Received: 02 April 2025 | Accepted: 21 May 2025
DOI: 10.52898/ijif.2025.1

ORIGINAL ARTICLE

AN EVALUATION ON THE PREMIUM/LOSS RELATIONSHIP OF AIRCRAFT INSURANCE IN TURKEY FOR 2019-2023

Hakan ÖZCAN

Abstract
The insurance system cannot prevent loss-causing events, but it protects the insured against these damages by paying for their financial loss. The same is true for aircraft. The study aims to determine whether there is causality between aviation insurance premium production and claims, total insurance premium production and claims for the period 2019-2023 in Türkiye. For this purpose, 5 insurance companies with high aviation insurance premium production were selected. In order to analyze the variables in the study, unit root tests were applied first. ADF and PP tests were applied for unit root tests. VAR analysis was performed to determine the appropriate lag and Granger Causality Test analysis was used to evaluate the short-run relationship. According to the results obtained, it is concluded that aircraft outstanding claims are the cause of total paid claims, aircraft insurance premium is the cause of total outstanding claims, and aircraft outstanding claims are the cause of total outstanding claims and a short-run relationship between the variables has been identified.

Keywords
Insurance, Air Vehicles, Premium, Claim

JEL Classification
G22, E64, L93, E42.

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1. INTRODUCTION

Social life involves significant dangers in people's daily activities (Kırkbeşoğlu, 2015: 4). People have needed an insurance system in order to reduce the financial impact of the damages caused by these hazards. This system cannot prevent the events that cause damage, but it protects the policyholder against these damages by paying the financial loss of the policyholder. The same is true for aircraft. Aircraft owners have to take out insurance against these uncertain risks. Aircraft insurance differs from other insurance branches in terms of legislation and utilization (El-Kasabi et al., 2003: 299).

Insurance branches are divided into three groups: property, life and liability in Türkiye. Aircraft insurances are also in the property group. There are many studies on the aviation sector. However, there are few studies on aviation insurance. When the literature is examined, it is seen that studies on aircraft, unmanned aerial vehicles (UAVs), risks in aviation companies, policy pricing and aviation insurance premium production are generally conducted. There is no study on the relationship between aircraft insurance premium and loss in Turkey. In this respect, it is thought that the study may make valuable contributions to the aviation and insurance sectors.

The study aims to determine whether there is causality between aviation insurance premium production and claims, total insurance premium production and claims for the period 2019-2023 in Türkiye. For this purpose, five insurance companies with aircraft insurance premium production were selected.

In the second part of the study, previous studies are presented. In the third section, the concept of insurance and risk in Türkiye, and in the fourth section, insurance and insurance premium, claims and outstanding data in Türkiye are presented. In the fifth section, aircraft coverage structures, insurance premiums, claims and outstanding data are shared.

The research section includes the purpose, hypotheses, sample, data and analysis. For the analysis of the variables that are the subject of the research, unit root tests were applied first. ADF and PP unit root tests were applied in the analysis. VAR analysis was performed to determine the appropriate lag and Granger Causality Test analysis was used to evaluate the short-run relationship. There is no study on the relationship between aircraft insurance premium and claims in Türkiye. In this respect, the study is expected to make valuable contributions to the aviation and insurance sectors.

2. LITERATURE REVIEW

The acceleration of developments in the insurance sector has increased the number of scientific studies in this field. The rapid growth in the aviation sector has brought the need for insurance to the agenda. When the literature is examined, it is found that there are few academic studies on aviation insurance.

Wells and Chadbourne (1992) studied the basic principles of insurance and risk as applied to the aviation industry. They discuss aviation insurance in the United States and investigate underwriting and pricing, risk management, premises liability and workers' compensation coverage.

Lee (2006), Safety risk management in aviation is important. The study developed a quantitative model to assess aviation safety risk factors as a way to improve the effectiveness of the safety risk management system. The model was developed by evaluating all relevant prediction factors according to their importance, how dangerous they are, detectability, probability, criticality and frequency.

