Proactive and Reactive Policy Agendas During Hurricanes: A Textual Analysis of Budget Documents*

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Abstract: Hurricanes are among the most destructive disasters to infrastructure and communities in the U.S., and the government plays a crucial role in identifying effective policies to not only respond to these events but also mitigate their adverse impacts. Drawing on punctuated equilibrium theory and the comprehensive emergency management framework, this study examines patterns of policy change related to disaster management. To address the lack of budgetary data on hurricane responses, the analysis employs computational text analysis to extract and analyze the narrative portions of official budget documents from seven hurricane-prone U.S. states, covering the period from 2005 to 2020. Cases from Louisiana, Alabama, Florida, and Georgia show that an increased incidence of major hurricanes coincides with greater attention to hurricanes from the government, indicative of a punctuated policy change. There is also evidence that, in all observed states except Florida, attention to hurricanes is associated more with reactive rather than proactive measures, calling into question the general preparedness of most state governments for future disasters.

Key words: punctuated equilibrium, emergency management, computational text analysis, state budget, hurricane
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1. Introduction

Over the past few decades, natural disasters have become more frequent, severe, and costly. The United Nations (2022) confirms that the number of global disasters, including droughts and extreme temperature events, has been increasing since the 1970s. Assuming the current trends continue, by 2030, the number of disaster events is projected to reach 560 per year. A report by the World Meteorological Organization (2021) shows that economic losses due to weather, climate, and water-related disasters have increased sevenfold, from around $49 million per day on average in the 1970s to $383 million per day on average in the 2010s. In the United States, following the world-wide trend, the overall number of disaster events is also on an upward trajectory. The National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NOAA NCEI, 2023) shows that disasters with costs exceeding $1 billion increased from around three per year in the 1980s to more than 12 per year in the 2010s.[1] Exceeding that average, in 2022, there were 18 major disaster events recorded across the country. Among the most recent and notable events were Hurricanes Helene and Milton, which significantly impacted communities and damaged critical infrastructure across several southern states, such as Florida and North Carolina.

This study focuses on hurricanes, which among all recorded weather disasters have caused the most deaths and destruction in the U.S. (NOAA, 2022a). Scientists have observed increased intensity of hurricanes in recent decades, which are associated with increased precipitation, winds, and extreme sea level events partly attributable to climate change (Collins et al., 2019; Walsh et al., 2015). Between 1980 and 2021, hurricanes were responsible for more than 6,600 deaths and

[1] The costs include physical damage to residential, commercial, and municipal buildings, vehicles, agricultural assets, and public infrastructure, among others. The estimates are considered conservative as they do not take into account losses to environmental degradation, healthcare related costs, and the value of statistical life.

$1.1 trillion in economic loss in the U.S., with an average cost of $20.5 billion per event. The deleterious economic effects of hurricanes are significant also in the Caribbean and Central America. Bluedorn (2005) finds that hurricane strikes damaged physical capital and immediately reduced the current account over GDP by five percentage points, although signs of improvement tended to appear three-to-eight years later.

When an area is hit by a disaster, its recovery depends on various factors. Among these, Hawkins and Maurer (2009) emphasized the role of social capital, linked to a sense of community and individual leadership, while Skarbek (2014) discussed bottom-up approaches, including contributions by nonprofit organizations. These studies highlight the significance of shared information and financial resources that local leaders and communities mobilize in response to disasters. Yet, there is a tendency for individuals and households to underestimate and underinvest in disaster preparedness (Neumayer, 2014), which justifies the need for government to take more proactive actions. Focusing on the financial aspects, Phaup and Torregrosa (1999) noted that the government could do this by raising taxes to increase national savings prior to a disaster, thereby augmenting underinvestment in mitigation efforts and improving allocations of available resources for public goods. Governments maintain a significant role given their authority and access to resources, and the extent of government actions is broader as it covers comprehensive emergency management from ex-ante preparedness and mitigation to ex-post response and recovery (National Governors' Association, 1979). Adopting the Sendai Framework, the United Nations (2015) also recognized that each government has a responsibility to prevent and reduce disaster risk.

This study considers states as the unit of analysis for two reasons. First, the force of a hurricane is unlikely to be contained within the smaller borders of counties and municipalities; at the same time, a study of the whole country may be too broad and could be skewed by information

from wholly unaffected regions. The geographic boundaries of states thus appear most suitable. Second, state leaders have the authority to declare an emergency status when a disaster strikes and to take certain responsive actions. In mitigating major disasters, vulnerabilities such as those related to infrastructure often require coordination at the regional level and are generally better addressed by state agencies rather than local authorities (Caruson & MacManus, 2008). In the U.S., it is common practice for states to allocate funds, often called budget stabilization or rainy-day funds, for disaster management purposes (Hou, 2004). Although the funds have historically been insufficient to cover revenue losses caused by economic downturns (Zhao, 2016), state governments are, by design, capable of effectively mobilizing resources to undertake emergency measures.

The extent to which a state government addresses this challenge remains an open question for empirical investigation. Therefore, this study aims to evaluate whether and how government attention to hurricanes has evolved over time. According to punctuated equilibrium theory (PET), policy change is characterized by a combination of incremental and occasionally, abrupt changes. To test whether hurricanes trigger such policy changes, this study analyzes data across from U.S. states that are most susceptible to hurricanes: Alabama, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Texas. A key source of data that can identify the executive's agenda for the corresponding fiscal year, including attention to hurricanes, is the official state executive or governor's budget proposals (hereafter referred to as "budget documents"). While prior studies focus on *budgetary data*, my study is the first to exploit the *narrative portions (or textual data)* of the budget documents using computational text analysis.

Following this introductory section, this study is organized as follows. Section 2 presents the theoretical framework relevant to hypotheses development. Section 3 elaborates on

computational text analysis as the methodology in this study, along with its limitations. Section 4 describes data sources and collection. Three subsections in Section 5 discuss analysis results. Finally, Section 6 concludes.

2. Theoretical Framework

Central to the field of public policy is the theory of incrementalism. Lindblom (1959) argued that policy actors generally have limited capacities to consider all the available information, values, and alternatives when dealing with complex problems, so they follow the "successive limited comparisons." Incrementalism focuses on the existing situation and departs from it with a relatively small degree of changes. The process is driven internally within an organization, and the exercise usually leads to a relatively predictable outcome. It is very practical, yet the method also has limitations for potentially overlooking better alternatives not suggested by the modest changes and successive series of policy decisions.

Davis, Dempster, and Wildavsky (1966) made the same observation but specifically in the field of public budgeting. It is rarely the case that decision-makers in the budget process exhaust all alternatives and actively review the whole budget. Instead, this year's budget is often based on the previous year's budget, with a narrow range of increases or decreases. Dempster and Wildavsky (1979) formalized two defining characteristics of incremental budgeting -- (1) an existing base and (2) regularity of the changes – and noted that the U.S. federal budget process reflects both. At least at a macro level, there have been gradual increases from time to time.

In laying out the theory, Dempster and Wildavsky (1979) also explained how budget increments, slow and steady changes, may encounter a "shift point," a sudden burst of changes that depart from incrementalism. Typically, such events are caused by external factors, such as wars and economic depressions. Birkland (1997) synthesized other impetus for policy changes, including human-caused accidents and natural disasters. These occasional, large-scale policy changes against a stable, incremental government agenda are then termed "punctuations" (Baumgartner and Jones, 2010; True et al., 2019), forming a new punctuated equilibrium.

Perfecting the idea of incrementalism in policy process, True (2000, p.1) argued that punctuated equilibrium theory (PET) is "a better way of relating politics, government institutions, and policies."

To revisit PET, my study begins by conducting a distribution analysis to assess the extent of shifts in government attention across seven major policy areas over time. The concept of government attention carries inherent nuances, as not all ideas necessarily translate into actions and institutions may at some point face limits of attention (Brunsson, 1993; Koski & Workman, 2018). In this regard, budgets, while serving as strong indicators of where the attention is directed, signify more than just ideas. As official public documents, budgets are enforceable and can be viewed as binding contracts between voters and elected officials (Patashnik, 1996). Budget documents are arguably the most reliable source for predicting the government's actions in a given period. Through computational text analysis of the budget documents, I will demonstrate that policy attention in state governments mostly reflects a lot of incremental changes, along with a few punctuations. The goal is to show that computational text analysis, as an alternative approach, is an appropriate methodology because it generates results that are consistent with the quantitative analysis of the budget documents, as extensively documented in the existing literature.

My study then proceeds with two analyses. *First,* it assesses changes in government attention with respect to one specific issue: disaster management in connection with hurricanes. Punctuations, as Jones et al. (1998, p. 2) put it, "can occur at all levels of activity in programs, in agencies, within broad functional categories of government activities" and may affect "related subsystems without affecting the rest of government." In other words, the concerns of PET are the *aggregate changes* in budgets over time, as well as the *components* of budgets. Previous studies have also considered different policy areas individually, such as highway infrastructure (Chen &

Flink, 2021), education (Flink, 2017; McLendon, 2003; Robinson, 2004), environment (Salka, 2004), and social welfare (Jensen, 2009). While some areas attracted little attention, those studies found that there were also times when the level of attentiveness spiked, indicative of punctuations. Accordingly, my analysis will focus on major hurricanes, along with the states and years in which they occurred, such as Hurricane Katrina in Louisiana in 2005 and Hurricane Michael in Florida in 2018, and will draw inferences from these events. To be clear, hurricanes are seasonal and thus expected in the southern U.S. states, but these two events stand out in magnitude, potentially qualifying them as distinct external forces on the government. The hypothesis is that an increased incidence of hurricanes coincides with the government's increased attention to hurricanes during the period of observation.

Second, beyond PET, this study also takes a closer look at hurricane-specific issues and examines whether government attention, if any, is associated with proactive or reactive measures. From a practical policy standpoint, unpacking these nuances is essential for understanding and ultimately anticipating future disasters. The analysis draws on the Comprehensive Emergency Management (National Governors' Association, 1979) framework for coordinating stakeholders when managing natural disasters, including hurricanes. The framework clusters activities surrounding emergency management into four key phases: mitigation, preparedness, response, and recovery. Mitigation and preparedness, conducted prior to a disaster, are proactive measures. Response and recovery are reactive as they are carried out after a disaster.

It is well established that hurricanes can cause substantial damage to property and critical infrastructure. In this context, proactive measures warrant specific attention, as government actions associated with them help reduce the extent of losses and, more importantly, save lives. The Multi-Hazard Mitigation Council (2019) assessed a range of mitigation strategies for hurricane-prone

areas in the U.S. and found positive benefit-cost ratios. For instance, constructing new homes in compliance with specific building codes yields a ratio as high as 16:1, while increasing roof strength in new buildings generates a ratio of up to 32:1. While mitigation is financially justified, it is often overlooked, as evidenced by the dominance of reactive measures. Within government, the tendency to favor response and recovery over mitigation and preparedness is primarily attributable to a combination of political and institutional factors (Donahue & Joyce, 2003; Healy & Malhotra, 2009; Kellet & Pichon, 2013). In this vein, the hypothesis is that the government attention to hurricanes is oriented more toward reactive rather than proactive measures.

