Flood Disasters and Fiscal Federalism: Evidence from U.S. States

Aichiro Suryo Prabowo
Southeast Asia Program, Cornell University
640 Stewart Ave, Ithaca New York 14850, USA
aichiro@cornell.edu

Abstract: This study investigates whether and to what extent the severity and frequency of flooding impact the state budgets. Drawing on the fiscal federalism framework, it analyzes state intergovernmental revenue, as well as its subcomponents related to housing, roads and streets, natural resources, and other categories. Using panel data from 50 U.S. states between 1997 and 2020, the analysis employs a two-way fixed-effects model. The results show that increased severity of flooding generally leads to higher state intergovernmental revenue two years after the event. Among the subcomponents, intergovernmental funding related to housing and roads and streets appears to be most responsive to severe flooding.

Key Policy Insights

- Sound fiscal management is an essential element of effective disaster mitigation, particularly in the context of flood management.
- Although federal assistance to state governments is often a well-intentioned response following flooding, it can lead to inefficiencies in society.
- Budgetary policies at all levels of government, both before and after flooding events, should be carefully designed to avoid creating problematic incentives.

Keywords: flooding, environmental policy, emergency management, fiscal federalism
JEL codes: Q54, H7, H12, H30, H53

1. Introduction

The United States has seen an increasing frequency and intensity in disaster events over the last few decades. According to the National Centers for Environmental Information (NCEI) under the National Oceanic and Atmospheric Administration (NOAA), the average count of disasters with larger-than-$1-billion costs quadrupled from 3.1 per year in the 1980s to 12.8 per year in the 2010s (NOAA NCEI, 2022a). This study focuses on one type of disasters, flooding, for three reasons: the damage level it has caused, the increasing intensity associated with climate change, and the ubiquity across the U.S.

First, a NOAA technical memorandum marks that flooding was responsible for more than 100 fatalities per year from 1959 through 1991 (Dittmann, 1994). A separate record reports that between 1974 and 2014, the average damage due to flooding was around $8 billion annually (NOAA, 2015). At least one flooding event causing damages of 1 billion or more was recorded each year between 2021-2024, resulting in a total cost of nearly $15 billion and 90 deaths (NOAA NCEI, 2022a). The Federal Emergency Management Agency (FEMA, n.d., para. 3) additionally noted that "flooding causes more damage in the United States than any other severe weather-related event, an average of $5 billion a year."

Second, several observational studies have shown that flooding is becoming more intense across the globe, including in large areas of the U.S. (Archfield et al., 2016; Mallakpour & Villarini, 2015; Slater & Villarini; Tellman et al., 2021; Wing et al., 2022). Scientists have not unanimously attributed the increase of flood events solely to climate warming, noting certain societal factors (i.e., urban development and water management) might have concurrently influenced their prevalence (Hirsch & Ryberg, 2012; Hodgkins et al., 2017; Intergovernmental Panel on Climate Change [IPCC], 2014; Pielke, 1999; Prein et al., 2017). But it is undeniable that extreme precipitation contributes to flooding and, as suggested in the federal government's Fourth National Climate Assessment, that "observed increases in the frequency and intensity of heavy precipitation events in most parts of the United States are projected to continue" (Hayhoe et al., 2018).

Third, unlike some other forms of disasters, flooding is possible in all of the 50 states in the U.S. at any time of the year (National Severe Storms Laboratory, n.d.). By way of comparison, other notable disasters like wildfires are typically found in the Western region of the U.S., while hurricanes mostly happen only in the Southern region. The ubiquity of flooding is essential for this study, as it helps with the estimation strategy by providing sufficient variability across states and over time to empirically estimate the average impact of a specific disaster and to generalize the findings nationwide.

When flooding occurs, the government is expected not only to respond swiftly but also to implement mitigation measures that reduce the impact of future events. In the U.S., the function to manage such disasters is shared primarily between the federal and state governments. While states play a frontline role in disaster mitigation and response, the federal government often provides financial assistance, especially when the scale of the event exceeds state capacity. As Figure 1 shows, both the number of disaster declarations and the amount of federal assistance to states associated with flooding have trended upward over time. This increase places growing pressure on federal budgets and raises important questions about the fiscal implications for states. It also serves as an opportunity for reflection on the normative role of each level of government within the fiscal federalism framework and to strengthen intergovernmental arrangements in disaster management.

[Figure 1 here]

To better understand the fiscal dynamics between these levels of government and further identify strategies for maintaining fiscal resilience, this study evaluates how flooding events impact the state intergovernmental revenue. In addressing the research question, the analysis applies two-way fixed effects model on a panel data of 50 U.S. states between 1997 and 2020. To the best of the author's knowledge, no previous studies have specifically investigated the incidence of flooding in the state budgeting context.

Following this introductory section, this paper is organized as follows: Section 2 provides a discussion of the theoretical framework relevant to the fiscal implications of natural disasters; Section 3 describes data collection and sources; Section 4 outlines the methodology; Analysis results and discussion are presented in Sections 5 and 6; and finally, Section 7 presents conclusions.

