
Impacts of high speed trains on tourism development: A case study of Ankara-Konya high speed rail lines

Ömer Faruk Görçün¹

Abstract

Regional and urban transportation systems have a key role in developments in tourism activities. While people prefer air and maritime transportation in cross-country travels, they may prefer rail and road transportation in domestic travels. In domestic travels, alternatives related to transportation play an important role in terms of increasing tourism demand. On the other hand, passenger transportation alternatives such as high speed rail systems, light rail systems, subways and trams in urban areas can play an important role in customer behaviors related to tourism demands. In the past, some factors, such as history, entertainment, food and beverage had an importance; nowadays factors related to transportation have begun to gain importance for customers for comfortable, safe, cheap, speedy and safe travels. If available, high speed trains are mostly preferred by passengers because of these advantages. High speed trains can help reduce the economic and external costs of transportation. International and domestic tourism demands may increase thanks to high speed trains (HST). This paper analyses the impacts of High Speed Trains (HST) on regional and urban tourism development. On the other hand, HST can provide unusual tourism alternatives, passengers may travel to places of interest which are not included in their original itinerary using HST. However, HST can increase tourism demand. Before and after the opening of the high-speed train services, occurred changes related to tourism demand, including customers' behaviors were taken into consideration and they were analyzed as variables. In this study, the high speed rail line between Ankara and Konya cities is selected as a case study. Impacts of HST on tourism demand are evaluated with the data obtained in the surveys.

Keywords: High Speed Trains, Tourism, Regional Development, Transportation

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¹ Asst.Prof., Kadir Has University, Istanbul, Turkey, omer.gorcun@khas.edu.tr

1. Introduction

The travel and tourism sector is very important for the economic well-being of both developed and developing countries. Even in the current economic crisis several international organizations argue that the tourist industry is a key driver for leading economies out of the crisis. Nevertheless, a debate exists about the impact of the travel and tourism sectors on the environment. Tourism is one of the main sources of wealth for numerous destinations. Tourism transportation represents one of the essential parts of the tourism system. The high speed rail system is an important part of domestic and international passenger transportation systems. Also, it can provide a successful connection between the passenger transportation modes. With globalization, technological developments have caused dramatic changes in social and economic life. One of these changes has been seen in tourism behaviours. Any new technological applications to revolutionize transportation will also exert a substantial influence on tourism. Technological improvements in transportation have led to the diversification of passenger transportation alternatives. In the past, while people had to choose unimodal transportation between departure and arrival points, nowadays they can choose multiple transport types in the same journey. The time-space effects of HST travel have significantly altered economic geography, shrinking continents. Tourists have the opportunity to choose from different passenger transport types, taking into account the different advantages of these transport alternatives. Short travelling times, low ticket fares, accessibility and safety are the main determinants of travel demands as well as comfortable journeys. The significance of these factors can vary for each user. Priority status of these factors can vary according to the customer's expectations, income and other conditions. In addition to users, operators, governments, local authorities, international institutions and habitants are also affected by negative and positive effects of different types of transportation. Each party of transport has different expectations for transport operations. For example; while the expectations of users are fast, cheap, comfortable and safe journeys; local authorities, governments and international institutions aim to minimize environmental impacts. Tourists arriving at international cities need mobility and few decide (or

can afford) to hire private transport. Because of this, the public transport system is an essential service for this population, especially in cities large enough to need bus, metro and train systems.

According to passenger behaviours and instant situations, the significance of these parameters can vary for each travel and passenger. Nevertheless, because they are focused on optimizing transport alternatives, users' choices are mostly rational. As a result, within the framework of their needs and present situations, passengers can prefer the most appropriate transport type from all of the alternatives. As a result, if the transport alternatives can be increased, preference of passengers may be more rational. On the other hand, optimal transport solutions can also be possible as a result of an increase in transportation alternatives. When the commercial speed increases, other parameters related to travel behaviour can also vary depending on the effects of the commercial speed. This study focuses on the impacts of commercial speed on the other parameters related to the passengers' choice of transport. In addition to that, since there is a correlation between commercial speed and effectiveness and efficiency; this study proposes that, if other parameters are constant and commercial speed increases, productivity and effectiveness of transportation can also increase.

