

# **RAILWAY COMMUTING PATTERNS AND DRIVING FORCES IN PORTUGAL: INSIGHTS FOR FUTURE HIGH-SPEED RAIL**

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## **ABSTRACT**

This paper is conducted as one of the preliminary and exploratory research to provide insights for the future advent of high-speed rail (HSR) service in Portugal. It is well recognized and empirically verified that transportation development changes the spatial pattern that is accompanied by changes in individual's housing and employment locations, which in turn causes changes in commuting patterns, and in the end in global travel behavior. From this departure point, we aim to explore the determinants of long-distance commuting and identify the distinctive features of this group of people. To obtain reference values of the railway commuting patterns and the driving forces for the HSR case in the future, a case study has been conducted on the two conventional railway lines in Portugal, which are Lisbon-Tomar (143 km) and Lisbon-Santarem (78 km). A survey is carried out on the passengers, who travel by train during the morning and evening peaks of weekdays. In the survey, respondents are asked about their information on personal and household demographic and socio-economic characteristics, their travel behavior (e.g. household daily activity patterns, commuting trip length and cost), residence satisfaction levels and their attitudes towards locations and commuting per se. The following results have been obtained through the analysis of the observed data: a) profile of the intercity railway commuters in Portugal and their general time-space using patterns; b) the driving forces behind this commuting behavior; c) some insights for future "super-commuting" of HSR in Portugal, taking into the considerations of the distinctive features of HSR.

*Keywords: Commuting Pattern, Driving Forces, Railway, High-Speed Rail.*

## **INTRODUCTION**

The number of commuters and the distances between home and work have increased considerably in the past few decades, thanks to the increase in the average speed of transportation related to the prevalence of the private cars, the introduction of public transport services, and the construction of extensive highway and railway networks (Rouwendal and Rietveld, 1994; Green et al., 1999). Jarvis (1999) and Van Ham (2001) both stated that people have become less prone to migrate, due to the rise in the share of dual-earner and dual-career households, but have become more compliant towards a longer commutes. The nature of dual-career family influences the choice of residence, because attention must be paid to two parties and it is more difficult combining family and work demands. Moreover, high workforce specialization and few jobs within ideal commuting time also forces some people to commute across cities or regions, because it is too costly to change job or move residence (Van Ham, 2001; Van Ham and Hooimeijer, 2009; Sandow and Westin, 2010; Van Ommeren and Rietveld, 2007). In the situation that the labor market in one region cannot satisfy both partners, one partner may choose to commute a long distance in other regions (Green, 1997). Therefore, commuting is becoming a means to balance a geographical mismatch of supply and demand of labor, and long-distance daily and weekly commuting are increasingly important substitutes for migration (Green et al., 1999; Lundholm et al., 2004; Lundholm, 2010).

The increased proportion of commuters traveling by car evidently requires more land to be used for the construction of road infrastructures and causes more emissions that affect the environment, thus, it contradicts the goals of the government and policy makers. Investment in regional railway services is therefore perceived as the most important measure for facilitating an increased long distance commuting and at the same time promoting a sustainable development (Sandow, 2008). Understanding the behavior and the determinants of this specific group of commuters is therefore crucial for planning the inter-regional railway services and for the regional development policies aimed at improving the local labor markets. Although previous research has contributed substantially to understanding commuting behavior in different metropolitan areas and less populated regions and concluded that social ties, individual characteristics, preferences and norms, household composition, etc., all would influence people's commute pattern (e.g. McLafferty and Preston, 1991; Rouwendal and Rietveld, 1994; Rouwendal and Meijer, 2001; Öhman and Lindgren, 2003; Sandow and Westin, 2010), few studies have specifically addressed the pattern and behavior of the interurban or interregional railway commuters.

In the planned high-speed rail (HSR) project for the connection between Lisbon and Oporto in Portugal, one of the relevant objectives is to shape a Lisbon-Oporto megalopolis, aiming to minimize the negative effects of HSR on small and isolated urban areas and maximize the regional economic gains. With the implementation of HSR service, the travel times between different cities will be significantly reduced which brings them “closer” to each other, and thus increases their potential interactions along the HSR corridor and creates a new type of region with a high intra- and inter-regional accessibility (Gutiérrez, 2001; Chen and Abreu e Silva, 2011). Wider labor markets, of course, mean more frequent and longer commuting trips. In this case, the HSR binds together cities in the corridor, where each pair of cities is at a time

distance of less than 30 min, which is a time distance that allows daily commuting and business trips (Blum et al., 1997). HSR has the important effect of creating a potential changes in the size of labor markets, not just for daily commuting, but also for reinforcing the possibility of long-distance weekly commuting where the constraints of housing or personal circumstances prevent job related migration (Vickerman, 2007). This also motivated the setting up of a research on the dynamics between the formation of megalopolises along the HSR line (Lisbon to Oporto) and the emergence of “super-commuting” patterns by the potential HSR users.

This paper is conducted as one of the preliminary and exploratory research to provide insights for the future advent of high-speed rail (HSR) service in Portugal. We aim to explore the determinants of inter-city railway commuting and identify the distinctive features of this group of people. To obtain reference values for the railway commuting patterns and the driving forces for the HSR case in the future, a case study has been conducted on two conventional railway services in Portugal, which are Lisbon-Tomar (143 km) and Lisbon-Santarem (78 km). In both cities (Tomar and Santarem) there is a relevant number of residents which work in Lisbon, which could therefore be classified as super commuters. A survey is carried out on the passengers, who travel by train during the morning peak on weekdays. In the survey, respondents are asked about their information on personal and household demographic and socio-economic characteristics, their travel behavior (e.g. household daily activity patterns, commuting trip length and cost), residence satisfaction levels and their attitudes towards locations and commuting. The descriptive statistics approach is used to analyze the influence of workers’ backgrounds, individual and household characteristics, as well as their social ties and preferences on their commuting behaviors, aiming to provide an insight into issues that shape the commuting patterns. The following results are obtained through the analysis of the observed data: a) profile of the intercity railway commuters in Portugal; b) the driving forces behind this commuting behavior; c) and the general time-space using patterns.

## **LITERATURE REVIEW**

Hägerstrand (1975) has identified that people’s engagement in everyday projects and activities, such as work, study, hobbies, friends and family, are related to the propensity to move and to the possibility to transfer or substitute these local projects. Transportation and communication technology, physical ability, household situation, social and financial condition, influence the decision-making of the individuals or households concerning their willingness to move or stay, which creates a selection of individuals into different commuting distances.