2. Theoretical framework

While the shared function between the U.S. federal and state governments in disaster management is well established, historical accounts suggest a gradual evolution of this arrangement. The responsibility for carrying out post-disaster reconstruction efforts once rested with individual states, but it became evident that the burden was often overwhelmingly beyond their capacity, paving the way for a greater federal role in preparing for and responding to disasters. In 1950, the US Congress passed the Federal Disaster Relief Act, which granted authority for federal actions and committed the federal government to providing assistance to states and localities (Bea, 2012). The establishment of the Federal Emergency Management Agency (FEMA) by President Carter in 1979 led to a further expansion of the federal government's involvement in disaster response and recovery efforts.

U.S. states play a central role as sovereign entities with constitutional authority over many local functions. But during emergencies, the federal government often assumes a more prominent role, with states serving as conduits between federal resources and local implementation. Upon the declaration of an emergency and a request from the state governor, a sitting president has discretion over funding mobilization to the states. The extent to which state governments operationalize the division of responsibilities remains an important area for empirical investigation. This study seeks to address the complexities of the intergovernmental relationships by focusing on their fiscal dimensions, particularly intergovernmental revenue and its key subcomponents.

The research makes a novel contribution to the literature by integrating a *state-level analysis* with a specific investigation into the impact of *flooding* as a distinct type of disaster. Previous studies often consider natural disasters as a broad category, within which the direction of fiscal implications remains ambiguous. For example, Fidrmuc (2015) and Miao et al. (2018)

analyzed disasters broadly and found that such events frequently lead to rises in state intergovernmental revenues. Other studies look at individual types of disasters, such as wildfires (Liao and Kousky, 2021), hurricanes (Deryugina, 2017; Jerch et al., 2023), as well as flooding (Crow et al., 2018; Sarmiento et al., 2006). However, most of these analyses considers lower-level jurisdictions (i.e., counties or municipalities) as the unit of analysis. In the study by Sarmiento et al. (2006), floods were found to disrupt local government activities and divert resources that would otherwise have been used for grant applications, resulting in lower intergovernmental revenue. Beyond those, there are cases in which intergovernmental transfers were found to be unaffected by disaster events (Liao and Kousky, 2021).

Grounded in the process and politics of budgeting, this study hypothesizes that state intergovernmental revenue increases after flooding events. This revenue, primarily sourced from the federal government, captures the fiscal dynamics between the federal and state governments. From the perspective of state governments, intergovernmental revenue provides “extra” resources that can serve as a cushion during emergencies. Relying on such transfers is an attractive option for state leaders, as it expands the states’ budgets without directly raising the tax burden on their residents. From the federal perspective, this budget component delineates the amounts of resources spent externally, and transfers to states effectively reduce the resources available to the federal government. However, in the context of disasters, federal actors appear more likely to allocate greater resources to states, primarily due to existing budgetary institutions and political incentives that often favor reactive over preventive measures.

As Rubin (2012, pp 7) asserted, “federal government by and large continued to be ad hoc and reactive until the latter half of the twentieth century.” Under the federal budget rules, the allocation of resources for *ex-ante* mitigation necessitates competing against other priorities through the regular appropriations process (Donahue and Joyce, 2002). In contrast, setting aside response funding with the emergency designation *after* a disaster occurs is more straightforward. Building on Peterson's (1995) functional and legislative theory of federalism, Donahue and Joyce (2002) further posit that public officials typically steer clear of mitigation efforts as they involve minimal visible actions that can be translated into electoral gains. Consistent with this view, Healy and Malhotra (2009) analyze over 3000 counties across the U.S. and present evidence suggesting that voters tend to reward the incumbent presidential party for delivering disaster relief, but not for investing in disaster preparedness.

The framework developed in this study recognizes that there are nuances of multilevel fiscal governance and that the most optimal level depends on the type of public program being implemented. In fiscal federalism theory, Oates (1972) introduces the term "correspondence principle" to explain that ideally, the assignment of government expenditure for public goods should align with the benefit coverage. Applying this theory, Bisaro et al. (2020) propose a multilevel governance framework for managing coastal floods, which considers heterogenous local preferences, appropriate level of government responsible for making decisions, aligned financing sources and beneficiaries, and the extent of spillovers of the public goods. While spending through lower-level jurisdictions is more effective for programs that benefit from local implementation and monitoring, such as interactive flood risk maps and property acquisition and redevelopment (Fraser et al., 2003), spending through higher-level jurisdictions is better suited for programs that extend beyond local boundaries and require regional partnerships, such as major infrastructure projects (Caruson & MacManus, 2008; Lubell et al., 2021; McGlynn et al., 2024).

3. Data

3.1. Constructing flooding dataset

FEMA (2020) defines flooding as "a general and temporary condition of partial or complete inundation of 2 or more acres of normally dry land area or of 2 or more properties." This condition can be triggered by the overflow of inland or tidal waters, unusual runoff of surface waters, or collapse of land along the shore of a lake. In the U.S., however, there are no widely adopted scales or indexes to categorize flooding events by severity and frequency.[1] The lack of standardized categorization presents challenges for analyzing flood disasters through cross-sectional and intertemporal lenses.

To address the limitations in existing data, this study makes use of indicators that are available and constructs a new dataset to measure flooding *severity* and *frequency*. While closely related, these are distinct concepts, each offering unique policy relevance. More severe flooding, even if infrequent, can have adverse effects on communities. Similarly, more frequent flooding events, regardless of severity, can lead to significant consequences in the short and long terms. In this analysis, the number of flooding events in a given state and year serves as a proxy for *frequency*, while the amount of flooding insurance claims is used as a proxy for *severity*. As Figure 2 demonstrates, there has been an increasing trend in both flooding severity (Panel A) and frequency (Panel B) in the U.S. since 1996.

