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Impact of high speed railway systems on inter-regional trips and accessibility in Turkey

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Abstract

High-speed trains are faster, safer, more comfortable than road transport for trips of 250–1000 kilometers. Accordingly, a significant increase has been observed in inter-city railway transport following the construction of high-speed railway (HSR) connections. The present study shows the effects of HSR on accessibility and potential savings in time when compared to other transportation modes. The time saved by HSR systems has been shown to change purpose trip. The level of accessibility provided by the HSR between Konya–Ankara–Istanbul link is compared with the accessibility of other travel modes through an investigation of the weighted average travel times and an analysis of costs. Furthermore, data gathered from a field study carried out among users of the Konya-Ankara HSR link is used to identify the distribution of travel choices among different transportation modes, based on such social and economic indicators as income, car ownership and employment status. It is found that HSR service increases accessibility between cities, and changes travel demands and purpose, in favor of railways, and that economic factors such as income and car ownership are important in the use of HSR services. Finally, this research identifies social and cultural activities as a new reason for travel, in which users diversify their travel destinations because of the time savings offered by HSR systems.

Keywords
High speed train, Accessibility, Transportation demands.

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1. Introduction

1.1. High speed railway services

Investments in transportation have contributed to social and economic development, developed both freight and passenger transportation, and led to the interconnection of cities and surrounding areas, thus fulfilling national and international goals (Klein, 2004). Today, transportation services and infrastructure are key areas of state investments (Amos, Bullock, & Sondhi, 2010).

High Speed Railways (HSRs) should be widespread because of security, safety, time savings, and costs. Simulations can provide indicators of the spatial impacts in and around HSRs. The economic impacts can be defined as employment creation, freight and passengers transportations, infrastructure investments (Çoygun, Turan, Turunç, & Pazarcık, 1986), energy consumption, service impact on other sectors (Taban, 2009), cost-benefit ratios, and social amenities (Inglada, Coto-Millán, Villaverde, & Casares, 2012).

The first HSR line, measuring 552 km, was constructed between Tokyo and Osaka in 1964, cutting the journey time between the two cities from 5.5 hours (by motor vehicle) to 3 hours (by HSR), representing significant savings in time (Takatsu, 2007) (Mizutani, 1994) (Anonim, 1996).

Although China did not launch HSR until after the 2000s, it today boasts the longest HSR network in the world (Amos, Bullock, & Sondhi, 2010). As of 2017, China had more than 300 high-speed trains carrying passengers around a country network totaling more than 31,000 km in length (UIC, 2019).

The European High Speed Train Network was established by the European Union to link the HSRs of different countries and to improve country relations, with many investments made since 1990. By 2017, the United Kingdom, France, Germany, the Netherlands, Belgium, Luxembourg, Spain, Italy and Switzerland were all connected by the European HSR network, reducing travel times between countries and increasing user activity. In the long term, Turkey is expected to join this network, for which the country is investing into the construction of its own HSR network.

France was the first country in Europe to invest in its HSR network, with a total of 1.872 km of HSR lines built since 1981, with the old conventional lines combined with the newly opened ones (Kızıltaş, 2013) (Facchinetti-Mannone, 2009) (Bonnafous, 1987).

The advent of HSRs in Spain led to significant changes in travel types on particular routes. With the opening of the Madrid-Barcelona HSR line, the ratio of journeys made by air between the two cities decreased from 88% to 52%. As a result of post-2000 investments, the length of the HSR network in Spain, along with its connecting lines, now exceeds 2,500 km, making it the country with the longest network in Europe (Kızıltaş, 2013).

The first HSR line in the United Kingdom (UK) was commissioned in 1994 when the Channel Tunnel project was realized with France. This project linked the UK to Amsterdam in the Netherlands via Belgium, providing an uninterrupted link between France, the United Kingdom, Belgium and the Netherlands.

An analysis of the HSR systems in different countries reveals a number of benefits, including time savings (Shih-Lung Shaw, 2014) (López, Gutiérrez, & Gómez, 2008), corporate economic sustainability, decreased operating costs (Doomernik, 2015) (Chen, 2013), increase in the number and types of trips (Casares & Millan, 2011), decrease in the number of accidents and environmental pollution (Takatsu, 2007).