Previous literature on job-related commuting shows that individual and household characteristics to be the determinants of commuting tolerance. Younger people are generally more inclined to migrate, which does not mean they have no local attachment, but their goals and preferences at that stage of their life differ from those of households with children. Age is found to be positively correlated with the preference to stay because of local attachments. Higher local attachment increases the unwillingness to move and start over at a new place,

which makes long-distance commuting an increasingly attractive solution with age (Van Ham et al., 2001). Empirical studies have found age to be negatively correlated to commuting distance (DaVanzo 1981; Rouwendal and Rietveld, 1994). DaVanzo (1981) stated that older people accumulate more location-specific capital, which restrains spatial mobility. In the study of Schwanen et al. (2004), age is found to be related only to commuting distance, not commuting time. Older people tend to commute fewer kilometers than younger workers. We therefore expected that as people grow older the probability of accepting a job at a greater distance would decrease rapidly.

Some findings from the literature also led us to expect that gender is as well important factor for commuting behavior. Women have been shown to have shorter commuting distances and times than men (Hanson and Johnston, 1985; McLafferty and Preston, 1991; Blumen, 1994). Hanson and Johnston (1985) concluded that working women are more sensitive to distance than men are for reasons related more to their mobility than to their "dual roles" of wage earner/homemaker. Because women face more time-space constraints than men, we expected them to show less workplace mobility. We further expected that the female workers, when they are older or have young children, their reluctance to accept jobs with long commutes is stronger (Rouwendal, 1999). Women consistently commute shorter distances than men who have the same demographical, social, financial and household statuses (Sandow, 2008).

Propensity to commute is also correlated with the education level attained by the individual. Studies have also shown that those who are highly educated are more willing than those with a lower education level to commute longer distances (DaVanzo, 1983; Harsman and Quigley, 1998; Trendle and Siu, 2007). The estimated commuting models by Harsman and Quigley (1998) showed that the sensitivity to commute time differs significantly between workers with different levels of education: the higher the education, the lower the influence of commute time. A higher education often leads to better paid jobs, which can compensate for commuting costs (Sandow, 2008). The study of Sandow (2008) showed that both women and men who are highly educated or have a high income are more inclined to commute longer distances compared to those with a lower level of education or income. Moreover, the higher the individual's level of education, the more specialized the occupations are to match the individual's competence. Thus, those with a high level of education have to search for jobs over a larger geographical area and, as a result, commute longer distances compared to those with a lower education.

Studies have also shown that the household composition is very important to the long-distance commuting decision. The presence of a partner and children increases the total location specific attachments of a household, thus reduces the commuting distances (Hjorthol, 2000; Sandow, 2008; Schwanen et al., 2004). Although single person households are not without local ties, the presence of partner and children should undoubtedly lead to a more complicated decision on where to live and work. With the dual-earner household, migration will create a search for two work opportunities in the same area. Hjorthol (2000) concluded that married women choose their job within a more restricted geographical area than their husbands do. For married men neither children in the family nor occupational status restrict their choice of work site. In the study of Sandow (2008), the estimations indicated that family commitments (marriage and children) constrain the commuting behavior

and reduce the propensity to accept a job requiring longer commuting distances, they constrain women to a higher extent than men. Besides the ties to a partner and children, an individual has also social ties to friends, relatives, etc. These social connections can be viewed as valuable, or even more, as having a job by the individuals and households. For example, grandparents support is really important for the households which have little children. Information on the importance of the social network or family support of an individual gives an understanding of the degree of motivation to stay or move.

The regional distribution of vocations is also a very important factor for describing the commuting behavior. In general, the capital and major cities have a much more varieties of positions, vacant job opportunities and lower unemployment rates as compared to the rest of the country. Even the occupations linked with public services, like education and healthcare, are not evenly distributed over the country. An individual faced with a lack of suitable job opportunities on the local labor market has to be spatially more flexible to find a job that matches his/her competence. Nowadays, high workforce specialization has given rise to a situation in which labor markets offer few potential jobs within a moderate distance, thus forcing workers to commute longer distances. Although workers dislike long commutes if they are not fully compensated by higher wages, it is too costly to change job or residence (Sandow and Westin, 2010; Van Ommeren and Rietveld, 2007). Sandow (2008) concluded that the probability that an individual will accept a longer commuting distance increases if the individual works in the private sector, and less likely for those employees in the public service sector. Longer commuting provided more opportunities for all members in a household and is often associated with higher income; it tends to be that long-distance commuting is a strategic mobility choice for households, rather than a short-term solution for a few years (Sandow and Westin, 2010).

Opposite to the attractiveness of the major cities for its labor market, the housing market in the capital or the large cities usually hinders the migrations. Housing prices in large cities are often much higher than in the rest of the country. This results in difficulties in buying or selling houses or apartments at acceptable prices. A family moving to a larger city have to face a situation of selling their house and might not be able to find a new place of equivalent standard at a reasonable price, because houses and apartments in large cities are often more expensive and more difficult to find. Opting to commute long distance could allow a family to reside in the countryside or in a less developed area, enjoying the fresh air, tranquility and a bigger house, and at the same time being able to access to the better career opportunities and more dynamic life style in a larger city. The time and money spent in commuting is probably offset by the salary level and the career advancement possibilities. Fischer and Malmberg (2001) stated that comparing to tenants the house owners have strong local bonds and are less prone to migrate. And the time and money invested in their houses also add up to the constraints of moving. The longer the family has been living in the same place, the stronger is the attachment to the place. Moving elsewhere would imply a loss of investment in different terms.

Several studies of commute behavior have also focused specifically on the railway commuters. Kitamura et al. (1997) found that travelers residing close to railway stations are more likely to commute by public transport. It is also suggested that access to the rail network and the quality of that network were important determinants of mode choice. The

availability of rail at both the residence and the workplace is critical for long-distance commuting by rail (Titheridge and Hall, 2006). Limtanakool et al. (2006) stated that train is more attractive when heading for jobs in high-density areas, other core cities, and municipalities with a high level of specialized services. Destinations with such characteristics are often associated with congestion and parking problems (Schwanen et al., 2002). Rickard (1988) showed that owning a rail season ticket, increases the propensity to travel over greater distances by rail, since it is more economical.

