

The Impact of Climate Change on Long-Term Economic Growth in China and The United States: Challenges and Opportunities

Yuhan Fu

Arts and Science, Queen's University, Kingston, Canada

Abstract. Climate change significantly impacts the long-term economic growth of the two world economies, China and the United States. This paper analyzes the impact of extreme weather caused by climate change on China and the United States regarding water resources, agriculture, infrastructure, and energy. In China, the reliance on coal and the need for early warning of sea level rise in convenience facilities have led to large investments in green energy, urban resilience, and rural infrastructure. In the United States, the economic consequences of extreme weather such as hurricanes and wildfires have highlighted the need for events to modernize infrastructure and transition from fossil fuels to renewable energy. This paper argues that China and the United States show that active cooperation and competition in climate adaptation and early warning can promote global economic and environmental dynamics. By addressing these challenges and taking advantage of emerging opportunities, sustainable economic growth can be achieved.

Keywords: Climate change, climate adaptation and early warning, China and the United States, sustainable economic growth.

1. Instructions

Extreme weather, natural disasters and ecosystem changes brought about by climate change have become key variables affecting global economic growth, gradually affecting the efficiency and stability of economic activities. As the world's two largest economies and carbon emitters, China and the United States face unique opportunities and challenges in the context of climate change. The impact of climate change on the long-term economic development of China and the United States is dual: it brings both severe challenges and opportunities for transformation. Both countries must take more proactive measures to accelerate the transition to green energy, optimize industrial structure, and jointly address the long-term impacts of global climate change through international cooperation.

In the field of agriculture, the impact of climate change on both countries has its own characteristics. China's agricultural production is mainly based on grain crops, and extreme high temperatures, droughts, and water scarcity pose a direct threat to food security.

In contrast, the agricultural system in the United States also faces the risk of yield fluctuations in high temperatures and changes in precipitation patterns, especially in areas where major export crops such as corn and soybeans are grown. Extreme weather conditions may cause significant fluctuations in food prices and further affect international market stability.

Climate change has affected the energy structure of both countries, and as a major energy consuming country, China's high temperature weather has increased its demand for electricity. Meanwhile, renewable energy projects face technological challenges. The United States needs to deal with the damage to energy infrastructure caused by extreme weather such as hurricanes, as well as the economic recession of the fossil fuel industry in the energy transition.

“Climate change has become a key constraint on global economic growth (Nordhaus, 2018). In recent years, a large number of studies have analyzed its negative impacts on agriculture, energy, and infrastructure, but most have focused on macro perspectives of a single country or a global scale (IPCC, 2021). However, as the two largest economies in the world, there is still insufficient analysis on the interaction, potential for cooperation, and competitive risks between the two countries in the field of climate change. This study aims to explore how climate change affects the long-term economic growth of China and the United States through agriculture, energy, and infrastructure,

analyze the differentiated response strategies of the two countries, and provide recommendations for future policy design

Existing research shows that climate change affects the global economy, but the specific impact mechanisms of China and the United States in the fields of agriculture, energy, and infrastructure still need to be analyzed in depth. This study aims to refine the impact of climate change on economic activities in China and the United States, and explore the economic adaptation capacity and policy coordination potential of the two countries, in order to provide targeted insights for global climate governance.

2. Analysis Of The Impact Of Climate Change On The Chinese And American Economies

2.1. Water resources and agriculture

2.1.1 China

The problem of water shortage has become more and more obvious. The river basin area north of the Yangtze River accounts for 64% of the country's total land area. But its water resources account for only 19% of the country's total (Guo ,2015). Under the principle of normal demand and avoiding excessive groundwater exploitation, the annual water shortage is about 30 billion to 40 billion cubic meters. Every year, 7 to 20 million hectares of farmland are affected by drought, with 400 out of 669 cities in China facing insufficient water supply and 110 cities facing severe water shortages. The shortage of water resources has become an important factor restricting China's economic and social development, especially in the northern regions. The impact of climate change on agriculture in China is double-sided (Xiao,2007). Although climate change positively affects crop growth in certain regions, overall, the negative impacts are more significant. The planting area of winter wheat in Northeast China is expanding, and the area of late-maturing corn varieties is also increasing; Extreme weather and climate events occur frequently nationwide, resulting in increased economic losses. The future planting system will undergo significant changes, and it is expected that the yield of major crops will decrease after 2050, with a maximum decrease of 37%, resulting in a decrease in quality, serious pest and disease problems, and increased production costs.

