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An Empirical Research on The Factors Affecting Profitability in Air Transportation[1]

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Hava Taşımacılığında Kârlılığı Etkileyen Faktörler Üzerine Ampirik Bir Araştırma[2]

Abstract

This study aims to analyse the impact of traditional airline companies' internal and external environmental factors on profitability. In total, 17 airlines operating in different regions were included in the study. Passenger load factor, cargo ton-km and the number of destinations were chosen as internal factors affecting the profitability of airlines. GDP, oil prices and exchange rate figures were external environmental factors affecting profitability. Panel ARDL analysis method was used in the study. In the model of the study, all variables were analysed together without division. All selected variables have been observed to affect airline profitability, and the effect of external environmental factors on profitability is more significant.

Keywords : Airline Transportation, Profitability, Internal Factors, External Environment, Panel Data Analysis.

JEL Classification Codes : G31, L93.

Öz

Bu çalışmanın amacı, geleneksel havayolu şirketlerinin iç ve dış çevresel faktörlerinin kârlılık üzerindeki etkisini analiz etmektir. Toplamda dünyanın farklı bölgelerinde faaliyet gösteren 17 havayolu çalışmaya dahil edilmiştir. Havayollarının kârlılığını etkileyen içsel faktörler olarak yolcu yük faktörü, kargo ton-km ve destinasyon sayısı seçilmiştir. Kârlılığı etkileyen dış çevresel faktörler olarak GSYİH, petrol fiyatları ve döviz kuru rakamları kullanılmıştır. Çalışmada Panel ARDL analiz yöntemi kullanılmıştır. Araştırmanın modelinde tüm değişkenler bölünmeden birlikte analiz edilmiştir. Sonuç olarak seçilen tüm değişkenlerin havayolu karlılığı üzerinde etkisinin olduğu, ayrıca dış çevre faktörlerinin kârlılık üzerindeki etkisinin daha fazla olduğu gözlemlenmiştir.

Anahtar Sözcükler : Havayolu Taşımacılığı, Kârlılık, İçsel Faktörler, Dış Çevre, Panel Veri Analizi.

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[2] *Bu çalışma THK Üniversitesinde Doç.Dr. Yaşar Köse danışmanlığında, 14.07.2021 tarihinde Emre Yılmaz tarafından savunulan "Hava Taşımacılığında Kârlılığı Etkileyen Faktörler Üzerine Ampirik Bir Araştırma" başlıklı doktora tezinden türetilmiştir.*

1. Introduction

From a broad perspective, the aviation industry consists of a global system of commercial airline companies, airports, fuel companies, air navigation service providers, aircraft manufacturers, and aircraft maintenance companies. Air transport is a dominant sector that connects the national economies, enables the wheels of the global economy to turn, creates jobs for millions of people and contributes to the quality of modern life.

Globally, air transport provides services to almost every country and forms an important part of the global economy. Airline transportation attracts more people's attention than other sectors in terms of the economic contribution it has created in the fields of tourism, trade, employment and the amenities it offers to people.

Air transport is highly competitive and has low profit margins compared to other sectors. On the other hand, air transport has an oligopoly market structure despite the liberalisation practices whose market structure is getting deeper and broader (Wensveen, 2011: 177). In oligopoly markets, there is a relationship of interdependence between firms. And firms influence each other through their decisions. For this reason, it is claimed that airline companies stay away from price competition (Vasigh et al., 2018: 81). It is also one of the sectors most affected by adverse events such as political, economic, terrorism, epidemic, etc. For example, the terrorist attack on September 11, 2001, the global economic crisis of 2008, and the latest Covid-19 pandemic have deeply affected the airline industry. Considering these explanations, it can be argued that air transport is a difficult sector to manage. Predictable and long-term profitability is the most critical factor for businesses to continue their activities. Therefore, the profitability of airline companies has been put under the spotlight within the scope of the study. In the study, the data of seventeen traditional airline companies for 2003-2019 were examined using panel data analysis to analyse the profitability of airline companies.

In the scope of the study, the analysis method and diagnostic tests will be included after the literature review. In the last section, the test results obtained by the panel data analysis method will be shared and interpreted in detail.

2. Literature Review

Oum and Yu (1998) used annual data to examine the profitability of 22 major airlines for the period 1986-1995 with the APC (American Productivity Center) model. This study analysed the effects of changes in airline transportation, efficiency increases and profit margins on airline profitability. In the APC model, profitability is calculated as the ratio of sales revenue to the total cost of inputs. As a result, it is seen that there are significant decreases in price recovery rates over the ten years. To counteract such trends, airlines increased their profitability in the 1990s by continually raising the efficiency ratio (Oum & Yu, 1998).

Wen (2012) used the data envelopment method to examine the financial performance of thirty-eight international airlines operating in North America, Europe, Latin America, Asia and the Middle East. Load factor, operational income from passenger transportation, ratio of total income to scheduled income, indirect costs, tangible fixed assets and speed of transfer of receivables were used as variables. The study showed the importance of reducing expenses and high load factors on scheduled flights (Wen, 2012).