[1] The NOAA database includes four types of events: "flood", "flash flood", "coastal flood", and "lakeshore flood," but does not specify the magnitude of each event. Flooding, which could last days or even weeks, is a longer-term event than a flash flood that typically clears within six hours or less (NOAA, 2022a). Flash floods are commonly referred to as rapid hydrological events triggered by local, intense rainfall (Kruczkiewicz et al., 2021). In contrast, other types of disasters have more standardized measures of severity. For example, NOAA documents and classifies hurricanes into five-level Saffir-Simpson scale, while the National Drought Mitigation Center at the University of Nebraska-Lincoln also develops the Drought Severity and Coverage Index to monitor drought levels (Akyuz, 2017).

[Figure 2 here]

Flooding insurance claims data are obtained from the National Flood Insurance Program (NFIP) records administered by FEMA (2022). NFIP covers for buildings and contents within the building structures that are damaged by flooding events. This data set has more than 50 million transactions collected since the 1980s. Personally identifiable information is redacted, but other key information is retained, including types of damaged building structures, years of loss, locations, and claims. As part of data cleaning, total claims in each state throughout the years of observation are aggregated. Total claims represent amounts in dollar terms that are paid on the building claims as well as contents claims. To support that flooding insurance claims is an appropriate measure of severity, its correlation with the monetary damage of weather disasters in a given state and year as measured by the National Weather Service (2021) was tested. This exercise generated a strong correlation pattern with a correlation coefficient of 0.89. Higher flooding insurance claims are associated with more severe flooding incidence.

Flooding events data are collected from the NOAA's National Centers for Environmental Information (NCEI) official publication. The agency has recorded natural disasters in the U.S. since the 1950s. Until the 1990s, however, it documented only certain types of disaster events, such as tornados, thunderstorms, and hail. The agency then upgraded the database in 2000. Among the changes was the way an event was entered; instead of free-text entries, NOAA added predetermined types of disasters to improve data functionality and consistency. Previously, there had been up to 950 unique event types, but with the change the number was reduced to fewer than

50 event types (NOAA, 2022b). This standardization, applied to natural disasters recorded from 1996 onwards, allows for identification and analysis of a specific disaster type, like flooding. Different types of floods in the NOAA database, namely flood, flash flood, coastal flood, and lakeshore flood will be included in the analysis. This NOAA data further provides information on where and when a disaster event occurred, which enables the identification and quantification of flooding events in a given state and year.

There are potential limitations to the severity and frequency measures employed in this study. First, flooding insurance claims could be correlated with the quality of flood mitigation infrastructure provided by the government. A more severe disaster may not necessarily lead to higher damage if the government capacity to mitigate it is excellent. In contrast, with poor mitigation capacity, even a less severe disaster can result in an expensive monetary damage. To overcome potential endogeneity, the model controls for state government spending on sewerage. Second, flooding insurance claims could also be correlated with property values. For instance, flooding with the same magnitude can lead to higher (or lower) claims for households living in an affluent (or lower-income) area. To address this potential endogeneity, per capita personal income is also controlled for in the model. Other studies on natural disasters also use similar type of measurement, such as the monetary costs of property and crop losses (Miao et al., 2018).

3.2. Measuring the state budget

Budget data were obtained from the U.S. Census Bureau (2022a). Every year, the agency conducts the Annual Survey of State Government Finances to collect budget data from all 50 states. The level of detail that goes beyond aggregate amounts (i.e., total revenue, total expenditure) provides an avenue for more granular analysis of the budget, such as intergovernmental revenue.

Also, since data are stored in one place with consistent formatting, accessing the database is more time efficient as compared to collecting the same information state by state (i.e., from each state government website.) An additional source for the subcomponents of state intergovernmental revenue and state expenditure on sewerage data is Willamette University's Government Finance Database (Pierson et al., 2015), which provides a formatted and consolidated version of the U.S. Census Bureau's state finance data.

At the broad level, the budget is comprised of two major flows: total revenue and total expenditure. Total revenue is subdivided into tax revenue, intergovernmental revenue, and other. This study focuses on intergovernmental revenue, which refers to funds transferred from other government entities, primarily the federal government. These transfers consist of major subcomponents, including housing, roads and streets, natural resources, and others.[2] Figure 3 illustrates the increasing trends in state intergovernmental revenue, measured on a per capita basis.

[Figure 3 here]

3.3. Controlling for state economic conditions

Economic data and other control variables are obtained from the University of Kentucky Center for Poverty Research (UKCPR, 2022). The center collects relevant variables from various

[2] According to the 2006 edition of the US Census Bureau's Government Finance and Employment Classification Manual, these subcomponents correspond to the following categories and codes: "housing and community development" (B50), "highways (including roads and streets" (B46), "natural resources" (B59), and "all other" (B89). "All other" combine "disaster assistance (FEMA)" with other federal aid, such as economic development, libraries, partks and recreation, etc.)

sources, such as U.S. Census Bureau (population, the number of state employees), Bureau of Labor Statistics (unemployment rate), U.S. Department of Commerce's Bureau of Economic Analysis (Gross State Product, personal income), and the Council of State Governments (governor's party affiliation). States like California and Texas are much different in terms of economic size and population from Wyoming and Vermont. Considering their influence on the size of the state budget, these need to be accounted for. Both unemployment rate and personal income are measures of affluence in a given state and year, which may correlate with how much a state collects in taxes and spends for public services. The number of full-time equivalent state employees are included in the analysis to control for government capacity. Lastly, governor's party affiliation reflects how the state government perceives and carries out tax policies and public spending.

