2019

The Local Government Financial Response to Natural Disasters in Kentucky

Lucas Taulbee
University of Kentucky, lucasnedtaulbee@uky.edu

The Local Government Financial Response to Natural Disasters in Kentucky

Lucas Taulbee

Executive Summary

This study seeks to estimate the effect of disasters on the total receipts and total spending of county governments in Kentucky. In addition to estimating the effects of disasters on total receipts and total spending, this study also seeks to estimate the effects of disasters on specific categories of revenue (taxes, intergovernmental, etc.) and spending (transportation, recreation, general government, etc.). These effects are estimated using data on county budgets for 2007 through 2017 from the Kentucky Department for Local Government (DLG) and data on disaster declarations and public assistance grants from FEMA.

The principle findings of this study suggest that:

- Disaster damage in the previous fiscal year is associated with an increase in total receipts per capita in the current fiscal year.
- There is no statistically significant relationship between disaster damage and total spending per capita.
- Disaster damage is associated with a decrease in tax revenues in the current fiscal year and an increase in intergovernmental revenues in the following fiscal year.
- Disaster damage is associated with a decrease in recreation and culture spending per capita in the current fiscal year and an increase in transportation spending per capita in the following fiscal year.

Overall, the results of this study suggest that the effects of disasters on local government budgets are not large. The small changes induced by average levels of disaster damage should be reasonably manageable by local governments given the amount of assistance available from

the state and federal government, however, damage well above average amounts does have the capacity to create large responses and strain the budgets of local governments.

Introduction

Economic losses from natural hazards in the United States have been steadily increasing since the 1960's (Cutter & Emrich, 2005). As the so-called built environment has grown in the United States, the potential for disaster losses has grown as well. In the United States, the Federal Emergency Management Agency (FEMA) declared disasters in 137 counties, parishes, or tribal territories in 2017 (FEMA, 2019). The increase in hazard and disaster losses and disaster declarations is an issue of key importance for governments at the federal, state, and local levels in the United States. All levels of government have a role to play in disaster response and recovery, but disasters are experienced at a local level and thus require immediate action by local governments.

The response of local governments to disasters affects the recovery of communities that have experienced disasters. While local governments must deal with the initial ramifications, state governments also have a role to play. It is the responsible of state governors to request disaster declarations from FEMA. Additionally, state governments typically provide a substantial portion of local government revenues and place guidelines and restrictions on local government duties. The federal government also plays an instrumental role in the disaster process. The U.S. President must declare that a disaster exists in order to make funds from FEMA available to affected communities. FEMA funds are an important source of financial assistance for governments and communities affected by disasters.

FEMA funds consist primarily of three grant programs: public assistance, individual assistance, and hazard mitigation. When a disaster is declared, the President's declaration will specify which grant programs will be available. The public assistance program makes funds available to state and local governments and nonprofit organizations to assist with debris

removal, protective measures, infrastructure repair, and other projects associated with disasters. The individual assistance program provides funds for individuals and households to cover expenses associated with temporary housing, home repair, disaster-caused medical care, and other needs resulting from a disaster. The hazard mitigation program provides funds for communities to enact mitigation measures with the goal of reducing future disaster losses.

There are generally four phases associated with natural disaster management: mitigation, preparedness, response, and recovery. This study will be concerned primarily with the response and recovery phases. *Table 1* summarizes the responsibilities and challenges faced by local governments in each phase of the disaster management process (Kusumasari et al., 2010). One of the key challenges faced at each phase of the disaster management process is constrained budgets. As such, determining what effects disasters typically have on budgets (both revenue sources and spending) will provide important information for local government officials.

The composition and duties of local government can vary from state to state. As such, this study will focus on county governments in Kentucky. This should be especially interesting since county governments in Kentucky are extensions of the state government. With Kentucky's state government experiencing financial difficulties, this constrains the direct assistance the state can provide to localities in the event of disaster.

This study will considers counties rather than cities because there are 419 cities in Kentucky ranging in population from less than ten to over 500,000. Additionally, the role and duties of cities varies drastically with size. Counties are a convenient unit of analysis because the state government defines their roles explicitly and they follow a uniform system of accounting. Fayette and Jefferson counties are excluded from this analysis due to their unique status as urban-county governments (combining city and county).