Brown (2016) researched 15-year data from 46 airlines. EBIT (pre-tax profit) was determined as the dependent variable. The explanatory variables of the study were defined as gross domestic product, tangible fixed assets, airline's liquidity, age and size, airline's political connections and expenses incurred for lobbying activities. The study used fixed and random effects models separately, and a positive relationship was found between explanatory variables and profitability. It has been understood that the contribution of political and lobbying activities is significant for airlines (Brown, 2016).

Gramani (2012) proposed a two-stage data envelopment analysis approach to examine airlines' operational and financial performance in their study. The study analysed the annual data of 34 airlines from Brazil and the USA from 1997-2006 by panel data method. As explanatory variables, the load factor was determined as paid passenger mileage (km), unit expenses per seat, offered seat mileage (km), fuel expenses, personnel expenses and social benefits. As a result of the study, it has been argued that operational performance is better than financial performance in emerging markets. Still, an increase in operating performance only sometimes contributes to financial performance. In addition, the correlation between operational and financial performance was found to be 0.49 in Brazilian airlines and 0.60 in US airline companies (Gramani, 2012).

Using Granger's causality test, Fernandes and Pacheco (2010) study the causality relationship between economic growth and domestic air passenger transportation in Brazil. The economic growth rates of gross domestic product with the demand for total domestic passenger-kilometre air transportation were used. As a period, the study covers the years 1966-2006. As a result, it has been determined that there is a one-way Granger causality relationship between economic growth and domestic air transport demand in Brazil and that it has high flexibility in the short term (Fernandes & Pacheco, 2010).

Zou and Chen (2017) examined how codeshare strategies and their structural placement in global alliances can affect airline performance. Using a dataset compiled from the annual reports of Flight Global and Airline Business, the study empirically investigated the impact of code-sharing partnerships and global alliances on airline profitability. According to the results based on a group of 81 airlines in the period 2007-2012, it showed that the profit margin of an airline is positively related to the number of code-share partners it had. In addition, as the share of an airline in the same global alliance increases, the profit margin from code sharing also increases (Zou & Chen, 2017).

Scotti and Volta (2017) examined the airline profitability change through the Bayesian cost function estimator. It was a study of the 53 worldwide largest airlines between 1983-2010. As a result, continuous productivity improvement has been observed since the early 1990s due to technological change. Also, it has been determined that the most crucial reason for the fluctuation in profitability over the past decade was the change in input prices. It has been evaluated that the increase in output prices is lower than the increase in input prices, and the reason for this was that some of the gains from efficiency were transferred to consumers. In general, it has been estimated that the cost-effectiveness increased from 0.67 in 1983 to 0.73 in 2010, with an average cost-effectiveness of 0.7 (Scotti & Volta, 2017).

Douglas and Tan (2017) examine whether the expansion in network access due to establishing global airline alliances has increased profitability among the founding members. In the study, the profitability of airlines was examined in two groups: pre-alliance and post-alliance periods. In this study, the difference in difference analysis was applied. Various airline-level, country level and global-level variables were included as control variables in the study. The study found no evidence that forming global alliances increases airlines' profitability or provides an economic advantage. (Douglas & Tan, 2017).

Uygur (2019) examined the macroeconomic effects of the eight countries determined between 1991 and 2018 on air transportation using the panel data method. A total of 7 variables were used, including the number of passengers transported annually, ton kilometre transported, carbon dioxide emissions, total number of flights, inflation rate, employment rate and gross domestic product ratio belonging to the relevant countries. The study examined the short- and long-term relationship between variables using the Panel ARDL method. Two different analyses were performed in the study. The dependent and explanatory variables are different in both analyses. A positive and significant relationship was found between the number of passengers, economic growth, and employment rate, and a negative and significant relationship with the inflation rate. (Uygur, 2019).

Xu et al. (2021) examined the profitability of airlines using LASSO analysis. They used quarterly profitability figures for the three largest airlines in China and data on exogenous factors. The result of the study is, in general, as follows. Despite the steady increase in China's gross domestic product per capita, it has been found that this has yet to have an absolute impact on the profitability of airlines. The main reason for this has been suggested as the increase in fuel prices. In addition, the exchange rate has been identified as a critical determinant of the profitability of Chinese airlines. (Xu et al., 2021).

Abbey (2016) examined the impact of hedging practices on profitability and, if any, its degree in airline businesses. This study analysed only the use of hedging for fluctuations in fuel prices. The quarterly profitability data of the hedged and unhedged airlines for 2001-2012 were analysed and compared using the time series method. As a result of the study, it was found that hedging practices significantly impact operating profit, and there are fewer fluctuations in profitability. It has also been determined that hedging practices were a restrictive factor in obtaining maximum profit (Abbey, 2016).

Alahyari (2014) examined the return on equity of airline companies operating in Turkey. In his study, company size, annual growth rate, total debt to total assets ratio, and liquidity ratio were chosen as explanatory variables. As a result of the study, it has been determined that the growth rate and liquidity ratio significantly affect the airlines' profitability. In addition, the ratio of fixed assets to total assets negatively affects the profitability of airline companies (Alahyari, 2014).

