A GENERAL REVIEW ABOUT CIVIL AVIATION INDUSTRY INCLUDING THE FACTORS AFFECTING OPERATIONAL EFFICIENCY OF AIRLINES

Araştırma Makalesi

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ABSTRACT

The history of civil aviation began on 17 December 1903 with Wright Brothers' first motorized flight attempt, which is accepted as the first phase, entered its fifth phase in 1978 with the liberalization period. Today belongs to post-1978 liberalization period and the most decisive factor for this period was the development of operational activities. Although operational activities are separated from financial activities; strategic elements, which are the most important concepts about financial success, are the group of activities that determine financial details. In this research, three main criteria that determine the operational efficiency of airlines; passenger paid, passenger paid kilometer and the number of landing numbers that determine the total number of touchdown of aircraft will be analyzed in the light of quarterly reports since 2004 and the effect of the relationship between these factors on operational efficiency will be analyzed.

Keywords: *Paid Passenger Kilometer, Paid Passenger, The Number of Aircraft Touchdown, Full Service Carrier Model, Low Cost Carrier Model.*

JEL Classification Codes: *Y1, Y2, Y9.*

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HAVAYOLLARININ OPERASYONEL VERİMLİLİĞİNİ ETKİLEYEN FAKTÖRLERLE BİRLİKTE SİVİL HAVACILIK ENDÜSTRİSİ HAKKINDA GENEL BİR İNCELEME

ÖZET

Sivil havacılık tarihi 17 Aralık 1903 tarihinde birinci evre olarak kabul edilen Wright Kardeşlerin ilk motorlu uçuş denemesiyle başlamış olup, 1978 yılında liberalizasyon dönemiyle birlikte beşinci evresine girmiştir. Günümüz 1978 sonrası liberalizasyon dönemini içermekte olup, bu dönemin havayolları için en belirleyici unsuru operasyonel faaliyetlerin geliştirilme süreci olmuştur. Operasyonel faaliyetler her ne kadar finansal faaliyetlerden ayrılsa da finansal başarıyı belirleyen en önemli kavram olan stratejik unsurlar mali detayları da belirleyen faaliyetler topluluğudur. Bu çalışmada havayollarının operasyonel verimliliklerini belirleyen 3 temel kıstas; ücretli yolcu, ücretli yolcu kilometre ve uçakların toplam iniş sayılarını belirleyen konma sayıları 2004 yılından beri 3 aylık çeyrek dilimler halinde alınan raporlar eşliğinde analiz edilecek ve aralarındaki ilişkinin operasyonel verimliliğe etkisi analiz edilecektir.

Anahtar Kelimeler: *Ücretli Yolcu Kilometre, Ücretli Yolcu, Toplam Teker Koyan Uçak Sayısı, Geleneksel Taşıyıcı Modeli, Düşük Maliyetli Taşıyıcı Modeli.*

JEL Sınıflandırma Kodları: *Y1, Y2, Y9.*

1. INTRODUCTION

Operational efficiency is an essential subject for to measure financial and operational success with the aid of annual reports that yearly published by airlines. Annual reports of airlines related with the yearly financial and operational condition of airlines for publishing the public and investors. These reports are included; financial and operational parameters. Financial paremeters are related with assets, liabilities and shareholders' equity at a specific point in time and provides a basis for computing rates of return and evaluating its capital structure. Operational parameters are related with the whole sequential process of airlines included; quality department, trade department, human relations department, vice and senior managers, flight crew, maintenance personnel, ground personnel, dispatcher, flight control, passenger service personnels.

When it is looked at in big frame, operational parameters are included financial parameters. So, the objective of this article to find the success level efficiency by examining operational parameters as selected. This research is to be the first related with giving information what is operational efficiency and how it is analyzed for airlines. The scope of this article is to determine the operational efficiency of the variables; passenger paid, passenger paid kilometer and the number of landing for specifying the total touchdown of aircrafts about the airlines' success level. These three variables are about the issue of load factor that defines the total occupancy rate (load factor) of airlines for to specify success level. If this occupancy rate is in high percentage, airlines can make profit.

At first sight if passenger paid increase, passenger paid kilometer and number of landing specify total touchdown of aircrafts increase too. On the other side if passenger paid decrease, passenger paid kilometer and number of landing specify total touchdown of aircrafts decrease too. This situation is really logical. But the situation is not simple like that. For instance Japan Airlines' passenger paid is not related with other efficiency variables. Because in Japan, ticket prices is expensive by the way passenger paid is high too. However, the other variables are not high like passenger paid. The financial purchasing power of Japanese people is really high, so passenger paid kilometer and total landing of aircrafts are not high like passenger paid.

