

# Study on the Mechanism of Climate Change Impact on Financial Stability and Response

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**Abstract.** This paper presents a summary of recent research on the impact of climate risk on the financial system, with a focus on the relationship between physical and transition risk. At the macroeconomic level, climate risk has a significant impact on overall economic growth and volatility. Research has shown that physical and transition risks arising from climate change interact with each other. Climate physical risks exacerbate the level of economic volatility by affecting the market value of the underlying assets, while climate transition risks impact the financial sector by affecting the level of carbon emissions. At the microeconomic level, climate risks affect various industries to varying degrees. This study offers specific ideas on how to address climate change from the perspectives of international cooperation, government regulation, and technical innovation based on a review of the literature. Governments should actively participate in international climate negotiations and reach agreements. The government should provide legal guarantee and normative basis for responding to climate change by formulating and implementing a series of laws and regulations related. The nation should boost the use of digital technology, encourage the circular economy and sustainable agriculture models, and spend more in the research and development of low-carbon technologies.

## 1 Introduction

Examining how climate change affects financial stability is crucial and essential given the current environment of more frequent and severe climate change. Rising temperatures, which trigger a string of severe rainstorms, tropical storms, floods, and other calamities, are the primary manifestation of climate change. These disasters have a knock-on effect of reduced agricultural yields, water scarcity, ecosystem destruction, and threats to human health and safety. From 2021 to 2024, the total number of climate change-induced natural disasters in China has risen steeply, topping 600 by 2024. Flooding in China during the June-September 2021 rainy season caused 347 deaths and \$30 billion in damages. The dangers presented by climate change have become more widely recognized as a result of this extreme weather event. The Global Risks Report 2023 shows that climate change-related risks account for 50 per cent of the top 10 global risks over the next decade, and that the top three risks are all climate-related.

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The stability of financial markets and economic institutions, as well as the hazards associated with climate change, have been the subject of study findings in this context. The influence of climate change on financial stability gained extensive attention [1]. Credit risk and other still-traditional financial risk transmission channels are some of the ways that climate change impacts financial stability. This result provides direction for subsequent research and data collection [2]. For the first time, financial risks were explicitly categorized in the context of climate and environmental shocks into physical and transition risks [3]. In addition to helping financial institutions and policymakers more precisely identify and evaluate climate change risks, this classification offers a clear framework for comprehending and assessing climate-related financial hazards. Furthermore, studies specifically note that the effects of climate change on financial stability have a cyclical feedback effect [4,5]. A textual analysis of climate change-related news reports and propose hedging strategies were conducted to effectively deal with climate change risks [6].

While some research has been done on how climate change affects financial stability, there isn't much examination of how climate change affects financial stability (risk). Few research has been done based on the real situation in China, whereas the majority of the studies that are now available are centered on industrialized nations in the US and Europe [7]. At the same time, the physical risk caused by climate change and the transition risk do not exist in isolation, and the relationship between them is vaguely defined in existing studies. However, the relationship between the transition risk and the physical danger brought on by climate change is not well characterized in literature, and the two risks do not exist in isolation. Moreover, most of the existing studies focus only on the banking, insurance and high-carbon industries, and rarely provide practical recommendations from a global perspective.

Thus, to address the current research gaps, this paper will focus on China. Drawing from existing literature, this paper will examine the two-way relationship between physical risk and transition risk before analyzing the main mechanism of how climate risk affects financial stability from a macro perspective. Through the research, this paper expect to provide ideas and suggestions on how countries and financial institutions can actively respond to the potential risks brought by climate change. Simultaneously, this paper aims to demonstrate quantitatively how climate risk affects the economic environment and urge all sectors and individuals to focus on carbon emissions and mitigate climate change risk from a personal standpoint in order to collectively preserve financial stability.

## **2 Key links between climate change and financial stability**

As the volatility of global climate change intensifies, responding to climate change has become the common responsibility and urgent task of all humankind. As an important part of the economic system, financial institutions must fully recognize the risks posed by climate change and take active and effective measures to cope with them. Climate change is a serious hazard to the financial market and could lead to systemic financial concerns [8]. Climate risk can be divided into two categories: physical risk and transformation risk. Physical risk includes direct economic losses, including those caused by extreme weather occurrences, while transformation risk includes losses brought about by changes in policy, technological advancements, and other factors. Financial institutions' sustainability and soundness can be enhanced by integrating climate risk management into a comprehensive risk management system and enhancing the identification, evaluation, and control of climate risk. This will also strongly support the low-carbon transition and the sustainable growth of the entire economic system. The major connection between financial stability and climate change is the shift to low-carbon industry. The low-carbon transition of industries will bring with a range of risks of asset devaluation and credit defaults, especially for high-carbon industries.