Aderamo (2010) examined the micro and macro factors affecting the passenger, cargo and aircraft demand in Nigeria's national air transport between 1975 and 2006 using multiple regression methods. Among the explanatory variables, the agricultural production index, the manufacturing production index, the gross domestic product and the inflation rate were important in explaining Nigeria's air transportation demand. He also argued that the government should improve the transport system to promote domestic air transport demand (Aderamo, 2010).

In their research on OECD countries, Küçükönal and Sedefoğlu (2017) examined the relationship between economic growth, tourism and employment data for the years 2000-2013 obtained from the World Bank's data set and airline transportation using Granger causality analysis. As a result of the study, it has been determined that there is a one-way short-term causality relationship between economic growth, tourism, employment and air transport, and these factors play an important role in the growth of air transport (Küçükönal & Sedefoğlu, 2017).

Kiracı and Battal (2018) examined the relationship between Turkey's domestic passenger demand, international passenger demand and international cargo demand and Turkey's macroeconomic variables between 1983 and 2015 using the VAR analysis method. The findings obtained from the study have determined that the variables of income per capita, gross domestic product and consumer price index significantly affect domestic and international passenger demand. In addition, it was concluded that the variables of the gross domestic product and the industrial production index affected the demand for international cargo (Kiracı & Battal, 2018).

When we look at the studies in the literature, it is understood that the studies examining the profitability of the airlines in terms of both the sample and the explanatory variables used are in a limited area. While the studies in the literature explain profitability, they only focus on internal or external factors as explanatory variables. In addition, airlines of a region or a country were used as a sample. In this study, the profitability of airlines was examined by considering internal and external factors together. In this regard, it will fill this gap in the literature. In addition, leading airlines from different countries were included in the sample.

3. Data and Methodology

In this study, traditional airline companies were preferred among airline companies according to their business model. Flag carrier airlines of the countries that are prominent in air transportation globally are included in the analysis. The study sample consists of seventeen publicly traded airlines selected from different countries. The time dimension of the study is limited by the data for the years 2003-2019. For a more comprehensive analysis, airlines worldwide were included in the sample. The selected airlines are the most significant and best-known companies in their region. It aimed to have more airlines in the sample, but each company's data in the relevant years could not be reached. Therefore, the model was limited to 17 airlines. The data obtained for the analysis in the study were acquired from the financial statements, annual reports and World Bank Open Data published annually by the relevant airline companies. The list of airlines that are the subject of the study is given in Table 1.

Table: 1
Airline Companies Included in the Study

No	Airline Name	No	Airline Name
1	Turkish Airlines	10	S.A.S
2	Air France	11	Korean Air
3	Lufthansa	12	Japan Airlines
4	Air Canada	13	Singapore Airlines
5	Air China	14	American Airlines
6	Qantas Air	15	Aeroflot
7	British Airways	16	Delta
8	Emirates	17	LATAM Airlines
9	Iberia		

Table: 2
Abbreviations and Definitions of Variables

Variables	Symbol	Explanation	
EBITDAR	lnEBITDAR	Profit Before Tax, Interest, Depreciation and Rent.	The dependent Variable
Load Factor	LF	Revenue Passenger Km. / Available Seat Km.	Independent V.
Cargo Tonne Km	lnCTKM	Total weight of cargo transported * Transport Distance	Independent V
Flight Network	FN	Number of flight destinations	Independent V
Fuel Price	lnFP	Annual Average Price of Jet Fuel	Independent V
GDP	LnGDP	Gross Domestic Product	Independent V
Exchange Rate	LnER	Local currency value / Dollar	Independent V
2008 Crisis	DV	Dummy Variable	Independent V

The EBITDAR value of the 17 airline companies listed in Table 1 above for 2003-2019 was determined as a dependent variable. As explanatory variables, load factor, number of flown points, cargo ton-km value, fuel price, GDP and exchange rate were selected. As stated earlier, the panel data analysis method was used to measure the effect of the explanatory variables in Table 2 above on EBITDAR. The panel data method is a method in which time series and horizontal section analysis can be used together. Both time and cross-sectional dimensions are included in the study (Gujarati, 2011). The panel data method can be defined as gathering cross-section observations such as countries, firms, households, people, etc., within a certain period (Tatoğlu, 2013).

EBITDAR: It is the airline's profit before interest, tax, depreciation, and aircraft lease. Airlines generally give more importance to the EBITDAR value in their evaluations in terms of operational performance. For this reason, EBITDAR will be included in the analysis as a dependent variable in the study**.**

Load Factor (LF): An airline with high occupancy rates often generates high unit revenues and can maintain profitability. Load Factor, a measure of an airline's capacity, is the ratio between RPK (Revenue Passenger Kilometres) and ASK (Available Seat Kilometres).

