55 years old) <18: 5% (0-14: 16.7%) 18-25: 26% (15-64: 72.5%) 26-35: **33%** (≥65: 10.8%) 36-49: 20% >50: 16%
World Bank (2014)	China, Beijing-Shanghai line (Jinghu-HSR), 2013 (National Bureau of Statistics of China, 2013)	Questionnaires Sample for Beijing-Shanghai line: 488	Gender Structure (Jinghu-HSR) **60% of males (51.2% of males)** 40% of females (48.8% of females) Age Structure (HSR route: Beijing-Shanghai) (most HSR passengers are 25-55 years old) <25: 22% (0-14: 16.4%) 25-55**: 68%** (15-64: 73.9%) >55: 10% (≥65: 9.7%)
World Bank (2014)	China, Changchun-Jilin line (Changji-HSR), 2013 (National Bureau of Statistics of China, 2013)	Questionnaires Sample for Changchun-Jilin ICR: 416	Gender Structure (Changji-HSR) **60% of males (51.2% of males)** 40% of females (48.8% of females) Age Structure (Changji-HSR) (most HSR passengers are 25-55 years old) <25: 19% (0-14: 16.4%) 25-55: **73%** (15-64: 73.9%) >55: 8% (≥65: 9.7%)
Chan and Yuan (2017)	China, Shenzhen–Xiamen route, April and May 2016 (National Bureau of Statistics of China, 2016)	Survey at Shenzhen North Railway Station and Xiamen Railway Station (n=328)	Gender: Males 43.9% **(51.2% of males)** Females 56.1% (48.8% of females) Age: 18-25: 48.8% (0-14: 16.7%) 26-40: 28.7% (15-64: 72.5%) 41-55: 17.7% (≥65: 10.8%) 56+: 4.9%
Wang and Zhu (2017)	China, Yangtze River delta region, 2013 (National Bureau of	Questionnaire Total: 620 Valid: 600	Gender Structure (Total) **80.2% of males (51.2% of males)** 19.8% of females (48.8% of females) Age Structure (Total) 20<: 1.1% (0-14: 16.4%)

	Statistics of China, 2013)		20-25: 18.6% (15-64: 73.9%) 26-35: **51.2%** (≥65: 9.7%) 36-45: 20.4% 46-60: 8.7%
Klein et al. (1997)	France, Paris to the Atlantic – Business purpose	On board survey, 1993	Gender Structure **75% of males (49% of males)** 25% of females (51% of females) Age Structure (Total) 20-29: 15% (15%) 30-39: 32% (15%) **40-49: 37% (14%)** 50-59: 14% (10%)
Klein et al. (1997)	France, Paris to the Atlantic – Leisure purpose (weekend)	On board survey, 1993	Gender Structure **46% of males (49% of males)** 54% of females (51% of females) Age Structure (Total) <30: 38% (41%) 30-59: 59% (39%)
Klein et al. (1997)	France, Paris to the Atlantic – Commutes	On board survey, 1993	Gender Structure **78% of males (49% of males)** 22% of females (51% of females) Age Structure (Total) <30: 29% (41%) 30-59: 70% (39%)
Cascetta et al. (2011)	Italy, Roma-Naples, 2008	On board survey 2008	Gender Males 67% (48.37%) Females 33% (51.63%)
JR TOKAI MEDIA GUIDE **2017**	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), **2015** (Statistics Bureau, 2015)	Internet investigation Total sample: 3800 User: 3000 Non-user: 800 (Definition: User: one month more than once; while Non-user: less than once per year)	Age Structure (all classes) (2015) 0-29 – 12.0% (27.0%) 30-39 – 21.7% (12.3%) 40-49 – 28.5% (14.5%) 50-59 – 26.4% (12.2%) 60+ – 11.4% (34.1%) 0-29 –male: 7.1% (28.3%), female: 4.9% (25.7%) 30-39 –male: 15.8**%** (12.8%), female: 5.9**%** (11.8%) 40-49 –male: 23.6% (15.0%), female: 4.9% (14.0%) 50-59 –male: 21.9% (12.4%), female: 4.5% (11.9%) 60+ –male: 9.8% (31.5%), female: 1.6% (36.6%) Total males: 78.2% / females: 21.8% Age Structure (First class) (2015) 0-29 – 19.8% (27.0%) 30-39 – **28.5%** (12.3%) 40-49 – 22.7% (14.5%) 50-59 – 19.8% (12.2%) 60+ – 9.2% (34.1%) Age Structure by gender (First Class) (2015) 0-29 –male: 13.0% (28.3%), female: 6.8% (25.7%) 30-39 –male: **19.6%** (12.8%), female: **8.9%** (11.8%) 40-49 –male: 17.0% (15.0%), female: 5.7% (14.0%) 50-59 –male: 16.0% (12.4%), female: 3.8% (11.9%) 60+ –male: 8.5% (31.5%), female: 0.7% (36.6%)

