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Government emergency budgeting and disaster impact: Evidence from China

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Abstract

Emergency budgets have become indispensable fiscal tools for governments around the world to cope with disasters, but how governments determine the size of emergency budgets and to what extent such budgets are effective remain unclear. Drawing on organizational learning theory and using data collected from 30 provinces in China, we conduct a series of panel regression analysis and robustness checks to investigate the determinants and impact of emergency budgets. We find that both prior disaster experience and government fiscal ability as measured by budget surplus are positively related to the size of subnational governments' emergency budgets, but the interaction effect between the two is negative. Moreover, while emergency budgets can help maintain the level of government budget surplus, they only play a limited role in moderating the negative impact of disaster damage on governments' fiscal ability. In particular, this study reveals the importance of socioeconomic environment and organizational capacity for the decision-making process and outcomes of emergency budgets, suggesting that subnational governments should always adopt a holistic approach and improve their financial preparedness for future emergencies by incorporating more information from past disasters and considering diverse drivers of the complex dynamics among emergency budgets, disaster experience, and government fiscal ability. 应急预算已成为各国政府应对灾害不可或缺的财政工具，然而我们仍

然不清楚政府如何确定应急预算的规模，以及这些应急预算在多大程度上发挥了作用。本研究借鉴组织学习理论，利用从中国30个省份收集的数据，进行了一系列的面板回归分析和稳健性检验，以探讨应急预算的决定因素及其影响。研究发现，先前的灾害经验和政府财政能力(以预算盈余衡量)与地方政府应急预算的规模正相关，但两者之间的交互项与应急预算的规模呈负相关。此外，尽管应急预算有助于维持政府预算盈余水平，但它在缓解灾害损失对政府财政能力的负面影响方面作用有限。本研究揭示了社会经济环境和组织能力对应急预算决策过程及结果的重要性。基于该研究结果，我们建议地方政府应从过去灾害中汲取更多信息，考虑应急预算、灾害经验和政府财政能力之间的多种动态因素，从而提高政府应对未来紧急情况的财务准备水平。

1 | INTRODUCTION

With the rising frequency and severity of natural, environmental, industrial, and transport disasters, governments around the world are increasingly adopting a more proactive role in preparing for and responding to disastrous events (Comfort et al., 2012; Lu & Xue, 2016; Krogh & Lo, 2023; Painter, 2024; Pew, 2020). It has become common for many governments to institute comprehensive emergency management processes encompassing disaster mitigation, preparedness, response, and recovery (Boin et al., 2005; Donahue & Joyce, 2001; Røiseland & Trætteberg, 2024), and China is no exception (Lu & Xue, 2016). During the preparation stage, a key fiscal tool is to budget for emergencies either by establishing an emergency fund or by allocating budgetary items for emergency management (Kirschner et al., 2018; Phaup & Kirschner, 2010). Such an emergency budgeting practice allows governments to set aside financial resources regularly for potential crises (Pew, 2020).

However, a critical question about the emergency budgeting practice is how governments can properly determine the size of emergency budgets given the uncertainty of disasters and their damage. A small emergency budget may not effectively mitigate the impact of disasters as it is supposed to, while an excessive emergency budget could unnecessarily crowd out other pivotal spending items for public schools, hospitals, and so forth. To make things worse, when governments are faced with political challenges or fiscal pressure, they might have to cut their emergency budgets even if the risk of disasters remains still high (Boin et al., 2005). Therefore, how governments establish and contribute to emergency budgets is a crucial area that calls for further investigation, but the public administration literature so far has paid little attention to this area (Comfort et al., 2012).

The key factors in emergency budgeting can be understood through multiple economic, political, and policy lenses. Typically, governments rely on the information at hand to make projections for future financial needs as they allocate available resources to meet those needs. In the process of emergency budgeting, this information could include past disaster experiences, the scale of disaster damage, disaster risk, the vulnerability of the local community, and the external resources available for disaster responses (GAO, 2009; Lee & Chen, 2022a; Lee et al., 2022; Pew, 2020). Lee and Chen (2022a) found that governments' financial resources and staff capacity are key determinants of the size of their emergency budgets. Moreover, since public budgeting is a political process in which various levels of government are involved, the interplay of political considerations and intergovernmental relations may affect how emergency budgets are made (Christensen et al., 2016; Donahue & Joyce, 2001). Additionally, the extant literature suggests that organizations can learn from past disastrous events to improve their preparedness for future

disasters (Bakema et al., 2019; Corbacioglu & Kapucu, 2006; Nava, 2022), but this learning process, especially in governmental organizations, is subject to political and fiscal constraints (Arapis & Chatterjee, 2023; Betten et al., 2021).

Taking these considerations into account, this research investigates the process through which emergency budgets are made and the factors that government contemplate when making those budgets. Focusing on governments' emergency budgets, we ask two specific research questions. In the first question, we wonder if past disaster damage is related to the size of governments' emergency budgets. This inquiry follows the reasoning that past disaster damage could increase governments' awareness of and motivation to prepare for future disasters, and therefore, it may contribute to a higher level of emergency budget and better preparedness. In the second question, we ask whether the size of emergency budgets is related to their effectiveness in mitigating negative disaster impact. The answer to the second question shows whether emergency budgets function as expected and whether larger emergency budgets are always preferred.

To answer the two research questions, we compiled a panel dataset from 30 subnational governments in China over 5 years (2016–2020) using hand-collected information from disaster events and subnational financial accounts. By conducting fixed-effect panel analyses, instrumental variable analyses, and various other robustness checks, we found that cumulative disaster damage from the past 3 years, government budget surplus, and debt level are all positively related to the size of subnational emergency budgets, suggesting that governments learn from disaster experience and take account of their financial situations when deciding on the size of emergency budgets. We also found that disaster damage can place a significant strain on governments' budgets while emergency budgets only play a limited role in moderating the negative impact of disasters on government finances. This may result from the insufficiency of emergency budgets and a lack of an effective mechanism for such budgets to function properly in China.

This research makes two contributions to the literature and practices in emergency budgeting and management. First, it is one of the first studies to explain the complex dynamics of emergency budgeting and empirically to test the determinants of the size and impact of subnational emergency budgets with hand-collected data from China. The findings from this research provide initial insights into and implications for improving emergency budgeting practices in China as well as in many other countries with similar multilayered government structures and fiscal situations. Second, this is also one of the first studies to explore how emergency budgets can mitigate the negative impact of disasters on government budgets. Although we find no evidence to support the effectiveness of emergency budget in moderating disaster damage on governments' fiscal ability, our findings can be connected to a broader discussion on possible ways to improve the design and use of emergency budgets.

2 | BUDGETING FOR DISASTERS: A LITERATURE REVIEW

In this section, we draw on the theoretical and empirical literature to explore the key determinants of the size and the impact of emergency budgets.

2.1 | Disaster experience

Disasters in the future are hard to predict and often impossible to imagine (Clarke, 1999), making it very difficult for governments to decide the right amount of emergency budget for disaster response and relief. Some scholars argue that emergency budgets can serve as tools for self-insurance: when setting aside an emergency budget or an emergency fund, governments actually pay a premium to remedy a potential loss caused by disasters (Phaup & Kirschner, 2010). In this sense, previous disaster experiences are likely to influence governments' decisions on emergency budgets—just as personal experiences with disasters may prompt people to increase insurance purchases (Dessaint & Matray, 2017; Gallagher, 2014; Gao et al., 2020; Wang & Kapucu, 2008).

When studying a person or a company's financial management decisions, both the behavioral finance and the public administration field have provided some important clues as to why the decision to set up a larger or smaller emergency budget could be related to prior disaster experiences. Gao et al. (2020) summarized three channels through which prior disasters could affect households' insurance purchases: the Bayesian learning model holds that households learn the severity of disasters from their most recent disaster experiences; the risk preference channel asserts that disasters influence individuals' risk preference levels, which in turn affect their financial decisions; and the salience theory emphasizes that households often overreact to the most salient disaster experiences. Prior studies also noted that disasters can cause people either to increase perceived risk because they focus on the downside of that risk (Dessaint & Matray, 2017; Gallagher, 2014), or to decrease perceived risk because they feel less risk with unexpected lucky disaster experience (Gao et al., 2020) or develop a sense of complacency under repeated emergency threats (Wang & Kapucu, 2008).

In the empirical inquiries on this topic, Gallagher (2014) found that after recent flood experiences, the take-up of flood insurance quickly spiked and then steadily declined afterward, suggesting that a recent flood caused individuals to learn or update their beliefs about the importance of flood insurance. Similarly, Cameron and Shah (2015) showed that disaster experiences in the past 3 years prompted people to increase the perceived risk of future disasters and to become more risk averse. Noticing that men who had experienced the 2011 Great East Japan Earthquake become more risk tolerant while women become more risk averse, Hanaoka et al. (2018) argued that such a discrepancy may result from different emotional reactions (such as fear and anger) to recent disasters. In addition, Dessaint and Matray (2017) found that managers of firms located near hurricane events increased their corporate cash holdings and expressed more concerns over hurricane risk, which supports the salience theory that the salience of a disastrous event may trigger managers' overreaction and increase their perceived disaster risk. Conversely, Gao et al. (2020) found that households perceive less risk when they experience disasters that have lower than expected fatalities, while Wang and Kapucu (2008) confirmed that the public became complacent under repeated threat warnings during the 2004 Florida hurricane season.