Accounting for data availability, this study constructs a panel data with 50 cross-sectional units (i.e., 50 states) over a 24-year period from 1997 to 2020. The result is a balanced panel data with 1200 observations altogether. Table 1 summarizes sources from which data are obtained in the study, and Table 2 reports the summary statistics for all variables in the analysis.

[Table 1 here]

[Table 2 here]

4. Methodology

4.1. Basic Approach

This study employs a two-way fixed effects regression model to estimate the impact of flooding on state finances. The model is appropriate for panel data, in which the same set of states is observed repeatedly across multiple years. The key identifying assumption is that any unobservable state-level characteristics that affect both the dependent variable and the independent variables of the regression are time-invariant. By using the fixed effects model, these unobserved variables need not be directly measured but could be controlled for. The threat of omitted variable bias is greatly reduced as a result. Examples of time-invariant state characteristics related to flooding are geographic and topographic features. Some states located near the coast (e.g., New York, South Carolina, and California) or bordering the Great Lakes (e.g., Wisconsin, Michigan, and Ohio) will unlikely change in the foreseeable future. Inclusion of state fixed effects removes these presumably time-invariant characteristics, measuring changes "within" each state over time.

A state can reasonably anticipate the regularity of floods, but it cannot fully control its occurrence. While the weather forecast agency can predict whether the next few days will have rain, the extent of likely flooding is typically assessed on a real-time basis (U.S. Geological Survey, 2022). Studies also report that flooding is influenced by not only the climate but also some societal factors (Kunkel et al., 1999; Changnon et al., 2000). For example, there is evidence that GDP and population, which account for social and economic conditions, can affect the level of flooding hazards (Barredo, 2006; Choi & Fisher, 2003; Pielke & Downton, 2000; Zhou et al., 2017). Others also discussed the role of institutional capacity in developing and implementing flood mitigation techniques (Brody et al., 2010; Shabman & Scodari, 2014). These variables vary from time to time and will not necessarily be accounted for by the fixed effects model. Since their omissions cause bias, this study proceeds by including in the model several relevant time-varying indicators as control variables in each state and year, such as gross state product, population, unemployment rate, personal income per capita, number of state government employees, state government spending on sewerage, as well as the governor's party affiliation.

4.2. Econometric Model

The model takes the following functional form:

$$budget_{it} = \alpha + \sum_{k=0}^{3} \beta_k flooding_{it-k} + \beta_4 gsp_{it} + \beta_5 population_{it} + \beta_6 unemployment_{it} + \beta_7 pcincome_{it} + \beta_8 bureaucracy_{it} + \beta_9 governor_{it} + \beta_{10} sewerage_{it} + \lambda_i T + \tau_t + \mu_i + e_{it}$$

$budget_{it}$	: budget indicator in state *i* in year *t*
$flooding_{it}$	: flooding frequency or severity (log-transformed) in state *i* in year *t*
gsp_{it}	: gross state product (log-transformed) in state *i* in year *t*
$population_{it}$	: population (log-transformed) in state *i* in year *t*
$unemployment_{it}$	: unemployment rate in state *i* in year *t*
$pcincome_{it}$	: per capita personal income in state *i* in year *t*
$bureaucracy_{it}$	: number of fulltime equivalent employees per capita in state *i* in year *t*
$governor_{it}$	: governor's party affiliation in state *i* in year *t*
$sewerage_{it}$	: sewerage spending as a share of total expenditure in state *i* in year *t*
λ_i	: state-specific trend
T	: year
τ_t	: year fixed effect
μ_i	: state fixed effect
e_{it}	: idiosyncratic error terms
α	: intercept

This study runs multiple regression models individually using a set of budget indicators ($budget_{it}$) as the dependent variable. The budget indicators are (1) state intergovernmental revenue, along with its subcomponents related to (2) housing, (3) roads and streets, (4) natural resources, and (5) other categories as the dependent variables, all measured in log-transformed terms. The log transformation is helpful to get the variables closer to a normal distribution as well as to make the data easier to interpret.

The analysis aims to evaluate the impact of an increased severity and frequency of flooding on the state government budget indicators. Accordingly, the key independent variable, $flooding_{it}$ is comprised of two measures: flooding severity (i.e., the amount of flooding insurance claims) and flooding frequency (i.e., the number of flooding events), both log-transformed, in a given state and year. In cases where the data contains a large number of zeros, the inverse hyperbolic sine function is applied as a transformation method, as it can effectively handle zero and negative values while retaining properties similar to the logarithm. The analysis also considers $lagged\ flooding_{it}$, separately and collectively, in addition to $flooding_{it}$ in the regressions. This allows the analysis to assess the impact of a natural disaster not only during the year it occurs but also up to three years after. Taken together, the dependent variables and the key independent variable test the hypotheses whether a budget indicator changes with increased frequency and increased severity of flooding.

