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Digging through Disaster Rubble in Search of the Determinants of Organizational Mitigation and Preparedness

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Abstract

Disaster researchers have established the determinants of mitigation and preparedness at the household level of analysis. However, at the organizational level, there is limited research and no theory to guide research on the determinants of mitigation and preparedness. The research question is "what are the determinants of mitigation and preparedness at the organizational level?" The data come from a survey of 227 organizations in Memphis, Tennessee. This study uses Tobit regression technique to identify the determinants and finds that organizational size and concern over disaster impact are strong positive determinants of mitigation and preparedness in organizations. In addition, there is a significant and nonlinear relationship between organizational obstacle and mitigation and preparedness activities. This study concludes with policy implications and recommendations for future studies.

Keywords: disaster, mitigation, preparedness, survey, organizations, Memphis

Introduction

This study defines disasters as events, such as floods or earthquakes, which lead to major organizational disruption, loss of life, or property destruction. Myriads of risks and hazards, such as natural hazards, technological hazards, and terrorism, are capable of becoming disasters or crises in the presence of suitable conditions. However, a good understanding of risks and hazards can help societies ameliorate the effects of these events. The following few examples highlight the monumental losses that can result when risks and hazards become disasters. The Loma Prieta earthquake of 1989 caused 62 deaths, injured 3,757 people, displaced over 20,000 people, destroyed 18,306 homes and businesses, and caused over 6 billion dollars in economic losses (Mileti and O'Brien 1992). The September 11 terrorist attacks caused 2,973 fatalities (National Commission on Terrorist Attacks Upon the United States 2004). The estimate of economic losses from Hurricane Katrina is over $200 billion (Burby 2006). The colossal nature of disaster-induced losses is, indeed, worrisome and data from government agencies, the insurance community, and the disaster literature suggest continued increases in disaster losses. In light of potential future increases in the number of disasters and, consequently, disaster losses, there is a need to study ways of stemming disaster losses. Engaging in mitigation and preparedness activities can help to lessen disaster impacts and ultimately reduce disaster losses.

A number of disaster researchers have established the determinants of preparedness and mitigation at the household level (Dooley et al. 1992; Edwards 1993; Bourque et al. 2006). However, at the organizational level, there is limited research on the determinants of mitigation and preparedness. In other words, there is a gap in the disaster literature regarding the determinants of organizational mitigation and preparedness. Furthermore, there is no theory to guide research on the determinants of mitigation and preparedness at the organizational level. Knowledge of these determinants can help to understand the factors that are instrumental in motivating organizations to adopt mitigation and preparedness measures. This study attempts to narrow this gap by studying the determinants of organizational mitigation and preparedness for disasters among Memphis/Shelby County organizations. In this study, an organization is "a social unit with some particular purposes" (Shafritz et al. 2005, 1). The broadness of this definition is useful for this study because it covers the organizations (private, nongovernmental, and public organizations) that this study examined. Organizations are the unit of analysis in this study for many reasons. First, there is a dearth of disaster research at the organizational level (Tierney 1997; Webb et al. 2000). Second, organizations are an important decision-

making unit in the community. Third, organizations are a significant contributor to the United States economy.

The research question is "what are the determinants of mitigation and preparedness in organizations?" Only by identifying these factors will policymakers be able to make appropriate policies to stem disaster losses in organizations. The following four sub-questions provide a good foundation for exploring the research question. (i) Does concern over disaster impact lead to more mitigation and preparedness? (ii) What is the relationship between mitigation and preparedness and organizational obstacles? (iii) Do single-location organizations engage in less mitigation and preparedness than multiple-location organizations? (iv) Does organizational size have a positive effect on mitigation and preparedness?

This study is important to disaster researchers by identifying the factors that make an organization want to prepare for and mitigate disasters. Knowledge of such factors can contribute to the development of appropriate theories and provide a solid basis on which to institute disaster policies.

Theoretical Foundation

Disasters and Organizational Survival

The survival of organizations is very important. This is why organizational theorists have devoted much time to studying how organizations manage to survive (e.g., Pfeffer and Salancik 1978). Acquisition and maintenance of resources are vital to organizational survival (ibid.) or as a vital stimulus for organizational formation and survival (Aldrich and Pfeffer 1976; DiMaggio and Powell 1983). No organization is self-reliant; every organization must transact with its external environment for needed resources (Pfeffer and Salancik 1978). However, the external environment is not dependable and may sometimes threaten the survival of organizations. Disasters may cause, among other types of losses, organizational disruption (Lindell and Perry 2007) and loss of services from public organizations and non-profit organizations, consequently undermining the economy and support systems of communities (ibid.). Organizations cannot control the physical characteristics of disasters, such as magnitude and frequency (Nigg 1996); they can, however, reduce their impacts by engaging in a number of mitigation and preparedness measures (Dahlhamer and D'Souza 1997).

Disaster Research at the Organizational Level: The Need for More

The field of disaster research has expanded since its inception in the early 1950s (Quarantelli 2003), with increased growth in research at the individual, household, community, and public-sector organizational levels (Tierney 1997; Webb et al. 2000). In fact, many studies in the disaster management literature focus either on household surveys (e.g., Jackson 1981; Davis 1989; Dooley et al. 1992; Edwards 1993; Farley 1998; Atwood and Major 2000) or on surveys of policy elite active in a community (e.g., Drabek et al. 1983; Mushkatel and Nigg 1987; Berke and Beatley 1992; May and Birkland 1994; Burby et al. 2000; Wood 2004). Unfortunately, disaster researchers have largely neglected the organizational level (Tierney 1997; Webb et al. 2000). The neglect of disaster research at the organizational level may be because organizations are difficult to sample or because some organizations are afraid of the potential consequences of divulging disaster information (Auf der Heide 1989).