2.2 | Organizational learning

Another important clue about the relationship between prior disaster experiences and emergency budgets stems from the organizational learning literature, which explores how organizations gain knowledge and develop new capacities from past adversary events (Argyris & Schön, 1978; Bakema et al., 2019; Betten et al., 2021; Corbacioglu & Kapucu, 2006; Nava, 2022). This stream of literature focuses on preparedness for future disasters as the learning outcome, and it explains the mechanisms through which disasters serve as the catalyst to stimulate organizational changes and improve disaster preparedness. Generally, disasters will expose the mismatch between the planned and experienced outcomes, revealing the organization's current vulnerabilities and limits (Argyris & Schön, 1978; Broekema, 2016; Corbacioglu & Kapucu, 2006). Therefore, over time, organizations can gain additional knowledge to restructure and develop new capabilities to survive upcoming disasters (Bakema et al., 2019).

Nevertheless, organizational learning from disasters does not happen automatically. There has to be a process to transfer knowledge from individual-level learning to and from organizational learning (Betten et al., 2021; Broekema, 2016). Individuals in an organization can gain new ideas and understandings after experiencing disasters, but these new ideas need to be shared collectively and integrated at the organizational level to form new routines, culture, norms, and governance improvements (Bakema et al., 2019). The outcome of organizational learning from disasters depends on the quality and depth of the cognitive process (Nava, 2022), which is the process through which organizations discuss and reflect on their disaster experience, identify problems, and find possible improvements.

Organizational learning from disasters, especially within governments, may also be subject to political constraints and resources (Arapis & Chatterjee, 2023; Argyris & Schön, 1978; Lee & Chen, 2022a). Betten et al. (2021) stressed

the importance of available resources in civil protection and emergency preparedness in the organizational learning process. Likewise, Corbacioglu and Kapucu (2006) found that adequate information and organizational flexibility can facilitate organizational learning and adaptation after disasters.

In the public sector, studies on emergency management often suggest that governments can learn from previous disaster experiences to improve their preparedness for future disasters. For example, based on a review of catastrophic disasters, a GAO (2009) report underscored the importance of effective collaboration among stakeholders in recovery efforts. Additionally, both Onuma et al. (2017) and Crow et al. (2018) found a reduction effect of past disaster damage on future disaster damage because individuals, organizations, and governments learned from previous disaster experiences and adjusted their behaviors after disasters. A few other studies showed that prior disaster experiences can create opportunities for governments to gain public support for disaster preparation and mitigation efforts and to enhance cooperation with civil society organizations (Berke et al., 1993; Shaw & Goda, 2004). For instance, Murphy et al. (2005) found that although the public support for government actions to disaster mitigation and preparedness was generally low when compared to other spending priorities, the support was higher from communities that have experienced disasters. In a similar vein, Scognamiglio et al. (2023) emphasized that robust governance strategies, in which the public sector involves other stakeholders in the process of learning from past experiences, anticipating environmental needs, and designing adaptive solutions, were crucial for effectively managing turbulent events like the COVID-19 pandemic.

2.3 | Other determinants of the size and impact of emergency budgets

In addition to past disaster experiences, an array of political, fiscal, and practical considerations as well as social challenges (e.g., social vulnerability of the community) that governments face can affect the size and the impact of governments' savings for disasters (Aldrich, 2016; Cutters et al., 2003; Cutters & Finch, 2008; Lee & Chen, 2022a).

Some studies have analyzed the difficulties in effectively budgeting for disasters before they occur, and outlined a series of factors that might be responsible for these difficulties. Phaup and Kirschner (2010) differentiated ex ante and ex post budgeting for disasters. Ex ante budgeting—setting aside budgetary resources for expected costs before a disaster occurs—is better because it encourages savings, increasing fiscal stability, promoting mitigation efforts, and reducing exposure to disaster risk. In comparison, ex post budgeting—providing financial assistance after a disaster occurs—may reduce people's incentives to save and encourage opportunistic decision-making. Ex ante budgeting for disasters includes government purchases of insurance and setting up contingency funds. In conclusion, Phaup and Kirschner (2010) pointed out that the impediments to effective budgeting for disasters include political incentives to defer costs, moral hazard issues due to public savings crowding out private savings for disasters, and the fear of misuse of the disaster funds.

Other studies emphasize that governments have different levels of fiscal resilience to disasters, which in turn determines their saving behavior for disasters and also the outcome of government saving (Clarke, 1999; Lee & Chen, 2022b). So far, the extant literature has identified two main factors for government fiscal resilience: one is social vulnerability and the other is government fiscal ability (Aldrich, 2016; Lee et al., 2022). Social vulnerability, which refers to the susceptibility of a certain community to withstand the adverse impacts of natural hazards (Cutters & Finch, 2008; CDC/ATSDR, 2018), will generally lead to higher requirements for financial resources from governments after disasters (Lee et al., 2022). By contrast, fiscal ability, usually a measure of financial resources available to the government, will generally enhance governments' fiscal resilience to external disastrous events. Lee and Chen's (2022a) study on organizational learning and saving for disasters found empirical evidence that the size of governments' savings for disasters was rationally determined based on the consideration of disaster risk, government financial capacity, and human capital. Similarly, Aldrich (2016) indicated that disaster damage, spending on disaster mitigation, population density, economic conditions or financial capability, and the power of politicians are all powerful predictors of disaster recovery.

Further, some scholars have investigated the adverse effects of disasters on government finances, warning that severe fiscal stresses may occur if the scale of disasters is beyond the government's capacity to respond effectively (Chen, 2020; Fannin et al., 2012; Hildreth, 2009). Focusing on disasters' impacts on subnational governments, many of these studies find that the savings for disasters and disaster aid from higher levels of government play a pivotal role in mitigating the negative impacts of disasters (Chen, 2020; Fannin et al., 2012). In the context of subnational governments of China, Miao et al. (2020) also noticed that disasters significantly increase subnational governments' spending, and that intergovernmental transfer revenues often cannot catch up with the increase in government spending as a result of the disasters.

Although the literature on the determinants of emergency budget remains fairly scarce (Comfort et al., 2012; Donahue & Joyce, 2001), such factors as quality and timing of emergency budgeting, social vulnerability, government financial capacity, human capital, and so forth, have all proven important for governments' decisions on emergency budget. Moreover, the existing literature points to the possibly severe consequences if governments are less fiscally resilient and the positive impact of government financial reserves in mitigating the adverse effects of disasters (Aldrich, 2016; Chen, 2020; Lee & Chen, 2022a).

3 | EMERGENCY BUDGETING PRACTICES IN CHINA AND RESEARCH HYPOTHESES

National context and the specific challenges from different types of disasters can affect emergency management capacity profoundly (Christensen et al., 2016). Therefore, to develop research hypotheses about emergency budget and disaster impact, we first review the process of emergency budgeting in China based on official documents and existing studies.

3.1 | How are disaster responses and recovery efforts funded in China?

After the 2003 SARS crisis, China built a new national emergency management system that follows the principle of "territory management" (Lu & Xue, 2016). This means that subnational governments assume the main management and financial responsibilities for coping with disasters within their jurisdiction while they are still subject to the leadership, mandates, and coordination of upper levels of government (Feng et al., 2011). When a disaster strikes, the emergency management branch of the lowest level of government (either county or district) will report the disaster situation and its initial response efforts to the upper levels of government, which will then provide resources and coordination mandates accordingly.

Typically, there are three possible funding sources for subnational governments to respond to disasters: a regular annual emergency budget, additional funds through subnational budget adjustments, and disaster relief fund from the central government. The first and most certain source is subnational governments' annual emergency budgets, which usually include a general emergency reserve fund and various contingency items for flood, earthquake, fire, and a few other particular types of disaster. Article 40 of the Budget Law of China stipulates that each subnational government should allocate 1%–3% of its annual budget to general reserve funds to cover unforeseen expenses related to natural disasters or other emergencies, but it provides no specific guidelines for the contingency items.[1] The second funding source is additional financial assistance from the corresponding subnational People's Congress through annual budget adjustments. Article 69 of the Budget Law outlines several specific situations in which a subnational government can, when there is a shortage of government emergency funds, request the congress to adjust the annual budget to allocate additional financial resources for disaster response and relief. The third possible source is the disaster relief fund from the central government. According to the Emergency Response Law of China, when a

subnational government's fiscal capacity does not match the scale of the disaster, it is allowed to apply for urgent financial aid from the central government.