In contrast, according to Kim and Sultana (2015), HSR services increase the polarization between cities on the HSR network and have a negative economic impact on small and medium-sized cities outside the network.

1.2. Methodology

The basic regional and interregional trips parameters that have changed as a result of HSR investments are: reductions in time, type of travel demand, changes in trip purposes, and increased production of high technologies.

In countries with HSRs, different models have been designed, using several indicators to measure the social, demographic and economic impacts of different components of HSR service, such as time, space and cost. Travel costs and travel times are frequently used parameters for economic impact (Urena, Menerault, & Garmendia, 2009) (Klein, 2004).

Transportation services enhance local and regional accessibility by providing savings in both costs and time.

The notion of accessibility has been studied since the mid-20th century, referring to the opportunities that different transportation modes offer for passengers and goods (Hansen, 1959). The notion of accessibility has been transformed overtime, shifting from only physical distance, to socio-economic and environmental conditions when assessing transport sustainability. It makes a meaningful contribution to connect the different land-use and regions[1] (Brunello, 2018).

"*In developing countries in particular, one key issue is knowing for whom and for what use these HSR lines are built. Does everybody have access to high-speed rail in developing countries? Are its uses and clients the same as in developed countries?*"

These questions are examined in Delaplace (2017). HSR could induce more inequalities in terms of access and use in developing countries than in developed ones, not least due to the spatial, economic and social differences among users (Delaplace, 2017).

In the present study, however, the survey results indicate that HSRs in Turkey have not led to inequality, everybody can access HSRs. The subsidies provided by the Turkish government have been instrumental in ensuring that the HSR system is accessible to all. This paper assesses the impact of the first HSR line constructed in Turkey: the Ankara–Konya link opened in 2011. Specifically, the time savings and changes in trip demands brought by the system are subjected to an accessibility analysis in terms of time and cost. The accessibility analysis investigates the travel time between the two cities, and tries to measure time changes depending on travel modes, such as roads, railways or airways. Accordingly, the parameters used for this analysis are population, travel times, travel modes and distance (Gutiérrez, 2001).

HSRs have emerged as a new mode of travel between cities. Prior to the opening of the HSR link between Konya and Ankara, the only transport was by road. Thus, HSRs is an alternative for road transportation, and there has been differences in travel modes and demands after HSRs get into operation. In this study, the effect of the new mode on time-based travel demand is explained within the framework of the accessibility analysis. The Istanbul–Ankara and Konya–Istanbul lines are also examined and compared with the Konya–Ankara line.

The most important finding of the case study is that the shorter travel times and increased accessibility have resulted in a significant rise in trip numbers among the cities on the HSR network, and as a change in mode choices and travel reasons. This finding is in agreement with similar studies in other countries with HSR networks, such as South Korea (Kim & Sultana, 2015), France (Facchinetti-Mannone, 2009) and Spain (Gutiérrez, 2001).

Another finding of the survey is particularly worthy of note: while studies of the HSR networks of other countries have found HSR journeys to be generally expensive, and thus mostly made by the middle- and upper-income groups, people of all income levels in Turkey are able use of HSR services because of government subsidies.

2. High speed trains in Turkey

2.1. High speed trains implementation in Turkey

Transportation across Turkey is predominantly by road vehicles as a result of highway investments made after the 1950s. In recent years, while the share of domestic passenger transportation made by road has declined following investments into railways, sea transport and aviation, road transport still leads in Turkey, accounting for 70% of

[1] *For a comprehensive review: Brunello, L. R. (2018). High Speed Rail and Access Transit Network. Cham: Springer.*

the total passenger trips. (TÜİK, 2017) (TCDD, Devlet Demiryolları İstatistik Yıllığı 2010-2017, 2018).