2. Methodology

This paper examines the factors that affect passengers' choice of transport modes. The main aim of this study is defining the relationships between these factors, and compare advantages of transport modes within the framework of characteristics such as effectiveness, productivity, price and travel times. Particularly, impacts of high speed trains on regional developments are analysed in comparison to conventional train, air and road transportation. All the parameters of passenger transportation alternatives are evaluated in terms of monetary values and they related to passenger transport alternatives are described as a constant value. In this study, a model of travel time cost is developed as a methodology to define travel demands related to tourism with the factors affecting it directly and indirectly. Travel time costs are modelled with parameters such as number of traveling passengers per transport operation, unit time costs, and travel times using that transport modes, occupancy

rates of vehicles per operation. Travel time costs are evaluated for each transport mode: air, conventional rail, road and high speed rail. The methodology can be formulated as below;

$$u_{ct} = \frac{ni_{pc}}{y_d \times d_h \times m} \tag{1}$$

$$t = \frac{d}{s_i} \tag{2}$$

$$t_{ct} = \frac{n_p \times u_{ct} \times t \times oc_r}{n_p} \tag{3}$$

While u_{ct} represents unit cost of travel times, ni_{pc} is the national income per capita, y_d is the number of days in a year, d_h is the hours in a day, m is the minutes in an hour, t_{ct} represents total cost of travel times, n_p is the number of passengers for i type of transport modes, t is unit travel time for each transport modes, oc_r is occupancy rate for i type of transport modes, t is travel times, d is distance between the departure and the arrival points, s_i is speed for i modes of transport.

3. Passenger transportation indicators

In this study, travel time cost of passenger transportation service in the tourism sector are analysed within the framework of five passenger transportation alternatives: buses, automobiles, airways, conventional trains and high speed trains. Each alternative has different characteristics and a great number of specific conditions. In order to compare the different types of transport, parameters related to the cost of time are defined in terms of fixed value. To determine the total cost of travel time within the framework of passenger transport alternatives, national income per capita were considered as constant value and were converted to the monetary value per minute. On the other hand, distance is considered as a variable factor. When the distance increases, changes related to the cost of travel time are observed. While the number of days in a year, hours in a day, minutes in an hour and occupancy rates are fixed values; speed, distances, number of passengers per transport operation are variable factors. Variables can be seen below in Table 1.