			Age Structure (Second Class) (2015) 0-29 – 10.6% (27.0%) 30-39 – 20.5% (12.3%) 40-49 – **29.7%** (14.5%) 50-59 – 27.6% (12.2%) 60+ – 11.6% (34.1%) Age Structure by gender (Second Class) (2015) 0-29 – male: 6.0% (28.3%), female: 4.6% (25.7%) 30-39 – male: 15.1% (12.8%), female**: 5.4%** (11.8%) 40-49 – male: **24.9%** (15.0%), female: 4.8% (14.0%) 50-59 – male: 23.0% (12.4%), female: 4.6% (11.9%) 60+ – male: 10.0% (31.5%), female: 1.6% (36.6%)
JR TOKAI MEDIA GUIDE **2018**	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata**), 2017** (Statistics Bureau, 2017)	Internet investigation Total sample: 3800 User: 3000 Non-user: 800 (Definition: User: one month more than once; while Non-user: less than once per year)	Age Structure (all classes) (2017) 0-29 – 11.9% (26.9%) 30-39 – 21.1% (11.8%) 40-49 – 29.2% (14.9%) 50-59 – **26.5%** (12.4%) 60+ – 11.3% (33.9%) 0-29 – male: 7.2% (28.4%), female: 4.7% (25.5%) 30-39 – male: 15.8% (12.3%), female: 5.3**%** (11.4%) 40-49 – male: 23.2% (15.5%), female: 6.0% (14.4%) 50-59 – male: 21.8**%** (12.8%), female: 5.6% (12.1%) 60+ – male: 9.6% (31.0%), female: 1.7% (36.7%) Total males: 77.6% / females: 22.4% Age Structure (First Class) (2017) 0-29 – 16.5% (26.9%) 30-39 – 24.5% (11.8%) 40-49 – 22.6% (14.9%) 50-59 – 24.9% (12.4%) 60+ – 11.5% (33.9%) Age Structure by gender (First Class) (2017) 0-29 – male:11.2% (28.4%), female:5.3% (25.5%) 30-39 – male:17.3% (12.3%), female:**7.2%** (11.4%) 40-49 – male:17.3% (15.5%), female:5.3% (14.4%) 50-59 – male:**19.3%** (12.8%), female:5.6% (12.1%) 60+ – male:9.6% (31.0%) / female:1.9% (36.7%) Total males: 74.7% / females: 25.3% Age Structure (Second Class) (2017) 0-29 – 11.2% (26.9%) 30-39 – 20.7% (11.8%) 40-49 – **30.1%** (14.9%) 50-59 – 26.7% (12.4%) 60+ – 11.3% (33.9%) Age Structure by gender (Second Class) (2017) 0-29 – male:6.6% (28.4%), female: 4.6% (25.5%) 30-39 – male:15.6% (12.3%), female: 5.1% (11.4%) 40-49 – male:**24.1%** (15.5%), female: **6.0%** (14.4%) 50-59 – male:22.1% (12.8%), female: 4.6% (12.1%) 60+ – male:9.6% (31.0%), female: 1.7% (36.7%) Total males: 78.0% / females: 22.0%

Chang and Lee (2008)	Korea, 2007 (Statistics Korea, 2007)	Surveys (n=4,380)	Gender (weekday/weekend/total): Males 70.7% / 60.1% / 65.6% (50.1%) Females 29.3% / 39.9% / 34.4% (49.9%) Age (weekday / weekend / total): <20s 1.3% / 2.0% / 1.6% (24.7%) 20s 17.7% / 25.4% / 21.4% (15.1%) 30s 32.3% / 32.1% / 32.3% (17.7%) 40s 30.4% / 27.2% / 28.9% (17.3%) 50-59+ 18.3% / 13.3% / 15.9% (27.2%)
Renfe (2016)	Spain (AVE)	Interviews (conducted in the year 2016) (National Statistics, 2016)	Gender: Males 53.4% (49.1%) Ages: 16-24 8% (10.3%) 25-34 25.2% (14.5%) 35-44: 28.0% (20%) 45-60: 31.0% (27.7%) >60 7.7% (27.5%)
Renfe (2016)	Spain, Madrid – Sevilla/Málaga HSR corridors **(only long-distance HSR services)**	Interviews (conducted in the year 2016) (National Statistics, 2016)	Gender: Males 55.5% (49.1%) Females 44.5% (50.9%) Ages: 16-24 10% (10.3%) 25-34 25.4% (14.5%) 35-44 28.9% (20%) 45-60 28.2% (27.7%) >60 7.5% (27.5%)
Spanish Ministry of Development. Press release (2005)	Spain, Madrid – Sevilla HSR line	Survey (conducted in the year 2004) (National Statistics, 2004)	Gender: Males 55% (49.2%) Females 45% (50.8%) Ages: 25-44: 63% (33.1%)
Vía Libre, FFE. Press release (2011)	Spain, Madrid – Sevilla HSR line	Survey (2010) (National Statistics, 2010)	Gender: Males 56% (49.4%) Females 44% (50.6%) Ages: 30-44: 58% (25.5%)
Román et al. (2010)	Spain, Madrid-Zaragoza, 2004	Survey (Spring 2004), n=75 (National Statistics, 2004)	Gender: Males 68% (49.2%) Females 32% (50.8%) Average age: 38
Román et al. (2014)	Spain, Madrid-Barcelona, 2009	Survey (Nov 2009), n=378 (National Statistics, 2010)	Gender: Males 70% (49.4%) Females 30% (50.6%) Average age: 43
Pagliara et al. (2012)	Spain, Madrid-Barcelona, 2010	Survey at Madrid Atocha Station	Gender: Males 71% (49.4%)

		(February and March 2009) (National Statistics, 2010)	Females 29% (50.6%) Ages: 18-24 6% (9.4%) 25-35 26% (21.8%) 36-50 44% (29.0%) 51-65 18% (20.6%) >65 6% (19.2%) N.A. 2%
Ministry of Transportation and communications, Institute of Transportation 2010 (MOTC-IOT-99-PBB808)	Taiwan (THSR), 2010 (National Statistics of Taiwan, 2010)	Mail survey and interview Sample number: Weekday: 6,147 Weekend: 7,166 Total: 13,313	Gender Structure (Total) 44.5% of males (50.1%) **55.5% of females** (49.9%) Age Structure (Total) ≤14: 16.4% (<20: 22.59%) 15-64**: 73.0%** (20-60: 62.23%) ≥65: 10.6% (>60: 15.18%)
Ministry of Transportation and communications, Institute of Transportation 2015 (MOTC-IOT-103-PBB003)	Taiwan (THSR), 2014 (National Statistics of Taiwan, 2014)	Telephone interviews; Sampling amplification Total: 549,000 Valid: 32,620 Short trips within metropolitan area living circle: 64.9% Crossed the living circle: 35.1%	Gender Structure (Total) 44.5% of males (49.9%) **55.5% of females** (50.1%) Age Structure (Total) 15-24: 14.0% (<20: 20.46%) 25-34: 16.8% (20-60: 61.38%) 35-44: 18.4% (>60: 18.16%) 45-54: 20.3% 55+: **30.5%**
Ministry of Transportation and communications, Institute of Transportation 2016 (MOTC-IOT-104-PBB003)	Taiwan (THSR), 2015 (National Statistics of Taiwan, 2015)	Personal interview and questionnaire (supplementary investigation) Newly increased sample: 6,364 Total: Weekday: 10,973 Weekend: 17,334	Gender Structure (Total) 53.8% of males (49.9%) 46.2% of females (50.1%) Age Structure (Total) 15-24: 14.5% (<20: 19.95%) 25-34**: 27.1%** (20-60: 61.07%) 35-44: 23.6% (>60: 18.89%) 45-54: 18.7% 55-64: 11.7% 65+: 4.5%