An analysis of trip numbers by different transport modes reveals a significant increase, especially by air. In contrast, no major changes can be identified in maritime transport, and the shares of road and railway trips have been decreasing. The main factor in decreasing of railway transportation is the termination of conventional train services on HSR lines or a decrease in their frequency. Many conventional train routes, especially between Ankara and Istanbul, have been abandoned with the entry into service of the HSR. Despite the decrease in the number of trains in service, the number of passengers have remained steady, and have even increased in recent years. The reason for the decrease in the share of road transport in total trips is that most of the passengers have shifted to air and railway modes.

Since 1960, with the development plan period discussed in the strategy document and action plan (TOBB, 1993), Turkey has embraced the HSR concept in 2003, when construction of the Ankara–Eskişehir link began. It was completed and gotten into service in March 2009. Consequently, the trip from Ankara to Eskişehir was reduced to 1 hour 25 minutes, with the high speed train travelling at an average speed of 250 km.

Construction of the Ankara–Konya line, as the second stage of the high-speed train project, started in 2006 and was completed in 2011. As a result, travel times between Ankara and Konya were reduced to 1 hour 15 minutes by train, from 3 hours 30 minutes by bus. Subsequently, the number of trips on the 306 km HSR line between the two cities has increased considerably, and trains are more frequent.

A new line that will connect Marmaray in the Pendik district of Istanbul, to Haydarpaşa. On the European side, a new line will link Halkalı to the Kapıkule border gate, and in the coming years connect to the HSR lines in Europe.

The ultimate goal of the HSR link from Ankara to Sivas is to open up to the Caucasus and the Caspian region via Tbilisi. Furthermore, there is a plan to link Ankara to Kars with an HSR link in 2023.

Turkey's huge HSR network project will link Europe and Asia, and is scheduled to total over 2,000 km in length. The different lines and distances are shown below and in Figure 1 (TCDD, TCDD, 2015).

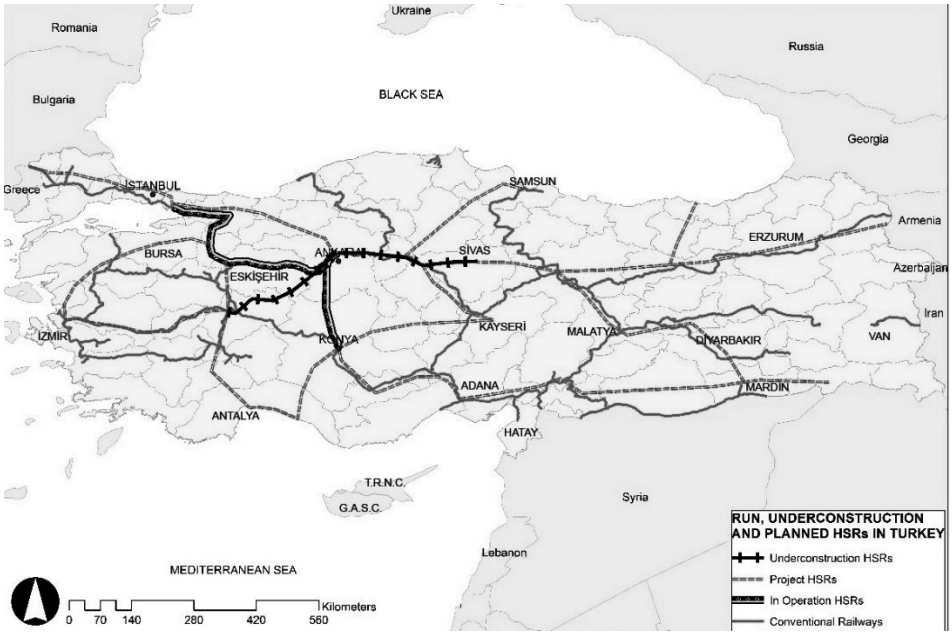

Figure 1. *HSR lines in Turkey that are constructed, under-construction and planned[2]. Source: TCDD, http://www.tcdd.gov.tr/files/icerikresim/tcddharita.jpg.*

[2]Map is prepared by author by using TCDD data.