Cargo Tonne Km (CTKM): Cargo transportation significantly financially contributes to airline companies. The contributions of air cargo transportation to the enterprises' profitability were considered. In this context, the cargo-tonne-kilometre variable was added to the model as one of the explanatory variables. Cargo ton-km is the distance in each flight leg multiplied by the weight of the cargo carried on these legs.

Flight Network (FN): Airline companies aim to increase their market share to compete with their competitors. One of the critical strategies they implemented in this regard was to expand the flight network. For this reason, the number of destinations to which the airlines fly has been added to the model as an explanatory variable. Within the scope of the study, the number of destinations declared by the airlines at the end of the year was taken as a reference.

Fuel Price (FP): Jet fuel cost is one of companies' most significant expenses. Therefore, the change in the fuel price can directly affect the air ticket prices. It also affects profitability. Within the scope of the explanations, the annual average fuel price published by the World Bank was added as an explanatory variable to measure the effect of the change in fuel prices on profitability.

Gross Domestic Product (GDP): Historically, it is clear that there is a close relationship between air transport and economic indicators. Along with economic growth, significant increases are experienced in passenger and air cargo demand. In addition, economic growth is an important indicator that airlines take as a reference in their investment decisions. To measure the effects of GDP on air transport, the annual GDP figures of the countries in which the airlines operate are added to the model as an explanatory variable in dollars.

Exchange Rate (ER): Since the aviation sector is international, airline companies use different currencies. Airlines make a significant part of their expenditures in foreign currency, and foreign currencies have a significant share in their revenues. For this reason, fluctuations in exchange rates can have a significant impact on the profitability of companies. To measure the effect above, the annual dollar exchange rates of the countries were added to the model as an explanatory variable.

2008 Crisis (Dummy Variable): Our data set is between 2003 and 2019. For this reason, it was added to the model as a dummy variable to measure the effects of the global crisis experienced in 2008 on airline transportation. Years of crisis were classified as 1.

4. Diagnostic Tests and Results

Various tests were performed to determine the most accurate estimator in this part of the study, and their results were reported. First, descriptive statistics and correlation tests related to variables are included. The descriptive statistics of the airline companies regarding the data for 2003-2019 are shown in Table 3 below. The total number of observations, average, standard deviation, minimum and maximum values of the airlines in the study are given in the table. In addition, the correlation results between the variables are shown in Table 4.

Table: 3
Descriptive Statistics

Variables	Observations	Mean	Standard Deviation	Min.	Max.
lnEBITDAR	289	21.34512	0.831938	17.97471	23.15547
LF	289	77.98125	4,801069	61,4	87,9
lnCTKM	289	4493,655	3316,676	370,182	13730
FN	289	2,068235	0,669796	0,871	3,08
lnFP	289	196,7059	103,9399	48	770
LnGDP	289	28.08339	1.336181	25.04930	30.69322
LnER	289	109,4702	285,9732	0,49977	1276,93
2008 Crisis	289	0,117647	0,322748	0	1

Table: 4
Correlation Test Results

	ebitdar	loadf	cartkm	destpoint	fuelprice	gdp	currency
lnEBITDAR	1.0000						
LF	0.4229	1.0000					
lnCTKM	0.7157	0.2474	1.0000				
FN	0.5349	0.4205	0.2433	1.0000			
lnFP	0.0621	0.2492	0.0338	0.0722	1.0000		
LnGDP	0.4042	0.2083	0.1507	0.5971	0.1373	1.0000	
LnER	-0.1151	-0.1384	0.2320	-0.2891	-0.0215	-0.1961	1.0000

4.1. Cross-Sectional Dependence Test Results

In this part of the study, it was tested whether there is a horizontal section dependence. Neglecting the horizontal section dependence in panel data analysis can cause significant problems with estimators' effectiveness and the results' reliability (Phillips & Sul, 2003). A cross-sectional dependence means a correlation between the decimals obtained for each unit that makes up the model. (Tatoğlu, 2017). In the panel data analysis, Robertson and Simons (2000), Anselin (2001), and Pesaran (2004) evaluated the necessity of horizontal section dependence tests in detail in their studies. (Breusch & Pagan, 1980; Pesaran, 2004).

When the literature is examined, it is seen that many tests have been developed to test the horizontal section dependence. Which test will be applied differs according to the time and cross-sectional size of the panel. In the panels where the time dimension is larger than the horizontal cross-sectional size (T>N) Breusch and Pagan (1980) LM test, in the panels where the time dimension is smaller than the horizontal cross-sectional size (T<N) Pesaran LM test is used to test the horizontal cross-section dependence. Pesaran (2004) developed the CDLM test, which is valid in both cases in terms of time and cross-sectional size (T>N or T<N) and gives results that have an average zero (Pesaran, 2004).