Appendix 2: HSR passengers by income

Source	**Market**	**Method**	**Findings (between brackets: national average)**

Xie (2017)	China, Beijing-Guangzhou line, 2016 (National Bureau of Statistics of China, 2016)	Questionnaires Sample: 160 Valid: 150	Monthly Income <3000: **34%** 3001-5000: 32% 5001-7000: 18% 7000-10000: 12% >10001: 4% Share of HSR passengers with income higher than 3000 RMB: 66% (Note: per capita monthly disposable income nationwide: 1985) Income level of social classes: - Low-income households: 461 - Low-middle-income households: 1045 - Middle-income households: 1744 - Upper-middle-income households: 2666 - High-income households: 4938
World Bank (2014)	China, Beijing-Shanghai line (Jinghu-HSR), 2013 (National Bureau of Statistics of China, 2013)	Questionnaires Sample for Beijing-Shanghai line: 488	Monthly Income (Jinghu-HSR) Passenger's monthly average income is about RMB 6,700 on Jinghu-HSR. <5000: 49% 5001-10000: **34.7%** >10000: 16.3% (Note: per capita monthly disposable income nationwide: 1526) Income level of social classes: - Low-income households: 367 - Low-middle-income households: 804 - Middle-income households: 1308 - Upper-middle-income households: 2030 - High-income households: 3855
World Bank (2014)	China, Changchun-Jilin line (Changji-HSR), 2013 (National Bureau of Statistics of China, 2013)	Questionnaires Sample for Changchun-Jilin ICR: 416	Monthly Income (Changji-HSR) Passenger's monthly average income is about RMB 4,300 on Changji-HSR. <2000: 18% 2001-5000: **54%** 5001-10000: 24% 10001-20000: 3% >20001: 1% Share of HSR passengers with income higher than 2000 RMB: 72% (Note: per capita monthly disposable income nationwide: 1526) Income level of social classes: - Low-income households: 367 - Low-middle-income households: 804 - Middle-income households: 1308 - Upper-middle-income households: 2030 - High-income households: 3855

Chan and Yuan (2017)	China, Shenzhen–Xiamen route, April and May 2016 (National Bureau of Statistics of China, 2016)	Survey at Shenzhen North Railway Station and Xiamen Railway Station (n=328)	Monthly personal income (RMB): <1501: 14.0% 1501-3500: 18.3% **3501-6000: 31.7%** 6001-8000: 13.4% 8011-10,000: 9.2% >10,000: 13.4% Share of HSR passengers with income of at least 1501 RMB: 86% (Note: per capita monthly disposable income nationwide: 1985) Income level of social classes: - Low-income households: 461 - Low-middle-income households: 1045 - Middle-income households: 1744 - Upper-middle-income households: 2666 - High-income households: 4938
Wang and Zhu (2017)	China, The Yangtze river delta region, 2013 (National Bureau of Statistics of China, 2013)	Questionnaire Total: 620 Valid: 600	Monthly income (Unit: RMB) < 2000: 2.3% 2000 ≤ a<5000: 32.2% 5000 ≤ a<10000: **40.3%** 10000 ≤ a<20000: 17.4% 20000 ≤: 7.8% Share of HSR passengers with income higher than 2000 RMB: 97.7% (Note: per capita monthly disposable income nationwide: 1526) Income level of social classes: - Low-income households: 367 - Low-middle-income households: 804 - Middle-income households: 1308 - Upper-middle-income households: 2030 - High-income households: 3855

JR TOKAI MEDIA GUIDE 2017	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), 2015 (Statistics Bureau, 2015)	Internet investigation Sample:3800 User-3000 Non-user-800 User: one month more than once Non-user: less than once per year	Family annual income (Total) (Unit:10000JPY) (respondents with family annual income above 1000 account for 28.9%) < 200: 2.7% 200 ≤ a<399: 8.3% 400 ≤ a<599: 15.0% 600 ≤ a<799: 18.0% 800 ≤ a<999: 17.7% 1000 ≤ a<1499: 18.4% 1500 ≤ a<1999: 6.2% 2000 ≤ a<2499: 1.7% 2500 ≤ a<2999: 1.1% 3000 ≤ a<4999: 0.7% 5000 ≤ a: 0.8% Not clear: 9.4% Income level of social classes: - Low-income households: <330 - Low-middle-income households: 330-446 - Middle-income households: 446-595 - Upper-middle-income households: 595-814 - High-income households: 814<
JR TOKAI MEDIA GUIDE **2018**	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), **2017** (Statistics Bureau, 2016)	Internet investigation Sample: 3800 User-3000 Non-user-800 User: one month more than once Non-user: less than once per year	Family annual income (Total) (Unit:10000JPY) (respondents with family annual income above 1000 account for 31.7%) < 200: 3.1% 200 ≤ a<399: 7.4% 400 ≤ a<599: 15.3% 600 ≤ a<799: 16.7% 800 ≤ a<999: 17.6% 1000 ≤ a<1499: 20.2% 1500 ≤ a<1999: 6.3% 2000 ≤ a<2499: 2.0% 2500 ≤ a<2999: 1.1% 3000 ≤ a<4999: 0.8% 5000 ≤ a: 1.3% Not clear: 8.2% Income level of social classes: - low income households: <330 - low middle income households: 330-446 - middle income households: 446-595 - upper middle income households: 595-814 - high income households: 814<