Wallis (2013), The study investigated the role of international organizations in enhancing civil aviation safety. It provides a brief description of their different roles and shows how they connect to provide a worldwide security structure for the benefit of air travelers. It addresses their strengths and weaknesses and discusses their different approaches to aviation security implementation.

Yardımcı (2019) investigated the impact of technological change and developments in the aviation sector on air vehicles. In recent years, the need for unmanned aerial vehicles has come to the agenda and the importance of insurance responsibility against the risks that may be encountered during use

has been emphasized.

Kahveci and Can (2017) Unmanned Aerial Vehicle (UAV) are an automatic and remote-controlled aircraft type that does not have a passenger or pilot, only carries appropriate equipment. The civil, military and scientific uses of UAV are rapidly spreading. The use of UAV for civil purposes in very wide areas and the need for insurance accordingly have been emphasized.

Ünan (2019) analyzed aviation insurance on the basis of insurance law. The study is deepened with judicial decisions and case studies.

In the study conducted by Macit and Göçer (2020), the financial performances of two aviation companies operating in Borsa İstanbul were compared with the data obtained from their financial statements. According to the findings of the study; Pegasus exhibits a higher financial performance than THY. It was observed that THY's profitability performance was better than Pegasus.

Aslan (2024) In the Civil Aviation Law, the carrier is obliged to have financial liability insurance. It is essential that the liability insurance to be taken out by the carrier is equal to the insurance amount determined in the legislation. The carrier's liability is limited to the death of the passenger; damages to the cargo and baggage are not covered. In the study, the content of the airline carrier liability insurance coverage in the event of bodily harm and death of the passenger was examined.

Despite the general trend towards a decrease in the accident rates involving commercial passenger aircraft due to their safer status, the aviation insurance market is far from stable. The study provides an overview of the importance of aviation insurance and its need in recent years. The distribution and pricing of risk among insurance companies has been examined.

Herdemir (2021) aviation insurance covers the liability of institutions operating in the aviation sector for problems that may arise due to the fault of their employees during flights or for unexpected accidental damages. Aviation insurance provides coverage for the economic part of the damage that may occur in parallel with the policy content. Aviation insurance is divided into 3 groups: body, liability and personal accident. In the study, aviation insurance data between the years 2012-2021 were used to comprehensively examine the changes in aviation premium productions in TL and USD, the number of policies, average premium changes per policy, and company-based aviation premium production analyses.

Khotsianovska (2023), The purpose of the study is to conduct a comprehensive study of the legal essence of certain types of contracts entered into by carriers with other participants of transportation services. It is concluded that the attention of legal science and practice is mostly focused on air transportation contracts, many contracts concluded between participants in aviation relations are not sufficiently detailed, and some aspects of air transportation contracts need further scientific research.

There are many studies on the aviation sector. However, there are few studies on aviation insurance. When the literature is examined, it is seen that studies on aircraft, unmanned aerial vehicles (UAVs), risks in aviation companies, law, policy pricing, passenger safety and aviation insurance premium production have been conducted. There is no study on the relationship between aircraft insurance premium and claims in Turkey. In this respect, it is thought that the study may make valuable contributions to the aviation and insurance sectors.

3. INSURANCE SECTOR

Insurance is defined as a bilateral contract made by paying a premium by foreseeing and preparing a policy in advance in order to eliminate the material damage that may be encountered for all living or non-living assets. The insurance policy is taken out with the aim of securing the insured financially (Uralcan, 2011: 21).

Throughout our lives, our values are faced with risks arising from various hazards. If precautions are not taken against the damages that may occur as a result of these hazards; it may become impossible to cover the damages financially. People have needed the insurance system in order to reduce the financial impact of these damages. The insurance contract cannot prevent the events that cause

damage, but it protects the policyholder against these damages by paying the financial loss (Çelik, 2024: 1002).