The possibility of long-distance commuting has been greatly increased due to the easiness of access to faster and more convenient transportation services, such as the closeness to a high-speed rail station, commuter rail station or due to higher car ownership levels. It enables workers to increase the job searching area and commute longer distances for better jobs, thus increasing the inter-regional labor participation. Commuting is time-consuming, but it may also produce or maintain a higher household income and an enhanced standard of living. The long-distance commuter is a selective group from the commuters in general. It is very important to analyze their preferences of job and residential location choices, and also the reasons why the individuals choose long-distance commuting and dual location to be their lifestyle and mobility strategy. The findings will provide insights for future transport infrastructure investments, e.g. HSR in Portugal, as well as the policy recommendations for the governments regarding the pricing and travel subsidies, etc. The focus of this study is on personal characteristics and household composition in combination with some job and housing situations. The investigation also includes social ties, preferences and transportation attributes.

## **SURVEY AND DATA**

This paper is based on a survey of intercity rail commuters' personal and household profile, inclination and opportunities to switch mode and change job or house location. A total of 450 passengers in the two intercity trains were randomly selected. A questionnaire was conducted in the form of face-to-face interview in January 2013. This survey has been conducted on two conventional regional rail services, which are Lisbon-Tomar (143 km, about 1 hour and 50 minutes by train) and Lisbon-Santarem (78 km, around 55 minutes by train). Tomar is a city of about 20,000 inhabitants and of the seat of the municipality, which has a total area of 351.0 km<sup>2</sup> and a total population of 40,674 inhabitants (INE, 2011). And Santarém with 29,180 inhabitants is seat of the same municipality with 560.2 km<sup>2</sup> and 62,200 inhabitants (INE, 2011).

*Railway Commuting Patterns and Driving Forces in Portugal: Insights for Future High-Speed Rail*

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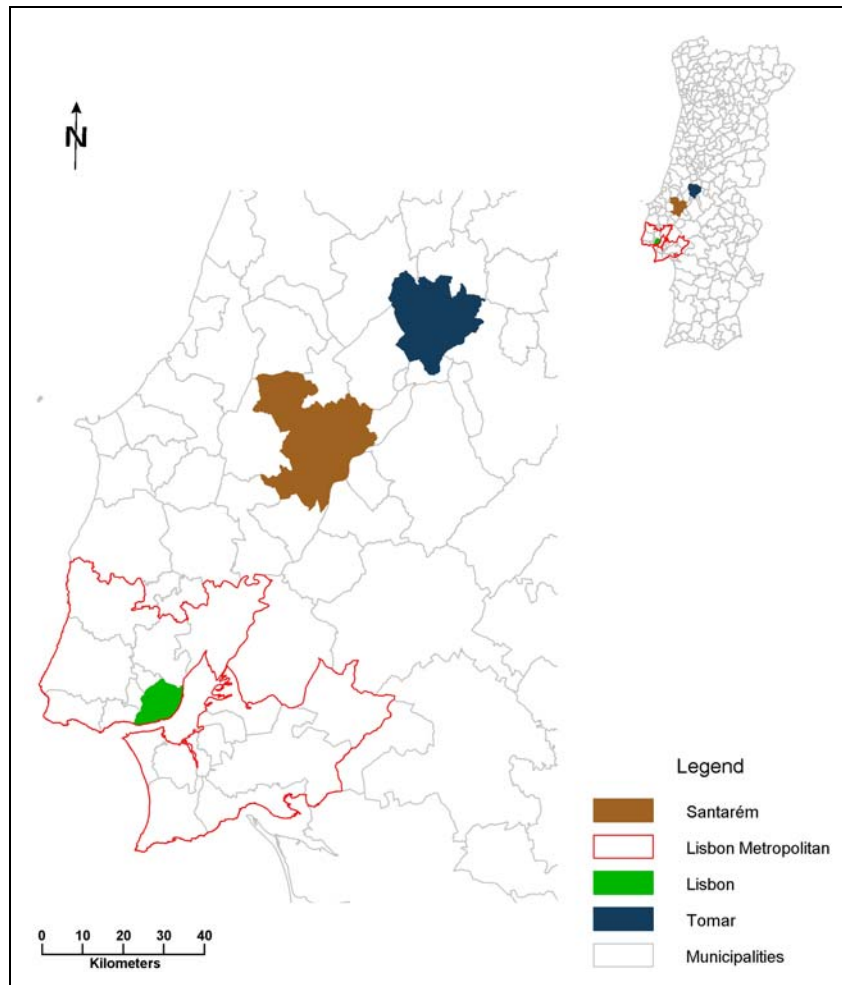


Figure 1 – Study Area

Based on the 2001 census, there were about 432 people commuting from Tomar to work in Lisbon and 1285 people commuting from Santarém to work in Lisbon (INE, 2001), which represented an increase of 54% and 58% when compared with the 2001 Census (see Figure 2– Number of Commuters in 1991 and 2001 ). Similar records are not made available yet in the latest Census of 2011.