A body of pre-disaster research at the organizational level is beginning to emerge due to the foundational work of some eminent researchers like Quarantelli, Lawrence, Tierney, and Johnson. This group of researchers examined how chemical companies and government agencies in 18 U.S. communities plan for chemical emergencies (Quarantelli et al. 1979). A little over a decade later, Drabek (1991; 1994a; 1994b) investigated how businesses in the tourism industry carry out evacuation planning. Mileti et al. (1993) studied how 54 businesses in eight San Francisco counties adopt earthquake preparedness measures. Furthermore, Barlow (1993) investigated the impact of Iben Browning earthquake prediction on 20 businesses in the St. Louis area. Dahlhamer and D'Souza (1997) investigated the determinants of business disaster preparedness in Memphis/Shelby County, Tennessee, and Des Moines/Polk County, Iowa. Lastly, Webb et al. (2000) used a series of surveys to explore the preparedness and disaster experiences of businesses in different parts of the country, including Memphis, Tennessee.

Why Mitigation and Preparedness?

Mitigation and preparedness are important to society both practically (to organizations and the emergency management community) and theoretically (to the academic community). First, mitigation and preparedness can make it easier for organizations to survive disasters by providing opportunities to lessen their severity. For example, before an earthquake, it is possible to

institute building codes that will help to strengthen buildings. Once an earthquake occurs, it will be too late to carry out this measure.

Similarly, organizations with effective contingency plans and warning systems would stand a better chance of survival than organizations without these preparedness measures. Second, if organizations have mitigation and preparedness strategies in place, they are likely to be less reliant on emergency responders, thus freeing up resources for other purposes. It is important to emphasize here that effective mitigation and preparedness programs and policies for disasters do not preclude the need for emergency responders. Third, mitigation and preparedness can help to lay a solid foundation for effective disaster response (Dahlhamer and D'Souza 1997) and serve as a first step in understanding recovery in organizations. For instance, mitigation and preparedness can assist researchers in understanding why some organizations fail and others survive disasters.

Determinants of Mitigation and Preparedness in Organizations

Many disaster researchers have focused on the determinants of mitigation and preparedness at the household level. At this level, the story is clear. Household preparedness depends, among other determinants, on the presence of children (Edwards 1993), marital status, concern about a disaster, length of residence (Dooley et al. 1992), education, and household income (Edwards 1993; Bourque et al. 2006). At the organizational level, the determinants are ambiguous and the amount of research is limited. Some scholars have recognized the dearth of studies in this area and have called for more research on disaster mitigation and preparedness at the organizational level (e.g., Drabek 1986; Dynes and Drabek 1994). Drabek (1986) issued a call after his review of the disaster literature unearthed only a few disaster preparedness studies at the organizational level. The current study is an attempt to heed this call. The following paragraphs discuss the determinants of mitigation and preparedness in organizations.

Firm size is the most consistent (Dahlhamer and D'Souza 1997) and important (Webb et al. 2000) predictor of organizational mitigation and preparedness in studies conducted by the Disaster Research Center (DRC). Past studies suggest that larger firms do more to mitigate and prepare for disasters than do smaller firms. For example, in their study of 18 chemical companies, Quarantelli et al. (1979) found that larger companies were more likely to engage in more planning than smaller companies. Similarly, in a study of disaster evacuation planning in the tourist industry, Drabek (1991; 1994a; 1994b) found that firms with more employees had more extensive

disaster evacuation plans than firms with less employees. Some researchers interpreted this relationship in the context of resource availability; the argument is that larger firms have more resources to devote to disaster mitigation and preparedness than smaller firms.

Such a resource argument is common in the disaster literature at the household (Mileti 1999), community (May and Birkland 1994; Wood 2004), and organizational levels (Mileti et al. 1993; Dahlhamer and D'Souza 1997).

Evidence in the disaster literature indicates that some sectors engage in more mitigation and preparedness than others. For instance, Drabek (1991; 1995) found that there was a significant relationship between business type and disaster evacuation planning, with lodging businesses having more extensive disaster evacuation plans than restaurants, entertainment businesses, and firms in the travel industry. Similarly, Dahlhamer and D'Souza (1997) found that businesses in finance, insurance, and real estate do more to prepare for disasters than businesses in other sectors. One reason for this finding is the higher degree of regulation and oversight in this sector (Webb et al. 2000).

There are indications in the disaster literature that a high level of concern over disaster impacts, such as loss of life and personal injury, may induce individuals to engage in preparedness activities. In her study of the effect of the Iben Browning earthquake prediction, Showalter (1993) found a positive relationship between concern over loss of life and personal injury and respondents' willingness to engage in preparedness activities. Research on risk perception and risk visualization suggests that information on the potential impacts of disasters can motivate people to reduce their risks (e.g., Slovic et al. 1991; Sandman et al. 1994; Flynn et al. 1999).

