

Climate Risk and Urban Fiscal Systems: A Review of Impacts and Policy Responses

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Abstract: As global climate change intensifies, climate risk has evolved from an environmental challenge into a critical concern for the sustainability of urban public finance systems. This paper systematically reviews recent research on the impacts of climate risk on urban public finance and the corresponding policy responses. The literature indicates that climate risk undermines the local fiscal revenue base through multiple channels, including suppressed economic growth, industrial structure disruption, and infrastructure damage. At the same time, it increases fiscal expenditures on climate adaptation and disaster response. The pressure on both revenue and expenditure exacerbates local fiscal imbalances and debt risks. In terms of response strategies, prior studies have proposed policy recommendations from two main dimensions: fiscal institutional reform and the optimization of investment and financing mechanisms. Finally, this paper identifies the limitations of the current literature and outlines directions for future research.

Keywords: Climate Risk; Fiscal System; Climate Change; Fiscal Sustainability

1. Introduction

Climate risk refers to the adverse impacts of climate change across environmental, corporate, and social dimensions. It is typically categorized into physical and transition risks[1]. Economic losses from climate-change-induced natural disasters have exhibited a sustained upward trend. According to data released by Munich Re, total global losses from natural disasters in 2025 amounted to approximately USD 224 billion. With the intensification of global climate change, mitigating climate risk has emerged as a cornerstone of national governance and sustainable economic development. The IMF

Fiscal Monitor (2023) highlights that policymakers face a dilemma in balancing climate targets, debt sustainability, and political feasibility. Against the backdrop of global climate action, China has elevated the implementation of its “dual carbon” goals and the promotion of a comprehensive green economic and social transition to a national strategic priority, which requires fiscal policy frameworks to systematically incorporate climate-related factors. In this context, climate risk is no longer a singular environmental challenge; rather, it has evolved into a major issue affecting the stable operation of urban economies, fiscal sustainability, and public governance security. In recent years, a large body of academic research has investigated the effects of climate risk on urban public finance and response routes, generating valuable theoretical insights and empirical data. This paper aims to conduct a systematic review of research progress in this field and to provide references for further theoretical development and policy practice.

2. Impacts of Climate Risk on Urban Public Finance

2.1 Impact on Fiscal Revenue

Extant literature generally indicate that climate risk disrupts regional economic production and business activities, leading to a decline in economic output. This consequently erodes the abundance of tax resources[2] and undermines tax base stability, thereby exerting negative shocks to local fiscal revenue. Chen et al. examined the relationship between rainfall shocks and urban economic growth. Their empirical evidence demonstrates that rainfall shocks exert a significant inhibitory effect on urban economic growth rates[3]. From the perspective of the three major sectors, Ding et al. utilized meteorological station observation data and regional agricultural economic data from

China, to empirically explain the mechanism through which climate risk affects agricultural development. The results indicate that agricultural economic growth in high-risk regions significantly underperforms relative to other areas. Further analysis reveals that climate risk, on the one hand, indirectly suppresses agricultural development by intensifying the severity of natural disasters, and on the other hand, directly exerts adverse impacts on agricultural economic performance[4]. Liu et al. that climate change exerts differential impacts across industrial sectors, notably in mining, construction, and the utilities sector[5]. These industries are often important sources of local fiscal revenue. In addition to direct output effects, related studies have also focused on the micro-level impacts of climate risk on market agents. Besides, recent research has also directed attention toward the firm level. Based on panel data from 31 provincial regions in China from 2003 to 2019, Zhang et al., constructed a PVAR model to empirically analyze the dynamic relationship between climate risk, corporate investment willingness, and local fiscal revenue. The study finds that climate risk significantly affects corporate investment willingness within regions and further influences local fiscal revenue[6].

2.2. Impact on Fiscal Expenditure

A consensus among scholars suggests that climate risk increases the scale of government expenditure, particularly spending related to climate adaptation and disaster response. From the perspective of functional classification of fiscal expenditure, Chen et al. systematically analyzed the fiscal implications of climate change across three categories of public expenditure: maintenance, economic, and social spending. Their analysis demonstrates that climate change generally leads to an overall increase in fiscal expenditure, with the most pronounced impact manifesting in climate-adaptive public spending[7]. Building on this, some studies further reveal the specific mechanisms through which climate risk affects fiscal expenditure. Lyu et al. utilized panel data from cities in China spanning 2003–2022 to explore the impact of extreme climate events on local fiscal risk and its underlying mechanisms. Their findings demonstrate that extreme precipitation events inflict damage on physical infrastructure, thereby escalating government

expenditures on repair and reconstruction and ultimately heightening fiscal vulnerability[8].