When an insurance company receives a policy proposal for evaluation, the process can be finalized in 4 ways. The first of these is direct acceptance, especially in compulsory policies. The other is that the offer can be rejected or accepted and managed with some conditions. Finally, the insurance company can accept and transfer the offer.

4. INSURANCE IN TÜRKİYE

The interest in insurance in Türkiye began in 1870 as a result of the great fire in Istanbul. After the great fire, foreign insurance agencies started their activities in our country. Within ten years, the number of agencies working in this manner reached fifteen. These agencies were directed by their own countries and issued the policies they used with their own licenses. The most important issue for agencies was that in case of a dispute, their authority was decided by the courts in their own countries. In the following years, the number of foreign companies increased and in 1883, with the help of the Ottoman Bank, they established an insurance agency called 'Osmanlı' (Ottoman) (Ererdi, 2018: 45). In 1925, our first national company Anadolu Sigorta T.A.Ş. was established. As of 2024, there are 50 non-life, 19 life and individual pension and 5 reinsurance companies in Türkiye.

4.1. Insurance Branches in Türkiye

Insurance branches in Türkiye are divided into three groups as property, life and liability. Property insurance is made against the consequences of risks that threaten the property of an institution or person. The purpose of making this insurance policy is to compensate the damage that may occur to the insured. Property insurance is also referred to as compensation insurance (Dursun, 2016: 2). It is in the property insurance branch of motor insurance, traffic, green card, fire, engineering, transportation, agriculture, sea and air vehicles. Life Insurances are insurances that cover risks to human life (Kayıhan, 2016: 252). Personal accident, life and private health insurances are life insurances. Liability Insurances refer to insurances that are activated in the regulation of damages caused by individuals and institutions within their responsibilities. Third party, occupation, product and employer liability insurance policies are in this group. With this guarantee, the insured person or institution transfers the payment debts requested from them to the insurance company through recourse (Ölmez, 2016: 2131).

4.2. Insurance Premium Production

Insurance premium production in Türkiye has been steadily increasing every year. The sector is growing in real terms (inflation-adjusted) every year.

Table 1

Annual Total Insurance Premium Production for 2014-2023

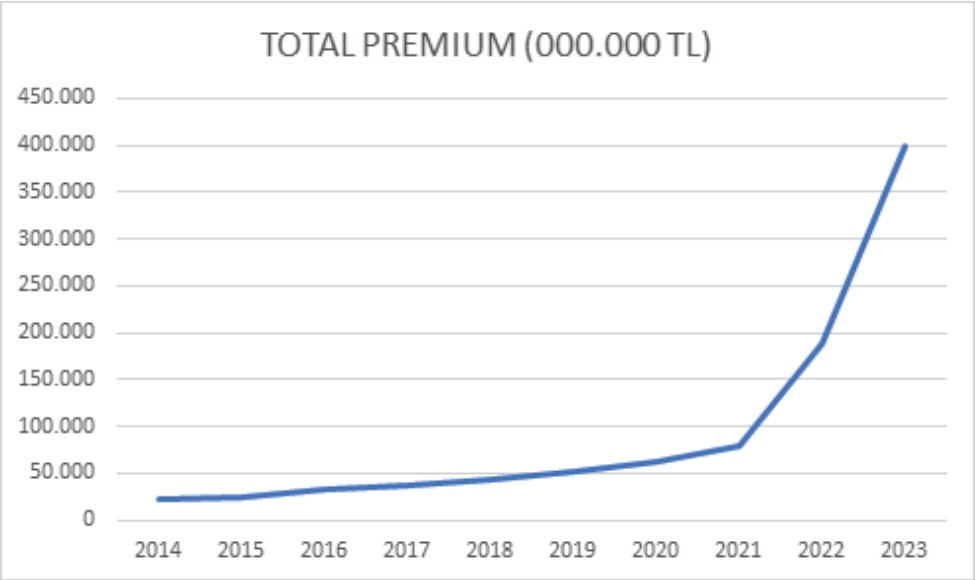
Year	Total Premium (000.000 TL)	Year	Total Premium (000.000 TL)
2014	22.056	2019	52.388
2015	24.495	2020	61.254
2016	33.442	2021	79.019
2017	37.111	2022	187.704
2018	43.470	2023	400.079