## 2.1 Transition risks

Governments have implemented stringent carbon emission laws, such as carbon taxes and carbon emission trading schemes, as the world's concern over climate change has steadily grown. The market value of associated assets will drop as a result of these policies' increased production costs and decreased profit margins for high-carbon businesses. Findings show that global fossil fuel reserves will depreciate by 37% to 50%, reaching \$13 trillion to \$17 trillion [9]. At the same time, governments are increasing their support for low-carbon industries, such as subsidies and tax incentives for renewable energy, while support policies for high-carbon industries are gradually being reduced or eliminated. This policy shift will reduce the relative value of assets in high-carbon industries, and investors will be more inclined to invest funds in low-carbon industries, leading to the depreciation of assets in high-carbon industries. The International Energy Agency 2020 predicts that the stranded size of assets in carbon-intensive industries will reach \$10 trillion and \$28 trillion by 2050 and 2100, respectively. The low-carbon transition has led to the restructuring of the industrial chain, with consumers more inclined to choose low-carbon and environmentally friendly products and services, and low-carbon industries gradually replacing high-carbon industries in a dominant position.

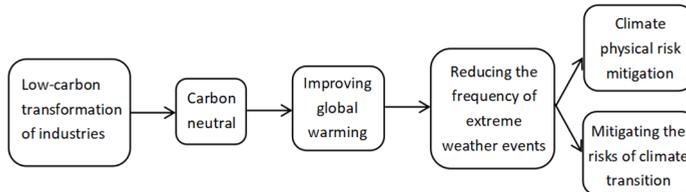
In addition, in the process of low-carbon transition, high-carbon enterprises need to invest a large amount of money in technological transformation, equipment renewal and construction of environmental protection facilities in order to meet stricter environmental requirements and carbon emission standards. And due to reduced market demand and intensified competition, enterprises in high-carbon industries may face problems such as lower product prices and reduced sales. High-carbon businesses may need to borrow money and use other strategies to tackle the problems presented by the low-carbon transition. This will increase the size of the firm's liabilities and raise the financial leverage, which will worsen the firm's asset-liability structure. Investors, however, are wary about the prospects for high-carbon industries' future growth. Investors think achieving sustainable development in the context of the low-carbon transition is challenging. This decline in confidence will lead to increased difficulties in corporate financing and higher financing costs, further aggravating the financial pressure on enterprises and increasing the risk of credit default.

"Effective responses to the economic, financial, and social risks that may accompany the green and low-carbon transition, preventing overreaction and ensuring safe carbon reduction" were urged in the 2021 State Council of the Central Committee of the Communist Party of China's Opinions on the Complete and Accurate Implementation of the New Development Idea and Doing a Good Job of Carbon Peak and Carbon Neutrality. Only in this way can the country closely grasp the critical link between climate change and financial stability.

## 2.2 Physical risks

The disruption in the financial sector caused by the low-carbon transition of proxy industries is particularly referred to as climate transition risk. Although, in the short term, a low-carbon transition of industry could be devastating for all sectors, especially high-carbon industries. According to the national strategy of "low-carbon environmental protection," "energy saving, and emission reduction," the long-term process of low-carbon industry transformation speeds up the global transition to carbon neutrality. This will reduce the global carbon content, thereby reducing the global warming caused by high carbon content. Extreme weather events will occur more frequently and with greater intensity as a result of global warming. Extreme weather events are also categorized as physical risks of climate change. The low-carbon transformation of sectors further reduces the influence of physical climate threats on financial

stability by slowing and enhancing the process of global warming. At the same time, a successful low-carbon transition of industry mitigates climate transition risks. Figure 1 illustrates this cyclical feedback effect of how climate change affects financial stability. Consequently, the low-carbon transition of industry is the primary connection between climate change and financial stability. Only when a smooth and stable industrial low-carbon transition strategy is successfully implemented can climate risks be effectively mitigated and financial stability maintained.