3.2 | Why does the emergency budget vary from government to government?

Although the Budget Law requires each subnational government to allocate 1%–3% of its total annual expenditure to reserve funds for emergency events, the actual size of total emergency budget varies greatly from one government to another. For instance, at the provincial level, the emergency budget as a percentage of total expenditure ranged from 0.91% (Liaoning) to 5.35% (Jilin), or 9.76 yuan (Liaoning) to 399.03 yuan (Shanghai) per capita in 2016.

There are at least two reasons for this wide variation among subnational governments in China. One is that, as mentioned earlier, the central government deliberately leaves some room for discretion within the 1%–3% range of total expenditure for the general reserve fund, and it allows subnational governments to decide their emergency budgets according to their own economic, social, and financial situations. Similarly, the central government provides no detailed guidelines for the contingency items. While subnational governments are encouraged to incorporate the projected expenses for disaster management and relief into their annual budget, they can make their own decisions on the specific contingency items and the amount for each item based on the actual needs as long as these budgets are reviewed and approved by the corresponding Congress. The other reason is that the external funding sources such as the financial aid for disaster response and relief that a subnational government can receive from the upper levels of government are highly unpredictable (Lu & Xue, 2016). For these reasons, the annual contribution to the emergency budget can be significantly different across subnational governments in China, and the accumulating differences in emergency budgets over multiple years can be even greater.

3.3 | Research hypotheses for subnational emergency budgets in the context of China

As discussed in the previous section, prior disaster experiences, especially very recent ones, may prompt governments to increase emergency budgets by influencing their risk perceptions and preferences (Gao et al., 2020; Phaup & Kirschner, 2010). Besides, organizational learning theory suggests that governments can learn from previous disasters and improve their preparedness for future disasters either by adjusting their managerial behaviors or by gaining more public support for disaster mitigation efforts and enhancing their cooperation with civil societies (Berke et al., 1993; Shaw & Goda, 2004). One way or the other, governments tend to increase their emergency budgets as a consequence of past disastrous events. As such, we expect a positive association between prior disaster experience and government emergency budgets.

To some extent, however, the size of the emergency budget also depends on subnational governments' fiscal ability. Defined as the availability of stable financial resources (Gorina et al., 2019; Hall, 2008), fiscal ability determines whether subnational governments can set aside enough financial resources for emergency purposes (Lee & Chen, 2022a). It is likely that subnational governments with recent disaster experience and high fiscal ability will allocate larger emergency budgets in preparation for future disasters. Conversely, subnational governments with no recent disaster experience and low fiscal ability will probably have little incentive to save for future disasters. In other words, prior disaster experience and government fiscal ability may interact with each other in determining the size of emergency budgets. The current regulations promulgated by the central government of China mandate that subnational governments take a holistic approach and comprehensively consider multiple factors including characteristics of disasters, level of economic and social development, fiscal condition, and so forth, when they set up their emergency budgets.[2] These regulations officially allow Chinese subnational governments to consider both the risk of disasters and their own fiscal ability, making the interaction between the two more likely.

Based on above discussion, we put forward Hypotheses 1A and 1B:

Hypothesis 1A. *A subnational government that has suffered greater disaster damage is more likely to reserve a larger emergency budget.*

Hypothesis 1B. *The effect of past disaster damage on a subnational government's emergency budget is moderated by its budget surplus.*

Regarding the impact of disaster damage on subnational fiscal ability as measured by budget surplus, a general consensus is that hazard events can place severe strain on government finances (Chen, 2020; Fannin et al., 2012; Hildreth, 2009). On the one hand, the occurrence of disasters can suddenly and significantly increase subnational governments' spending for emergency response and relief (Miao et al., 2020); on the other hand, some widespread hazard events can also reduce subnational governments' revenue by impairing their tax base and infrastructure. As a result, larger disaster damage usually leads to less budget surplus (or more budget deficit) for subnational governments.

By contrast, previous studies often suggested that government savings can effectively mitigate the fiscal stress caused by sudden external shocks (Hou, 2003; McGranahan, 2002). This is because an adequate amount of government savings can serve as a financial cushion to dampen the adverse impact from hazard events and thereby avoid cutting too much spending from other social programs. This is also because regular contribution to and efficient management of emergency budgets can discipline governments and help them to develop the good habit of saving for uncertainties. From this perspective, if subnational governments have larger emergency budgets, a particular form of government savings, the negative consequences of disasters on the subnational finances will be smaller.

Like the dynamics of disaster damage and government fiscal ability, there may also be an interaction effect between disaster damage and emergency budgets. For one thing, governments with a higher level of emergency budgets can respond more quickly to hazard events and devote more resources to disaster relief (Donahue & Joyce, 2001; Phaup & Kirschner, 2010), therefore reducing the financial losses, especially the indirect financial losses caused by disasters. For another, governments that have developed the habit of reserving a higher level of emergency budgets are likely to be fiscally healthy and financially disciplined governments (Crow et al., 2018; Hildreth, 2009). Such governments generally can achieve a better state of disaster preparedness as a result of higher organizational capacity, administrative efficiency, or human resource capability, thereby leading to less disaster damage. As such, assuming that emergency budgets function properly and effectively, we expect that the fiscal ability (as represented by budget surplus) of subnational governments with larger emergency budgets will be affected less by disaster damage, whereas the fiscal ability of governments with a smaller emergency budget will be affected more.

Although fiscal ability should be a composite measure that includes multiple economic and fiscal items, the key element in this measure is governments' ability to maintain balanced budgets, which is probably also one of the most important considerations for governments to make decisions on emergency budgets. As such, it is not uncommon that empirical studies operationalize fiscal ability or capability in terms of budget balance or surplus/deficit (Benito & Bastida, 2009; Chen, 2020).

In sum, we propose Hypotheses 2A and 2B to test the impact of disaster damage and emergency budget on subnational governments' fiscal ability as measured by budget surplus:

Hypothesis 2A. *Disaster damage is negatively associated with a subnational government's budget surplus.*

Hypothesis 2B. *The impact of disaster damage on a subnational government's budget surplus is moderated by the size of its emergency budget.*

However, it is worth mentioning that some researchers have raised concerns about the effectiveness of emergency budgets in China (Lu & Xue, 2016; Miao et al., 2020; Yi et al., 2012; Zhang et al., 2015). First, the emergency budgets of many subnational governments are not only very low, sometimes even below the minimum level required by the Budget Law,[3] but also they are often scattered into different departments to deal with specific types of

disasters (Lu & Xue, 2016; Miao et al., 2020; Wang, 2021; Yi et al., 2012; Zhang et al., 2015). This arrangement has made it very hard for subnational governments to use their emergency budgets effectively to cope with large-scale disasters. Second, the current division of financial power and administrative responsibilities between the central and subnational governments in China may create moral hazard problems, causing subnational governments to depend more on the central government than on themselves for disaster relief funds (Cui & Yang, 2013; Feng et al., 2011; Liu & Chen, 2003). Last, since there is no standard supervision and evaluation procedure for subnational emergency management (Zhang et al., 2015), irrational distribution, abuse, and waste of emergency funds frequently occur at the subnational level of government (Feng et al., 2011; Lu & Xue, 2016; Wang, 2021; Zhang, 2015; Zhang & Wu, 2020). Taken together, these particular problems and issues in China may hamper subnational emergency budgets' capability for moderating the negative impact of disaster damage on government fiscal ability.

4 | DATA, VARIABLES, MODELS, AND METHODS

4.1 | Data

In this research, we collected and employed a panel dataset comprising 30 provincial governments in China between 2016 and 2020 to test the research hypotheses. This sample is appropriate for our study because the subnational governments of China play a key role in emergency management and differ widely in disaster experience and damage, and over time, they have developed their own practices in preparing emergency budgets within the policy and legal framework mandated by the central government (Miao et al., 2020; Zhang et al., 2015). Moreover, we follow the common practice in the research with China's subnational data and exclude Tibet from the sample due to its unique characteristics. Since earlier data on emergency budgets in China are not available, our sample only includes the most recent 5 years of data.

4.2 | Model and variables

Hypotheses 1A and 1B are tested with the following equation:

$$Emergency\_budget_{it} = f\left(\sum_{j=1}^{3} Disaster\_experience_{i(t\text{-}j)}, Budget\_surplus_{i(t\text{-}1)}, X_{i(t-1)}\right). \quad (1)$$

In Equation (1), the dependent variable is *Emergency_budget*, which is measured by the size of subnational emergency budget per capita in log. The first key independent variable *Disaster_experience* is measured by per-capita cumulative disaster damage in the past 3 years. We used 3 years as the time window in the main model to examine the impact of the most recent disaster experiences, but we also used other time windows for robustness checks. The second key independent variable *Budget_surplus* is the annual budget surplus (or deficit) as a percentage of total revenue.[4] This variable is lagged for 1 year because the emergency budget is usually made before the beginning of the current fiscal year. To capture the possible interactive effect, we also include an interaction term between disaster experience and budget surplus.[5] According to Hypotheses 1A and 1B, we expect *Disaster_experience*, *Budget_surplus*, and their interaction term to have a positive association with *Emergency_budget*.

