

# A Typology of Fiscal Stress Following Disasters

Julie Winkler and Skip Krueger\*

*Department of Public Administration, University of North Texas, Denton, USA;*

\*Corresponding author: skip.krueger@unt.edu

Julie Winkler is a doctoral student in the Department of Public Administration at the University of North Texas. Her research interests center around the financial aspects of disasters, communication processes during disaster response, and long-term housing recovery.

Skip Krueger is an Associate Professor and PhD Program Coordinator in the Department of Public Administration at the University of North Texas. His research interests include the financial aspects of natural disasters, regional cooperation among local governments, and state and local budgeting.

**Abstract:** In the United States, local governments often face significant fiscal challenges following disasters. For example, damage to homes and businesses can impact various revenue sources; emergency response, debris removal, and infrastructure stabilization can temporarily drive expenditures above normal levels; and long-term repair and replacement of facilities can all place sometimes dramatic stress on the resources of local governments, including cities, counties, townships, and special districts. While federal and state governments may later help ease some of the fiscal stress of a disaster, those resources are usually provided much later, are not available for some categories of public-sector losses, and typically only partially cover local costs. Despite all this, few studies have been conducted on the fiscal impact of disasters on local governments and the recovery process those governments go through in the aftermath of disasters. More importantly, existing studies – while insightful – have not utilized a theoretical framework to systematically understand how disasters affect local fiscal conditions in the short and long run. We address this issue by developing a typology of fiscal stress experienced by U.S. local governments that results from natural disasters. We then apply that typology to four case studies of cities that faced fiscal stress after hurricanes. We evaluate 10 different fiscal indicators over several years before and after a major hurricane in four cities: Orange and Galveston, Texas, before and after Hurricane Ike, and Biloxi and Gulfport, Mississippi, before and after Hurricane Katrina. We assess the degree to which the disaster fiscal stress typology fits the different experiences in these four cities.

Keywords: disaster finance, fiscal stress, disaster recovery, local government

Special thanks to Brittney Huff for help in data collection.

Prepared for the IPPA Workshop on Emergency Management, Disaster, and Policy at the International Workshops in Public Policy, University of Pittsburgh, June 26-28, 2018. Please do not cite without permission of the authors.

## Introduction

Local governments whose communities experience local disasters are caught in a catch 22; damage to homes and changes in demography as residents choose not to return can degrade the tax base and cut revenue, while response and recovery is costly, requiring added expenditure to remove debris and fix public facilities. But not all experiences of disaster are the same; disaster events can add on to already existing socioeconomic conditions, influencing recovery, and the severity of a disaster can determine fiscal patterns for several key revenues local governments rely on.

We know that cities are strategic in their response to disaster; changing tax rates (Hildreth 2009) , or recognizing the cyclic nature of disaster in designing their land management and planning schedules (Handley 2006), but so far research has been limited to case studies, making it difficult to determine what predictable patterns cities follow, to manage their fiscal stress following disaster. In this paper, we hope to develop a framework to classify the type of fiscal stress cities face following disaster, to better understand the diversity of fiscal challenges of disaster found in the literature.

The impact of a disaster can vary in severity, in terms of the number of people effected, homes damaged, businesses disrupted, area covered, duration of the hazardous conditions. During a hurricane, cities who are coastal may experience storm surge and sudden wave conditions, while further low-lying inland areas may face flooding and longer lasting stagnant water conditions.

Disasters events act within specific socioeconomic conditions, which can influence the speed of recovery. Communities which have less access to financial markets, are already facing high levels of unemployment, are experiencing an economic depression, are highly dependent on resources impacted by the storm, are also likely to have a drawn-out recovery process. Cities with less resources and low staffing will find it difficult to manage additional grants and projects related to recovery.

Following a disaster, cities often provide the first response, organizing evacuation and return, clearing debris, repairing roads and vital facilities damaged by a storm, and working with the state and

county to disburse federal grants for public assistance. While the dominant paradigm may suggest that cities do little more than await federal assistance, others suggest that cities act strategically. Cities hold more cash on hand when they are more reliant on volatile revenue streams or are more at risk to hazardous conditions.

However, the fiscal impact and recovery process of local governments following disasters is not well understood. Several case studies have shown that disasters can have complex and lasting influence on city finance, but these disparate cases are not grounded in a framework which allows for comparison. Do cities with different experiences of disaster face different financial challenges during the recovery phase, and do they respond using different strategies? Which fiscal patterns following a disaster are more predictable, and where are they more volatile?

We develop a framework, adapted from Levine (1985), to classify cities' experiences of disaster based on the severity of the event and duration of recovery, based on the fiscal impact on several key indicators in their revenue stream and expenditure patterns. We look at four cities, two in Texas following hurricane Ike, and two in Mississippi following hurricane Katrina, and measure 10 variables for two years before the storm, and seven years after the storm, to determine what patterns emerge.

In the following section we will provide a discussion of the literature on disaster finance and the local and state level. Then we will develop our framework, based on Levine's (1985) typology of fiscal stress, before analyzing the four cities using our model.

## **Literature Review**

Following at least some types of disasters, local governments can face significant fiscal stress. Unanticipated fiscal effects may include having to pay for additional staffing and assets, rebuilding damaged or destroyed buildings and equipment vital for delivering services, and sometimes severe revenue shortfalls.

Sylves (2007) suggests that local governments are often constrained in their spending by the level of revenue they take in, due to requirements to keep a balanced budget. Local governments are able to use taxes and fees, intergovernmental funds, special assessments, and bonds to pay for emergency management efforts. As Settle (1985) describes, disasters often face losses in property taxes, have a shrinking tax base, business disruptions can cut into sales tax, and new costs can increase the debt ratio. However, disasters can vary in factors like severity and length, resulting in different financial outcomes following disaster, making disaster finance generalizations difficult.

Several case studies have considered a single catastrophic event and the resulting fiscal effects. Ebdon, O'Neil, and Chen (2012) looked at three overlapping jurisdictions, Omaha Airport Authority, Omaha Public Power District, and the city of Omaha, during the Missouri River flooding in 2011. Because the flooding event lasted months, this case served to better understand the fiscal strain caused by continuing emergency management costs, where response, recovery, mitigation and even preparedness activities may have occurred simultaneously. Furthermore, these overlapping jurisdictions had interdependencies, and shared decision-making networks, possibly making response more difficult.

In Omaha, no major destruction happened: the airport stayed open; the powerplant was not severely damaged; major flooding within the city was avoided (Ebdon, O'Neil, and Chen 2012). While some sewage was released into the river, the sewage plant remained unscathed and the city was able to continue functions, including holding festival events. Mitigation efforts, like using sandbags to reinforce the levees, and the timely construction of levees to protect the sewage plant were deemed successful, and communication between the three jurisdictions was fruitful. However, the reliance between the jurisdictions may indicate a higher level of risk; if the airport had shut down, the city would have seen more consequences as business would also be disrupted. While mitigation efforts throughout the flooding event were costly, the three jurisdictions avoided longer-term costs from any severe damages.

Analyzing the recovery process following hurricane Katrina in New Orleans, Hildreth (2009) finds that the city's budgets and priorities were revised, revenues trended downwards as expenditures went up, and assets needed repair but intergovernmental revenue and other new revenue streams to use in response followed complicated new rules and processes which were difficult to navigate. Rising costs of recovery initially forced New Orleans to lay off 2,400 employees, about half their workforce, in order to cut spending to match revenues. The result was a decreased scope of services like garbage pickup, while other emergency staff worked overtime.

Hildreth (2009) also found that in the year after Katrina, property assessment values had substantially decreased, and in order to compensate the city increased the property tax rate, to cover the debt supported by the tax. The burden of this tax largely fell on income-producing property, which were not included in the homestead exemption. Furthermore, operations funded through enterprise funds faced difficulty in continuing services, and in securing income.