3. Methodology

3.1. Gauging Policies Using Textual Data

Jones et al. (1998) explained that earlier evidence of PET, which relied more on general observation and case studies, motivated them to adopt a more quantitative approach. By leveraging time series analysis, they showed two major punctuations that affected the spending patterns of the U.S. federal government: high increases after 1956 attributable to the post-war period, and slower growth after 1976 due to political disagreement between the Congress and the executive branch concerning control over the budgetary process. Quantitatively, Robinson et al. (2007) also used frequency density histograms to illustrate that the federal government's budgets were characterized by small and large changes.

This study will replicate the approach similar to those studies.[2] The analysis is geared toward mapping the distribution of the changes and confirming whether there are more data points in the center. Such result corresponds to the leptokurtic pattern, different from the normal distribution that resembles a bell curve. However, since budgetary data regarding specific issues like disaster management is limited, if not entirely unavailable, some adjustment is made to leverage the textual data. Instead of examining budgetary changes, gauging changes in policy attention is conducted based on the narrative portions of the budget documents, as follows:

$$\Delta_{pst} = \frac{x_{pst} - x_{pst-1}}{x_{pst-1}} \qquad (1)$$

[2] In their analysis, Jones et al. (2003, p. 153) calculated each entry in the histogram as "the inflation-adjusted expenditure in a budget category in a year, minus that expenditure the year before, divided by the earlier expenditure." In the same vein, Robinson et al. (2007) considered the percentage changes in instructional spending per pupil as an indication of how the organization's educational strategy changes over time, and categorized punctuations as changes that are plotted beyond the outer intersection of a normal distribution.

As a measure of government attention, x_{pst} reflects the frequency of mentions of key words within policy area p in state s for the year t. In a similar manner, x_{pst-1} provides the same information for the preceding year (t-1). The policy areas follow a subset of policy categories from the Lexicoder Topic Dictionaries developed by Albugh et al. (2013). Lastly, Δ_{pst} indicates the changes of government attention in a given policy area and state, specifically between year *t-1* and year *t*.

Next, analyses are performed to (1) identify changes in government attention potentially resulting from the major hurricanes, and (2) determine whether any government attention is associated more with proactive or reactive measures. Note that the study examines two notably impactful hurricane events, from which inferences are drawn qualitatively. For the first analysis, in principle, changes are identified by comparing mentions of hurricane-related keywords within a state as well as between states. In the within-state analysis, I compare the frequency of mentions in a given state before and after a hurricane. In the between-state analysis, the focus is on comparing the number of mentions in two states affected by the same hurricane, albeit with different magnitudes.

The second analysis seeks to understand the context in which the hurricane-related keywords appear. Using keywords-in-context approach, the words surrounding a certain keyword in a text document is examined (Benoit et al., 2018). A window of text can be set, such as five words before and after the keyword of interest. The iteration helps uncover broader themes that may not be immediately obvious when considering the keywords in isolation. Finally, a series of robustness checks are performed to ensure the reliability of the findings, including substituting keywords with more specific terms and using alternative measurements to confirm that the results remain consistent across different iterations.

3.2. Steps in Computational Text Analysis

The choice to utilize textual data is driven by the unavailability of budgetary data on specific issues like disaster management (for a more detailed discussion regarding what data are and are not available, see Appendix A2). Textual information is more readily available in various government reports and publications, which can be extracted, classified, and analyzed computationally with the following steps:

(1) Importing data: Budget documents, typically in Portable Document Format (PDF), are commonly posted on government websites. In each state, the search will generate a collection of budget documents from different years. In the state of Florida, for example, there are 16 budget documents from 2005 through 2020. Once the documents are retrieved, relevant texts can be extracted. The result is a text *corpus*, which is equivalent to a dataset that contains document-level variables and a designated variable for texts. Referring to the Florida example, its corpus contains 16 observations that correspond to the 16 budget documents extracted previously.

(2) Preprocessing data: Preprocessing transforms the data into a dataset that is ready for analysis. This requires obtaining the original texts within each corpus, converting all characters to lowercase, removing whitespaces and stop words, and eliminating any numbers. In Florida's 2019 budget document, for example, a line item like "GRANTS AND AIDS - STATE AND FEDERAL DISASTER RELIEF OPERATIONS FROM FEDERAL GRANTS TRUST FUND" would simplify into "grants aids state federal relief operations federal grants trust fund." The procedure eliminates a hyphen and two stop words, "and" and "from", from that portion of the text. Doing so reduces text complexity without losing its key message, which helps with computation by making it parsimonious (Grimmer et al., 2022).

(3) Analyzing data: Once the textual data are ready, the next step is to conduct analyses in accordance with the study objectives. The iteration involves applying dictionaries to the budget documents to identify and quantify the frequency of certain key terms within the documents, including their locations and contexts.

3.3. Limitations to the Methodology

Computational text analysis has at least two limitations. First, the existing dictionaries are not exhaustive. For instance, the Laver and Garry Dictionary of Policy Positions (Laver & Garry, 2000) assesses political actors' stances on policies in the UK, such as liberal versus conservative ideologies or pro- versus anti-environment. Meanwhile, the Lexicoder Topic Dictionaries includes over 400 key terms categorized under various policy areas, such as healthcare, education, and transportation. But none of these dictionaries provide disaster-related terms. The second limitation concerns the inherent subjectivity in determining which keywords should be included or excluded. Even well-established dictionaries, like those mentioned earlier, involve a reasonable degree of subjectivity, leading to categorization that may not be entirely accurate.

In addition to the robustness checks, I also take additional procedures to manually verify the results generated by computational text analysis. For example, one part of the study reveals that that mentions of environment-related terms across the seven states in 2020 were 45 in Alabama, 58 in Georgia, 156 in Florida, 20 in Louisiana, 36 in North Carolina, 11 in South Carolina, and 164 in Texas. A manual review of Alabama's budget documents was conducted to identify which parts correspond to the 45 mentions. Through this process, specific sentences mentioning "conservation," "environment," "water supply," and "hazardous waste" were identified. The same steps were also applied to the other states.

4. Data

This study uses data provided by NOAA's Hurricane Research Division (2022) to identify where and when a hurricane event occurs. This agency has documented hurricanes by chronological order since the 1950s, along with their names, location, and time. NOAA also assesses the strength, as measured by the central pressure, maximum wind speed, and Saffir-Simpson Hurricane Wind Scale categories. This scale rates maximum sustained wind speeds: Category 1: 74-95 miles per hour (mph), Category 2: 96-110 mph, Category 3: 111-129 mph, Category 4: 130-156 mph, and Category 5: 157 mph or higher (NOAA, 2022b). Later in the discussion, the NOAA data is supplemented with the database provided by the Federal Emergency Management Agency (FEMA) (2022), which records individual major disaster and emergency declarations by state and by year.

My analysis selects seven states in the southern U.S. region that are the most prone to hurricanes: Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina, and Texas.[3] A technical memorandum released by NOAA (2005) reported that between 1851 and 2004, more than 80 percent of hurricane direct hits in the U.S. occurred in these states (the detailed table is provided in Appendix Table A1). Figure 1 shows more recent records of where hurricanes typically landed in the U.S. between 2000-2021. Consistent with older data, almost all hurricanes in the US between 2000-2021 made landfall in these seven states, except Hurricane Isabel in Virginia (2003) and Hurricane Sandy in New York (2012). Table 1 provides details of hurricane categories on the Saffir-Simpson scale in the observed states and years, whereas Table 2 lists each of the hurricane

[3] Data availability are also taken into consideration when deciding what states and periods to observe. Among the seven states, most budget documents are available as far back as 2005 through 2020 fiscal years. Louisiana is an exception with missing budget documents in 2005, 2006, and 2016. Mississippi also experienced hurricane events multiple times, but its budget documents are not publicly accessible; therefore, this state is excluded from the observation.

events by chronological orders between 2005 and 2020. The discussion will later focus on some of the major hurricane events that occurred in more than one state, such as Hurricane Katrina which struck Louisiana, Alabama, and Florida in 2005, and the more recent Hurricane Michael, which hit Florida and Georgia in 2018.

[Figure 1 here]

[Table 1 here]

[Table 2 here]

A key source of data to identify and quantify attention to hurricanes in state governments from year to year is the official budget documents, particularly their narrative portions. The documents, produced every year (annually) or two years (biennially) in accordance with the state's budget cycle, reflect the executive's agenda for the corresponding fiscal year. In the U.S., budget documents prepared by the various states do not adhere to common standards. However, the general structure—such as sections, tables, and formatting--within each state likely follow similar patterns.

Table 3 presents a summary of the budget documents corpus that has been extracted. It shows the variations across states in terms of the number of documents, pages, sentences, and words contained in their respective documents. Note that the numbers represent a median over the course of observation within a state. The medians of pages are 357 (Alabama), 353 (Florida), 425 (Georgia), 208 (Louisiana), 218 (North Carolina), 347 (South Carolina), and 992 (Texas). The median sentences also vary from 1,181 (Louisiana) to 19,328 (Texas). Median tokens, which indicate the number of words used in a budget document are highest in Texas (596,275), followed by Florida (189,708), South Carolina (185,909), Alabama (149,691), North Carolina (83,249), and Louisiana (73,828). Meanwhile, the number of unique words range from 6,761 to 30,374.

[Table 3 here]

5. Analysis

5.1. Distribution Analysis

Using computational text analysis, this subsection aims to confirm that governments change their attention to major policy areas mostly in small incremental steps with occasional punctuations in accordance with PET. Building on the works of Jones et al. (2003) and Robinson et al. (2007), the frequency density histogram is used to illustrate changes to the federal government's budget from one year to the next. Instead of budgetary changes, my analysis examines changes in the level of attention state governments allocate to some policy areas as defined by the Lexicoder Topic Dictionaries. These are areas which state governments have relatively significant control over: macroeconomy, healthcare, education, environment, social welfare, transportation, and agriculture.

As previously described, the level of attention to a specific policy area is determined by counting the number mentions of relevant key terms. Following equation (1), each entry is calculated as the attention to a policy area in a year, minus the attention the year before, divided by the earlier attention. As an example, in Florida, environment-related terms were mentioned 151 times in 2019 and 156 in 2020. The entry for this specific time and policy area is thus (156-151)/151 = 0.0331.

Figure 2 illustrates the distribution of the entries in the form of a frequency density histogram. The x-axis indicates changes of attentiveness level to a given policy area; an entry that is closer to zero indicates smaller changes between two observed years in a given state, while an entry that is far from zero indicates bigger changes. Each bar takes an interval of 0.1 and is formed by how many entries lie within that range. The y-axis indicates the frequency--the taller the bar chart, the more frequent. Visually, the highest bar hovers around zero value, where entries are most

concentrated. The further it goes from the center, the lower the bar, except little bumps in the tails, indicative of punctuations.

[Figure 2 here]

Similar to Jones et al. (2003), skewness and kurtosis normality test is also performed to supplement this frequency density distribution chart, generating a kurtosis value of 66.8. As comparison, normal distribution has a kurtosis value of 3. Using textual data, this analysis shows that policy agenda in state government appears to be characterized with a lot of small changes and a few large changes. This result substantiates previous PET studies and confirms the prevalence of incrementalism and punctuations in state government budget narratives.

5.2. Government Attention to Hurricanes over Time

This subsection considers government attention to disaster management in connection with hurricanes. Accordingly, the list of keywords is narrower. The exercise looks for two terms specifically, "hurricane" and "cyclone," as a proxy for government attentiveness to hurricanes in each state and year. In the U.S., both terms are used interchangeably to describe hurricane-related events. As before, the assumption is that more mentions of the terms indicate greater attention to disaster management in connection with hurricanes.