Table 1 – Stages, Responsibilities, and Challenges of Disaster Management

Disaster Stage	**Responsibilities**	**Key Challenges**
Mitigation	Evaluation, monitoring, and dissemination	Low public awareness, low commitment of government
Preparedness	Planning, exercise, and training	Inadequate early warning system, constrained budgets
Response	Need assessment, information exchange, and logistical expertise	Communication, coordination, inadequate public information, volunteer help
Recovery	Damage assessment, debris removal, and disaster assistance skills	Budget constraints, lack of expertise, and central government control

In order to inform the effects of disasters on county government budgets in Kentucky, this study will seek to estimate the effect of disasters on the total receipts and total spending of county governments. In addition to estimating the effects of disasters on total receipts and total spending, this study will also seek to estimate the effects of disasters on specific categories of revenue (taxes, intergovernmental, etc.) and spending (transportation, recreation, general government, etc.). These effects will be estimated using data on county budgets for 2007 through 2017 from the Kentucky Department for Local Government (DLG) and data on disaster declarations from FEMA. The statistical method employed by this study will be ordinary least squares (OLS) regression. Fixed effects of counties will be utilized to take advantage of the panel structure of the data.

In addition to identifying the budget effects of disasters, this study will provide detail on what the possible implications of these effects may be. The results of this study will have implications for policy-makers at the state and federal levels as well as the local level. For example, if the study finds that intergovernmental transfers offset all local spending increases, this would demonstrate that the state and federal governments are bearing the full cost of disasters. As another example, if we find that local governments have to cut spending for several categories in order to remove debris and repair infrastructure, we may be interested in thinking about the long-term effects that these cuts to other categories may have.

Literature Review

There are primarily three areas of literature relevant for this study. The first is concerned with the role of local governments in the disaster management process. In order to determine the effects of disasters on local government finances, a defined role for local government is necessary. The second area of literature is concerned with estimating the effects of disasters on a variety of outcomes. This literature will influence the research design and methodology for this study. The third area of literature is concerned with the modelling of state and local government expenditures. This literature is important for this study because it provides an idea of what variables may need to be controlled.

The Role of Local Government in Disaster Management

It can be difficult to define the role of local government in disaster management because perceptions may differ between citizens and public officials. Using interview data from 29 public officials and 64 "active citizens" from The Flood Recovery Task Force and The Flood Victim's Action Council, Wolensky & Miller (1981) concluded that perceptions of the role of

local governments did indeed differ between citizens and officials. While active citizens and local government officials considered the "everyday" role of officials to be merely custodial, citizens expected local government officials to take an "active" role in disaster response while officials considered their role in disaster response to be "custodial". In addition, there is evidence that the rebuilding decisions of citizens affected by disasters are driven by their perceptions of government's intent and capacity to assist in the rebuilding process (Chamlee-Wright & Storr, 2009).

Since citizens have expectations of government response that differ from the expectations of government officials, voters may attempt to hold public officials accountable for disasters. Generally, voters tend to reelect incumbents when economic conditions are good and vote them out when conditions are poor (Healy & Malhotra, 2009). There is evidence that voters hold local public officials responsible for disasters (by voting against them) when they believe the local government is responsible for disaster preparation (Arceneaux and Stein, 2006). Healy & Malhotra (2009) demonstrate that voters reward the political party of the incumbent U.S. President for disaster relief spending. The authors also find that voters do not reward a political party for investing in disaster preparedness spending and argue that this distorts the incentives of public officials and leads to underinvestment in disaster preparedness.

The role of local government in disaster response actually varies quite substantially across states; however, "state and local governments are generally responsible for all phases of disaster management." (Col, 2007, 115) Since 1978, the Federal Emergency Management Agency (FEMA) has taken on an increasing role in the task of assisting state and local governments, particularly when events "overwhelm" state and local governments. In 1979, President Jimmy Carter signed an executive order that merged six other disaster response

agencies including The Federal Insurance Administration, The National Fire Prevention and Control Administration, and others with FEMA. FEMA has since been absorbed by the Department of Homeland Security and responsibility for disasters has been further centralized at the federal level.

"The first few hours following any large-scale disaster present a complex array of organizational demands that constitute a unique managerial problem." (Drabek, 1985, 85) The nature and type of disaster determines which organizations must respond and which tasks they will confront. In 1984, the Integrated Emergency Management System (IEMS) was implemented in the U.S. at all levels of government. The goal of IEMS was to move towards a model of Comprehensive Emergency Management (CEM), a generalized approach to disaster management (Drabek, 1985). CEM applies to all four phases of disasters (mitigation, preparedness, response, and recovery and refers to a government's responsibility to coordinate the actions of numerous agencies in managing disasters.