Even though the hurricane had a relatively short duration, federal reimbursements for public assistance takes years to materialize (Hildreth 2009). This led to difficulty for local officials to properly forecast revenues, and in turn properly budget expenditures in the following years. At the state level, Louisiana saw more extreme budget changes than Mississippi. Despite regulations requiring funding to be fully obligated within 2 years for the public assistance program, FEMA seemed to drag their feet, with a large increase in projects being obligated a week before being required to report their progress, rather than steadily disbursed throughout the 2 years. Furthermore, FEMA seemed to have preference for suburban infrastructure, rather than repairing older systems within the city, and were required to only rebuild to previous conditions, rather than upgrade or improve facilities.

Focusing on the financial impacts of hurricanes Ivan and Katrina on Alabama, Handley (2006) finds that in the Mobile region communities are proactive and strategic towards storm preparation. In Mobile, sales tax revenues two months following hurricane Katrina were 50% higher than the year before,

which had been 1 month following hurricane Ivan. Unemployment also declined following Katrina and Ivan, at least in part due to increased construction activities leading to new job opportunities. While hurricane activities did discourage tourism, revenues from attractions did not see overwhelming changes. While other states with more damage had negative impacts to their bond ratings, Alabama was not downgraded following Katrina. Mobile recognizes the cyclic nature of coastal storms and try to incorporate the likelihood of damage into their decision-making framework for land use and development.

MacManus and Caruson (2008) surveyed Florida city and county finance officers, and found that motivations for entering into cost-sharing agreements for emergency management include a stronger faith in horizontal than vertical agreements, and a perceived inadequacy in federal funding. Local government officials find that they cannot secure enough preparedness mitigation funds prior to an event, and following an event, federal reimbursement programs take years to approve and obligate. The use of interlocal agreements and mutual aid in emergency and fire services is well established in the literature, (Andrew and Hawkins 2013; Cohen and Werker 2008; Carr and LeRoux 2005; Kwon, Feiock, and Bae 2014) showing that local governments make use of multilateral agreements in preparation and response to disasters.

Ismayilov and Andrew (2016) look at sales tax revenues following hurricane Ike, for three cities in Texas, and find that during a two year period the cities experienced a short-term spike in revenues, followed by a long-term decline. This suggests a more nuanced management approach is necessary, to ride through an initial bump in revenue, bracing for a longer decline during the start of the long-term recovery phase. In a nuanced 50 state panel analysis over 43 years, Miao, Hou, and Abrigo (2018) looks at how disasters impact state revenue, expenditure, debt issuance and federal state transfers, and find that often there are fluctuations in sales tax revenues, matching similar findings at a local level.

Miao, Hou, and Abrigo (2018) also find that following a disaster there is also often an increase in non-disaster related federal welfare program funding, often because natural disasters may stretch the resources of those just above aid program requirements into needing assistance, due to property damage and income insecurity or business disruption.

While the literature has several detailed case studies of the fiscal effects of natural disasters at the local or state level for many different revenue and expenditure streams, there is a definite absence of a comprehensive theoretical framework which links these different case studies in a way which allows for comparison. While some analyses focus on one kind of revenue, like sales tax, over several cities or disasters, a more complete analysis on a wide area of fiscal measures in both revenue and expenditure is necessary to determine what strategies cities implement when facing fiscal stress from disaster.

## Theory

Previous studies provide important insights on the fiscal effects of disaster on local government. Missing, however, is a theoretical framework that links the disparate findings in a way that would allow for accumulation of knowledge about disaster effects and local government responses to those effects.

We suggest that an existing framework for understanding fiscal crises can be adapted to systematically evaluate the fiscal effects of natural disasters on local governments. Specifically, we propose to borrow Levine's (1985) classification of fiscal stress to classify different levels and types of disaster impacts and their consequent responses by local governments. We suggest that the fiscal effects of natural disasters on local governments can vary in both intensity and duration in ways very similar to the more commonly studied effects of economic crises.

Levine's (1985) framework for understanding the fiscal stress caused by general economic fluctuations suggests that local governments react strategically to both the severity and the duration of economic downturns. Shorter or less severe fiscal stresses may require short term solutions like deferred maintenance and hiring freezes, while more intense fiscal stress that spans multiple years may require

significant restructuring of the services being provided and revenue streams utilized and may include such innovative solutions as partnering with nonprofits, outsourcing, or creating multilateral agreements with other jurisdictions.

Levine (1985) categorizes economic crises into four types, based on their severity and length. Using police departments as an example, he finds that public organizations use different solutions to respond to different types of stress. The first category - an economic downturn of low severity and short duration - is identified as a fiscal crunch and is typically associated with a modest decline in revenues due to moderate recessions. Levine says that local government responses to crunches should likewise be expected to be modest, with freezing unfilled positions being the most common response. Levine (1985) defines the second category – a low severity economic downturn with a long duration -a fiscal squeeze. These are economic declines which may develop over a period of years. Local governments are likely to aim for efficiency improving systems, increased use of service fees, and downsizing fleets. The third category, a steep economic downturn with a short duration, is named a fiscal crisis. A Crisis may be caused sudden economic events leading to year-end budget deficits and can must be dealt with by shutting down programs and laying off employees. Finally, the fourth category, named a fiscal crush, is classified as a steep economic downturn with a long duration. A Crush may be caused by a major employer or military base closure, leading to degraded tax base. Coping methods may require innovative solutions and extensive contracting and multilateral partnerships.

As laid out by Levine (1985), cities act strategically to fiscal stress, based on factors of duration and intensity. We extended this model to analyze the fiscal effects of hurricanes, because we believe that the fiscal challenges faced following disasters are similar to those faced in cut back management. As we have seen in the literature, cities face different hazards with different levels of severity, within the context of different types of economic conditions, and illicit different strategic responses, and different types of fiscal stress. Adapting from Levine, we propose to categorize cities' experiences of hurricanes



into four categories, based on level of storm severity, and duration of economic consequences, categorized in a similar fashion as Levine (1985) for economic stressors. See Table 1 for a description of the disaster conditions expected in the four categories.

[Table 1 here]

### **Fiscal Crunch**

In a fiscal crunch, a city experiences fiscal stress that is short term and has low severity after a natural disaster. In this category, most economic losses are insured in the private marketplace, and public losses – including revenue declines and extraordinary expenditures are minimal. Such events may have widespread flooding, and some destruction of private commercial and residential property, as well as modest effects on public infrastructure, but those effects would be primarily resolved within a year of the hurricane. A fiscal crunch should have little business disruption, and any evacuees quickly returning home. Any impacts to finance for local government should be small, with a faster recovery.

### **Fiscal Squeeze**

In a fiscal squeeze, a city experiences fiscal stress that has a long duration, but is low severity, following a natural disaster. We would expect that areas which already faced financial strain in the years prior to a hurricane may not have ample resources to deal with a new stressor. In this category, a lack of ability to manage and obtain grants may hinder recovery speeds. We expect that the city will spend fund balance reserves to balance the budget. Even with a low severity event, a city with little capacity to deal with new financial stress will likely take longer to recover, with damage still unrecovered after more than 1 year, leading to decreased revenue income from sales and property tax. Widespread damage may delay evacuee return, leading to higher levels of business disruption. Slow growth may discourage small businesses or push them out of business. We may even expect a decline in population, as evacuees find less hope in a full recovery by returning.

## **Fiscal Crisis**

A fiscal crisis, or high severity event following a natural disaster, but a short duration, will likely occur in areas where storm surge causes severe damage to infrastructure and roads. Income producing public infrastructure, like water treatment facilities may be compromised, leading to a temporary decline in revenue for those facilities, and the need for capital projects to fix facilities. A city may take on new debt in order to pay for public infrastructure, beyond any federal aid or intergovernmental money. We would expect significant but short-term revenue decline in all categories. Federal assistance from presidential declarations and new debt are able to cover recovery costs, leading to a quick recovery. A previously healthy economy is able to restart quickly following the event.

