



THE EFFECTS OF AIRPORT SLOT ALLOCATION METHOD ON COMPETITION: EMPIRICAL ANALYSIS OF COMPETITION THROUGH SLOTS AT JFK INTERNATIONAL AIRPORT

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ABSTRACT

Purpose- This study aims to indicate the effects of the current slot allocation method specified in the IATA Worldwide Slot Guidelines, which is used to allocate airport slots to airlines, on airline transport market concentration and competition.

Methodology- John F. Kennedy Airport (JFK), which allocates slots to airlines with the IATA method, was taken as a sample in the study. Airline's JFK slot data obtained from the Federal Aviation Administration's Slot Administration Office were analysed with the Herfindahl-Hirschman Index (HHI) and the n-Firm Concentration Ratio (CRn).

Findings- According to the findings obtained from the analyses, it has been stated that the concentration in the JFK International Airport market is high and the competition is low. It has been determined that the majority of the slots are owned by 3 long-established US airlines using the airport as their base airport, and the remaining slots are shared by many airlines.

Conclusion- As a result of the study, it is revealed how the historical rights and pool system in the current slot allocation method affect concentration, competition, new entrants to the market and the power of new entrants to increase their shares.

Keywords: Airport slot, market concentration, competition, Herfindahl-Hirschman, CRn

JEL Codes: B22, D40, L93

1. INTRODUCTION

The total demand for the air transport sector tends to increase continuously, excluding the temporary recessions in the years when it was affected by global economic crises and events. According to the data of the International Civil Aviation Organization (ICAO), the number of scheduled revenue passengers in the world increased by 66% from 2.7 billion to 4.5 billion between 2010-2019. The amount of cargo carried also increased by 20% from 48 million tons to 57.6 million tons (ICAO, 2019). The number of flights in Europe, which was 9.5 million in 2010, increased to 11.1 million in 2019, within the scope of EUROCONTROL data (EUROCONTROL, 2020).

Air transport was severely affected in 2020, and there was a decrease in passenger transport and flight traffic due to the global Covid-19 epidemic. However, with the start of the normalization process with vaccination and measures, an increase is observed again in 2021. European flight traffic, which fell from 11.1 million to 5 million annually due to the epidemic, has entered an upward trend again based on EUROCONTROL data. The number of flights in Europe will reach the highest level of 11.1 million again in 2024, and it will be 11.8 million in 2027 and will continue to increase according to the forecasts of EUROCONTROL (EUROCONTROL, 2021).

According to Bureau of Transportation Statistics (BTS) data, the flight traffic in the United States reached 10.2 million flights from 9.5 million flights between 2014-2019. The number of revenue passengers, which was 852 million in 2014, increased by more than 200 million in 5 years and reached 1 billion 53 million in 2019 (BTS, 2021). Although the number of revenue passengers decreased to 400 million in 2020 due to the global Covid-19 epidemic, it will exceed 1 billion 600 million in 2040 according to the long-term forecast of the Federal Aviation Administration (FAA) (FAA, 2021).

Increasing flight traffic creates airport capacity problems. Although building new airports seems to be the first solution that comes to mind, this process is not as easy as it seems because it requires cost, space, and time. For this reason, slot

applications are carried out for capacity control at airports. These applications take place in the form of allocating airport slots to airline operators by considering various criteria.

This study aims to reveal the effects of the current airport slot allocation method on the competition and market structure in airline transportation by using economic indices. As a result of the findings obtained in this context, it is intended to evaluate the current slot allocation system.

Firstly, the concept of slot and the method used to allocate slots are stated in the study. Besides, studies addressing the problems brought by the current slot allocation method and studies measuring market concentration and competition in air transport are mentioned separately. In the next stage, the slot data of the airline companies flying to JFK Airport were analysed with the n-Firm Concentration Ratio and Herfindahl-Hirschman indices and the findings were interpreted. Based on the findings, how and to what extent the current slot allocation method affects market concentration and competition is revealed in the conclusion section.