Chang and Lee (2018)	Korea, 2007 (Statistics Korea, 2007)	Surveys (n=4,380)	Monthly income, 10^3 won (weekday / weekend / total): <1000 4.2% / 4.5% / 4.3% (30.5%) 1000-1999 15.4% / 18.4% / 16.9% (37.1%) 2000-2999 22.8% / 24.9% / 23.8% (20.5%) 3000-3999 22.7% / 20.7% / 21.7% (6.5%) 4000-4999 12.1% / 10.7% / 11.4% (3.1%) 5000-5999 8.9% / 7.7% / 8.3% (5000+: 2.4%) 6000+ 11.2% / 10.3% / 10.8% N.A. 2.7% / 2.8% / 2.8%
Román et al. (2010)	Spain, Madrid-Zaragoza, 2014	Survey (Spring 2014)	Per capita weekly income: €318.36
Román et al. (2014)	Spain, Madrid-Barcelona, 2009	Survey (Nov 2009), n=378	Monthly family income: €3888.15 Per capita weekly family income: €375.86
Pagliara et al. (2012)	Spain, Madrid-Barcelona, 2010	Survey at Madrid Atocha Station (February and March 2009)	Income (€/year): 0–20,000 6% (44.1%) 20,000–40,000 26% (40.7%) 40,000–80,000 44% (13.5%) 80,000–150,000 18% (>80,000 1.4%) >150,000 6% No response 2%
Ministry of Transportation and communications, Institute of Transportation 2015 (MOTC-IOT-103-PBB003)	Taiwan (THSR), 2014 (National Statistics of Taiwan, 2014)	Telephone interviews; Sampling amplification Total: 549,000 Valid: 32,620 Short trips within metropolitan area living circle: 64.9% Crossed the living circle: 35.1%	Personal annual income (Total) (10,000 TWD) < 20: 15.4% 20 ≤ a<30: 13.2% 30 ≤ a<40: **15.2%** 40 ≤ a<50: 14.0% 50 ≤ a<60: 12.4% 60 ≤ a<80: 13.2% 80 ≤ a<100: 7.5% 100 ≤ a<120: 4.7% 120 ≤ a: 4.5% Share of HSR passengers with income of at least 40,000 NT$: 56.3% (Note: per capita monthly disposable income nationwide: 37,858 NT$)

Ministry of Transportation and communications, Institute of Transportation 2016 (MOTC-IOT-104-PBB003)	Taiwan (THSR), 2015 (National Statistics of Taiwan, 2015)	Personal interview and questionnaire (supplementary investigation) Newly increased sample: 6,364 Total: Weekday: 10,973 Weekend: 17,334	Personal annual income (Total) (Unit:10000TWD) < 20: 16.8% 20 ≤ a<30: 13.4% 30 ≤ a<40: **15.0%** 40 ≤ a<50: 13.8% 50 ≤ a<60: 12.1% 60 ≤ a<80: 12.8% 80 ≤ a<100: 7.2% 100 ≤ a<120: 4.3% 120 ≤ a: 4.7% Share of HSR passengers with income of at least 40,000 NT$: 54.9% (Note: per capita monthly disposable income nationwide: 38574 NT$)

Appendix 3. HSR passengers by social class and occupational group

Source	**Market**	**Method**	**Findings (between brackets: national average)**
Xie (2017)	China, Beijing-Guangzhou line, 2016 (National Bureau of Statistics of China, 2016)	Questionnaires Sample: 160 Valid: 150	Occupation Structure Free-lancer: 6.6% Regular full-time employees: **31.3%** Staff of state-owned enterprises: 12% Officials: 11.3% Self-employed: 9.4% Manual labour: 4% Student: 18% Retiree: 4.7% Other: 2.7% (Lack of comparable national data)
Chan and Yuan (2017)	China, Shenzhen–Xiamen route, April and May 2016 (National Bureau of Statistics of China, 2016)	Survey at Shenzhen North Railway Station and Xiamen Railway Station (n=328)	Business clerk 31.1% Public servant 4.3% Manager 10.3% Professionals (e.g. lawyer, doctor) 12.2% Peasant 1.2% Self-employed or freelance 18.4% Retired 8.5% Student 14.0% (lack of comparable data at national level)
Wang and Zhu (2017)	China, The Yangtze river delta region, 2013 (National Bureau of Statistics of China, 2013)	Questionnaire Total: 620 Valid: 600	Occupation (Total) Administrative official: 3.4% Manager: 18.8% Technician and associate professional: **44.2%** Clerk: 3.9% Service and sales worker: 12.7% Skilled agricultural, forestry and fishery worker: 0.4% Plant and machine operator: 2.1% Private enterprise owner: 6.5% Individual-owned business: 4.1% Solider: 1.3% Other: 2.6% (Lack of comparable national data)

Klein et al. (1997)	France, Paris to the Atlantic – Business purpose	On board survey, 1993	Executive: 58% Manager: 8% Employee/worker: 10% Freelance: 10% Technician: 6% Others: 8%
Klein et al. (1997)	France, Paris to the Atlantic – Leisure purpose (weekend)	On board survey, 1993	Executive: 48% Employee/worker: 22% Freelance: 11% Technician: 12% Retired/unemployed: 6%
Klein et al. (1997)	France, Paris to the Atlantic – Commutes	On board survey, 1993	Executive: 51% Employee/worker: 29% Freelance: 7% Technician: 12%
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – Côte d'Azur section	Surveys (March)	Intermediate 19% (12%) Upper* 31% (8%) Retired 26% (30%) Employees, workers 10% (30%) Students 5% (10%) Shopkeepers, artisans 2% (5%) Others not working 7% (5%)
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – Provence section	Surveys (March)	Intermediate 27% (12%) Upper* 39% (8%) Retired 10% (30%) Employees, workers 9% (30%) Students 6% (10%) Shopkeepers, artisans 2% (5%) Others not working 7% (5%)
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – TOTAL	Surveys (March)	Intermediate 25% (12%) Upper* 37% (8%) Retired 14% (30%) Employees, workers 9% (30%) Students 6% (10%) Shopkeepers, artisans 2% (5%) Others not working 7% (5%)
RFF and SNCF (2007)	France, Northern HSR, 2003/2004	Surveys (winter time)	Intermediate 17% (12%) Upper* 46% (8%) Retired 4% (30%) Employees, workers 12% (30%) Students 11% (10%) Shopkeepers, artisans 2% (5%) Others not working 8% (5%)