## **Fiscal Crush**

Finally, a fiscal crush is classified as a high severity event with lasting economic consequences., following a natural disaster. We would expect that a fiscal crush is best classified as an event like hurricane Katrina, where massive destruction across the board leads to changes in demographics and population for the city permanently, changing the tax base, and can alter expected services and citizen priorities. There is likely a permanent reduction in budget size, and total assessed value of housing stock. Extreme housing damage may lead to new land use and changes to housing patterns during recovery. High costs to deal with debris and damages lead to fiscal structural imbalances, as the city struggles to match revenue and expenditure. There are dramatic and permanent revenue declines, and even layoffs and cuts in service. As with a fiscal squeeze, limited management capacity leads to a reduced ability to process grants, leading to slow implementation. The city may see a negative change to their bond rating, reducing their ability to borrow. There will be permanent business loss, as recovery drags out. The city may try to increase outsourcing, or partnering with other jurisdictions, nonprofits, or private firms to reduce costs for service provision, facing long term financial decline in budgets.

## Hypotheses

The framework proposed here generates numerous hypothesis, not all of which can be tested simultaneously within a single model. The processes described in the framework operate at multiple levels of analysis and timeframes, requiring multiple data sources. For the purposes of this paper, we narrowly focus on the fiscal effects measurable within a local government's Comprehensive Annual Financial Report (CAFR).

We focus on 10 variables, which we expect to help differentiate between the four categories laid out in the theory. We look at four measures of revenue: Own source revenue (net of taxes), property tax revenue, sales tax revenue, and intergovernmental revenue. While we expect intergovernmental revenue, including donations and grants, to increase following a disaster, we expect all other forms of revenue to decrease following disaster due to the damage and business disruption caused by the disaster. We expect own source revenue to drop due to disruption in service and business. We expect property tax revenue to decline because the damage to housing likely decreases assessed values. Sales tax will likely see an initial increase due to immediate recovery needs and debris removal, but more permanent disruption to business and changes in demography as some evacuees do not return may lead to a decline in sales tax revenue. We anticipate that the level of change and duration in revenue will be a function of the intensity of the disaster, and the socioeconomic context.

We look at three measures of expenditure: capital outlay, public works, and all other expenditures. In all three cases, we expect a level of increase to match the level of severity of the storm, and the speed of recovery for the fiscal effects to match the economic pace of recovery. We expect capital outlay to increase when there is more rebuilding necessary, due to destruction from the storm. We expect public works to increase due to debris removal and road repair. Other types of expenditure are likely to also increase, as costs in transporting evacuees, increased work hours, sheltering costs, and other disaster related activities may come out of several types of expenditures. We anticipate that the

level of change in expenditure and the duration will be a function of the intensity of the disaster, and the socioeconomic context.

Finally, we consider three additional measures, of tax rates, assessed values, and fund balance. In some prior literature changing the tax rates has been suggested as a tool for increasing revenue when assessed value declines, so we are using these measures to further analyze recovery of property taxes, which cities are largely reliant on. Fund balance is another measure of fiscal solvency. For a complete list of our expectations, see Table 2.

[Table 2 here]

## Methodology

In this paper, we focus on four cities; two in Mississippi which were impacted by hurricane Katrina in 2005, and two in Texas which were impacted by hurricane Ike in 2008. These cities vary in size, density, and demographic characteristics, allowing for a more nuanced and varied narrative on how cities cope in response to natural disasters. For descriptive statistics on the four cities, see Table 3. Table 4 shows the amount of federal assistance FEMA approved, for the individual and public assistance programs.

[Table 3 here]

[Table 4 here]

Hurricane Katrina struck the gulf coast in August 2005, leading to widespread damage along the coast. While media and research often focus on the levees breaking and the utter destruction in New Orleans, the Mississippi coast also sustained record 145 MPH winds and so much as 30-foot storm surges, surpassing protective seawalls, damaging homes and facilities, resulting in 238 deaths in Mississippi, 53 of which were in Biloxi (Smith 2012).

In Mississippi we examine the financial condition of Gulfport and Biloxi, which together share the county seat for Harrison County. Both are coastal and underwent severe damage in the storm. These two larger cities and their neighboring smaller communities and suburbs also make up the Gulfport–Biloxi metropolitan statistical area, which extends into two neighboring counties. In the year before the hurricane in 2004, Biloxi had seen a 3% decrease in population since 2000, while Gulfport had seen an 8% increase (City of Biloxi Biloxi, Mississippi 2004, 2004; United States Census Bureau 2000).

Hurricane Ike struck Texas on September 13<sup>th</sup>, 2008, making landfall near Galveston as a category 2 storm. In Texas we focus on Galveston and Orange. Substantial damage occurred in Galveston island and Galveston bay, where storm surge waves were recorded at up to 20 feet, surpassing seawalls (Morss and Hayden 2010). Record windfall and winds resulted in additional damage as the storm moved forward. The city of Orange, had flooding up to 15 feet, and even though the county is 20 miles inland, the deep waterways channeled the 22-foot storm surge into the county, resulting in the destruction of care facilities and schools, leaving debris in its wake. Prior to the storm, in 2007 Galveston had a population of 58,329, almost a 2% increase from 2000, while Orange had a smaller population of 18,643, with the same estimate from seven years earlier.

Pulling data from the Comprehensive Annual Financial Reports (CAFR) for the four cities from three years prior to the storm and seven years following the storm, we focused on revenue and expenditure values which have been shown to change following a disaster, to look at the long-term trends of recovery. In order to better compare the results, we normalized the data using CPI to account for inflation, and calculated values per capita, using 2000 population values. We then calculated the change in dollars from the year before the hurricane, to better illustrate whether values returned to pre-hurricane levels.

## Findings

### Own Source Revenue Net of Taxes

We measured own source revenue, excluding property tax, sales tax and also excluding intergovernmental funds, grants, and donations. We would expect that a disaster, regardless of severity, would result in a decrease in this type of revenue, because of a disruption of business activities which would be captured in the form of a loss of revenue from fees to the city. The level of severity and the socioeconomic context should determine the level of decline.

Following the hurricane, both Galveston and Orange saw a loss of own source revenue following the hurricane. However, both of the year of hurricane Ike for these cities also corresponds with the peak of the 2008 recession, and so at least for Galveston, the decrease in own source revenue appears to be following a larger trend from the recession.

Biloxi and Gulfport both saw an increase in own source revenue following the disaster, and then a decline following the peak of the 2008 recession, three years after hurricane Katrina. It may be that the hurricane events in our sample have such short time periods when business is disrupted, that there is no extensive drop in revenue. Alternatively, any decrease in revenue from business disruption is made up for in building permits during recovery.

In own source revenue, there was a lack of distinct pattern following all hurricanes, where Mississippi cities saw an increase in revenue, while Texas cities saw a decline as we had anticipated. This suggests that own source revenue is largely swayed by the economic recession, but the experience of hurricane Katrina in the Mississippi coast, while considered high severity by many scholars, did not decrease revenue. Please see Figure 1 for the full trend of the four cities in terms of own source revenue, net of taxes.

[Figure 1 here]

## Property Tax Revenue

Because of the extensive damage to homes during a hurricane, we anticipated that property tax revenue would decline, relative to the severity of the event. However, in three of the four cities we analyzed there was a slight increase in property tax revenue the year following the event, followed by a steep decline in the second year after the hurricane. This may be due to the difficulty in assessing the value of the homes directly following the disaster, leading to a lag in revenue decline.

Biloxi and Gulfport saw a deep decline in the second year, possibly due to the additive effect of the recession in 2008, which largely impacted the housing market. Biloxi only returned to pre-hurricane levels four years after the hurricane, and then again saw a fall in revenue. Hurricane Katrina may have also resulted in more extensive or widespread damage, leading to slower recovery.