Reference: TSB Official Statistics (Premium Production)

Non-life insurance premium production in Türkiye grew approximately 20 times between 2014 and 2023. The share of insurance in national income increased from 1.3% to 2% in the last 10 years.

Graphic 1

Annual Total Insurance Premium Production for 2014-2023



5. AVIATION INSURANCE IN TÜRKİYE

Institutions and individuals operating in Türkiye are obliged to have their interests in Türkiye insured by insurance companies in Türkiye. However, when air and sea vehicles are purchased with foreign loans, insurance policies can be taken out abroad until the loan debt is paid.

5.1. Aviation Insurance Coverage Structures

Most aviation insurance contracts are indemnity contracts. The uncertainty here is whether the damage will occur or not. The aim of an indemnity policy is to restore the person/company to the financial position it was in before the damage. Insurances such as loss of license and personal accident insurance are not based on indemnity. The uncertainty here is when the damage will occur. In both cases, in order to be entitled to compensation, it is sufficient for the insured to prove that he or she had an interest and benefit in the subject matter at the time of the damage.

The contractual process begins when the insured fills out a proposal form containing the elements of risk and submits it to the insurer. Insurance companies or their intermediaries try to provide the most appropriate coverage according to the needs and requirements of the insured. Aviation insurance includes coverage for the airframe, third parties and passengers.

5.2. Aircraft Insurance Policy

The policy, which is accepted as AVN 1C and is used for both hull risks and passenger and third-party liability in the field of general aviation, although it was also created to determine the coverage of small airlines, has found wide use. This policy has 3 sections; damage to the airframe, third party liability and passenger liability.

Damage to the Airframe: Insurers may repair, pay for or replace damaged parts due to accidental damage or loss arising from risks arising from the aircraft in motion and while parked (in-flight, taxiing and ground parked).

5.3. Aircraft Insurance Premium Production

Aircraft insurance premium production in Türkiye has been steadily increasing every year.

Table 2

Annual Total Insurance Premium Production for Aircrafts for the 2014-2023

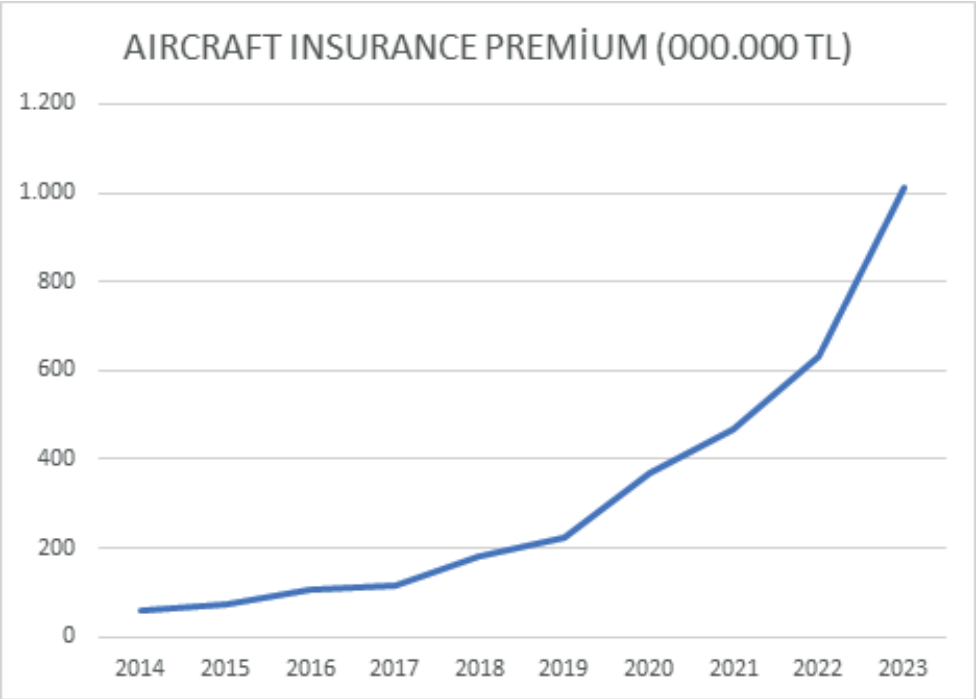
Year	Aircrafts Premium (000.000 TL)	Year	Aircrafts Premium (000.000 TL)
2014	58	2019	223
2015	75	2020	369
2016	105	2021	469
2017	114	2022	634
2018	180	2023	1.011