The model includes several control variables. First, gsp_{it} is the gross domestic product of state i in year t, and $population_{it}$ measures the number of state population in state i in year t. Next, $unemployment_{it}$ is the unemployment rate of state i in year t while $pcincome_{it}$ is per capita personal income in state i in year t. To control for government capacity in providing public goods and services (i.e., capital outlay and maintenance expenditure) associated with flood mitigation, the model includes $sewerage_{it}$, sewerage spending as a share of total expenditure, and

$bureaucracy_{it}$, the number of fulltime equivalent employees per capita in state i in year t. $governor_{it}$ denotes the governor's party affiliation in state i in year t.

λ_I is state-specific trend, which captures the budget trend over the years of observation. Year dummies (τ_t) are included to control for variables that are constant across states but may change through time. One example is the condition of the U.S. national economy (i.e., economic boom or economic crisis) that might have affected all 50 states. The state fixed effect is denoted μ_i. Finally, the model also considers robust standard errors, clustered at the state level, to overcome outliers in the observations. It will safely correct the standard errors under heteroskedasticity.

5. Results

5.1. Impact of Flooding on State Intergovernmental Revenue

The first part of the analysis examines the impact of flooding on state intergovernmental revenue. Baseline results are presented in Table 3: column (1) reports estimates based on flooding severity, while column (3) reports estimates based on flooding frequency. The findings indicate an increase in state intergovernmental revenue in the year after flooding, although as shown in columns (2) and (4), this effect is no longer statistically significant once control variables are included. In the second year, the effect associated with an increased severity grows larger, while that associated with an increased frequency moves closer to zero. Holding all else equal and controlling for relevant variables, a 1-percent increase in the number of flooding insurance claims coincides with a 0.001-percent increase in intergovernmental revenue two years after flooding. The positive result is statistically significant at the 10% level. As an illustration, consider Florida's fiscal year 2019 budget, just before the COVID-19 pandemic. According to the US Census Bureau, intergovernmental revenue accounted for approximately $30 billion. A 0.001-percent increase in intergovernmental revenue equates to more than a quarter of a million dollars. This is significant in nominal terms and can substantially impact the quality and quantity of public goods and services that the state can afford. The accumulated amount may be even higher if the state experiences more severe flooding events in a given year.

[Table 3 here]

5.2. Impact of Flooding Frequency By Type on State Intergovernmental Revenue

The previous section has demonstrated that changes in flooding frequency have no significant impact on state intergovernmental revenue. However, since flooding frequency was measured by aggregating all flood types, meaningful variation and individual effects may have been inadvertently obscured. To be more thorough, this study examines different types of flooding separately to assess whether the observed patterns hold consistently across flood types. These types are flood, flashflood, and a category labeled as "other," which includes less common flooding events such as coastal floods and lakeshore floods.

As Table 4 shows, when all flooding events are evaluated collectively, the point estimates are not statistically significant at the conventional confidence interval. The pattern holds when different types of flooding are examined individually: floods, flash floods, and other floods appear to have no discernible effect on state intergovernmental revenue up to three years after flooding. These null findings suggest that the allocation of state intergovernmental revenue is not responsive to increased flooding frequency, regardless of the type of flooding. The result reinforces the contrast with earlier findings on flooding severity. One possible explanation for this differential impact is that frequent but non-severe flooding is less visible than infrequent but severe flooding events. As discussed earlier in the theoretical framework of this study, political incentives matter. Severe disasters attract greater public attention and offer more plausible electoral gains, which likely prompts a stronger fiscal response from both federal and state governments.

[Table 4 here]

5.3. Impact of Flooding Severity on Intergovernmental Revenue, By Subcomponent

The previous analysis has shown that state intergovernmental revenue is responsive to severe flooding. Building on the results, this final part of the analysis examines the subcomponents of intergovernmental revenue: housing, roads and streets, natural resources, and other categories. Table 5 presents the full regression estimates for the effects of flooding severity on these subcomponents. Flooding severity affects two subcomponents: housing and roads and streets. The impact is especially visible two years after flooding, consistent with the timing observed in the previous analysis on state intergovernmental revenue. Holding all else equal and including all relevant control variables, a 1-percent increase in the severity of flooding is associated with a 0.03-percent increase in transfers designated for housing and a 0.005-percent increase in transfers for roads and streets, both observed two years after flooding. These results are statistically significant at the 5-percent level, corroborating earlier findings and providing even stronger evidence on the fiscal implications of severe flooding. In contrast, natural resources and other categories are unaffected.

[Table 5 here]

While federal funding reaches states through multiple channels, the findings clarify the specific channels through which state intergovernmental revenue is affected by severe disasters. Housing and roads and streets are critical infrastructure that often receive the most attention after a disaster. Surprisingly, the "other" categories, which includes disaster assistance from FEMA, shows no significant effect. One possible explanation is that this category aggregates FEMA aid with a wide range of other federal assistance programs, such as those economic development, libraries, civil defense, public broadcasting, parks and recreation, and water transportation. As a result, the variability specific to disaster assistance may be diluted.

6. Discussion

The main finding is that after severe flooding events, state governments receive more federal funding. This might have been well-intentioned given the conventional view that natural disasters like flooding would have a negative impact on state economies. In such cases, federal transfers to states are expected to stabilize and stimulate the local economy. However, there are two inefficiency arguments to be made related to these post-disaster transfers.