Figure 3 shows how state government attention to hurricanes in Alabama, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Texas has developed over time. Figure 4

reproduces Figure 3 but excludes attention levels for some outlier years in Louisiana, to show the detail of attention for more typical years in other states. In both charts, the y-axis indicates the level of attention to hurricanes, while the x-axis corresponds to the fiscal year. Each line is colored differently to represent each state.

[Figure 3 here]

[Figure 4 here]

I will highlight the significant changes in government attention following Hurricane Katrina in Louisiana and the relative indifferences in Florida despite Hurricane Michael. In Louisiana, a striking pattern of punctuated change is visible, starting off with extremely high attention, declining moderately while still remaining higher than in other states, before eventually returning to the typical level of attention to hurricanes. Nohrstedt (2022) refers to this as "interest decline" scenario, which is characterized by a period of intense policy, followed by a gradual decrease in the policy process away from lasting change. The heightened focus in 2007 was a reaction to Hurricane Katrina, which devastated the state in August 2005. A Category 3 hurricane, Katrina was estimated to have caused at least 1,800 fatalities and more than $100 billion in damage, surpassing the destruction record previously held by Hurricane Andrew in 1992 (NOAA, 2022c). NOAA's Hurricane Research Division also shows Katrina made a landfall in neighboring states

Florida and Alabama, although with much less severity. On the Saffir Simpson Hurricane Scale, Katrina was rated a Category 3 in Louisiana and a Category 1 in Florida and Alabama. In the latter two states, Katrina did create localized effects, such as storm rain and injuries in Florida and power outages and structural damage in Alabama, but to a far lesser extent.

By contrast, the same level of increased attention was not observed following Hurricane Michael in Florida, despite it being classified as a Category 5 hurricane. Hurricane Michael caused storm surge inundation and severe winds, which led to eight direct fatalities and significant structural damage to homes, businesses, hospitals, and agricultural communities (National Weather Service, 2018). As this hurricane moved to Georgia, its strength was downgraded to Category 2. Heavy rainfall followed, resulting in local flooding and sporadic damage in parts of this state. The economic ramifications of Hurricane Michael were not as damaging as that of Katrina in Louisiana.

The fluctuations in attention to hurricanes for each state are illustrated individually in Figures 5-11, with a fitted line across the years of observation. With few exceptions, changes in attention to hurricanes appear to be incremental across the board, showing a declining trend in Florida and Louisiana, while increasing in Alabama, North Carolina, and South Carolina. More importantly, the results suggest that hurricanes can trigger a punctuation, as seen in Louisiana following Katrina, but not in other places. In PET, what matters is not only the type of event but also its magnitude and economic impact, which, in the case of hurricanes, can vary across time and place. Government attention to disaster preparedness may also contribute to these differences. The next subsection examines the budget documents to determine whether government attention in the states is more closely associated with proactive, reactive, or neutral policies.

[Figure 5 here]

[Figure 6 here]

[Figure 7 here]

[Figure 8 here]

[Figure 9 here]

[Figure 10 here]

[Figure 11 here]

5.3. Attention to Hurricanes: Proactive Versus Reactive

Irrespective of the presence of PET, this third subsection takes a closer look at state government's attention to hurricanes and analyzes whether, and the extent to which, the attention is associated with proactive measures (i.e., mitigation and preparedness) and reactive measures (i.e., response and recovery). New dictionaries are developed to include terms like "prepare" and "mitigate" to assess proactive measures undertaken by the government, and "respond" and "recover" to evaluate reactive measures. Additionally, the respective dictionary includes English derivational morphology of the terms. For instance, along with "prepare," the dictionary also considers "preparedness," "prepared," and "preparing."

One challenge with this exercise is that the words like "prepare" and "respond" are quite generic. Simply applying these key words to budget documents can produce results that are distorted and potentially misleading as a basis for drawing insights. To filter out this noise, the analysis employs the "keywords-in-context" technique to identify not only the keywords but also the words surrounding them. For example, the results are sorted to include only instances of the keyword "prepare" that are in proximity to the keyword "hurricane."[4]

The results of this iteration are presented in Figure 12. The x-axis shows the 7 states: Alabama, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Texas. The-y axis denotes the proportions of attention that are proactive, reactive, and neutral. Each bar, representing a state, appears in three colors: green denoting proactive measures, blue denoting reactive measures, and yellow denoting neutral. When the surrounding words do not match with either proactive or reactive dictionaries, the attention is categorized as neutral. Focusing on the portions

[4] The first two rows in Appendix Table A3 are examples of results that contain the keyword of interest (i.e., "prepare" or its derivational morphology) but relate to an entirely different context – that is, education policy – in South Carolina's budget documents. The bottom two rows provide examples of results that are correct and contain key words with the intended context – hurricane mitigation.

of reactive and proactive measures in each state, government attention to hurricanes is more associated with reactive measures than with proactive measures in all observed states but Florida. This tendency is most noticeable in Louisiana and North Carolina, and also to a lesser extent in Texas, South Carolina, Alabama, and Georgia.

[Figure 12 here]

5.4. Robustness Checks

5.4.1. Verifying the distribution across each policy area

As a robustness check to the distribution analysis in Section 5.1, I examine the seven policy areas individually, as shown in Figure 13, to verify that the concentration in the center applies broadly across all of them rather than being driven by just one or two areas. The y-axis indicates the policy areas, and the x-axis indicates changes in attention to each policy area. There is a graph box that corresponds to each policy area, indicative of the 25^{th} percentile, the median, and the 75^{th} percentile. An adjacent line outside the box shows the lower and upper adjacent values, and beyond those ranges are outliers. Major changes of attention are more salient on the right-hand side of the boxes, suggesting positive rather than negative changes. Greater volatility is observed more in agriculture, environment, and social welfare policy areas, at least visually. Nonetheless, the results confirm that changes across different policy areas are concentrated around the center, supporting the conclusion that incrementalism persists with occasional larger shifts.

[Figure 13 here]

5.4.2. Using alternative measurements for hurricane-related terms

Instead of using general terms like “hurricane” and “cyclone” in Section 5.2, the next analysis replaces these keywords with a specific name of the major hurricane event in Louisiana: “Katrina.” The results, as Figure 14 depicts, resemble those in Figures 3 and 4. Attention notably increased in Louisiana immediately after 2005, primarily due to the lasting impact of Hurricane Katrina. This result provides even stronger evidence that the higher attention is attributable not just to “hurricanes” in general but to “Katrina” specifically. As expected, in other states no significant increases in attention were observed.

[Figure 14 here]

The length of budget documents may vary in terms of pages, as do the number of sentences and words. Therefore, it is reasonable to argue that the same frequency of mentions of a specific term in a given year and state carries different weight relative to the total number of words in the budget document. An additional analysis is performed to address these differences by standardizing the measure, weighting the mentions of hurricane-related terms by the total word

count in the corresponding budget document. The results, illustrated in Figure 15, are consistent with previous analyses. It shows that weighted mentions were extremely high in Louisiana right after Hurricane Katrina, followed by moderate decline before eventually reaching a level of weighted attentiveness comparable to that in the other states.

[Figure 15 here]

5.4.3. Imposing stricter conditions on keyword-in-context analysis

The keyword-in-context analysis conducted in Section 5.3 set a window of five words before and after the keywords of interest. To test the robustness of these findings, the window is narrowed to two words only. As seen in Figure 16 below, this stricter condition does not significantly alter the results. Attention to reactive measures is more salient than to proactive measures across all states, except in Florida. While most states prioritize responses and recovery efforts more, Florida takes a more sensible approach by giving relatively greater attention to proactive measures.

[Figure 16 here]

6. Conclusion

Natural disasters are on the rise, and hurricanes are no exceptions in the U.S. The government plays a crucial role in conducting response and recovery measures immediately after a hurricane strikes. More importantly, the government is the most strategic actor in coordinating mitigation and preparedness efforts in anticipation to future occurrences. How much attention the government gives to hurricanes, and whether that attention is geared more toward proactive or reactive policies, remains an empirical question. This study seeks to answer this by examining budget documents between 2005 and 2020 for southern U.S. states that are highly vulnerable to hurricanes: Alabama, Florida, Georgia, Louisiana, North Carolina, South Carolina, and Texas.

As an empirical work, this research was not primarily intended to be a methodological article. Yet it demonstrates how computational text analysis of the narrative portions of budget documents can serve as an alternative method for evaluating government priorities across various policy areas. In cases where budgetary data are not readily available, such as in disaster management, particularly in relation to hurricanes, this method proves valuable. The use of computer assistance allows for a faster and more systematic collection and analysis of textual data, which would otherwise be unreasonably tedious given the length of the source documents. Consistent with the literature on punctuated equilibrium theory (PET), my textual analysis shows that government attention to major policy areas in the selected U.S. states changes mostly incrementally, with occasional punctuations.

This study yields two main findings. First, major hurricanes can trigger a punctuation. As seen in Louisiana following Hurricane Katrina, the level of government attentiveness to hurricane was extremely high. However, not all hurricanes generate significant shifts in government attention necessarily, as observed in other hurricane events in the U.S. In PET, what matters is not

only the type of event but also its magnitude and economic impact, which, in the case of hurricanes, can vary over time and across locations. Second, there is evidence that in most of the observed states, attention to hurricanes is more often reactive than proactive. Notably, Florida is the only southern state where attention to hurricanes is geared toward proactive rather than reactive measures. Across all analyses, the conclusions hold under multiple robustness checks.

All phases of comprehensive emergency management are interlinked, but proactive mitigation and preparedness are especially important. These measures are undertaken before a disaster strikes and, when done effectively, can significantly save both money and lives. With the increasing frequency and severity of hurricanes in the U.S., one would expect the government to address this challenge proactively. However, this study reveals mixed results among these states, with the majority leaning toward a reactive approach. As FEMA's 2018-2022 strategic plan suggests, the focus should always be on building a culture of preparedness that is integral to improving disaster resilience. While the results of this study raise concerns about the overall preparedness of state governments for future hurricanes, an optimistic perspective would view this as an early warning and an opportunity for improvement.