In this research it is found that purchasing power related with financial status of passengers in a country is important as the selected parameters. Because of that the three variables' relationship is not always true. Financial status of passengers in a country is not a measurable parameter so the

effect of this situation can not be observable for evaluating the operational efficiency. For these reasons solely the measurable variables are evaluated in this research for to find operational efficiency of airlines.

Because the existence of uncertain situations in civil aviation industry, airlines extremely require to take long term decision making. The reason for this decision makings are; cost factors such as fuel and labor, acquisition and order of aircrafts, establishment of facilities and improving of route planning with adding new destinations are the factors that constituted by one and multi-year planning. The intensive use of capital assets is essential for buying and leasing of aircraft and construction of facilities, so capital cost is important for taking long term plans for decision making. With using operational strategies in an effective way, it is possible to decrease the capital cost and making more profit for airlines.

Environmental and safety concerns are also have big importance. For instance, low noise and fuel emission indicators are specified as prerequisite for broaden the service level at numerous airports (Schefzyk, 1993: 303). Tunstall-Pedoe et all. (1996) have dissertated these issues of environmental factors which include environmental and social responsibities of airports, so these subjects have also big importance for airlines' efficiency. Also Janić (1999: 165) generally examined the external environmental factors in civil aviation industry for to examine operational efficiency of airlines.

To sum up all details, all the informations above related with operational efficiency of airlines. Operational efficiency means to analyze uncertain conditions such as fuel, labor prices, acquisition and order of aircrafts with the factors of paid passenger (000), paid passenger KM (Million), number of aircraft touchdowns related with landing. It is important to solve these variables for creating profitable status for airlines.

2. LITERATURE REVIEW

There are lots of researchs about operational factors in airlines and also for airports. First of all, Upham (2001a: 239) confronted the theory of sustainability between UK and European Airports' with the terms of policy and practice. Furthermore, Upham debated the social concerns matched the definition of environmental capacity of civil aviation industry (Upham, 2001b: 226; Upham et al., 2003: 147). Hooper and Lever (2002: 23) analyzed restricted rate of environmental reporting doing by airlines for taking currently notices and authorizes corporate stakeholders.

Commercial airport and airlines' sustainability and environmental reports are generally examined. Both sustainability and environmental

reports include theme-based informations segmentating the grades of circumstances which apply for mitigation surveys, ecological environmental quality, wastes and lower level models of resource consumption (Upham and Mills, 2005: 170). Furthermore they are seen as irrelevant, sustainability and environmental factors affect the level of operational success of airlines as a whole.

Supporting the necessity of long term decision making generally evaluates in two categories and an airline enters one of these two categories. The first dominant category is classical strategy that directs strategic parameters. These are; core focus on business, load factors, internalization and productivities in wide framework with the concept of regulations (Frentz, 1992: 419; Levine, 1987). The another essential category is the research of productivity that operates econometric methods to evaluate the productivity of airlines, generally compare with its competitors (Caves, Christensen and Tretheway, 1983: 316; Cornwell, Schmidt, and Sickles, 1990: 189). Flight delay is a critical issue that has taken rising caution in the United States. In January 2019, nearly one in four US airline flights arrived at its destination over 15 min late (BTS, 2019).

Quarter of these late arrivals were a consequence of insufficiency in aviation system to process the traffic demands that were established onto it, however, the other quarter effected from interior airline troubles. The majority of the residual was caused by aircraft' late arrival and by the way the departing of the aircraft should be late on its following flight (BTS, 2009). After the 9/11 attacks between the years 2002 and 2007, civil aviation industry rescued with the increment of scheduled airline flights with an average of 22 %. However, late arrived flights were increased more than doubled. Beginning from 2007, delays about air traffic have decreased by the effect of recession. Federal Aviation Administration (FAA) specified that air traffic flight number reached the expectation number of 2012 at the year of 2007. With this growth trend, air transportation have increased the number of passengers with high percentages such as more than %30 by 2025 (Zou and Hansen, 2012: 1035). Civil aviation industry had been in financial crisis after the events of September 11, 2001. In last quarter of the years 2001 and 2002 a new period has grown up which named as Low Cost Revolution in civil aviation industry, however, this strategy was found with Ryanair in 1991.