First, increased federal assistance after flood disasters can reinforce a tendency among receiving governments to underinvest in emergency preparedness. If state leaders anticipate that federal assistance will be readily available whenever an emergency arises, they may not act to sufficiently mitigate future risks. In the previous analysis, the null results from the natural resources subcomponent illustrate this inclination. This category includes federal assistance for forests and grasslands, soil and water conservation, and flood prevention and drainage -- areas that are crucial for long-term disaster mitigation but were not prioritized in the immediate aftermath of flood disasters. While the predictable availability of federal assistance provides substantial support to states after floods, it may inadvertently create problematic incentives, especially for states more vulnerable to severe flooding.

This finding aligns with prior studies that have documented a similar tendency across various public settings. Local communities, in response to generous post-disaster relief, often substitute short-term actions for long-term environmental management (Birkland et al, 2003). At the federal level, infrastructure investments are skewed, with the bulk of spending focused on recovery and response rather than mitigation. It is estimated that the federal government allocates only $6-7 billion annually to improve resilience in anticipation for future events, a figure that pales in comparison to more than $46 billion spent each year on response and recovery after natural disasters (Frank et al., 2021). In the context of international aid allocated for disaster-related expenditures, only 12.7 percent are earmarked for preparedness, while the vast majority is directed toward reconstruction, rehabilitation, and emergency response (Kellet & Caravani, 2013).

Second, intergovernmental transfers generate benefits that are geographically concentrated, but the financial burden is shared nationally. Besides, greater federal involvement may also reduce local stakeholders' incentives to improve service quality and lower provision costs (Carolan, 2007). For decades, the federal government has provided emergency funding to state governments through FEMA, whose mission is to help people “before, during, and after disasters.” This commitment is manifested in various programs, including disaster relief and emergency assistance. Other federal agencies, such as the U.S. Departments of Agriculture, Commerce, Health and Human Services, Defense, Interior, and Justice, also provide emergency assistance to states in response to natural disasters (Healy & Malhotra, 2009). These agencies are funded by through the federal budget, meaning that the costs are ultimately distributed across the broader U.S. taxpayer base. From a budgetary standpoint, these transfers could be inefficient, therefore policies in this area should be carefully developed to ensure that federal intervention occurs only when the overall socioeconomic benefits unambiguously outweigh the costs.

After a disaster event, the undertaking geared toward response and recovery is indeed crucial as it determines how much time is required for the economy to recover. Ideally, however, the government also invests in mitigation and preparedness to the extent possible.[3] A study by the National Institute of Building Sciences (2020) estimated that for every $1 spent on federal mitigation grants for riverine floods, society saves up to $7. Phaup and Kirschner (2010) classified

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[3] According to the National Governors’ Association (1979), the 'comprehensive emergency management' framework encompasses four main phases: mitigation, preparedness, response, and recovery. The first two are undertaken before a disaster, while the latter two are after. The framework is applicable to many forms of emergencies, including floods and other types of natural disasters.

budgetary treatments before and after a disaster event as ex-ante budgeting and ex-post budgeting, respectively. They also argued that ex-ante budgeting is more favorable to reduce risk exposure, although it requires trade-offs of present consumption for disaster mitigation and preparedness.

Budgeting for mitigation is financially sensible, but one might well argue that it is not politically feasible. That is not entirely true. Surveys show that one-third of U.S. adults report personal experiences with extreme weather events in the past two years (Gallup, 2022), and more than 70 percent of registered voters across the U.S. support policies that will enable communities to better prepare for and respond to floods (Pew Charitable Trusts, 2018). Flooding, like other types of disasters, can be politically appealing and provides electoral leverage. With the popular view favoring mitigation over response, allocating budget is within reach, which concludes this discussion with an optimistic lens.

7. Conclusion

The analysis estimates the impact of severe and frequent flooding events on state intergovernmental revenue, along with its subcomponents related to housing, roads and streets, natural resources, and other categories. Using a panel data of 50 U.S. states between 1997 and 2020, the study employs a two-way fixed-effects model to address the research questions. The main findings indicate that (1) states receive higher intergovernmental funds after severe flooding. By contrast, (2) frequent flooding does not have to a significant effect on state intergovernmental revenue, whether assessed in aggregate or by specific flood types. Within intergovernmental revenue, (3) subcomponents related to housing and roads and streets appear to be most responsive to severe flooding. While reliance on federal assistance can help states facing budget constraints, this study argues that it may also create problematic incentives for states, reinforcing a tendency among receiving governments to underinvest in emergency preparedness.

Future research directions may examine how other key budget components respond to flood disasters. These include tax revenue and spending on environmental programs, which are critical to understanding the broader fiscal impacts of flooding. Beyond the scope of this study, another important policy issue is the socioeconomic impact of flooding, and future research needs to take equity dimension into account as well. A report by FEMA shows that lower-income households (earning below $30,000 annually), who presumably find affordable housing in higher-risk areas, endure more flood damage than other income groups (Sarmiento & Miller, 2006). The state budget plays a crucial role in effective flooding mitigation, yet admittedly it represents just a part of the broader spectrum.

Flooding has become more frequent and destructive in recent decades in the U.S. and across the globe. In the last few years only, the U.S. has witnessed major flooding in Texas, Mississippi, Kentucky, Missouri, and Colorado, among other states. The increasing prevalence of flooding, and the response measures undertaken by the government, carries significant fiscal implications. While this study focuses on U.S. fiscal federalism contexts, its core messages about post-disaster outcomes and the need for proactive mitigation and preparedness are highly relevant to other countries as well. Moreover, intergovernmental collaboration during emergencies has become increasingly common, driven by the need to share resources essential for effective response and recovery. As a concluding note, this study encourages both policymakers and scholars to collaboratively develop an enhanced framework for a comprehensive emergency management that incorporates sound fiscal planning.