Figure 1. Hurricane Events between 2000-2021 across U.S. States

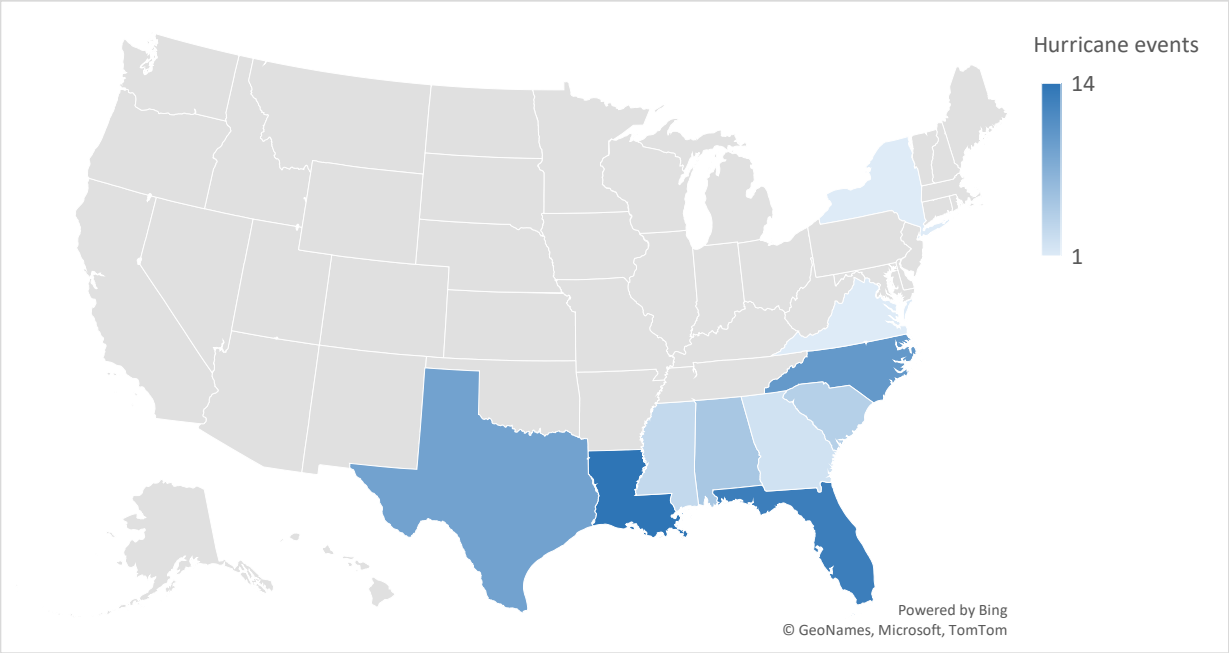


Figure 2. Changes in Government Attention to Major Policy Areas between Years

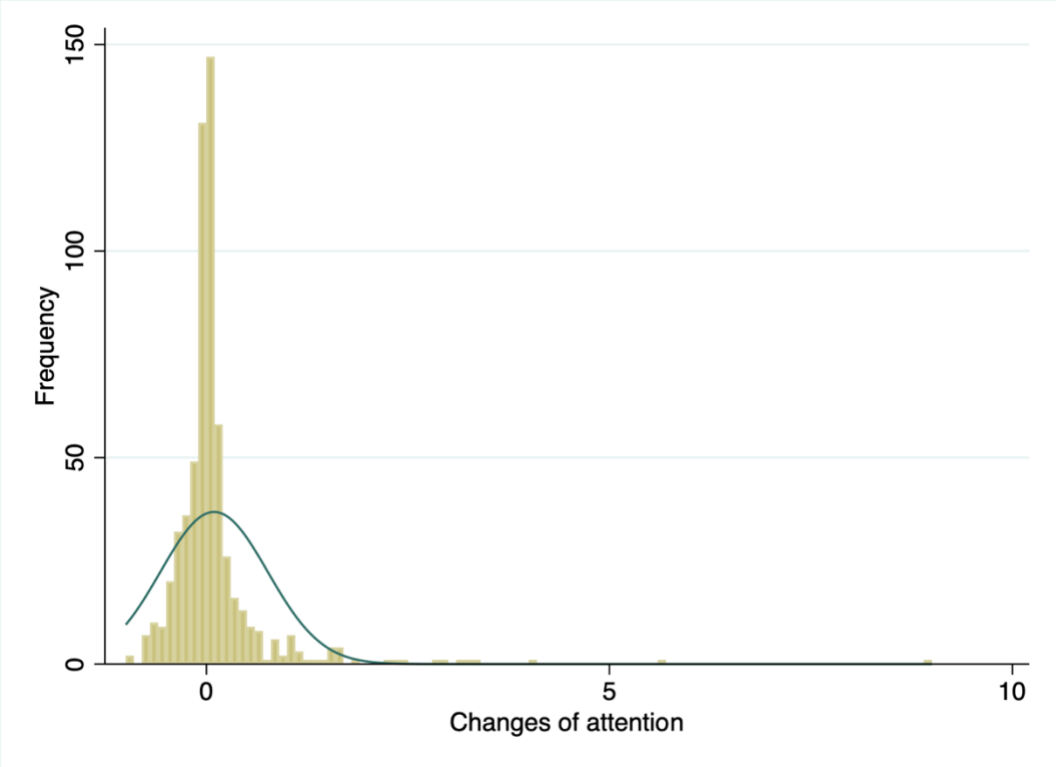


Figure 3. Mentions of Hurricane-related Terms in the 2005-2020 Budget Documents in 7 States

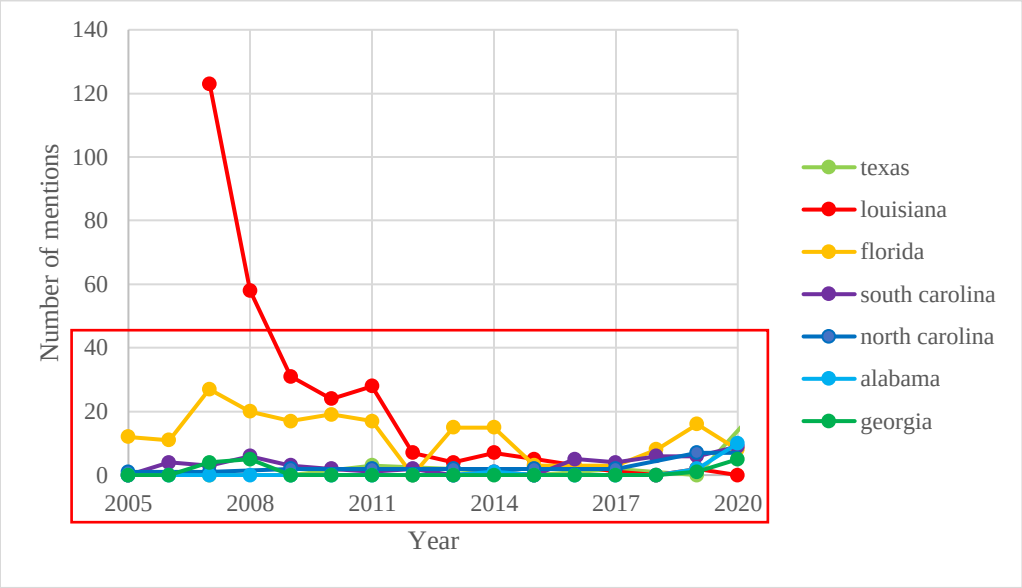


Figure 4. Mentions of Hurricane-related Terms in the 2005-2020 Budget Documents in 7 States

