Climate Impact and High-quality Development Level of the Low-altitude Economy: From the Perspective of Physical Risk

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Abstract. Under the background of intensified climate change and frequent extreme weather, the low-altitude economy, as a new strategic industry in China, is facing severe external environmental challenges. Based on the panel data of 30 provinces in China from 2010 to 2021, this paper uses the entropy method to construct high-quality development indicators of a low-altitude economy and empirically analyzes the impact mechanism of climate physical risks. The results show that the climate physical risk significantly inhibits the high-quality development of a low-altitude economy, and the effect is still stable after endogenous mitigation and robustness test, and there is a time lagging feature. Heterogeneity analysis shows that extremely low temperatures and extreme rainfall have the most significant inhibitory effects, the northern region is more affected by climate risks, and the southern region has a certain buffering capacity. The research enriches the industrial application of the economic effects of climate risk and expands the theoretical perspective of low-altitude economic risk management.

Keywords: Climate risk; Physical risk; Low altitude economy.

1. Introduction

Relying on low-altitude airspace resources and taking manned and unmanned aircraft as carriers, the low-altitude economy, as a comprehensive economic form to promote multi-field integration and development, has become a strategic emerging industry to cultivate new quality productivity and promote high-quality development in China. Different from the traditional aviation economy relying on large airports and high-altitude routes, the low-altitude economy is widely used in multiple scenarios such as logistics and transportation, air traffic, and emergency rescue through distributed nodes and flexible scheduling, showing strong industrial integration and innovation potential. In 2021, the *Outline of the National Comprehensive Three-Dimensional Transportation Network Plan* first proposed “developing low-altitude economy” [1]. Since then, many national strategic documents have successively included it in the key layout, clearly promoting airspace management reform and infrastructure improvement. The Ministry of Industry and Information Technology proposes to form a trillion-dollar market scale by 2030 [2]. The Civil Aviation Administration of China predicts that the scale is expected to exceed 3.5 trillion yuan in 2035. Low-altitude economy is becoming a new engine for industrial upgrading and regional coordinated development, and plays an important role in the transformation of old and new kinetic energy and the improvement of public services, helping China’s high-quality economic development.

However, the vigorous development of a low-altitude economy also faces many challenges: as a new industry, the technology research and development cycle is long, the capital investment is large, the risk is high, and the process from technological innovation to industrial application is full of uncertainty [3]. Especially in the context of global climate change, climate risk will continue to be listed as the most threatening risk category in the world in the next decade, and extreme weather events are considered the primary factor that is most likely to trigger a major crisis at present [4]. The low-altitude economy is highly sensitive to the meteorological environment. Extreme weather phenomena such as strong winds, rainstorms, and low temperatures may have many effects on aircraft flight safety, airspace resource allocation, and operational efficiency, and then interfere with its stable development. Against this background, as an important external environmental variable, how climate physical risk affects the path and mechanism of high-quality development of a low-altitude economy needs in-depth study and systematic evaluation.

Compared with previous studies, the marginal contribution of this paper is mainly reflected in the following aspects: First, in terms of research perspective, this paper breaks through the previous research ideas of investigating the development path of the low-altitude economy mainly from the perspectives of technological innovation and institutional arrangement within the industry and introduces the external environmental variable of climatic physical shock in an innovative way. This study also discusses its restrictive effect on the high-quality development of the industry and broadens the research horizon of low-altitude economic risk sources. Second, in terms of research content, this paper reveals the characteristics of the impact of climate physical risks on low-altitude economic development in multiple dimensions, identifies its significant lag effect in the time dimension, and further explores the heterogeneous impact paths of different types of climate risks (such as extreme low temperature and extreme rainfall), and finds that the impact of climate risks on low-altitude economy is significantly different between the north and the south. These findings provide new empirical support for understanding the interaction between climate change and emerging industries.