There are two types of transportation model in civil aviation industry. These are; national flag carriers' (like Turkish Airlines, Lufthansa, British Airways) model also named ad full service transportation strategy and other secondary airlines model also named ad low cost transportation strategy (like Pegasus, Ryanair, EasyJet). Before 21st century flag carriers also defined

as full service carriers or legacy carriers were in high importance. However in 21st century, this situation was changed and low cost carriers has been a sample of national flag carriers exclude international transportation which are extended range flights (long range and oversea flights). So, national flag carriers reevaluate their strategies and by this way changed their proper structure. For national flag carriers' majör perceived area of cost savings is passenger services which includes; meals, drinks and other services to passengers as part of their fare. As well as, this cost savings include meals or accommodation of transit for delayed passengers. LCC' strategy is having cost savings in passenger services such as; cold and hot meals, drinks and other services as a part of paying fare for them that is about the comfort level of passengers. The other advantages of LCC are; low ticket prices and potential savings from cost of sales more than full service carriers (Scheraga, 2004: 51). In addition to these strategies, LCC' sell their products and services on their web sites that is related with passenger comfort by adding extra payments to the tickets (Doganis, 2001).

In LCC model the significant factors that affected passenger intentions does not examined in detail because in this model cheap ticket fare strategy is important. To reach a more successful LCC model like Ryanair, airlines should find reasons which affected passenger decisions in a more detailed way. Decision making processes should be well done and enforceable. In this way, LCC model has similarities between FSC model. These similarities are; service expectancy, service perception, service worth, passenger pleasure, airline image and behavioral intentions. These factors are confirmed the status of an airline as can take outcomes and get feedbacks from passenger intentions in a planned system (Chiou and Chen, 2010: 226).

Civil aviation industry declined substantially primarily in the USA and all over the world during the economic recession which affected many nations. First of all, business industry was affected from this international economic recession which end up with significant reduction in foreign currencies. Civil aviation industry has affected primarily from all economic crisis and developments all over the world simultaneously (Neal and Kassens-Noor, 2010). The first decade of the 21st century was a period overlapped as a session of development for LCC model and reduction for FSC model (Goetz and Vowles, 2009: 254). Primarily, LCC model focused on leisure passengers that travel for the purpose of holiday, spare time and entertainment. However, LCC model also seized the business passengers that travel for the purpose of labour, working and significant job descriptions. Especially, this trend has been more evident in European countries and Brazil which has the growing country in civil aviation (Huse and Evangelho, 2007: 261). During regressions when business passengers' price susceptibility rises, this situation directs business passengers to be close to leisure passengers

related with their purchasing decisions. In this way, LCC model charms business passengers and these passengers start to intrude the market niche anciently commanded by FSC model (Mason, 2007: 302).

The strategic collation among FSC and LCC model is firstly related with fare of tickets. LCC model airlines are mainly characterized by an integration avoid from implementing use of network effects. They carry out point to point strategy instead of network strategy. While FSC model airlines use the centre airport of a country like Heathrow for United Kingdom, Schiphol for Netherlands, Barajas for Spain; LCC model airlines use the secondary airport of a country like Charleroi for Brussels, Hahn for Frankfurt and Standted for London. LCC model airlines' mission is applying inexpensive costs, decrease delays, shorter turnaround times (the time which an aircraft stand in the apron before taking off) and lower distribution costs than FSC model airlines (Bieger, Döring and Laesser, 2002: 53).

Table 1. Strategic Comparison Between FSC and LCC Models

	FSC Model Airlines	**LCC Model Airlines**
Business Model	Global strategy and high costs.	Niche strategy and low costs.
Network	Hub & Spoke Strategy and Centre Airports with Global Alliances.	Point to Point Strategy and Secondary Airports.
Fleet	Various types of aircrafts such as wide body aircrafts for long haul flights and narrow body aircrafts for short haul flights.	Standardization in types of aircrafts such as one to three types narrow body aircrafts for solely short haul flights.
Product	Full Service Strategy with high comfort service level.	Low Cost Strategy with low comfort self service level.
Sales Policy	Global Distributions System (GDS), sales departments, direct sales, call centres and internet.	Sales departments, direct sales, call centres and internet.

(Keller, 2002: 17).