Ankara–Istanbul	: 533 km
Ankara–Konya	: 306 km
Ankara–Sivas	: 405 km
Ankara–İzmir	: 663 km
Bursa–Osmaneli	: 106 km
Yerköy–Kayseri	: 150 km
Halkalı–Kapıkule	: 230 km

2.2. Konya–Ankara–Istanbul HSRs

Passenger trips between Konya and Ankara prior to the opening of the HSR link had to be made by road, with 70% made by coach and 29% by car, and less than 1% of by air. The trip mode distribution between Eskişehir and Ankara was the same as the Konya–Ankara link, although there was a conventional train line between Eskişehir and Ankara that carried 8% of the traffic prior to the opening of the HSR link (Table 1).

No direct railway line existed between Konya and Ankara prior to the HSR. Upon its opening, the number of people using the railway increased rapidly. According to 2017 data, the Konya–Ankara–Istanbul HSR lines accounted for approximately 43% of all rail trips in Turkey.

When the impact of these trips on other modes of transportation is evaluated, as can be clearly seen in Table 1 a significant decrease in bus trips has been experienced. The use of private cars on the Eskişehir–Ankara and Konya–Ankara routes is similar, although the ratio in the total has decreased by more than 50%.

The Konya–Istanbul and Ankara–Istanbul HSR routes opened in 2012 with the completion of the Eskişehir–Istanbul line. The high-speed train cannot maintain its 250 km/h operating speed in some regions, as parts of the route makes use of the existing conventional line with some rehabilitation.

Trip cost is one of the main factors in the choice of transport mode by passengers. When the tariffs of the different travel types on the Konya–Ankara–Istanbul route are examined, it is clear that ticket prices are generally similar. While there is a small difference between bus and high-speed train prices, the cost of private car trips is somewhat higher. The cost of flights on the route can be considered acceptable, being close to that of the high-speed train when bookings are made in advance.

Ticket prices of different transport modes on the Konya–Ankara–Istanbul route[5] (TL):

	Bus[6]	Train[7]	Car[8]	Air[9]
Konya–Ankara	35.00	30.00	100.00	00.00
Konya–Istanbul	110.00	85.00	273.00	150.00
Ankara–Istanbul	85.00	70.00	185.00	150.00

3. Impact of high speed train in terms of accessibility

There have been many studies in different countries analyzing the economic, social and spatial impacts of HSR, the findings of which can be categorized under different headings: time savings and reductions in the cost of service (Doğan, 2012) (Gutiérrez, 2001) de-

[3]*Passengers, whom travel by bus, ratio is estimated ratio which is calculated from the occupancy of bus company.*

[4]*Airways passengers are taken from aviation companies in which managed in Turkey. Foreign companies don't include into the calculation because of transit passenger.*

[5]*Average price of a one-way ticket in 2017.*

[6]*Ticket prices shown are average fares, calculated from the company's price list. There may be seasonal changes in prices.*

[7]*One-way economy class HSR ticket in 2017.*

[8]*Price calculated based on gas consumption at 0.40 TL per km.*

[9]*Average flight ticket price, calculated from airline company price lists. Prices may differ by season and discounts may apply.*

Table 1. *Passenger distribution in terms of transportation modes 2017. Source: TCDD A.Ş, Annual Travel Statistic Reports of 2018, TUİK, 2018.*

Transportation Mode	Ankara-Eskişehir (%)		Ankara-Konya (%)		Ankara-İstanbul (%)		Konya-İstanbul (%)	
	Before	After	Before	After	Before	After	Before	After
Bus[3]	55	10	70	17	30	22	50	30
Private Car	37	18	29	17	35	33	35	31
HSR	8	72	-	66	10	15	5	17
Airways[4]	-	-	1	-	25	30	10	22

Table 2. *Total passengers number whom traveled by HSR between 2010 and 2017. Source: TCDD A.Ş, Annual Travel Statistic Reports of 2018.*