2. LITERATURE REVIEW

2.1. Slot Concept and Current Slot Allocation Method

Slot means the permission required by the airline operators to land and take off at an airport at certain times and to use the entire infrastructure of the airport during this time. Airports in almost all European countries and a few airports in the USA allocate slots to airline operators in accordance with the Worldwide Slot Guidelines (WSG) published by the International Air Transport Association (IATA) in the current system (IATA, 2019).

IATA divides airports into 3 categories according to their density. Category 3, in other words, coordinated airports, are the busiest airports and airline operators need to have slots for flight planning. Slots are allocated to airlines seasonally, in summer and winter. In the current slot allocation method, the first criterion when allocating slots to airlines is "Grandfather Rights" based on historical priority. According to these rights, an airline can hold this slot indefinitely as long as it is 80% or more compatible with the slot it had in the previous year. If the airline stays below the 80% limit and loses its slot, this slot is transferred to the slot pool. 50% of the slots transferred to the pool are allocated to airlines that do not currently have a flight at the airport that has just entered the market, according to other criteria determined by IATA (IATA, 2019). Although the pool system is a practice introduced to remove the barrier to new entrants to the market, it is thought that the historical rights called grandfather's rights to give new entrants a disadvantage and affect competition negatively. The disadvantageous situation of new entrants will bring the market closer to a monopoly structure and will prevent the increase of competition despite the increasing demand for air transport. The lack of competition in a market negatively affects the development of the sector and especially the benefit provided by consumers in many ways when we consider it from an economic point of view. (Dotecon, 2001).

2.2. Studies on Slot Allocation Problems

The problems caused by the method currently used in allocating slots to airlines have been expressed by many researchers in the literature. Matthews and Menaz (2003) conducted a literature review on various slot allocation methods and slot pricing at airports in their compilation study on airport capacity and slot allocation problems. They evaluated the current system of slot allocation in terms of pricing, auction, secondary trading, and administrative regulations. Researchers concluded that it might be appropriate to use the methods in a balanced way when performing the slot allocation process. They suggested retaining some of the existing allocation system based on historical priority when allocating slots to Airlines, but also using various pricing mechanisms. They determined that as a pricing mechanism, a high price method can be used for slots when demand is high, and a low price for slots when demand is low. They also emphasized that the slot pool system should continue due to attract new entrants to the market and allow competition. Madas and Zografos (2006), conducted a compilation study on slot allocation methods as well. They have mentioned the problems of the current method. Researchers evaluated the methods that can be used for slot allocation and the integration of these methods with each other, in their research. Uslu (2015) conducted a literature review and case study on the slot problems at airports in Turkey, using the compilation method. He emphasized that the current method of slot allocation causes unfair competition. Suggestions were made such as creating a website where users can access slot information, re-evaluating the slot instruction in terms of language, and eliminating the gaps in the control mechanism in his study. He also suggested that the slot allocation be made by the largest airport operator in Turkey (General Directorate of State Airports Authority (DHMI)) in the form of sales by the tender method in order to reach a long-term solution. He stated that when implemented in this way, slot allocation will be fairer and more transparent in terms of competition and that the revenues obtained can be used to improve this system and increase airport capacities in terms of infrastructure in the long term. Ates and Uzulmez (2016) discussed the classification of slot allocation through semi-structured interviews with two different employees, one working in the airport and the other in an airline company. They made suggestions regarding the improvement of the slot coordination system used at Atatürk Airport. There is no auction approach in the current slot allocation system at Atatürk Airport. Therefore, they concluded that a purely economic approach would cause some problems and may lead to monopoly, especially in airports such as Atatürk