2. Literature Review

2.1 Literature review of the low-altitude economy

In the past, scholars have conducted in-depth discussions on the connotation and development path of a low-altitude economy from multiple dimensions. Zhong and Hu (2024) believed that the high-quality development of a low-altitude economy depended on the deep empowerment of new digital productivity. The penetration of digital technology not only improves the operational efficiency of all links in the low-altitude industrial chain but also helps its green transformation and ecosystem optimization [5]. Ouyang (2025) further pointed out that a low-altitude economy has the characteristics of technological innovation, spatial dependence, and cross-border integration, a long industrial chain, and a strong driving effect, and can promote new business forms and stimulate new kinetic energy through the integration of “low-altitude+logistics” and “low-altitude+transportation” [6]. In international research, scholars paid more attention to the system construction and ecological analysis of urban air traffic (UAM) and advanced air travel (AAM). Cohen et al. (2021) systematically combed the development history, industrial ecology, and main obstacles faced by UAM, and considered that infrastructure, supervision system, and community acceptance were still the core challenges restricting the sustainable development of low-altitude transportation systems [7]. Dulia et al. (2022) quantitatively evaluated the social and environmental benefits of AAM in Ohio by cost-benefit analysis and verified the positive role of the low-altitude travel system in improving traffic efficiency, reducing carbon emissions, and improving medical transportation, which provided strong empirical evidence for the sustainability of low-altitude economy [8].

2.2 Literature review on climate risk

In recent years, climate physical risks and their impact on economic activities have gradually become the focus of global attention. Extreme weather events occur frequently and increase in intensity, which has become an important external factor disturbing macroeconomic operation and industrial chain safety. Relevant research generally holds that climate change not only directly damages infrastructure and production efficiency, but also may have a systematic impact on the financial system and macroeconomic stability through channels such as shrinking asset value and increasing fiscal expenditure (Stern, 2008; Dietz et al., 2016) [9][10]. At the industrial level, a large number of literature has paid attention to the impact of climate physical risks on agriculture (Elias et al., 2019) [11], energy (Sobik, 2022) [12], transportation (El-Hermisy, 2021) [13], and other traditional industries, revealing that it affects industrial operation efficiency and economic resilience through production interruption, imbalance between supply and demand, infrastructure destruction and other mechanisms. However, the existing research mostly focuses on traditional industries, lacking systematic discussion on emerging industries, especially low-altitude economy, which is highly dependent on meteorological conditions and infrastructure support and has not thoroughly evaluated the impact of climate risk on its high-quality development.

3. Theoretical Mechanism and Research Hypothesis

Climatic physical risks affect the high-quality development of a low-altitude economy through two paths: supply-side impact and demand-side inhibition. On the one hand, the supply-side impact shows that extreme weather events (such as low temperature, rainstorms, strong wind, etc.) interfere with the normal operation of aircraft, affect the stability of navigation, communication, and flight control systems, reduce the availability and safety of aircraft, and weaken the support capacity of infrastructure. On the other hand, demand-side inhibition is reflected in the fact that climate shock increases operational risks and uncertainties, reduces users' acceptance of low-altitude economic services, compresses market demand, and further affects enterprise investment expectations and market expansion space. With the aggravation of climate physical risks, the low-altitude economy is facing greater pressure in-flight environment, infrastructure, market demand, and other aspects, and the resilience and sustainability of high-quality industrial development are significantly challenged. Based on this, this paper puts forward the following research hypotheses:

H1a: Climate physical risks will have a negative impact on the high-quality development level of a low-altitude economy.

4. Data Description and Model Construction

4.1 Data description

4.1.1 Explained variable

In this paper, the high-quality development level of a low-altitude economy is used as the explained variable. Referred to Liu (2025) [14], based on the measurement method, the index system is constructed from five dimensions: technological innovation, infrastructure, industrial scale, market demand, and economic environment, which systematically reflects the comprehensive development level of low-altitude economy. Specific indicators are set as shown in Table 1, covering many secondary indicators such as innovation environment, communication and navigation, industrial income, transportation, and logistics demand, and comprehensively examining the supporting conditions and industrial capabilities of the low-altitude economy. To determine the weight of each index objectively, this paper uses the entropy weight method to calculate the weight, makes full use of the internal information entropy of the index, scientifically distributes the weight, and finally gets the scores of low-altitude economic modernization level of each province. The higher the score, the higher the high-quality development level of the low-altitude economy. This indicator covers 30 provinces (excluding Hong Kong, Macao and Taiwan, Tibet) from 2010 to 2021, and the data mainly comes from authoritative data sources such as *China Statistical Yearbook, China Statistical Yearbook on High-Technology Industry,* and provincial statistical yearbooks. For a small number of missing data, the moving average method is used to fill in reasonably to ensure the continuity and integrity of the data.