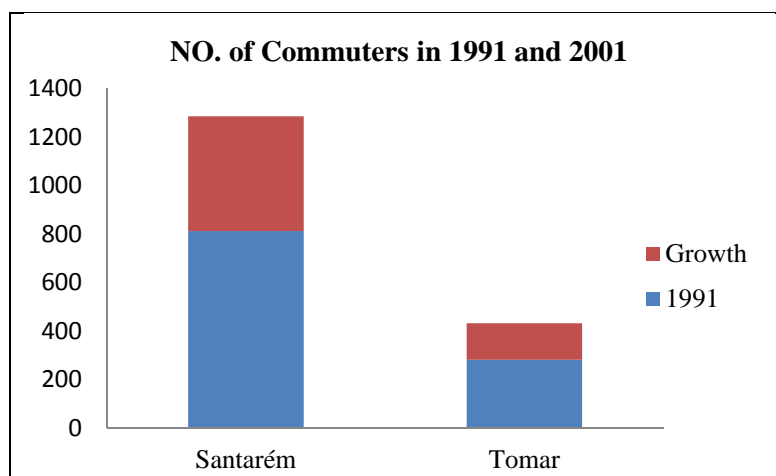


Figure 2– Number of Commuters in 1991 and 2001

The questionnaire contained seven sections. The first part asked questions about the respondent's background: age, education level, occupation, family status, working address/zip code, etc. The second part concerned the similar questions about the respondent's spouse and children. The third part contains questions about the house characteristics, including house type, size, neighborhood type, ownership status, parking availability, etc. In the fourth part, respondents were asked to assign values to the importance of local social ties, support network from family or relatives, the satisfaction level of their current house and neighborhood, and as well as their preferences of current municipality versus Lisbon. The fifth section includes the questions about their commuting characteristics, e.g. departure time at home, travel time and mode to the railway station, travel time in the train, travel time and mode from the destination station to workplace, departure time from the workplace, total trip cost, type and frequency of errands carried out in Lisbon, etc. The sixth part contains the questions concerning their income, house expenditure level, rent/mortgage cost. The seventh part contains the questions about hypothetical mode choice situations and the propensity to change job or house locations to current municipality of residence, Lisbon metropolitan area, Lisbon suburb or nearby municipalities of the current residence municipality. On the basis of the information collected by the RP survey, we defined a set of potential explanatory factors pertaining to the traveler's background, household and socioeconomic situations, housing and job conditions, etc. (see Table 1).

Table 1 - Attributes in RP Section

<b>Variable</b>	<b>Explanation</b>	<b>Variable</b>	<b>Explanation</b>
<b>ID</b>	Interviewee ID	<b>HOS</b>	House Ownership Status
<b>Age</b>	Age of Interviewee	<b>HS</b>	House Size
<b>ED</b>	Education	<b>NT</b>	Type of Neighborhoods
<b>MS</b>	Marital Status	<b>NPS</b>	Number of Parking Spots
<b>OC</b>	Occupation of Interviewee	<b>HA</b>	House Address
<b>WA</b>	Work Address of Interviewee	<b>TTHT</b>	Travel Time from Home to Train Station
<b>TRP</b>	Transit Pass Ownership	<b>MHS</b>	Mode from Home to Train Station
<b>DL</b>	Driver License Ownership	<b>TTIT</b>	TT in Train
<b>NOC</b>	Number of Cars in the House	<b>TTSW</b>	TT from Lisbon Station to Work
<b>DCA</b>	Daily Car Access	<b>MSW</b>	Mode from Lisbon Station to Work
<b>SN</b>	Support Network	<b>KR</b>	Kiss and Ride
<b>NOCH</b>	Number of Children	<b>TTC</b>	Total Travel Cost to Work
<b>AOP</b>	Age of Partner	<b>ETL</b>	Errand Type in Lisbon
<b>OOP</b>	Occupation of Partner	<b>EFL</b>	Errand Frequency in Lisbon
<b>WAOP</b>	Work Address of Partner	<b>HEX</b>	Household Expenses per Month
<b>PMTW</b>	Partner Mode to Work	<b>SL</b>	Salary Level per Month
<b>PTTW</b>	Partner Travel Time to Work	<b>ML</b>	Mortgage Level per Month
<b>AOC</b>	Age of Child	<b>RL</b>	Rent Level per Month
<b>OOC</b>	Occupation of Child	<b>HVL</b>	Preference of Home over Lisbon
<b>WAOC</b>	Study/Work Address of Child	<b>IVSN</b>	Importance of Vicinity to Social Network
<b>CMTW</b>	Child Mode to School/Work	<b>HSL</b>	House Satisfaction Level
<b>CTTW</b>	Child Travel Time to School/Work	<b>NSL</b>	Neighborhood Satisfaction Level
<b>HT</b>	House Type	<b>IBSN</b>	Importance of Benefit from Social Network



## RESULT ANALYSIS

In total, all of the respondents are long-distance railway commuters, who work in Lisbon but live in Tomar and Santarém. More than 60% of the respondents were married or cohabiting. About half of the respondents had children, and slightly less than half, 42% of the respondents had children living in their households. 92% of them had a driver's license. Their car ownership is really high, 97% of the respondents had car in the household. It was more common to have two cars in the households than to have one car, 47% and 39%, respectively.

### Personal Characteristics

As mentioned in the literature, most of the previous studies indicated that the typical long-distance commuter to be male, middle-aged, more highly educated, and working in certain well-paid occupations. Our result has confirmed this conclusion (see Figure 3). According to the figure, one can see that our respondents are mostly between 30-40 years old, and the share gradually decreases as the group age increases, yet the group 40-50 years old also holds a relatively high percentage. The majority of them possess a Bachelor's degree or higher.