Galveston and Orange, who were hit with hurricane Ike during the same year as the peak of the recession saw less dramatic declines in property tax revenue and never dipped below pre-hurricane levels. Orange even saw a continuous increase in revenue until five years following the storm, likely due to unrelated factors. The revenue from property taxes appears to be unaffected by the hurricane for Orange, Texas. Please see Figure 2 for the full trend of the four cities in terms of property tax revenue.

[Figure 2 here]

## Donations, Grants & Intergovernmental Revenue

Federal Aid following disasters comes in the form of reimbursement and is managed as intergovernmental revenue at the local level. We anticipated that immediately following the disaster there would be an increase in donations, grants, and intergovernmental revenue, and the level of increase would correspond to the severity of the event. Differences in the duration of the increase in revenue before returning to pre-hurricane levels would be influenced by the economic context and socio-economic factors.

For Galveston, Biloxi and Gulfport, there was an initial increase in revenue as anticipated; Orange however, saw little change in revenue until year four and six after the event, which are likely unrelated. Galveston continued to have elevated levels of intergovernmental revenue during all seven years following the hurricane, while Biloxi and Gulfport both dropped to near pre-hurricane levels in the third year. Please see Figure 3 for a graph of the trends in donations, grants, and intergovernmental revenue.

[Figure 3 here]

### **Sales Tax Revenue**

With sales tax, we anticipated an overall trend showing a decrease in revenue. Previous literature suggests a more nuanced trend, where a bump in sales tax due to rebuilding in the months following the event and then see a larger decline, resulting in below pre-hurricane levels. Galveston saw a short decrease, then a short increase for a few months, before seeing a severe larger decline in January 2011. By 2015 sales appears to be at levels consistently similar to pre-hurricane levels.

Orange on the other hand saw a direct increase following the hurricane, followed by a slower decline back to pre-hurricane levels by 2012, and in 2015 there is again growth to levels of sales tax revenue which exceed pre-hurricane levels. For Galveston and Orange, the initial increase occurs during the recession, which differs from Biloxi and Gulfport, which saw a downward trend during the recession.

Gulfport saw a trend similar to Orange, where a large increase peaked a few months following the storm, and then declined and stabled out six years after the hurricane. In Gulfport, the new stable conditions were lower than pre-hurricane levels, and there was no trend for increasing revenues, with steady revenue from 2011 until 2017.

Biloxi saw a steep decline in sales tax revenue directly following the hurricane, followed by a brief increase in 2007, before seeing a decrease throughout the recession in 2008. Sales tax revenue saw a low in 2011, and only small growth until 2017. For Biloxi and Gulfport, sales tax never reached pre-storm



levels, or even levels from before the recession. Please see Figures 4-9 for the graphs showing moving average of sales tax for the states of Texas and Mississippi, as well as each of our cities: Orange, Galveston, Biloxi and Gulfport. In these graphs, the line represents the hurricane event, while the grey area shows the years of the recession.

[Figures 4-9 here]

## **Capital Outlay**

Hurricanes can cause a lot of damage, which results in high expenditures to rebuild and repair. We anticipated that following a hurricane, there would be an increase in capital outlay, and the level of severity of the city's experience of the storm would determine the level of expenditure, and economic factors would determine the duration of the increase in expenditures.

Orange saw three distinct bumps in capital outlay, which correspond to years when specific facilities were rebuilt. It is likely that a lack of capacity and resources to manage all projects capital projects following the event resulted in the three peaks in the years following the event. Galveston saw a delay in capital outlay, with an increase in expenditure only occurring two years following hurricane Ike. Capital outlay levels remained higher than pre-storm levels for the duration of the seven years following the hurricane.

Gulfport saw a gradual increase in capital outlay, with a larger bump following the peak of the recession, three years after the hurricane. Biloxi on the other hand saw a steep decline in capital outlay in the first year following the hurricane, and continued to have low levels of expenditure, almost reaching pre-hurricane levels five years after the storm, before again dipping down. It is possible that hurricane damages disrupted existing capital outlay projects, resulting in the steep decline. Please see Figure 10 for a graph of the trends in capital outlay.

[Figure 10 here]

## Public Works

The process to clean up debris and repave roads following a hurricane falls largely under the purview of public works, and we therefore expected a quick increase in public works expenditure in the year following the hurricane, with variation in the level of increase and the duration dependent on factors like the incident severity and other economic and sociodemographic factors which influence recovery. Orange Texas had little change in public works expenditure, but the other three cities had an increase in public works expenditure in the year following the hurricane, followed by a steep decrease in the second year. Biloxi and Gulfport saw a steady decrease in expenditure, while Galveston saw a longer recovery, with elevated levels of public works expenditure in year three after the storm. All four cities had stable levels of public works expenditure at the same level as before the hurricane starting four years after the hurricane. Please see Figure 11 for a graph of the trends in public works expenditure.

[Figure 11 here]

## Other Expenditure Net Capital Outlay and Public Works

All other expenditures, without capital outlay and public works, we also expect to have an increase, proportionate to the intensity of the hurricane and the economic context. However, in Orange, Gulfport and Biloxi only saw a minor increase by year three, with no steep increase directly following the event. However, Galveston had a large jump in expenditures in year two, which are mostly attributable to increases in planning and community development expenditures, and debt service. This rise in expenditures slowly decreased but did not drop down to pre-hurricane levels in the seven years we considered. Please see Figure 12 for a graph of the trends in all other expenditures, net of capital outlay and public works.

[Figure 12 here]

## Property Tax Rates

Tax rates were mostly stable, throughout the time period we looked at, both before and after hurricanes, for all four cities. Orange saw a small decrease in operating millage prior to the hurricane. In the second year after the hurricane Galveston saw a small increase in tax rates, which stayed at the higher rate for the remaining five years afterwards. It is possible that this increase in property tax rates were used to offset the decrease in assessed value of housing stock, in order to maintain a higher level of tax revenue, however there was only a small increase, and this level was mostly stable in the following years and did not dip back down to pre-hurricane levels. It is possible that political factors make it difficult to gain support for tax rate increases, especially to those who have just suffered loss or damages from the hurricane. Please see Figure 13 to see the trends in property tax rates.

[Figure 13 here]

## Assessed Property Values

We would expect a decrease in assessed values following the hurricane, as the damaged houses would bring down the property values. Instead, in the year following the hurricane, we see an increase in Orange and Galveston. However, the hurricane also coincides with the peak of the recession in 2008, and so the increase in assessed values may stem from changes in the economy, rather than due to the hurricane. A similar, smaller bump occurs following Biloxi and Gulfport in 2009 following the recession, four years after they were hit by hurricane Katrina. Orange saw a steady increase in housing values, throughout the seven years following the storm, but Galveston saw a large decrease in values two years after the storm, but assessed values continued to stay above pre-hurricane levels. Biloxi also saw a small dip, two years after the storm, and both Mississippi cities had little change in assessed values throughout the seven years. Please see Figure 14 to see the trends in assessed property values.

[Figure 14 here]

## Fund Balance

Because we anticipated an increase in expenditures and decrease in revenues, we also expected that cities would need to draw from their fund balance, and we would see a decrease in fund balance, with the level of decrease and duration consistent with factors of the storm intensity, within the context of socioeconomic factors. Instead, in Biloxi and Gulfport we saw an increase in fund balance, with the values peaking in the first year following the hurricane for Gulfport, and two years following the hurricane in Biloxi. Galveston and Orange, which were just coming out of the recession as hurricane Ike hit, did not see an increase, and mostly stayed steady around no change from pre-hurricane levels. Please see Figure 15 to see the trends in fund balance, and table 5 for a summary of the percent change from pre-hurricane levels for all ten variables.