3. METHODOLOGY

In this article; paid passenger KM (Million) was taken as dependent variable, number of aircraft touchdowns and paid passenger (000) were included as independent variables. Quarterly data were collected from Turkish Airlines, between the years of 2005-2019. In order to examine the relationship between dependent and independent variables, binary line graphs were used. The stability of the series was examined by ADF (Augmented Dickey Fuller) test. In order to decide the correct model, the cointegration properties were tested and the vector error correction model was adopted. Model assumptions were examined by using Portmanteau test for autocorrelation, Lomnicki-Jarque-Bera test for normality and ARCH-LM test

for non-homogeneity of variances. In order to measure the effect of any variable in the model, Impact-Response functions and Variance Separation methods were used. The model assumptions were met and the prospective estimation was made with the conditional expectation method.

3.1. General Information

The concept of cointegration can be defined as a common movement between economic variables in the long run. Technically according to Engle-Granger (1987: 254), each of the variables are integrated at the level I. The linear composition of the series can be stationary, though the series are not stationary by level. If the series is not stationary, the linear composition is stationary then the error correction models need to be established because the standard Granger causality inferences will be invalid. Before applying Granger causality tests, the co-integrated features of the original series must be tested (Çetintaş, 2004: 25).

Diagnostic tests can be used to check the assumptions and characteristics of the model. These tests are suitable for testing autocorrelation, normality and heteroscedasticity assumptions. Portmanteau test for autocorrelation of residues; portmenteau statistics are used for autocorrelation of residues. Lomnicki (1961) and Jarque & Bera (1987) proposed a test on skewness and kurtosis, in other words, based on the 3rd and 4th moments on normality. ARCH-LM test is a popular test for heteroskedasticity. It is also used to estimate the residues of the ARCH (q) model. The effect response functions obtained from VAR models that are used to examine the effects of shock to one of the variables in the system. Any shock to a variable in the system spreads not only directly to the variable in question, but also other internal variables thanks to the dynamic nature of the VAR model (latency times). The effect-response functions follow the effects of a one-time shock on one of the changes to the present future values about the internal variables. In other words, the effect response functions show the dynamic response of each variable in the VAR model to structural shocks when they occur.

The variance decomposition of the prediction error is used to analyze extent changes in a series are caused by their shocks and other variables. As a result, variance decomposition of prediction error is a tool that used to measure the effect of other variables on any variable within the system (Köse and Saraçoğlu 1999: 16). R program uses conditional expectation method when forecasting. Probability distribution gives information about measurement and random process. In most cases, it is more useful to make a single estimate to observe the new perception of the process. The conditional expectation makes the best estimate with the least squares mean.

4. FINDINGS

Paid Passenger KM (Million) is determined as dependent variable. Number of Aircraft Touchdowns and Paid Passenger (000) are determined as independent variables for application.

Paid Passenger Km (Million)' Relationship Between Other Variables

Paid Passenger KM (Million) showed an increasing trend between 2005-2019 and decreased in the last quarter of each year. Seasonal difference will be taken for seasonally adjusted series.

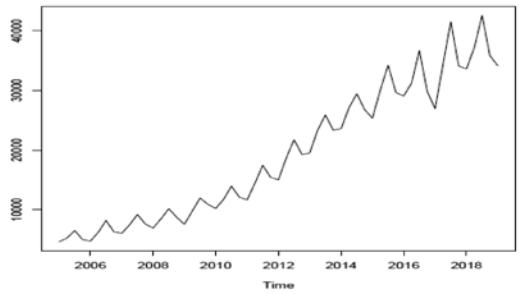

Chart 1. Passenger Paid Km (Million)

The Passenger KM (Million) is given with the graphs that showing the change over time and the relationship between other variables used in the model. Variables were standardized to observe these variables in the same graph (The standardization process does not disrupt the overall course of the series).

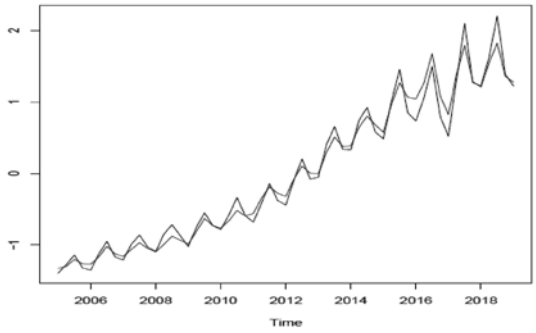

Chart 2. Passenger Paid Km (Million) Between Passenger Paid Relationship Chart

Passenger Paid KM (Million) between Passenger Paid Relationship Chart have similar trend.