Airport, which do not have other alternatives around. Cengiz (2012) examined the slot allocation practice in the European Union and Turkey. He explained the historical development and basic concepts of slot allocation in order to make a legal assessment of the allocation in his study. In addition, he stated how the national and international regulations based on the slot allocation and the application method of the slot allocation will be with these regulations. Besides, he discussed the legal nature of the allocation, the slot trade, the improper allocation process, and the improper use of the allocated time slots. He stated that there are deviations from EC 95/93 (the EU regulation on common rules for the allocation of slots at Community airports) in the Slot Implementation Instructions of DHMI (General Directorate of State Airports Authority) applied in Turkey. He discussed what will happen in Turkey when this regulation is implemented correctly in terms of form and content, according to the model proposed. He concluded that the barrier to entry to the market, which is in the content of the current slot allocation method, will reach a sufficient solution in terms of the market, considering the scope of the aviation sector in Turkey. In addition, he argued that it is unfair for DHMI, which is also the airport operator, to have the authority and responsibility for slot allocation for Turkey. He explained that it should be transferred to the Directorate General of Civil Aviation of Turkey (DGCA) in the first stage and a legal entity of private law in the last stage. Erol and Karaman (2016) researched the factors that determine airport capacity and slot coordination management and evaluated the role of slots in the aviation system. It is stated that when the optimum distribution of demand is ensured with slot allocation, it will be possible for more airlines to fly to that airport. The researchers argued that the historical slots, which the airlines qualify as inalienable rights, prevented the establishment of a competitive balance in the market. They stated that airlines should be penalized by the authorities for improper use since slots are an important factor in ensuring competition. They also emphasized that the most comprehensive authority on this issue is IATA. Avenali et al. (2015) studied the efficiency of the current slot allocation method. They stated that the historical rights in the current method push airlines to use them inefficiently in order not to lose their slots. they aimed to prevent inefficient slot usage, in their research. They proposed an incentive pricing mechanism for airport slot allocation for this purpose.

2.3. Studies Measuring Competition and Market Concentration in Air Transport Industry

Some studies measure market concentration in various ways in the air transport sector. Measurements are generally made over the shares of airline companies from passengers, cargo, or traffic. Clougherty (2002) analysed the concentration of international country pair markets and domestic markets among 21 developed aviation countries for the period 1983-1992 using the Herfindahl-Hirschman index. Yaşar and Kiracı (2018) analysed the market structure and competitiveness of the worldwide air transport market using the n-Firm Concentration Ratio, Herfindahl-Hirschman, Entropy and Comprehensive Concentration Indices. Mantin and Koo (2009) investigated market concentration as one of the factors in their study on the factors affecting price distribution in the airline industry. They used the Herfindahl-Hirschman index to measure the concentration in the US domestic market. Giaume and Guillou (2004) examined the relationship between price discrimination and concentration in the European air transport market using the Herfindahl-Hirschman index. Johnston and Ozment (2011) analysed the concentration in the US airline industry between 1970 and 2009 with the Herfindahl-Hirschman and n-Firm Concentration Ratio indices. Oliveira and Oliveira (2018) measured the market concentration in the Brazilian air transport city-pair market between 2002 and 2013 with the Herfindahl-Hirschman and n-Firm Concentration Ratio indices. Yang (2016) investigated the relationship between passenger demands and influential factors based on direct flights on Taipei, Shanghai, Seoul and Tokyo airport pair routes. He used the Herfindahl-Hirschman index to measure the market concentration on these routes. Zhang et al., (2020) analysed the market concentration of the China air transport market using the Herfindahl-Hirschman and the market power of Chinese airline companies using the Lerner index to reveal the impact of high-speed rail transport in China on the airline market. Grosche et al., (2020) used the Herfindahl-Hirschman index to measure the market concentration before and after the bankruptcy of Air Berlin to reveal the impact of the bankruptcy on the German air transport market. Yaşar and Gerece (2018) conducted a concentration analysis by considering each city pair as a separate market in domestic airline transportation in Turkey. They used the n-Firm Concentration Ratio, Herfindahl-Hirschman Index and Entropy Index to measure the concentration in the market structure of 1447 city pairs in Turkey. Saribaş and Tekiner (2015) measured the market concentration and competition in the Turkish civil aviation industry between 2011 and 2013 with the n-Firm Concentration Ratio and Herfindahl-Hirschman indices. Yaşar et al., (2017) used the n-Firm Concentration Ratio and Herfindahl-Hirschman Index to analyse the market concentration and competition level in the air transport market of the five largest airports in Turkey.