Ownership pattern implies whether an organization is a single firm or a franchise. Empirical evidence suggests that franchises do more to mitigate and prepare for disasters than single firms. For instance, Drabek (1991; 1994a; 1994b; 1995) found that firms that were part of a larger chain engaged in more disaster evacuation planning than single firms. This finding is in line with that of Quarantelli et al. (1979), who found that national chemical companies engaged in more preparedness than single local chemical firms. This finding may be due to the mandates given to local chapters by corporate headquarters to engage in disaster preparedness (Dahlhamer and D'Souza 1997).

Both internal and external obstacles confront organizations. This study focuses on internal organizational obstacles to disaster mitigation and preparedness, while recognizing the existence of external organizational obstacles, such as competition from other organizations. This study defines internal organizational obstacles as factors inside organizations that inhibit

organizations' ability to mitigate and prepare for disasters. Because this study considers internal obstacles only, the word "obstacle" implies internal organizational obstacles.

Disasters can sometimes be beyond human control. We can, however, mitigate and prepare using an important ingredient, the acquisition of information (Major 1998).

The disaster management literature has focused much on the role of information in household preparedness for earthquakes. Information on earthquake risks can induce households to take preparatory action (Jackson and Mukerjee 1974; Sullivan et al. 1977; Palm 1981; Turner 1983; Russell et al. 1995; Flynn et al. 1999; Atwood and Major 2000; Celsi et al. 2005). Researchers have documented the pivotal role policy entrepreneurs or champions play in the policymaking process (e.g., Kingdon 1984; Prater and Lindell 2000; Wood 2004; Olshansky 2005). These entrepreneurs are willing to, among other strategies, mobilize support for their issues if necessary (Berke and Beatley 1992). Support from different levels within an organization provides a variety of functions that affect the probability of success (Selznick 1957; Yukl 1989; Bass 1997). Support is just as important in organizations as it is in the policymaking arena. For instance, the support of upper-level management is crucial in the adoption of mitigation and preparedness measures. Mitigating and preparing for disasters require time, money, and effort (Wyner and Mann 1986). Lack of financial and technical resources can constrain the adoption of earthquake mitigation policies (Bostrom et al. 2006).

Study Location: Memphis/Shelby County and Disasters

Memphis is the largest city in Tennessee with a population of about 650,000 people. Earthquakes are a big disaster risk in the Memphis area due to the hazard posed by the New Madrid Fault Zone. The three most powerful earthquakes in the U.S. (magnitude 7.0–8.1) occurred in the New Madrid Seismic Zone (NMSZ) (Memphis and Shelby County were not settlements then) between December 16, 1811 and February 7, 1812 (United States Geological Survey (USGS) 2008). USGS (1998) estimated that there is more than 90% probability of a moderate earthquake (magnitude 6–7) hitting the NMSZ within the next 50 years. Still, Memphis faces threats from other disasters, such as floods, tornadoes, ice storms, chemical spills, fires, severe storms, violent crimes, and toxic releases. For instance, on July 22, 2003, a windstorm (later called Hurricane Elvis) left over 300,000 utility consumers in the dark; it took two weeks to restore power for everyone (Shepard 2003).

A study of organizations in Memphis/Shelby County makes for an interesting case for several reasons. The rarity of major earthquakes (magnitude 7.0 or greater) in Memphis/Shelby County in recent time poses challenges for organizations in deciding to mitigate and prepare. The absence of such disasters makes organizations apathetic and reluctant to adopt such measures (May 1986; Lindell and Perry 2007).

In addition, a vast majority of studies on earthquakes and disasters exist on the west coast, especially California (e.g., Jackson and Mukerjee 1974; Kiecolt and Nigg 1982; Mulilis and Duval 1995; Argothy 2003; May and Wood 2003; Wood 2004; Celsi et al. 2005). Very few studies have analyzed responses to disaster risks in Memphis (e.g., Edwards 1993) and few in the NMSZ where risks have low probabilities and high consequences (e.g., Mushkatel and Nigg 1987; Olshansky 1994; Farley 1998; Major 1998; Atwood and Major 2000). Finally, studies on organizational preparedness suggest that organizations in Memphis/Shelby County do little to prepare for disasters (e.g., Dahlhamer and D'Souza 1997; Webb et al. 2000).

Methodology

Data Collection

The data used in this study come from studying the influence of organizational structures on earthquake decision-making in Memphis/Shelby County, Tennessee. The research team collected disaster information from a random sample of public, private, and nonprofit organizations involved in disaster risk issues and organizations that a major disaster will significantly affect.

Interview Phase. The research team conducted 15 exploratory interviews with 15 different organizations in Memphis/Shelby County in the spring and summer of 2006. The interviews consisted of open-ended interview questions, conducted in person or via telephone with the professional managers in the offices of their organizations. Interview questions addressed attitudes toward hazard risk management and risk information, as well as organizational actions with respect to risk. The interviews took approximately 30–60 minutes each. The research team summarized the interviews and sent them back to the interviewees to ensure the accuracy of the information provided. The interviews inform the survey questions.

Survey Phase. This phase consisted of a survey administered in fall 2006. The survey questions were in two parts. The first part consists of questions regarding risk issues in organizations, such as availability of risk managers, amount of resources devoted to disaster planning, level of disaster concern, use of disaster information, impacts of disasters, engagement in mitigation and preparedness activities, sources of disaster information, and obstacles to disaster planning.

The second part deals with demographic information about organizational representatives that answered the surveys, such as age, length of residence in Memphis/Shelby County, duration in current position within the organization, and educational level.