Although the group average was zero in the CDLM test developed by Pesaran in 2004, the average of each horizontal section in the panel differs from zero. Therefore, deviations may occur in the calculated results. Pesaran et al. (2008) corrected this deviation in the results by adding the variance and the mean to the test statistics (Mercan, 2014). This test deviation has been passed to the literature as a corrected LM test, the $CDLM_{adj}$ test. The mathematical equations of the CDLM and $CDLM_{adj}$ tests are shown in equations 1 and 2, respectively.

$$CDLM = T\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^{2} \frac{X_{N(N-1)}^{2}}{2} \tag{1}$$

After adding the variance and the mean to the CDLM test, the $CDLM_{adj}$ test statistics were created (Pesaran et al., 2008).

$$CDLM_{adj} = \left(\frac{2}{N(N-1)}\right)^{\frac{1}{2}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{p}_{ij}^{2} \frac{(T-K-1)\hat{p}_{ij}-\hat{\mu}_{Tij}}{\upsilon_{Tij}} N(0,1) \tag{2}$$

The hypothesis of the test H_0 and H_1 is as follows.

H_0: There is no horizontal section dependence,

H_1: There is a horizontal section dependence.

In Table 5 below, the LMCD test proposed by Peseran (2004) and Pesaran et al. (2008) $LMCD_{adj}$ (Bias adjusted LM) test results are included. As seen in the table, both test results are above the value of 0.05. In this case, no cross-sectional dependence between the units is established as the H_0 hypothesis is accepted.

Table: 5
Horizontal Section Dependence Test Results

	Test Statistics	P value
LM Adj#	0.1192	0.9051
LM CD#	-0.24	0.8140

*Notes: #: two-way testing, *** significant at 1%; ** significant at 5%; * significant at 10%.*

4.2. Unit Root Test Results

Many tests are developed to test the stationarity of series in panel data analysis. Which tests to choose from varies according to the horizontal section dependence test results. Therefore, the horizontal section dependence test was performed first. According to the horizontal section dependence test results, H_0, the hypothesis has been accepted, and it has been concluded that no cross-sectional dependence exists. As a result, the lack of cross-sectional dependence requires first-generation panel unit root tests to be performed. For this reason, the Fisher Extended Dickey-Fuller (Cross-Sectionally Augmented Dickey-Fuller) unit root test as the first generation has been applied.

Table: 6
Fisher ADF Unit Root Test Results

	Test Statistics	FISHER ADF		Test Statistics
	Constant	P Value	Constant +Trend	P Value
lnEBITDAR	0.0793	0.53	0.4815	0.68
LF	1.1131	0.86	-0.6509	0.25
lnCTKM	0.6257	0.73	0.4643	0.67
FN	1.0224	0.84	-1.1336	0.12
lnFP	1.0898	0.13	1.0694	0.85
LnGDP	-0.9889	0.16	0.6209	0.73
lnER	2.6236	0.99	2.1729	0.98
	Test Statistics	FISHER ADF		Test Statistics
	Constant	P Value	Constant +Trend	P Value
ΔlnEBITDAR	-11.9995	0.000***	-2.5292	0.005***
ΔLF	-4.0147	0.000***	-5.6420	0.000***
ΔlnCTKM	-6.2695	0.000***	-3.4158	0.000***
ΔFN	-4.2907	0.000***	-2.7066	0.003***
ΔlnFP	-2.3102	0.011**	-1.8838	0.031**
ΔLnGDP	-5.6637	0.000***	-0.6131	0.000***
ΔlnER	-5.1373	0.000.***	-6.0885	0.000***

*Notes: ***significant at 1%; **significant at 5%; * significant at 10%. The delay length was determined according to the SIC (Schwarz Info Criterion) criterion. Δ; denotes the first degree of difference of the series.*

H_0 The hypothesis is that all units contain the unit root.

H_1 The hypothesis is that at least one unit is stationary.

According to the first-generation Fisher ADF test results in Table 6 above, when the first difference of the series is taken, the H_0 hypothesis has been rejected. It is seen that the series are not stationary at level I(0), and after taking the first difference, the series are stationary in I(1).

4.3. Panel Cointegration Test Results

Cointegration in panel data analyses means a long-term relationship between the series that cannot be stationary at level I(0) and are I(1) stationary when the first difference is taken. The Kao cointegration test was preferred to test the existence of panel cointegration. The Kao Cointegration test results are shown in Table 7 below.

Table: 7
KAO Cointegration Test Results

	Test Statistics	P Value
Modified Dickey-Fuller t	-3,6445	0,000***
Dickey-Fuller t	-4,3291	0.000***
Augmented Dickey-Fuller t	-3,2286	0,000***
Unadjusted modified Dickey-Fuller	-6,6058	0.000***
Unadjusted Dickey-Fuller t	-5,4279	0.000***

*Notes: ***significant at 1%; **significant at 5%; * significant at 10%*

H_0 There is no cointegration.

H_1 There is a cointegration for the entire panel.

According to Table 7 above, the H_0 hypothesis is rejected in all tests conducted at the 99% confidence level. As a result, it is concluded that there is a cointegration or a long-term relationship between the series.

4.4. Autocorrelation Test Results

One of the main assumptions of the linear regression model is that there is no relationship between error terms. If there is a relationship between error terms in any observation, an autocorrelation problem is encountered in the model. Autocorrelation in linear panel data models reduces the effectiveness of the results because it deflects standard errors. Therefore, it is important to determine the presence of autocorrelation in the panel data model (Drukker, 2003). Many tests for autocorrelation have been proposed in panel data models. In this study, the autocorrelation test proposed by Wooldridge (2002) was applied, and the related test results are given in Table 8 below.