2.1.2 America

Since 2000, the arid area in the western United States has increased by 17%. In the past, drought was mainly seen because of insufficient precipitation, but now, 66% of drought-prone areas can experience drought independently of insufficient precipitation (NOAA,2024). In the context of climate change, the shortage of water resources directly affects agricultural production. As precipitation decreases and evaporation increases, soil moisture in farmland significantly decreases, leading to inhibited crop growth. California farmers have already felt this change, especially in drought-prone years where many crops have experienced significant declines in yield, leading to instability in the food supply chain. The impact of climate change on agriculture in the western United States is becoming increasingly significant, particularly in areas such as water scarcity, declining crop yields, and rising food prices. With the continuous rise of temperature, the water level of reservoirs is rapidly decreasing, and agricultural irrigation in many areas is facing unprecedented challenges. Due to the frequent occurrence of droughts and extreme weather events, farmers' production costs increase, ultimately transferring these costs to consumers, leading to a significant increase in food prices. Especially in the western United States, many families are facing increasing food expenses, which undoubtedly exacerbates economic pressure.

Faced with the harsh reality of climate change, people must recognize that water resources and agriculture are the foundation of human survival and development, and in the face of climate change, people should adopt sustainable agricultural practices and effective water resource management.

2.2. Energy market

2.2.1 China

The Chinese energy market is dominated by coal and faces the problem of uneven distribution of resources. The western region produces coal, while the eastern coastal region has high energy demand and relies on energy transportation. Wind and solar power are concentrated in the northwest, but there are issues with electricity reception and utilization efficiency. The projects of "West-East Electricity Transmission" and "North-South Coal Transportation" have alleviated the uneven distribution of regional energy, but the transmission efficiency and cost still face challenges (State Council, People's Republic of China, 2007).

2.2.2 America

The energy consumption in the United States is mainly based on natural gas, oil, and renewable energy. In 2022, oil will account for approximately 36% of total energy consumption, natural gas for 32%, and renewable energy for 13% (Owen, C. 2023). Texas is a major producer of oil and natural gas, with abundant wind energy resources in the Midwest. California is a center for solar power generation, and the Appalachian region remains a major coal-producing area, but the coal market is severely shrinking. The energy market and industrial structure in the United States are characterized by a coexistence of fossil fuel dominance and the rise of clean energy. However, in some regions, energy infrastructure is severely aging, and the destructive impact of extreme weather on energy supply is intensifying. The high carbon emissions of fossil fuels put pressure on climate goals.

The positive impact of climate change on the economies of China and the United States: Promoting the development of emerging industries, the clean energy industry has become a new growth point. Reduce energy costs and improve efficiency. The negative impact of climate change on the economies of China and the United States: The decline of traditional industries, economic downturn in resource-scarce regions, and rising transformation costs require increased investment in infrastructure reform.

2.3. Infrastructure and social costs

The impact of climate change on infrastructure and social costs is mainly reflected in frequent extreme weather events, rising sea levels, and energy supply-demand imbalances. These impacts differ between China and the United States, but both pose serious challenges to economic development, social stability, and public policies.

2.3.1 China

The infrastructure construction speed is fast, but the disaster resistance and adaptability are insufficient, and rural areas are particularly vulnerable. The coastal areas of China are greatly threatened by rising sea levels and storm surges. The roads and water supply systems in rural areas are difficult to withstand extreme weather, especially in the southwestern mountainous and northwestern arid regions, where infrastructure has weak disaster resistance capabilities.

Public healthcare, post-disaster reconstruction, and agricultural production losses are the main costs.

2.3.2 America

The problem of aging infrastructure is serious, and the disaster resistance capability is high, but it faces a huge investment demand for renovation and upgrading. Cities along the East Coast of the United States and the Gulf Coast of Mexico are facing serious threats from rising sea levels and hurricanes. The costs of insurance compensation, post-disaster recovery, and social support for low-income groups have significantly increased.