X_{it} in Equation (1) involves socioeconomic, fiscal condition, and social vulnerability variables. The socioeconomic variables consist of GDP growth rate, unemployment rate, and population to capture possible impacts from external microeconomic and demographic conditions. The fiscal condition variables encompass intergovernmental aid per capita (log) and subnational government debt as a share of GDP to control for the influences from the fiscal situations of subnational governments. Finally, we followed the methodology described in CDC/ATSDR (2018) and some

previous studies (Cutters et al., 2003; Cutters & Finch, 2008; Lee & Chen, 2022b), and we included four variables to capture social vulnerability[6]: proportion of elderly population, proportion of low-income people, proportion of population with a college degree, and number of private vehicles per capita. Table 1 contains a detailed description of all variables used in Equation (1), and Table 2 reports the descriptive statistics.

Next, we tested Hypotheses 2A and 2B using Equation (2) with provincial governments' budget surplus as the dependent variable, and the emergency budget and disaster damage as key independent variables.

$$Budget\_surplus_{it} = f(Disaster\_damage_{it}, Emergency\_budget_{it}, X_{it}). \quad (2)$$

In Equation (2), the dependent variable *Budget_surplus* is the proportion of a provincial government's annual fiscal surplus to its total revenue, which is also used as a lagged independent variable in Equation (1). The first key

TABLE 1 Variables and data sources for Hypotheses 1A and 1B.

Variable	Measure	Data source	Unit
Dependent variable			
Emergency budget (Ln)	Log of the emergency budget per capita	Annual general public budget documents of subnational governments in China	Yuan (RMB)
Key independent variables			
Cumulative disaster damage (3-year)	Log of cumulative damage per capita over the past 3 years	China Statistical Yearbook	Yuan (RMB)
Budget surplus %	Annual budget surplus as a percentage of total revenue	China Financial Yearbook	%
Socioeconomic controls			
GDP growth rate %	GDP growth rate	China Statistical Yearbook	%
Unemployment rate %	Unemployed people as a percentage of total population	China Statistical Yearbook	%
Population (million)	Population in millions	China Statistical Yearbook	Million people
Fiscal controls			
Intergovernmental aid (Ln)	Log of percapita intergovernmental aid	Annual intergovernmental transfer disclosure documents of the Ministry of Finance of China	Yuan (RMB)
Debt level %	Total government debt as a percentage of GDP	Annual debt disclosure documents of subnational governments in China	%
Social vulnerability controls			
Elderly population %	The proportion of the population aged 65 and over	China Statistical Yearbook	%
Low-income population %	The proportion of the population receiving the minimum subsistence allowance	China Statistical Yearbook	%
Education %	The proportion of the population with a college diploma or higher	China Statistical Yearbook	%
Vehicles per capita	Number of private vehicles per capita	China Statistical Yearbook	%

TABLE 2 Summary statistics for Hypotheses 1A and 1B.

Variable	*N*	Mean	SD	Min	Max
Dependent variable					
Emergency budget (Ln)	150	4.117	0.812	2.279	5.989
Key independent variables					
Cumulative disaster damage (Ln) (3-year)	150	5.193	1.210	0.481	6.865
Budget surplus % ($t-1$)	150	−141.125	103.576	−560.291	−8.005
Socioeconomic controls					
GDP growth rate % ($t-1$)	150	8.380	3.643	−3.950	21.244
Unemployment rate % ($t-1$)	150	3.167	0.636	1.300	4.500
Population (million) ($t-1$)	150	46.417	28.882	5.770	124.890
Fiscal controls					
Intergovernmental aid (Ln) ($t-1$)	150	8.348	0.770	6.484	10.046
Debt level % ($t-1$)	150	20.135	12.539	2.801	69.901
Social vulnerability controls					
Elderly population % ($t-1$)	150	11.082	2.216	7.097	16.263
Low-income population % ($t-1$)	150	4.454	3.185	0.470	16.373
Education % ($t-1$)	150	15.233	7.686	7.000	50.000
Vehicles per capita ($t-1$)	150	0.132	0.039	0.064	0.229

independent variable *Disaster_damage* is measured as the current per-capita damage (log) caused by all disasters within a province's jurisdiction. We assumed that the disaster damage during the current fiscal year would affect the government's fiscal ability of the same year, so there was no need to lag this variable. The second key independent variable *Emergency_budget* is the per-capita emergency budget (log). To examine the possible interactive effect, we also generated an interaction term of the two key independent variables.[7] According to Hypotheses 2A and 2B, we expected that *Disaster_damage* would be negatively related to *Budget_surplus*, and that *Emergency_budget* should, to a greater or lesser extent, moderate the negative impact of disaster damage (i.e., the regression coefficient of the interaction term should be positive). However, as we have explained earlier, the moderating effect of *Emergency_budget* might be limited in the context of China.

Based on the existing literature and our analyses, the control variables X_{it} in Equation (2) encompass a set of socioeconomic and social vulnerability variables such as GDP growth rate, proportion of second industry, unemployment rate, percentage of population with a college degree, vehicles per capita, and population. Similar to Equation (1), we also included intergovernmental aid per capita (log), and the subnational debt as a share of GDP to control for a subnational government's fiscal conditions. In addition, we followed the literature in this field and added a political variable, turnover of governors (dummy), to capture possible impacts from varying political power and government policy changes (Aldrich, 2016; Benito & Bastida, 2009). Tables 3 and 4 present the details of the variables in Equation (2) and the descriptive statistics.

4.3 | Estimation methods

As the baseline estimation, we first estimated both Equations (1) and (2) controlling for the year and province fixed effects with clustered (by province) standard errors. Considering that the monetary losses inflicted by hazard events may be endogenous with both emergency budget and budget surplus due to the mitigation efforts or socioeconomic

TABLE 3 Variables and data sources for Hypotheses 2A and 2B.

Variable	Measure	Data source	Unit
Dependent variable			
Budget surplus %	Annual budget surplus as a percentage of total revenue	China Financial Yearbook	%
Key independent variables			
Disaster damage (Ln)	Log of per-capita disaster damage in the current year	China Statistical Yearbook	Yuan (RMB)
Emergency budget (Ln)	Log of per-capita emergency budget	Annual general public budget documents of subnational governments in China	Yuan (RMB)
Socioeconomic controls			
GDP growth rate %	GDP growth rate	China Statistical Yearbook	%
Second industry %	The added value of the secondary industry as a percentage of GDP	China Statistical Yearbook	%
Unemployment rate %	Unemployed people as a percentage of total population	China Statistical Yearbook	%
Education %	The proportion of the population with a college diploma or higher	China Statistical Yearbook	%
Vehicles per capita	Number of private vehicles per capita	China Statistical Yearbook	%
Population (million)	Population size in millions	China Statistical Yearbook	Million people
Fiscal controls			
Intergovernmental aid (Ln)	Log of per-capita intergovernmental aid	Annual intergovernmental transfer disclosure documents of the Ministry of Finance of China	Yuan (RMB)
Debt level %	Total government debt of as a percentage of GDP	Annual debt disclosure documents of subnational governments in China	%
Institutional controls			
Turnover of governors	Coded as 1 if there was a turnover of governors between July of the previous year and June of the current year; coded as 0 otherwise	Compiled by the authors from publicly available documents and information	Dummy variable

status of the subnational government, we employed a set of four instruments for disaster intensity in both equations, including the percentage of the population affected by climate disasters, earthquakes, and geological disasters, and the percentage of the population living in rural areas (Cutters et al., 2003). The data for the instrumental variables all came from the China Statistical Yearbooks of multiple years. Conceptually, this set of four instruments should be valid because it is highly correlated with the severity of disasters, but it is not influenced by the governments' mitigation efforts or fiscal conditions. We conducted rigorous tests to ensure the instruments were appropriate. Last, to check the robustness of the results from Equation (1), we conducted additional regression analyses using the previous 2, 4, and 5 years' cumulative disaster damage as the independent variable instead of the 3-year cumulative damage. For Equation (2), we estimated an alternative model using governments' operating surpluses at time $t + 1$ to examine whether disasters have an enduring impact on governments' budgets.

TABLE 4 Summary statistics for Hypotheses 2A and 2B.

Variable	N	Mean	SD	Min	Max
Dependent variable					
Budget surplus %	150	−150.814	108.791	−560.290	−8.005
Key independent variables					
Disaster damage (Ln)[a]	150	4.898	1.472	0.000	7.354
Emergency budget (Ln)	150	4.117	0.812	2.279	5.989
Socioeconomic controls					
GDP growth rate %	150	7.787	3.932	−5.337	21.244
Second industry %	150	37.954	7.138	15.967	49.591
Unemployment rate %	150	3.170	0.622	1.300	4.600
High education %	150	15.893	7.763	7.000	50.000
Vehicles per capita	150	0.145	0.039	0.077	0.241
Population (million)	150	46.609	29.164	5.820	126.240
Fiscal controls					
Intergovernmental aid (Ln)	150	8.443	0.757	6.484	10.076
Debt level %	150	25.290	13.045	6.752	79.899
Institutional controls					
Turnover of governors	150	0.287	0.454	0.000	1.000

[a]"1" is added to disaster damage when the original number is equal to 0.