Table 1: Low-altitude Economy and High-quality Development Level

Primary index	Secondary index	Tertiary index
Technical innovation	Innovative environment	Public budget for science and technology
		Education public budget
	Innovation investment	R&D investment
		Number of R&D personnel
	Innovative output	Number of patents granted by domestic applicants
		Technology market turnover /GDP

Infrastructure	Communication	Length of long-distance optical cable line per unit area
		Telephone penetration rate
	Transport	Length of air mail route
	Navigation	Number of meteorological service stations receiving satellite cloud images
	Detection	Number of high-altitude detection service stations
Industrial scale	Industrial income	Operating income
		High-tech operating income
		the total profit
	The number of the enterprise	Number of enterprises established by drones
		Computer, communication, and other electronic equipment manufacturing industry
		High-tech industry
	Production capacity	Automobile production
	Employment population	Employment in the air transport industry
Market demand	Traffic demand	Graded highway mileage
		Operational mileage of railways
		Private car ownership
	Logistics demand	Cargo turnover
Economic environment	Level of economic development	Per capita GDP
	Fiscal expenditure	General public budget expenditure
	Industrial development level	Rationalization of the structure of production
		Advanced industrial structure
		Banking amount, loan balance of institutions

4.1.2 Explanatory variables

In this study, climate physical risk (CPR) is taken as the core explanatory variable, and the data comes from GCRID (Guo et al.,2024) [15]. Referring to the definition method of extreme weather events, the historical meteorological observation data from 1973 to 1992 are used to set thresholds: extreme high temperature (HTD) and extreme low temperature (LTD) are defined by the 90th and 10th percentiles of daily maximum temperature and minimum temperature, extreme rainfall (ERD) is defined by the 95th percentile of daily precipitation and extreme drought (EDD) is defined by the 5th percentile of daily relative humidity. Then, based on the daily observation data of meteorological stations from 2010 to 2021, the number of days exceeding or falling below the above threshold in each year is counted respectively to construct four sub-indicators of climate physical risks. To ensure the comparability and scientificity of the indicators, this paper standardizes the four sub-indicators and takes their average values to construct a comprehensive CPR index to measure the climate physical risk level of each region.

4.1.3 Control variables

In the selection of control variables, this paper combines the relevant literature and the characteristics of low-altitude economic development and considers the urbanization rate (CT), the degree of opening to the outside world (OPEN), the size of the labor force (LA), the level of education (HUM) and the level of informatization (IT) to control the possible important influencing factors of low-altitude economic development from the dimensions of social economy, industrial base, and technical support.

4.2 Model construction

This paper mainly studies the impact of climate physical risks on the high-quality development of low-altitude economy, selects provincial panel data from 2010 to 2021, and constructs the following econometric model (Formula (1)):

$$LAE_{it}=\beta_0+\beta_1\cdot CPR_{it}+\sum_{n=2}^{6}\beta_n\cdot X_{it}+u_i+\lambda_t+\varepsilon_{it} \tag{1}$$

Among them, LAE_{it} is the explained variable, indicating the high-quality development level of low-altitude economy in the province i in the year t; CPR_{it} is the core explanatory variable, representing the climate physical risk level of the province i in the year t; β_0 is the intercept term, β_1 and β_n are the coefficients of explanatory variables and control variables respectively; X_{it} represents a control variable; u_i is the fixed effect for the province; λ_t is the time-fixed effect; ε_{it} is a random error term.

5. Empirical Results

5.1 Descriptive statistics of data

Table 2 reports the descriptive statistical characteristics of the main variables. The average LAE of a low-altitude economy is 0.153, which indicates that the overall development level is low and the regional differences are significant. The average value of climate physical risk (CPR) is 0.460, and there is obvious inter-provincial fluctuation. There are some differences in the range and dispersion of the other control variables, which reflect the different development levels of urbanization, openness, labor supply, education, and information foundation in different regions, and provide a good variable basis for the subsequent empirical analysis.

