Competitor Analysis to Quantify the Benefits and for Different Use of Transport Infrastructure

Dimitrios J. Dimitriou, Maria F. Sartzetaki

Abstract**—**Different transportation modes have key operational advantages and disadvantages, providing a variety of different transport options to users and passengers. This paper reviews key variables for the competition between air transport and other transport modes. The aim of this paper is to review the competition between air transport and other transport modes, providing results in terms of perceived cost for the users, for destinations high competitiveness for all transport modes. The competitor analysis variables include the cost and time outputs for each transport option, highlighting the level of competitiveness on high demanded Origin-Destination corridors. The case study presents the output of a such analysis for the OD corridor in Greece that connects the Capital city (Athens) with the second largest city (Thessaloniki) and the different transport modes have been considered (air, train, road). Conventional wisdom is to present an easy to handle tool for planners, managers and decision makers towards pricing policy effectiveness and demand attractiveness, appropriate to use for other similar cases.

Keywords—Competitor analysis, generalized cost, transport economics, quantitative modelling.

I. Introduction

CONTEMPORARY demand is influenced by integrated transportation systems that require maximum flexibility in the use of each transport mode. As a result, modal competition exists at various levels and takes different dimensions. Modes can compete with one another in terms of cost, speed, accessibility, frequency, safety, comfort, etc. The most prevailing competition concerns costs versus time and level of service. Cost is one of the most important considerations in modal choice. Because each mode has its own price/performance profile, the actual competition between the modes depends primarily upon the distance travelled, and thus, that is why air transport is the most competitive mode in long distances.

The objective of this research is to review the competition between air transport and other transport modes, in terms of infrastructure cost, price policy and regulation. This analysis framework presents the key components that affect transport mode competitiveness for domestic high demanded OD pair. The case study analysed is an OD corridor in Greece that connects the Capital city (Athens) with the second largest city (Thessaloniki) and the different transport modes have been considered (air, train, road).

D. J. Dimitriou is Assistant Professor and Maria F. Sartzetaki is PhD candidate in Department of Economics, Democritus University of Thrace, Greece, Panepistimioupoli, 69100 Komotini, (phone: +30 25310 39507, fax: +30 25310 39830, e-mail: ddimitri@econ.duth.gr, ddimitri@econ.duth.gr).

II. Background of Transport Modes Competition

Transport and mobility have been at the top of the agenda of the European Commission in order to foster competition and to improve public transport through a regulatory framework [1]. There are many important factors that influence transport mode choice, such as cost, environment, and frequency [2]. According to an extended literature review on empirical case studies, [2] highlights that price is the most important factor when choosing transport services, the quality is a factor of high importance, and environmental impact is a factor with very low importance.

As analyzed in [3], examining the competition between air and high speed rail for a given city-pair, the reduction in the number of flights is based on many conditions, including length of the high speed train journey and the strategic planning and regulatory framework provided by the airlines [3].

By analyzing the competition of transport modes in a very large intra-European connection, Rome-Milan [4] found a low degree of competition in rail and air transport services and highlighted that a reduction in the difference between airline and rail operators in terms of costs of accessibility could lead to a higher degree of competition between these operators [4].

III. Methodology Framework

In order to face the competitive environment, intermodal transport operators have increasingly adopted business practices which focus on reducing the operational costs, increase the profit margins, and improve their competitive situation in the market industry [5].

The methodology framework is based on competitor analysis. The concept is based on the development of KPIs that will provide results on performance and efficiency and the main pillars of the competitor analysis framework are:

- Develop KPIs to provide results on performance/efficiency,
- Sensitivity analysis to estimate demand attractiveness,
- Background for elasticity oriented evaluation;
  - Fare/price elasticity,
  - Gross elasticity between different transport options.

In this content, the assessment framework deals with the review of the key decision parameters which are:

(a) to compare the most suitable transport options; and
(b) to compare this performance between transport infrastructures [6].

This functionality provides a quite flexible measure to review operational performance for the alternative transport options in a city pair. Taking into account most of the perceived mode choice variables, the selected variables are:

- o Fare variables
- o Time variables

On the other hand, taking into account all the transport system operation characteristics, the other variables that affect the modeling framework are:

- o Location of transport node from the city centre
- o Speed/travel time [1].

A. Generalized Cost Method

There are many factors that influence mode choice in transport. Especially within an intermodal chain where the main distance is covered by air, rail or road the role of time is crucial [6].

The generalized cost method enables each individual agent to make a decision on what mode of transport it will take given a range of options from A to B. The monetary and non-monetary aspects of the journey can be summated with different valuations of the non-monetary aspects dependent on the agent and the mode. The generalized cost function can be defined as:

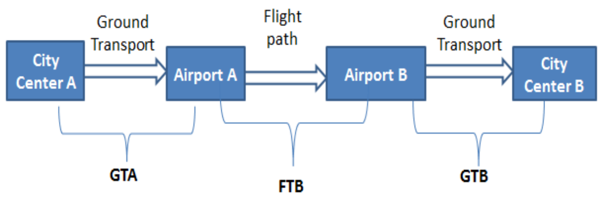
$$GC_{A-B} = TRC_{A-B} + TC_{A-B} \quad (1)$$

TRC refers to the monetary (out-of-pocket) costs of the journey. *TC* refers to the non-monetary (time) costs of an uncongested journey.