5 | EMPIRICAL FINDINGS

The baseline estimation results for Equation (1) are in Table 5, without (column 1) and with the interaction term (column 2). The key findings are summarized below.

First, in both columns of Table 5, there is clear evidence that subnational governments with higher cumulative disaster damage tend to reserve larger emergency budgets. Specifically, all else being constant, a 1% increase in cumulative disaster damage is related to a 0.055%–0.083% increase in per-capita emergency budgets. These results confirm Hypothesis 1A, indicating that an increase in damage from prior disasters has a positive relationship with an increase in subnational governments' emergency budgets.

Second, the coefficient on subnational fiscal ability as measured by budget surplus is also positive and significant across both columns in Table 5. The results suggest that holding other variables constant, the higher the budget surplus of a subnational government, the larger the emergency budget it will reserve. In specific, a one percentage point increase in a provincial government's budget surplus is associated with 0.5%–0.6% increase in its per-capita emergency budget. This finding reveals that fiscal ability is also a critical factor that can influence subnational governments' decisions on emergency budgets.

Third, we find that fiscal ability negatively moderates the relationship between disaster experiences and emergency budgets, which is against Hypothesis 1B. As Column (2) of Table 5 shows, the coefficient of both the disaster damage and budget surplus are positively associated with emergency budgets. However, in the high group of budget surpluses, the impact of a disaster on emergency budgets is weaker than in the low group. While we expect that governments with stronger fiscal ability would set aside larger emergency budgets, the findings suggest that when governments face equivalent levels of disaster damage, those with greater fiscal ability do not necessarily save more for future disasters. This may be attributable to the greater flexibility they possess in managing their budgets, because governments with greater fiscal ability are also wealthier governments.

TABLE 5 Effect of disaster experience on governments' emergency budgets (Dependent = Emergency Budget per Capita, Log).

	Two-way fixed-effect model	
	(1)	(2)
Cumulative disaster damage (3-year) (CDD)	0.066** (0.025)	0.083*** (0.027)
Budget surplus % ($t-1$)	0.005** (0.002)	0.006*** (0.002)
CDD × High/low budget surplus ($t-1$)		−0.022* (0.013)
GDP growth rate % ($t-1$)	0.008 (0.006)	0.010* (0.006)
Unemployment rate % ($t-1$)	0.038 (0.112)	0.029 (0.106)
Population (million) ($t-1$)	−0.062 (0.043)	−0.059 (0.042)
Intergovernmental aid (Ln) ($t-1$)	−0.007 (0.126)	0.005 (0.127)
Debt level % ($t-1$)	0.020*** (0.007)	0.021*** (0.007)
Elderly population % ($t-1$)	0.038 (0.029)	0.048 (0.031)
Low-income population % ($t-1$)	0.035* (0.019)	0.033* (0.019)
High education % ($t-1$)	−0.005 (0.014)	−0.003 (0.014)
Vehicles per capita ($t-1$)	3.561 (4.761)	4.265 (4.643)
Constant	5.967** (2.490)	5.600** (2.478)
Province and year fixed effects	Yes	Yes
N	150	150
R^2	0.349	0.354
Hausman test (Chi^2)	97.420***	32.620***

Note: Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

Last, the results of some control variables in Equation (1) are also worth mentioning. The GDP growth rate seems to have a generally positive effect on emergency budgets, but it is only significant at the 10% level for the model with interaction term. The debt level is also positive and significant at the 1% level, indicating that subnational governments with more borrowings can probably redirect the funding from other programs (e.g., infrastructure) to emergency budgets. Moreover, the percentage of low-income population is significant at the 10% level and positively associated with emergency budgets as well. This is probably because subnational governments with higher proportions of low-income people are less able to mobilize resources during disasters. Therefore, they tend to allocate more emergency budgets to get better prepared for future crises.

As robustness checks for these findings, we first re-estimated the baseline models with the set of four instrumental variables (IVs) as described before. The IV regression results are presented in Columns 1 and 2 of Table 6. The set of instruments generally performs well from a statistical perspective. The endogeneity tests showed that disaster damage is indeed endogenous with the dependent variable in this equation and the under-identification (Kleibergen–Paap rk LM) tests rejected the null hypothesis of under-identification for both models, confirming that the instruments are correlated with the endogenous explanatory variable. Furthermore, the weak identification tests (Cragg–Donald Wald *F*) were both significant at the 5% level whereas the overidentification tests (Hansen *J*) were not significant, indicating that the instrumental variables are not weak instruments and they are not correlated with the disturbance process. Overall, the tests for the IVs showed that the set of instruments can provide reliable and sufficient identification power for the parameter estimates. Comparing Columns 1 and 2 of Table 6 with Table 5, we can see that the IV regression results are mostly similar to the baseline results in Table 5, except that the control

TABLE 6 Robustness checks for Hypotheses 1A and 1B (Dependent = Emergency Budget per Capita, Log).

	Instrumental variable model		Two-way fixed-effect model					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative disaster damage (3-year) (CDD)	0.150***	0.165***						
	(0.052)	(0.054)						
CDD (3-year) × High/low budget surplus ($t-1$)		−0.033**						
		(0.015)						
Budget surplus % ($t-1$)	0.006***	0.006***	0.005**	0.006***	0.005**	0.005**	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
CDD (2-year)			0.066**	0.080***				
			(0.028)	(0.029)				
CDD (2-year) × High/low budget surplus ($t-1$)				−0.023*				
				(0.014)				
CDD (4-year)					0.048	0.061		
					(0.060)	(0.057)		
CDD (4-year) × High/low budget surplus ($t-1$)						−0.016		
						(0.012)		
CDD (5-year)							0.046	0.061
							(0.058)	(0.057)
CDD (5-year) × High/low budget surplus ($t-1$)								−0.016
								(0.011)
GDP growth rate % ($t-1$)	0.008	0.011*	0.007	0.008	0.008	0.009	0.008	0.009
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Unemployment rate % ($t-1$)	0.037	0.023	0.038	0.027	0.048	0.042	0.048	0.043
	(0.099)	(0.095)	(0.111)	(0.105)	(0.115)	(0.110)	(0.115)	(0.111)
Population (million) ($t-1$)	−0.055**	−0.052**	−0.064	−0.061	−0.065	−0.063	−0.068	−0.067
	(0.026)	(0.025)	(0.041)	(0.040)	(0.045)	(0.045)	(0.044)	(0.044)
Intergovernmental aid (Ln) ($t-1$)	−0.023	−0.003	−0.069	−0.051	−0.009	0.000	−0.012	−0.005
	(0.132)	(0.135)	(0.128)	(0.129)	(0.123)	(0.125)	(0.123)	(0.124)
Debt level % ($t-1$)	0.022***	0.023***	0.020***	0.020***	0.019**	0.019**	0.018**	0.019**
	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Elderly population % ($t-1$)	0.030	0.046	0.027	0.037	0.049	0.057*	0.047	0.055*
	(0.031)	(0.034)	(0.031)	(0.033)	(0.029)	(0.031)	(0.031)	(0.032)
Low-income population % ($t-1$)	0.044**	0.040**	0.039**	0.038**	0.031*	0.030*	0.032*	0.031
	(0.019)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.020)	(0.020)
High education % ($t-1$)	−0.010	−0.006	−0.001	0.000	0.002	0.003	0.001	0.003
	(0.014)	(0.014)	(0.014)	(0.014)	(0.016)	(0.016)	(0.016)	(0.016)
Vehicles per capita ($t-1$)	1.883	3.168	4.160	5.009	3.149	3.714	3.111	3.584
	(4.298)	(4.097)	(4.637)	(4.532)	(4.940)	(4.928)	(4.599)	(4.550)
Constant			6.576**	6.170**	6.016**	5.748**	6.244**	5.982**
			(2.509)	(2.466)	(2.659)	(2.672)	(2.596)	(2.608)
Endogeneity test	4.091**	4.070**						

(Continues)

TABLE 6 (Continued)

	Instrumental variable model		Two-way fixed-effect model					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Under-identification test	19.382***	20.822***						
Weak identification test	19.857**	20.087**						
Overidentification test (Hansen *J*)	1.470	0.995						
Province and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	150	150	150	150	150	150	150	150
R^2	0.389	0.401	0.423	0.434	0.403	0.408	0.402	0.406

Note: Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

variable for population now turns statistically significant. This result is not surprising because governments with a larger population base can afford to reserve less emergency budget on a per capita basis.