With the help of the Memphis Regional Chambers of Commerce, the research team queried an online reference service, *Reference*USA, using "number of employees" as a key index variable to allow organizations of all sizes in the Memphis Metropolitan Area to be surveyed and represented in sufficient numbers. The research team re-categorized "number of employees" into seven categories (1–9, 10–19, 20–49, 50–99, 100–249, 250–499, and ≥500). The research team sampled 100 organizations from the first six categories and sampled the entire population of 101 organizations from the last category, and added 32 utility companies to make 733 organizations.

The research team delivered the surveys following a modification of the Total Design Method (Dillman 2000). Of the 733 organizations, 227 organizations returned the survey, giving a response rate of about 31%. This response rate is lower than the 40% obtained by Dahlhamer and D'Souza (1997). Nevertheless, what is more important about this response rate is the extent to which it provides a balanced sample of the original population. In addition to the interviews and surveys, the research team analyzed publicly available documents and reports, such as Memphis newspapers, USGS reports, and Federal Emergency Management Agency (FEMA) reports.

Uniqueness of Data

The organizational survey data are unique in two ways. First, the data contain rare information on organizational representatives' perspective on how their organizations address disaster risks. Getting disaster information on organizations is difficult because some organizations are afraid of the potential consequences of divulging such information (Auf der Heide 1989). Second, the data contain information on organizational mitigation and preparedness for many types of disasters in an area subject to moderate

seismic risk. The literature on disasters shows that there is a tendency for researchers investigating disaster preparedness in organizations to focus on specific hazards (Mileti 1999). Thus, with the exception of the DRC data, there are no other data available, to my knowledge, on how organizations are preparing for different types of disasters. In addition, some researchers have surveyed organizations in high seismic risk regions, like California, and only a small number of researchers have surveyed organizations in the NMSZ.

Data Issues

The research team recognizes the potential problems that could plague the organizational survey data, such as internal validity, data entry errors, and selection bias. As a result, the research team took some steps to minimize these problems. Internal validity refers to the possibility that the conclusions drawn by a study may not precisely reflect what went on in that study (Babbie 2007). Prior to the design of the organizational surveys, the research team conducted 15 interviews. These interviews provided a good understanding of the issues of interest and the way in which Memphis organizations conceptualized these issues. For instance, the research team gained insights on what Memphis/Shelby County organizations understood by the word "disasters." In sum, the interview phase enabled the research team to define relevant concepts properly prior to administering the surveys. Nevertheless, this study faces the potential threat to internal validity resulting from testing (ibid.). For instance, the organizations interviewed, who are among those that answered the survey, may give biased responses on the survey because they knew what issues were of interest to the research team from the preliminary interviews.

To reduce data entry errors, two graduate students, including myself, entered and coded the organizational survey data separately. The other coder and I resolved a few typographical errors. With regard to selection bias, this study used the Heckman approach (the analysis is not shown here). The result from the Heckman model indicated that there was no selection bias in the organizational survey data.

Hypotheses

In order to answer the research questions, I test the following hypotheses. The null hypothesis in each case is that there is no significant relationship between the independent variable and the dependent variable.

Hypothesis 1: Organizations that are concerned about disaster impact will be more likely than organizations that are not to engage in mitigation and preparedness activities.
Hypothesis 2: There is a relationship between organizational obstacles and mitigation and preparedness activities.
Hypothesis 3: Single location organizations will be less likely to engage in mitigation and preparedness activities than multiple-location organizations.
Hypothesis 4: There is a positive relationship between organizational size and engagement in mitigation and preparedness activities.

Estimation Methodology

In this section, this study uses Tobit analysis to answer the research question. Before discussing the Tobit analysis, this study makes two assumptions. First, it assumes that there are some organizations in the sample that are against the adoption of mitigation and preparedness activities. These organizations are considered as having negative values for mitigation and preparedness activities. Second, it assumes that there are some organizations in the sample that engaged in more than ten mitigation and preparedness activities over the past year. For instance, some organizations might have purchased emergency supply kits in addition to engaging in the 10 activities.

This study has restricted the sample based on the dependent variable by bounding it between 0 (lower limit) and 10 (upper limit). In other words, the dependent variable is censored from both left and right, meaning that we cannot observe organizations that are below 0 or above 10. Tobit is the appropriate technique for analyzing censored samples because Ordinary Lease Square will yield biased coefficients (Wooldridge 2003). The Tobit model in this study takes the form:

Organizational Mitigation and Preparedness $(Y_i^*) = \beta_0 + \beta_1$ (disaster impact) $- \beta_2$ (organizational obstacle) $+ \beta_3$ (organizational obstacle^2) $+ \beta_4$ (single location) $+ \beta_5$ (organizational size) $+ \beta_6$ (educational sector) $+ \beta_7$ (health sector) $- \beta_8$ (wholesale/retail sector)$+ \varepsilon$

Organizational Mitigation and Preparedness $(Y_i) = \beta_0 + \beta_1$ (disaster impact) $- \beta_2$ (organizational obstacle) $+ \beta_3$ (organizational obstacle^2) $+ \beta_4$ (single location) $+ \beta_5$ (organizational size) $+ \beta_6$ (educational sector) $+ \beta_7$ (health sector) $- \beta_8$ (wholesale/retail sector) $+ \varepsilon$, if $0 < Y_i^* \leq 10$
$Y_i = 0$, if $Y_i^* \leq 0$

where, Y_i^* is the latent mitigation and preparedness activities adopted and Y_i is the observed mitigation and preparedness activities adopted.