Table 1. Indicators of passenger transportation alternatives

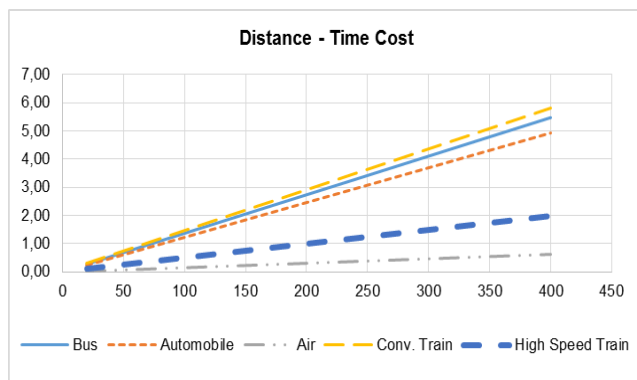
<i>d</i>	<i>Buses</i>				<i>Automobiles</i>				<i>Airways</i>				<i>Conventional Train</i>				<i>HST</i>			
	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>
20	90	13	45	0.3	100	12	1	0.3	800	1.5	149	0	85	14	256	0.3	250	5	419	0.1
40	90	26	45	0.6	100	24	1	0.5	800	3	149	0.1	85	28	256	0.6	250	10	419	0.2
60	90	40	45	0.8	100	36	1	0.7	800	4.5	149	0.1	85	42	256	0.9	250	14	419	0.3
80	90	53	45	1.1	100	48	1	1	800	6	149	0.1	85	57	256	1.2	250	19	419	0.4
100	90	67	45	1.4	100	60	1	1.2	800	7.5	149	0.2	85	71	256	1.5	250	24	419	0.5
120	90	80	45	1.6	100	72	1	1.5	800	9	149	0.2	85	85	256	1.7	250	29	419	0.6
140	90	93	45	1.9	100	84	1	1.7	800	11	149	0.2	85	99	256	2	250	34	419	0.7
160	90	107	45	2.2	100	96	1	2	800	12	149	0.3	85	113	256	2.3	250	38	419	0.8
180	90	120	45	2.5	100	108	1	2.2	800	14	149	0.3	85	127	256	2.6	250	43	419	0.9
200	90	133	45	2.7	100	120	1	2.5	800	15	149	0.3	85	141	256	2.9	250	48	419	0.98
220	90	147	45	3	100	132	1	2.7	800	17	149	0.3	85	155	256	3.2	250	53	419	1.08
240	90	160	45	3.3	100	144	1	3	800	18	149	0.4	85	169	256	3.5	250	58	419	1.18
260	90	173	45	3.6	100	156	1	3.2	800	20	149	0.4	85	184	256	3.8	250	62	419	1.28

Table 1. Indicators of passenger transportation alternatives (Cont.)

<i>d</i>	<i>Buses</i>				<i>Automobiles</i>				<i>Airways</i>				<i>Conventional Train</i>				<i>HST</i>			
	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>	<i>s_i</i>	<i>t</i>	<i>n_p</i>	<i>t_{ct}</i>
280	90	187	45	3.8	100	168	1	3.5	800	21	149	0.4	85	198	256	4.1	250	67	419	1.38
300	90	200	45	4.1	100	180	1	3.7	800	23	149	0.5	85	212	256	4.3	250	72	419	1.48
320	90	213	45	4.4	100	192	1	3.9	800	24	149	0.5	85	226	256	4.6	250	77	419	1.58
340	90	227	45	4.7	100	204	1	4.2	800	26	149	0.5	85	240	256	4.9	250	82	419	1.67
360	90	240	45	4.9	100	216	1	4.4	800	27	149	0.6	85	254	256	5.2	250	86	419	1.77
380	90	253	45	5.2	100	228	1	4.7	800	29	149	0.6	85	268	256	5.5	250	91	419	1.87
400	90	267	45	5.5	100	240	1	4.9	800	30	149	0.6	85	282	256	5.8	250	96	419	1.97

According to Table 1, when the distance increases, cost of travel time is also increased for each passenger transport alternative. Whereas, the costs of travel time for each transport type is close to each other in short distances. When the distance increases, differences between travel times costs of transport modes gradually increase. Buses, automobiles and conventional trains cannot compete with airways and high speed trains (HST) in terms of these indicators. On the other hand, these transport modes are slow and their passenger carrying capacities, excluding conventional trains, are low compared with airways and HST.

Figure 1. Passenger transport types, distance and time cost



3.1. Road transportation

Automobiles cannot be a good solution compared to other transport modes in terms of their passenger capacity. On the other hand, because of its individual characteristic, it cannot be used for public and tourism transport. When accidents, casualties and injuries are considered, buses cannot provide a safe transportation opportunity. On the other hand, the number of transport operations is not enough to respond to the needs in terms of price and customer satisfactions. Especially in longer distances, number of expeditions carried out by buses may be low. Therefore, passenger transport operations cannot be productive and effective. More importantly, when the distance travelled by buses increases, the cost of travel time also increases. Cost of travel time and elapsed transport time between two points is extremely high in travelling by conventional trains compared to other types of passenger transportation since conventional train is the

slowest transport mode among these alternatives. According to the figures related to the cost of travel times of transportation modes, the most advantageous types of transportation are air and high speed trains. Especially in longer distances; buses, automobiles and conventional trains cannot compete them. Buses and coaches can be operated more frequently in short distances and they may be used in short distances providing advantages for transfers between long distance transport modes.