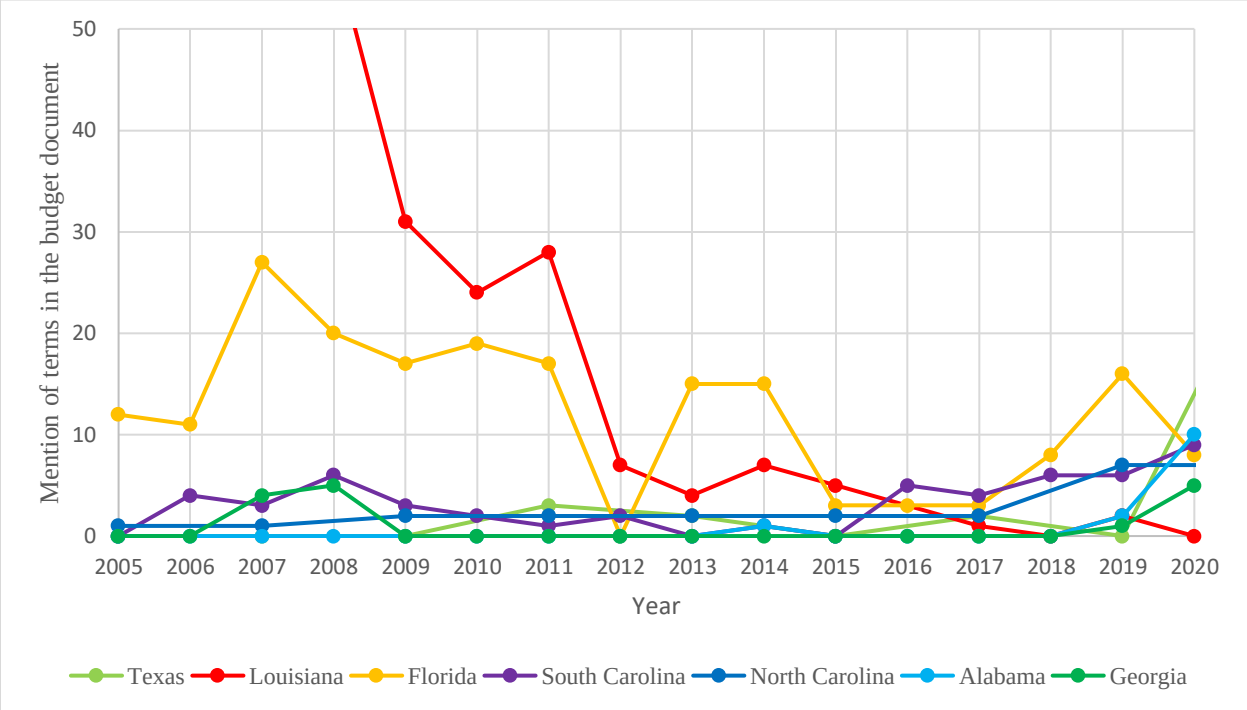


Figure 5. Mentions of Hurricane-related Terms in Budget Documents of Alabama

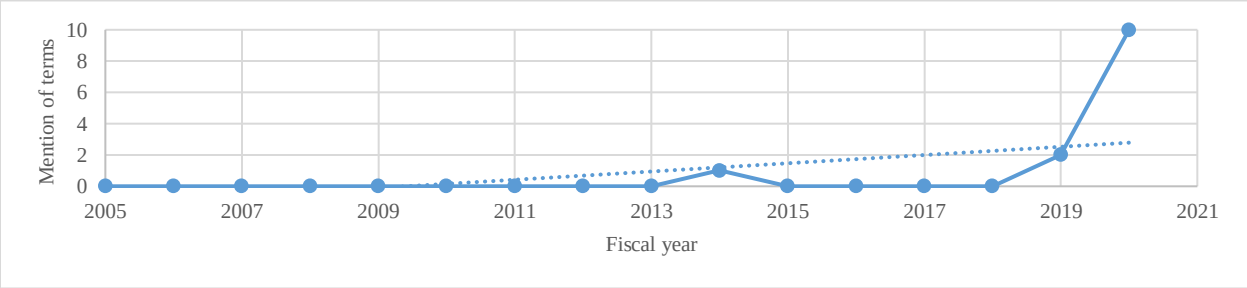


Figure 6. Mentions of Hurricane-related Terms in Budget Documents of Florida

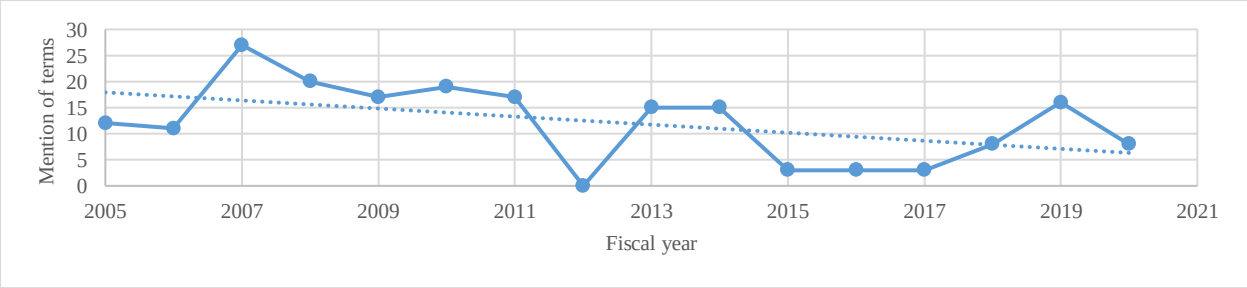


Figure 7. Mentions of Hurricane-related Terms in Budget Documents of Georgia

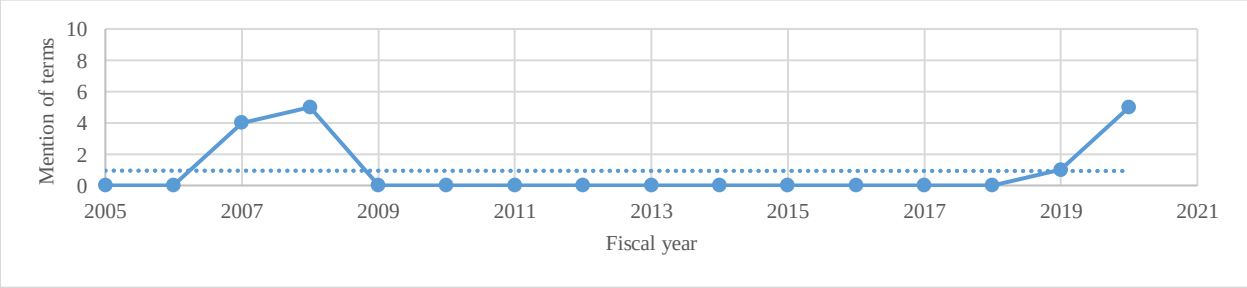


Figure 8. Mentions of Hurricane-related Terms in Budget Documents of Louisiana

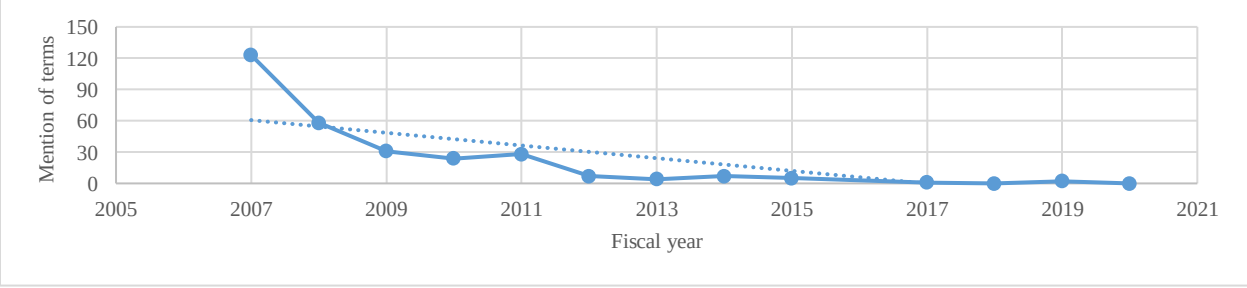


Figure 9. Mentions of Hurricane-related Terms in Budget Documents of North Carolina

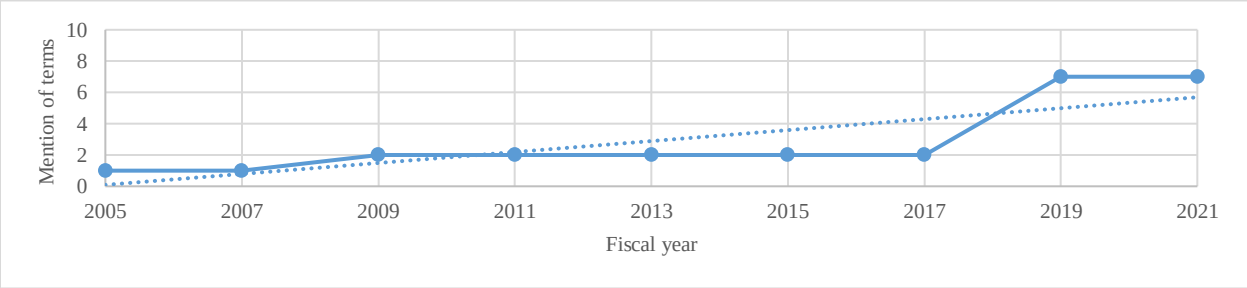


Figure 10. Mentions of Hurricane-related Terms in Budget Documents of South Carolina

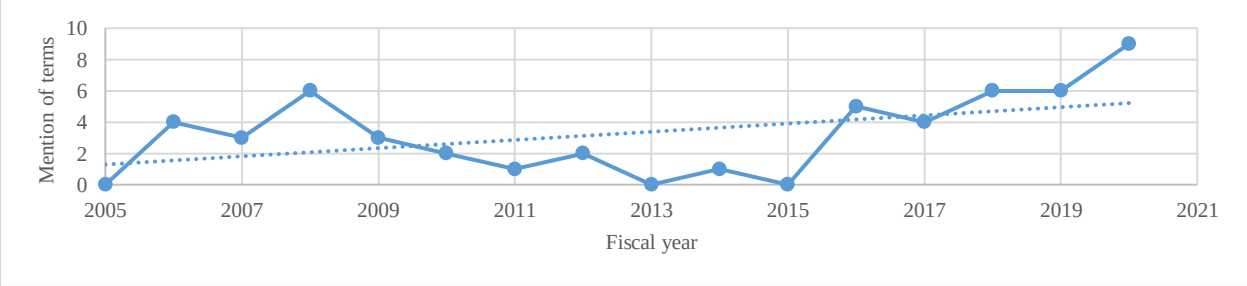


Figure 11. Mentions of Hurricane-related Terms in Budget Documents of Texas

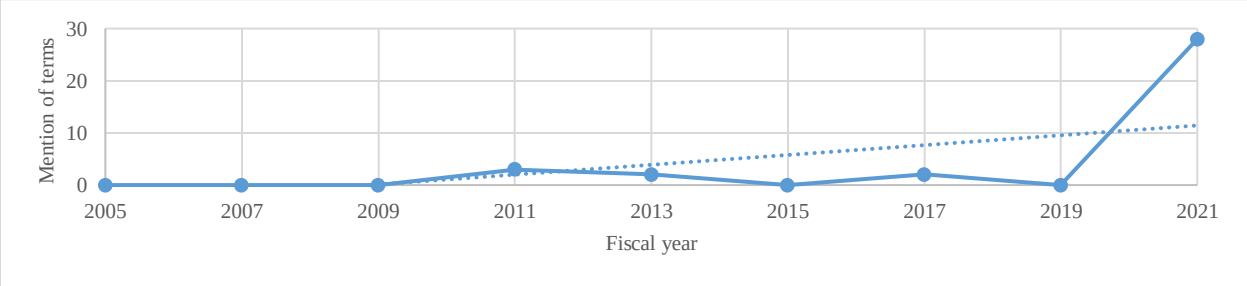
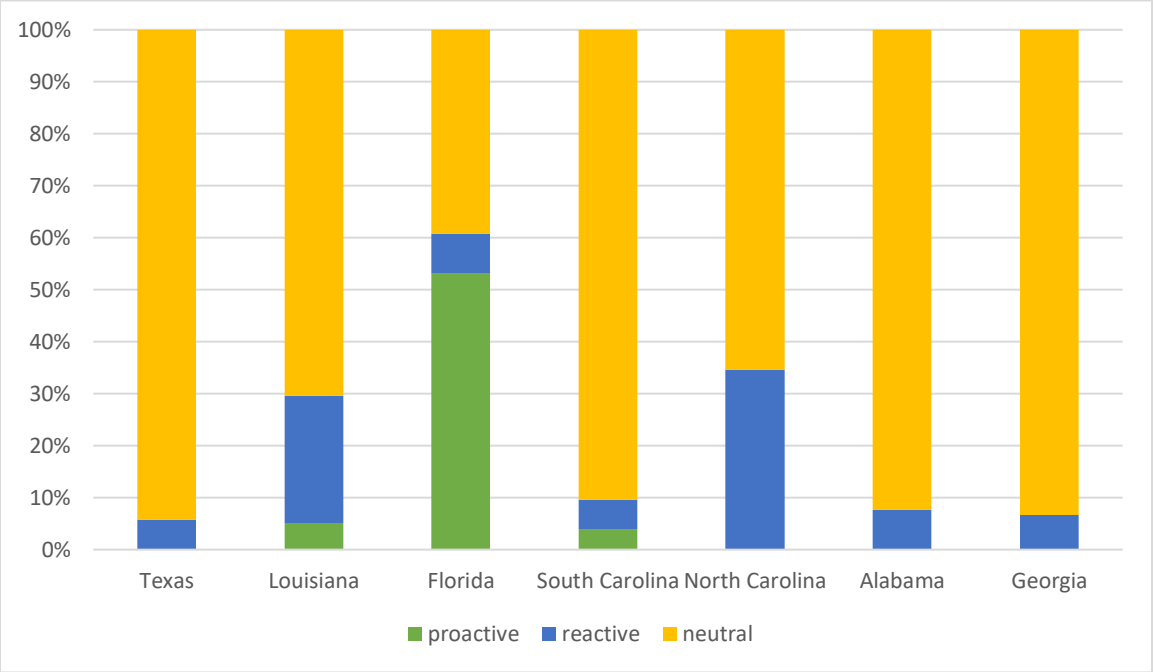


Figure 12. Attention to Proactive and Reactive Measures towards Hurricanes



Notes: The window is set to include 5 words before and after the keywords

Figure 13. Robustness Check: Changes in Government Attention across Different Policy Areas

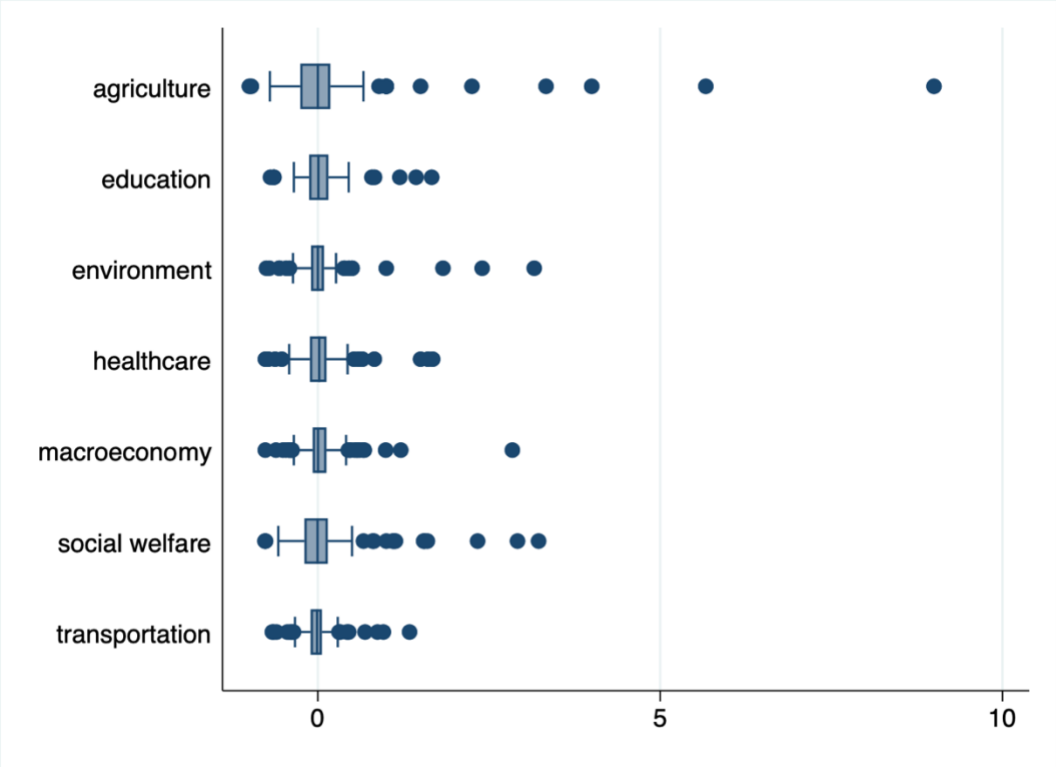


Figure 14 – Robustness Check: Mentions of "Katrina" in the 2005-2020 Budget Documents in 7 States