Table: 8
Wooldridge Autocorrelation Test Result

	Test Statistics	P Value
Wooldridge Test	0.259	0.617

*Notes: ***significant at 1%; **significant at 5%; * significant at 10%*

H_0 The hypothesis is that there is no autocorrelation.

H_1 The hypothesis is that there is autocorrelation.

According to the Wooldridge autocorrelation test result given in Table 8 above, the H_0 hypothesis could not be rejected, and it was determined that there was no autocorrelation problem in the panel.

4.5. The Result of the Varying Variance Test

Linear regression models assume that the variance of the unit values of the dependent variable will remain constant while the unit values of the independent variables change. In the literature, the fixed variance (homoscedasticity) is called for this assumption (Gujarati, 2009). If the variance of the error term is different, there is a varying variance (heteroscedasticity). In the case of changing variance, estimators maintain the property of neutrality and consistency but lose their effectiveness (Yamak & Köseoğlu, 2006). In the scope of the study, Breusch-Pagan and LR tests were performed to test the existence of varying variances. The relevant test results are given in Table 9.

Table: 9
The Results of the Breusch-Pagan and LR Varying Variance Tests

	Test Statistics	P Value
Breusch-Pagan Test	2.66	0.103
LR Test	26.69	0.460

*Notes: ***significant at 1%; **significant at 5%; * significant at 10%*

H_0 The hypothesis is that there is a constant variance.

H_1 The hypothesis is that there is no fixed variance.

According to the results obtained in Table 9 above, the H_0 hypothesis has been accepted. As a result, the problem of varying variance has yet to be encountered.

4.6. Pooled Mean Group (PMG) Estimator

An estimator will be determined by the tests conducted earlier in this part of the study. Pesaran and Smith (1995) developed the mean group estimator (MG: Mean Group). Then, Pesaran et al. (1999) developed the pooled mean group estimator (PMG: Pooled Mean Group) to analyse the panel's characteristics.

According to the MG estimator, according to the relevant forecasters, there is heterogeneity for all parameters and no restrictions between the decimals. MG estimator does not allow the parameters that make up the panel to be the same in units. For this reason, Pesaran et al. (1999) developed a Pooled Mean Group estimator (PMG: Pooled Mean Group) that allows homogeneity in long-term parameters.

PMG estimator: an estimator that can vary according to the section while keeping the long-term parameters constant for all the cuts that make up the panel, error correction, and fixed and short-term parameters. The results for the entire panel are obtained by averaging the estimates made for each cross-section.

Pesaran et al. (1999) suggested that the homogeneity of long-term parameters should be tested by the Hausman (1978) test for which of the MG and PMG estimators should be preferred. Therefore, the Hausman (1978) test was applied to choose between MG and PMG estimators before performing the analysis. The results of the relevant test are presented in Table 10 below.

Table: 10
The Hausman Test Result

	Test Statistics	P Value
Hausman Test	0.01	1.000

H_0: Long-term coefficients are homogeneous.

H_1: At least one of the long-term coefficients is heterogeneous.

Looking at the probability value of the Hausman (1978) test result above, H0hypothesis is accepted. For this reason, it was decided to use the PMG estimator, which allows homogeneity between the series in the long term. The PMG above estimator's mathematical equation is shown in equation 3 (Tatoğlu, 2017).

$$\Delta Y_{it} = \emptyset(Y_{it-1} - \emptyset' X_{it-1}) + \sum_{j=0}^{p-1} \delta_{ij} \Delta X_{it-j} + u_i + e_{it} \quad (3)$$

Short and long-term relationships can be observed between variables with the PMG estimator. In addition, with the error correction parameter obtained, it can be seen how long the imbalances that occur in the panel will be corrected. The results of the PMG estimator performed within the scope of the study were examined in a separate section, and evaluations have been made for each variable.

5. Empirical Results

The PMG estimator described in the previous title is based on the assumptions of long-term homogeneity and short-term heterogeneity of variables in the panel ARDL model. The Hausman test result in Table 10 also supports this assumption. The model established by the relevant variables is shown in equation No. 4. According to equality 4, y is the independent variable, Φ; the coefficient of influence of the unit, x; the independent variables and ε_it refers to error terms.

$$lny_{it} = \Phi_0 + \lambda_i ln\, y_{it-1} + \delta_{10,i}\, X_{1it} + \delta_{11i}\, X_{1it-1} + \delta_{20i}\, lnX_{2it} + \delta_{21i}\, lnX_{2it-1}) + \delta_{30i}\, X_{3it} + \delta_{31i}\, X_{3it-1} + \delta_{40i} lnX_{4it} + \delta_{41i} lnX_{4it-1} + \delta_{50i} lnX_{5it} + \delta_{51i} lnX_{5it-1} + \delta_{60i} lnX_{6it} + \delta_{61i} lnX_{6it-1} + \varepsilon_{it}$$

As a result, the properties of the panel are referenced according to the short- and long-term slope coefficients of the variables obtained with the PMG estimator and the error correction parameter coefficient are included in Table 11 below.