We then re-estimated the baseline models with cumulative disaster damage of different time lengths, and reported the outcome in Columns 3 to 8 of Table 6. The new results indicated that the cumulative damage over past 2 years has had a negative and significant effect on subnational emergency budgets, while the government fiscal ability has negatively moderated the relationship between disaster damage and emergency budgets. This is consistent with our main findings. However, the coefficients of cumulative disaster damage and the interaction terms over the past 4 and 5 years are not statistically significant. Put together, the regression results using different lengths of cumulative disaster damage seem to suggest that disaster damage can significantly influence government decisions on emergency budgets for about 2–3 years but not any longer, possibly due to public complacency under repeated disasters (Wang & Kapucu, 2008).

Table 7 presents the results of the baseline model for Equation (2). *Disaster_damage* is negatively associated with subnational government fiscal surplus, which confirms Hypothesis 2A. However, while *Emergency_budget* has a positive and significant marginal effect on fiscal surplus, there is no statistically significant evidence to support the interaction effect between disaster damage and emergency budget, implying that emergency budgets may have limited capability to moderate the negative impact of disasters on subnational governments' fiscal ability. Therefore, Hypothesis 2B is not supported by our data. Finally, the estimation results for Equation (2) also reveal that a higher percentage of second industry, a higher percentage of educated residents, more population and intergovernmental aid, and turnover of governors will all lead to higher subnational budget surpluses, whereas higher debt level will reduce budget surpluses.

Table 8 reports the results of robustness checks for Equation (2). We first re-estimated the model using the same set of instrumental variables as in the IV model for Equation (1). The endogeneity tests, under-identification test (Kleibergen–Paap rk LM), and weak identification tests (Cragg–Donald Wald *F*) are all significant at the 5% level or better, whereas the overidentification tests (Hansen *J*) are not statistically significant, suggesting that the set of instruments is appropriate for this model. Based on the results in Columns (1) and (2) of Table 8, we can conclude that disaster damage has a negative effect, while emergency budget has a positive effect on subnational governments' budget surpluses. However, there is no interaction effect between disaster damage and emergency budgets, which is in line with our baseline results. Next, we rerun the model using governments' budget surpluses at $t + 1$ to examine whether disasters have an enduring impact on governments' budgets. The estimation results in Columns (3) and (4) of Table 8 clearly show that such an impact does not exist.

TABLE 7 Effect of disaster damage on government budget surplus (Dependent = Budget Surplus %).

	Two-way fixed-effect model	
	(1)	(2)
Disaster damage (Ln)	−2.037** (0.982)	−2.098* (1.095)
Emergency budget (Ln)	15.717** (5.922)	15.280** (6.335)
Disaster damage × High emergency budget		0.118 (0.720)
GDP growth rate %	0.043 (0.784)	0.056 (0.812)
Second industry %	6.681*** (2.078)	6.729*** (2.153)
Unemployment %	−0.831 (4.477)	−0.760 (4.285)
High education %	1.371* (0.801)	1.363* (0.816)
Vehicles per capita	4.336 (3.864)	−1.394 (3.941)
Population (million)	9.282** (3.522)	9.260** (3.505)
Intergovernmental aid (Ln)	24.226*** (7.913)	24.040*** (7.792)
Debt level %	−0.879* (0.431)	−0.866* (0.473)
Turnover of governors	7.591*** (2.506)	7.581*** (2.511)
Constant	−1084.163*** (232.800)	−1081.483*** (229.660)
Province and year fixed effects	Yes	Yes
N	150	150
R^2	0.731	0.731
Hausman test (Chi^2)	192.810***	174.600***

Note: Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

6 | DISCUSSION AND CONCLUSIONS

As more and more governments globally begin to implement a system of emergency budgets in preparation for disasters, it has become increasingly important for public administrators to understand and evaluate such systems. By compiling and analyzing a sample of 30 subnational governments of China, we provide significant insights into how governments decide the size of their emergency budgets and whether these budgets can function as intended to moderate the negative impact of disasters. We summarize and discuss the main findings of this study below.

First, we find that prior disaster experience is positively associated with the size of subnational emergency budgets. This result lends empirical supports to organizational learning theory, which states that organizations can develop new capabilities from past disasters to become better prepared for subsequent disasters (Bakema et al., 2019; Betten et al., 2021; Corbacioglu & Kapucu, 2006). This result is consistent with some previous empirical studies (Chen, 2020; Lee & Chen, 2022a), corroborating the hypothesis that as governments gain more experience from past disaster damage, they are more likely to adapt to the new environment and adopt a more ex ante budgeting strategy to improve their emergency preparedness (Phaup & Kirschner, 2010). However, we also found empirical evidence that the stimulating effect of organizational learning on the emergency budget may only last for 2–3 years into the post-disaster period, probably reflecting the short length of organizational memory or public complacency (Wang & Kapucu, 2008).

Second, this study confirms that governments' preparedness for disasters varies depending on their actual fiscal ability as measured by budget surpluses, indicating that subnational governments' fiscal ability can negatively moderate the effect of disaster damage on emergency budgets. One possible reason for this counterintuitive interaction effect is that, thanks to their better economic structure and demographic characteristics, governments with higher

TABLE 8 Robustness checks for Hypotheses 2A and 2B (Dependent = Budget Surplus %).

	Instrumental variable model		Two-way fixed-effect model	
	Budget surplus %		Budget surplus % ($t+1$)	
	(1)	(2)	(3)	(4)
Disaster damage (Ln)	−5.102***	−5.393***	−0.969	−1.335
	(1.775)	(1.779)	(1.502)	(1.496)
Emergency budget (Ln)	16.753***	15.095**	3.841	0.144
	(5.563)	(6.060)	(6.130)	(8.355)
Disaster damage × High emergency budget		0.454		0.808
		(0.693)		(0.817)
GDP growth rate %	0.093	0.141	−0.318	−0.157
	(0.734)	(0.742)	(0.692)	(0.732)
Second industry %	6.697***	6.880***	2.640*	3.039**
	(1.838)	(1.912)	(1.516)	(1.363)
Unemployment %	−1.106	−0.838	−2.756	−2.913
	(4.282)	(4.064)	(6.807)	(6.688)
High education %	1.374*	1.342*	2.072*	1.821
	(0.793)	(0.805)	(1.147)	(1.116)
Vehicles per capita	39.444	18.125	73.277	68.080
	(34.730)	(35.127)	(60.793)	(62.082)
Population (million)	9.037***	8.948***	7.286**	6.868**
	(3.396)	(3.377)	(3.064)	(2.923)
Intergovernmental aid (Ln)	26.397***	25.727***	39.141***	38.160***
	(7.788)	(7.768)	(13.979)	(13.440)
Debt level %	−0.985**	−0.939**	−0.938	−0.724
	(0.408)	(0.453)	(0.704)	(0.839)
Turnover of governors	7.719***	7.684***	−1.742	−1.703
	(2.401)	(2.396)	(2.374)	(2.340)
Constant			−1002.660***	−971.100***
			(278.478)	(268.291)
Endogeneity test	4.411**	4.769**		
Under-identification test	17.212***	15.575***		
Weak identification test	20.099**	17.050**		
Overidentification test (Hansen *J*)	0.290	0.384		
Province and year fixed effects	Yes	Yes	Yes	Yes
N	150	150	120	120
R^2	0.716	0.715	0.610	0.614

Note: Clustered standard errors in parentheses.
***$p < 0.01$; **$p < 0.05$; *$p < 0.10$.

fiscal ability usually possess higher levels of financial reserves while bearing less financial burden for social welfare programs such as pension and unemployment insurance. Therefore, these governments are probably more able to draw on existing reserves or to transfer funds from other social programs, instead of maintaining a high level of

emergency budget, to cope with disasters (Aldrich, 2016; Chen, 2020). Another possible reason is that governments with higher fiscal ability also have more financial (e.g., debt proceeds) and social resources (e.g., private donations), so they can mobilize at any time to respond to emergencies, which potentially reduces the need to enhance disaster preparedness in the form of emergency budgets (Lee & Chen, 2022b; Pew, 2020). In any event, high fiscal ability and emergency budget seem to be complementary to each other: both can buffer the financial shocks resulting from disasters, but each may achieve this purpose through its own channel and mechanism.

Third, we find that disaster damage is negatively associated with subnational governments' fiscal ability in terms of budget surplus, which is in line with prior findings (Miao et al., 2020; Ouattara & Strobl, 2013). However, contrary to common wisdom, our results reveal that, while the emergency budget at the subnational level can help to maintain budget surpluses in times of crisis, it cannot effectively moderate the negative financial impact of disaster losses. Linking this finding with the results shown in Table 5 and Table 6, we can see that governments may have an added incentive to increase their emergency budgets after experiencing disaster damage. However, such an increase may still be insufficient to alleviate the effects of disasters, or the defects in emergency management system may impede the effective use of emergency budgets. As some scholars have observed, the questionable effectiveness of emergency budgets may arise from a series of ongoing issues in China's emergency budgeting process (Lu & Xue, 2016; Miao et al., 2020; Yi et al., 2012), including the unclear central-local division of financial responsibilities that may lead to moral hazard issues (Cui & Yang, 2013; Feng et al., 2011; Liu & Chen, 2003) and insufficient supervision and evaluation of emergency budgets (Wang, 2021; Zhang, 2015). In this sense, as some studies have suggested, the specific political, administrative, and cultural characteristics of China may play a key role in understanding the logic behind and predicting the outcomes of emergency budgeting (Christensen et al., 2016).