3. METHODOLOGY

John F. Kennedy (JFK) International Airport, an airport in the USA that allocates slots to airlines according to IATA Worldwide Slot Guidelines, is discussed in this study. It is aimed to determine the market concentration ratio and competition situation by examining the distribution of the slots allocated to the airline companies operating at JFK Airport.

The data of the 2019 winter season slots at JFK Airport and the data of the airlines that have these slots were used in the research. Data were obtained from the Federal Aviation Administration Slot Administration Office (FAA, 2021).

All coordinated (Level 3) airports constitute the main population of the research. The fact that most countries' airport or civil aviation authorities do not share slot data with the public limits the research. JFK Airport was chosen as a sample in this study because the FAA shares its slot data with the public.

The obtained slot data were analysed with the n-Firm Concentration Ratio (CR_n) and Herfindahl-Hirschman Index (HHI) methods, which are used to measure market concentration and competition in economics. Market concentration can be expressed as the distribution of enterprises in terms of number and size. Increasing concentration means that economic activities in the market are carried out with fewer businesses. Therefore, there is an inverse relationship between concentration and competition. Markets with high concentration approach the monopoly, and markets with low concentration approach the perfect competition market (Yıldız, 2012).

The n-Firm Concentration Ratio, which is the first of the methods used, expresses the sum of the market shares of the 'n' companies with the largest market share operating in the market as it is seen in Eq. (1). The index result is between 0-100 and as the value increases, concentration increases and competition decreases. It is calculated as follows (Su, 2003):

$$CR_n = S_1 + S_2 + \dots + S_n = \sum_{i=1}^n S_i \quad (1)$$

S: Market share of a firm; n: Number of firms

The other method, the Herfindahl-Hirschman Index, is the sum of the squares of the market shares of all businesses operating in the market. It is shown in Eq. (2). A value between 0-10000 is obtained and as the value increases, concentration increases, competition decreases, the market approaches monopoly. It is calculated as stated below (Su, 2003):

$$HHI = S_1^2 + S_2^2 + S_3^2 + S_4^2 + \dots + S_n^2 = \sum_{i=1}^n S_i^2 \quad (2)$$

The common aspect of the studies carried out using the same method in air transportation is that the market shares of the enterprises are evaluated as the number of passengers carried, the amount of cargo or the number of flights between two points. The market of airline companies is considered as the airport and their market share is considered as the slots they hold at the airport in this research.

4. ANALYSIS AND FINDINGS

The distribution of JFK slots to airlines for the 2019 winter season is given in Table 1. The "number of slots" in Table 1 corresponds to the total number of landing and take-off slots an airline has during the day. Slots held less than 5 days a week are not included in the table. This is how the Federal Aviation Administration shares the data of the slots that airlines have with the public.

Table 1: Airlines Flying to JFK International Airport and Their Number of Slots

CODE	AIRLINE	NUMBER OF SLOTS
AAL	AMERICAN AIRLINES	212
AAR	ASIANA AIRLINES	2
AEA	AIR EUROPA	2
AFL	AEROFLOT	4
AFR	AIR FRANCE	10
AIC	AIR INDIA	2
AIJ	ABC AEROLINEAS dba INTERJET	8
AMX	AEROMEXICO	10
ANA	ALL NIPPON AIRWAYS	4
ARG	AEROLINEAS ARGENTINAS	2
ASA	ALASKA AIRLINES	24
AUA	AUSTRIAN	2
AUI	UKRAINE INT'L AIRLINES	1
AVA	AVIANCA	6
AZA	ALITALIA	8