Table2 Descriptive Statistics

Variable	N	Mean	SD	Min	Max
LAE	360	0.153	0.102	0.030	0.764
CPR	360	0.460	0.0870	0.258	0.843
CT	360	0.590	0.125	0.340	0.900
OPEN	360	0.277	0.295	0.008	1.464
LA	360	7.597	0.781	5.624	8.864
HUM	360	0.020	0.006	0.008	0.042
IT	360	0.070	0.140	0.017	2.520

5.2 Benchmark regression

Column (1) of Table 3 reports the regression results of climatic physical risks to the high-quality development of a low-altitude economy when no control variables are added. Column (2) shows the estimation of the impact of climate physical risks on the high-quality development level of a low-altitude economy after the control variables are included.

Table 3 Benchmark Regression Results

	(1) LAE	(2) LAE
CPR	-0.0776***	-0.0513**
	(-2.8659)	(-2.1004)
CT		0.3684**
		(2.5564)
OPEN		-0.1761***
		(-5.4694)
LA		0.0874**

		(2.4811)
HUM		-3.3936**
		(-2.1965)
IT		-0.0052
		(-0.4365)
_cons	0.1402***	-0.6102**
	(9.9311)	(-2.2720)
Year Effect	YES	YES
Province Effect	YES	YES
N	360	360
R2	0.5482	0.6488

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Column (1) of Table 3 shows that the coefficient of climatic physical risk is -0.0776 without any control variables, and it is significant at the level of 1%, which shows that CPR significantly inhibits the high-quality development of a low-altitude economy without considering other factors. In column (2), the coefficient of CPR is still negative (-0.0513) after the control variable is introduced, and it is significant at the level of 5%, which shows that the influence has strong robustness. The reason for this result may be that the development of the low-altitude economy is highly dependent on the stability of the meteorological environment, the safety of flight path and the controllability of airspace resources, and the frequent occurrence of climatic and physical risks will directly weaken these basic conditions. For example, extremely high temperatures, rainstorms, and windy weather may lead to aircraft navigation failure, flight control system interference, communication interruption or landing obstruction, and interfere with the normal operation of low-altitude carriers such as drones and navigators. More importantly, frequent disastrous weather will continue to push up the operational uncertainty and risk exposure of enterprises, bring higher facilities maintenance and insurance costs, and make regulators tend to be cautious in flight approval and safety assessment, thus indirectly inhibiting the willingness of enterprises to expand investment and technology layout. In this context, it is often difficult to form a stable and sustainable low-altitude economic ecology in areas with high climate risks, and its development quality and efficiency are therefore inhibited.

From the control variables, the results are generally in line with expectations. The urbanization rate (CT) is significantly positive, indicating that urban agglomeration helps form the application scenario and demand base of a low-altitude economy. The degree of openness is negative, or it is constrained by cross-border supervision and institutional adaptation; Labor force (LA) is significantly positive, reflecting the supporting role of human resources in the development of low-altitude industries; The education level (HUM) is negative, and there may be a mismatch between the talent structure and the industrial demand. The level of information technology (IT) is not significant, indicating that its supporting role has not been fully demonstrated.

To sum up, the results of benchmark regression show that climate physical risk has become an important factor restricting the high-quality development of a low-altitude economy at the current stage, and the relationship remains stable after controlling a series of socio-economic variables.