A Model of Organizational Mitigation and Preparedness

This section presents a model of mitigation and preparedness at the organizational level. This model was developed from prior research on business disaster preparedness (e.g., Quarantelli et al. 1979; Dahlhamer and D'Souza 1997; Webb et al. 2000) and earthquake preparedness at the household level (e.g., Showalter 1993). This model assumes that the relationships that exist between the dependent variable and the independent variables at the household level will also exist at the organizational level. This assumption is reasonable because households and organizations share many goals, including survival. This model is a simple representation of the factors that affect mitigation and preparedness in organizations and the potential direction of each factor.

Organizational Mitigation and Preparedness $(Y_i) = \beta_0 + \beta_1$ (disaster impact) $- \beta_2$ (organizational obstacle) $+ \beta_3$ (organizational obstacle^2) $+ \beta_4$ (single location) $+ \beta_5$ (organizational size) $+ \beta_6$ (educational sector) $+ \beta_7$ (health sector) $- \beta_8$ (wholesale/retail sector) $+ \varepsilon$

Variable Measurement

Dependent Variable. This study defines the dependent variable, total number of mitigation and preparedness activities, as engagement in 10 mitigation and preparedness activities. The survey asked, "Has your organization engaged in any of these activities over the past year?" Each of the dependent variables has two options, yes and no. The mitigation and preparedness activities are the following: (i) Attended disaster meetings/training courses outside your organization. (ii) Mentioned a potential disaster in an organizational meeting. (iii) Held disaster-related workshops/trainings within your organization. (iv) Discussed in an organizational meeting short-term responses to disasters. (v) Discussed in an organizational meeting long-term strategies for recovery from disasters. (vi) Arranged site visits by consultants or experts to better prepare for disasters. (vii) Provided information to customers/members of the community on issues related to disasters. (viii) Assessed or evaluated vulnerability to disasters or estimated potential losses from disasters. (ix) Engaged in nonstructural mitigation measures (e.g., securing computers). (x) Engaged in structural mitigation measures (e.g., strengthening parts of a building).

The operational measure of the dependent variable is an index of the aforementioned 10 different mitigation and preparedness activities that organizations can engage in. This study creates 10 dummy variables, each coded 1 for those organizations who said they engaged in that particular activity and 0 otherwise. The responses for each respondent were added to arrive at the total number of mitigation and preparedness activity for each observation. This ten-item index is reliable (Cronbach's alpha = 0.88). Adding mitigation and preparedness activities together is a simple and convenient way of creating an index, but it does have problems.

First, the addition implies that each activity is equally weighted. For example, based on effort, it is not reasonable to expect that "Mentioning a potential disaster in an organizational meeting" would require the same level of effort as "Engaging in structural mitigation." Second, the addition makes the values of the dependent variable range from 0 to 10.

Independent Variables. This study explains mitigation and preparedness using the independent variables below and includes three variables as controls for organizational sector.

Concern over Disaster Impacts. Evidence in the disaster literature on household preparedness for earthquakes shows that people concerned over loss of life and personal injury are likely to engage in preparedness activities (Showalter 1993). In other words, organizations that are concerned about disaster impacts, such as loss of employee life, are more likely to engage in mitigation and preparedness activities than organizations that are not. This study measures this variable by the survey question: "Please indicate the extent to which the following disaster impacts might adversely affect your organization" (1=Minor Adverse Impact, to 5=Major Adverse Impact). Respondents could check a box for responses deemed "Not Applicable." The 13 disaster impacts are (i) damaged reputation, (ii) disruption in supplies or deliveries, (iii) inability to communicate with employees, (iv) inadequate number of employees, (v) loss of commercial goods, (vi) loss of customers, (vii) loss of data, (viii) loss of life, (ix) loss of life support (food, water, etc.), (x) loss relative to competitor's loss, (xi) power outage, (xii) structural damage, and (xiii) transportation disruption. The scale of the variables is 1 to 5 (minor to major adverse impact). For simplicity, this study considers scales 1 and 2 to be minor adverse impact, scale 3 to be moderate adverse impact, and scales 4 and 5 to be major adverse impact. This study creates a new independent variable, the mean of all the 13 impacts, by adding the values for all the disaster impacts (Cronbach's alpha = 0.81) and dividing by 13.

Organizational Obstacles. This study measures this independent variable by the survey question "Please indicate the extent to which of the following statements are obstacles to disaster planning in your organization: (a) Lack of financial resources to prepare for disasters, (b) Lack of support from upper-level management within your organization, (c) Lack of support from mid- and lower-level organizational members, (d) Lack of information about the frequency and magnitude of disasters, (e) Lack of convincing information about the potential impacts of disasters, (f) Unclear organizational benefits from disaster planning and mitigation." The scale of the variables is 1 to 5 (minor to major obstacle).

Again, for simplicity, this study considers scales 1 and 2 to be minor obstacle, scale 3 to be moderate obstacle, and scales 4 and 5 to be major obstacle. This study develops an index, the mean of all the obstacles, by adding the values for all the obstacles together (Cronbach's alpha = 0.85) and dividing by 6. A new variable, the square of the mean of all the obstacles, was generated in Stata. This new variable takes care of the nonlinear relationship between the dependent variable and this independent variable.