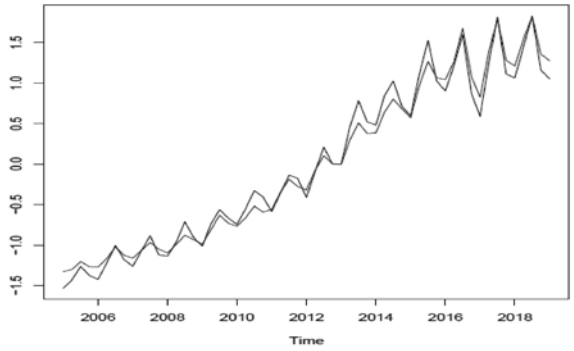

Chart 3. Passenger Paid Km (Million) Between Number of Aircraft Touchdown Relationship Chart

Passenger Paid KM (Million) between Number of Landings Relationship Chart have similar trend.

4.1. Determination of the Model

After examining the general structure of the variables, the model is determined based on the given theory. This section will focus on testing the stability of the series and investigating the existence of cointegration. In the light of these findings, model selection and predictions will be made. All these analyzes were performed by using R program. Used critical values are the automatic outputs of the R program (Praff, 2008).

4.2. Stability Tests and Number of Suitable Delays

Augmented Dickey-Fuller test was used to investigate the stability of the series. In order to solve the autocorrelation problem, it was stated that the delays of dependent variable were added to the right of equation, so the test applied to a new model called ADF test. This test was based on Said and Dickey (1984). The authors developed this test based on the problems arising from autoregressive time series in their articles. Their articles were theoretical based on the proof of assumptions and theorems. As can be seen in the table below, the null hypothesis is rejected at the 0,05 level of significance. It is seen that differences of the variables are stationary.

Table 2. Differences of the variables

VARIABLES	DELAY NUMBER	P-VALUE
s_ks	0	<0,001
s_uy	0	<0,001
s_uy^2	0	<0,001

s_ks (standardized number of landings)
s_uy (standardized passenger paid)
s_uy^2 (standardized passenger paid km)

When determining the appropriate lag length after stasis tests; Likelihood Ratio Test (LR), Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SC) and Hannan-Quinn Information Criteria (HQ) were used. The optimal lag length is determined by the smallest value in all tests except the LR test. The LR test is found by testing the likelihood ratio statistic with the determined significance level. The appropriate lag length should be short enough not to cause loss of information about the interaction of the series, but long enough not to cause autocorrelation between error terms (Kasapoğlu, 2007: 53). As mentioned before, the R program was used in the tests. The program gives the results of AIC, HQ, SC and FPE tests. The optimum lag length was found to be 6 in these tests using VAR model structure for this data set, however, the number of delays were determined as 2 considering the low number of data and the structure of the variables. After the cointegration analysis series were measured, the relevance of error series were tested.

4.3. Determining The Suitable Model

In the table below, r indicates the number of cointegration equations. The hypothesis is rejected because the test statistic is small for r = 1 at 5 % significance level. The presence of cointegration is mentioned. For this reason, the vector error correction model was made.

Table 3. Cointegration Test Results

	Test	10pct	5 pct	1pct
r<= 2	2,19	6,50	8,18	11,65
r<=1	10,93	15,66	17,95	23,52
r= 0	42,88	28,71	31,52	37,22

As a result of the obtained results, a VECM was formed with r = 1 cointegration vector. The delay number of the model is taken as 2 as mentioned before. The assumptions of the model are observed in the following results: Since

the p-value = 0,709 portmanteau test (autocorrelation of residues), the null hypothesis cannot be rejected. So there is no autocorrelation between residues. In another hypothesis, arch test (heterokedasticity) is p-value = 0,220. The null hypothesis cannot be rejected and assumption is provided. Finally when the normality test is performed, the JB test p-value = 0,959 null hypothesis cannot be rejected. So, the assumption is provided. Accordingly, the effect-response functions and variance decomposition results can be examined for the interpretation of the model.

4.4. Results of Effect-Reaction Function

It is very difficult to interpret the predicted coefficients in this model. Therefore, in order to interpret the results of the model, effect-response function graphs which are graphical representations of the responses about variable shocks are used. The effect-reaction function graphs are obtained from the vertical axis. The direction and magnitude of the response of other variables show an increase at the standard deviation that reacts to the relevant variable. The shock is given the horizontal axis in 12 month period. Red dashed lines represent ± 2 standard error confidence intervals for the reaction of the variables and play an important role in determining the statistical significance of the results. The lower and upper band showed the same sign indicating that the reaction was statistically significant at 95 % confidence level. The straight lines in the graphs represent the point estimates of the effect-reaction coefficients and the dashed lines represent the confidence intervals. In order the findings to be accepted as reliable, both confidence intervals must remain in the region above (or below) the zero band. Therefore, the evaluations in the research were made only if the confidence intervals were in the same region (the effect-reaction coefficients were significant within the confidence intervals). As a result of the surveys show in chart 4.