3.2. Air transportation

While the low cost of travel time is low in airways, fares are high compared to other passenger transport alternatives. It should also be kept in mind that, the process before and after the flight, boarding and leaving the plane may take much time. The geographical and quantitative comparison of railway and air travel is a delicate matter, since the ways in which the two modes operate differs². Airlines may be a success in long distance passenger transportation. This transportation type can create the best solution for very long distance transportation that cannot be equalled by other passenger transportation types. As a result, passengers can prefer air transport in long distance tourism transportation. When fares of airways are similar or close with other passenger transport types, air may be preferred. According to Froidh; for high-speed long-distance services of about one to three hours of train travelling time, or distances of 200–600 km, trains have gained travellers from cars, coaches and airlines³. In general, tourists can choose airways, if the distance is over 600 kilometres. High speed trains can be preferred at distances of up to six hundred kilometres by passengers in international or domestic tourism transport.

3.3. Turkish domestic passenger transport and tourism

In Turkey, both freight and passenger transportation have gained new perspectives at the beginning of the 2000s. A great number of structural changes have been observed in air, rail and road transportation. To global competition, organizational structure of the airline sector has changed. This sector has become more competitive and flexible in the global scale. Turkish airline industry continues its

² Dobruszkes F. (2011), "High-Speed Rail and Air Transport Competition in Western Europe: A Supply-Oriented Perspective", *Transport Policy*, 18: 870–879.

³ Froidh O. (2014), "Perspectives for A Future High-Speed Train in the Swedish Domestic Travel Market", *Journal of Transport Geography*, 16: 268–277.

improvements year after year. Especially, it has grown a capacity and a capability in domestic flights compared to their competitors and alternative transport modes. In the past, Turkish transport system was completely dependent on road transportation.

Nowadays, passenger transportation is largely carried out by road transportation in Turkey. Although important improvements have been observed in the railway passenger transportation in the recent years, it has not yet reached a sufficient level. Road passenger transportation has negative impacts such as higher energy consumption, environmental and air pollution, noise, accidents and economic and social losses. On the other hand, road transportation cannot provide users' expectations such as short travel times, cheap, comfortable and safe travel at the required level. In Turkey, buses are largely used in passenger transportation. They cause external costs of transportation such as environmental and air pollution, noise and economic losses. Buses are not an effective and productive transport alternative for sustainable transportation and tourism policies. They cannot be the single transportation option for the tourism sector but can only be a complementary type of transportation. Road transportation may provide integration between air and rail transport.

3.4. High speed trains in Turkish tourism market

High speed trains are the most important component of the tourism sector as well as of transport activities. Especially in domestic tourism activities, they can provide the best solution in the middle and long distances compared to other transportation alternatives. Beyond its direct impacts, HST will inevitably have longer-term indirect impacts on the geography of economic activities, simultaneously on regional (inter-regional), urban (intra-regional) and local (intra-urban) scales⁴.

On the other hand, passengers can prefer this transport type when they consider advantages such as minimizing travel costs, high speed, low fares and safer transportation. In addition to that, high speed rail systems can affect the urban transport systems and