3. Challenges And Opportunities

3.1. Challenges

China is facing the problems of carbon industry transformation and regional development inequality. Achieving the carbon neutrality goal requires profound reforms in high-energy-consuming industries, but this may inhibit economic growth in the short term. The energy structure in the western region relies on fossil fuels, and the transformation cost is higher; the developed coastal areas face financial pressures for infrastructure upgrades and disaster resilience. Extreme weather has increased social costs, increasing the costs of public health, disaster relief, and post-disaster reconstruction.

The United States is also facing energy industry adjustments and economic losses caused by extreme climate. The transition of energy structure to clean energy will lead to the shrinkage of traditional energy industries, causing employment problems and regional economic recession. Hurricanes, wildfires, cold waves, and other climate events are frequent, and the impact on infrastructure, agriculture, and insurance will continue to increase.

3.2. Opportunities

Climate change provides a major opportunity for China and the United States to achieve sustainable growth (Garnaut, R. 2024). The transition to renewable energy and green technology lays the foundation for new industries and economic growth. China's leading position in solar and wind energy development and the United States' technological progress in energy storage hydrogen and nuclear energy enable the treaty to inspire a leading position in the global green economy. Traditional high-emission industries are transforming to higher-value low-carbon alternatives (CGEP, C. 2023). This creates more green jobs while stimulating regional economic development. Additional efforts are made to promote infrastructure construction and improve disaster preparedness.

4. Conclusion

Climate change has had a dual impact on the long-term economic development of China and the United States, bringing both severe challenges and opportunities for transformation. Firstly, extreme weather conditions create uncertainty in the economic growth of both countries. China is facing issues such as reduced agricultural production and water scarcity, while the United States is threatened by hurricanes and rising sea levels in coastal areas. Secondly, the transformation of energy structure has become a common challenge for China and the United States. China needs high investment to achieve carbon neutrality goals, while the United States is affected by policy instability in the development of new energy. Climate change has accelerated industrial restructuring. The proportion of high carbon industries will decrease, and green economy will become a new growth point for both countries. Infrastructure and urbanization processes have also been affected, and flood control and upgrading of old facilities in coastal cities have become urgent issues that need to be addressed. Finally, there are both opportunities for cooperation between China and the United States in addressing climate change, such as the development of clean energy technologies and carbon markets, as well as competition, such as in green technology patents. Overall, China and the United States should actively address the long-term challenges of climate change to economic development through energy transformation, industrial upgrading, and international cooperation.

References

- [1] Asif, Z., Chen, Z., Sadiq, R., Zhu, Y. 2023. Climate change impacts on water resources and sustainable water management strategies in North America. *Water Resources Management* 37(6–7):2771–2786.
- [2] IPCC. 2021. Climate change 2021: The physical science basis. Retrieved from <https://www.ipcc.ch/report/sixth-assessment-report-working-group-i/>

- [3] CGEP, C. 2023. How the us and china could renew cooperation on climate change - center on global energy policy at Columbia University Sipa: CGEP.
- [4] Garnaut, R. 2024. China, global economic disintegration, and the Climate Change Challenge. *Oxford Review of Economic Policy* 40(2):374–386.
- [5] Guo, J.P. 2015. Progress on the impact of climate change on agricultural production in China. *Applied Journal of Meteorology* (01),1-11.
- [6] NOAA, 2024. New research finds rising heat driving western U.S. Retrieved from <https://www.drought.gov/news/new-research-finds-rising-heat-driving-western-us-droughts-2024-11-08>
- [7] Owen, C., Elesia, F. 2023. Nonfossil fuel energy sources accounted for 21% of U.S. Energy Consumption in 2022 - U.S. energy information administration (EIA). Retrieved from <https://www.eia.gov/todayinenergy/detail.php?id=56980>
- [8] Xiao, G.J., Zhang, Q., Wang, J. 2007. Progress in studying the impact of global climate change on agroecosystems. *Journal of Applied Ecology* (08):1877-1885.
- [9] State Council, People's Republic of China. 2007. China's energy situation and policy. Retrieved from https://www.gov.cn/zhengce/2007-12/26/content_2615763.htm