BAW	BRITISH AIRWAYS	20
BEL	BRUSSELS	2
BWA	CARIBBEAN AIRLINES	5
CAL	CHINA AIRLINES	1
CCA	AIR CHINA	2
CES	CHINA EASTERN AIRLINES	3
CMP	COPA AIRLINES	2
CPA	CATHAY PACIFIC	7
CSN	CHINA SOUTHERN AIRLINES	2
DAL	DELTA AIR LINES	401
DLH	DEUTSCHE LUFTHANSA	6
EIN	AER LINGUS	6
ELY	EL AL ISRAEL AIRLINES	1
ETD	ETIHAD	4
EVA	EVA AIRLINES	1
FDX	FED EX	4
FIN	FINNAIR	2
HAL	HAWAIIAN AIR	2
IBE	IBERIA AIRWAYS	4
ICE	ICELANDAIR	2
ICL	CARGO CARRIER	2
ISS	AIR ITALY	2
JAL	JAPAN AIR LINES	4
JBU	JETBLUE AIRWAYS CORP.	334
KAC	KUWAIT AIRWAYS	2
KAL	KOREAN AIR	3
KAP	CAPE AIR	4
KLM	KLM ROYAL DUTCH	4
KQA	KENYA AIRLINES	2
LAN	LAN AIRLINES	4
LNE	LAN ECUADOR	1
LOT	LOT - POLISH AIRLINES	2
LVL	LEVEL	2
MSR	EGYPT AIR	2
NAX	NORWEGIAN AIR SHUTTLE	5
NRS	NORWEGIAN AIR UK	3
PAC	POLAR AIR CARGO	2
QFA	QANTAS AIRLINES	2
QTR	QATAR AIRWAYS	4
RAM	ROYAL AIR MAROC	2
SAA	SOUTH AFRICAN AIRWAYS	2
SIA	SINGAPORE AIRLINES LIMITED	2
SVA	SAUDI ARABIAN AIRLINES	2
SWR	SWISS INTERNATIONAL AIRLINES	6
TAM	TAM BRAZILIAN AIRLINES	2
TAP	TAP-AIR PORTUGAL	1
THY	TURKISH AIRLINES, INC.	3
UAE	EMIRATES	4
UAL	UNITED AIRLINES	45
UPS	UNITED PARCEL SERVICE	2
VIR	VIRGIN ATLANTIC AIR	9
VIV	VIVA AEROBUS	2
VOI	VOLARIS	2
WJA	WESTJET	2
TOTAL	69 AIRLINES	1244 SLOTS

Source: FAA - Slot Administration Office

As seen in Table 1, there are a total of 69 airlines with slots (at least 5 days a week) at JFK Airport in the winter season of 2019. The total number of slots at JFK airport (held at least 5 days a week) is 1244. In the following sections, the data in this table were used in the analyses performed with the N-Firm Concentration Ratio and Herfindahl-Hirschman indices.

4.1. Evaluation of JFK International Airport Slot Distribution According to CR3 Index

3 airlines holding the most slots at JFK Airport in the winter season of 2019 are discussed within the scope of this analysis. The slot shares at the airport are obtained by dividing the number of slots the airlines own by the total number of slots of all airlines, and this value was considered the market share. Table 2 shows the 3 airlines with the most slots and their slot shares in the winter season of 2019.

Table 2: 3 Airlines Holding The Most Slots - CR3 Index

CODE	AIRLINE	NUMBER OF SLOTS	SLOT SHARE (%)
DAL	DELTA AIR LINES	401	32,23
JBU	JETBLUE AIRWAYS CORP.	334	26,85
AAL	AMERICAN AIRLINES	212	17,04
CR3 INDEX			76,13

Table 2 shows that Delta Air Lines, which has the most slots with 401 slots at JFK Airport, has approximately 1/3 of the total slots. It is followed by Jetblue Airways with a slot share of 26.85% and American Airlines with a slot share of 17.04%. These airlines are also 3 airlines that use JFK Airport as a hub airport. Only 3 of the 69 airlines flying to JFK Airport brought the Concentration Ratio Index to 76.13. This finding means that only 3 airlines hold 76.13% of the total slots. In other words, 23.87% of the slots at JFK airport are shared by 66 airlines. According to this finding, JFK Airport has an oligopoly market structure, and the market concentration is high when it is evaluated through slots.