5.3 Endogenous test

In this study, the independent variable climate physical risk (CPR) may have endogenous problems. On the one hand, the measurement of CPR may contain errors, such as systematic observation errors caused by uneven distribution of weather monitoring stations, which makes it related to residual terms. On the other hand, some potential variables related to CPR may not be fully controlled by the model, resulting in missing variables bias. Therefore, to alleviate the potential endogenous problems of CPR, this paper uses the instrumental variable method to estimate. In the aspect of tool variable selection, this paper refers to the construction method of share transfer tool variables (Nunn & Qian, 2014; Goldsmith-Pinkham et al., 2020）[16][17] to construct a share transfer tool variable (Post) based on the interaction between historical structure exposure and national climate shock. In this paper, the share part corresponds to the number of Ming Dynasty stations in each province, which is used to measure the connection degree of various regions in the national infrastructure and spatial organization in history. Because the share part does not change with time, to use this tool variable in the panel model, the Shift part of this paper adopts the national annual CPR average. The rationality of this setting lies in that the number of post stations in the Ming Dynasty reflects the early level of regional government decree transmission and basic transportation network construction, and has long-term path dependence effect on modern urban structure, land use pattern, and climate exposure structure, so it has strong structural correlation. At the same time, the annual average value of CPR, as a systematic index of national climate impact, reflects climate fluctuation in the time dimension, but it does not directly determine the low-altitude economic development process of a specific province in a cross-section, meeting the requirements of time exogenous. Therefore, the tool variable construction method takes into account both correlation and externality and has strong recognition effectiveness.

Table 4 reports the estimation results of the instrumental variable method. The results of the first stage show that there is a significant positive correlation between instrumental variables and endogenous variables CPR, and the statistics of Anderson canon. corr. LM ($p < 0.05$) eliminates the problem of unidentifiable, which shows that the model has effective identifiability. However, the Cragg-Donaldwald F-Statistical value is 5.570, which is lower than the critical value of Stock-Yogo (2005) of 10%, suggesting that there may be a problem with weak tool variables. To solve this problem, this paper further uses the limited information maximum likelihood method (LIML) to estimate the robustness. Compared with 2SLS, the LIML method has better small sample properties when the sample size is limited or the tool variables are weak (Fang & Zhao,2011; Zhang & Gu,2023) [18][19]. As shown in column (3) of Table 4, the estimation results of LIML are highly consistent with column (2) of 2SLS benchmark regression in terms of coefficient direction, numerical value, and significance level. This result shows that although there is a certain degree of risk of weak instrumental variables, it has little influence on the main conclusions of this paper, and the estimation results are robust and reliable. To sum up, it can be considered that the results reported by instrumental variables are consistent with the results of benchmark regression after alleviating endogenous factors.

Table 4 Regression Results of Instrumental Variable Method

	Phase I	Phase II	
	(1)	(2)	(3)
	Post	LAE (2SLS)	LAE (LIMI)
CPR	0.0037**	-0.8569**	-0.8569**
	(0.0016)	(-2.2606)	(-2.3709)
CT	0.4627	0.6529*	0.6529*
	(0.3651)	(1.7659)	(1.8521)
OPEN	-0.0331	-0.1936***	-0.1936***
	(0.0806)	(-2.6126)	(-2.7401)
LA	-0.1420	-0.0208	-0.0208
	(0.0902)	(-0.2116)	(-0.2219)
HUM	2.3822	-1.4541	-1.4541
	(3.8511)	(-0.4030)	(-0.4227)
IT	0.0241	0.0168	0.0168
	(0.0278)	(0.6270)	(0.6576)
F-statistic		5.771	6.348
Anderson canon. corr. LM statistic		[0.0163]	[0.0117]
Cragg-Donald Wald		5.570	5.570
F-statistic		[16.38]	[16.38]
Year Effect	YES	YES	YES
Province Effect	YES	YES	YES

N	330	330

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

Note: values in [] correspond to the p-value of the LM test, and values in [] correspond to the Stock–Yogo 10% critical value.

5.4 Robustness test

5.4.1 Removing extreme values

Considering that extreme observations may interfere with the regression results, the main variables are truncated at a 1% level in this paper. As shown in the results in column (1) of Table 5, the coefficient of climate physical risk (CPR) is -0.0494, and it is still significant at the significance level of 5%, indicating that the benchmark conclusion is still robust after removing the extreme value.

5.4.2 Replacing explanatory variables

To further verify the reliability of the results, this paper uses the affected area (AD) of each province as a substitute index for climate physical risk for regression.[20]. The results in column (2) of Table 5 show that the coefficient of AD is -0.0085, and it is significantly negative at the level of 5%. It shows that after replacing the explanatory variables, the conclusion that climate physical risks have a negative impact on the low-altitude economy is still stable.