2.3 Impact on Fiscal Balance

Chen et al. observe that the impacts of climate change on public finance are ultimately reflected in fiscal behavior, fiscal costs, and fiscal relations[7]. Qi et al. indicate that the intensification of future climate change may lead to a reduction in government revenue sources and an increase in government expenditure, thereby exacerbating fiscal imbalance through the structural reconfiguration of fiscal revenues and expenditures[2]. Moreover, climate risk may further amplify fiscal pressure by constraining government financing conditions. Drawing on a sample of Chinese urban local government financing vehicle (LGFV) bonds spanning 2008–2023, Zilu Dong constructed a climate risk index and empirically found that climate risk heightens the credit risk premium of LGFV bonds by raising local fiscal deficit ratios[9]. Guo et al. examined the relationship between climate risk and local government financing costs and corroborated that climate risk significantly drives up LGFV bond issuance costs, thereby inflating the aggregate financing costs for local governments[10]. Ma et al., based on panel data from 31 Chinese provinces between 2019 and 2023, show that climate risk is positively correlated with the yield spreads of local government special bonds, indicating that climate risk premiums are being priced into project financing[11]. Synthetically, these studies suggest that climate risk not only precipitates short-term fiscal volatility but also undermines the long-term solvency and resilience.

3. Main Pathways for Urban Public Finance in Responding to Climate Risk

3.1 Reforming the Fiscal System

Chen et al. propose a holistic institutional framework from a systemic perspective, arguing that the fiscal policy framework should explicitly incorporate climate change considerations. They advocate reforming existing fiscal expenditure policies, revenue policies, fiscal investment and financing policies, government budgeting systems, government procurement policies, and ecological compensation mechanisms[7]. Pang points out that climate budgeting, green budgeting, and

carbon budgeting are three core instruments for promoting the deep integration of urban climate governance and fiscal budgeting systems, and suggests incorporating climate budgeting into the entire fiscal budget management process[12]. Zhang et al. propose that the introduction of a carbon tax, coupled with refinements to environmental resource levies and consumption taxes, would broaden the environmental tax base and thereby diversify and strengthen funding streams for climate change mitigation and adaptation[13]. On the expenditure side, Zhang et al. suggest that fiscal authorities, in concert with relevant government agencies, should enact supportive policies for renewable energy development and energy efficiency initiatives while substantially increasing public investment in these sectors[14]. Ranger et al. find that increasing investment in resilient and inclusive sustainable infrastructure is crucial for reducing the long-term economic impacts of climate change as well as for promoting development and poverty reduction[15].

3.2 Optimizing Fiscal and Financial Policy Instruments

International local practices provide substantial empirical evidence for the innovation of urban climate investment and financing instruments and institutional arrangements. An empirical investigation covering 203 cities across 21 EU countries and 46 million residents finds that more than 80% of funding for urban climate action derives from government grants and public procurement, while innovative instruments such as green bonds and public-private partnerships remain underutilized. Based on case studies of Toronto, Coventry, and Cape Town, a research summarizes feasible innovative financing instruments, including green bonds, public-private partnerships, and blended finance. It further argues that, in order to close the resilience financing gap, cities must strengthen their fiscal and financial capacities and develop long-term, sustainable climate financing strategies[16]. Drawing on the case of Kommunitinvest, Kaj et al. propose the establishment of collective municipal financing frameworks. By pooling borrowing demand and forming joint credit ratings in capital markets, such mechanisms mitigate borrowing costs and leverage economies of scale, facilitating professionalized debt management[17]. In China, An et al. suggest that governments should

accelerate the establishment of climate financing support systems and disaster insurance mechanisms, while improving intelligent monitoring and governance frameworks[18]. Wang takes Qingdao as a case study and systematically summarizes its governance experience in developing sponge cities, advancing climate-adaptive urban planning, and establishing climate insurance mechanisms, providing actionable pathways for other cities to enhance climate resilience[19].

4. Literature Review

Research on the financial consequences of climate risk for urban governments has made significant progress, moving from early evaluations of isolated extreme occurrences to integrated frameworks that take both transition and physical hazards into account. The detrimental fiscal effects of climate risk have been widely acknowledged by academics, who have also put out a variety of policy solutions. However, there are still significant gaps. The majority of empirical evidence is still limited to provincial aggregates, and city-level variation across fiscal capacities and industrial structures is not given enough consideration. The accuracy of forward-looking fiscal policy design is limited by the lack of empirical research on micro-level transmission channels, especially those that operate through company investment decisions and household spatial behavior.

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