Cascetta et al. (2011)	Italy, Rome-Naples	On boead survey 2008	Occupational groups - Managerial/executive: 42.4% - Teacher: 4% - Engineer/technical: 12.9% - Administration:13.6 - Services to families: 3% - Students: 9.5% - Retired: 3.4% - Unemployed:1.7 - Others: 9.5% To summarise: - Employed (Managerial/executive+ Teacher+ Engineer/technical+ Administration+ Services to families+ Others): 85.4% (45%) - Unemployed: 1.7 (5.8) - Not workforce (Retired+Students): 12.9 (49.2)
JR TOKAI MEDIA GUIDE 2017	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), 2015 (Statistics Bureau, 2015)	Internet investigation Sample:3800 User-3000 Non-user-800 User: one month more than once Non-user: less than once per year	Occupation Structure (First Class) (2012) (business person accounts for **85.4%**) Regular full-time employees: 52.1% (26.1%) Manager: 8.9% (2.7%) Officials: 4.7% (2.3%) Medical staff: 9.1% (1.6%) Teacher: 2.1% (1.0%) Self-employed: 5.1% (4.5%) Free-lancer: 1.7% (4.6%) Dispatched employees: 1.7% (0.9%) Part-time worker: 4.9% (11.0%) Student: 1.7% (14.6%) Other: 8.0% (-) Occupation Structure (Second Class) (2012) (business person accounts for **89.4%)** Regular full-time employees: 69.6% (26.1%) Manager: 3.3% (2.7%) Officials: 4.4% (2.3%) Medical staff: 2.5% (1.6%) Teacher: 1.5% (1.0%) Self-employed: 3.7% (4.5%) Free-lancer: 1.8% (4.6%) Dispatched employees: 2.6% (0.9%) Part-time worker: 3.4% (11.0%) Student: 1.1% (14.6%) Other: 6.1% (-)

JR TOKAI MEDIA GUIDE **2018**	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), **2017** (Statistics Bureau, 2017)	Internet investigation Sample: 3800 User-3000 Non-user-800 User: one month more than once Non-user: less than once per year	Occupation Structure (First Class) (2017) (business person accounts for **87.3%**) Regular full-time employees: 54.4% (27.2%) Manager: 12.0% (2.7%) Officials: 4.0% (not been released) Medical staff: 6.7% (not been released) Teacher: 1.6% (1.1%) Self-employed: 5.9% (4.3%) Free-lancer: 1.9% (4.4%) Dispatched employees: 0.8% (1.1%) Part-time worker: 4.3% (11.6%) Student: 0.8% (14.4%) Other: 7.6% (-) Occupation Structure (Second Class) (2017) (business person accounts for **88.9%**) Regular full-time employees: 69.7% (27.2%) Manager: 3.2% (2.7%) Officials: 4.7% (not been released) Medical staff: 3.0% (not been released) Teacher: 1.1% (1.1%) Self-employed: 3.3% (4.3%) Free-lancer: 1.6% (4.4%) Dispatched employees: 2.3% (1.1%) Part-time worker: 3.4% (11.6%) Student: 1.5% (14.4%) Other: 6.2% (-)
Chang and Lee (2018)	Korea, 2007 (Statistics Korea, 2007)	Surveys (n=4,380)	Occupation (weekday / weekend / total): Employee 55.0% / 55.3% / 55.1% (59.8%) Student 6.6% / 9.3% / 7.9% (4.6%) Business owner 23.3% / 18.8% /21.1% (2.6%) Unemployed married women 8.3% / 10.1% / 9.2% (0.6%) Job seekers 1.8% / 1.5% / 1.6% (1.7%) Others 5.1% / 5.0% / 5.1% (38.2%)
Renfe (2016)	Spain (AVE)	Interviews (conducted in the year 2016)	HSR passengers come from: - The upper class: 32.7% - The upper-middle class: 38.4% - Middle class: 25.9% - Lower-middle class: 2.7% - Lower class: 0.3%
Renfe (2016)	Spain, Madrid – Sevilla/Málaga HSR corridors **(only long-distance HSR services)**	Interviews (conducted in the year 2016)	HSR passengers come from: - The upper class: 36.6% - The upper-middle class: 35.3% - Middle class: 25.7% - Lower-middle class: 2.1% - Lower class: 0.3%

Menéndez et al. (2002)	Spain, Madrid – Ciudad Real – Puertollano connections **(only regional HSR services)**	Survey (2002) (Census data, 2001)	Occupational groups - Managerial/executive/business owner: 14% (3.2%) - Technical/Liberal professional: 32% (9.3%) - Skilled worker: 14% (8.3%) - Public worker: 3% (3.9%) - Housekeeper: 6% (11.8%) - Student: 18% (20.2%) - Retiree: 2% (17.3%) - Others: 12% (25.9%)
Ureña et al. (2001). Unpublished report	Spain, Madrid – Cordoba link	Survey (December 2000) (Census data, 2001)	Occupational groups - Managerial/executive/business owner: 17% (3.2%) - Technical/Liberal professional: 43% (9.3%) - Service and sales worker: 5% (6.0%) - Public worker: 10% (3.9%) - Self-employed: 3% - Housekeeper: 4% (11.8%) - Student: 6% (20.2%) - Retiree: 1% (17.3%) - Unemployed: 0% (6.6%) - Others: 9% (21.6%) - No response: 2%
Vía Libre, FFE. Press release (2008)	Spain, Madrid – Málaga HSR line	Survey (2008, summertime) (Census data, 2011)	More than 50% of travellers of passengers are executives or have a technical position (8.8% of total population; 17.2% of active population)
Vía Libre, FFE. Press release (2011)	Spain, Madrid – Sevilla HSR line	Survey (2010) (Census data, 2011)	60% of passengers have a higher occupational positions in their jobs (8.8% of total population; 17.2% of active population)
Spanish Ministry of Development. Press release (2005)	Spain, Madrid – Sevilla HSR line	Survey (conducted in the year 2004) (Census data, 2001)	68% of passengers have a higher occupational positions in their jobs (8.1% of total population; 20.2% of active population)
Ureña et al. (2001). Unpublished report	Spain, Madrid – Sevilla link	Survey (December 2000) (Census data, 2001)	Occupational groups - Managerial/executive/business owner: 27% (3.2%) - Technical/Liberal professional: 37% (9.3%) - Service and sales worker: 7% (6.0%) - Public worker: 8% (3.9%) - Self-employed: 3% - Housekeeper: 2% (11.8%) - Student: 4% (20.2%) - Retiree: 1% (17.3%) - Unemployed: 1% (6.6%) - Others: 9% (21.6%) - No response: 1%