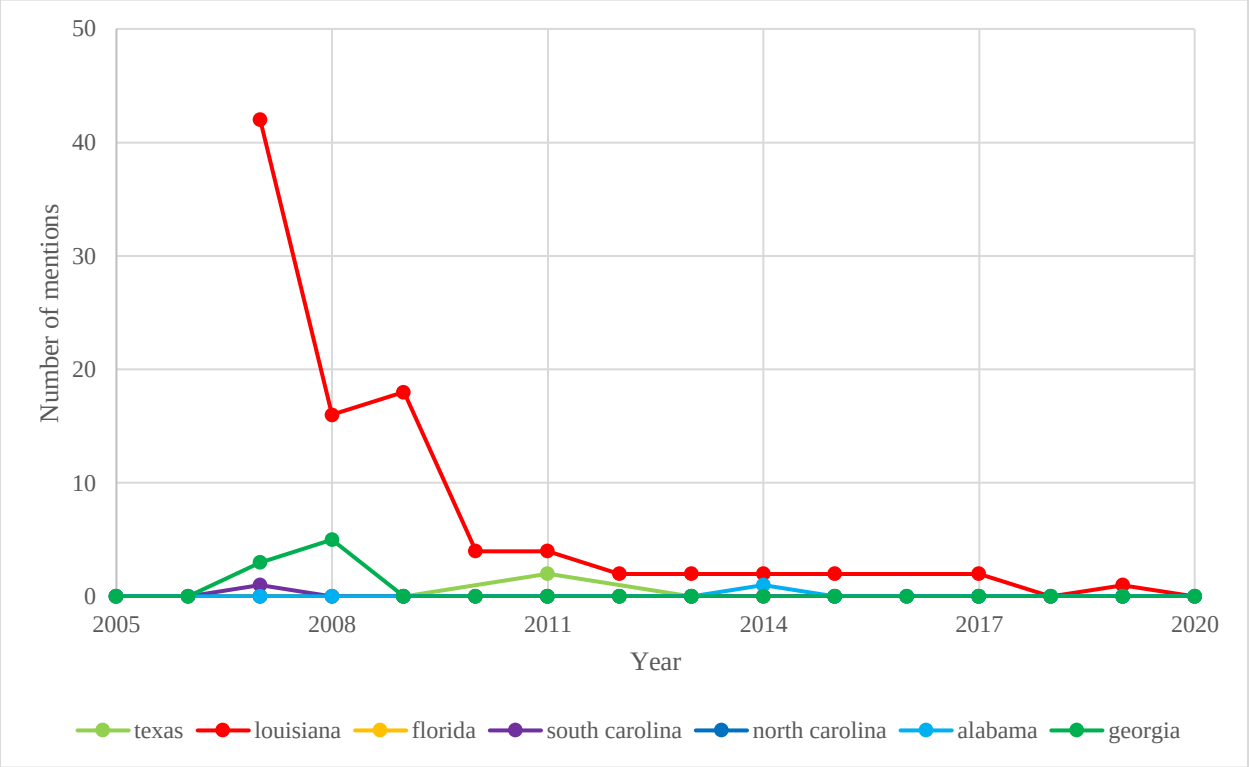


Figure 15 – Robustness Check: Weighted Mentions of Hurricane-related Terms in the 2005-2020 Budget Documents in 7 States

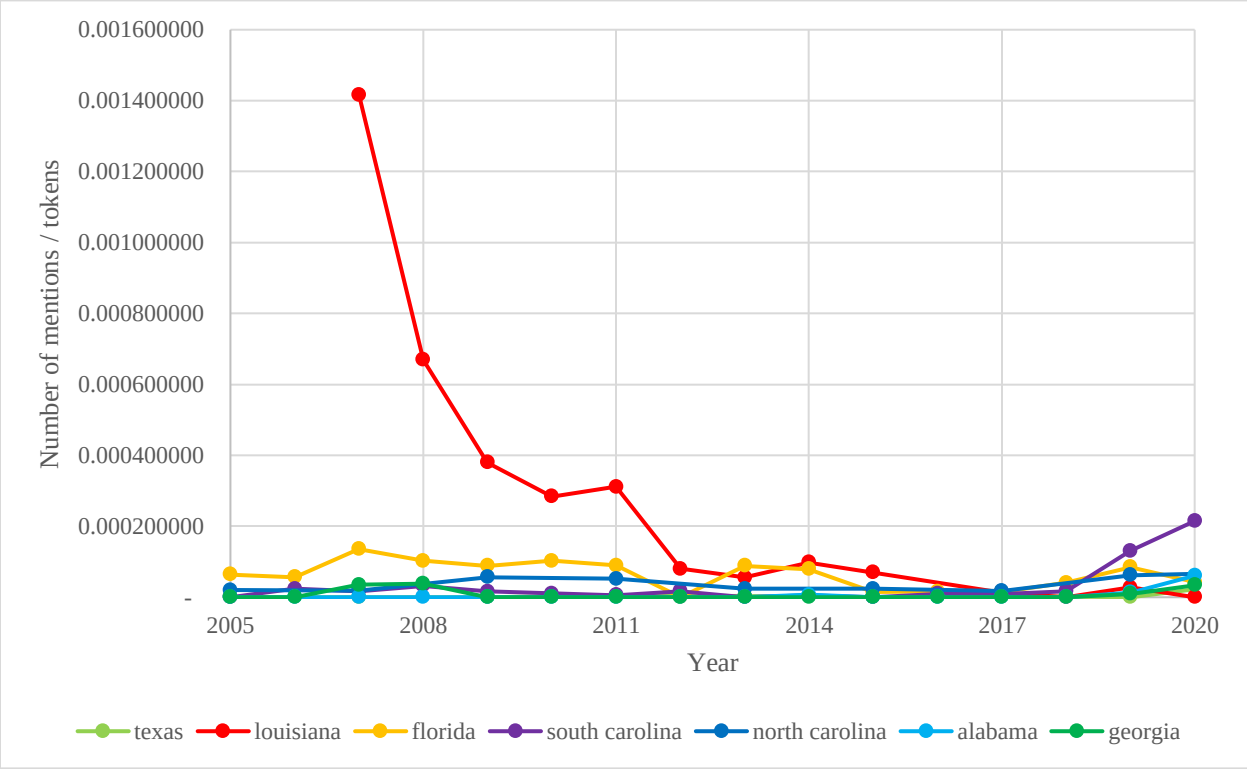
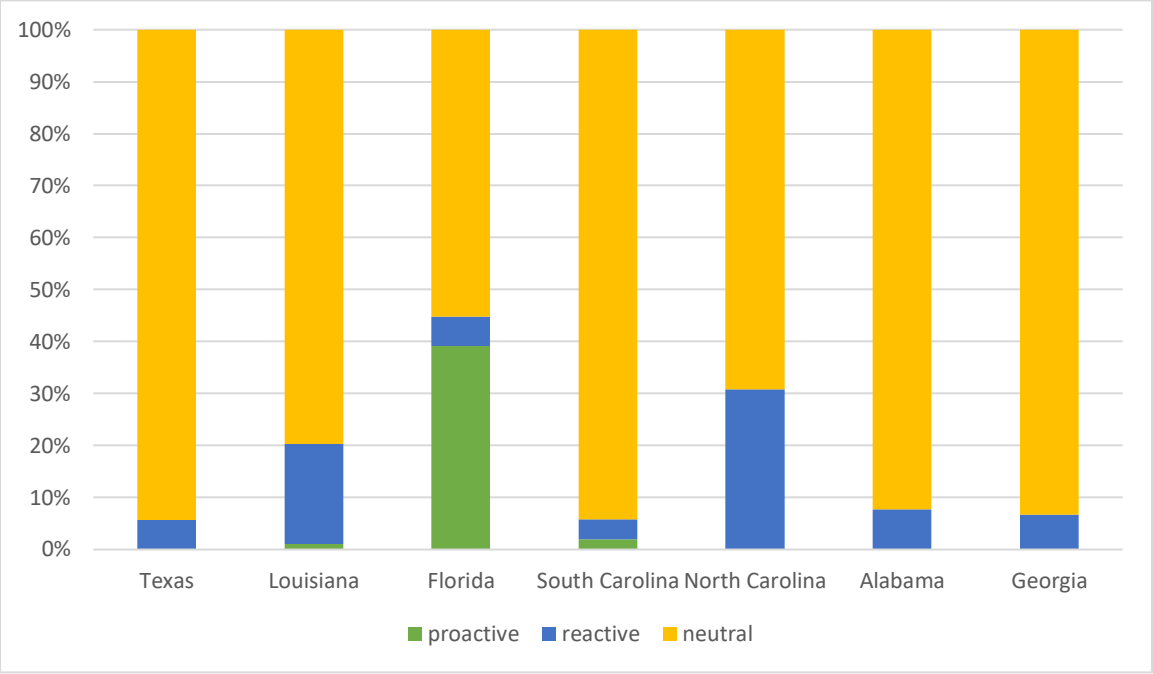


Figure 16 – Robustness Check: Attention to Proactive and Reactive Measures towards Hurricanes



Notes: The window is set to include 2 words before and after the keywords

Table 1. Hurricane Events between 2000-2021

State	Category					All hurricane events	%	Severe hurricane events	%
	1	2	3	4	5				
Louisiana	7	2	3	2		14	22.6%	5	33.3%
Florida	3	3	4	2	1	13	21.0%	7	46.7%
N. Carolina	7	3				10	16.1%	0	0.0%
Texas	6	2		1		9	14.5%	1	6.7%
Alabama	3	1	1			5	8.1%	1	6.7%
S. Carolina	4					4	6.5%	0	0.0%
Mississippi	1	1	1			3	4.8%	1	6.7%
Georgia	1	1				2	3.2%	0	0.0%
Virginia	1					1	1.6%	0	0.0%
New York	1					1	1.6%	0	0.0%
					Total	62	100%	15	100%

Notes: By convention, hurricanes are considered severe only if they are category 3 or above. Other U.S. states with zero hurricane events between 2000-2021 were not included in the table. Data are tabulated and analyzed based on hurricane records of NOAA's Hurricane Research Division (2022).