The perceived breakdown is based on the concept of generalized cost for the different means of transport that cover one route from point A to point B.

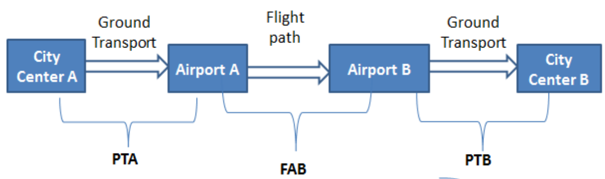
B. Air Transport

Especially for the air transport mode option, the total time and fare are estimated according to following equations.



$$TOTAL\ TRAVEL\ TIME = GTA + FTB + GTB$$

Fig. 1 Estimation of total travel time



$$TOTAL\ FARE = PTA + FAB + PTB$$

Fig. 2 Estimation of total fare

The variables that are used in order to estimate the total cost from Airport A to Airport B are the variables presented analytically in Fig. 3.

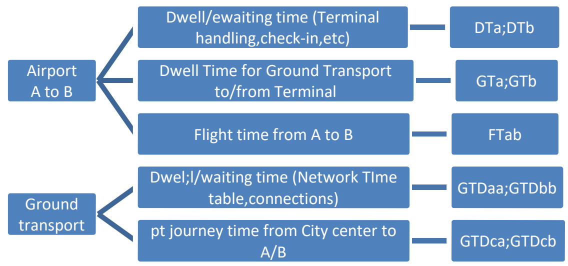


Fig. 3 Variables for assessing accessibility to airports

The equation that gives the total generalized cost for the air transport mode is:

$$GFC_{A-B} = \sum(DT_a + GT_a + GT_i + FT_a + GTD_{aa} + GTD_{bi} + GTD_{ca} + GTD_{cb} \quad (2)$$

C. Rail Transport

The variables that are used in order to estimate the total time and fare from Airport A to Airport B are:

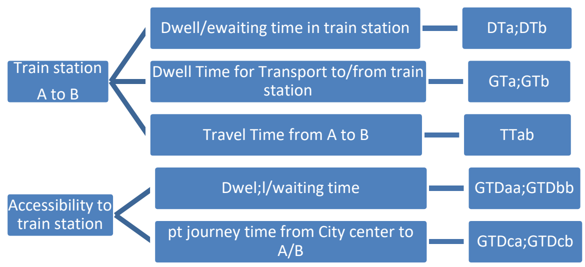


Fig. 4 Variables for assessing accessibility to train station

The equation that gives the total generalized cost for the rail transport mode is:

$$GRC_{A-B} = \sum(DT_a + GT_a + GT_i + TT_{ab} + GTD_{aa} + GTD_{bi} + GTD_{ca} + GTD_{cb} \quad (3)$$

D. Assumptions and Hypothesis

The key hypothesis in calculations for the previous indicators adopted in this analysis could be summarized as:

- Only direct routes are taken into account.
- Distance is measured in kilometers (km) and fares in Euros (€).
- The calculations take into account only the best route in terms of travel time.
- Transport fares are calculated for 1 adult (single ticket) and for students' discount rates for rail and bus.
- Dwell time is calculated as the time that passenger is not using a transport mode. This includes the time a passenger needs to reach the station/stop, the waiting time for the next operation and the waiting time to transit from a transport mode to another.
- Concerning road access by cars, the dwell time e.g. time waiting in traffic signals, cross sections etc. is not considered.
- For the car using cost calculation, the average fuel price is

taken 1.45 € per liter, and the fuel consumption in urban environment is 7 liters per 100 km, representing a car consumption medium rate for a medium class car.

IV. Case Study

The case study is a route in the nation of Greece. Greece has undergone significant changes in the past decades, improving the efficiency and performance of country's transport infrastructure. Improvements especially to the road infrastructure and airports have all led to a higher competition between the different transport modes.

The case study is the Route between A-Athens (Capital City of Greece) and B-Thessaloniki (the second largest city in Greece). The route is covered by four modes of transport: airplane, train, bus and private car).

Fig. 5 Route from (Athens) to B (Thessaloniki)

This route is less than 1,000 km. Each mode has a different fare policy. For all the transport options the variables in the generalized cost equation are the fare and the cost of the time. Regarding the cost of time an average Cost of the FTE Working Hour equal to 6.45€ is considered [7].