Table: 11
Short and Long-Term Results of the PMG Estimator

SHORT TERM RESULTS				
	Coefficient	**Standard Error**	**t-statistics**	**P-Value**
ΔLF	.0221518	.019036	-1.16	0.245
ΔlnCTKM	.7787702	.267011	2.92	0.004***
ΔlnFP	-.299943	.157581	-1.90	0.057*
ΔFN	-.004940	.006159	-0.80	0.422
ΔlnGDP	5.55065	1.85588	2.99	0.003***
ΔlnER	4.416166	1.87822	2.35	0.019**
ΔDV	-.115899	.112166	-1.03	0.301
Error Correction P.	-.570895	.101833	-5.61	0.000***
LONG TERM RESULTS				
	Coefficient	**Standard Error**	**t-statistics**	**P-Value**
LF	.0543129	.00760	7.14	0.000***
lnCTKM	.6025735	.05234	11.51	0.000***
lnFP	-.429459	.05143	-8.35	0.000***
FN	.0010561	.00031	3.35	0.001***
lnGDP	.8915092	.08106	11.00	0.000***
lnER	-1.096725	.19495	-5.63	0.000***
DV	-.1580769	.04016	-3.94	0.000***

*Notes: ***significant at 1%; **significant at 5%; * significant at 10%*

Looking at Table 11, it is observed that quite useful information has been obtained about the factors affecting profitability in air transportation, and important evaluations have been made. The results obtained in the short term are at the level of I(1), and those in the long term are at the level of I(0).

The error correction parameter: Before explaining the relationship between the independent variables in Table 11 and airline profitability, another important result that should be emphasised is the error correction parameter. As can be seen from the table, the error correction parameter is negative and significant. This situation indicates the existence of a long-term relationship. Looking at the coefficient of the error correction parameter, it is seen that 57% of the imbalances experienced in one period have improved in the next. After the imbalances experienced in this case, it can be said that the panel balanced in about two periods.

The Relationship between Load Factor (LF) and Profitability (EBITDAR): Although there is no significant relationship between load factor and profitability in the short term for the general sample, it can be said that there is a positive relationship. In the long time, it is seen that there is a significant relationship at the 99% confidence level. It was concluded that a one-point increase in the load factor in the long term increased airline companies' profitability (EBITDAR) by 0.054%.

The Relationship between Cargo Tonnage Km (CTKM) and Profitability (EBITDAR): It is observed that there is a significant relationship between cargo tonnage and profitability (EBITDAR) at the 99% confidence level in the short and long term. In the short term, the 1% increase in the annual change experienced in CTKM contributes to the 0.77% increase in the yearly EBITDAR figure of airlines. When we look at the results obtained in the long term, a rise of 1% in the number of tons of cargo transported increases the profitability (EBITDAR) figure by 0.6%.

The Relationship between Fuel Price (FP) and Profitability (EBITDAR): A negative and significant relationship exists between fuel price and EBITDAR at 90% in the short term. An increase of 1% in the annual rate of increase in fuel prices reduces the yearly increase in the EBITDAR figure by 0.29%. A significant and negative relationship was found at 99% in the long-term relationship. An increase in fuel prices by 1% over the long term leads to a decrease in the profitability (EBITDAR) figure by -0.4%.

The Relationship between the Flight Network (FN) and Profitability (EBITDAR): No significant relationship was found between the number of destinations and profitability (EBITDAR) in the short term. A significant and positive relationship was found at the level of 99% when viewed over a long period. In the long run, each new destination opened by airlines contributes 0.001% to the profitability (EBITDAR) figure. When short and long-term results are compared, it is seen that the short-term negative relationship between the number of points flown and profitability (EBITDAR) has evolved into a positive and significant relationship in the long term. As a reason for this situation, it can be interpreted that the number of passengers in the newly opened city pair is small in the first months and the number of passengers is increasing in the long term.

The relationship between Gross Domestic Product (GDP) and Profitability (EBITDAR): A significant and positive relationship was found at 99% in the short and long term. In the short time, it is seen that an increase of 1% in the annual change in GDP contributes positively to the yearly change in the profitability (EBITDAR) figure of 5.55%.

In addition, when looking at the long-term results, it is observed that an increase in the GDP figure of 1% led to a rise in the profitability (EBITDAR) figure of 0.89%.

The Relationship between Exchange Rate (ER) and profitability (EBITDAR): When looking at the short-term results, a significant and positive relationship was found between the annual exchange rate change rate and EBITDAR at 95%. An increase of 1% in the annual exchange rate change contributes to a positive contribution of 4.41% to the yearly change in the profitability (EBITDAR) value. In the long run, a significant relationship was found at the level of 99%, but the direction of the relationship returned to negative. In the long run, the 1% increase in the exchange rate reduces the profitability (EBITDAR) figure by -1.09%. Considering both situations together, it is seen that airlines, a significant part of whose revenues are foreign currency, are positively affected by foreign exchange increases in the short term. Still, the timing of payment of foreign currency-denominated debts and the pressure caused by the rise in foreign currency on costs show their adverse effects over the long term.