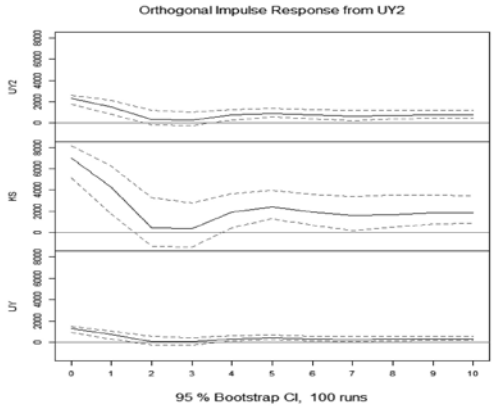

Chart 4. Orthogonal Impulse Response

While the number of Paid Passengers (000) and the number of aircraft touchdowns reacted positively to the shock given in the short term. Paid Passenger KM (million) lost its reaction to the Paid Passenger (000) in the long term. However, after losing a short period of reaction for the number of aircraft touchdowns, the reaction is seen in the long term.

4.5. Variance Seperation of Forecast Error

The effect of independent variables on Paid Passenger KM (Million) can be seen by separating the variance of prediction error. The variance decomposition of prediction error is used to analyze to what extent changes in a series are caused by their shocks and by what other variables. Variance decomposition is used to determine the effect of other variables on a surprise shock that occurs in any of the variables. This is an expression of how many percent of a shock unit occurred in one variable is caused by the changes in other variables. As it can seen in chart 5.

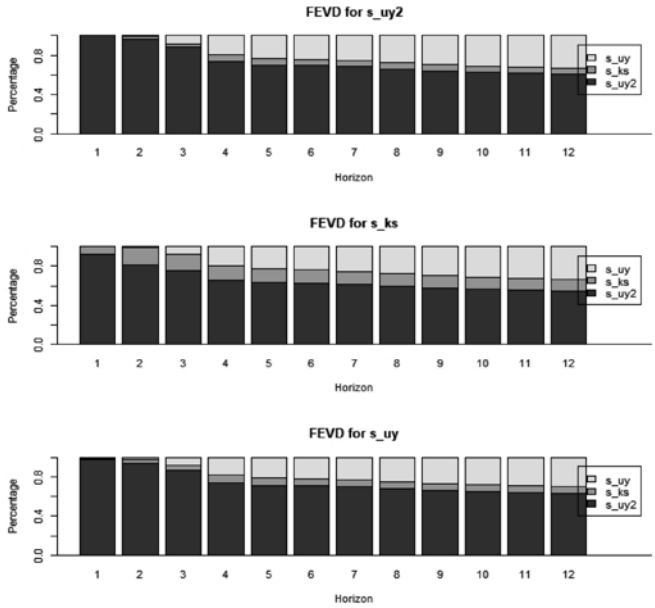

Chart 5. Variance Decomposition of Variables

Paid Passenger KM (Million);

In the first period, 100 % of the variance is explained by its own past shocks. In the 2nd period, the number of strokes explains 3 % of the variance. In the long run, the passenger (000) explained 20 % in the 4th period, while this rate has increased to 30 % in the 10th period.

Number of Aircraft Touchdowns;

In the first period their past shocks explained a large part of the variance, while in the long term the effect of Paid Passenger (000) and Paid Passenger KM (Million) increased gradually.

Paid Passenger (000);

In the first period their past shocks explained a large part of the variance, while in the long run the number of touchdowns and Paid Passenger KM (Million) effect increased gradually.

5. DISCUSSION

3-quarter forecast was made with the model created. More accurate results will be obtained in the short term when the value of the Passenger KM (Million) is announced for each quarter and added to the model. Accordingly, Q2, Q3, Q4 estimates can be made. Prediction results are as follows. The predicted values are within the 95 % confidence interval. Looking at the forecast graph, it can be said that the Passenger KM (Million) will increase in Q2 and Q3 and decrease in Q4.