4.2 Evaluation of JFK International Airport Slot Distribution According to HHI Index

The number of airlines according to the number of slots they hold in the winter season of 2019 and the Herfindahl-Hirschman Index obtained from the slot shares of all 69 airlines are shown in Table 3. In Table 3, "number of slots" corresponds to the total number of landing and take-off slots an airline has during the day (for at least 5 days a week) in JFK (refer to Table 1), while "number of airlines" indicates how many airlines have that number of slots.

Table 3: Number of Airlines According to The Number of Slots - HHI Index

NUMBER OF AIRLINES	NUMBER OF SLOTS
3	More than 100
5	Between 10-100
10	Between 5-9
15	3 or 4
36	1 or 2
HHI INDEX	2076,15

As indicated in Table 3, the number of airlines that have 1 or 2 slots at the airport is more than half of the total number of airlines (36 of 69 airlines). The airlines which hold more than 100 slots are the 3 airlines that use JFK Airport as a hub. There is an inverse relationship between the number of slots owned and the number of airlines holding the slot. The HHI index calculated through the market share is 2076,15. According to the index result, the market concentration is high, and the level of competition is low at JFK Airport (European Commission, 2004).

If we compare the 2 indices with each other, The concentration value in the HHI index (2076.15) is more moderate than the concentration value in the CR3 index (76.13) (Kvalseth, 2018). This is due to the fact that there are many airlines (69) in the market, but 3 airlines based in JFK own most of the slots, while other airlines share the rest of them. The fact that many airlines have slots (albeit a small amount), and they compete among themselves prevents the HHI index from getting excessively high, while the fact that only 3 airlines have 76.13% of the slots causes the CR3 index to be high.

5. CONCLUSIONS

The allocation method specified in IATA Worldwide Slot Guidelines used when allocating airport slots to airlines is discussed in the study. It is aimed to indicate the effects of this slot allocation method on the competition and market structure at the

airport. Empirical analysis of the distribution of slots allocated to airlines at JFK airport was made using the n-Firm Concentration Ratio and Herfindahl-Hirschman Indices.

As a result of the research, according to the slot distribution of the airport, it is seen that the market concentration is high and the competition between the airlines is low. Historical rights, which are the main basis of the slot allocation method, provide a highly competitive advantage to the airlines that have held the slots at the airport in the past. Airlines are not completely prevented from entering the market under the current slot allocation method, as it is the rule that 50% of the lost slots are allocated to the new airline operators. Although airlines that have just entered the market are entitled to have slots, the number of slots they hold is limited to a few, as this rule only provides advantages for new entries to the market, as revealed in the research. Therefore, it does not seem possible for the airlines that have just entered the airport to increase their slots as much as the airlines that have been flying at that airport in the past. This shows that the current slot allocation method prevents competition among airlines.

The right to hold the slot unlimitedly as long as it is used, provided to the airlines by the historical rights, can be re-evaluated in order to increase competition. In addition, the slot pool system can be arranged in a way that not only provides benefits to newly entered airlines but also provides an advantage to airlines that have a small number of slots.

Some studies contain opinions that the current slot allocation system prevents competition or causes unfair competition in the literature. This study indicates the level of competition at the airport with empirical analysis. The study was conducted by selecting JFK Airport in the USA as a sample since airports in Europe mostly do not share slot data. The samples can be diversified and compared with each other by using the same method in the next research if the airports share their data transparently with the public. In addition, since the slots of the airports are reallocated each season according to the specified criteria, there will be changes in the concentration and competition situation in the market over time. Therefore, the study can be repeated at certain time intervals and the results can be compared with each other.

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