Reference: TSB Official Statistics (Aircraft Premium)

Aircraft insurance premium production in Türkiye grew approximately 17.5 times between 2014 and 2023.

Graphic 2

Annual Total Insurance Premium Production for Aircrafts for 2014-2023



6. APPLICATION

6.1. Objective of the Application

To determine whether there is causality between aviation insurance premium production and claims, total insurance premium production and claims in the period 2019-2023 in Türkiye

6.2. Hypothesis of the Application

H_{0a} : Aircraft insurance premium is not the cause of total insurance premium
H_{0b} : Paid claims on aircraft is not the cause of total insurance premium
H_{0c} : Aircraft outstanding claims are not the cause of total insurance premium
H_{0d} : Aircraft insurance premium is not the cause of total paid claims
H_{0e} : Aircraft paid claims are not the cause of total paid claims
H_{0f} : Aircraft outstanding claims are not the cause of total paid claims
H_{0g} : Aircraft insurance premium is not the cause of total outstanding claims
H_{0h} : Aircraft paid claims are not the cause of total outstanding claims
H_{0i} : Aircraft outstanding claims are not the cause of total outstanding claims

6.3. Sample and Data

For the purpose of the aircraft research, five insurance companies producing aircraft premiums were selected. These companies are Türkiye Sigorta, Ak Sigorta, Anadolu Sigorta, Allianz and Eureko. The total aircraft premium production of the five selected companies corresponds to approximately 90% of the total sector production. For this purpose, total premium, paid, outstanding and aviation premium, paid, outstanding data of the five selected companies are used on a quarterly basis between 2019 and 2023. Data were obtained from the official statistics portal of TSB (Insurance Association of Türkiye).

6.4. Analysis Method

For the analysis of the variables that are the subject of the research, ADF and PP, which are unit root tests, were applied first. VAR analysis was conducted to determine the appropriate lag and Granger Causality Test analysis was used to evaluate the short-run relationship. The VAR (Vector Autoregression) model is an econometric method used to model interdependencies and causal relationships among multiple time series variables. It was first developed by Christopher Sims (1980). In this study, this method is preferred to analyze how past values affect current variables.

6.5. Findings

Table 3 shows the mean, median, maximum, minimum and standard deviation values of the descriptive statistics of total insurance premium, total paid claims, total outstanding claims, aircraft insurance premium, aircraft paid claims and aircraft outstanding claims variables before Granger Causality Analysis.