5.4.3 Lagging explanatory variables

The occurrence of climatic physical risks not only affects the high-quality development of a low-altitude economy at present but may also have a certain time lag effect. To further verify this point, this paper introduces the 1-4 lag term of climate physical risk (CPR) and investigates its continuous impact on the low-altitude economy. The regression results are shown in columns (3)-(6) of Table 5. The lagging coefficient of CPR, the core explanatory variable, passed the significance test in the first three periods, and the influence coefficient showed a gradually decreasing trend, indicating that climate risk had a certain persistent inhibitory effect on the low-altitude economy, but the impact effect weakened with time. By the fourth period, the coefficient was no longer significant. Therefore, this paper holds that the negative impact of climate physical risks on the low-altitude economy has a lag effect, and the negative impact will decrease with time.

Table 5 Robustness Test Results

	(1)	(2)	(3)	(4)	(5)	(6)
	LAE	LAE	LAE	LAE	LAE	LAE
CPR	-0.0494**					
	(-2.2164)					
AD		-0.0085**				
		(-2.4959)				
L.CPR			-0.0790***			
			(-3.2547)			
L2.CPR				-0.0784***		
				(-3.1893)		
L3.CPR					-0.0550**	
					(-2.1203)	
L4.CPR						-0.0288
						(-0.9819)
Controls	YES	YES	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES	YES	YES
N	360	360	330	300	270	240

R2	0.6937	0.6508	0.6363	0.6291	0.6168	0.5870

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

5.5 Heterogeneity test

5.5.1 Different extreme weather types

To further explore the differential effects of climate physical risks, this paper analyzes the heterogeneous effects of four types of extreme weather on the high-quality development of a low-altitude economy, and the results are shown in Table 6. Column (1) shows that extreme low temperature (LTD) has a significant inhibitory effect on low-altitude economic development, with a coefficient of -0.0474, which is significant at the level of 1%, indicating that low temperature has a direct impact on the navigation, take-off and landing and operating environment of aircraft. This limits the industrial development. In column (2), the coefficient of extreme high temperature (HTD) is 0.0277, which is significantly positive at the level of 10%, which may have a limited positive impact because of the hot weather stimulating the demand of specific scenes such as agricultural inspection and power detection. In column (3), extreme rainfall (ERD) also showed an inhibitory effect, with a coefficient of -0.0149, which was significant at the level of 10%, in line with the expectation that extreme rainfall would disrupt flight scheduling and increase safety risks. In contrast, the extreme drought (EED) coefficient in column (4) is -0.0185, which is negative but not significant, indicating that the direct impact of drought on the low-altitude economy is less, and it is more indirectly transmitted through the demand side or industrial chain. Generally, there are significant differences in the impact of different types of extreme weather on the low-altitude economy, among which low temperature and rainfall, as factors directly affecting flight safety, have more prominent inhibitory effects.

Table 6 Heterogeneity Analysis of Different Extreme Weather

	(1) LAE	(2) LAE	(3) LAE	(4) LAE
LTD	-0.0474***			
	(-2.8704)			
HTD		0.0277*		
		(1.9495)		
ERD			-0.0149*	
			(-1.8370)	
EED				-0.0185
				(-1.2326)
Controls	YES	YES	YES	YES
Year Effect	YES	YES	YES	YES
Province Effect	YES	YES	YES	YES
N	360	360	360	360
R2	0.6530	0.6481	0.6477	0.6456

t statistics in parentheses
* p < 0.1, ** p < 0.05, *** p < 0.01

5.5.2 Regional heterogeneity

Table 7 shows the results of heterogeneous regression between the North and the South. Among them, column (1) is the regression estimation of the southern region, and column (2) is the regression estimation of the northern region. The results show that the climate physical risk (CPR) has a significant inhibitory effect on the low-altitude economic development in the northern region, and the CPR coefficient is -0.0567, which is significant at the level of 1%, indicating that the low-altitude economic operation in the northern region is greatly impacted when facing the climate physical risk. This result also echoes the conclusion in the previous analysis that extremely low-temperature events have a stronger inhibitory effect on the low-altitude economy, suggesting that in the background of severe cold in winter and frequent extremely low temperatures, the operation of aircraft is limited and the vulnerability of infrastructure is exposed, which further aggravates the negative impact of climate risk on the low-altitude economy. In contrast, the CPR coefficient of the southern region is 0.0802, which is positive and does not reach a significant level, indicating that although the southern region is also facing climate risks, its industry has strong long-term adaptability and a certain buffering mechanism, and the direct inhibitory effect of risk shocks on low-altitude economic development is relatively limited.

