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Research on Changes in Travel Insurance Premiums Driven by Climate Change: A Case Study of Hong Kong Region

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ABSTRACT

This research aims to study the impacts of climate change on worldwide general travel insurance in Hong Kong and to provide a scientific basis for premium pricing strategies in a climate-driven context. The study adopts both qualitative and quantitative research methods to reveal the relationship between climate change and travel insurance. The qualitative analysis part constructs a theoretical framework through literature review. Taking into account the current state of research, the impact of climate change on the demand for travel insurance as well as the challenges and opportunities of premium pricing strategies are discussed in depth. The quantitative analysis section collected data on flights at the Hong Kong International Airport (departures, delays, and cancellations) and travel insurance claim occurrence. The weather conditions were also checked through the weather website to analyze the correlation between climate factors and insurance claims. The findings indicated that climate change has a significant impact on the demand for travel insurance, especially during the prolonged rainy season in Hong Kong, when extreme weather events lead to an increased risk of cancellation or delay of travel plans. Meanwhile, the quantitative analysis results demonstrated a significant correlation between weather factors and flight status and insurance occurrence, which provided empirical evidence for risk assessment and premium pricing of worldwide travel insurance in Hong Kong.

KEYWORDS

Climate change; Travel insurance; Premium pricing; Flight delays or cancellations; Claim occurrence

1. INTRODUCTION

With the intensification of global climate change, the frequent occurrence of extreme weather events has become an indisputable fact. These extreme weather events bring about not only direct impacts on the production and life of human society, but also far-reaching effects on the tourism industry and the related insurance industry. Hong Kong, as a cosmopolitan city and an important transit point for tourists, is particularly sensitive to climate change in the development of its tourism industry. The long rainy season from March to June each year, when Hong Kong is susceptible to extreme weather conditions such as typhoons, torrential rains and thunderstorms, poses a significant risk of trip cancellation or delays to local residents and related travelers.

Against this background, the premium pricing and claims policies of travel insurance, as an important component of the tourism industry, must adapt to the new trend of climate change in order to safeguard the interests of travelers and the stable operation of insurance companies. Therefore, the objective of this study is to examine the impact of climate change on general travel insurance for Hong Kong travelers to the world, with particular focus on how to provide a scientific basis for premium pricing of travel insurance through in-depth analysis of changes in climatic factors.

The core structure of the research consists of two parts: qualitative analysis and quantitative analysis. The qualitative analysis part of this study will build a theoretical framework from the perspective of literature review to sort out the current research status of the impact of climate change on tourism, especially the research progress in the field of tourism insurance. In-depth discussions will be conducted on the impact of climate change on the demand for travel insurance, as well as the challenges and opportunities for premium pricing strategies of travel insurance. It will help insurers to better meet the needs of travelers in Hong Kong by providing more comprehensive and adaptable travel insurance products. In the quantitative part of the analysis, flight data from the Hong Kong International Airport to other airports around the world will be collected and combined with the flight profiles of the relevant travel insurance claims in force. Meanwhile, the reasons for the delays are checked through the weather website, and the correlation between weather factors and the validity of flight delay claims will be analyzed. It will provide an empirical basis for premium pricing of travel insurance, enabling insurers to assess risks and formulate premium strategies accordingly more accurately.

2. LITERATURE REVIEW

In exploring the impact of the association between climate change and travel insurance, qualitative analysis provides a framework for a deeper understanding of this complex relationship from a fundamental perspective. The impact of climate change on tourism and the related insurance industry has become one of the hot topics of international research in recent years, and the related studies are gradually deepening.

2.1. The Theoretical Connection

Based on risk management theory and insurance economics theory, a theoretical link can be constructed for climate change and travel insurance. In risk management theory, climate change is regarded as an emerging systemic risk that not only affects a single insurance product or market, but also poses a threat to the stability of the entire insurance industry [1]. Insurance companies need to identify and assess the risks posed by climate change and then control these risks through product innovation and pricing strategies. Insurance economics theory, on the other hand, focuses on supply and demand in the insurance market and how insurance costs reflect changes in risk [2]. In the context of climate change, changes in insurance costs can be viewed as the market's response to changes in risk.