	Prediction Value	% 95 Confidence Interval Lower Limit	% 95 Confidence Interval Upper Limit
2019 Q2	37444,47	32919,17	41969,77
2019 Q3	39219,25	33732,34	44706,16
2019 Q4	39117,09	33327,59	44906,58

Chart 6. Prediction Results

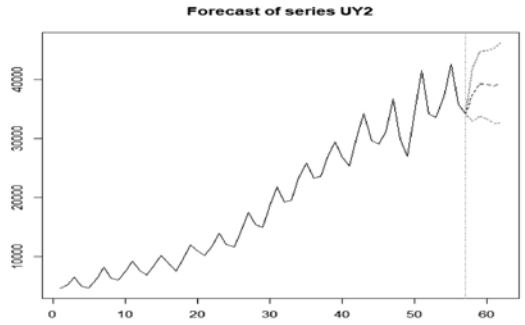

Chart 7. Prediction Graph

6. CONCLUSION

In the operational reports of airlines which have published in three month period, it is examined five operational variables to show data and informations about the airlines' situation to the public. In this research, it is examined three of them. The remaining variables which excluded are available seat kilometer and load factor that defines the occupancy rate. These two factors are related with passenger paid kilometer, passenger paid and number of aircraft touchdown that defines the airlines' performance measurement of operational activities. Because of this, it is not used these two variables in the article. The other three variables' measurement is directly related with operational efficiency of airlines. The reason for selecting these factors is ponderability. Passenger paid kilometer is related with amount paid per ticket for each flight multiplied with total kilometer departed for each flight.

For instance; it is determined two destinations one is İstanbul to Ankara with a total distance of 300 km and 180 passenger with a seat capacity of 200 people, the another destination is Ankara to London with a total distance of 3000 km and 160 passenger with a seat capacity of 200 people again. When it is done a simple calculation, the average people is 170 and it shows a % 85 occupany rate. If we multiple the distance with the total passenger, it is found a occupancy rate of % 80,9.

The other variable passenger paid is about amount per ticket for each flight by evaluated only with ticket prices per passenger. The last variable number of aircraft touchdown is about in daily, weekly, monthy and yearly the total number of aircraft landed for the selected airport. When the total number of landing is increased then passenger paid kilometer (million) and passenger paid (000) are increased too. By the way passenger paid kilometer is related with operation and finance, because of this it is selected as independent variable. Passenger paid and the number of aircraft touchdown is related solely with operation, so these parameters are selected as dependent variables. The relationship between these three variables show the success of operational efficiency in airlines. If these three variables are increased at the same time, the operational efficiency of an airline is increased too. When only one variable is decreased, then operational efficiency is decreased too.

All the three variables are increased in the first 3 quarter and decreased in the last quarter. This situation shows a gradual trend between these three variables from the years of 2005 to first quarter of 2019. At the prediction results and graph table, second, third and fourth quarter of 2019 will be the same trend of previous years. However, in this research it is found a

different scenerio. This scenerio is standardized number of landings (s_ks) that define the variable number of total touchdowns is different from other two variables. This difference is in the first quarter when all the variables are increased, number of total touchdown variable is increased but not in the same trend. Because between the months of january to march, the weather conditions are bad. So, in the first quarter too many aircrafts can not take off and land because of bad weather conditions. By the way, this situation is created a lack of operational efficiency for civil aviation industry. In this research it is found that independent variable of number of landings (s_ks) has negative effect to operational efficiency, but this damage is not noteworthy to affect the ascending trend.