[Figure 15 here]

[Table 5 here]

## Conclusion

The findings show that cities have different fiscal experiences following hurricanes, resulting in variations in the level and even direction of revenue and expenditure for years following the event. Trends developed following the storm may take years to peak before returning to pre-hurricane conditions. What becomes apparent is that not all cities fit one mold; disasters may exacerbate longer term economic trends, and other factors about the disaster can determine if revenues and expenditures go up and down, and how long it takes to recovery to pre-hurricane levels. We find that the four cities have three different patterns of fiscal stress following the hurricane.

Throughout the ten fiscal measures considered, Orange had the least change following the hurricane. In some cases, Orange was even able to continue growth in property tax following the hurricane, while other cities in our model saw a decline in year two after the event. While capital outlay had several spikes, which correspond with rebuilding facilities damaged with the hurricane, Orange otherwise had

little impact, most notably there was no increase in public works following the hurricane, likely because the damage was confined to areas near waterways, and not widespread., since the city was more inland and therefore more protected than coastal cities. We would classify the experience for Orange County to be a crunch, in our model.

Galveston, on the other hand, saw tremendous changes following the hurricane. Own source revenue declined and stayed low, and there was a large increase in intergovernmental revenue, which stayed elevated for years following the hurricane. A large decline in sales tax saw a relatively fast recovery, and capital outlay saw a modest but continual increase following the hurricane. There were increases in public works expenditure, which continued to have elevated levels a year longer than the Mississippi cities. Other expenditure was also heavily increased by the second year following the storm, possibly linked to recovery efforts. Galveston even saw a minor increase in tax rates, possibly to counteract the large dip in assessed values two years following the hurricane. Because Galveston often saw the most extreme changes in expenditure and revenue following the hurricane, we classify Galveston as a fiscal crisis. While there was an extreme decline in sales tax revenue following the hurricane, this was followed by a much faster recovery than other cities in our model, who had modest growth in the years following a decline. Furthermore, Galveston saw growth in property values after the second year following the hurricane.

Gulfport and Biloxi, who share a county seat and are geographically close, saw many similar trends in fiscal recovery following the hurricane. Both saw a dip in property tax in year two, and then saw an increase following the recession, three years after the hurricane, suggesting that economic conditions outside of the events of the hurricane had a larger sway on the cities' fiscal outcomes. Similar to Galveston they saw an increase in intergovernmental revenue, and both Mississippi cities saw a continuous decline in sales tax revenue during the recession, however between the hurricane and the recession, the two cities saw reverse trends in sales tax revenue. Biloxi saw a large decline in capital outlay, while Gulfport saw a steady increase. Biloxi also saw a decrease in other expenditure in the two

years following the hurricane, while Gulfport saw little change. Public works expenditure for both cities peaked in year one, and saw a faster return to normalcy, compared with Galveston. They both saw little change in assessed value in the years before and after the hurricane. Interestingly, they both saw a large peak and then gradual recovery in fund balance. We extended lack of growth in assessed values, which affected property tax revenue, and the lower levels of change in all variables, compared with Galveston, suggests that this was a low intensity longer duration event. Economic factors like the recession extended fiscal recovery. We classify both cities as a fiscal squeeze.

Using the ten variables we considered, three distinct patterns emerge. Orange has the least fiscal impact following the disaster and behaves like a fiscal crush in our model. Galveston had the most extreme changes, with extended high levels of public works even three years after hurricane Ike. Given the speed of recovery from these extreme changes, especially in sales tax, we classify Galveston as a fiscal crisis. Biloxi and Gulfport had remarkably similar patterns to one another throughout, and both saw almost no growth in assessed values throughout the seven years following the storm, even after the peak of the recession, suggesting a protracted recovery, despite lower levels of change in expenditure and revenue to recovery from, compared with the extreme changes seen in Galveston. With a slow recovery and a lower level of fiscal impact, we classify the Mississippi cities of Biloxi and Gulfport and their experience of Katrina as a fiscal squeeze.

Table 1: Typology of Fiscal Stress for Disasters – Adapted from Levine (1985)

	Short Duration	Long Duration
Low severity	<p>I. Fiscal Crunch</p> <p>(a) Economic losses primarily covered through private insurance.</p> <p>(b) Most recovery projects completed within first year of disaster.</p>	<p>II. Fiscal Squeeze</p> <p>(a) Relatively modest, but widespread damage.</p> <p>(b) Weak pre-disaster economic conditions slow recovery.</p> <p>(c) Slow recovery disrupts local business activity.</p>
High severity	<p>III. Fiscal Crisis</p> <p>(a) Severe disaster, but relatively quicker recovery.</p> <p>(b) Significant portion of recovery within one year.</p> <p>(c) Major infrastructure damage.</p> <p>(d) Income producing infrastructure disrupted.</p>	<p>IV. Fiscal crush</p> <p>(a) Slow or no complete recovery.</p> <p>(b) Permanent changes to demography and severe damage to housing stock degrade the tax base.</p> <p>(c) Fiscal structural imbalance.</p> <p>(d) Capital projects overwhelm management capacity.</p> <p>(e) Ability to borrow reduced, and possible debt rating reductions.</p>

Table 2. Summary of Expectations

Independent Variable	Crunch	Squeeze	Crisis	Crush
Own Source Revenue Net of Taxes	small decrease / fast recovery	small decrease / slow recovery	large decrease / fast recovery	large decrease / slow recovery
Property Tax Revenue	small decrease / fast recovery	small decrease / slow recovery	large decrease / fast recovery	large decrease / slow recovery
Sales Tax	small decrease / fast recovery	small decrease / slow recovery	large decrease / fast recovery	large decrease / slow recovery
Donations, Grants & Intergovernmental Revenue	small increase / fast recovery	small increase / slow recovery	large increase / fast recovery	large increase / slow recovery
Capital Outlay	small increase / fast recovery	small increase / slow recovery	large increase / fast recovery	large increase / slow recovery
Public Works	small increase / fast recovery	small increase / slow recovery	large increase / fast recovery	large increase / slow recovery
Other Expenditure Net Capital Outlay and Public Works	small increase / fast recovery	small increase / slow recovery	large increase / fast recovery	large increase / slow recovery
Tax Rates	no change	small increase	no change	large increase
Assessed Values	small decrease / fast recovery	small decrease / slow recovery	large decrease / fast recovery	large decrease / slow recovery
Fund Balance	no change	small decrease / slow recovery	large decrease / fast recovery	large decrease / slow recovery



Table 3. Demographics of Cities

	Mississippi		Texas	
	Biloxi	Gulfport	Galveston	Orange
Baseline				
2000 Population	50,644 <sup>(1)</sup>	71,127 <sup>(1)</sup>	57,247 <sup>(1)</sup>	18,643 <sup>(1)</sup>
Percent White	71.40% <sup>(1)</sup>	62.20% <sup>(1)</sup>	58.70% <sup>(1)</sup>	60.60% <sup>(1)</sup>
Square Miles	46.53 <sup>(1)</sup>	64.23 <sup>(1)</sup>	208.35 <sup>(1)</sup>	20.77 <sup>(1)</sup>
Median Household Income	34,106 <sup>(1)</sup>	32,779 <sup>(1)</sup>	28,895 <sup>(1)</sup>	29,519 <sup>(1)</sup>
Percent Owner Occupied Housing	49% <sup>(1)</sup>	59% <sup>(1)</sup>	44% <sup>(1)</sup>	60% <sup>(1)</sup>
2004 Population (Pre-Hurricane Katrina)	48,972 <sup>(3)</sup>	77,000 <sup>(2)</sup>		
2007 Population (Pre-Hurricane Ike)			58,329 <sup>(4)</sup>	18,643 <sup>(5)</sup>
Sources: (1) 2000 Census, (2) 2004 CAFR, City of Gulfport, (3) 2004 CAFR, City of Biloxi, (4) 2007 CAFR, City of Galveston, (5) 2007 CAFR, City of Orange				