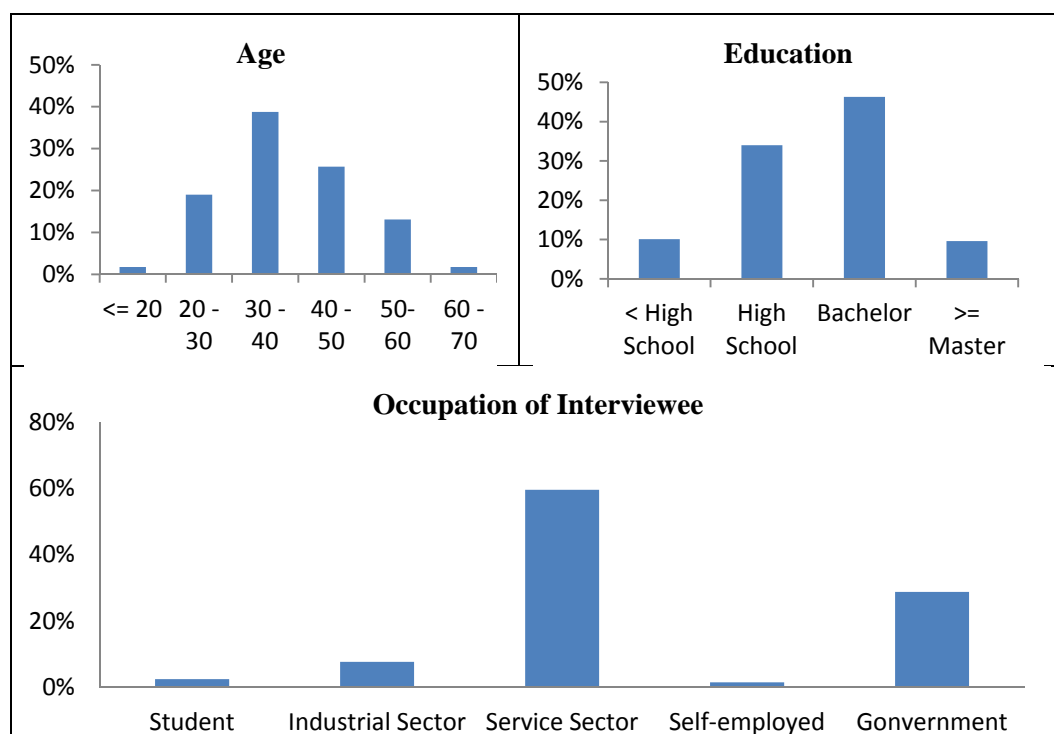


Figure 3 – Background of Interviewee

In the bottom chart of Figure 3, the distribution of different occupation types is presented, namely students, employees in industrial sector, employees in service sector, self-employed businessman, civil servants, and unemployed, respectively. The results show that the occupations of the respondents are concentrated in the service sector and government employees, which are often managerial and professional positions, and well paid.

## Household Composition

The presence of a partner and children could possibly increase the total location specific attachments of a household. Of all the daily railway commuters, 61% of them are married, 50% have children, and 42% have children living at home. Children could cause an obstacle to migration, as a change of school / kindergarten and friends is complex and not desired. The results also demonstrate that that long-distance commuting is more common among households with children in school age. Of all the children, more than 75% of them are students, who need to be taken care of daily. 65% of the children are accompanied to school every day, of which, 64% were accompanied by the partner of the respondents, 23% by grandparents or relatives, only 13% were accompanied by the respondents themselves.

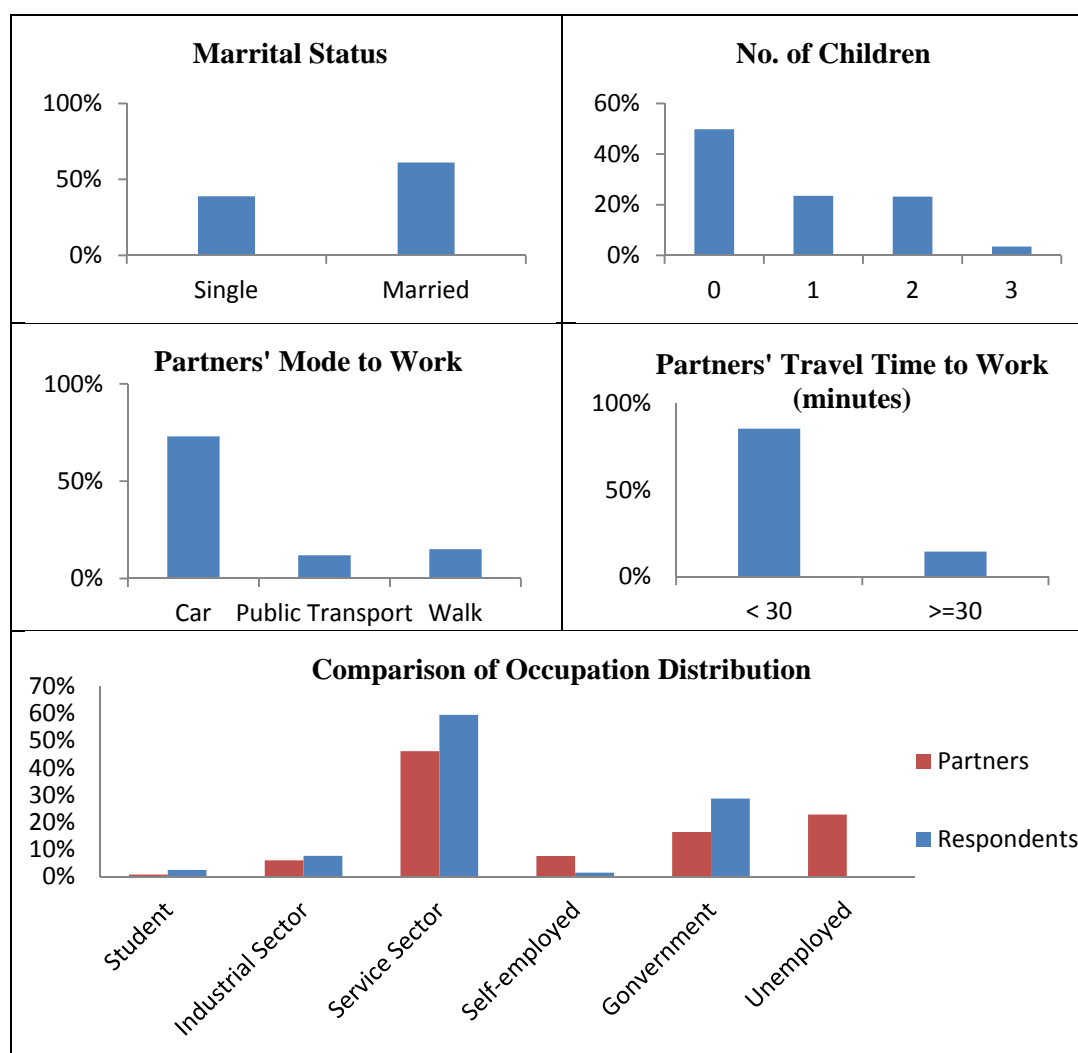


Figure 4 – Characteristics of Household Composition

The distribution of occupations for the partners is similar to the one from the respondents, except the ratios of self-employment and unemployment are much higher (see Figure 4). The possible explanation is that in the household, where one of the couple is a long distance commuter, the other needs to have a more flexible schedule or more time budget allocated to household activities, such as taking care of the children, housekeeping, etc. Being self-

employed or a full-time housewife allows this to happen. Moreover, being self-employed also significantly reduces the willingness to relocate. Since the business is attached to the local market, relocating would obviously jeopardize it.

It is also worth noting that almost all the partners are not long-distance commuters, they work in the municipality where they live or in the nearby municipalities. About 85% of the partners have a reported commuting time lower than 30 minutes. Among all the partners of the respondents, 73% commute by the car, 12% by public transport and 15% by walking. Although single person households are not without local ties, the presence of partner and children should undoubtedly lead to a more complex decision on where to live and work.