IEMS is related to an increase in federal assistance provided to local governments in the aftermath of disasters. The processes for intergovernmental communication and collaboration have become more well-defined. As such, "After a major disaster, local officials are involved in complex intergovernmental processes and in key public policy choices that affect the future of the community (Rubin & Barbee, 1985). This puts a lot of pressure on local officials and managers to make good decisions and lead communities in recovery.

Waugh & Streib (2006) stress the importance of an effective leadership strategy in responding to disasters. The authors contrast a command and control leadership strategy with a more open and democratic strategy. A command and control strategy can lead to faster, more consistent decision-making; however, a more open and democratic strategy can lead to better

communication. Ultimately, the authors call for a flexible leadership style in handling disaster response. Harrald (2006) points to improvisation, adaptability, and creativity as being critical success factors for leaders faced with a disaster.

Estimating the Effect of Disasters on Outcomes

While I can find no literature in which researchers estimated the effect of disasters on local government finances, recent literature seeks to estimate the effects of disasters on a variety of outcomes using a variety of empirical methods. Noy & Nualsri (2011) estimated the effect of disasters (by magnitude) on several fiscal outcomes of countries (government consumption, revenue, payment, cash surplus, and debt) using a panel VAR specification. Cavallo & Borensztein (2007) considered the effects of hurricanes on the debt-to-GDP ratio of local governments conditional on amount of disaster insurance by conducting a debt sustainability analysis. Noy & Vu (2010) estimated the impacts of specific disasters on annual output growth in Vietnam using a Blundell-Bond GMM estimator.

Strobl (2011) estimated the impact of hurricanes on local economic growth rates and per capita wealth in coastal counties in the United States. This methodology is particularly relevant for this study because it is concerned with counties in the United States. The author developed a hurricane destruction index in order to account for the varying levels of damage of which hurricanes are capable. Cavallo & Galiani (2010) estimated the effects of severe natural disasters on country-level GDP per capita using synthetic controls to construct a counterfactual trend.

Deryugina (2016) used an event study approach to determine the effects of hurricanes in the United States on non-disaster government transfers. The author found that hurricanes

actually increase government transfers for unemployment insurance and public medical payments. Kirchberger (2017) used an instrumental variables approach to estimate the effect of earthquakes on labor market outcomes (wages, employment status, and hours worked). Zhao et al. (2018) used a difference-in-difference specification to estimate the effect of a major earthquake on county-city-level GDP and GDP per capita in China.

Two conclusions can be drawn from the literature on the effects of natural disasters. The first is that there is a gap when it comes to the effect of disasters on local fiscal outcomes. More research is needed to identify these effects. The second conclusion is that a number of methods have been applied to estimate these effects, each with distinct strengths and weaknesses.

Modelling State and Local Government Expenditure

Fisher (1961) suggested that the variables necessary for estimating state and local government expenditure are population density, urbanity of the population, and per capita income. Using data from the 1957 Census of Governments, Fisher was able to explain a substantial amount of the variation in the level of state government spending using these three factors.

Sacks and Harris (1964) suggested adding state and federal government aid to this equation for estimating local government expenditure. The authors were similarly able to explain a large amount of variation with a model including only the five variables. Osman (1968) outlined three objections to the use of state and federal aid in these models. The first is that aid may be distributed evenly to lower levels of government from higher levels and would simply become a part of the constant term. The second objection is that aid from state and federal governments depends on expenditures by the local government (e.g. matching grants).

The third and final objection discussed by Osman is that aid may no longer be an important determinant of spending once the reverse-caused portion of it is removed.

The aforementioned studies were primarily concerned with modelling levels of expenditures. Bahl and Saunders (1965) were interested in modelling changes in expenditures. The model employed by these authors included changes in per capita income, population density, urban population, federal grants, and public school enrollment as determinants of changes in state government expenditure.

Research Design

Goals and Empirical Strategy

This study seeks to estimate the effects of FEMA declared disasters on county government revenues and spending in Kentucky. To this end, I will statistically analyze the budgets of 118 Kentucky county governments from fiscal year 2007 through fiscal year 2017 using OLS. This analysis excludes Fayette and Jefferson counties due to their unique structure as urban-county governments. In order to determine the effects of disasters on total receipts and total spending, a number of equations are estimated. The most direct of these is as follows:

$$Y_{ct} = \beta_0 + \beta_1 Disasters_{ct} + \beta_2 Disasters_{c,t-1} + \gamma \boldsymbol{X}_{ct} + \alpha_c + \varepsilon_{ct}$$

In this specification, *c* denotes county while *t* denotes fiscal year. *Y* represents either total receipts per capita or total spending per capita. **X** represents a vector of control variables (per capita income, unemployment, vote share, and population density). County fixed effects (α_c) are included to control for unobserved time-invariant factors that may affect the outcomes across counties. In this equation, Disasters is the count of FEMA-declared disasters in a county in a given year. As an alternative, a similar model is also estimated including each unique count as a

binary variable (OneDisaster = 1 if a county experienced one disaster in a given year, TwoDisasters = 1 if a county experienced two disasters in a given year, continued up to FourDisasters since four is the maximum number of disasters experienced by any one county in any year in this data.)