Table 4. Level of Damages

County	Disaster	Individual and Households Assistance (Per Capita)	Public Assistance (Per Capita)
Orange (County)	Hurricane Ike (DR-1791)	\$805.50	\$520.77
Galveston (County)		\$760.11	\$1,655.33
Harrison (County) (Gulfport and Biloxi)	Hurricane Katrina (DR-1604)	\$2,613.13	\$5,871.08

Table 5. Summary of Percent Change from Pre-Hurricane Levels

Year	Change from Pre-Hurricane Levels (Percent)											
	Biloxi			Galveston			Gulfport			Orange		
	1	3	5	1	3	5	1	3	5	1	3	5
Assessed Values	-1%	-16%	3%	29%	19%	21%	-4%	-12%	7%	36%	46%	45%
Capital Outlay	-87%	-58%	-6%	28%	352%	441%	-51%	158%	376%	294%	72%	14%
Donations, Grants & Intergovernmental Revenue	111%	-16%	62%	1076%	626%	517%	857%	106%	159%	28%	109%	24%
Fund Balance	139%	58%	-26%	16%	-31%	20%	101%	-39%	-74%	4%	-22%	-21%
Other Expenditure (Net Capital Outlay & Public Works)	-10%	3%	-1%	9%	84%	63%	10%	30%	10%	14%	13%	7%
Own Source Revenue (Net of Taxes)	42%	406%	88%	-27%	-26%	-34%	35%	21%	-13%	7%	-5%	-7%
Property Tax Revenue	1%	-17%	1%	16%	14%	22%	9%	-10%	10%	27%	32%	28%
Public Works	573%	52%	22%	1803%	474%	11%	835%	65%	0%	-4%	-2%	-21%
Tax Rates	-7%	-7%	-7%	3%	16%	18%	0%	-4%	-5%	-12%	-13%	-15%

Figure 1. Per Capita Change from Pre-Hurricane Levels:  
Own Source Revenue (Net of Taxes)

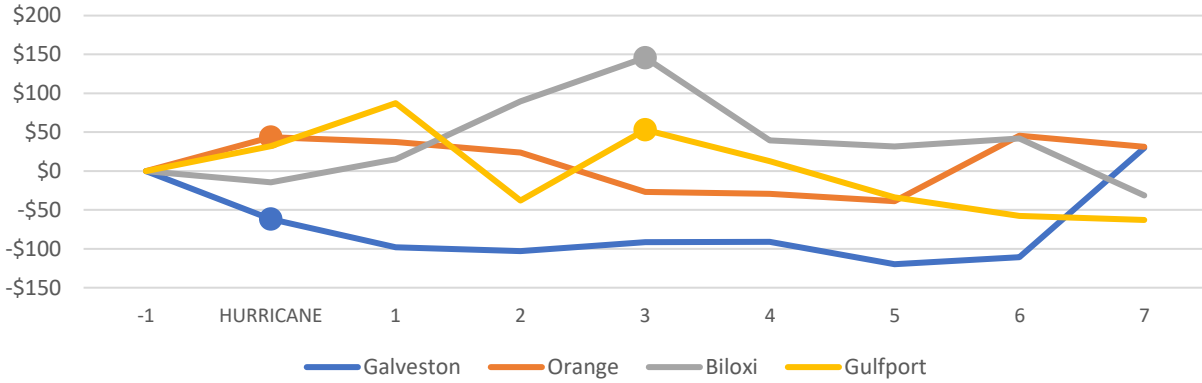


Figure 2. Per Capita Change from Pre-Hurricane Levels:  
Property Tax Revenue

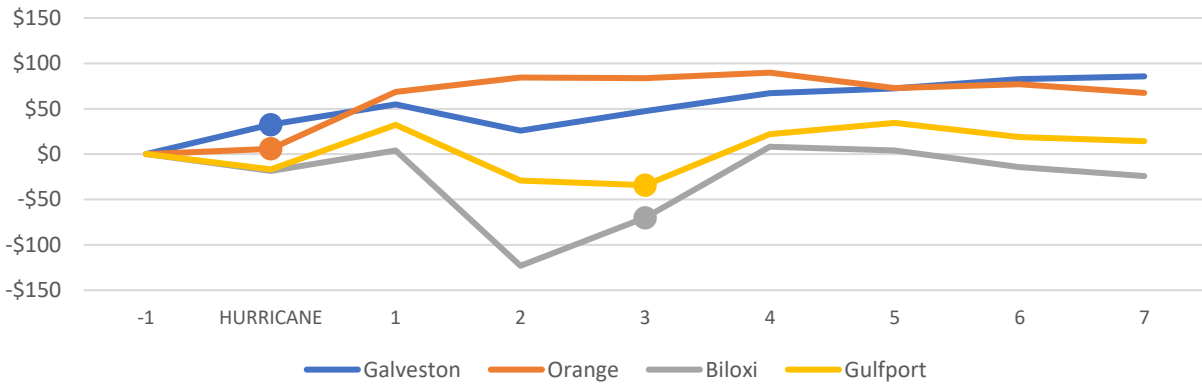
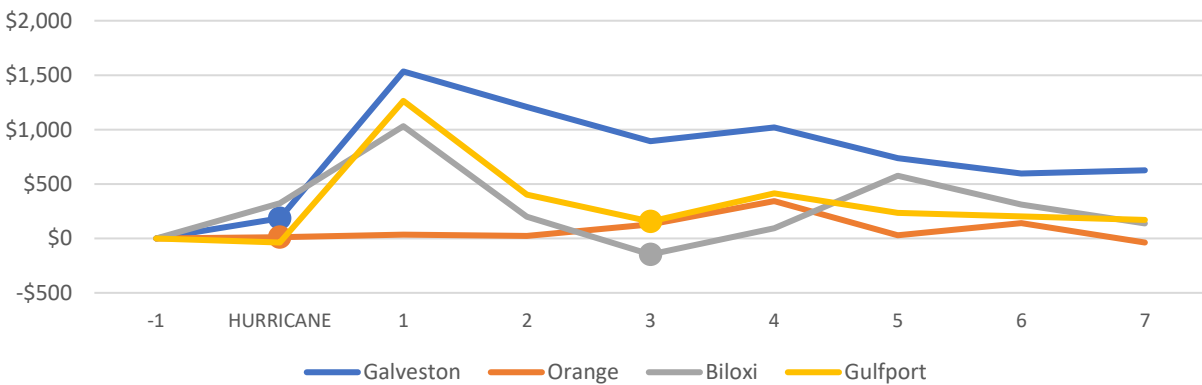


Figure 3. Per Capita Change from Pre-Hurricane Levels:  
Donations, Grants & Intergovernmental Revenue