Ownership Pattern of Organizations. Evidence in the disaster literature indicates that franchises do more to mitigate and prepare for disasters than single firms (Quarantelli et al. 1979; Drabek 1991; 1994a; 1994b; 1995). This variable is a dummy: 1=single-location firm, 0="others." The "others" category includes headquarters, subsidiaries, and branch. Memphis Regional Chambers of Commerce provided the information on whether an organization is a single firm or franchise.

Organizational Size. Previous disaster studies suggest that larger firms do more to mitigate and prepare for disasters than do smaller firms (Quarantelli et al. 1979; Drabek 1991; 1994a; 1994b; Dahlhamer and D'Souza 1997). This study operationalizes this variable by the number of employees in an organization. Memphis Regional Chambers of Commerce provided the information on organizational size.

Organizational Sector. Disaster researchers have found a significant relationship between organizational sector and engaging in preparedness activities (Drabek 1991; 1995; Mileti et al. 1993; Dahlhamer and D'Souza 1997). This study uses three variables as controls for three sectors: education, health, and wholesale/retail trade. Each of these control variables is a dummy variable: 1 if a respondent organization belongs to a sector and 0

otherwise. Memphis Regional Chambers of Commerce provided the information on the organizational sector.

Missing Values

Some of the variables had some missing values. In order to increase the sample size, this study recoded missing values as zeroes (for the dependent variable, total number of mitigation and preparedness activities) and recoded missing values and "not applicable" responses as zeroes (for the independent variables, disaster impact and organizational obstacle).

It does seem reasonable to recode "not applicable" as zero for these independent variables because by selecting not applicable, the respondent is indirectly saying that a disaster impact is less than "minor disaster impact" or that an organizational obstacle is less than "minor obstacle." In this case, zero is less than "minor disaster impact" and less than "minor obstacle," each of which has a value of 1 (on a scale of 1−5). After recoding, the sample size went up from 146 to 215 because observations that were previously excluded by Stata due to missing values are now included.

Empirical Results

Descriptive Statistics of Respondents

Table1 shows the minimum, maximum, mean, and standard deviation values for age, years of residence, years in current position within the organization, and years of formal education for the respondent individuals.

Table 1. Minimum, Maximum, Mean, and Standard Deviation for Individual Respondents

	Minimum	Maximum	Mean	Std. Dev.	N (# of observations)
Age of respondent	22	84	49.77	10.54	211
Number of years of residence in Memphis/Shelby County	0	76	32.97	18.15	216
Number of years in current position within organization	0	52	11.69	10.78	217
Number of years of formal education	2	25	15.96	3.34	216

Descriptive Statistics for Dependent and Independent Variables

Table 2 presents the descriptive statistics for the dependent and independent variables. On average, Memphis/Shelby County organizations engaged in 4.3 of the 10 mitigation and preparedness activities. This result may be an indication that Memphis/Shelby County organizations are actually doing more to mitigate and prepare for disasters than previous studies suggest (e.g., Dahlhamer and D'Souza 1997). Respondents reported that disaster impacts have a moderate adverse impact on their organizations (3.29).

In addition, respondents view organizational obstacles as minor impediments to disaster planning (1.88). Single-location organizations represent 78% of all respondent organizations. This number is comparable to the proportion of single-location organizations in the sampling frame (71%). About 8% of respondent organizations belong to the educational sector. Twice this number belong to the health sector, and 15% of respondent organizations constitute the wholesale/retail sector.

Table 2. Descriptive Statistics for Dependent and Independent Variables with Recoded Values

Variable Description	Mean	Std. Dev.	Min.	Max.	Observation
Total number of mitigation and preparedness activities (DV)	4.34	3.40	0	10	225
Mean disaster impact	3.29	1.27	0	5	225
Mean number of organizational obstacle to mitigation and preparedness	1.88	1.33	0	5	225
Mean number of organizational obstacle to mitigation and preparedness squared	5.29	5.28	0	25	225
Single-location organization	0.78	—	0	1	218
Number of employees	3.86	1.87	1	7	215
Educational sector	0.08	—	0	1	225
Health sector	0.16	—	0	1	225
Wholesale/retail sector	0.15	—	0	1	225

Correlation between the Dependent and Independent Variables

Before discussing the results of the multivariate regression, this study discusses the results of the correlations between the dependent variable and the independent variables. The goal is to understand the association between the dependent variable and each of the independent variables. Table 3 shows

that there is a positive association between mitigation and preparedness and disaster impact, mean organizational obstacle, number of employees, organizations in the educational sector, and organizations in the health sector.

Table 3. Pairwise correlations between dependent and independent variables

	Total Number of Mitigation and Preparedness Activities (DV)	Observation
Mean disaster impact	0.218***	225
Mean number of organizational obstacle to mitigation and preparedness	0.084	225
Mean number of organizational obstacle to mitigation and preparedness squared	−0.015	225
Single-location organization	−0.270***	218
Number of employees	0.485***	215
Education	0.188***	225
Health	0.120*	225
Wholesale/retail	−0.273***	225

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

Conversely, there is a negative association between mitigation and preparedness and mean organizational obstacle squared, single-location organizations as well as organizations in the wholesale/retail sector. All the correlation coefficients are significant except for the correlation coefficient on the mean number of organizational obstacle and the mean number of organizational obstacle squared.