HSR Lines	2010	2011	2012	2013	2014	2015	2016	2017
Konya-Ankara	0	406.636	1.371.369	1.744.605	1.890.320	1.798.000	1.775.000	2.047.000
Konya-İstanbul	0	0	0	0	30.776	659.000	684.000	905.000
İstanbul-Ankara	0	0	0	0	992.098	1.956.000	2.203.000	2.873.000
Ankara-Eskişehir	1.889.666	2.149.879	1.978.155	2.264.394	1.924.431	1.280.000	1.237.000	1.339.000
Total	1.889.666	2.556.515	3.349.524	4.207.324	5.085.697	5.693.000	5.899.000	7.164.000

velopment of new service areas, reductions in regional disparities (Blum, Haynes, & Karlsson, 1997) (Rus, 2012), high energy productivity due to low CO2 emissions (Greengauge21, 2010) (Givoni, 2006), high passenger capacity, contributions to economic growth (Amos, Bullock, & Sondhi, 2010), and improvement of high technologies and enhancing accessibility (Kobayashi & Okumura, 1997) (Givoni, 2006).

Meer et al. (2012) analyzed the effects of the HSR on regional accessibility in Spain at two different scales: regional and urban. The services produced at an urban scale are affected directly by the selection of station location, which increases communications depending on production and travel demands at a regional scale (Gutiérrez, 2001). In this study, we attempt to calculate the effects of HSR services on accessibility among cities as part of an accessibility analysis.

3.1. Accessibility analysis

Accessibility is a key factor in transportation planning, city planning and other planning applications as first raised by Hansen (Hansen, 1959). Experts and scientists have addressed the issue of accessibility, coming up with different definitions and methods of measurement. Currently, average travel times and daily accessibility data are mostly used to measure the effects of HSR services between cities (Yang, Guo, Li, & Huang, 2018) (Zhang, Nian, & Lyu, 2016) (Kim & Sultana, 2015) (Vickerman, 2015). Accordingly, the time changing is measured in terms of distance and population between the two cities before and after the establishment of an HSR systems. Accessibility is defined in the study as the ability of people to carry out displacement by one or more alternative modes of transport between two locations. In this context, the parameters affecting accessibility and the attractiveness of the settlements, and the parameters affecting travel demand are defined as follows:

Accessibility: time, distance, total cost

Attractiveness: population, employment, total trip production

Travel Demand: Income, car ownership, occupational distribution.

The following equation is used to measure the effect of access to HSR services on accessibility between two cities on the Konya–Ankara–Istanbul route (Gutiérrez, 2001).

$$A_i = \frac{\sum_{j=1}^{n}(T_{ij}.lnM_j)}{\sum_{ij=1}^{n}(lnM_{ij})} \qquad (1)$$

where A_i is the accessibility i city, T_{ij}, is the travel time between cities i and j, and Mij is the population of cities i and j (Table 3).

In order to measure the effect of travel time and cost on transportation mode choice and accessibility, a logarithmic transformation is used to reduce the effect of the population size in the different cities on the accessibility index. The effect of the large population difference between Istanbul and Konya or Ankara is therefore reduced.

Passengers travel between Konya and Ankara while using three different

[10]*The distance for the flight is calculated as the distance of the bird flight. The duration includes the time between the departure of the aircraft from airport to the arrival airport.*

Table 3. *Travel times (minute) and distances (km) over the Konya–Ankara–Istanbul route by travel mode and population (TÜİK, 2017).*

City	Population (2017)	Time/Distance (Car)			Time/Distance (HSR)			Time/Distance (Bus)			Time/Distance[10] (Airways)		
		Konya	Ankara	İstanbul	Konya	Ankara	İstanbul	Konya	Ankara	İstanbul	Konya	Ankara	İstanbul
Konya	2.180.149	0	150 / 250	435 / 683	0	103 / 285	278 / 552	0	200 / 250	545 / 683	0	0	70 / 500
Ankara	5.445.026	150 / 250	0	200 / 464	103 / 285	0	255 / 489	200 / 250	0	420 / 464	0	0	60 / 400
İstanbul	15.029.231	435 / 683	200 / 464	0	278/ 552	255 / 489	0	545 / 683	420 / 464	0	70 / 500	60 / 400	0