2.2. Impacts of Climate Change on Tourism and Tourist Behavior

Many studies have been conducted in the world on the impacts of climate change and tourism. Scott’s team (2005) pointed out that climate change will significantly affect tourism seasonality, which may lead to changes in peak tourism periods [3]. Becken (2007) found that extreme weather events can negatively affect the attractiveness of tourist destinations by examining changes in the behavior of tourists [4]. In Moreno's (2010) study, the importance of tourism's adaptability to climate change is emphasized, and coping strategies and measures are proposed [5]. In China, with the rapid development of tourism, related studies have gradually increased. Domestic scholars such as Zhang and others (2012) analyzed the potential impacts of climate change on China's tourism industry and explored the tourism industry's adaptation countermeasures in the background of climate change [6]. Li's team (2015) studied the impact of climate change on travel decisions of tourists from the perspective of tourists instead [7]. Such studies analyzed the alterations that occur in the behavioral changes of tourists driven by climate change.

2.3. Impact of Climate Change on the Demand for Travel Insurance

Both direct factors brought about by climate and indirect factors triggered by behavioral changes have a high influence on the demand for travel insurance. Travel insurance serves as a risk management tool during travel, and as travelers face increasing risks and uncertainties, the demand for insurance increases [8]. Rubi's team (2022) conducted a mechanistic learning prediction of consumers' willingness to purchase travel insurance, and the results show that the impact of climate change gives a positive Influence Factor [9]. With the increasing impact of climate change on the tourism industry, the behavior of travelers continues to change and the demand for travel insurance continues to increase.

2.4. Implications of Climate Change for Risk Management and Pricing Strategies in Travel Insurance

Climate change has led to an increase in the number and intensity of extreme weather events, and insurers need to consider emerging climate-related risks to adjust the risk management strategies and premium pricing strategies accordingly. It requires in-depth research on the relationship between climate change and travel insurance, and the development of appropriate models and methodologies to support risk assessment and premium pricing decisions. The study by Botzen and van den Bergh (2009) proposes a response approach to managing climate risk from a product design perspective, such as climate change-adaptive insurance products. It proposes that insurance products can be developed specifically for climate change-induced extreme weather events (e.g., typhoons, heavy rains, thunderstorms, etc.) to adapt to the uncertainty caused by climate change [10]. In addition to this, Surminski and Oramas-Dorta (2014) also conducted a relevant study in the perspective of travel insurance product innovation. It proposes that personalized insurance solutions can be developed to flexibly adjust the coverage and terms and conditions so as to address the risks and trends in the travel insurance industry [11]. Collier's team (2021), on the other hand, analyzes the social impacts brought by climate change from a macroeconomic perspective, and offers advice to the insurance industry on climate risk governance [12]. In terms of pricing strategies for travel insurance, Maynard (2008) points out the challenges faced by insurance companies in insurance pricing strategies in the climate change scenario and argues that insurance companies need to update historical data and measure the rate of climate change growth in real time in order to price premiums more accurately [13]. Ermolieva and others (2013) analyze the impacts of extreme weather events on travel insurance by building a risk assessment model. It analyzes the impacts of extreme weather events on travel insurance and proposed a corresponding insurance pricing strategy [14]. Li (2023) analyzed the premium pricing strategy of flight delay insurance using big data. It proposes to construct a dynamic premium pricing mechanism to adjust premiums in real time according to the latest weather forecasts and climate change trend predictions [15].

2.5. Analysis of the Causes of Air Delays

In terms of the analysis of the causes of flight delays, Allan's team (2001) analyzed the impact of weather factors on the takeoff and landing of flights and the flight process [16]. Meng (2015) comprehensively analyzed the various causes of flight delays and modeled the delay time using the Cox proportional risk model [17]. Miao's team (2016), on the other hand, modeled the probability distribution of flight delays caused by weather factors with a normal distribution, and established an optimization model for seasonal scheduling plans to reduce the waves of flight delays [18]. In terms of the causes of flight delays or cancellations, weather factor is an important factor that affects the probability of travel insurance outages. With the increasing impact of climate change on the tourism industry, the behavior of travelers continues to change and the demand for travel insurance continues to increase.