Results of the Tobit Analyses

This section presents the results of the Tobit model. Table 4 indicates that this model and all the independent variables are statistically significant. This study focuses on the signs and significance of the coefficients in the following paragraphs.
Table 4. Summary of Results

Total Number of Mitigation and Preparedness Activities (DV)	Tobit with Recoded Values (n=215) Pseudo R^2=0.107
	0.53 (0.20)***
Mean disaster impact	
Mean number of organizational obstacle to mitigation and preparedness	1.03 (0.54)*
Mean number of organizational obstacle to mitigation and preparedness squared	−0.33 (0.14)**
	−2.71 (0.61)***
Single-location organization	
	0.84 (0.13)***
Number of employees	
	3.02 (0.89)***
Educational sector	
	1.71 (0.67)**
Health sector	
	−2.20 (0.70)***
Wholesale/retail sector	

Note: Figures in parentheses are standard errors.
*** p<0.01
** p<0.05
* p<0.1

The Tobit result suggests that there is a significant positive association between mitigation and preparedness and concern over disaster impacts, organizational obstacle, and number of employees. Conversely, there is a significant negative association between mitigation and preparedness and organizational obstacle squared and single-location organization.

Memphis/Shelby County organizations that were concerned about disaster impacts engaged in mitigation and preparedness activities over the past year (p<0.01). Similarly, one could argue that the more disaster mitigation and preparedness activities an organization engages in, the lower the concern about disaster impact. In other words, there may be simultaneity between mitigation and preparedness and concern about disaster impact. However, the positive association between mitigation and preparedness activities and concern about disaster impact in the data casts doubt on such a

negative relationship. In addition, past disaster studies at the household level have found similar positive relationships (Showalter 1993).

The coefficients on organizational obstacle ($p<0.1$) and organizational obstacle squared ($p<0.05$) show that there is a positive significant association between mitigation and preparedness and organizational obstacle until organizational obstacle peaks at 1.56, and then the association becomes negative.[1] The perception of respondents is that increases in the level of organizational obstacle lead to increases in the number of mitigation and preparedness activities adopted until organizational obstacle peaks at 1.56 where further increases in organizational obstacle lead to decreases in the number of mitigation and preparedness activities engaged in over the past year.

The result also indicates that mitigation and preparedness activities are negatively associated with single-location organizations. This significant result ($p<0.01$) is in line with that of previous research (Quarantelli et al. 1979; Drabek 1991; 1994a; 1994b; 1995).

Furthermore, number of employees is a significant predictor of mitigation and preparedness ($p<0.01$). The larger the organization, the more likely it is to have engaged in mitigation and preparedness activities in the past year. This finding is in accordance with that of previous studies (Quarantelli et al. 1979; Drabek 1991; 1994a; 1994b). One reason for the positive relationship between organizational size and mitigation and preparedness is that larger organizations have the necessary resources, such as staff and time, to adopt mitigation and preparedness measures (Dahlhamer and D'Souza 1997).

Finally, all the control variables have significant associations with mitigation and preparedness. This association is positive for organizations in the educational and health sectors and negative for organizations in the wholesale/retail trade sector. Dahlhamer and D'Souza (1997) also found a negative but insignificant relationship between organizations in the

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[1] *Mitigation and preparedness = 1.03 meanobstacle – (0.33) meanobstacle^2*
Δ mitigation and preparedness/Δ meanobstacle = 1.03 – 2(0.33) meanobstacle
Δ mitigation and preparedness/Δ meanobstacle = 1.03 – 0.66 meanobstacle
1.03 – 0.66 Meanobstacle = 0
Meanobstacle = 1.03/0.66 = 1.56

wholesale/retail sector and disaster preparedness. In sum, the signs from the bivariate analysis are similar to those of the multivariate analysis.

The marginal effects are the same as the Tobit coefficients. The independent variable with the biggest marginal effect is single-location organization. Holding all other variables at their means, single-location organization decreases expected mitigation and preparedness by about 2.71 units. Conversely, a unit increase in number of employees leads to a 0.84 unit increase in expected mitigation and preparedness holding other variables at their means.

Conclusions and Recommendations

The main goal of this study is to answer the question "what are the determinants of mitigation and preparedness at the organizational level?" The multivariate Tobit analysis result reveals that there is a significant positive relationship between mitigation and preparedness and organizational size. In other words, the smaller the organization, the fewer the number of mitigation and preparedness activities that will be adopted. This finding is in accordance with that of previous research (e.g., Quarantelli et al. 1979; Drabek 1994a; 1994b; 1995; Dahlhamer and D'Souza 1997). Some disaster studies have explained the positive association between mitigation and preparedness and organizational size in terms of unavailability of resources. In other words, smaller organizations do not have the resources to invest in mitigation and preparedness. This resource argument is common in the disaster literature (Mileti et al. 1993; Dahlhamer and D'Souza 1997).

This study also finds that concern over disaster impact is a significant positive determinant of mitigation and preparedness among Memphis/Shelby County organizations. In addition, the ownership pattern of organizations is a significant determinant of mitigation and preparedness in organizations. Single-location organizations are less likely to engage in mitigation and preparedness when compared to organizations with multiple locations. This result is in line with that of previous research (e.g., Quarantelli et al. 1979; Drabek 1991; 1994a; 1994b; 1995). One reason why multiple-location organizations are more likely to engage in mitigation and preparedness is because the corporate headquarters of these organizations mandate their local chapters to engage in risk reduction (Dahlhamer and D'Souza 1997).