Table 1. Data and Sources

Variable	**Data source**	**Years Available**
Flooding insurance claims ($)	FEMA	1996-2021
Flooding frequency (count)	NCEI	1996-2021
Intergovernmental revenue ($ m)	US Census Bureau	1992-2020
Intergovernmental expenditure ($ m)	US Census Bureau	1992-2020
Subcomponents of intergovernmental revenue ($ m)	Willamette University	1996-2020
Population (thousand)	UKCPR National Welfare Data	1980-2020
Gross State Product ($ m)	UKCPR National Welfare Data	1980-2020
Unemployment rate (%)	UKCPR National Welfare Data	1980-2020
Personal income per capita ($)	UKCPR National Welfare Data	1980-2020
Governor is democrat (1 = Yes)	UKCPR National Welfare Data	1980-2020
Sewerage spending ($ m)	Willamette University	1996-2020
Number of state employees (m)	US Census Bureau	1997-2020

Table 2. Summary Statistics

Variable	**(1) Mean**	**(2) Standard deviation**	**(3) Minimum**	**(4) Maximum**	**(5) Observations**
Flooding insurance claims ($ thousand)	10,136	110,646	0	3,015,920	1,250
Flooding frequency (count)	118	139	0	1,345	1,250
State intergovernmental revenue ($ m)	9,383	12,053	650	102,420	1,250
State intergovernmental expenditure ($ m)	8,826	14,102	124	118,963	1,250
Population (thousand)	6,022	6,669	480	39,538	1,250
Gross State Product ($ m)	285,422	373,921	14,672	3,132,801	1,250
Unemployment rate (%)	5.41	1.94	2.30	13.70	1,250
Personal income per capita ($)	38,947	11,080	18,644	77,542	1,250
Governor is democrat (1 = Yes)	0.42	0.49	0	1	1,250
State sewerage spending ($ m)	42.7	119.1	0	2,019.6	1,250
Number of state employees	85,524	73,077	11,023	438,305	1,200

Note: Mean, standard deviation, minimum, and maximum values are calculated in 1996-2020, except for number of state employees 1997-2020.
Sources: FEMA (2022d); NOAA NCEI (2022b); (Pierson et al., 2015); UKCPR (2022); U.S. Census Bureau (2022a, 2022b)

Table 3. Impact of Flooding on State Intergovernmental Revenue

	(1) Flooding severity	(2) Flooding severity	(3) Flooding frequency	(4) Flooding frequency
Year of flooding	0.000422	-0.000581	0.00149	-0.00120
	(0.000777)	(0.000720)	(0.00524)	(0.00499)
1 year after flooding	0.00195**	0.000726	0.0137**	0.00591
	(0.000878)	(0.000792)	(0.00652)	(0.00576)
2 years after flooding	0.00242***	0.00134*	0.00820	-0.00141
	(0.000781)	(0.000748)	(0.00544)	(0.00502)
3 years after flooding	0.00204*	0.00120	0.00851	-0.00117
	(0.00103)	(0.000818)	(0.00606)	(0.00461)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Observations	1100	1100	1100	1100
Adjusted R2	0.908	0.945	0.908	0.944

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4. Impact of Flooding Frequency by Type on State Intergovernmental Revenue

	(1) All Floods	(2) Flood	(3) Flash Flood	(4) Other Flood
Year of flooding	-0.00120	-0.00415	0.00113	-0.00452
	(0.00499)	(0.00283)	(0.00398)	(0.00317)
1 year after flooding	0.00591	0.00141	0.00433	-0.00121
	(0.00576)	(0.00281)	(0.00494)	(0.00350)
2 years after flooding	-0.00141	-0.00356	0.000696	0.00471
	(0.00502)	(0.00321)	(0.00501)	(0.00342)
3 years after flooding	-0.00117	-0.00356	0.00128	-0.00123
	(0.00461)	(0.00296)	(0.00468)	(0.00377)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	1100	1100	1100	1100
Adjusted R2	0.944	0.945	0.944	0.944

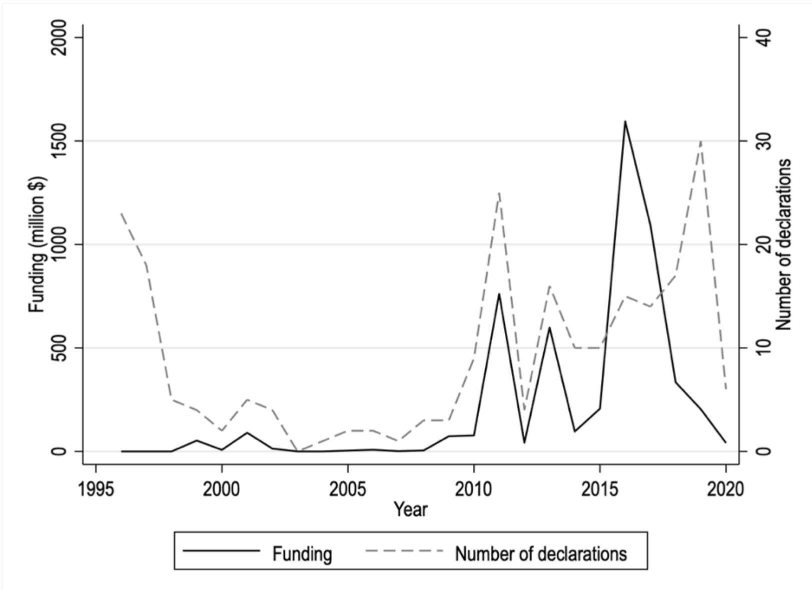
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Impact of Flooding Severity on Intergovernmental Revenue, By Subcomponent

