The Impact of Climate Risk on the Risk-Taking Behavior of Insurance Companies

Yufan Wang*

International Business School, Southwest University of Finance and Economics, Chengdu, Sichuan 611100, China

*wyf0503291@outlook.com

Abstract

In recent years, extreme weather occurring has increased significantly and frequently. Insurance companies, as important financial institutions, are affected by climate risks in their portfolios, claims expenditures, and reinsurance market pressures. At the same time, due to the unique risk-sharing function and asset-liability structure of insurance companies, their sensitivity to climate risks and response mechanisms may be significantly different from those of other financial institutions. Through the two-way fixed effect model, it is found that climate risk has a negative influence on the risk-taking behavior of insurance companies, and this impact is more significant in high-climate risk provinces. The research expects to enrich the relevant theories of insurance companies and provide suggestions for insurance companies to optimize risk management from both theoretical and practical levels.

Keywords

Climate Risk, Insurance Company, Risk-Taking Behavior, High Climate Risk Provinces.

1. Introduction

In recent years, climate risk problems characterized by climate warming have intensified and gradually become a global phenomenon, which has had a serious affect on the world economy, and then caused irreversible damage to the improvement of society. Existing academic literature typically categorizes climate risk into two primary dimensions: physical risk and transition risk. [1].

Based on the increasing climate risk, there is a large amount of literature that discusses the economic and financial impact of climate risk and provides ways to deal with it. Climate risk perception can improve ESG performance through corporate environmental spending effects, green innovation effects, and pollution reduction effects. In addition, climate warming has a negative influence on corporate profitability by reducing corporate revenue and increasing corporate costs [3]. Climate risks can also affect companies' financing and performance, with many companies losing revenue due to soaring energy costs and damage to production facilities due to climate risks [4].

Although many existing literatures explore how climate risk will affect enterprises from the aspects of performance and risk taking, there is little exploration of what the behavior of the insurance company if there are climate risks. Insurance companies are important financial institutions established in accordance with the law and specializing in insurance business, which play an important role in risk transfer, loss compensation, and fund management in the face of climate risks, and occupy an important position in maintaining social development and stability. Therefore, climate risk may have a greater impact on the risk-taking behavior of insurance companies.

There are several contribution of this paper. Firstly, at the theoretical level, this research enriches the research framework concerning the driving factors behind insurance companies' risk - taking behavior. Moreover, it offers a novel theoretical interpretation for a deeper understanding of such risk - taking conduct exhibited by these companies. It also provides theoretical support. Second, the existing literature has mostly centered on the impact of climate risk on the risk - taking behavior of enterprises and banks. In contrast, this paper explores the connection between climate risk and insurance companies, thereby further enriching the relevant theoretical system. Third, at the practical level, the study is based on empirical analysis, which can promote insurance companies to optimize risk management strategies, enhance capital solvency, promote climate model integration and customer risk education, and promote the sustainable development of companies.

2. Existing Research

2.1. Possible Influence of Climate Risks

The increasing global climate change problem, increase in extreme weather events, the continuous rise in sea levels, and the severe situation facing biodiversity conservation not only have irreversible impacts on the environment, but also pose significant challenges to the operation of enterprises [5]. Extreme climate disasters have become a major economic and social challenge on a global scale [6]. Relevant scholars have indicated that climate risks are likely to exert a certain degree of impact on the financing activities and operational performance of listed companies worldwide, and many companies have reduced their profits due to soaring energy costs and damage to production facilities [4]. Extreme climate change is one of the important triggers for the accumulation of risks in the financial system, such as physical risks, which often have serious negative impacts on the financial system through balance sheets and credit provision [7]. Existing literature analyzes the possible impact of climate risk in detail from the aspects of global ecology and economic and financial systems, including enterprises, but the existing literature rarely analyzes the risk assumption of property insurance companies.