A. Air Transport Mode

The flight time is on average 50 minutes. Nevertheless, the total time required for a passenger to travel from the center of Athens to the airport, and from the Thessaloniki airport to the Thessaloniki city center is estimated three hours and 30 minutes. Currently, four air carriers serve the route A-B: Aegean airlines, Olympic airlines, Ellinair and Ryanair. The total generalized cost for the air transport mode is depicted analytically in Table I.

B. Rail Transport Mode

The route A (Athens)-B (Thessaloniki) is covered by 7 connections per day. The travel time is 5 hours and 20 minutes. There are two different classes A and B with the ticket price being 55€, 40€ and 45.40€, respectively. The total generalized cost for the rail transport mode is depicted analytically in Table II.

TABLE I
Total Generalized Cost (GFC) for Air Transport Mode

Airlines	**TRC**			**TC**	**Total**
	PTA	**FAB**	**PTB**		
Aegean	10€ 5€/students	71€	1€ 0.50€/students	21.28€	**103.57€**
Olympic Air	10€ 5€/students	43€	1€ 0.50€/students	21.28€	**76.57€**
Ellinair	10€ 5€/students	33€	1€ 0.50€/students	21.28€	**66.57€**
Ryanair	10€ 5€/students	41€	1€ 0.50€/students	21.28€	**74.57€**

TABLE II
Total Generalized Cost (GRC) for Air Transport Mode

Class	**TRC**			**TC**	**Total**
	PTA	**FAB**	**PTB**		
Class A	6€ 3€/students	55.4€	1€ 0.50€/students	33.54€	**95.94€**
Class B	6€ 3€/students	45.4€	1€ 0.50€/students	33.54€	**85.94€**

C. Private Car (PC)

The average travel time by car is 5 hours (speed 100 km/h).

The travel cost varies according to the type car. The travel cost for petrol engine car is 55.43€ (7.5 l/100 km), for diesel engine is 26.02€ (4.5 l/100 km) for gas engine is 29.45€ (8.5 l/100 km). The cost of the tolls is 29.45€.

D. Bus

The travel time by bus is 6 hours on average. For this route there are seven connections per day. The fare ticket is 45€ one way. The total generalized cost for the bus is depicted analytically in Table III.

TABLE III
Total Generalized Cost (GC) for Bus

Type	**TRC**			**TC**	**Total**
	PTA	**FAB**	**PTB**		
Regular	1 €	45 €	1 €	38.7/6.45€	**86.10 €**
Student discounts	0.50€	-25%	0.50€	38.7/6.45€	**76.10 €**
Other Social Discounts	0.50€	-50%	0.50€	38.7/6.45€	**66.10 €**

E. Results

The results as depicted in Fig. 4 indicate that air transport has the lowest GC; the second is the train and the third is bus transportation. The highest GC value belongs to the private car. These results highlight that the pricing policy at motorway tolls has to be revised, taking into account the risks raised to PPP motorway project in which the payback period is more than 30 years.

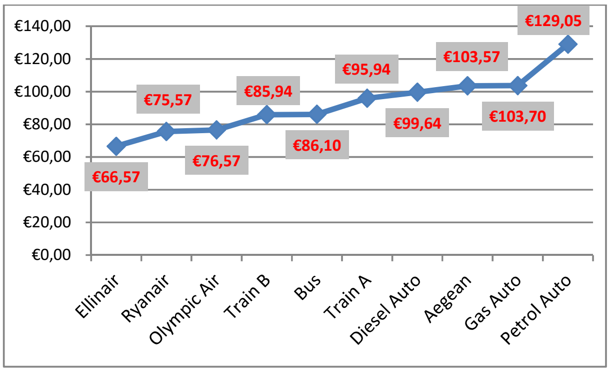


Fig. 6 Total generalized cost for the 4 different transport modes

V. Concluding Remarks

Different transportation modes have key operational advantages and properties. However, contemporary demand is influenced by integrated transportation systems that require maximum flexibility in the use of each mode. For a similar market and accessibility conditions, two modes that offer a different level of service will tend to compete with one another. The most prevailing competition concerns costs vs. time and level of service. Cost is one of the most important considerations in modal choice. Because each mode has its own price/performance profile, the actual competition between the modes depends primarily upon the distance travelled, which is why air transport is the most competitive mode for long distances.

The objective of this research is to review the competition between air transport and other transport modes, in terms of infrastructure cost, price policy and regulation. This analysis framework presents the key components affect transport mode competitiveness for domestic high demanded OD pair. The case study analysed is an OD corridor in Greece that connects the Capital city (Athens) with the second largest city (Thessaloniki) and the different transport modes have been considered (air, train, road).

The results highlight that in some cases the air transport option is more beneficial in terms of overall time and fare cost. This is an essential conclusion regarding transport mode pricing policy efficiency and the price elasticity in ticket fares.

The paper provides key messages on transport modes competition. The analysis approach provides a flexible and easy to handle framework to review the transportation for a high demanded corridor. The analysis of key findings highlights important messages to planners, managers and decision makers towards pricing policy and infrastructures investments.

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