Table 2. Hurricane events listed in chronological order for selected states and years

Year	Alabama	Florida	Georgia	Louisiana	North Carolina	South Carolina	Texas
2005	Dennis, 1 Katrina, 1	Dennis, 3 Katrina, 1 Wilma, 3 Rita, 1		Cindy, 1 Katrina, 3 Rita, 3	Ophelia, 1		Rita, 2
2006							
2007				Humberto, 1			Humberto, 1
2008				Gustav, 2 Ike, 1			Dolly, 1 Ike, 2
2009							
2010							Alex
2011					Irene, 1		
2012				Isaac, 1			
2013							
2014					Arthur, 2		
2015							
2016		Hermine, 1 Matthew, 2	Matthew, 1		Matthew, 1	Matthew, 1	
2017		Irma, 4		Nate, 1			Harvey, 4
2018		Michael, 5	Michael, 2		Florence, 1		
2019				Barry, 1	Dorian, 2		
2020	Sally, 2 Zeta, 1	Sally, 2		Laura, 4 Delta, 2 Zeta, 3	Isaias, 1	Isaias, 1	Hanna, 1 Laura, 1

Notes: The number next to each event indicates the hurricane's strength according in the Saffir-Simpson scale

Table 3. Summary of Corpus of Budget Documents in Seven Selected States

	AL	FL	GA	LA	NC	SC	TX
Year	2005-2020	2005-2020	2005-2020	2007-2015, 2017-2020	2005-2021	2005-2020	2005-2021
Budget cycle	Annual	Annual	Annual	Annual	Biannual	Annual	Biannual
Budget Documents	16	16	16	13	9	16	9
Pages	356	353	425	208	218	347	992
Sentences	1,370	8,583	4,276	1,181	1,452	4,069	19,328
Tokens (Words)	149,691	189,708	132809	73,828	83,249	185,909	596,275
Unique words	26,897	15,426	14,832	6,761	8,671	18,205	30,374

Notes: Pages, sentences, tokens, and unique words are the medians across observed years within a given state. Token is a technical term in text analysis used to describe a "word" or "term." AL = Alabama; FL = Florida; GA = Georgia; LA = Louisiana; NC = North Carolina; SC = South Carolina; TX = Texas.

References

Albugh, Quinn, Julie Sevenans and Stuart Soroka. 2013. Lexicoder Topic Dictionaries, June 2013 versions, McGill University, Montreal, Canada

Anastasopoulos, L. J., Moldogaziev, T. T., & Scott, T. A. (2017). Computational text analysis for public management research: an annotated application to county budgets.

Anastasopoulos, L. J., & Whitford, A. B. (2019). Machine learning for public administration research, with application to organizational reputation. *Journal of Public Administration Research and Theory*, *29*(3), 491-510.

Baumgartner, F. R., & Jones, B. D. (2010). *Agendas and instability in American politics*. University of Chicago Press.

Benoit, Kenneth and Watanabe, Kohei and Wang, Haiyan and Nulty, Paul and Obeng, Adam and Müller, Stefan and Matsuo, Akitaka. (2018). *quanteda: An R package for the quantitative analysis of textual data.* Journal of Open Source Software, 3 (30). p. 774. DOI https://doi.org/10.21105/joss.00774

Birkland, T. A. (1997). *After disaster: Agenda setting, public policy, and focusing events*. Georgetown University Press.

Bluedorn, J. C. (2005). *Hurricanes: intertemporal trade and capital shocks.*

Breunig, C., & Jones, B. D. (2011). Stochastic process methods with an application to budgetary data. *Political Analysis*, *19*(1), 103-117.

Brunsson, N. (1993). Ideas and actions: Justification and hypocrisy as alternatives to control. *Accounting, Organizations and Society*, *18*(6), 489-506.

Caruson, K., & MacManus, S. A. (2008). Disaster vulnerabilities: How strong a push toward regionalism and intergovernmental cooperation?. *The American Review of Public Administration*, *38*(3), 286-306.

Chen, C., & Flink, C. M. (2022). Budgetary changes and organizational performance: Evidence from state transportation agencies. *Policy Studies Journal*, *50*(3), 595-613.

Collins, M., Sutherland, M., Bouwer, L., Cheong, S. M., Frolicher, T., DesCombes, H. J., & Timmermans, M. L. (2019). Extremes, abrupt changes and managing risk.

Congressional Research Service. (2022). The Disaster Relief Fund: Overview and Issues. Available at https://crsreports.congress.gov/product/pdf/R/R45484

Davis, Otto A., Michael Alan Howarth Dempster, and Aaron Wildavsky. (1966). "A theory of the budgetary process." *American Political Science Review* 60, no. 3: 529-547.

Dempster, Michael AH, and Aaron Wildavsky. "On change: or, there is no magic size for an increment." *Political Studies* 27, no. 3 (1979): 371-389.

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

Federal Emergency Management Agency. (2018). FEMA Strategic Plan 2018-2022. Available at https://www.fema.gov/about/strategic-plan/2018-2022

Federal Emergency Management Agency. (2020). *Glossary.* Available at https://www.fema.gov/about/glossary

Federal Emergency Management Agency. (2022). Historic Disasters. Available at https://www.fema.gov/disaster/historic

Flink, C. M. (2018). Ordering chaos: The performance consequences of budgetary changes. *The American Review of Public Administration*, *48*(4), 291-300.

Gilmore, E. A., & St. Clair, T. (2018). Budgeting for climate change: Obstacles and opportunities at the US state level. *Climate Policy*, *18*(6), 729-741.

Grimmer, J., Roberts, M. E., & Stewart, B. M. (2022). *Text as data: A new framework for machine learning and the social sciences*. Princeton University Press.

Hawkins, R. L., & Maurer, K. (2010). Bonding, bridging and linking: How social capital operated in New Orleans following Hurricane Katrina. *British Journal of Social Work*, *40*(6), 1777-1793.

Healy, A., & Malhotra, N. (2009). Myopic voters and natural disaster policy. *American Political Science Review*, *103*(3), 387-406.

Hou, Y. (2004). Budget stabilization fund: Structural features of the enabling legislation and balance levels. *Public Budgeting & Finance*, *24*(3), 38-64.

Jensen, C. (2009). Policy punctuations in mature welfare states. *Journal of Public Policy*, *29*(3), 287-303.

Jones, Bryan D., Frank R. Baumgartner, and James L. True. (1998). "Policy punctuations: US budget authority, 1947-1995." *The Journal of Politics* 60, no. 1: 1-33.

Jones, B. D., Sulkin, T., & Larsen, H. A. (2003). Policy punctuations in American political institutions. *American Political Science Review*, *97*(1), 151-169.

Kellett, J., Caravani, A., & Pichon, F. (2013). Financing disaster risk reduction. *A 20 year story of international aid*.

Koski, C., & Workman, S. (2018). Drawing practical lessons from punctuated equilibrium theory. *Policy & Politics*, *46*(2), 293-308.

Laver. M. & Garry, J. (2000). Estimating Policy Positions from Political Texts. *American Journal of Political Science*, 44 (3), 619-634.

Lindblom, C. E. (1959). The science of" muddling through". *Public Administration Review*, 79-88.

Marlowe, J. (2021). Stories and Sentiment in State and Local Government Finance. *State and Local Government Review*, *53*(3), 248-259.

McLendon, M. K. (2003). The politics of higher education: Toward an expanded research agenda. *Educational policy*, *17*(1), 165-191.

National Governors' Association. (1979). "Comprehensive Emergency Management: A Governor's Guide"

Multi-Hazard Mitigation Council (2019). Natural Hazard *Mitigation Saves: 2019 Report.* Principal Investigator Porter, K.; Co-Principal Investigators Dash, N., Huyck, C., Santos, J., Scawthorn, C.; Investigators: Eguchi, M., Eguchi, R., Ghosh., S., Isteita, M., Mickey, K., Rashed, T., Reeder, A.; Schneider, P.; and Yuan, J., Directors, MMC. Investigator Intern: Cohen-Porter, A. National Institute of Building Sciences. Washington, DC. www.nibs.org

National Oceanic and Atmospheric Administration. (2005). NOAA Technical Memorandum NWS TPC-4: The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2004 (and Other Frequently Requested Hurricane Facts). Available at https://www.nhc.noaa.gov/paststate.shtml

National Oceanic and Atmospheric Administration. (2022a). *Hurricane Costs*. Available at https://coast.noaa.gov/states/fast-facts/hurricane-costs.html

National Oceanic and Atmospheric Administration. (2022b). *Saffir-Simpson Hurricane Wind Scale.* Available at https://www.nhc.noaa.gov/aboutsshws.php

National Oceanic and Atmospheric Administration. (2022c). *Extremely Powerful Hurricane Katrina Leaves a Historic Mark on the Northern Gulf Coast*. Available at https://www.weather.gov/mob/katrina

National Oceanic and Atmospheric Administration Hurricane Research Division. (2022). Continental United States Hurricane Impacts/Landfalls 1851-2021. Available at https://www.aoml.noaa.gov/hrd/hurdat/All_U.S._Hurricanes.html

National Public Radio. (2014). *Checking In On Education Bills As Florida Legislature Reaches Halfway Point.* Available at https://stateimpact.npr.org/florida/2014/04/07/checking-in-on-education-bills-as-florida-legislature-reaches-halfway-point/ (accessed April 18, 2023)

National Weather Service. (2018). Post tropical hurricane report. https://www.weather.gov/tae/michael_psh

Neumayer, E., Plümper, T., & Barthel, F. (2014). The political economy of natural disaster damage. *Global Environmental Change*, *24*, 8-19.

Nohrstedt, D. (2022). When do disasters spark transformative policy change and why?. *Policy & Politics*, *50*(3), 425-441.

Patashnik, E. M. (1996). The contractual nature of budgeting: A transaction cost perspective on the design of budgeting institutions. *Policy sciences*, *29*(3), 189-212.

Pew Charitable Trusts. (2018). What we don't know about state spending on natural disasters could cost us. Available at https://www.pewtrusts.org/en/research-and-analysis/reports/2018/06/19/what-we-dont-know-about-state-spending-on-natural-disasters-could-cost-us

Pew Charitable Trusts. (2020). *How States Pay for Natural Disasters in an Era of Rising Costs*. Available at https://www.pewtrusts.org/en/research-and-analysis/reports/2020/05/how-states-pay-for-natural-disasters-in-an-era-of-rising-costs

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

Phaup, M., & Torregrosa, D. (1999). Budgeting for Contingent Losses. in Roy T. Meyers (ed.), *Handbook of Government Budgeting, Jossey-Bass, San Francisco, CA, United States*, 699-719.

Pierson K., Hand M., and Thompson F. (2015). The Government Finance Database: A Common Resource for Quantitative Research in Public Financial Analysis. PLoS ONE doi: 10.1371/journal.pone.0130119

Robinson, S. E. (2004). Punctuated equilibrium, bureaucratization, and budgetary changes in schools. *Policy Studies Journal*, *32*(1), 25-39.

Robinson, S. E., Caver, F. S., Meier, K. J., & O'Toole Jr, L. J. (2007). Explaining policy punctuations: Bureaucratization and budget change. *American Journal of Political Science*, *51*(1), 140-150.

Salka, W. M. (2004). Mission evolution: the United States Forest Service's response to crisis. Review of Policy Research, 21(2), 221-232.

Skarbek, E. C. (2014). The Chicago Fire of 1871: a bottom-up approach to disaster relief. *Public Choice*, *160*(1), 155-180.

True, J. L. (2000). Avalanches and incrementalism: Making policy and budgets in the United States. *The American Review of Public Administration*, *30*(1), 3-18.

True, J. L., Jones, B. D., & Baumgartner, F. R. (2019). Punctuated-equilibrium theory: explaining stability and change in public policymaking. In *Theories of the policy process* (pp. 155-187). Routledge.