2.2. Definition, Measurement Method and Influencing Factors of Risk-Taking Behavior

Risk-taking behavior is the tendency of the owner or management of the company to take risks in order to obtain high returns [8]. Some studies have also pointed out that underwriting risk and investment risk are the two most important risks that insurance companies face in business practice, while property insurance companies mainly provide short-term protection business and play the role of risk bearers in the market [9]. For the risk-taking behavior of insurance companies, some studies have used the proportion of insurance funds used in external investment to measure investment risk [10].Regarding the risk-taking behavior of enterprises, some studies have pointed out that the salary flow and ownership incentive ratio of the senior management team are negatively correlated with the enterprises' risk-taking behavior, and their option holdings are positively correlated with the them[11]. There is also literature suggesting that enterprise performance evaluation may exert a negative impact on the risk - taking behavior of enterprises[12]. It can be seen that the influencing factors of banks and enterprises' risk-taking behavior has been studied, such as asset level, degree of digitalization, climate risk. However, it is rarely discussed from insurance companies.

3. Theoretical Basis and Research Hypothesis

The global average temperature in 2023 will be 1.45℃ higher than in 19th century, and extreme weather events will exacerbate, causing huge economic losses to the world [3].

According to the Blue Book of China Climate Change (2021), from 1961 to 2020, China's climate risk index has also presented an upward trend [13]. Climate change can have significant impacts such as droughts, storms, high temperature, flood, and heavy rainfall [14]. These natural disasters caused by climate change will cause certain losses to social development and living environment to a greater or lesser extent.

Insurers have multiple functions in the face of losses caused by climate risks, including the core business of risk transfer and loss compensation, such as financial compensation for property, personal or business losses caused by extreme weather for example the flood, high temperature. Studies have demonstrated that insurance improves social welfare through risk sharing from the perspective of welfare economics, especially for unpredictable losses [15]. In summary, this paper proposes the following hypotheses:

H1: Climate risks can have a negative influence on the risk-taking behavior of insurance companies.

Climate change risk encompasses the likelihood and severity of harmful consequences for both natural ecosystems and socio-economic systems, resulting from shifts in the climate system due to natural variability or human-induced disruptions. [16]. With the future socio-economic development, the risk of climate change will be coupled with the natural environment and socio-economic risk bearers to form a regular spatio-temporal pattern of risk [17]. Studies have identified that China's high-risk drought zones are primarily concentrated in southern Inner Mongolia, the Loess Plateau, and the country's southwest region. The medium and medium risk zones of drought are mainly distributed in the Inner Mongolia Plateau, North China, South China and other regions. The national heat wave risk areas are mainly distributed in the inland of North China, the inland of East China, and the eastern coast. The flood-prone areas are primarily concentrated in three key regions: the eastern coastal zone, the middle and lower basins of the Yangtze River, and the lower reaches of the Yellow River. These regions face heightened vulnerability due to a combination of heavy rainfall, dense population centers, and low-lying topography. The southern wing of the Eastern Himalayas is a high and moderate flood risk area.

This paper consults the research on the distribution of climate risks in China by Wu Shaohong et al., and argues that the risk-taking behavior of insurance companies located in provinces with high climate risks will be different from those in other provinces. In summary, this paper proposes the following hypotheses:

H2: Being located in these provinces with higher climate risks will exacerbate the negative impact of climate risks on the risk-taking behavior of insurance companies.

4. Research Method

4.1. Variable Interpretation

This paper chooses A-share listed companies excluding ST and financial industry (CSRC 2012 edition industry classification) from 2010 to 2019, and the data related to the risk-taking behavior of insurance companies and other financial data comes from CSMAR and Wind, the climate risk-related data comes from the China Climate Change Blue Book. After removing the missing values and suffocating the tail, 1076 observations were finally obtained, and the panel data was used for regression.

The variable explained in this paper is risk-taking behavior (*risk*). The risk-taking behavior of an insurance company refers to the risk of transferring the policyholder through the insurance contract. For climate risk, the risk-taking behavior of insurance companies refers to the compensation that insurance companies need to pay in the face of losses caused by climate disasters such as typhoons and floods. This paper draws on the research by Wang Lizhen to

calculate [18]. The smaller the proportion of non-business expenses, the more insurance companies spend on climate risks.

The explanatory variable for this paper is climate risk (*CPRI*). Climate risk refers to the threat and negative impact on the social, economic, and ecological environment systems caused by climate change and related extreme events. In this paper, using the research method of Guo, the original meteorological data from the National Oceanic and Atmospheric Administration of the United States is processed using the data of extreme high temperature, low temperature, precipitation, and drought within one year, constructing a comprehensive index for each part, and finally take the average to obtain a CPRI index [19]. Use CPRI to measure climate risk in provinces. If the CPRI index is higher, the climate risk for the province will be greater.