	(1) Housing	(2) Roads & Streets	(3) Natural Resources	(4) Other
Year of flooding	0.00985	0.000860	-0.00228	-0.000472
	(0.00945)	(0.00328)	(0.00209)	(0.00233)
1 year after flooding	0.0161	0.00335	-0.00106	0.00319
	(0.0127)	(0.00363)	(0.00206)	(0.00237)
2 years after flooding	0.0309^{**}	0.00510^{**}	0.000279	0.00347
	(0.0148)	(0.00235)	(0.00258)	(0.00257)
3 years after flooding	0.0147^{*}	0.00489	0.00340	0.00292
	(0.00776)	(0.00370)	(0.00209)	(0.00220)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes
Observations	1100	1100	1100	1100
Adjusted R2	0.631	0.381	0.586	0.557

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1. Funding and Number of Declarations Trend Over Time



Notes: While the FEMA database includes all types of incidents, the funding and number of declarations presented here are limited to flooding.

Figure 2. State-Level Flooding Trends (1996 – 2020)

a. Insurance Claims

b. Flooding events

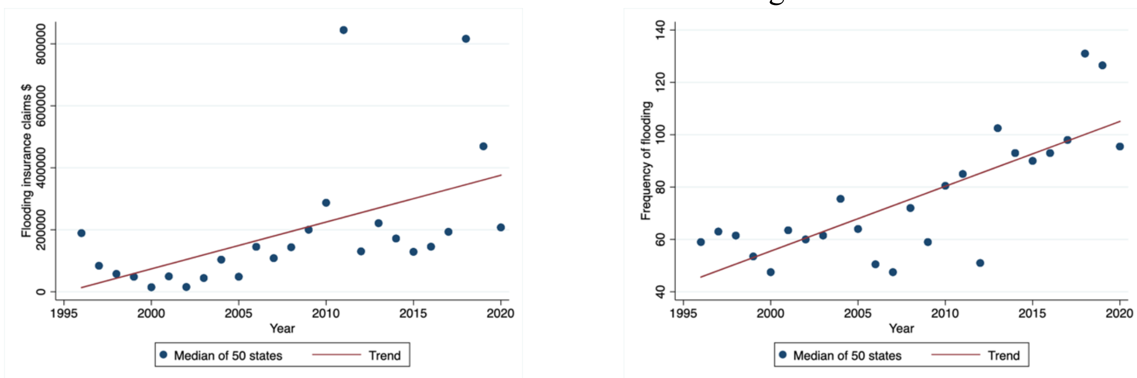
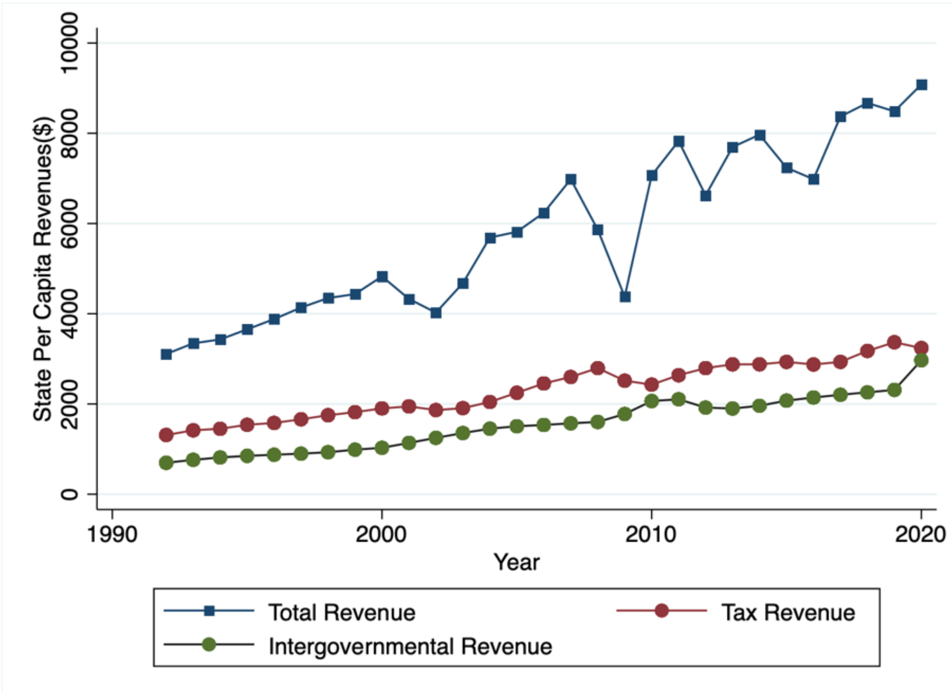


Figure 3. Per Capita State Revenues Trends (1992 – 2020)



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