Since disasters vary drastically in nature and in damage that they cause, it is difficult and perhaps unreasonable to characterize the average disaster. As such, this study will also consider the following specification:

$$Y_{ct} = \beta_0 + \beta_1 FEMA\_PA_{ct} + \beta_2 FEMA\_PA_{c,t-1} + \gamma \boldsymbol{X}_{ct} + \alpha_c + \varepsilon_{ct}$$

Where FEMA_PA represents the per capita public assistance grant funding approved by FEMA. Public assistance grant funding (PA) is used as a proxy for disaster damage or magnitude. While there may be some variation in grants awarded based on the ability of grant-writers in a county, PA grant funding is still the most reasonable proxy for disaster damage available.

This specification using public assistance grants as a proxy for damage will be the specification used to identify the effects of disasters on specific categories of revenues and spending. The following revenue categories will be considered:

- Tax revenues
- Intergovernmental revenues
- Borrowing

In addition to estimating the effects of disasters on these revenue categories, the effects of disasters on the following spending categories are also estimated:

- General Government
- Protection to Persons and Property

- General Health and Sanitation
- Social Services
- Recreation and Culture
- Roads and Transportation
- Capital Projects
- Administration

Expectations

The expectations of this study are intuitive. Since a Presidential Disaster Declaration makes counties eligible for public assistance funds (and other grant programs) through FEMA, I expect that the occurrence of at least one disaster will increase total revenues and total spending (in per capita terms). Additionally, I expect that the magnitude of this effect will be larger as more disasters occur within one fiscal year. Formally, this can be expressed as ($0 < \beta_1 < \beta_2 < \beta_3$) for all *Y*s considered.

For the specific categories of revenues and spending, I expect the following:

Category	**Expected Change in Response to Disasters**
Tax Revenues	Decrease
Intergovernmental Revenues	Increase
Borrowing	Increase
General Government	Increase
Protection to Persons and Property	Increase
General Health and Sanitation	Increase
Social Services	Increase

Recreation and Culture	Decrease
Roads and Transportation	Increase
Capital Projects	No Change
Administration	Decrease

The results of this analysis may be of great interest to policymakers at varying levels of government. The resulting estimates will allow us to determine the balance of revenue and spending responses by local governments. For example, my expectation is that total receipts and total spending will both increase because of a disaster. If this expectation is correct, we will have an estimate of the amount by which both increase. If the results suggest that spending increases more than revenues because of a disaster, this could imply that counties are saving an adequate amount for disasters. If the results suggest that revenues increase more than spending because of a disaster, this might imply that the inflow of new funds (likely through intergovernmental transfers or borrowing) exceeds the amount actually needed to offset the costs of disasters. In other words, it would suggest that counties are receiving new funds but spending additional funds.

Data

The county budget data used in this study are from the Kentucky Department for Local Government (DLG). These data contain detailed information on the revenues and spending of 118 county governments in Kentucky for fiscal years 2007 to 2017. There are only eight missing budgets (county-year combinations) and no more than two missing budgets for any given year. For this study, I aggregate the data from line-item detail up to total spending and revenues and to

totals for general categories of spending and revenues using accounting codes from the *County Budget Preparation and State Local Finance Officer Policy Manual* (Kentucky DLG, 2017).

In order to put the budget variables in per capita terms, I use Census Bureau midyear population estimates from the Bureau of Economic Analysis (BEA). I use these same population estimates to calculate per capita personal income using data on personal income from the BEA and to calculate population density (supplemented with land area information from the U.S. Census Bureau). In addition to these variables, I use local area unemployment data from the Bureau of Labor Statistics (BLS) for a measure of the county-level unemployment rate. I also utilize data from the MIT Election Data and Science Lab (2018) on county presidential election returns from 2000 through 2016 to construct a measure of vote-share to account for political factors. Vote-share reflects the political ideology in a given county and may lead to variations in budget activity.