Referring to the relevant research of Wang, this paper selects variables that may have an impact on the risk-taking behavior of insurance companies as control variables [18]. (1) Company size(*size*). The natural logarithm of a company's total assets. (2) ROA. Calculated through the ratio of net profit to total assets. (3) Reinsurance ratio (*inrein*). Measured using the ratio of ceding premiums to total premiums. (4) Profit growth rate (*profit*). It is measured as the ratio of the difference in profits over two years to the average total assets during this period. (5) Market share(*market*). It is measured as the ratio of premium income to the total premium income of the market. In order to carry out the heterogeneity test, this paper calculates the average company size, which is 1 for the size of companies larger than the average and 0 for the size of companies less than the average.

Drawing on Wu's research, this paper designates insurance companies located in provinces with higher climate risks as moderating variables, assigning a value of 1 to those in such provinces and 0 to those in other provinces[17].

4.2. Model Setting

In order to verify this inference, this paper uses model (1) to analyze the two-way fixed benefit model.

$$risk_{i,t=}\beta_1 + \beta_2 CPRI_{i,t} + \beta_3 size_{i,t} + \beta_4 ROA_{i,t} + \beta_5 inrein_{i,t} + \beta_6 profit_{i,t} + \beta_7 market_{i,t} + \gamma_i + \delta_t + \theta_{pro} + \varepsilon_{i,t} \quad (1)$$

In model (1), i is insurance company, t is year, β1is constant term, β2−β7 is the coefficient, controlling the year and province, and ε is random perturbation term, where the dependent variable is risk, independent variable is CPRI, and the factors at the insurance company level are controlled, as well as the fixed effects of the control industry and province.

Next, to further verify the moderating effect of climate characteristics in the province, a model (2) is constructed:

$$risk_{i,t} = \beta_1 + \beta_2 CPRI_{i,t} + \beta_3 province_{i,t} + \beta_4 risk_{i,t} * province_{i,t} + \beta_5 ROA_{i,t} + \beta_6 inrein_{i,t} + \beta_7 profit_{i,t} + \beta_8 market_{i,t} + \beta_9 size_{i,t} + \gamma_i + \delta_t + \theta_{pro} + \varepsilon_{i,t} \quad (2)$$

In model (2), i is insurance company, t is year, β1is the constant term, β2-β9 is the coefficient, controlling the year and province, and ε is the random perturbation term, where the moderating variable is the province, and the intersection is risk*province.

5. Analysis of Empirical Results

5.1. Descriptive Results

According to analysis (Table 1), it can be seen that the current insurance companies' compensation expenditure on climate risk is large, and the differences between companies are large and the level of CPRI varies greatly between provinces.

Table 1. Descriptive Results

VarName	Obs	Mean	SD	Min	Max
risk	1014	-9.072	1.532	-13.208	-5.581
CPRI	1014	43.795	8.657	25.810	59.720
size	1014	9.727	2.047	5.982	14.996
ROA	1014	-0.003	0.042	-0.183	0.083
inrein	1014	12.496	19.307	-0.630	99.920
profit	1014	0.103	2.949	-10.880	10.500
market	1014	0.799	1.983	0.000	10.780

5.2. Hausman Test and Benchmark Regression Results

According to the Hausman test, the difference in the obtained coefficients is significant, so this study fixes province and year variables for regression. According to the Table 2, correlation coefficient between CPRI and insurance companies' risk-taking behavior (risk) is -0.0125 (>0), and P=0.064 (<0.1), indicating that there will be a negative effect and the impact is significant. The hypothesis of H1 was verified.