Figures 4-9. Sales Tax Revenue

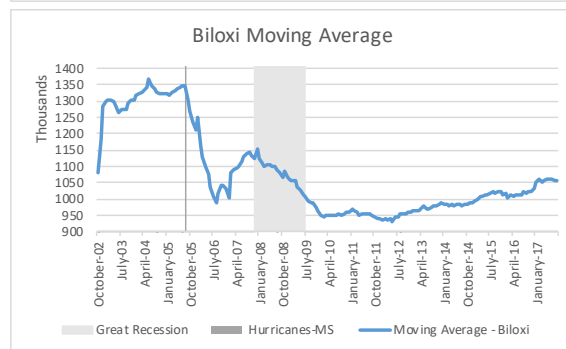
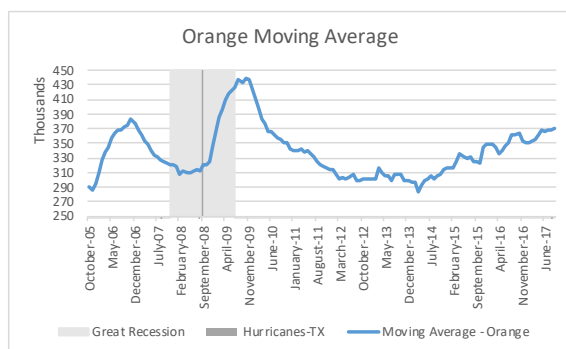
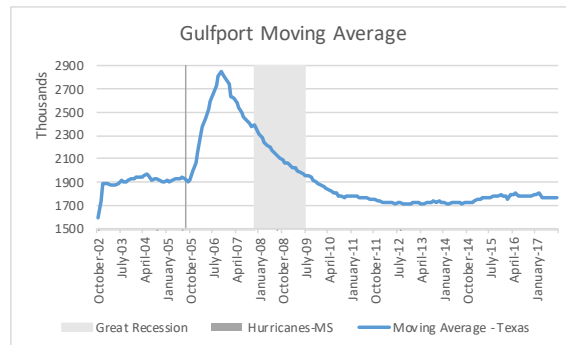
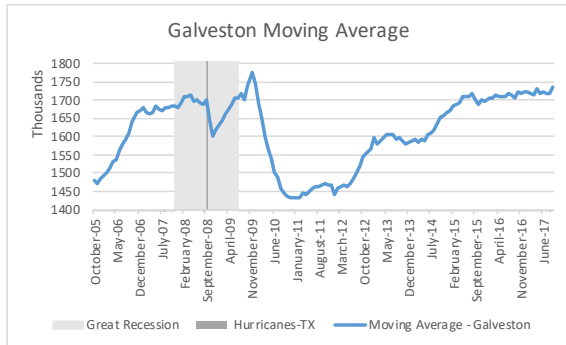
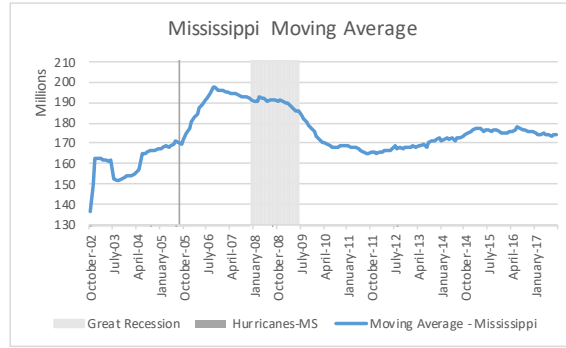
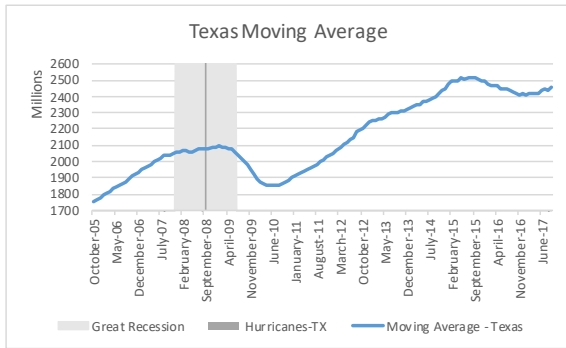


Figure 10: Per Capita Change from Pre-Hurricane Levels:  
Capital Outlay

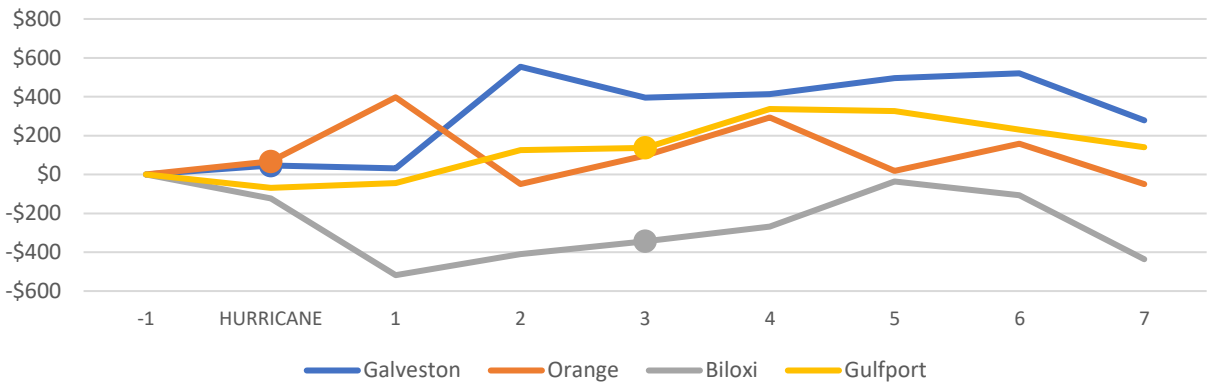


Figure 11. Per Capita Change from Pre-Hurricane Levels:  
Public Works

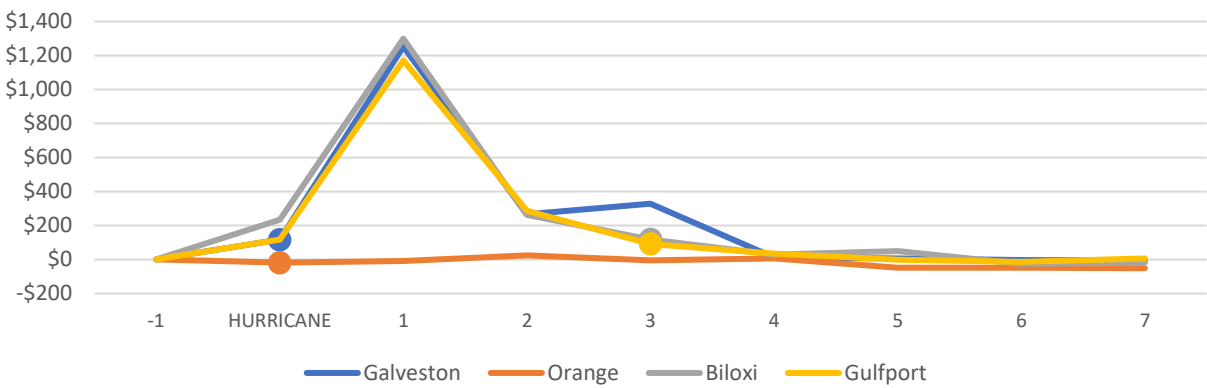


Figure 12. Per Capita Change from Pre-Hurricane Levels:  
Other Expenditure (Net Capital Outlay & Public Works)