For the variables of interest (disasters), I use FEMA's disaster declarations database. The FEMA data contains some detail for each disaster declared, including relevant dates, grant programs made available, a brief description of the disaster, and an indication of type of disaster. The disaster types that occurred in Kentucky during the period of analysis include fire, floods, storms, ice, and snow. The following tables contains summary statistics for the variables discussed:

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Disasters	1292	0.53	0.84	0	4
PA Per Capita	1290	$9.24	$31.04	$0.00	$496.35
Population	1290	28171.33	26831.88	2134	165399
Population per square mile	1289	95.30	122.74	18.66	1032.13
Per Capita Income	1290	$2,897.26	$5,026.01	$17,384.46	$61,565.74
Unemployment	1292	8.36	2.88	3.3	20.5
Democratic Vote Share (0 - 100)	1292	31.75	9.49	8.75	69.8

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Total Receipts	**1288**	**$579.98**	**$253.76**	**$69.48**	**$2,087.32**
Tax Revenue	1288	$140.33	$80.61	$2.40	$1,050.78
Intergovernmental Revenue	1288	$212.98	$129.25	$0.00	$1,038.80
Borrowing	1288	$10.53	$60.37	$0.00	$1,304.34
Total Spending	**1288**	**$435.10**	**$177.82**	**$12.14**	**$2,053.27**
General Government	1288	$77.28	$51.87	$1.72	$1,321.88
Protection to Persons and Prop.	1288	$98.75	$58.18	$2.14	$643.58
General Health and Sanitation	1288	$28.52	$41.21	$0.00	$828.89
Social Services	1288	$6.01	$11.06	$0.00	$135.07
Recreation and Culture	1288	$12.25	$15.50	$0.00	$180.72
Roads and Transportation	1288	$88.71	$52.00	$0.00	$441.67
Capital Projects	1288	$22.20	$45.89	$0.00	$527.72
Administration	1288	$77.00	$42.62	$5.33	$669.95

- *Categories will not add up to totals because several revenue categories and one spending category (debt service) are excluded.*

Analysis

The results from estimating my equations with total receipts per capita as the dependent variable are reported in the following table:

Dependent Variable - Total Receipts (Per Capita)

	(1)	(2)	(3)	(4)	(5)	(6)
Count of Disasters	-7.816*	-2.016				
	(4.332)	(7.347)				
Count of Disasters (Lag)	3.087	0.573				
	(4.291)	(8.681)				
One Disaster			-6.983	0.220		
			(8.802)	(9.362)		
Two Disasters			-23.02**	-6.943		
			(11.60)	(22.40)		
Three Disasters			-9.682	9.643		
			(15.75)	(25.25)		
Four Disasters			-29.38	-12.49		
			(39.63)	(44.72)		
One Disaster (Lag)			2.397	6.515		
			(9.922)	(12.17)		
Two Disasters (Lag)			-25.56**	-42.40*		
			(11.52)	(23.26)		
Three Disasters (Lag)			49.90***	31.21		
			(18.26)	(32.23)		
Four Disasters (Lag)			-15.42	-37.07		
			(50.42)	(59.52)		
FEMA PA per Capita					-0.0193	0.0555
					(0.146)	(0.150)
FEMA PA per Capita (Lag)					0.867*	0.926*
					(0.501)	(0.558)
Constant	535.8***	603.1***	527.6***	596.2***	548.4***	608.3***
	(151.1)	(168.6)	(154.2)	(173.5)	(153.8)	(166.5)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	1,166	1,166	1,166	1,166	1,164	1,164
R-squared	0.010	0.019	0.020	0.031	0.056	0.067

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

* All models estimated using county fixed effects and controlling for population density, unemployment, vote-share, and income

Columns (1) and (2) report the results where the explanatory variable is the count of disasters. Even numbered columns are estimated using year fixed effects. The results from columns (1) and (2) suggest that there may be a negative relationship between disasters in the

current fiscal year and current year receipts and a positive relationship between disasters in the previous fiscal year and current year receipts. These results are not statistically significant at the 95% level and they provide no statistical evidence.

Columns (3) and (4) report the results when the explanatory variables are binary variables for each count of disasters. These results are inconsistent and somewhat confusing. Additionally, all statistical significance (at the 95% level) goes away when year fixed effects are included. Overall, the results in columns (1) through (4) do not provide convincing evidence that the count of disasters is associated with changes in per capita total receipts. These models also fail to explain a substantial portion of the variation in per capita receipts.

The estimates in columns (5) and (6) were calculated using per capita approved FEMA public assistance grant funds as the explanatory variable. These results suggest that current-year disaster damage has no relationship with current-year receipts. This is a reasonable result as there are administrative frictions in place that prevent immediate changes to show up. There is some evidence (significant at the 90% confidence level) that previous year disaster damage is associated with an increase in current-year per capita receipts.