### Social Attachment

Besides the ties to a partner and children, an individual has social ties to parents, friends, relatives, etc. Those social contacts can be perceived as really valuable and important. Different associations at home and the local community have been proven to be of importance for our respondents too. In our survey, Respondents were asked to assign values from 1 to 7 to indicate the importance of being close to their social networks, and as well as the importance of having benefits from the social networks. Higher value corresponds to higher importance. Information on the social network of an individual gives an understanding of the degree of motivation to stay or move. From Figure 5, one can see that almost all the respondents assigned the highest value to both questions, indicating that the creation and cultivation of social relations to family, relatives, and friends are of the most importance to them. Social attachment is an essential aspect for the explanation of their commuting decisions.

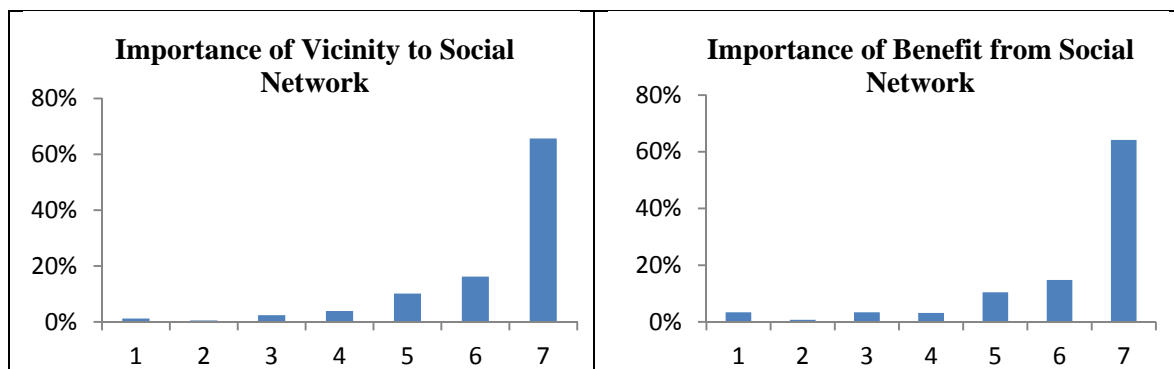


Figure 5 – Importance of Social Tie

### Location Attachment

As it was found in the literature review, compared to tenants, house owners have been shown to have a stronger local attachment and less prone to relocate their residence, due to the fact that time, money and social engagements are invested in their current houses. This pattern has been found in our results too (see Figure 6). According to the collected data, 71% of the respondents own their houses, 16% live in their parents' house, and only 13% of them live in a rented house. House-ownership is a local attachment by itself, but an individual

living in a detached house or a row house could also suggest that there might be some more money and time invested in the residence. Moreover, a detached house or a row house generally requires more caretaking than an apartment, which would as well hinder longer absences from home. Regarding the house types, 38% of the respondents live in detached houses, 8% live in row houses and 54% live in apartments.

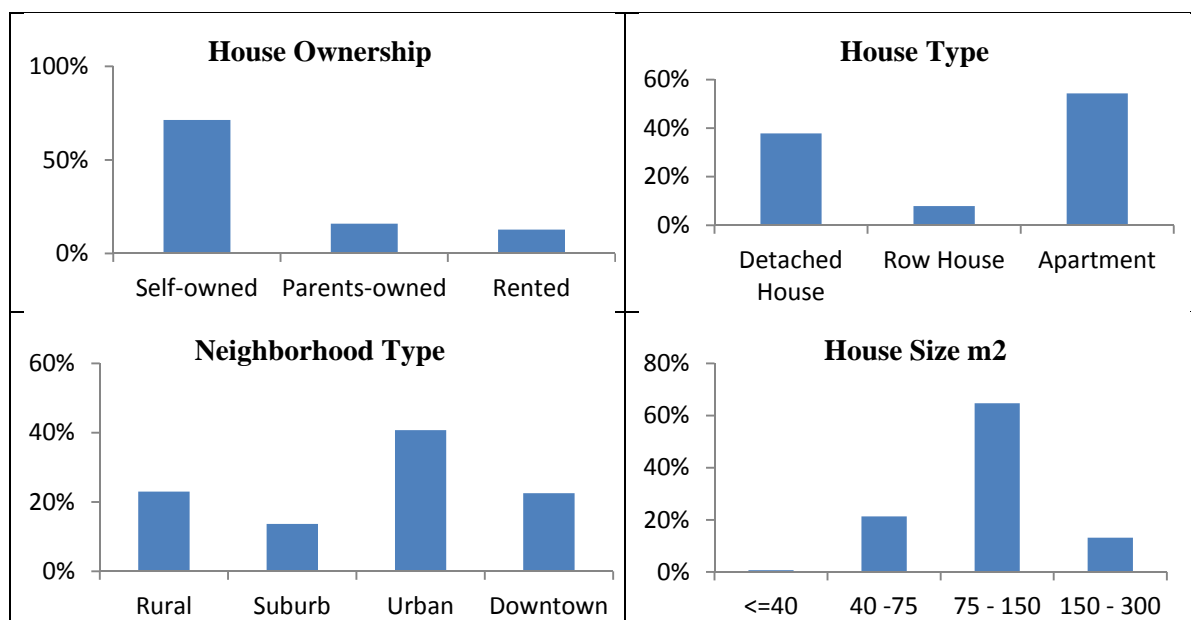


Figure 6 – Housing Characteristics

In the survey, respondents were also asked to rank their levels of satisfactions towards their houses and neighborhoods, and as well as to indicate their location preferences between their current home and Lisbon. The value from 1 to 7 indicates the increasing level of satisfaction.