**Fig. 1.** Mechanisms for mitigating climate risk through low-carbon transition of industries

### 3 Transmission mechanisms of climate change on financial stability

The view that “climate risk (physical risk, transition risk) leads to financial risk” has begun to become a consensus among financial regulators globally, marked by a report published in 2019 by the Network for Green Finance (NGFS), a network of central banks and regulators [5]. Climate change has a profound impact on financial stability through two core mechanisms: physical risk and transition risk and is transmitted to the financial system through a variety of financial institutions, including credit, market, liquidity and systemic risk. Future research should concentrate on the financial hazards that climate change may cause, and climate change considerations should be routinely considered in financial institution stress testing [10].

#### 3.1 Transition risks

Climate policy shifts and technological innovations can increase operating costs and reduce the profitability of high-carbon-emitting firms. Transition risks can lead to increased volatility in the market value of related assets, triggering asset revaluation. At the same time, investors' preference for low-carbon industries increases, leading to changes in capital market fund flows. Through the supply chain and industrial chain, transition risk can spread to other industries, endangering the financial system's overall stability. A so-called climate Minsky moment could occur if the risks associated with the climate transition are serious enough, as former Bank of England governor Mark Carney stressed.

In addition, climate change exacerbates credit, market and liquidity risks through reduced solvency of borrowers, volatile asset prices and a wave of selloffs of high-carbon assets. The cross-border transmission of these risks through the interconnectedness of financial institutions and global supply chains could create a systemic financial crisis. The threat of climate change to financial stability is particularly complex owing to the long-term, abrupt and non-linear nature.

#### 3.2 Physical risks

Extreme weather and long-term environmental changes create physical hazards that can result in credit defaults and systemic instability through the devaluation of collateral, the loss

of business assets, increasing pressure on insurance payouts, and macroeconomic shocks. A sudden decline in the value of high-carbon assets, an increase in stranded assets, market volatility, and asset revaluation are all possible outcomes of transition risks, which are brought on by low-carbon policy changes, technological advancements, and shifts in consumer preferences. These events would also have an impact on the stability of financial institutions' balance sheets and portfolios. The physical effects of climate change have an impact on financial stability through conventional channels of financial risk transmission, including operational, credit, underwriting, market, and legal risk; the transformational effects have an impact on financial stability through the same channels [5]. The financial system will also be affected physically by climate change through the liquidity risk channel. The financial system may be affected transformationally through five different channels: credit risk, market risk, liquidity risk, operational risk, and underwriting risk. There are five different ways that the financial system might be affected by the transition: underwriting risk, market risk, liquidity risk, credit risk, and operational risk [3].

Natural disasters and ecological harm brought on by climate change may have an impact on the market value of associated assets, increasing asset price volatility. Affected enterprises need large amounts of capital for post-disaster reconstruction and production recovery, which will increase the pressure on financial institutions to meet their capital needs. In addition, natural disasters cause disruptions in the production and operation of enterprises, which is impossible for enterprises to repay their debts on time, and financial institutions face difficulties in recovering funds. At the same time, if a financial institution owns a lot of assets that are significantly impacted by climate change, including those in the energy and agriculture sectors, the risk of the firm's entire portfolio rises. By eliminating the top 10 percent of carbon-intensive companies from the four main GHG-emitting industries, "decarbonizing" portfolios might cut carbon emissions by 20 percent [11]. Specific industries, such as agriculture and energy, have a high sensitivity to climate change. When hit by physical risks, these industries could trigger a crisis in the whole sector, with systemic implications for the financial system. The Ministry of Emergency Management (MEM) reports that in 2023, China experienced 95,444,000 people affected by various natural disasters, with direct economic damages of 345.45 billion yuan.

## **4 Climate change and financial policy response mechanisms**

Responding to climate change requires a multifaceted, multidisciplinary and comprehensive mechanism, including government regulation, international cooperation, policy guidance, financial instruments, technological innovation, natural ecological protection, social participation and adaptive construction.