Ureña et al. (2001). Unpublished report	Spain, Sevilla – Cordoba link	Survey (December 2000) (Census data, 2001)	Occupational groups - Managerial/executive/business owner: 18% (3.2%) - Technical/Liberal professional: 37% (9.3%) - Service and sales worker: 8% (6.0%) - Public worker: 6% (3.9%) - Self-employed: 6% (N.A.) - Housekeeper: 10% (11.8%) - Student: 1% (20.2%) - Retiree: 1% (17.3%) - Unemployed: 0% (6.6%) - Others: 9% (21.6%) - No response: 4%

* Directors, senior managers, professions and higher education.

Appendix 4. HSR passengers by education

Source	**Market**	**Method**	**Findings (between brackets: national average)**
Wang and Zhu (2017)	China, The Yangtze river delta region, 2013 (National Bureau of Statistics of China, 2013)	Questionnaire Total: 620 Valid: 600	Education Attainment (No schooling: 5.0%) (Primary school: 26.4%) Junior high school or below: 3.6% (40.8%) Senior high school or secondary vocational school: 11.4% (16.5%) Vocational college: 17% (Vocational college and above: 11.3%) Undergraduate: 55.2% Postgraduate: 10.8% PhD and above: 2.0% [Total: 100%/100%]
Xie (2017)	China, Beijing-Guangzhou line, 2016 (National Bureau of Statistics of China, 2016)	Questionnaires Sample: 160 Valid: 150	Education Attainment (No schooling: 5.7%) (Primary school: 25.6%) Junior high school: 4% (38.8%) Senior high school or secondary vocational school: 16% (16.9%) Undergraduate or vocational college: 62% (12.4%) Master and above: 18% (0.6%) [Total: 100%/100%]
Chan and Yuan (2017)	China, Shenzhen–Xiamen route, April and May 2016 (National Bureau of Statistics of China, 2016)	Survey at Shenzhen North Railway Station and Xiamen Railway Station (n=328)	Junior secondary school or below 3.1% (70.1%) Senior secondary school 11.0% (12.8%) Junior college 34.2% (6.9%) Undergraduates 37.2% (5.5%) Postgraduate or above 14.6% (0.6%) (No schooling: 5.7%) [Total: 100%/100%]
Vía Libre, FFE. Press release (2011)	Spain, Madrid – Sevilla HSR line	Survey (2010) (Census data, 2011)	69% of passengers have university education (22.5%)

Spanish Ministry of Development. Press release (2005)	Spain, Madrid – Sevilla HSR line	Survey (conducted in the year 2004) (Census data, 2001)	72% of passengers have university education (13.1%)
Ureña et al. (2012)	Spain, Madrid – Barcelona	Not specified (-) (Census data, 2011)	69% of passengers have university education (22.5%)
Ureña et al. (2012)	Spain, Madrid – Ciudad real – Puertollano	Not specified (-) (Census data, 2011)	58% of passengers have university education (22.5%)
Ureña et al. (2012)	Spain, Madrid – Toledo	Not specified (-) (Census data, 2011)	66% of passengers have university education (22.5%)
Ureña et al. (2012)	Spain, Madrid - Segovia	Not specified (-) (Census data, 2011)	72% of passengers have university education (22.5%)
Menéndez et al. (2002)	Spain, Madrid – Ciudad Real – Puertollano connections **(only regional HSR services)**	Survey (2002) (Census data, 2001)	Education - University degree: 33% (6.9%) - University bachelor: 18% (6.2%) - Senior high school: 24% (18.2%) - Junior high school: 10% (26.1%) - Elementary: 13% (23.7%) - Without education: 2% (18.9%)
Ureña et al. (2001). Unpublished report	Spain, Madrid – Sevilla link	Survey (December 2000) (Census data, 2001)	Education - University degree: 50% (6.9%) - University bachelor: 19% (6.2%) - Senior high school: 16% (18.2%) - Junior high school: 7% (26.1%) - Elementary: 6% (23.7%) - Without education: 1% (18.9%) - No response: 1%
Ureña et al. (2001). Unpublished report	Spain, Madrid – Cordoba link	Survey (December 2000) (Census data, 2001)	Education - University degree: 52% (6.9%) - University bachelor: 20% (6.2%) - Senior high school: 16% (18.2%) - Junior high school: 5% (26.1%) - Elementary: 6% (23.7%) - Without education: 0% (18.9%) - No response: 1%
Ureña et al. (2001). Unpublished report	Spain, Sevilla – Cordoba link	Survey (December 2000) (Census data, 2001)	Education - University degree: 52% (6.9%) - University bachelor: 10% (6.2%) - Senior high school: 17% (18.2%) - Junior high school: 10% (26.1%) - Elementary: 9% (23.7%) - Without education: 1% (18.9%) - No response: 1%