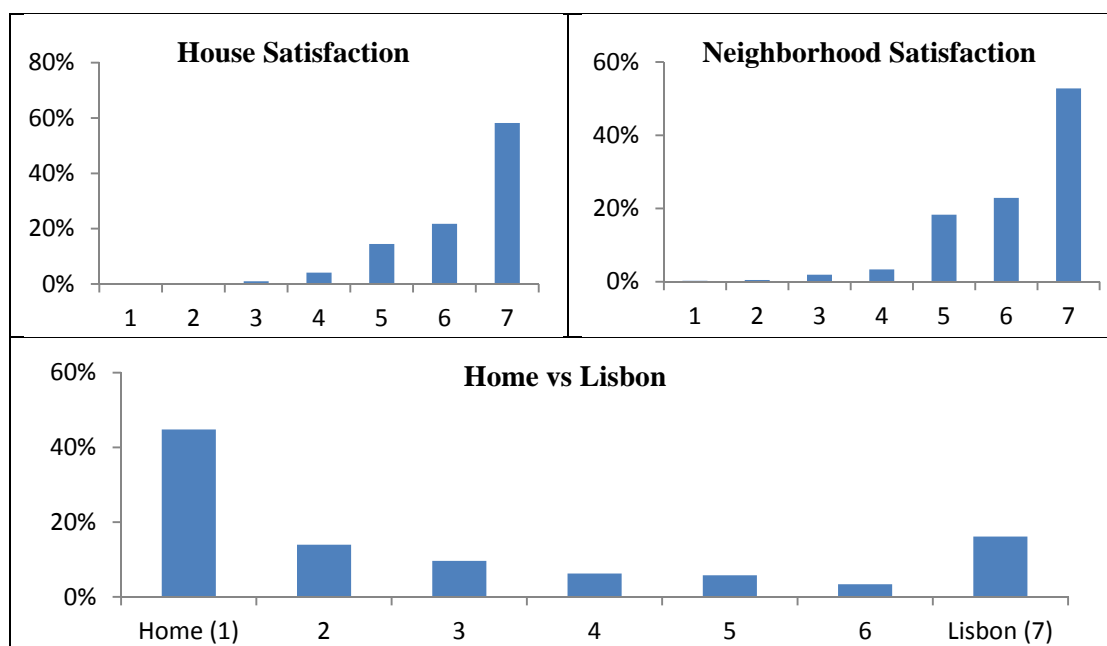


Figure 7 – Housing and Neighbourhood Satisfaction

From Figure 7, one can observe that most of the respondents indicate rather high levels of satisfaction. And their preferences of the current municipality where they are living now are dominantly higher than their preferences towards Lisbon. This could be probably explained by the bottom two charts of Figure 6. Almost 80% of the houses are of the size greater than 75m<sup>2</sup>, of which 65% are between 75-150m<sup>2</sup>, 13% are greater than 150m<sup>2</sup>. Their house sizes are bigger than the average housing size in Lisbon. In terms of the convenience provided by the surrounding neighborhood, 64% of the houses are situated in the urban and downtown (central area) areas of the municipality, where they have very high accessibility to amenities and services. Only 36% of them are located in suburbs and rural areas. However, these respondents residing in the countryside could enjoy the benefits of fresh air, tranquility, bigger housing size and lower housing costs, and at the same time still be relatively easy to access various services and diversity of entertainment in the center thanks to the smaller geographical size of their current residence municipality.

### Accessibility to Public Transportation

In the survey, we have also collected the data regarding the travel time and mode from their houses to the origin train station and as well as from the destination station (Lisbon) to their workplaces. Through analyzing the data, we have reached the same patterns (see Figure 8) as it was found in the literature review that accessibility to railway both at original and destination and the possession of season tickets are the important determinants for long-distance commuters by railway.

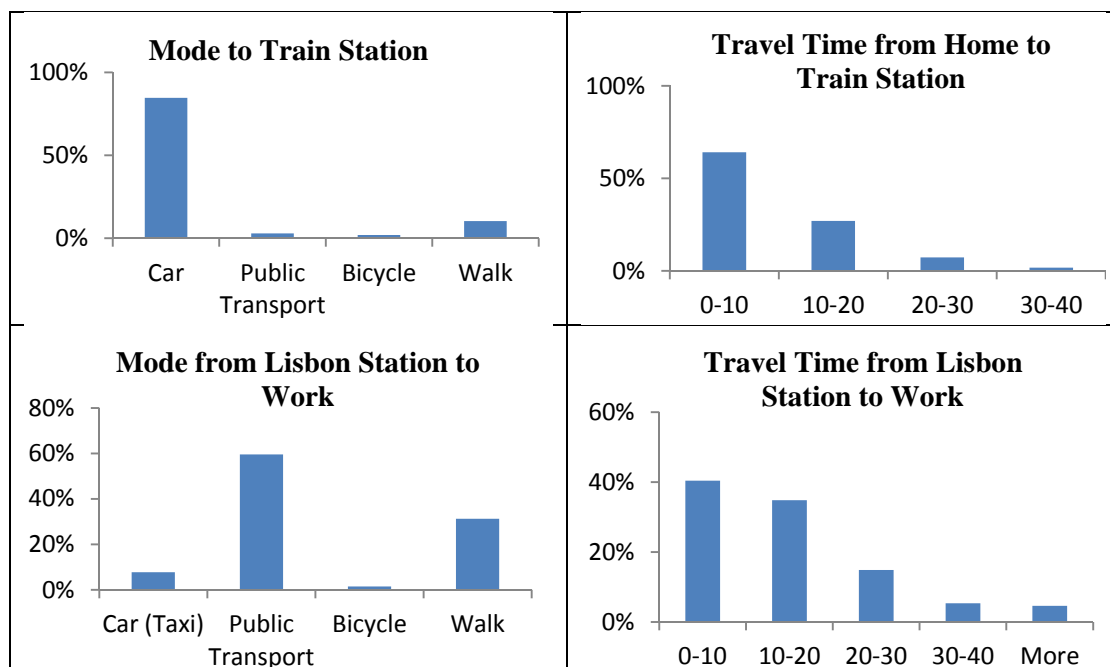


Figure 8 – Accessibility at Origin and Destination

According to the results, 64% of the respondents take less than 10 minutes to go from home to the train station, and in total 91% take less than 20 minutes. Car is the dominant mode of this part of the trip. After arriving in Lisbon, 75% of them need less than 20 minutes to go

from the station to their workplaces. In general, 90% of them arrive at their workplaces within 30 minutes. Almost all of them go by public transport or walk from the railway station to work. Moreover, of all the respondents, 76% of them have a railway transit pass.

### Daily Time-Space Patterns

The average daily time-space patterns are presented in the following figure. The commuters from both cities exhibit almost the same time-space patterns, leaving home around 7:00 am and arrive back at home around 19:30. The average travel time from the house to home station and from Lisbon station to work are the same for both groups of commuters, 11 minutes and 17 minutes respectively. The main differences between the two groups of commuters are the average departure time from home and from work, as well as the travel time in train.