The estimates in (5) and (6) suggest that for each dollar in disaster damage in the previous fiscal year, there is an increase in current year per capita receipts of between $.87 and $.93. This result could reflect two things. First, it might reflect that the counties are actually receiving the public assistance funds (subject to a federal cost share) one year after the disaster(s) occur. Second, it could reflect that receipts are increasing as a result of increases in borrowing or other revenue sources. The models that estimate the effects of damage on specific revenue categories will help to disentangle this.

The results from estimating my equations with total spending per capita as the dependent variable are reported in the following table:

Dependent Variable - Total Spending (Per Capita)

	(1)	(2)	(3)	(4)	(5)	(6)
Count of Disasters	-8.933**	-2.929				
	(3.940)	(4.825)				
Count of Disasters (Lag)	2.549	0.887				
	(2.991)	(4.758)				
One Disaster			-3.627	2.674		
			(8.343)	(8.078)		
Two Disasters			-15.53*	1.928		
			(9.175)	(12.22)		
Three Disasters			-19.99	1.807		
			(13.53)	(18.62)		
Four Disasters			-63.55*	-43.59		
			(36.55)	(37.33)		
One Disaster (Lag)			6.039	7.658		
			(7.582)	(9.176)		
Two Disasters (Lag)			-21.80***	-33.80***		
			(7.974)	(11.61)		
Three Disasters (Lag)			37.03**	25.97		
			(14.51)	(19.70)		
Four Disasters (Lag)			-18.09	-32.09		
			(27.12)	(31.68)		
FEMA PA per Capita					-0.105	-0.0334
					(0.139)	(0.152)
FEMA PA per Capita (Lag)					0.786	0.849
					(0.513)	(0.572)
Constant	424.8***	473.7***	419.7***	468.5***	431.7***	477.8***
	(82.45)	(89.93)	(81.68)	(89.70)	(84.99)	(87.01)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	1,166	1,166	1,166	1,166	1,164	1,164
R-squared	0.012	0.022	0.021	0.034	0.067	0.082

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

* All models estimated using county fixed effects and controlling for population density, unemployment, vote-share, and income

For the sake of clarity, I will focus on the results reported in columns (5) and (6). These results suggest that there is no relationship between current or previous year damage and current year spending. This result is interesting because if the results from the total receipts models are to be believed, this would suggest that county government surpluses are increasing because of disaster damage. This could happen for at least two reasons. The first is that counties are opportunistic and take advantage of the availability of FEMA grant funds to increase revenues. The second is that counties may cut spending from various categories to supplement disaster relief funding. The models that estimate the effects of damage on specific spending categories will help to detail what is occurring.

The results from estimating my equations with revenue categories (per capita) as dependent variables are reported in the following table:

Dependent Variables - Revenue Categories

	Taxes		Intergovernmental		Borrowing	
	(1)	(2)	(3)	(4)	(5)	(6)
FEMA PA per Capita	-0.0194	-0.0441*	-0.212*	-0.185	0.0371	0.0677
	(0.0167)	(0.0250)	(0.113)	(0.116)	(0.0595)	(0.0542)
FEMA PA per Capita (Lag)	-0.0317	-0.0716	0.232**	0.222**	0.0556	0.0810
	(0.0332)	(0.0542)	(0.108)	(0.110)	(0.0704)	(0.0640)
Constant	279.1***	301.2***	144.3***	231.9***	-2.745	-59.16
	(90.29)	(97.14)	(54.96)	(53.19)	(43.01)	(45.37)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	1,164	1,164	1,164	1,164	1,164	1,164
R-squared	0.026	0.040	0.052	0.095	0.004	0.015

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

* All models estimated using county fixed effects and controlling for population density, unemployment, vote-share, and income

These results suggest that tax revenues decrease by $.044 per capita for each dollar in per capita damage in the current fiscal year. Additionally, the results suggest each dollar in per capita damage in the previous fiscal year is associated with a $.222 per capita increase in intergovernmental revenues. There appears to be no significant relationship between borrowing and disaster damage.