This study finds a significant positive relationship between mitigation and preparedness and organizations in the educational and health

sectors. One interpretation of this result is that educational and health sector organizations are more likely to engage in mitigation and preparedness activities because they are highly regulated by the local, state, and federal governments. This is not uncommon since they deal with vulnerable populations like children, the old, and the sick. Conversely, there is a significant negative relationship between mitigation and preparedness and organizations in the wholesale/retail sector. One explanation is that organizations in the wholesale/retail sector do not usually deal with vulnerable populations. This may be why they are less likely than organizations in other sectors to mitigate and prepare for disasters. Dahlhamer and D'Souza (1997) also found an insignificant negative relationship between preparedness and organizations in the wholesale/retail sector. In addition, the coefficients on organizational obstacle and organizational obstacle squared show that there is a positive association between mitigation and preparedness and organizational obstacle until organizational obstacle peaks and then the association becomes negative.

Policy Implications

Organizations concerned over the impact of disasters seem to be more likely than those that are not to mitigate and prepare for disasters. This result has an implication for policymaking by suggesting that governments may be able to design and implement computer programs capable of estimating different types of disaster losses. This result may have implications for organizations that have invested in such computer programs. FEMA and The Mid-America Earthquake Center, for example, have invested heavily in HAZUS and MAEviz, respectively (FEMA 2008; Mid-America Earthquake Center 2006). The rationale behind developing these programs is that they can help to visualize disaster impacts and motivate organizations and people to act. The result of this study supports this rationale. However, this study cannot say whether such programs are effective in actually motivating organizations to adopt mitigation and preparedness activities because this depends, among other factors, on the design and implementation of the program. If local, state, and federal agencies can design and implement such programs properly, they may be able to motivate organizations to mitigate and prepare for disasters.

      The significant positive relationship between organizational size and mitigation and preparedness suggests that governments at all levels should regard small businesses as a special group that may need specific incentives like tax breaks and subsidies to make them adopt more mitigation and preparedness measures.

Limitations and Recommendations for Future Research

This study has some limitations. First, this study may suffer from omitted variable bias because of the omission of some independent variables relevant to mitigation and preparedness—past disaster experience, age of the organization, and whether an organization leases or owns its business property (Dahlhamer and D'Souza 1997; Mileti 1999). In addition, this study did not explore community, political culture, and social variables as possible determinants of mitigation and preparedness. Second, recoded values are not the actual values of the missing data. Third, adding mitigation and preparedness activities together implies that each activity is equally weighted. This may not be a reasonable assumption as explained earlier. These limitations engender words of caution in generalizing the results of this study.

This study suggests several next steps in understanding the determinants of mitigation and preparedness in organizations. First, further research is needed that can incorporate the independent variables that this study did not explore to understand fully the relevant determinants of mitigation and preparedness in organizations. Second, researchers may explore community, political culture, and social variables as possible determinants of mitigation and preparedness. Third, it might interest some researchers to investigate the relative costs and benefits of each of the mitigation and preparedness activities. Fourth, future research endeavors might want to examine whether the determinants of mitigation are different than those of preparedness at the organizational level.

Appendix

Results of the Additional Analyses

This study carries out two additional analyses. First, this study drops all the cases with missing values and runs a Tobit analysis using the same independent and dependent variables. The results show that four independent variables (concern over disaster impacts, organizational obstacle, organizational obstacle squared, and organizations in the health sector) that were initially significant (n=215) became insignificant. In addition, two independent variables (organizational obstacle and organizational obstacle squared) reversed their signs.

Second, this study examines each of the mitigation and preparedness activities individually with the same independent variables as in the Tobit analysis. The aim is to gain a deeper understanding of the relationships between each of the mitigation and preparedness activities and each of the independent variables. The number of employees and single-location organization is significant. In fact, number of employees is significant and positive in all the 10 activities. Single-location organization is significant in all but one activity and has a negative sign in all the activities. Organizational obstacle, organizational obstacle squared, and concern over disaster impact are insignificant in all but one activity each. In sum, the results from the two additional analyses differ from that of the current analysis.

Result of the Sample Representative Test

The result of the difference of means tests reveals that there is no statistical difference between the population mean and the sample mean. The implication is that the organizational survey sample is representative of the population based on the number of employees alone. However, this study cannot say anything about the representativeness of the organizational survey sample based on unobservable characteristics like the mitigation and preparedness activities adopted.

Results of the Specification Tests: Nonlinearity and Omitted Variable

This study performs a RESET Test on the data with the aim of investigating whether the relationship between the dependent variable and any of the independent variables is nonlinear. This study created a squared term for each of the independent variables and then tested if these squared terms belong to the model or not (Stata dropped all dummy variables because of perfect collinearity). The null hypothesis is that none of the squared terms of all the independent variables belongs in the model. The result of the F-test revealed that organizational obstacle squared belongs in the model.

This study also performs a LINK test on the mitigation and preparedness model to ascertain if Tobit is the appropriate function to use and if the model has omitted important determinant(s). If the model is specified properly, there should not be any additional determinant(s) that would be significant in the model except by chance. What the LINK test does is to rebuild the model using the linear predicted values (_hat) and the linear predicted value squared (_hatsq). The result of the LINK test indicates that the linear predicted value is a statistically significant predictor and the

linear predicted value squared is not a statistically significant predictor. Since the linear predicted value squared is not significant, the LINK test is not significant. Although the result indicates that my model uses the appropriate function and there are no omitted variables, still there may be problems with the model that the LINK test failed to detect.

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