The findings of this study have important theoretical and practical meanings for public budgeting and emergency management. From a theoretical standpoint, this research enriches the organizational learning literature by shedding light on how subnational governments can learn from past disaster experience and adapt themselves to get better prepared for future disasters. This study also adds to the organizational learning literature by specifying the length of organizational memory with respect to disaster damage. This interpretation supports the premise of the bounded rationality that policymakers, usually overloaded by a deluge of information, only use a limited amount of and probably the most recent information in making decisions, even during life-threatening emergency events (Wang & Kapucu, 2008). As such, to improve the effectiveness and efficiency of emergency budgeting, subnational governments should be encouraged to design their own policies and process about emergency budgets by incorporating the unique characteristics of their jurisdictions, and if possible, longer and more extensive disaster information.

From a policy and practice perspective, this study has uncovered the complex dynamics between subnational fiscal ability and emergency budgets and suggested useful ways for budgeting officers and emergency managers to improve emergency preparedness. On the one hand, since stronger fiscal ability leads to better financial preparedness, it is pivotal for subnational governments to maintain a healthy and sustainable fiscal equilibrium, especially when the risk of disasters is high (Hildreth, 2009). On the other hand, the fact that subnational fiscal ability may attenuate the effect of prior disaster experiences on emergency budgets implies that policy makers, instead of focusing on the disasters themselves, should always adopt a holistic strategy by combining multiple economic, financial, and organizational factors in the process of budgeting for emergencies (Betten et al., 2021). In addition, our findings suggest that the cultural context may play a key role in determining the outcome of an emergency budget. Therefore, in the case of China, for instance, policy makers should take steps to reduce the fragmentation of emergency budgets by establishing a more uniform central-local coordination system for emergency management, enforce the emergency budget regulations more strictly, and improve the evaluation and supervision procedures to avoid the moral hazard problem and to minimize any waste of resources (Feng et al., 2011; Lu & Xue, 2016; Zhang, 2015).

Future studies should employ larger and longer datasets to improve the accuracy and generalizability of the estimation results. Attempts should also be made to include more relevant variables, such as disaster risk perceptions and external resources, to test a complete model of emergency budget in multiple cultural contexts. Finally, given the limitations of traditional regression analysis, researchers are encouraged to use surveys, interviews, experiments, and other innovative methods to develop more in-depth insights into the complex emergency budgeting process.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTES

[1] See the Emergency Response Law of the People's Republic of China, Regulation on the Relief of Natural Disasters (2019 Revision), Regulation on the Defense against Meteorological Disasters (2017 Revision), National Emergency Plan for Natural Disaster Relief.

[2] Regulation on the Relief of Natural Disasters, the National Emergency Plan for Natural Disaster Relief, and the Implementation Regulations on the Budget Law of the People's Republic of China.

[3] From 2016 to 2018, the proportion of the reserve funds in Liaoning, Hebei, and Qinghai provinces of China were all less than 1%, which does not meet the minimum level stipulated by the Budget Law.

[4] It is worth noting that, under the tax-sharing financial system implemented in China, there is a routine fiscal imbalance between revenue and expenditure, causing large general-fund deficits for subnational governments. In our database (National Bureau of Statistics: http://www.stats.gov.cn/), Shanghai was the city with the greatest financial capacity. Even so, the city amassed a total on-budget deficit of 51.281 billion Yuan in 2016, net of intergovernmental transfers and extra-budgetary revenues. This deficit increased to 178.5 billion Yuan in 2022. In fact, due to routine and sizable deficits, Chinese subnational governments typically rely on extra-budgetary revenues, such as intergovernmental transfers from the central government, land sales revenues, debt proceeds, and so forth, to cover their large on-budget gaps.

[5] Following prior research (Brunner & Sonstelie, 2003; Wang & Scorsone, 2020), we converted the continuous variable of Budget surplus % into a binary variable to construct the interaction term. The threshold for this binary variable is the median of Budget surplus %. There are two reasons for using a binary variable in the interaction term. First, using the interaction term of two continuous variables makes it more difficult to obtain a statistically significant result on the interaction term because the differences in a continuous variable are less distinct, and it is also more difficult to interpret the coefficient of the interaction term between two continuous variables. Second, given the research purpose of this study, we are more interested in knowing whether subnational governments with stronger fiscal ability would fare better in the face of disaster than those with weaker fiscal ability. In this sense, using a dummy variable for fiscal ability better serves our purpose than using a continuous one. To ensure robustness, we've also rerun the estimation with a continuous variable for budget surplus. We find that the results remain in the same directions but are only significant at the 10% level for a one-tailed test.

[6] The Social Vulnerability Index (SoVI) (CDC/ATSDR, 2018, p. 3) approach has been widely used in research and practice (Spielman et al., 2020; Tate et al., 2021). Specifically, the SoVI integrates a variety of socioeconomic and demographic variables, such as personal wealth, age, density of the built environment, single-sector economic dependence, housing stock and tenancy, race, ethnicity, occupation, and infrastructure dependence, to evaluate community resilience against environmental threats (Cutters et al., 2003). However, the SoVI is mainly based on the US census data, many of which—including the density of the built environment, single-sector economic dependence, housing stock and tenancy, race, ethnicity, occupation, and infrastructure dependence—are not available in the Chinese context. Considering the limitation of data availability in China, we include four variables to capture social vulnerability: proportion of elderly population, proportion

of low-income people, proportion of population with a college degree, and number of private vehicles per capita. Collectively, these variables related to social vulnerability may impact emergency budgets.

[7] Like *Budget_surplus*, we also converted the continuous variable of *Emergency_budget* into a binary variable when constructing the interaction term. The threshold for this binary variable is the median of *Emergency_budget*.

REFERENCES

Aldrich, D.P. (2016) It's who you know: factors driving recovery from Japan's 11 March 2011 disaster. *Public Administration*, *94*(2), 399–413.

Arapis, T. & Chatterjee, V. (2023) Saving for national disasters: evidence from Pennsylvania local governments. *State and Local Government Review*, *55*(2), 120–138.

Argyris, C. & Schön, D. (1978) *Organizational learning: a theory of action perspective*. Reading, MA: Addison-Wesley.

Bakema, M.M., Parra, C. & McCann, P. (2019) Learning from the rubble: the case of Christchurch, New Zealand, after the 2010 and 2011 earthquakes. *Disasters*, *43*(2), 431–455.

Benito, B. & Bastida, F. (2009) Budget transparency, fiscal performance, and political turnout: an international approach. *Public Administration Review*, *69*(3), 403–417.

Berke, P.R., Kartez, J. & Wenger, D. (1993) Recovery after disaster: achieving sustainable development, mitigation and equity. *Disasters*, *17*(2), 93–109.

Betten, T., Vian Pettersen, K. & Albrechtsen, E. (2021) Learning in municipalities after disasters. *Disaster Prevention and Management: An International Journal*, *30*(3), 400–411.

Boin, A., 't Hart, P., Stern, E. & Sundelius, B. (2005) *The politics of crisis management: public leadership under pressure*. Cambridge, UK: Cambridge University Press.

Broekema, W. (2016) Crisis-induced learning and issue politicization in the EU: the braer, sea empress, erika, and prestige oil spill disasters. *Public Administration*, *94*(2), 381–398.

Brunner, E. & Sonstelie, J. (2003) School finance reform and voluntary fiscal federalism. *Journal of Public Economics*, *87*(9–10), 2157–2185.

Cameron, L. & Shah, M. (2015) Risk-taking behavior in the wake of natural disasters. *Journal of Human Resources*, *50*(2), 484–515.

Centers for Disease Control and Prevention & Agency for Toxic Substances and Disease Registry (CDC/ATSDR). (2018) *Social Vulnerability Index (SVI)*. Available at: https://www.atsdr.cdc.gov/placeandhealth/svi/index.html [Accessed July 1, 2024].

Chen, G. (2020) Assessing the financial impact of natural disasters on local governments. *Public Budgeting & Finance*, *40*(1), 22–44.

Christensen, T., Danielsen, O.L., Lægreid, P. & Rykkja, L.H. (2016) Comparing coordination structures for crisis management in six countries. *Public Administration*, *94*(2), 316–332.

Clarke, L.B. (1999) *Mission impossible: using fantasy documents to tame disaster*. Chicago: University of Chicago Press.