Appendix 5. HSR passengers by travel purpose

Source	Market	Method	Measure	Business	Commuting	Leisure/Holiday	VFR	Others
Chan and Yuan (2017)	China, Shenzhen–Xiamen route, April and May 2016	Survey at Shenzhen North Railway Station and Xiamen Railway Station (n=328)	Major purpose of travel	15.2%	4.9%	52.4%	22.0%	5.5%
JR TOKAI MEDIA GUIDE 2017	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), 2015	Internet investigation Sample: 3800 User-3000 Non-user-800 User: one month more than once Non-user: less than once per year	Trip purpose, Tokyo to Shin-Osaka Shin-Osaka to Hakata	67.0 59.5	0.9 1.5	17.4 23.5	# 	14.4 15.5
JR TOKAI MEDIA GUIDE 2018	Japan (Tokyo to Shin-Osaka & Shin-Osaka to Hakata), 2017	Internet investigation Total sample: 3800 User: 3000 Non-user: 800 (Definition: User: one month more than once; while Non-user: less than once per year)	Trip purpose, Tokyo to Shin-Osaka Shin-Osaka to Hakata	68.3 60.2	1.0 1.6	18.1 23.3	# 	12.6 14.9
Ministry of Transportation and communications, Institute of Transportation 2015 (MOTC-IOT-103-PBB003)	Taiwan (THSR), 2014	Telephone interviews; Sampling amplification Total: 549,000 Valid: 32,620 Short trips within metropolitan area living circle: 64.9% Crossed the living circle: 35.1%	Trip purpose Weekday Weekend	8.23 12.4 3.2	8.71 7.7 1.8	22.65 4.7 8.5	40.11 47.0 59.0 (‘personal’)	2.81 4.5 3.9

Ministry of Transportation and communications, Institute of Transportation 2016 (MOTC-IOT-104-PBB003)	Taiwan (THSR), 2015	Personal interview and questionnaire (supplementary investigation) Newly increased sample: 6,364 Total: Weekday: 10,973 Weekend: 17,334	Trip purpose Weekday Weekend	17.52 41.8 16.1	20.62 11.2 1.9	15.30 10.3 17.5	35.20 29.0 56.7 ('personal')	2.76 7.8 7.8
Wang and Zhu (2017)	China, The Yangtze river delta region, 2013	Questionnaire Total: 620 Valid: 600	Trip purpose	61.9	11.2	9.2	2.6 ('personal')	15.1
World Bank (2014)	China, Beijing-Shanghai line (Jinghu-HSR), 2013	Questionnaires Sample for Beijing-Shanghai line: 488	Trip purpose	62		28		10
World Bank (2014)	China, Changchun-Jilin line (Changji-HSR), 2013	Questionnaires Sample for Changchun-Jilin ICR: 416	Trip purpose	23	17	51		9
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – Provence section	Surveys (March)	Main purpose of travel	42%				
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – Côte d'Azur section	Surveys (March)	Main purpose of travel	24%				
RFF and SNCF (2007)	France, Mediterranean HSR, 2003 – TOTAL	Surveys (March)	Main purpose of travel	37%				
RFF and SNCF (2007)	France, Northern HSR, 2003/2004	Surveys (winter time)	Main purpose of travel	45%				

Chang and Lee (2008)	Korea	Survey (n=4,380)	Purpose of travel – Weekday	70.8	3.3	7.1	14.1	4.7
Chang and Lee (2008)	Korea	Survey (n=4,380)	Purpose of travel – Weekend	36.9	3.2	16.8	35.4	7.7
Chang and Lee (2008)	Korea	Survey (n=4,380)	Purpose of travel – Total	54.3	3.3	11.8	24.4	6.2
Cascetta et al. (2011)	Italy, Rome-Naples, 2008	Survey in March	Purpose of travel		71.8	4.8	11.6	11.7
Ureña et al. (2001). Unpublished report	Spain, Madrid – Sevilla link	Survey (December 2000)	Purpose of travel	56% (Business: 41%; Work-related: 15%)		21%	17%	6% (Study: 2%; medical: 1%; others: 3%)
Ureña et al. (2001). Unpublished report	Spain, Madrid – Cordoba link	Survey (December 2000)	Purpose of travel	40% (Business: 30%; Work-related: 10%)		31%	21%	8% (Study: 2%; medical: 3%; others: 3%)
Ureña et al. (2001). Unpublished report	Spain, Sevilla – Cordoba link	Survey (December 2000)	Purpose of travel	65% (Business: 42%; Work-related: 23%)		10%	10%	15% (Study: 9%; medical: 4%; others: 2%)
Menéndez et al. (2002)	Spain, Madrid – Ciudad Real – Puertollano connections **(only regional HSR services)**	Survey (2002)	Purpose of travel	26%	19%	11%	21%	22% (Study: 13%; medical: 6%; others: 3%)
Renfe (2016)	Spain, Madrid – Sevilla/Málaga HSR corridors **(only long-distance HSR services)**	Interviews (conducted in the year 2016)	Purpose of travel	29.8%	21.1%	22.1%	19.3%	7.6%

Vía Libre, FFE. Press release (2011)	Spain, Madrid – Sevilla HSR line	Survey (2010)	Main purposes of travel	Work: 61%	21%		
Spanish Ministry of Development. Press release (2005)	Spain, Madrid – Sevilla HSR line	Survey (conducted in the year 2004)	Main purposes of travel	Work: 51%		27% (personal issues)	
Ureña et al. (2012)	Spain, Madrid – Barcelona	Not specified (-)	Main purposes of travel	Work: 61%			
Ureña et al. (2012)	Spain, Madrid – Ciudad real – Puertollano	Not specified (-)	Main purposes of travel	Work: 46%		22%	
Ureña et al. (2012)	Spain, Madrid – Toledo	Not specified (-)	Main purposes of travel	Work: 42%	37%		
Ureña et al. (2012)	Spain, Madrid - Segovia	Not specified (-)	Main purposes of travel	Work: 62%	15%		
Pagliara et al. (2012)	Spain, Madrid-Barcelona, 2010	Survey at Madrid Atocha Station (February and March 2009)	Purpose of travel	Work: 81%	7%	9%	3%

Notes:

Included in others (others include personal migration trip for jobs, visiting families, personal events such as weddings, funerals)

VFR refers to visits to friends and relatives.