Table 3
Descriptive Statistics of Variables

	Total İnsurance Premium	Total Paid Loss	Total Outstanding	Aircraft Insurance Premium	Aircraft Insurance Paid Loss	Aircraft Insurance Outstanding
Average	1.36E+08	35604955	53639369	7.66E+09	4.13E+09	8.57E+09
Medyan	1.24E+08	5273641.	12904334	5.65E+09	2.23E+09	4.83E+09
Maximum	5.88E+08	2.56E+08	5.04E+08	2.78E+10	2.81E+10	5.95E+10
Minimum	264835.4	0.000000	452634.9	1.56E+09	1.80E+08	3.61E+08
Standard Deviation	1.39E+08	55564789	89260821	6.10E+09	5.27E+09	1.06E+10

Table 4
Unit Root Test (Augmented Dickey Fuller-ADF and Phillips Perron- PP)

Variables		Phillipsperron-Pp		Augmenteddickey Fuller-Adf	
		T-Statistics	Probability	T-Statistics	Probability
Total Insurance Premium	Level	1,0000	1,0000	0.9004	0.9470
	1.Difference	0.0031	0.0180**	0.5506	0.0006***
Total Paid Claims	Level	0.9997	1,0000	0.8472	*0.7649*
	1.Difference	0.0023	0.0309**	0.0033	00017***
Total Outstanding Claims	Level	0.9999	0.9996	1.0000	1.0000
	1.Difference	0.0951	0.0027***	0.0009	0.0015***
Aircraft İnsurance Premium	Level	0.9576	0.3621	0.8627	*0.9978*
	1.Difference	0.0000	0.0000***	0.0214	0.0269**
Aircraft Paid Claims	Level	0.8029	0.5864	0.7074	0.4128
	1.Difference	0.0221	0.0005***	0.5506	0.0006***
Aircraft Outstanding Claims	Level	0.1268	0.6953	0.0996	0.6982
	1.Difference	0.0001	0.0017***	0.0000	0.0017***

An important point in the study is the stationarity of the variables. ADF (Augmented- Dickey Fuller) and PP (Phillips Perron) tests were conducted for stationarity determination. As a result of the analysis with constant and trend for each of the variables, it was observed that they were not stationary at the level, but they were stationary when the first difference was taken. In this respect, causality analysis was performed by taking the first level differences of the variables.

Table 5
Var Model

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-7.768.828	NA	1.4e+105	259.1609	259.3704	259.2429
1	-7.455.000	554.4289	1.4e+101	249.9000	251.3660	250.4735
2	-7.410.350	69.95234	1.1e+101	249.6117	252.3343	250.6766
3	-7.378.670	43.29518	1.4e+101	249.7557	253.7349	251.3122
4	-7.218.580	186.7727	2.61e+99	245.6193	250.8552	247.6674
5	-7.152.401	63.97264	1.34e+99	244.6134	251.1058	247.1529
6	-7.087.175	50.00668	8.97e+98	243.6392	251.3882	246.6702
7	-6.994.124	52.72872*	3.55e+98	241.7375	250.7432	245.2601
8	-6.855.901	50.68185	6.77e+97	238.3300*	248.5923*	242.3442*

LR: Ordered Modified LR test statistic (each test at 5% level), FPE: Final Forecast Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion, HQ: Hannan-Quinn Information Criterion

Since the variables are stationary at first difference, the VAR model is run by taking their first differences. After the VAR model is established, the appropriate lag length should be determined. Findings regarding the appropriate lag length are presented in Table 5. According to FPE, SC, AIC and HQ information criteria, the appropriate lag length is 8.

Table 6
Granger Causality Analysis

H	Hypotheses	Probability	Decision
H_{0a}	Aircraft insurance premium is not the cause of total insurance premium	0.3509	Accepted
H_{0b}	Paid claims to aircraft is not the cause of total insurance premium	0.9891	Accepted
H_{0c}	Aircraft outstanding claims are not the cause of total insurance premium	0.5580	Accepted
H_{0d}	Aircraft insurance premium is not the cause of total paid claims	0.1172	Accepted
H_{0e}	Aircraft paid damage is not the cause of total paid claims	0.9022	Accepted
H_{0f}	Aircraft outstanding claims are not the cause of total paid claims	0.0004	Rejected
H_{0g}	Aircraft insurance premium is not the cause of total outstanding claims	0.0278	Rejected
H_{0h}	Damage paid for aircraft is not the cause of total outstanding claims	0.9649	Accepted
$H_{0ı}$	Aircraft outstanding claims are not a cause of total outstanding claims	0.0186	Rejected

