Climate Change, Green Finance and Economic Growth

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Abstract. Climate change has been a thorny issue in the context of China becoming “carbon neutral”.It is important to mitigate the negative effect and potential side effect of climate change to stable the economic growth. Green finance is a crucial measure to address the issue. This paper reviews the current state of research on the impact of climate change on economic growth and the application of green finance in mitigation. Hence, finding out the green finance method and mitigation strategy of climate change is crucial in further application.

Keywords: Climate change; green finance; economic growth.

1. Introduction

With the rapid economic growth, environmental protection is still a hot topic worth exploring. Since the report of the 19th National Congress of the Communist Party of China, ecological civilization construction has become one of the most important issues of China's economic development. Green finance provides a good link between economic development and environmental governance.

However, over the past few decades, China has warmed up faster than elsewhere in the same latitude and in the northern hemisphere. It cannot be ignored that climate change bringing the conundrums of economic growth. As the second-largest economic entity, China is meeting the major challenge of climate change for economic growth, which can be mitigated through green finance. Using green finance to promote the economy was verified by history, “the green New Deal”. The effects of climate change have global ramifications [1].

Many researchers have modeled the impacts of climate change and economic growth in different provinces of China, but few of them analyze the potential challenge can be receded by the measure of green finance, which not only benefits the economy, but also make the society more sustainable.

This paper focuses on exploring the relationship between climate change and economic growth, using green finance to alleviate the impacts of climate change. The research status in migrating the climate change effects is shown, and related policies using green finance to address the climate-risks companying with enhancing the economic growth is presented. Collecting relevant policies and applications, the significance of green finance and the further prospect are proposed in the paper to solve relevant problems orientally.

2. Research Status in The Mitigation of Climate Change.

2.1 The relationship between climate change and economic growth

The effects of climate change have been a historical debate. As the capacity of calculating growth, the development of methodology and other statistical improvements, more scientist have applied themselves into the field. Wei Zhudeng et al. reviewed the impact of climate change on China's development in the past 2000 years and found that there may be an intrinsic correlation mechanism in the temporal resonance phenomenon between China's historical social economy and climate change [2]. Generally speaking, the warm period climate is beneficial to the healthy progress of social economy, while the negative socio-economic impact caused by the cold period climate may be related to the social evolution itself, and the negative impact will be amplified by society. Although this qualitative analysis has brought some inspiration, its role in policy making is limited due to the lack of quantitative data support.

According to the quantitive analysis, Chen Shuai et al. used econometrics to analyze the effects of climate change to rice and wheat production based on the data of panel planting structure and weather in the production provinces in China [3]. The results showed that the temperature, precipitation and sun exposure et al. and other factors do affect the per unit yield, which exist the non-linear relationship of "increase before decrease".

Li Wenting and Duan Hongbo constructed the model combined climate change and Chinese experiences, based on the threshold model within the period of 1961-2018 China's provinces climate economy [4]. Quantitative analysis of climate sensitivity differences was made due to diverse economic level development. The research results showed that: the impact of global warming on China's economy is significantly greater than that on the global whole and it is found that the impact of global warming on China's economy is obviously nonlinear, and the critical point is likely to have passed when using different subsets. The gap between the provincial development is a crucial factor to trigger the climate sensitivity.