tourism activities of the cities. Consequently, the analysis on how urban tourism destination choices may be affected by HSRS needs to identify the elements affecting the choice of destination and the role played by transport⁵. HSR trains operating at a maximum speed of up to 350 km/h were reduced to 300 km/h. those trains with a maximum speed of up to 250 km/h were reduced to 200 km/h. and trains with a maximum speed of up to 200 km/h were reduced to 160 km/h.⁶. In 2002, since road transportation is not a sustainable and safe transport mode, Turkey's policy makers were seeking an effective solution to better transportation operations and to balance the use rates of transportation modes. They took a decision to improve the railway system in Turkey. Unlike the past, they focused on the high speed rail systems. According to Turkish policy makers, high speed rail systems might be the best solution for transportation problems. This policy has become a prioritized strategy. Compared with other successful examples around the world, High Speed Train operations are a fairly new in Turkey. TCDD started the construction of the high speed rail line between Ankara and Eskisehir in 2003. Its test driving was carried out on 23 April 2007 and the first operation began on 13 March 2009. Despite the use of HSR for a short time, TCDD has developed its own capabilities and capacity related to high speed rail operations within a very short period. Another important part of these systems is high speed rail lines located between the cities of Konya and Ankara. High speed trains have begun to run on 24 August 2009 between Ankara and Konya. In both directions, high speed train operations are carried out 16 times a day. While the average number of passengers who travelled by conventional trains before the high speed trains was 572, this number reached to 7.500 after high speed trains were opened for service. Between 24 August 2011 and 31 December 2012, the total number of expeditions is 6705 and the number of passengers traveling by high-speed trains is observed as 1,778,148. In 2012, while the total number of passengers is 1,371,152; average number of passengers who were traveling by high speed trains are increased and it has reached to 114,293. The average occupancy

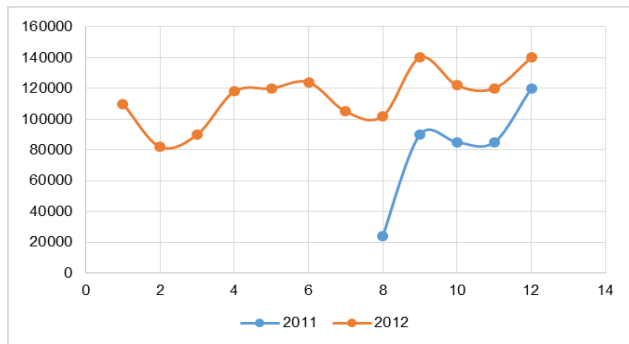
⁴ Chen C. L., Hall P. (2011), "The Impacts of High-Speed Trains on British Economic Geography: A Study of the UK's Intercity 125/225 and Its Effects", *Journal of Transport Geography*, 19: 689-704.

⁵ Delaplace M., Pagliara F., Perrin J. & Samuel Mermet (2014), "Can High Speed Rail Foster the Choice of Destination for Tourism Purpose? Social and Behavioral Sciences, 111: 166-175.

⁶ Shaw, S. L., Fang, Z., Lu S., Tao R., (2014), "Impacts of high speed rail on railroad network accessibility in China", *Journal of Transport Geography*, Volume 40, October 2014, Pages 112-122.

rate of these trains is observed as 62%⁷. High speed trains which operated between Konya and Ankara were used by averagely 3,747 passengers per day in 2012⁸. Between 1 December 2011 and 9 February 2012, the number of passengers went up depending on the increased number of daily HSR operations. In this period, the number of HSR expeditions has increased from 8 to 14. But due to severe winter conditions, the number of expeditions was reduced to 10, consequently, the number of passengers decreased. This situation shows that there is a correlation between travel demands and the number of expeditions. In addition, the number of passengers who prefer speed trains may vary depending on various factors such as enrolment period, festivals and special occasions. According to the statistical data of TCDD, the number of passengers is increasing at a level of 14% especially in festivals and special occasions⁹.

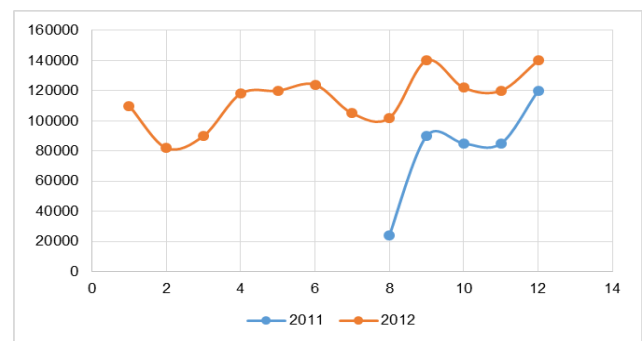
Figure 2. Number of passenger in Konya – Ankara HST line