Comfort, L.K., Waugh, W.L. & Cigler, B.A. (2012) Emergency management research and practice in public administration: emergency, evolution, expansion, and future directions. *Public Administration Review*, *72*(4), 539–547.

Corbacioglu, S. & Kapucu, N. (2006) Organizational learning and self-adaptation in dynamic disaster environments. *Disasters*, *30*(2), 212–233.

Crow, D.A., Albright, E.A., Ely, T., Koebele, E. & Lawhon, L. (2018) Do disasters lead to learning? Financial policy change in local government. *Review of Policy Research*, *35*(4), 564–589.

Cui, J. & Yang, Q. (2013) Learning from and insights into intergovernmental emergency financial responsibility sharing mechanisms based on the experiences of the United States and Australia. *Chinese Public Administration*, *5*, 86–90 (in Chinese).

Cutters, S.L., Boruff, B.J. & Shirley, W.L. (2003) Social vulnerability to environmental hazards. *Social Science Quarterly*, *84*(1), 242–261.

Cutters, S.L. & Finch, C. (2008) Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences*, *105*(7), 2301–2306.

Dessaint, O. & Matray, A. (2017) Do managers overreact to salient risks? Evidence from hurricane strikes. *Journal of Financial Economics*, *126*(1), 97–121.

Donahue, A.K. & Joyce, P.G. (2001) A framework for analyzing emergency management with an application to federal budgeting. *Public Administration Review*, *61*(6), 728–740.

Fannin, J.M., Barreca, J.D. & Detre, J.D. (2012) The role of public wealth in recovery and resiliency to natural disasters in rural communities. *American Journal of Agricultural Economics*, *94*(2), 549–555.

Feng, Q., Liu, M. & Hou, D. (2011) Institutional framework design of emergency financial fund management in China—based on the perspective of major natural disasters. *Public Finance Research*, *9*, 7–11 (in Chinese).

Gallagher, J. (2014) Learning about an infrequent event: evidence from flood insurance take-up in the United States. *American Economic Journal: Applied Economics*, *6*(3), 206–233.

Gao, M., Liu, Y. & Shi, Y. (2020) Do people feel less at risk? Evidence from disaster experience. *Journal of Financial Economics*, *138*(3), 866–888.

Gorina, E., Maher, C. & Park, S. (2019) Toward a theory of fiscal slack. *Public Budgeting & Finance*, *39*(4), 1–27.

Government Accountability Office (GAO). (2009) *Disaster recovery: experiences from past disasters offer insights for effective collaboration after catastrophic events*. Available at: https://www.gao.gov/products/gao-09-811 [Accessed July 1, 2024].

Hall, J.L. (2008) Assessing local capacity for federal grant-getting. *American Review of Public Administration*, *38*(4), 463–479.

Hanaoka, C., Shigeoka, H. & Watanabe, Y. (2018) Do risk preferences change? Evidence from the Great East Japan Earthquake. *American Economic Journal: Applied Economics*, *10*(2), 298–330.

Hildreth, B. (2009) The financial logistics of disaster: the case of hurricane Katrina. *Public Performance & Management Review*, *32*(3), 400–436.

Hou, Y. (2003) What stabilizes state general fund expenditures in downturn years—budget stabilization fund or general fund unreserved undesignated balance? *Public Budgeting & Finance*, *23*(3), 64–91.

Kirschner, C.L., Singla, A. & Flick, A. (2018) *Financing community resilience before disaster strikes: lessons from the United States*. *Oxford Research Encyclopedia of Natural Hazard Science*. Available from: https://doi.org/10.1093/acrefore/9780199389407.013.191

Krogh, A.H. & Lo, C. (2023) Robust emergency management: the role of institutional trust in organized volunteers. *Public Administration*, *101*(1), 142–157. Available from: https://doi.org/10.1111/padm.12894

Lee, S. & Chen, G. (2022a) Disaster experience and governments' savings: the moderating role of organizational capacity. *Journal of Public Administration Research and Theory*, *32*(3), 591–609.

Lee, S. & Chen, G. (2022b) Understanding financial resilience from a resource-based view: evidence from US state governments. *Public Management Review*, *24*(12), 1980–2003.

Lee, S., Dodge, J. & Chen, G. (2022) The cost of social vulnerability: an integrative conceptual framework and model for assessing financial risks in natural disaster management. *Natural Hazards*, *114*(1), 691–712.

Liu, S. & Chen, S. (2003) Constructing an emergency response mechanism for public finance. *Public Finance Research*, *8*, 15–20 (in Chinese).

Lu, X. & Xue, L. (2016) Managing the unexpected: sense-making in the Chinese emergency management system. *Public Administration*, *94*(2), 414–429.

McGranahan, L. (2002) Unprepared for boom or bust: understanding the current state fiscal crisis. Economic perspectives. *Federal Reserve Bank of Chicago*, *26*(3), 2–25.

Miao, Q., Chen, C., Lu, Y. & Abrigo, M. (2020) Natural disasters and financial implications for subnational governments: evidence from China. *Public Finance Review*, *48*(1), 72–101.

Murphy, B., Falkiner, L., McBean, G., Dolan, H. & Kovacs, P. (2005) *Enhancing local level emergency management: the influence of disaster experience and the role of households and neighborhoods*. Institute for Catastrophic Loss Reduction Research Paper Series No. 43.

Nava, L. (2022) Rise from ashes: a dynamic framework of organizational learning and resilience in disaster response. *Business & Society Review*, *127*, 299–318.

Onuma, H., Shin, K.J. & Managi, S. (2017) Household preparedness for natural disasters: impact of disaster experience and implications for future disaster risks in Japan. *International Journal of Disaster Risk Reduction*, *21*, 148–158.

Ouattara, B. & Strobl, E. (2013) The fiscal implications of hurricane strikes in the Caribbean. *Ecological Economics*, *85*, 105–115.

Painter, W.L. (2024) *The disaster relief fund: overview and issues*. Congressional Research Service Report R45484. Available at: https://crsreports.congress.gov/product/pdf/R/R45484 [Accessed July 1, 2024].

Pew Charitable Trusts (Pew). (2020) *How states pay for natural disasters in an era of rising costs: A nationwide assessment of budgeting strategies and practices*. Available at: https://www.pewtrusts.org/-/media/assets/2020/05/how-states-pay-for-natural-disasters-in-an-era-of-rising-costs.pdf [Accessed July 1, 2024].

Phaup, M. & Kirschner, C. (2010) Budgeting for disasters: focusing on the good times. *OECD Journal on Budgeting*, *10*(1), 1–24.

Røiseland, A. & Trætteberg, H.S. (2024) Emergency management through enduring collaborative networks: lessons on phases and levels. *Public Administration*, *102*(4), 1728–1744. Available from: https://doi.org/10.1111/padm.12998

Scognamiglio, F., Sancino, A., Caló, F., Jacklin-Jarvis, C. & Rees, J. (2023) The public sector and co-creation in turbulent times: a systematic literature review on robust governance in the COVID-19 emergency. *Public Administration*, *101*(1), 53–70. Available from: https://doi.org/10.1111/padm.12875

Shaw, R. & Goda, K. (2004) From disaster to sustainable civil society: the Kobe experience. *Disasters*, *28*(1), 16–40.

Spielman, S.E., Tuccillo, J., Folch, D.C., Schweikert, A., Davies, R., Wood, N. et al. (2020) Evaluating social vulnerability indicators: criteria and their application to the Social Vulnerability Index. *Natural Hazards*, *100*, 417–436.

Tate, E., Rahman, M.A., Emrich, C.T. & Sampson, C.C. (2021) Flood exposure and social vulnerability in the United States. *Natural Hazards*, *106*(1), 435–457.

Wang, S. & Scorsone, E. (2020) Economic resilience after the Great Recession: an examination of unreserved fund balance in Michigan counties. *Local Government Studies*, *46*(5), 716–733.

Wang, X. (2021) *Construction of emergency budget system in China*. Beijing: China Social Sciences Press. (in Chinese).

Wang, X. & Kapucu, N. (2008) Public complacency under repeated emergency threats: some empirical evidence. *Journal of Public Administration Research and Theory*, *18*(1), 57–78.

Yi, L., Ge, L., Zhao, D., Zhou, J. & Gao, Z. (2012) An analysis on disasters management system in China. *Natural Hazards*, *60*, 295–309.

Zhang, W. (2015) Main problems and countermeasures innovation of government financial contingency risk early warning management. *Chinese Public Administration*, *1*, 126–132 (in Chinese).

Zhang, X. & Wu, Z. (2020) Building a financial governance system that adapts to the needs of emergency management with Chinese characteristics. *Public Finance Research*, *04*, 22–34 (in Chinese).

Zhang, Y.L., Ma, Y.N., Chen, A. & Lin, Y.H. (2015) Research on Chinese public finance in response to domestic natural disasters. *Natural Hazards*, *77*, 1799–1810.

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