2.2 Mitigate the effects of climate change by green finance

Green finance is essential in economic entities especially developing countries, which can be the panacea to tackling a series of risks, such as investment risks, ecological risks and climate risks. Compared with the conventional transaction, Wang and Zhi found that green finance has to do with environmental activities which prevent the eco-system from degradation in 2016 [5]. It is conspicuous that the world needs to take actions to mitigate the climate change effect avoiding the calamities. Thus, green finance is a basic stone to limit the threat of negative climate change-associated risks. Not only the government regulators, but also central banks should consider the potential danger (Gagnon and Sack 2018). Muhammad Atif Nawaz and others looked for the factor that will determine the catalyst for green finance by the N-11 and BRICS countries and their strategies for mitigating climate change. The DID method was used in the period of 2005 - 2019, and the outcome covariates: some of the factors are very significant in promoting green financing and climate change mitigation in the study countries (such as FDI, CO_2, inflation, technical corporation grants, R&D) [6]. Based on the data of 11 provinces and cities along the Yangtze River Economic Belt from 2007 to 2019, Qi Fangmei, Pei Xiao and Sun Ye constructed a synthetical evaluation index system of high-quality economic development, and analyzed the impact of environmental protection and green finance on high-quality economic development by using the spatial Tobit model [7]. The consequence showed green finance promotes the local economic growth showing significant positive spillover effect. Jiang Jinjin mentioned the effect of COVID-19 was still a Knotty issue during the past three years [8]. Both of the extreme weather caused by climate change and the global epidemic had severe negative externality. Under the carbon neutral background, the uncertainty of the low-carbon transformation path was increasing, and the risk of transformation increases, which has a secondary impact on the financial market. In addition, economic stimulus policies under the pandemic could restrict the central bank's ability to address climate-related risks. Monetary policy and macro-prudential policy should emphasize forward-looking responses to the dual risks of "climate + epidemic" to prevent financial turbulence

3. Green Finance Related Policies

3.1 Green finance to mitigate the impact of climate change

The need to use green finance mitigate the negative effects of climate change is on urge. It is significant to formulate policies and suggestions to address the climate risks and impacts [9]. Within the analysis of Nawaz, Muhammad Atif, et al, different results are obtained according to mixed methods, as N-11 and BRICS countries do not distinct significantly in terms of green finance and climate risk [6]. Thus, developing sustainable approach to tackle the risks and climate change is vital, especially for the developing countries, which benefits a lot [10]. Here are some suggestions to mitigate the effects of climate change in the aspect of green finance.

3.1.1 Develop green bond market

Governments should make efforts to develop green bond market, which not only relief the climate change effects, but also make the society eco-friendlier. And the non-corporates bodies in emerging and developing countries, such as pension funds, should issue green bonds in facing climate change. Without doubt, all the entities should obey the basic principles and rules, in order to make a sustainable life. Agliardi, E. and Agliardi, R acknowledged that since 2007, the first issuance has coined as a key finical tool to address the new challenges, which presented the benefits of directed environmental project primarily climate change mitigation and adaption [11]. With the deceasing amount of GHG, the global warming led by GHG would be mitigated.

3.1.2 Support international green finance activities

The current applications of international green finance activities are G20, Green Finance Study Group 81, Sustainable Insurance Forum 82 and NGFS. In order to keep both the developing countries and developed countries' green finance improvement, it is vital for supporting the international corporation. Rogoff calls for the establishment of a world carbon bank, which will become a tool for developed economies to coordinate aid and technology transfer to developing countries [12]. In April 2021, IPSF published<<Report of the Common Catalogue of Sustainable Finance—Climate Change Mitigation>>, which is a fusion of the strength of both China and Europe. Hence, it is significant for the whole society to promote China-eu green investment and financing cooperation, guide cross-border climate investment and financing activities, and reduce the green cost of cross-border transactions [13].

3.1.3 Disclosure the climate-related financial risks

In the process of financial market and sustainable development, the financial risks in the climate-related market should be on great attention. Hence, enforcing or encouraging companies and investors to disclose climate-related financial risks is crucial [14]. Although there are applications for now, "FSB Task Force on Climate-related, Financial Disclosures, French Energy Transition Law" and other organizations should take actions. According to the current applications, the focuses are as follows: (1) Stress climate-related factors disclosure and focusing on TCFD, which is a widely acknowledged standard. (2) concentrate on the related economic risks and enhancing prevention. (3) Underscore the GHG emission disclosure and diverse disclosure. (4) Meet the demands of regulatory stakeholders. From the global perspective, all these practices earn the relative achievement. Table 1 reflects the development and significance of disclosure.