In the Ankara - Konya HST line, occupancy rates are variable according to the departure times of high speed trains. From Ankara to Konya, mostly trains which are departing in the early morning hours are preferred by passengers. From Konya to Ankara, mostly night trains are used by passengers. High speed trains, departing from Konya at 6:00 p.m. and 8:30 p.m. are mostly preferred. In the past, passenger transportation between Ankara and Konya depended on road transportation, which was especially carried out by buses and automobiles. This dependence has reduced in recent years as a result of the high speed rail line's launch. Nowadays, the dependency to road transportation is steadily declining for passenger transportation and tourism sector. Before the launch of

the high speed rail service, rate of buses in passenger transportation was 70% and the rate of automobiles was 29%; after the high speed trains, share of buses decreased to 18% and the share of automobiles to 19%. Whereas, high speed trains have reached a share of %65 in two years, which began operating of high speed trains¹⁰. After the high speed rail lines was opened between Ankara and Konya cities, an increase of 8.5% in total travel demands was observed at compared to the travel demands of the past years. It is estimated that; the share of high speed trains is 12% within new travel demands.

Figure 3. The changes in share of transport types after and before of the high speed trains



High speed trains have obtained a significant portion from the share of the buses. While, 72% of total share of high speed trains has been gained from buses, obtained share from automobiles is 15%. After the high speed trains, the share of the airways was reduced from 1% to 0%. These figures show that, if a travel opportunity by high speed trains is available, high speed trains might be an important choice for passengers.

As a result of the opening of the high-speed train services, significant changes are observed in the social life of the city where high speed trains service is given. They bring dynamism to economic, touristic, social and cultural life of the cities where they are established. High speed trains contribute most importantly to tourism activities and tourism sectors of these cities. Passengers and tourists may travel by high speed trains within the same day with organized day tours.

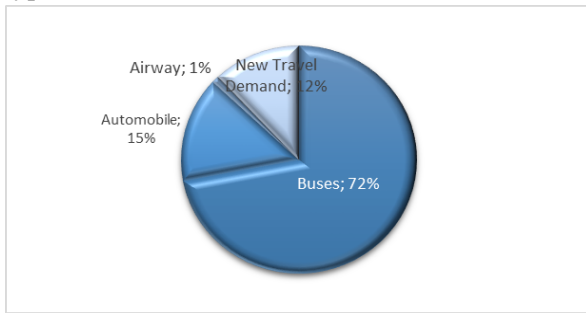
⁷ TCDD, Report of Sub- Committee of Railway Transportation, Transport Forum, 2013: 57-61.

⁸ TCDD, Report of Sub- Committee of Railway Transportation, Transport Forum, 2013: 65-69.

⁹ TCDD, Report of Sub- Committee of Railway Transportation, Transport Forum, 2013: 80-84.

¹⁰ TCDD, Report of Sub- Committee of Railway Transportation, Transport Forum, 2013: 90-114.

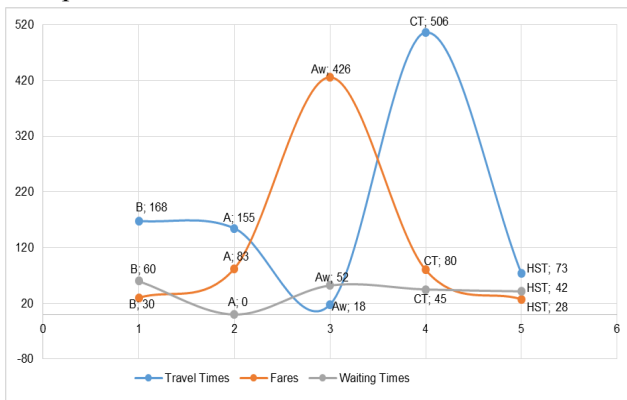
Figure 4. The Share of HST from other transport types



On the other hand, high speed trains can effect tourism activities in terms of economy, safety, speed and environmentally-friendly transport. There are no foreseeable technological revolutions in the short and medium terms in terms of fuel and therefore emissions; the potential for growth remains substantial¹¹. Many factors are taken into consideration by tourists and passengers while they take a decision related to cities where they travel and transport types they use. Passenger transportation is affected by many factors such as environment, social and cultural habits of passengers, safety and security, comfort and economy, low ticket prices.