The significant results from estimating my equations with spending categories (per capita) as dependent variables are reported in the following table:

Dependent Variables - Spending Categories

	Rec & Culture		Transportation		Administration	
	(1)	(2)	(3)	(4)	(5)	(6)
FEMA PA per Capita	-0.0143**	-0.0131**	-0.0713***	-0.0331	-0.0359*	-0.0229
	(0.00615)	(0.00615)	(0.0261)	(0.0277)	(0.0193)	(0.0203)
FEMA PA per Capita (Lag)	0.00165	-0.00314	0.172***	0.172***	-0.0124	-0.00841
	(0.00831)	(0.00974)	(0.0552)	(0.0571)	(0.0139)	(0.0160)
Constant	-1.946	2.195	51.07*	84.62***	149.8***	164.1***
	(10.46)	(10.75)	(27.05)	(23.52)	(34.34)	(36.79)
Year Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	1,164	1,164	1,164	1,164	1,164	1,164
R-squared	0.028	0.040	0.064	0.135	0.059	0.093

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

* All models estimated using county fixed effects and controlling for population density, unemployment, vote-share, and income

The results from estimating the effects of disaster damage on other spending categories did not produce any statistically significant results. These results suggest that disaster damage in the current fiscal year is associated with decreases in per capita spending for recreation and culture as well as administration. Furthermore, the results suggest that each dollar in per capita

damage in the previous fiscal year is associated with a $0.17 per capita increase in roads and transportation spending per capita in the current fiscal year.

Discussion and Conclusion

To summarize the significant results from my preferred specifications (FEMA PA funds per capita as the explanatory variable, year fixed effects included);

- Disaster damage in the previous fiscal year is associated with an increase in total receipts per capita in the current fiscal year.
- There is no statistically significant relationship between disaster damage and total spending per capita.
- Disaster damage is associated with a decrease in tax revenues in the current fiscal year and an increase in intergovernmental revenues in the following fiscal year.
- Disaster damage is associated with a decrease in recreation and culture spending per capita in the current fiscal year and an increase in transportation spending per capita in the following fiscal year.

These results raise a few questions. The first being, are county governments increasing their surplus because of disasters? When estimating a model where the dependent variable is surplus per capita, the explanatory variable is FEMA PA funds per capita, and year fixed effects are included, the are not statistically significant. Therefore, this analysis does not present compelling evidence that counties are increasing their surplus as a result of disasters.

The second question concerns economic significance. When looking at the results, it is a little unclear what the magnitude of the results is. Let us begin by quantifying the effect of damage on total receipts. The point estimate suggests that total receipts increase by $0.93 for

each dollar in per capita FEMA PA funds in the previous fiscal year. This amounts to a $9.33 per capita increase in total receipts for an average level of previous-year damage. Given that the average level of per capita receipts is $580, this is roughly a 1.6% increase in per capita receipts due to an average level of damage.

Let us now consider the magnitude of changes in taxes and intergovernmental revenues. The point estimate for the average decrease in tax revenues resulting from one dollar in current year damage is -0.04. For an average level of damage, this is a $0.4 per capita decrease in tax revenues. Given that the average level of per capita tax revenues is $140, this amounts to a trivial decrease in tax revenues. The point estimate for the average increase in intergovernmental revenues resulting from one dollar in previous year damage is 0.22. For an average level of damage, this is a $2.20 increase in intergovernmental revenues. Given that the average level of per capita intergovernmental revenues is $220, this amounts to a 1% increase in intergovernmental revenues.

It is important to note that the $2.20 increase in intergovernmental revenues only accounts for a portion of the $9.33 increase in total receipts per capita attributable to an average level of disaster damage in the previous year. The remaining portion of the increase must come from some combination of insurance, donations, and other sources not considered by this study. It is also possible that this gap is partially accounted for by an increase in borrowing despite the lack of statistical significance in my estimates.

We should also specify the magnitudes of effects on spending categories so that we can compare the increase in receipts with changes in spending. For each dollar of current-year PA per capita, recreation and culture spending decreases by $0.01 per capita on average. For an average level of damage, this amounts to a $0.10 decrease. Given that the average level of per

capita recreation and culture spending is $12.25, this equates to a trivial decrease in rec and cultures spending of less than 1%. Each dollar of per capita PA in the previous fiscal year is associated with a $0.17 increase in roads and transportation spending in the current fiscal year. For an average amount of damage, this is a $1.70 increase in transportation spending. Given that the average amount of transportation spending is $88.71 per capita this amounts to a roughly 2% increase in transportation spending.

The results of this study are somewhat encouraging in that they suggest that the effects of disasters on local government budgets are not large. The small changes induced by average levels of disaster damage should be reasonably manageable by local governments given the amount of assistance available from the state and federal government. It should be noted, however, that the average amount of per capita disaster damage is $10 per capita. If we were to consider the effects when disaster damage is much higher (maximum of $496.35), the effects of disasters will be much larger. As an extension to this study, it may be useful to identify a better measure of disaster magnitude or damage to determine the reliability of these findings.