Table 4. *Accessibility index over the Konya–Ankara–Istanbul route according to travel modes.*

Mode	City	Konya	Ankara	İstanbul
Ai (Car)	Konya	0	72,71972	210,8872
	Ankara	77,28028	0	96,83074
	İstanbul	224,3931	103,1693	0
Ai (HSR)	Konya	0	53,06579	147,6231
	Ankara	49,93421	0	131,5408
	İstanbul	130,3769	123,4592	0
Ai (Bus)	Konya	0	103,0404	289,405
	Ankara	93,79634	0	216,6554
	İstanbul	255,595	203,3446	0
Ai (Plane)	Konya	0	0	37,17128
	Ankara	0	0	30,95078
	İstanbul	32,82872	29,04922	0

transportation modes: intercity buses, private cars, and high speed train. Passengers can travel by air between Konya and Istanbul and Ankara and Istanbul. The values of the accessibility index for the four different travel modes are presented in Table 4.

The accessibility values and interregional relations are inversely related, as the accessibility values shrink, the interregional relations depend on the trip type.

As the time and distance traveled by air are different, the accessibility values were quite lower than those of the other transportation modes. While the accessibility index between Konya and Istanbul was 37.17, between Ankara and Istanbul it was 30.95. there is a 10-minute difference in travel times between the Konya–Istanbul trips and Ankara–Istanbul trips that can be attributed to the population factor. It is important to note that airports are generally located outside the city, and so considerable time is spent travelling to and from the airport. In addition, in both domestic and international travels, the obligatory baggage and control operations make it necessary to be at the airport 45–60 minutes prior to the departure time. These periods are not included in the accessibility index because these times may vary considerably. The main purpose of the present study is to measure the differences between travel modes, rather than the time spent in the city. Accordingly, the time spent on urban transportation (public transportation, waiting at the station or delays) is not included in the analysis.

Travel by private car between regions would seem to be more attractive for distances up to 250 km, while travel by HSR for journeys in the 250–1000 km range is more advantageous. Compared to other transportation modes, flying is more advantageous for distances over 1,000 km.

When the accessibility indices of the different travel modes are examined, it is seen that HSR trips of between 250 and 1,000 km offer significantly increased accessibility as compared to the other modes, saving time in comparison to the other transportation modes on the Konya–Istanbul and Ankara–Istanbul routes.

It should be noted that, in the choice of travel mode, travel cost is as influential as travel time, and in this regard, HSR is as attractive as intercity bus transportation.

3.2. Survey analysis

The HSR service between Konya and Ankara was launched in 2011. More than 400,000 passengers used the HSR in its first year, and ridership has increased since then, with more than 2 million passengers making the journey in 2017 (Table 2). In order to measure the effect of HSR on accessibility, a questionnaire was devised and applied using a semi-random sample selection method involving face-to-face interviews with 1,153 people who were traveling by HSR in 2017[11] (Table 5 and 6).

The survey results show that 45% of the passenger's had an income level below the minimum wage, (there is a large number of students in this group). Some 22% of the people whose income was above 1,501 TL earned 3501 TL and more. The other income ranges were 1,501–2,000, 2,001–2,500, 2,501–3,000 and 3,001–3,500 TL.

Some 69% of the respondents were not car owners. However, 60% of the 69% had a company or family car. Accordingly, approximately 60% of the

[11] *The survey interviews were made aboard the trains over May 11–19, 2017, during the week and on weekends, on the Ankara–Konya–Ankara route in the morning between 06:00-09:00, at noon between 12:00–14:00, and in the evening between 18:00–20:00.*

Table 5. *Interview numbers in the survey according as the day and time.*

Day/Time	06.00-09.00	12.00-14.00	18.00-20.00	Total
11.05.2017	91	66	122	279
12.05.2017	98	80	68	246
13.05.2017	54	50	60	164
15.05.2017	26	0	41	67
16.05.2017	31	0	39	70
17.05.2017	36	0	62	98
18.05.2017	50	41	41	132
19.05.2017	57	0	40	97
Total	443	237	473	1153

Table 6. *Basic statistical information about survey data.*

		Sexuality	Age	Education	Marital Status	Income
N	**Valid**	1153	1153	1153	1153	1103
	Missing	0	0	0	0	50
Mean		1,43	30,31	3,60	1,63	3,88
Std. Deviation		,496	11,495	,910	,527	2.323
Variance		,246	132,126	,828	,277	5,398

respondents who travel by HSR had a private car.