Table 1. The development and significance of disclosure.

Disclosure Focusing	Timing	Development and Significance
Society liability	1997	CERES and UNEP sponsored GRI, constructing the economyenvironment-social-Trinity Sustainable Development Framework.
ESG	2004	The United Nations Global Compact (UN Globle Gompact) first proposed the concept of ESG.
ESG	2012.8	The Hong Kong Stock Exchange of China issued the ESG Reporting Guidelines for the first time as a voluntary listing company information disclosure recommendation.
Climate	2019	UNEP FI led the development of the Principles for Responsible Banking (PRB), which aims to guide banks to set daily standards in the most substantive areas
Climate	2021.11	ISSB established and promoted the integration and harmonization of standards.

For energy-clean enterprises, information disclosure systems can be better identified and screened, so that enterprises can gain more opportunities and investment favors in financial markets, thus broadening financing channels and reducing financing costs [15]. To be specific, Taskforce on Climate-related Financial Disclosures (TCFD), which was established by ISSB, issued “standardize the company to provide standardized environmental information disclosure” and other items. And disclose the company's business strategy and related measures. Through these, investors can assess a company's ability responding to climate-related risks. With the development of climate-related finance risks disclosure, the system would become completer and more practical. From the Table 1 above, it can present that the factors of sustainable and other green finance factors were came out gradually, accompanying the relevant of climate change and climate-related risks. By refining the disclosure, the related risks can be mitigated, paralleling to promote the development. Other effective policies can also be applied. Table 2 shows the relevant policies and applications related to climate change and green finance.

Table 2. Policies and applications related to climate change.

Policy	Concept	Applications
Environmentally aligned prudential regulation policy	Incorporate environmental considerations into prudential	Banque du Liban, Banco Central do Brasil
Green central bank financing	Provide additional subsidized liquidity to banks that lend	Bangladesh Bank, Bank of Japan
Lending quotas	Set a minimum proportion of bank loan inflows	Reserve Bank of India, Bangladesh Bank
ESG factors in asset eligibility criteria	ESG included in the asset eligibility criteria	Only for own purchase (DNB, Norges Bank)

For example, “central banks are also increasingly viewing green financial instruments as additional tools for foreign exchange reserve management” (Bolton et al, 2019). HKMA, which manages a foreign exchange reserve fund, a series of measures were announced in 2019 to support and promote the development of green finance in Hong Kong. If long-term returns are comparable to other investments on the basis of risk adjustment, priority can be given to green and ESG investment. It is definitely showed the crucial role in sustainable development and related financial growth.

3.2 Green finance to enhance economic growth

To realize the green finance in the role of carbon neutrality and emission reduction, we should analyze the effects of climate change to economic growth. The constructed model can be further applied to the field of climate change economics. When substantial economy cannot effectively complete the resources allocation, the green finance can make up for the market failure in some areas. Also, with sufficient information of green finance and climate change data, the financial system can effectively convert savings into investment, which lead to economic growth in a sustainable and renewable way. In some specific industries, the green premium is relatively high, largely because the technological limitation and supportive statistical methodology. Thus, facing climate change brought severe situation and trying methodology breakthrough of high-tech industry, it is crucial for scholars to find out a reasonable model that can really benefits the economy within green finance. In other words, finding a balance point between the existing and incremental asset in finance and green economy when confront with climate change is important so that keep the stability of financial system and earn the sustainable development. Not only the public policy will call for actions from the financial system, but also the government will set up laws and regulations to enhance economic growth by green finance when facing the climate change.