* Directors, senior managers, professions and higher education.

** “Private purpose”

References

Chan, C.-S. & Yuan, J. (2017). Changing travel behaviour of high-speed rail passengers in China, *Asia Pacific Journal of Tourism Research* 22(12), 1221–1237.

Chang, J. & Lee, J.-H. (2008). Accessibility analysis of Korean high-speed rail: a case study of the Seoul metropolitan area. *Transport Reviews* 28 (1), 87–103.

JR TOKAI Agency (2017) *JR Tokai Media Guide 2017*. Tokyo: JR TOKAI Agency. https://www.jrta.co.jp/pdf/JR_MEDIA_GUIDE_2017_all.pdf

JR TOKAI Agency (2018) *JR Tokai Media Guide 2018*. Tokyo: JR TOKAI Agency. https://www.jrta.co.jp/pdf/JR_MEDIA_GUIDE_2018_all.pdf

Klein, O., Claisse, G., Pochet, P. (1997). Le TGV-Atlantique : entre récession et concurrence. Evolution de la mobilité et mise en service du TGV-Atlantique : analyse des enquêtes réalisées en septembre 1989 et septembre 1993. Études et Recherches, Lyon: LET.

Menéndez, J. M., Coronado, J. M., & Rivas, A. (2002). El AVE en Ciudad Real y Puertollano. Notas sobre su incidencia en la movilidad y el territorio. Cuadernos de Ingeniería y Territorio. Ciudad Real, Spain: E.T.S.I. Caminos, Canales y Puertos, Universidad de Castilla - La Mancha.

MOTC-IOT (2010). *Comprehensive Transportation Planning Research Series: Transportation system and social-economic development trends (2/2),* MOTC-IOT-99-PBB008, Final report presented on 12 November 2010, Taipei, Taiwan.

MOTC-IOT (2015). *The 5th Taiwan Area Comprehensive Transportation Planning Research Series - Intercity Travel Survey and Preliminary Analysis*, MOTC-IOT-103-PBB003, Taipei: Ministry of Transportation and Communications, Institute of Transportation.

MOTC-IOT (2016). *The 5th Taiwan Area Comprehensive Transportation Planning Research Series - Intercity travel analysis and additional survey*, MOTC-IOT-104-PBB003, Taiwan: Ministry of Transportation Research Institute.

Pagliara, F., Vassallo, J. M., & Román, C. (2012). High-Speed Rail Versus Air Transportation. Case Study of Madrid–Barcelona, Spain, *Transportation Research Record: Journal of the Transportation Research Board* 2289, 10–17.

Renfe (2016). Encuesta anual de calidad-producto Renfe viajeros - servicios comerciales. Datos Generales. *Dirección General de Desarrollo y Estrategia, Gerencia de Área de Estudios, RENFE*

RFF and SNCF (2007). Bilan LOTI de la LGV Méditerranée, Rapport.

Román, C., Espino, R., & Martin, J. C. (2010). Analyzing Competition between the High Speed Train and Alternative Modes. The Case of the Madrid-Zaragoza-Barcelona Corridor. *Journal of Choice Modelling* 3(1), 84–108.

Román, C., Martín, J. C., Espino, R., Cherchi, E., Ortúzar, J. de D., Rizzi, L. I., González, R. M., & Amador, F. J. (2014). Valuation of travel time savings for intercity travel: The Madrid-Barcelona corridor. *Transport Policy* 36, 105–117.

Spanish Ministry of Development (2005). 'El AVE Madrid-Sevilla, primera línea de Alta Velocidad en España, cumple 13 años. Más de 58 millones de viajeros han usado el AVE Madrid–Sevilla desde su inauguración en 1992', Press release (21/04/2005). Ministerio de Fomento. Available at: http://www.fomento.gob.es/NR/rdonlyres/F7E428B2-9583-46EA-9B52-C06C60CA70B0/60987/0504211.pdf

Ureña, J.M., Coronado, J.M., Escobedo, F., & Martínez, A. (2001). Algunos efectos de la línea de Alta Velocidad Madrid-Sevilla sobre el territorio y el transporte. Algunos efectos sobre el territorio en la provincia de Ciudad Real. Ciudad Real. ETSI Caminos, Canales y

Puertos de la UCLM. Unpublished report for TYPSA and the Spanish Ministry of Development.

Ureña, J.M., Coronado, J.M., Garmendia, M., Romero, V. (2012). Territorial implications at national and regional scales of high-speed rail, in: Ureña, J.M. (Ed.), Territorial Implications of High Speed Rail: A Spanish Perspective. Ashgate, London, pp. 129–162

Vía Libre, FFE (2008). 'El AVE entre Málaga y Madrid ha sido utilizado por un millón y medio de viajeros desde su puesta en servicio', Vía Libre, La revista del ferrocarril, Fundación de los Ferrocarriles Españoles. Press release (29/09/2008). Available at: https://www.vialibre-ffe.com/noticias.asp?not=2420&cs=oper

Vía Libre, FFE (2011). 'Más de 53 millones de viajeros han utilizado el AVE Madrid-Sevilla desde su puesta en servicio en 1992', Vía Libre, La revista del ferrocarril, Fundación de los Ferrocarriles Españoles. Press release (26/04/2011). Available at: https://www.vialibre-ffe.com/noticias.asp?not=7080&cs=alta

Wang, X.P. & Zhu, Q.S. (2017) *High-speed rail-driven regionalised urban integration and urban spatial restructuring*. Nanjing: South-East University.

World Bank (2014). *Regional Economic Impact Analysis of High-Speed Rail in China* (No: ACS9734). Washington, DC: The World Bank.

Xie, N.G. (2017) 'Analysis on the Tourism Characteristics and Behavioral Intention of High-speed Rail Passengers', *Journal of Xi'an University (Natural Science Edition)*, 20(1), January, pp.92-99.