An analysis of the means by which the respondents travelled to the HSR station shows that 58% used public transport and 13% walked, indicating that the HSR stations in Konya and Ankara can be accessed without private cars.

57% of passengers is using public transportation modes for reaching the HSR station, the fact that more than 60% of the respondents have a private car indicates that the HSR stations in Konya and Ankara are easily accessible by public transport (Figure 2).

When the occupational distribution of passengers is examined, students account for 36% of the total, private company employees for 27%, public sector employees for 26%, retired people for 4%, unemployed people for 4%, and housewives for 3% (Figure 3).

The private and public sector employee respondents were generally travelling for business purposes, while the student respondents were travelling for education or family visit purposes. Housewives travel for family visits and entertainment purposes (visiting relatives and friends, shopping or sightseeing), and that few trips were made before the advent of HSR service. Therefore, since the advance of the HSR, new trip demands and reasons have emerged, which can be attributed to reduced travel times. The trip takes around 5 hours 30 minutes by car, but only 2 hours 30 minutes by HSR, so that such trips between Konya and Ankara line can now be completed within a day.

Another consequence of this situation is an increase in the number of daily trips between Konya and Ankara. Approximately 10% of the trips are made daily. When weekly and monthly trips are added, the rate of travel by HSR between Konya and Ankara is close to 50% (Figure 4). An analysis of the profile of the passengers forming this group reveals that employees generally travel for business, while students travel for education. One student who lives in Ankara travels to Konya every day in order to study. Similarly, one employee who lives in Konya commutes to Ankara daily (Figure 5).

The most significant factor in the above findings is that the HSR offers time savings over other transportation modes at an acceptable cost.

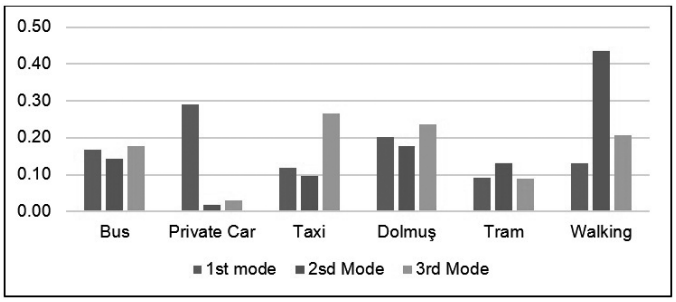

Figure 2. *Distribution of transportation modes that passengers travel to reach the HSR station (%).*

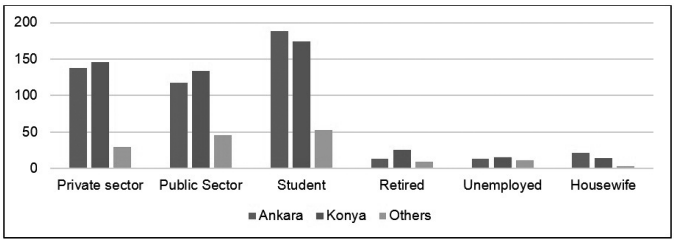

Figure 3. *Vocational distribution of HSR passengers.*

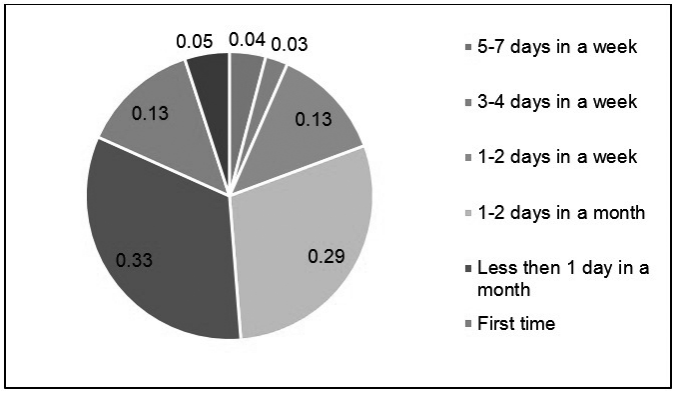

Figure 4. *Frequency Distribution Rates of Passengers Using HSR Service in Konya-Ankara Line.*