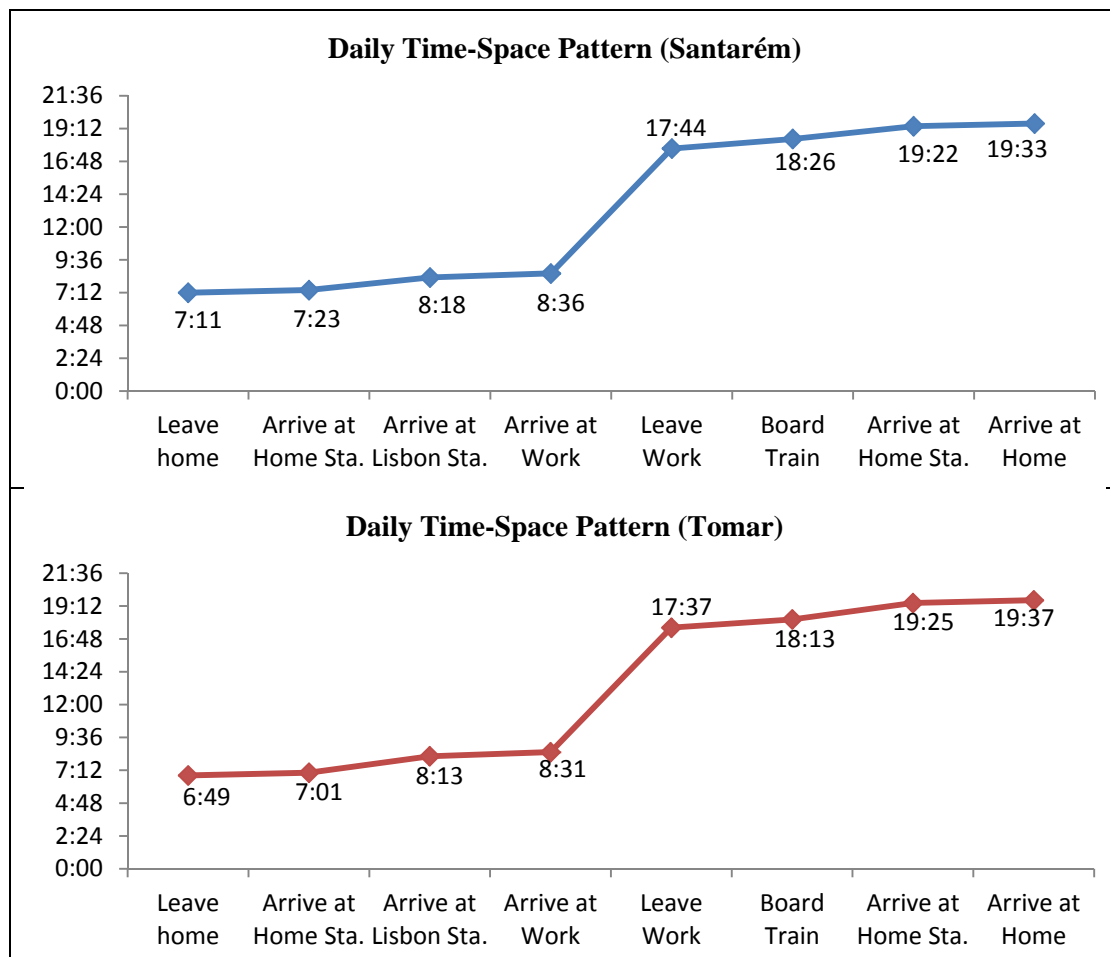


Figure 9 – Daily Time-Space Pattern of Santarém and Tomar

## CONCLUSIONS

The aim of this study has been to examine the determinants of long-distance commuting by railway. To summarize the results, the typical long-distance railway commuter can be

characterized as someone with bachelor degree or higher, between 30-50 years old, working in service or government sectors, living in an apartment with good access to the railway station in or near a small-sized city, with a partner and children. Being close to the social network, such as parents, relatives and friends, etc. and as well as receiving the benefits from them are considered to be critical for the commuters. Most of them are very satisfied with their housing and neighborhood conditions, and they prefer their current municipality more to the city where they are working, in this case, Lisbon. Therefore, this group of long-distance railway commuters resides in the less developed and less populated municipality enjoys the benefits of fresh air, tranquility and lower housing costs and, at the same time, access better career opportunities and diversity of entertainment in a larger city. Additionally, most of the commuters have railway transit passes, and they have very good access to public transportation both at their houses and their workplaces. However, the revealed commuting pattern also involves some uncertainty issues. For example, as Portugal is undergoing the period of economic recession, which causes an increase in unemployment, even in larger cities, therefore the tenured positions become scarce, and temporary time-limited employments have become more common, thus more insecurity is added to the individual's decision on where to locate home and work. The revealed commuting pattern during this period of time might not be stable over time, and there might involve some irrationality behind.

The future development of the HSR in Portugal is expected to give rise to different types of inter-city connections and bring HSR stations closer to metropolitan areas. In general, it can be argued that a new HSR line that allows a metropolitan connection within 1h travel time will promote the metropolitan integration through reinforcing the existing tendency and creating new mobility patterns (Garmendia et al., 2011). The change in the trade-offs between travel time and travel cost brought by HSR service could possibly change the traditional commuting to work patterns from the daily commuting into more flexible patterns, such as commercial service trips and business trips, etc. Hence, the future study about HSR commuting has to be extended beyond the daily commuting pattern to weekly, business commuting, etc. Furthermore, in the future, it is also necessary to find out the impacts of long-distance commuters' wishes and preferences on the decision of relocating and commuting by HSR. Relocation preferences are also of great importance, because certain groups of households might choose to move instead of continuing to commute, if the household thinks that increased accessibility will allow it to keep its social network in the region where it moves from. One also has to note that some other groups of households might find it more attractive to move to the desired region and still commute to their jobs in the old region, and households in other regions might as well might move to one of the regions in the corridor to take advantage of the accessibility that the new HSR line offers.

In terms of the insights for policy, as the accessibility to the railway station is considered to be important for the mode choice of the commuters, therefore, at the advent of HSR, it is of rather critical to renew or improve the systems of feeder traffic to the HSR service, in order to extend the range of potential participation of HSR commuters. Even though HSR helps to integrate the cities along the line, there is a strong need to revitalize the local and regional strategies of the previously less developed cities to attract population and businesses and new opportunities for urban developments, in order to avoid the polarization to occur.

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