The Effects of the 2008 Crisis: The aviation sector is one of the sectors affected by the economic crisis 2008. Looking at the results in Table 11, it is seen that there is a negative and significant relationship in both the short and long term.

6. Discussion and Conclusion

With $ 3.5 trillion globally, airline transportation has made a significant contribution to the world economy, created jobs for millions of people directly and indirectly, played an active role in the development of global trade and with a share of 58% in international tourism, has been the most preferred type of transport and has pioneered the development of many technological sectors. Thanks to these spheres of influence created by the sector, it has become one of the locomotives of globalisation and change. In the conditions of our era, airline transport is one of the most significant and critical parts of a puzzle depicting the modern world.

Therefore, within the study's scope, airline companies' profitability was examined by considering internal and external environmental factors and significant empirical results were obtained. Analyses of the internal and external environment constitute the most critical strategic management processes. In this context, conducting an excellent internal and external environmental analysis in a successful strategic management is essential. For this reason, the empirical results obtained in the study provide important information to airline companies at the strategic management level.

The explanatory variables, which we defined as the airlines' operational activities or internal factors and which we assumed to impact profitability, were determined as passenger load factor, cargo ton-km amount and number of destinations. The external environmental factors, which we presume to impact airlines' profitability, were chosen as GDP, fuel prices and exchange rates.

When we look at the studies in this field in the literature, it is seen that although similar explanatory variables are used, only a few are studied. In this study, airlines were evaluated together regarding internal and external environment, looking from a much broader perspective. In addition, previous studies are specific to airlines of a region or a country. In this study, airlines worldwide were included in the sample. The Panel ARDL method used in the study has significant differences compared to the studies in the literature. Thanks to this model, both short-term and long-term empirical results have been obtained.

To briefly touch on the results in terms of independent variables, a long-term linear and significant relationship was found between passenger load factor and profitability in airline companies. In this case, airlines may need to reconsider destinations with low load factors and, if necessary, reduce the frequency of flights on the leg. In addition, they can implement new advertising and marketing strategies to reduce the number of empty seats.

Cargo, which provides a significant income to airlines, is also an explanatory variable in our study. It has been determined that there is a strong and linear relationship between the cargo ton-km amount and profitability in the short and long term. Although the cargo carried on passenger planes is limited, the cost is very low. For this reason, airlines can increase the amount of cargo carried on passenger planes by giving lower prices than alternative transportation types. The cargo should be transported by dividing it into several parts if necessary.

The number of destinations is a critical issue for airline companies. In this way, airlines aim to increase their market share. Looking at the results of the relationship between the flight network and profitability, it has been determined that new destinations cause losses in the short term, but these destinations provide profits to businesses in the long run. Every newly opened destination carries some risks for airlines. The slots and recognition of the airlines that have entered this market before us give them a great advantage. For this reason, the situation of the competitors in this relevant market and the severity of the competition are the most basic factors to be considered. Another issue to consider is the demand factor. The population in that market, the commercial activities of the market and whether the market has the feature of being a tourism centre should be examined.

Fuel costs are one of the most significant expenses of airlines. According to the results obtained on the fuel price and profitability relationship, it has been determined that there is a negative and intense relationship in the short and long term. Fuel is mainly affected by global developments. This situation negatively affects the planning of the companies and prevents predictability. Airlines should apply hedging methods to avoid the adverse effects of fuel price volatility. Thus, they will be affected to a limited extent by sudden increases in fuel prices.

When we look at the analysis results on the relationship between GDP and profitability, a very strong and linear relationship was found in the short and long run. In this context, airlines should not be evaluated independently of the economic situation of the country they belong to. A country's economic welfare, employment and trade increase will positively affect the airlines.

When we look at the results of the relationship between exchange rate and profitability, it is concluded that there is a positive relationship between exchange rate and profitability in the short run. Still, there is an inverse relationship in the long run. Since airlines operate in different currencies, they are affected by the change in the exchange rate. In the short run, the increase in the exchange rate has a positive effect by converting foreign currency into domestic currency. However, in the long run, when the payment in foreign currency comes due, the increase in foreign currency will lead to a rise in expenses. In this case, payments are made by converting the local currency to foreign currency. To be less affected by the fluctuations in the currency, airlines should hedge the exchange rate and the fuel.

When the results obtained related to explanatory variables are evaluated together, it is seen that external environmental factors have a more significant impact on profitability than the operational activities of airlines. Considering the coefficients obtained over the long term, it has been found that GDP, exchange rate and fuel prices are more determinative of profitability. According to the findings, we can define air transport as a fragile, complex and difficult-to-manage sector with much uncertainty. Good management of the activities carried out within the sector does not mean anything by itself; it is important that the external environmental factor is well studied and the necessary measures are taken.

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