Travel time and ticket fares are top priority factors in the decisions and behaviours of the passengers compared to other factors. While tourists and passengers decide the transport type, take into account ticket fares and travel times. If travel time is too long, this transport type may not be preferred by passengers even if the ticket price is low. At the same time, if ticket fares are too high and travel time is short, passengers may show the same behaviour.

Figure 5. Travel, waiting times and ticket fares of transport alternatives



As seen in figure 5, travel time is very long in travel by conventional trains (CT) between the cities of Konya and Ankara while ticket fares are high in travel by airlines (Aw). On the other hand, the values of parameters are close to each other in high speed trains compared to other transport alternatives. This situation increases desirability of high-speed trains (HST). In other transportation alternatives, the differences between the values of the parameters are high. These differences have negative effects, according to preferable of these transport types. On the other hand, when the unit ticket fares per kilometres are taken into consideration, unit ticket fares can be possible in travels by high speed trains.

While the unit ticket fares are 0,090 € / kilometres in travel by high speed trains, this value is higher in other passenger transport alternatives. In airlines, this value reaches to 1.79 €/km and is very high compared to other alternatives; however, air is the fastest transport type. Due to high fixed costs in the airline industry, cheap transport cannot be possible by airlines. According to already Ivaldi and Vibes, high speed railway lines are a significant source of competition for the air transport sector¹².

4. Result and conclusion

When passenger transport alternatives compared with each other in terms of parameters such as costs and travel times all of them were evaluated within the framework of a travel time cost model. As a result of this analysis, when the distance increases, effectiveness and productivity of passenger transportation by airline can also increase. Whereas, in distances less than 600 kilometres; productivity, effectiveness and popularity of airlines decrease. The high speed rail system is the most effective passenger transportation system in distances less than 600 kilometres. This system is a more economic, safe and fast type of passenger transport compared to other alternatives. It can provide fast, comfortable and low-price transport for passengers and tourists. When these advantages of high speed trains are taken into consideration, other passenger transportation types cannot compete with this transportation system.

¹¹ Peeters, P., Dubois, G. (2009), "Tourism Travel under Climate Change Mitigation Constraints", *Journal of Transport Geography*, 18: 447-457.

¹² Ivaldi, M., Vibes, C. (2005), "Intermodal and Intramodal Competition in the Long-Haul Passenger Transport Markets", *Idei Report*, 9. March.

Tourism forecasts are known to be highly uncertain. One reason for this uncertainty is that tourism, and in particular long-haul tourism, relies heavily on the availability of affordable transport connections between tourist source markets. If preferences of passengers and tourists are taken into account, the increases observed in travel demands by high speed trains proves the correlation between travel demands and transport parameters such as travel times, ticket fares and travel time cost. As a result, high speed train has many advantages compared to other transport alternatives. If a transport service that supplying by HST is increased, travel demands to high speed trains may also increase.

The high speed rail system may be a successful transport type in short and middle distance travel. Especially, when all the transport modes compared to each other in terms of ticket fares, travel costs and travel times, high speed rail system have obvious superiority compared to other transport types. On the other hand, a high speed rail system can provide a systematic and orderly travel opportunity for passengers and tourists. As a result of its systematic and orderly structure, high speed rail system can provide more reliable, productive and effective passenger transportation system. The existence of a high speed rail system in a country also affects tourism demands and tourist's behaviours. Passengers and tourists seek comfortable, safe, cheap and fast transport alternatives in travel and they can choose the touristic countries according to the advantages of transport alternatives.

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