3. CORRELATION ANALYSIS OF CLIMATE CHANGE AND TRAVEL INSURANCE

3.1. Data Collection and Cleaning

In studying travel insurance in Hong Kong, this paper focuses on the impact of airplane flight delays on travel insurance and claims. To conduct the related research, this paper firstly collected data on the specific time of flight departure and landing, as well as the historical weather data of the origin and destination. In the process of data collection, the cross-influence of factors such as the amount of flight data, travel preferences of Hong Kong residents, and the global representativeness of air routes were considered. In the process of data collection, the cross-influence of factors such as the amount of flight data, travel preferences of Hong Kong residents, and the global representativeness of air routes were considered. Route data from Hong Kong International Airport to 12 airports, including Shanghai Pudong Airport, Beijing Capital Airport, Tokyo Narita Airport, Los Angeles International Airport, London Heathrow Airport, Sydney Kingsroyd Airport, Toronto Pearson Airport, Moscow Sheremetcheva Airport, Dubai International Airport, Frankfurt International Airport, Paris Charles de Gaulle Airport, and Johannesburg Airport in South Africa, were finally selected. A total of 7,791 flight data on these 12 routes were quantitatively analyzed. These data were obtained from flight information on Flightaware and the Air Traveler App, including information on the flight's origin, destination, departure time, arrival time, and flight time. The flight data from March 1, 2024 to May 27, 2024 were selected.

Table 1. Flight status statistics table

HK→	Total number of flights	Number of delays	Number of cancellations
Shanghai	1986	619	357
Beijing	1267	356	129
Tokyo	1773	725	44
Los Angeles	560	230	75
London	584	274	31
Sydney	277	128	7
Toronto	254	113	2
Moscow	85	33	0
Dubai	344	116	9
Frankfurt	294	142	21
Paris	307	178	53
Johannesburg	60	19	10
Total	7791	2933	738

Data from the Civil Aviation Administration of China (CAAC) shows that weather factors account for 56% of the factors affecting flight regularity from 2016 to 2020 [19]. Therefore, this paper also focuses on the collection of route weather data, including information on rainfall, wind speed, typhoons, and rainstorm warnings for Hong Kong and destinations. These data were obtained from weather websites such as the China Meteorological Network and the Hong Kong Observatory. In addition, in order to study the related travel insurance situation, information on travel insurance was collected from the official websites of insurance companies in Hong Kong (e.g. AXA, HSBC, Prudential, Ping An, etc.). Eventually, the study collected and organized data on the number of flights with travel insurance in force, cases of insurance claims, amount of claims, and terms of insurance.

3.2. Data Processing

Statistically, most insurance companies in Hong Kong usually use a five-hour time limit, which means flight delays must exceed a certain number of hours before an insured person can make a claim. Compensation won't be paid if the delay is only short due to air traffic control.

According to the terms and conditions of Ping An Insurance's flight delay insurance, delay time is defined as either [20]:

From the original scheduled departure time of the aircraft until the actual departure time of the aircraft, or up to the departure time of an alternative means of transportation arranged by the airline.

From the time the aircraft was scheduled to arrive at its destination until the time the aircraft arrives at its destination, or up to the arrival time of an alternative means of transportation arranged by the airline.

Therefore, the delay time of the airplane is accurately calculated and matched with the conditions for the insurance to be effective, so as to determine the number of flights whose delay exceeds the time for which the insurance is effective.

Eventually, the following collected data elements were obtained:

Table 2. Climatic factors statistics table

Air Routes: HK→	Total number of flights		Normal Departure		Delayed or canceled		Number of flights reaching claim criteria	
Impact of climatic factors (√ or ×)	√	×	√	×	√	×	√	×
Shanghai	1118	868	227	783	891	85	234	139
Beijing	525	742	83	699	442	43	56	79
Tokyo	770	1003	73	931	697	72	60	8
Los Angeles	300	260	86	169	214	91	94	2
London	324	260	76	203	248	57	41	5
Sydney	162	115	45	97	117	18	16	2
Toronto	144	110	43	96	101	14	7	2
Moscow	40	45	17	35	23	10	1	3
Dubai	158	186	52	167	106	19	13	4
Frankfurt	154	140	40	91	114	49	22	7
Paris	226	81	37	39	189	42	66	16
Johannesburg	30	30	7	24	23	6	1	10
Total	3951	3840	786	3334	3165	506	611	277
	7791		4120		3671		888	

Through statistical analysis, in 7791 flight data, 3671 flights were delayed or canceled, with a probability of about 47.12%. Among them, 3,165 flights were delayed or canceled due to climatic factors, and the probability of delayed or canceled flights under the influence of climate is as high as 80.11%. It can be seen that climatic factors have a significant impact on flights in Hong Kong. After calculation and statistics, the number of flights delayed for more than 5 hours or canceled to meet the criteria for insurance claim is 888, accounting for about 11.40%. Among these flights, 611 flights were effective because of climate, and the probability of insurance being effective under the influence of climate is about 15.46%, which is 4.06% higher than the total probability of being effective. It can be shown that climate factors also have a certain impact on whether travel insurance is effective in Hong Kong.