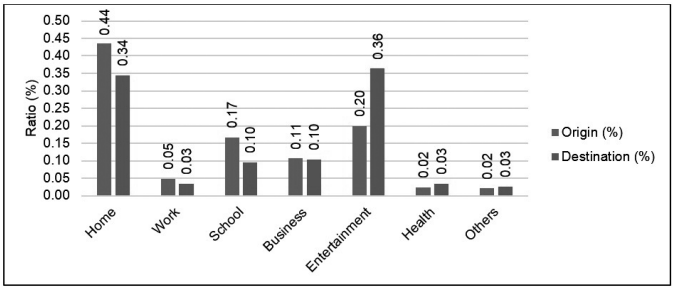

Figure 5. *Frequency Distribution Rates of Passengers Trip Purpose in Konya-Ankara HSR Line.*

4. Conclusions

As a result of technological improvements, the costs of transportation modes have decreased, as compared to previous decades. The number of people who opt for rail and air travel between Konya, Ankara and Istanbul has increased significantly. The results of the accessibility analysis conducted within the scope of the present study confirm this situation. For the high-speed train line constructed between Konya and Ankara in particular, an increase and change in both the number of trips and the modes of travel have been experienced. This can be attributed to the ability of passengers to travel the same distance faster and at an appropriate cost. The same applies to the Ankara–Istanbul and Konya–Istanbul HSR routes, although the addition of the air option on these routes influences travel choices on these routes.

The identification of changes in trip purposes and frequencies are another outcome of this study. The survey results show that, the HSR allows passengers to travel between Konya and Ankara within a day, which has a major impact on the trip purpose variable. Passengers can easily travel between the cities, which has led to an increased diversity in reasons for travel with the addition of entertainment, education, business, etc. Currently, there are eight or nine HSR trips scheduled every day on the Konya–Ankara–Istanbul route, which can be considered low when compared to the frequency of high-speed trains in developed countries. For instance, in Japan, the train frequency on the Osaka–Tokyo HSR route is between 3 and 5 minutes at peak hours, and a similar situation can be found in Germany, France and Spain. Accordingly, in the near future, diversification in mobility and transportation modes will increase in terms of frequency and income level in Turkey.

In the coming years, the number of passengers traveling by rail is expected to increase as the HSR network extends into other regions and attractive pricing policies continue to be implemented. In addition, it is also possible to differentiate the functions of districts such as Ankara, Konya and Istanbul, and the different functions of these provinces as a result of easing of transportation and shortening the time.

Another issue raised by the present study is the diversification of travel purposes as accessibility increases. Unprecedented travel demands are arising with the spread of the HSR network, which has resulted not only in an increase in business passengers, but also in those travelling for entertainment, education and health. The functional diversification of cities and the urban macroform will change with the increased access to cities in the short term.

Examining the relationship of HSR lines with urban public transport systems will open up new areas of study. Depending on this consequences choosing spatial location of stations and how the functions to be developed in and around the city and stations will ensure the literature of HSR systems in Turkey as well as transportation modes.

It is predicted that advances in high-speed train technologies will contribute not only to travel demands and travel modes, but also to technological development, governance of railway institution, product diversification and development, as well as to the development of tourism.

There is still a lack of comprehensive railway policies in Turkey, especially related to HSR systems, and issues such as how to integrate HSR networks with other transport modes stand unresolved. Could HSR systems reduce spatial inequity by enhancing accessibility? This is a very important issue in developing countries in the face of income divergence. In this regard, comprehensive studies in both the academic and political fields are vital.

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