3.2.1 Implement green finance policies according to local conditions to promote regional differentiated development

China asserts that, on the one hand, we will intensify the central and western regions' implementation of green finance policies while also strengthening the eastern region's role as a leader and demonstrator of green finance development. On the other hand, we will improve the development level of green finance in resource-endowment cities, reduce resource dependence, and promote green regional economic growth through the transformation of energy consumption structure. According to Li’s research, it has the positive promotion to the investment within enterprises but the effects are subtle because of the immature policies [16]. In Yuan's research, it was found that resource-based cities and non-resource-based cities had significantly different driving effects on local economic green growth [17]. Among them, non-resource-based cities had a significant positive impact on regional economic green growth. Therefore, resource-based cities should lessen their reliance on natural resources, lower their use of fossil fuels, raise their efforts in research and development, get rid of their outdated manufacturing facilities, and maximize their use of energy. Non-resource-based cities should keep growing their industrial chains, actively create locally relevant sectors like tourism on the backs of existing industries and optimize the impact of green finance on sustainable economic growth.

3.2.2 Enterprises should increase investment in R&D and accelerate the application of technology

Businesses should place a high value on the ability to contribute that technological innovation makes to green economic growth, implement fiscal subsidies for industries with high energy and pollution consumption, and ensure that the funds from all these subsidies are only used to endorse the flow of green and technological innovation. Ding’s study reflected not only the government policy in collaborate with universities and companies, but also the central funding should be effectively exploited in sustainable and green projects is essential [18]. The government should promote regulations that encourage enterprise independence in innovation, urging businesses that are energy-consuming and generate a lot of pollution to gradually phase out conventional manufacturing methods and upgrade to more environmentally friendly ones with the help of innovators. Meanwhile, financial institutions should also play a vital role, increasing financing for green transformation, encouraging companies to "double the carbon target”, exploring green, low carbon technology innovation, applying more talent [19]. So that, accelerate the technology implantation to mitigate the climate-related damage and promote the economic growth.

3.2.3 Enterprises eliminate existing high-pollution equipment and optimize the energy consumption structure

Financial institutions should be on the basis of existing green financial product innovation, guide more capital investment to promote enterprises, green, low carbon adjustment project, power coal, thermal power and other traditional industry green low carbon transformation [20]. So that, promote photovoltaic renewable energy innovation and hydrogen energy. Businesses are encouraged to switch from coal to green hydrogen, to promote the transformation of the traditional energy system into a low-carbon energy system, which strengthens green economic growth. Further increase the support for fiscal and tax policies such as VAT policies for financial enterprises, support the energy storage industry, promote green certificate transactions, etc. In the research of Zhu, it has a significant influence on the reduction of emissions, in particular CO2, SO2, ammoniacal nitrogen and ammoniacal nitrogen oxides when optimizing the energy structure and developing green credit [21]. Hence, the understanding of reducing which the sorts of emission and optimize the consumption structure to decrease potential dangers of the climate and enhance the finical-economic growth is indispensable [22].

4. Conclusion

Many scholars have studied the relationship between the climate change and economic growth and constructed models to analyze the diverse circumstances. Hence, promoting the stable economy under the background of "carbon neutrality" is a hot issue in China. Although China has made great progress in green finance, it still needs to overcome some obstacles to achieve carbon neutrality, such as insufficient green bond market and financing, lack of unified standards for green finance, and no mandatory requirements for information disclosure. On this basis, relevant policy recommendations are put forward, such as developing a green bond market, supporting international green finance activities, and disclosing climate-related financial risks, which are experimented in several areas and have its practical value. Further research will continue to explore the application and prospect of green finance so that mitigate the negative effects of climate change. Specifically, implement green finance policies according to different situations; for enterprises, they should increase the investment in R&D so that promote the creativity in green high-tech and optimize the energy consumption structure. In this paper, there are also some defects, the relevant research in different aspects and perspectives are abound, so that it is difficult for author to summarize all the perspectives. In other words, the paper is focusing on the broader level to evaluate the relationship between green finance and climate change, unlike other scholars focusing on the micro factors, such as the review of financial market supervision to climate-risks. Hence, there are some micro aspects may ignore the paper, but the author will further study the topic.

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