Granger causality analysis is used to detect bidirectional relationships when the variables are stationary at the level or stationary at the same level. Since all variables are stationary at the first difference in the findings of the study, this method was preferred to detect bidirectional relationships. Since each of the variables are stationary at the same level, Granger causality analysis is used to test the short-run relationship between the variables. According to the results obtained, it is concluded that aircraft outstanding claims are the cause of total paid claims, aircraft insurance premium is the cause of total outstanding claims and aircraft outstanding claims are the cause of total outstanding claims and a short-run relationship between the variables is detected. As a result, the hypotheses H0f, H0g and H0ı are rejected, while the hypotheses cannot be rejected for the other cases.

7. CONCLUSION AND DISCUSSION

Insurance premium production in Türkiye has been rising steadily every year and growing in real terms. Non-life insurance premium production in Türkiye grew nearly 20-fold between 2014 and 2023 and the share of insurance in GDP increased from 1.3% to 2%. Aircraft insurance premium production in Türkiye has also been steadily increasing every year and growing in real terms. Aircraft insurance premium production in Türkiye grew approximately 17.5 times between 2014 and 2023. Institutions and individuals operating in Türkiye are obliged to insure their interests in Türkiye with insurance companies in Türkiye. However, when aircraft and marine vessels are purchased with foreign loans, insurance policies can be taken out abroad until the loan debt is repaid. The share of annual insurance premium production for aircraft in total premium production is quite low; approximately 2.5 per thousand for the 2014-2023 period. Due to the high coverage risk and reinsurance capacity of insurance companies, only around 10 of them are able to provide aircraft insurance. The share of aircraft premiums in total premium production of the five companies subject to the study is higher, around 6 per thousand.

For the purpose of the study, five insurance companies that produce aircraft premiums were selected. These companies are Türkiye Sigorta, Ak Sigorta, Anadolu Sigorta, Allianz and Eureko. The total aircraft premium production of the five selected companies corresponds to approximately 90% of the total sector production. For this purpose, total premium, paid, outstanding and aviation premium, paid, outstanding data of the five selected companies are used quarterly between 2019 and 2023.

The study has 9 hypotheses; the causality of aviation premiums, paid claims and outstanding claims between total premiums, total paid claims and total outstanding claims is investigated.

Since each of the variables are stationary at the same level, Granger causality analysis is used to test the short-run relationship between the variables. According to the results obtained: Aircraft outstanding claims are the cause of total paid claims; since aircraft claims will be high depending on the coverage, the relationship between high outstanding and paid claims is in line with expectations. Air vehicles insurance premium is the cause of total outstanding claims; this result is in line with expectations as the probability of claims will increase as aircraft insurance premium production increases. Aircraft outstanding claims are the cause of total outstanding claims; it is a result consistent with expectations that losses incurred in aircraft insurance affect total outstanding claims due to high outstanding claims. Finally, while H0f, H0g and H0ı hypotheses are rejected, the hypotheses cannot be rejected for the other cases.

There are many studies on the aviation sector. However, there are few studies on aviation insurance. When the literature is examined, it is seen that studies on aircraft, unmanned aerial vehicles (UAVs), risks in aviation companies, policy pricing, law, security and aviation insurance premium production are generally conducted. There is no study on the relationship between aircraft insurance premium and claims in Turkey. In this respect, it is thought that the study may provide valuable contributions to the insurance sectors, especially in the pricing and risk selection process on the premium and loss relationship.

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How to cite this article: Özcan H. (2025). An Evaluation on the Premium/Loss Relationship of Aircraft Insurance in Turkey for 2019-2023. *International Journal of Insurance and Finance, 5*(1), 1-10. https://doi.org/10.52898/ijif.2025.1