Table 2. Hausman Test and Benchmark Regression Results

	(1)	(2)	(3)
	S1	S2	S3
VARIABLES	risk	risk	risk
CPRI	-0.0108	-0.0126*	-0.0125*
	(0.0067)	(0.0067)	(0.0067)
size		-0.4728***	-0.4921***
		(0.1285)	(0.1315)
ROA		1.0307	0.7019
		(1.9140)	(2.2641)
inrein		-0.0084**	-0.0084**
		(0.0039)	(0.0039)
profit			0.0046
			(0.0149)
market			0.0881*
			(0.0529)
Constant	-8.2325***	-3.8868***	-3.8100***
	(0.3214)	(1.2022)	(1.2280)
Observations	1,008	1,008	1,008
R-squared	0.0217	0.0668	0.0681
Number of id1	141	141	141

The brackets are robust standard errors *** p<0.01, ** p<0.05, * p<0.1

5.3. Moderating Effect

To explore the effect of the different province, multiplication term (riskpro) of the independent variable and the moderating variable was added in this study, and the regression was carried out using model (2), fixed province and year (year). According to the regression results (Table 3), it is found that the correlation coefficient between risk-taking behavior (risk) and riskpro of insurance companies is 0.974 (>0) and P=0.063 (<0.1), and the correlation coefficient between risk-taking behavior and climate risk of insurance companies is -0.00757 (<0), This indicates that in the provinces with higher CPRI, the negative impact is exacerbated, and the effect is statistically significant. This result validates the hypothesis of H2.

Table 3. The regression results

	(1)	(2)	(3)
	S1	S2	S3
VARIABLES	risk	risk	risk
CPRI	-0.0066	-0.0077*	-0.0076*
	(0.0041)	(0.0041)	(0.0040)
riskpro	0.9952***	0.9739***	0.9746***
	(0.0056)	(0.0128)	(0.0130)
size		-0.2527**	-0.2697**
		(0.1096)	(0.1121)
ROA		0.4519	1.0543
		(1.1320)	(1.2691)
inrein		-0.0042	-0.0042
		(0.0029)	(0.0029)
profit			-0.0093
			(0.0092)
market			0.0645
			(0.0459)
Constant	-8.7004***	-6.3723***	-6.2692***
	(0.2071)	(1.0142)	(1.0297)
Observations	1,008	1,008	1,008
R-squared	0.5581	0.5705	0.5716
Number of id1	141	141	141

The brackets are robust standard errors *** p<0.01, ** p<0.05, * p<0.1

6. Robustness Test

This study replaces the measure of insurance companies' risk-taking behavior with an alternative indicator: the ratio of non-operating expenses to insurance business income (denoted as risk1). The results of this robustness test (Table 4) show that CPRI still exerts a significant negative impact on insurance companies' risk-taking behavior.

Table 4. Robustness Test

	(1)	(2)	(3)
	S1	S2	S3
VARIABLES	risk1	risk1	risk1
CPRI	-0.0173**	-0.0181***	-0.0182***
	(0.0068)	(0.0067)	(0.0067)
size		-0.2207*	-0.1995
		(0.1302)	(0.1299)
ROA		-2.8257	-3.0597
		(1.9268)	(2.1817)
inrein		0.0087**	0.0087**
		(0.0041)	(0.0041)
profit			0.0039
			(0.0138)
market			-0.0871
			(0.0536)
Constant	-6.7975***	-4.9654***	-5.0735***
	(0.3453)	(1.2225)	(1.2320)
Observations	1,008	1,008	1,008
R-squared	0.0205	0.0441	0.0455
Number of id1	141	141	141

The brackets are robust standard errors *** p<0.01, ** p<0.05, * p<0.1

7. Conclusion

Research illustrates that, first, climate risk has a negative impact on insurers' risk-taking behavior. Secondly, the moderating effect shows that provinces with more extreme weather will strengthen the negative impact of climate risks. This means that in provinces with more extreme weather, insurance companies will reduce non-operating expenses to ensure their compensation for climate risks. Finally, further analysis shows that the heterogeneity of insurance company size has no significant impact on the relationship between climate risk and insurance companies' risk-taking behavior.

Implications of this study are that insurance companies should face up to climate risks, adjust contracting strategies and optimize capital management, and minimize the company's compensation expenses on the basis of customer interests. Insurance companies should continue to innovate, actively introduce dynamic climate science models, update model parameters regularly, improve prediction capabilities, and make sufficient preparations for a better response to climate risks. or cooperate with customers to promote disaster prevention measures to reduce the company's compensation expenses. Insurance companies should also share data with the government and scientific research institutions as much as possible, and participate in the formulation of climate adaptation policies so that the policies truly benefit all parties.

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