REFERENCES

- BIEGER, T., DORING, T. & LAESSER, C., (2002), **Transformation of business models in the airline industry - impact on tourism**, *Air Transport and Tourism, AIEST, 44,* 49-83.
- CAVES, D. W., CHRISTENSEN, L. R. & TRETHEWAY, M. W., (1983), **Productivity performance of US trunk and local service airlines in the era of deregulation**, *Economic Inquiry,* 21 (3), 312-324.
- CHIOU, Y. C. & CHEN, Y. H., (2010), **Factors influencing the intentions of passengers regarding full service and low cost carriers: A note**, *Journal of Air Transport Management,* 16, 226-228.
- CORNWELL, C., SCHMIDT, P. & SICKLES, R. C., (1990), **Production frontiers with cross-sectional and time-series variation in efficiency levels,** *Journal of econometrics,* 46 (1-2), 185-200.
- ÇETİNTAŞ, H., (2004), İhracat ve Ekonomik Büyüme, *Dokuz Eylül Ünv. İşletme Fak. Dergisi,* 5 (1), 23-34.
- DOGANIS, R., (2001), **The Airline Business in the 21st Century, London, England and New York,** *New York; Routledge.*
- ENGLE, Robert F. & GRANGER, Clive W. J., (1987), **Co-integration and error correction: Representation, Estimation and Testing, Econometrica**, 55 (2), 251-276.
- FRENTZ, M., (1992), **Deadalus 1992, Strategische Wettbewerbsvorteile der Luftverkehrsindustrie im liberalisierten Europaischen Markt'**, *Zeitschrift für Betriebswirtschaft,* 62 (4), 415-434.
- GOETZ, A. R. & VOWLES, T. M., (2009), **The good, the bad and the ugly: 30 years of US airline deregulation,** *Journal of Transport Geography,* 17, 251-263.
- HOOPER, P. D. & LEVER, M., (2002), **Corporate environmental reporting in the airline sector: A route to stakeholder empowerment?**, *In 10th Greening of Industry Network Conference, Gothenburg,* 23-26.
- https://www.transtats.bts.gov/ot_delay/ot_delaycause1.asp, (Accessed on: Erişim Tarihi: 03.04.2019).
- https://www.transtats.bts.gov/ot_delay/ot_delaycause1.asp, (Accessed on: Erişim Tarihi: 03.04.2019).
- HUSE, C. & EVANGELHO, F., (2007), **Investigating business traveller heterogeneity: Lowcost vs. service airline users?** *Transportation Research Part E: Logistics and Transportation Review,* 43, 259-268.
- JANIĆ, M., (1999), **Aviation and externalities: The accomplishments and problems,** *Transportation Research Part D: Transport and Environment,* 4 (3), 159-180.
- KASAPOĞLU, Ö., (2007), **Parasal Aktarım Mekanizmaları: Türkiye İçin Uygulama**, Uzman Yeterlilik Tezi, 53-56.

- KELLER, P., (2002), **Introduction: Air Transport and tourism: Strategic issues**, *Air Transport and Tourism, AIEST,* 44, 13-23.
- KORKMAZ, T. & UYGURTÜRK, H., (2008), **Türkiye'deki Emeklilik Fonları İle Yatırım Fonlarının Performans Karşılaştırması ve Fon Yöneticilerinin Zamanlama Yetenekleri**, Kocaeli Ünv. Sosyal Bilimler Ens. Dergisi, 15 (1), 114-147.
- KÖSE, N. & SARAÇOĞLU, B., (1999), **Vektör Otoregresyon Yaklaşımı ile Enflasyonla Mücadelede Politika Seçimi: Türkiye Örneği 1980-1996,** İktisat, İşletme ve Finans, 159, 12-27.
- LEVINE, M. E., (1987), **Airline Competition in Deregulated Markets: Theory,** *Firm Strategy and Public Policy,* 4.
- MASON, K. J. & ALAMDARI, F., (2007), **EU network carriers, low cost carriers and consumer behaviour: A Delphi study of future trends,** *Journal of Air Transport Management,* 13, 299-310.
- SCHEFCZYK, M., (1993), **Operational performance of airlines: An extension of traditional measurement paradigms,** *Strategic Management Journal,* 14 (4), 301-317.
- SCHERAGA, C. A., (2004), **The relationship between operational efficiency and customer service: A global study of thirty-eight large international airlines,** *Transportation journal,* 48-58.
- TUNSTALL PEDOE, N., RAPER, D. & HOLDEN, J. (Eds.), (1996), **Environmental management at airports: Liabilities and social responsibilities**.
- UPHAM, P., (2001a), **A comparison of sustainability theory with UK and European airports policy and practice,** *Journal of Environmental Management,* 63 (3), 237-248.
- UPHAM, P., (2001b), **Environmental capacity of aviation: Theoretical issues and basic research directions,** *Journal of Environmental Planning and Management,* 44 (5), 721-734.
- UPHAM, P. J. & MILLS, J. N., (2005), **Environmental and operational sustainability of airports: Core indicators and stakeholder communication,** *Benchmarking: An international journal,* 12 (2), 166-179.
- UPHAM, P., THOMAS, C., RAPER, D. & GILLINGWATER, D., (2003), **Environmental capacity of airports: Operational issues and prospects,** *Journal of Air Transport Management,* 9 (3), 145-151.
- ZOU, B. & HANSEN, M., (2012), **Impact of operational performance on air carrier cost structure: Evidence from US airlines,** *Transportation Research Part E: Logistics and Transportation Review,* 48 (5), 1032-1048.