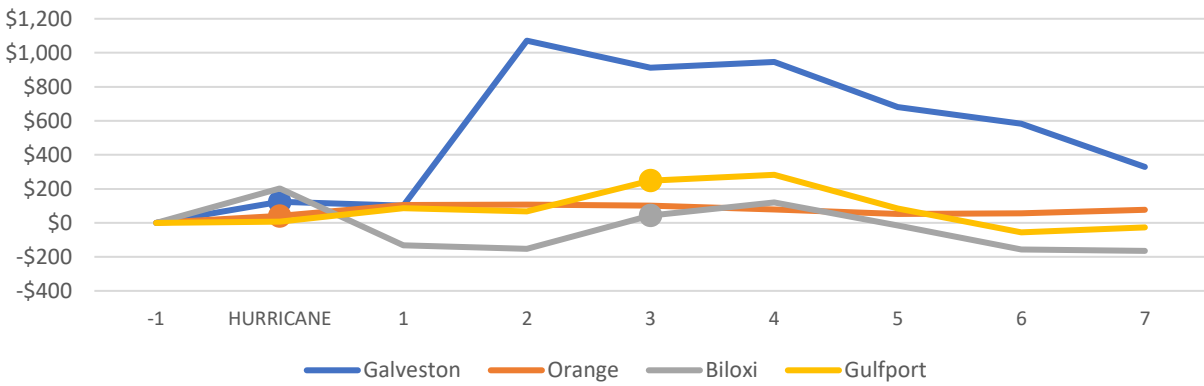


Figure 14. Change from Pre-Hurricane Levels:  
Property Tax Rates

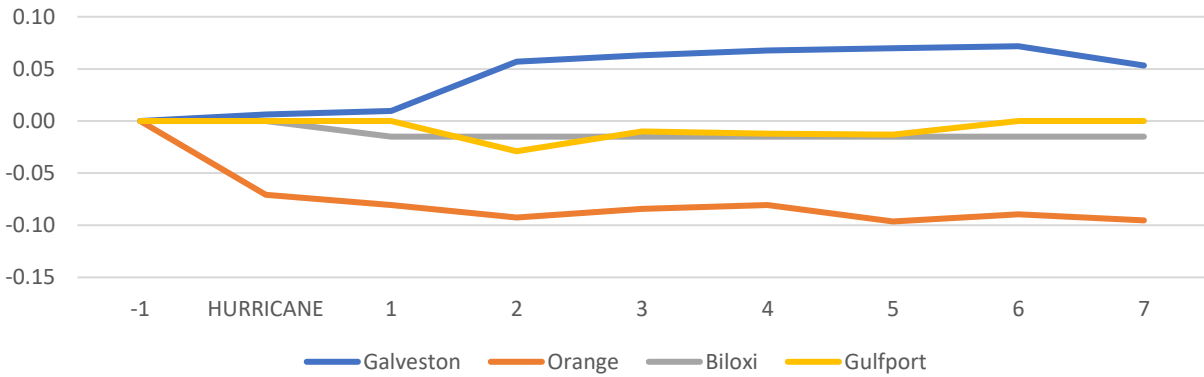


Figure 14. Per Capita Change from Pre-Hurricane Levels:  
Assessed Values

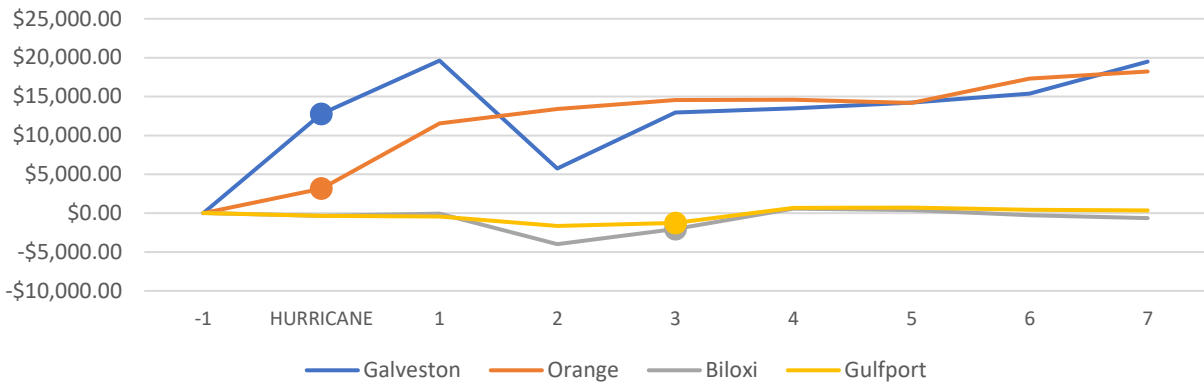
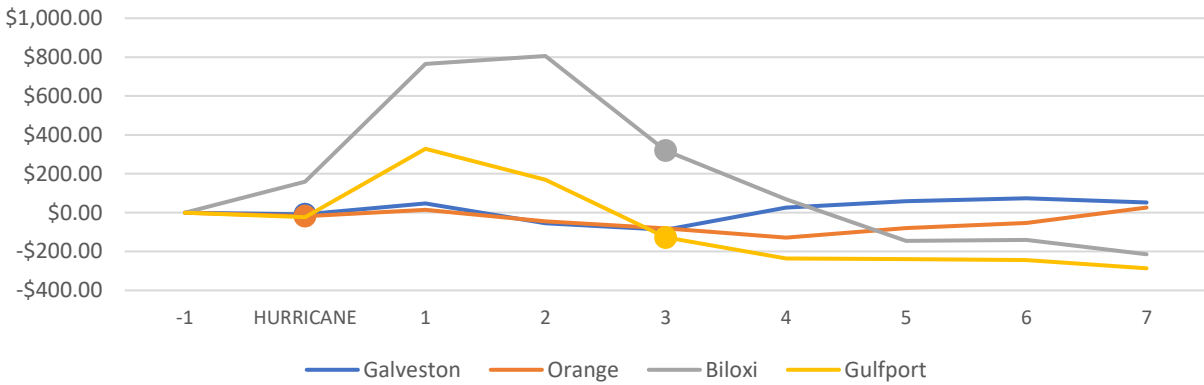


Figure 15. Per Capita Change from Pre-Hurricane Levels:  
Fund Balance





## References

- Andrew, Simon A., and Christopher V. Hawkins. 2013. "Regional Cooperation and Multilateral Agreements in the Provision of Public Safety." *The American Review of Public Administration* 43 (4): 460–75.
- Carr, Jered B., and Kelly LeRoux. 2005. "Which Local Governments Cooperate on Public Safety?: Lessons from Michigan." *Working Group on Interlocal Services Cooperation*, 4.
- City of Biloxi Biloxi, Mississippi. 2004. "Comprehensive Annual Financial Report (CAFR)."
- Cohen, Charles, and Eric D. Werker. 2008. "The Political Economy of 'Natural' Disasters." *Journal of Conflict Resolution*.
- Ebdon, Carol, Pat O'Neil, and Gang Chen. 2012. "The Regional Ripple Effects of the 2011 Missouri River Floods: Disaster Management in Omaha, Nebraska." *Municipal Finance Journal* 33 (2): 35–59.
- Handley, Donna Milam. 2006. "Hurricanes on the Alabama Gulf Coast: The Manageable Impacts of Ivan and Katrina." *Municipal Finance Journal* 27 (2): 95–111.
- Hildreth, W. Bartley. 2009. "The Financial Logistics of Disaster: The Case of Hurricane Katrina." *Public Performance & Management Review* 32 (3): 400–436.
- Ismayilov, Orkhan, and Simon A. Andrew. 2016. "Effect of Natural Disasters on Local Economies: Forecasting Sales Tax Revenue after Hurricane Ike." *Journal of Contemporary Eastern Asia* 15 (2).
- Kwon, Sung-Wook, Richard C. Feiock, and Jungah Bae. 2014. "The Roles of Regional Organizations for Interlocal Resource Exchange: Complement or Substitute?" *The American Review of Public Administration* 44 (3): 339–57.
- Levine, Charles H. 1985. "Police Management in the 1980s: From Decrementalism to Strategic Thinking." *Public Administration Review*, 691–700.
- MacManus, Susan A., and Kiki Caruson. 2008. "Financing Homeland Security and Emergency Preparedness: Use of Interlocal Cost-Sharing." *Public Budgeting & Finance* 28 (2): 48–68.
- Miao, Qing, Yilin Hou, and Michael Abrigo. 2018. "Measuring the Financial Shocks of Natural Disasters: A Panel Study of US States." *National Tax Journal* 71 (1): 11–2.
- Morss, Rebecca E., and Mary H. Hayden. 2010. "Storm Surge and 'Certain Death': Interviews with Texas Coastal Residents Following Hurricane Ike." *Weather, Climate, and Society* 2 (3): 174–189.
- Settle, Allen K. 1985. "Financing Disaster Mitigation, Preparedness, Response, and Recovery." *Public Administration Review* 45: 101–6.
- Smith, James Patterson. 2012. *Hurricane Katrina: The Mississippi Story*. Univ. Press of Mississippi.
- Sylves, Richard. 2007. "Budgeting for Emergency Management." In *Emergency Management: Principles and Practice for Local Government*, edited by William L. Waugh and Kathleen J. Tierney. ICMA Press.
- United States Census Bureau. 2000. "Profile of General Demographic Characteristics: 2000 Census 2000 Summary File 1 (SF 1) 100% Data." DP-1. <http://factfinder.census.gov>.