References

Arceneaux, K., & Stein, R. M. (2006). Who Is Held Responsible When Disaster Strikes? the Attribution of Responsibility for a Natural Disaster in an Urban Election. *Journal of Urban Affairs*, 28(1), 43-53.

Bahl, R. W., Jr., & Saunders, R. J. (1965). Determinants of Changes in State and Local Government Expenditures. *National Tax Journal, 18*(1), 50-57.

Berke, P. R., Kartez, J., & Wenger, D. (1993). Recovery after Disaster: Achieving Sustainable Development, Mitigation and Equity. *Disasters*, 17(2), 93-109.

Cavallo, E. A., Galiani, S., Noy, I., & Pantano, J. (2010). Catastrophic Natural Disasters and Economic Growth. *SSRN Electronic Journal*.

Cavallo, E. A., Valenzuela, P., & Borensztein, E. (2007). Debt Sustainability Under Catastrophic Risk: The Case for Government Budget Insurance. *SSRN Electronic Journal*.

Chamlee-Wright, E., & Storr, V. H. (2009). Expectations of government's response to disaster. *Public Choice*, 144(1-2), 253-274.

Col, J. (2007). Managing Disasters: The Role of Local Government. *Public Administration Review*, 67, 114-124.

Cutter, S. L., & Emrich, C. (2005). Are natural hazards and disaster losses in the U.S. increasing? *Eos, Transactions American Geophysical Union,86*(41), 381.

Deryugina, T. (2016). The Fiscal Cost of Hurricanes: Disaster Aid Versus Social Insurance. *Working Paper*.

Drabek, T. E. (1985). Managing the Emergency Response. *Public Administration Review*, 45, 85.

Fisher, G. W. (1961). Determinants of State and Local Government Expenditures: A Preliminary Analysis. *National Tax Journal,14*(4), 349-355.

Harrald, J. R. (2006). Agility and Discipline: Critical Success Factors for Disaster Response. *The Annals of the American Academy of Political and Social Science*, 604(1), 256-272.

Healy, A., & Malhotra, N. (2009). Myopic Voters and Natural Disaster Policy. *American Political Science Review*, 103(03), 387-406.

Kartez, J. D., & Lindell, M. K. (1987). Planning for Uncertainty: The Case of local Disaster Planning. *Journal of the American Planning Association*, 53(4), 487-498.

Kirchberger, M. (2017). Natural disasters and labor markets. *Journal of Development Economics,125*, 40-58.

Kusumasari, B., Alam, Q., & Siddiqui, K. (2010). Resource capability for local government in managing disaster. *Disaster Prevention and Management: An International Journal*, 19(4), 438-451.

Noy, I., & Nualsri, A. (2011). Fiscal storms: Public spending and revenues in the aftermath of natural disasters. *Environment and Development Economics,16*(01), 113-128.

Noy, I., & Vu, T. B. (2010). The economics of natural disasters in a developing country: The case of Vietnam. *Journal of Asian Economics,21*(4), 345-354.

Osman, J. W. (1968). On The Use of Intergovernmental Aid As An Expenditure Determinant. *National Tax Journal,21*(4), 437-447.

Petak, W. J. (1985). Emergency Management: A Challenge for Public Administration. *Public Administration Review*, 45, 3.

Rubin, C. B., & Barbee, D. G. (1985). Disaster Recovery and Hazard Mitigation: Bridging the Intergovernmental Gap. *Public Administration Review*, 45, 57.

Sacks, S., & Harris, R. (1964). The Determinants of State and Local Government Expenditures and Intergovernmental Flow of Funds. *National Tax Journal,17*(1), 75-85.

Settle, A. K. (1985). Financing Disaster Mitigation, Preparedness, Response, and Recovery. *Public Administration Review*, 45, 101.

Strobl, E. (2011). The Economic Growth Impact of Hurricanes: Evidence from U.S. Coastal Counties. *Review of Economics and Statistics,93*(2), 575-589.

Waugh, W. L., & Streib, G. (2006). Collaboration and Leadership for Effective Emergency Management. *Public Administration Review*, 66(S1), 131-140.

Wolensky, R. P., & Miller, E. J. (1981). The Everyday Versus the Disaster Role of Local Officials. *Urban Affairs Quarterly*, 16(4), 483-504.

Zhao, R., Zhong, S., & He, A. (2018). Disaster Impact, National Aid, and Economic Growth: Evidence from the 2008 Wenchuan Earthquake. *Sustainability,10*(12), 4409.