### **4.1 Government regulation**

The government has formulated and implemented a series of laws and regulations related to climate change to provide legal safeguards and normative basis for responding to climate change. In order to strengthen the position in addressing the global climate issue, China announced the "dual-carbon" target in September 2020. This objective actively promotes the complete green transformation of the economy and society. The first batch of 2,162 important emission units in the power generation sector marked the formal beginning of China's national carbon emissions trading market on July 16, 2021. With the first shipment of 2,162 important emission units from the power generation sector, China formally opened the national carbon emissions trading market. Businesses are encouraged to lower greenhouse gas emissions and support low-carbon development by the ability to buy carbon emission allowances to satisfy their own emission requirements through carbon emissions trading. To

guarantee that all rules and regulations are properly implemented, the government must simultaneously improve the oversight and enforcement of laws and regulations pertaining to businesses and individuals in tackling climate change.

## **4.2 International cooperation**

Governments have also reached and signed international climate agreements and actively participated in climate negotiations. Nationally Determined Contributions (NDCs) and the Green Climate Fund (GCF) have been promoted by the international community to support global mitigation and adaptation efforts through the Paris Agreement and multilateral cooperation platforms. International financial mechanisms such as the Green Climate Fund (GCF) provide financial assistance for climate adaptation and mitigation projects in developing countries. This also enhances green financial products like green bonds and carbon market trading systems, encourages the evaluation and management of climate risks, and directs the low-carbon transition through carbon pricing, green economic policies, and legal requirements. Through international cooperation, countries can share and exchange advanced technologies and experiences in addressing climate change and promote technological innovation and application on a global scale.

## **4.3 Technological advances**

The state should invest more in low-carbon technology research and development and encourage technical innovation and application in the energy, industrial, transportation, and construction sectors. In order to improve the economic structure's environmental resilience, the country should simultaneously support sustainable farming models and the circular economy. The nation should, however, leverage digital technologies like artificial intelligence, the Internet of Things, and big data to optimize manufacturing and energy management procedures, increase energy use efficiency, and precisely reduce emissions. Simultaneously, the government should urge businesses, academic institutions, and scientific research centers to collaborate on technological research and development. This will encourage a pattern of collaborative innovation between industry, academia, research, and application. And this will speed up the development and adoption of low-carbon technologies.

Governments should insist on nature-based solutions, such as ecosystem restoration and green infrastructure construction, which could help to enhance carbon sink capacity and mitigate the threat of extreme weather. In addition, the public should enhance climate awareness and adopt low-carbon lifestyles. To fully improve the capacity to adapt to climate change, society should integrate effective climate early warning systems with the development of resilient infrastructure. All the people can achieve the goal of sustainable development, improve the resilience of the global economy and environment, and reduce greenhouse gas emissions through coordinated multifaceted efforts.

## **5 Conclusion**

Based on existing research, this paper clarifies the circular feedback effect of physical risk and transition risk, and then from a macro perspective. This paper concludes that climate risk mainly affects financial stability through industrial low-carbon transition. Readers will have a deeper understanding of the intimate relationship between climate change and financial stability as a result of the research presented in this paper. This paper will serve as a warning and guidance for all industries and each individual's specific behavior.

Climate risk is more closely linked to financial stability. Financial institutions regularly assess and identify climate risks and include these risks into their routine risk management procedures. To estimate risk exposures under various climate scenarios and evaluate the long-term effects of climate change on credit, market, liquidity, and systemic risk, sophisticated climate modeling and data analysis tools are employed by the institutions. Meanwhile, to address climate risk, financial institutions develop and innovate a range of risk management tools. Financial regulators also strengthen their regulatory requirements on climate risk management for financial institutions. In order to further encourage financial institutions to fulfill their climate risk management responsibilities, regulators should create stricter standards for climate risk disclosure, mandate that financial institutions regularly report the climate risks faced and the steps took to mitigate them, conduct stress tests for climate risk, evaluate the resilience of financial institutions under various climate scenarios, and create a regulatory framework for climate risk that makes clear the duties and obligations of financial institutions in this area. The following is a summary of the findings of the study.

International cooperation in the field of climate financing can be further strengthened as nations confront the shared problem of global climate change. Countries work together to develop climate finance norms and regulations, encourage the market's interconnectedness and interoperability, and support the global climate governance process through multilateral financial institutions, international organizations, and other platforms. In the process of low-carbon transition and response to climate change, financial institutions in various countries will face a new competitive landscape.

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