United Nations. (2015). *Sendai Framework for Disaster Risk Reduction 2015–2030.* Available at https://www.undrr.org/implementing-sendai-framework/what-sendai-framework (accessed August 7, 2022)

United Nations. (2022). *Global Assessment Report on Disaster Risk Reduction. Our World at Risk: Transforming Governance for a Resilient Future, Summary for Policymakers.*

U.S. Census Bureau. (2006). Government Finance and Employment: Classification Manual. Available at https://www.census.gov/programs-surveys/state/technical-documentation/methodology.html

U.S. Government Accountability Office. (2015). *Budgeting for Disasters: Approaches to Budgeting for Disasters in Selected States.* Available at https://www.gao.gov/products/gao-15-424

Walsh, K. J., McBride, J. L., Klotzbach, P. J., Balachandran, S., Camargo, S. J., Holland, G., ... & Sugi, M. (2016). Tropical cyclones and climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *7*(1), 65-89.

World Meteorological Organization. (2022). *WMO Atlas of Mortality and Economic Losses from Weather, Climate, and Weather Extremes (1970-2019).*

Yang, L. (2021). Auditor or adviser? Auditor (in) dependence and its impact on financial management. *Public Administration Review*, *81*(3), 475-487.

Zhao, B. (2016). Saving for a rainy day: Estimating the needed size of US state budget stabilization funds. *Regional Science and Urban Economics*, *61*, 130-152.

Appendix

Appendix Table A1 - Hurricane Hits across U.S. States by Saffir-Simpson Scale, 1851-2004

State	Saffir-Simpson Hurricane Wind Scale categories					Total
	1	2	3	4	5	
Florida	**43**	**32**	**27**	**6**	**2**	**110**
Texas	**23**	**17**	**12**	**7**	**0**	**59**
Louisiana	**17**	**14**	**13**	**4**	**1**	**49**
North Carolina	**21**	**13**	**11**	**1**	**0**	**46**
South Carolina	**19**	**6**	**4**	**2**	**0**	**31**
Alabama	**11**	**5**	**6**	**0**	**0**	**22**
Georgia	**12**	**5**	**2**	**1**	**0**	**20**
Mississippi	2	5	7	0	1	15
Virginia	9	2	1	0	0	12
New York	6	1	5	0	0	12
Connecticut	4	3	3	0	0	10
Massachusetts	5	2	3	0	0	10
Rhode Island	3	2	4	0	0	9
Maine	5	1	0	0	0	6
Maryland	1	1	0	0	0	2
Delaware	2	0	0	0	0	2
New Jersey	2	0	0	0	0	2
New Hampshire	1	1	0	0	0	2
Pennsylvania	1	0	0	0	0	1

Source: (NOAA, 2015)

Appendix A2 – Discussion: From budget documents to text-as-data

For decades, the social sciences have utilized text analysis as a qualitative method, so this methodology is not entirely new. The biggest difference is that analyses were traditionally done manually, whereas quite recently researchers began applying it computationally. The availability of computer assistance allows for a faster and more systematic way to collect and analyze data, and for that reason it has gained growing popularity among public policy scholars and practitioners (Anastasopoulos and Whitford, 2019). Computational text analysis has been used in recent studies to examine various sources of information, including governments' social media, financial reports, and audit results (Anastasopoulos et al., 2017; Marlowe, 2021; Yang, 2021).

The literature on PET, which investigates the extent to which the government pays attention to some major policy areas, has largely utilized quantitative analyses of the budgets (Breunig and Jones, 2011). Recently, Chen and Flink (2021) used a dataset of 50 U.S. states from 2005 to 2013 to evaluate changes in budgetary inputs in connection to organizational performance outcomes. Meanwhile, at the federal level, among the most prominent was a study by Baumgartner and Jones (2010), which analyzed policy stability and change while also empirically assessing the degree of attentiveness of policymakers to national issues based on the U.S. federal budget data.

However, budget information regarding specific issues like disaster management is limited, if not entirely unavailable. The U.S. Census Bureau (2006) surveys the state spending of all states on an annual basis. While the data are provided in a considerable detail, the existing budget classification does not include a specific category or subcategory for disaster management, disaster mitigation, or disaster response. Disaster-related items are incorporated in other budget components; for instance, disaster assistance from the Federal Emergency Management Agency (FEMA) to states is classified as "All Other" under "Intergovernmental Revenue." By contrast, the

Census survey creates specific codes to identify federal aid expenses associated with other key functions, such as “Education,” “Health and Hospitals,” “Highways,” “Housing and Community Development,” and “Public Welfare.” “All Other” is a broad category that lumps federal assistance for disasters together with other federal transfers for economic development, libraries, public broadcasting, parks and recreation, and water transportation activities. As a result, it is impractical to use the Census data to identify, trace, and analyze budget allocations for disasters, let alone for a specific type of disaster like hurricanes.

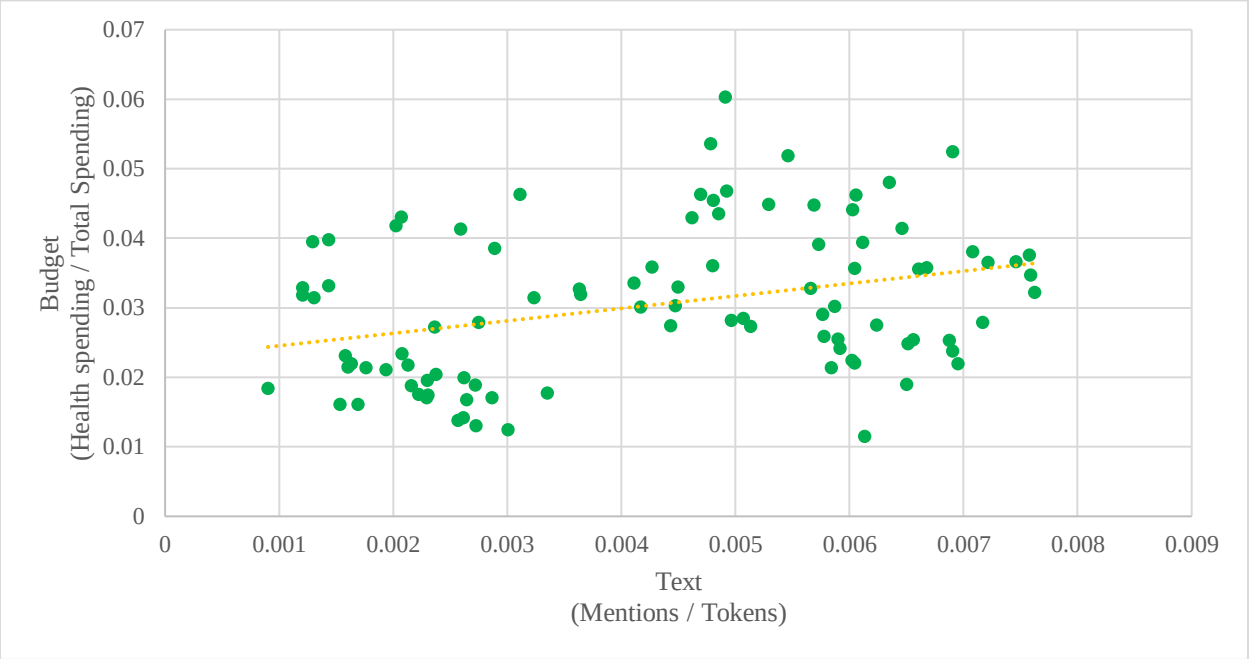
In 2015, U.S. Government Accountability Office (GAO) documented disaster spending information, but this analysis was limited to only in 10 selected states for a single fiscal year (2014). Pew Charitable Trusts (2020) assessed statewide disaster accounts and compiled some disaster funding data, but only 27 states and one fiscal year (2018) were included in the study. Since disaster spending data are available for one or two years, it is not possible to evaluate intertemporal patterns of disaster management in a given state, let alone government response to a specific type of disaster such as hurricanes. According to a survey of state emergency managers by the Pew Charitable Trusts (2018), most states do not comprehensively track natural disaster spending. In a broader climate change context, Gilmore and St. Clair (2018) found that state budgets provide little detail on climate-related programs, which makes it difficult to quantitatively assess state responses to climate change.

As for the federal level, a study from the Congressional Research Service (CRS) (2022) tracks the federal disaster relief appropriations since the 1960s, which has shown increases over the last few decades. The CRS data also show the detail of appropriations, such as whether funds went through annual or supplemental appropriations in the budget process. Given its coverage, the CRS data are well-suited for time series analysis. For example, it enables identification of years

when appropriations were significantly higher due to major disaster events, such as in 2005 following Hurricane Katrina. However, there is quite limited information regarding states to which the federal aids were channeled. Disaster funds are also such a broad category that includes all kinds of emergencies, including the COVID-19 pandemic. Without more disaggregated information, it is difficult to know how much was allocated for a specific type of disaster like hurricanes.

This study assumes that textual data and budgetary data are consistent with each other and yield similar insights when analyzed individually. If this assumption holds true, any policy area or specific subject that receives more government attention should correspond to both more frequent mentions of related keywords and higher spending in that area. In cases where budgetary data are unavailable--such as disaster management in connection with hurricanes--textual data can sufficiently serve as a substitute. To validate this assumption, the study tests the correlation between textual and budgetary data in a policy area where both data types are available: healthcare. The budget documents and measurement strategies outlined in the data and methodology sections are used, supplemented by budgetary data obtained from the Government Finance Database (Pierson et al., 2015). As shown in Appendix Figure A2, textual and budgetary data in the health policy area are positively correlated.

Appendix Figure A2 – Positive Correlation between Textual and Budgetary Data in the Area of Health Policy



Appendix Table A3 - Examples of Keywords-in-Context in South Carolina's Budget Documents

Example 1: "Preparation" is mentioned in the context of education policy
Text from FY 2005 budget document of South Carolina, page 269 Rationale: We propose restoring the full FY 03-04 funding to ensure continued access to the PSAT for underprivileged students. We believe the end result will be improving SAT scores as the PSAT provides another opportunity to practice for the SAT test. In addition, we believe this funding will continue to provide academic challenges to our gifted students and promote achievement. However, we also believe that public and private higher institutions could provide access to SAT preparation and other prep classes for high achieving students as a part of their recruiting process. The objectives of college partnerships are certainly worthwhile, and we hope to see those programs continue with other funding. We commit these savings to funding the bonuses for National Board Certification, allowing us to invest more general fund dollars toward the Base Student Cost.
Example 2: "Preparation" is mentioned in the context of hurricane mitigation
Text from FY 2006 budget document of South Carolina, pages 202-203 **State match for natural disasters such as hurricanes and ice storms by providing $3 million** to the Adjutant General's Office. In preparation for and in the aftermath of natural disasters such as hurricanes, tornadoes, or winter storms, the state is faced with the responsibility of clearing debris, repairing public roads, and utility infrastructure and providing additional law enforcement, security, and traffic control. When these costs exceed a federally established threshold the state becomes eligible for assistance from the Federal Emergency Management Agency (FEMA). This program reimburses the state for 75 percent of the eligible approved costs. Currently, after having experienced four federally declared disasters in 2004 (a record in South Carolina), reserves for the state matching portion have been depleted. We propose the creation of a disaster contingency account of $3 million to be funded from the Capital Reserve Fund. This additional funding will allow us to speed disaster relief to local communities.