Table 7 Regional Heterogeneity

	(1) LAE	(2) LAE
CPR	0.0802	-0.0567***
	(1.6143)	(-3.2098)
Controls	YES	YES
Year Effect	YES	YES
Province Effect	YES	YES
N	168	192
R2	0.7496	0.7779

t statistics in parentheses

* p < 0.1, ** p < 0.05, *** p < 0.01

6. Conclusions and Policy Suggestions

6.1 Conclusions

With the intensification of global climate change, extreme weather events show a trend of increasing frequency and intensity, and climatic physical risks have become an important external shock source that restricts various economic activities. The low-altitude economy, as a strategic emerging industry to cultivate new productivity and promote high-quality development in China, is highly dependent on the meteorological environment, infrastructure, and policy support, and its high-quality development faces more uncertainties and challenges under the background of climate change. Although there have been a lot of studies on the impact of climate risk on traditional industries, there is still a lack of systematic empirical analysis on the impact path of emerging industries, especially the low-altitude economy. Based on this, this paper selects the panel data of 30 provinces in China from 2010 to 2021, constructs the indicators of high-quality development level of low-altitude economy based on entropy method, and systematically evaluates the impact of climatic physical risks on high-quality development of low-altitude economy, and draws the following main conclusions: First, the benchmark regression results show that climatic physical risks have a significant negative impact on high-quality development level of low-altitude economy, which is based on the tool variable method to alleviate endogenous problems. It is still stable after various robustness tests, such as variable replacement, eliminating extreme values, lagging explanatory variables, etc., and the impact of climate risk on low-altitude economic development presents a certain time lag effect, but the impact intensity gradually weakens. Secondly, heterogeneity analysis shows that different types of climatic physical risks have different effects on low-altitude economies, among which extreme low temperature and extreme rainfall have the most significant inhibitory effects. In addition, there are obvious differences between the North and the South in coping with the impact of climate risk. The negative impact of climate risk is more prominent in the north, while the south shows a certain buffering capacity.

6.2 Policy suggestions

Based on the research conclusion of this paper, the climate physical risks have a significant negative impact on the high-quality development of a low-altitude economy, and different types of climate risks and their effects in different regions are prominent. To effectively alleviate the impact of climate risk and improve the resilience and sustainable development level of a low-altitude economy, the following policy suggestions are put forward.

First of all, it is important to strengthen the adaptability of climate risk and improve the meteorological monitoring and early warning system. Because of the significant impact of extremely low temperatures and extreme rainfall on low-altitude economic operation, it is suggested to speed up the construction and improvement of meteorological monitoring, early warning, and emergency response systems in low-altitude airspace, and improve the prediction accuracy and response timeliness of extreme weather events. Meanwhile, enterprises are encouraged to integrate climate risk adaptation strategies into flight scheduling, route planning, infrastructure design, and other links to enhance the stability and safety of the industrial chain in the face of meteorological disturbances. This measure will provide a basic guarantee for the industry as a whole to enhance its ability to resist risks.

On this basis, because of the significant differences in climate risk exposure and adaptability between the north and the south, it is necessary to optimize the industrial layout according to local conditions and strengthen regional differentiation policy support. It is important to promote the formation of a diversified and differentiated development pattern according to the climate characteristics, industrial base, and development stage of each region. For the northern region, it is necessary to increase policy inclination and support, focusing on improving the anti-risk ability of infrastructure and the adaptability of the industrial chain. On the other hand, the southern region can continue to improve the synergy and innovation ecology of the industrial chain on the existing basis, and further consolidate its resilience advantage. Through regional coordination and differentiated support, the stability and development momentum of a low-altitude economy in a diversified climate environment will be enhanced.

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