3.3. Correlation Analysis

3.3.1. Climatic factors and flight delays

A chi-square test was performed on the data counted above to test whether there is a correlation between climatic factors and flight delays or cancellations.

Table 3. Chi-square test for Climatic factors and flight delays

		Whether delayed or canceled		Total	X^2	p
		√	×			
Whether flights were canceled or delayed due to climatic factors	√	3165 (1861.65) [912.48]	786 (2089.35) [813.04]	3951	3500.9134	p*<0.00001
	×	506 (1809.35) [938.86]	3334 (2030.65) [836.54]	3840		
Total		3671	4120	7791		
* p<0.05 ** p<0.01						

$$T_{11}=\frac{(a+c)(a+b)}{a+b+c+d}=\frac{3671\times3951}{7791}=1861.651;\ T_{12}=\frac{(b+d)(a+b)}{a+b+c+d}=\frac{4120\times3951}{7791}=2089.349$$

$$T_{21}=\frac{(a+c)(c+d)}{a+b+c+d}=\frac{3671\times3840}{7791}=1809.349;\ T_{22}=\frac{(b+d)(c+d)}{a+b+c+d}=\frac{4120\times3840}{7791}=2030.651$$

$$x2=\sum\frac{(T-A)^2}{T}=3500.9134$$

The chi-square statistic was calculated to be 3500.9134, p<0.00001. therefore, it can be found that there is a great correlation between climatic factor effects and flight delays or cancellations at a confidence level of 0.05.

3.3.2. Climatic Factors and Travel Insurance Claim Occurrence

Next, the chi-square test is conducted to determine whether climate factors are correlated with travel insurance Claim Occurrence. Different sample sizes will be selected for the test in this part. First, the correlation between the two is analyzed in delayed or canceled flights.

Table 4. Chi-square test for Climatic factors and Insurance claim occurrence in delayed or canceled flights

Of delayed or canceled flights		Whether the claim criteria have been met		Total	X^2	p
		√	×			
Whether flights were canceled or delayed due to climatic factors	√	611 (765.60) [31.22]	2554 (2399.40) [9.96]	3165	298.762	p*<0.00001
	×	277 (122.40) [195.27]	229 (383.60) [62.31]	506		
Total		3671	888	3671		
* p<0.05 ** p<0.01						

The chi-square statistic is calculated to be 298.762 and p<0.00001 at 95% confidence interval level. therefore, it can be proved that there is a great correlation.

The correlation analysis between the two is then continued with a sample range of all flight numbers.

Table 5. Chi-square test for Climatic factors and Insurance claim occurrence in all flights

Of all flights		Whether the claim criteria have been met		Total	X^2	p
		√	×			
Whether flights were canceled or delayed due to climatic factors	√	611 (450.33) [57.33]	3340 (3500.67) [7.37]	3951	131.2753	p*<0.00001
	×	277 (437.67) [58.98]	3563 (3402.33) [7.59]	3840		
Total		888	6903	7791		
* p<0.05 ** p<0.01						

The chi-square statistic is calculated to be 131.2753 and p<0.00001 at 95% confidence interval level. therefore, it can be proved that there is a great correlation.

Combined with the above analysis, it is reasonable to believe that climatic factors have great correlation with the rate of travel insurance claims as determined by whether the claim criteria of travel insurance are met.

4. SUMMARY

The research examines the impact of climate change on the travel insurance industry through an in-depth analysis of the changes in travel insurance premiums in Hong Kong. The relationship between climate change and travel insurance was analyzed at the theoretical level through the literature research method study. Through the empirical research method and statistical analysis, it also shows that the empirical data reveals the actual impact of climate factors on flight delays and worldwide travel insurance claim occurrence in Hong Kong. This paper utilizes the chi-square distribution for correlation test and the findings show that the increase in adverse weather conditions leads to an increase in flight delays and consequently an increase in the probability of travel insurance claims and that there is a significant correlation between the two. This implies that the climatic factors brought about by climate change have a great impact on the effective claims of travel insurance.

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