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MITIGATING AND PREPARING FOR DISASTERS: A SURVEY OF MEMPHIS ORGANIZATIONS

A Dissertation Presented to
The Academic Faculty

By

Abdul-Akeem Ademola Sadiq

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy in Public Policy

Georgia State University and Georgia Institute of Technology

May, 2009

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MITIGATING AND PREPARING FOR DISASTERS: A SURVEY OF MEMPHIS ORGANIZATIONS

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To my parents, Alhaji R. O. Sadiq and Alhaja B. A. Sadiq for emphasizing the importance of good education.

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SUMMARY

Earlier in this study, I explored the disaster literature and pinpointed the contributions made by previous disaster studies and emphasized the gap in the disaster literature regarding the determinants of organizational preparedness and mitigation. My exploration revealed that there is no theory to guide research on the determinants of preparedness and mitigation at the organizational level of analysis. 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 preparedness and mitigation for disasters among Memphis/Shelby County organizations.

The main goal of this study is to answer the question "what are the determinants of mitigation and preparedness at the organizational level?" The following four sub-questions provide good basis for exploring this 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 other types of organizations? (iv) Does organizational size have a positive effect on mitigation and preparedness? In order to answer the question regarding the determinants of mitigation and preparedness in organizations, this study utilizes four independent variables - concern over disaster impacts, organizational obstacles, ownership patterns of organizations, and organizational size. In addition, this study includes three variables as controls for organizational sector: education, health, and wholesale/retail trade.

This study uses Tobit regression technique to identify the determinants of mitigation and preparedness at the organizational level of analysis. Tobit is appropriate because of the censored nature of the dependent variable: Left-censored at zero and right-censored at 10.

The main findings of this study are: (1) Organizational size is a strong positive determinant of mitigation and preparedness in organizations. Larger organizations in Memphis/Shelby County are more likely to engage in mitigation and preparedness activities compared to smaller organizations. (2) Concern over disaster impact is also a strong positive determinant of mitigation and preparedness in organizations. Organizations that are worried about the impact of disasters on their organizations are more likely to engage in mitigation and preparedness activities than organizations that are not. (3) There is a non-linear relationship between organizational obstacle and mitigation and preparedness activities. The coefficients on organizational obstacle and organizational obstacle^2 show that there is a positive association between mitigation and preparedness and organizational obstacles until organizational obstacle peaks and then the association becomes negative.

The policy implications of this study are as follows: (1) The strong positive relationship between concern over disaster impact and engagement in mitigation and preparedness activities suggests that computer programs capable of estimating different type of disaster losses, such as loss of life and property may be able to motivate Memphis/Shelby County organizations to adopt mitigation and preparedness activities. This result suggests that properly designed and implemented programs, which are capable of showing organizations the type and extent of losses they stand to incur if a disaster

occurs might be effective in stimulating organizations to adopt mitigation and preparedness measures. (2) 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 to make them adopt more mitigation and preparedness activities.

CHAPTER I: INTRODUCTION

This study defines disasters as events, such as floods or earthquakes, which lead to major organizational disruption, loss of life, or property destruction. The consequences of disasters include but not limited to deaths, loss of properties, and disruption in business activities. The colossal nature of disaster-induced losses is, indeed, worrisome and evidence from government agencies, insurance community, and the disaster literature suggest continued increases in disaster losses (e.g., Munich Reinsurance Group, 2008). In light of potential future increases in the number of disasters and consequently, disaster losses, there is need to study ways of stemming disaster losses. Although, it is impossible to change the magnitude and frequency of disasters, engaging in mitigation and preparedness activities can help to ameliorate disaster impacts or consequences. In this study, mitigation activities include securing computers and strengthening parts of a building, while preparedness activities include attending disaster meeting/training courses and arranging site visit by consultants to better prepare for disasters.

A number of disaster researchers have established the determinants of preparedness and mitigation at the household level of analysis. According to this literature, adoption of mitigation and preparedness measures depend among other factors on family size, education, previous experience with disaster, gender, and income. However, at the organizational level, there is limited research on the determinants of preparedness and mitigation.

Many large-n quantitative studies in the disaster management literature have focused on levels other than the organization, such as household and community. In

between households and communities are organizations, which disaster researchers have largely neglected (Tierney, 1997; Webb et al., 2000). In this study, the unit of analysis is the organization because they are an important decision-making unit in the community and undoubtedly a significant contributor to the United States economy, and in particular, to the Memphis/Shelby County economy. For instance, small businesses alone provide more than fifty percent of the total employment in the United States (Alesch et al., 2001).

One of the fundamental goals of organizations is survival (Shafritz et al., 2005). Disasters constantly threaten this goal by causing organizational disruption and undermining the economy of communities (Lindell & Perry, 2007). The challenge for organizations is to find ways of ensuring continuity during and after disasters. Organizations stand a better chance of surviving disasters if they have preparedness and mitigation strategies in place before disasters strike (McManus & Carr, 2001). These measures can make it easier for organizations to protect the lives of their personnel and properties as well as help their communities to prepare for and mitigate disasters. The organizations examined in the study are public agencies, nonprofit groups, and private enterprises at risk of major disasters or those involved in seismic risk issues. They include but not limited to utility companies, schools, health facilities, chemical companies, financial institutions, religious institutions, transportation, and restaurants.

Disaster researchers have studied how organizations are preparing for and mitigating disasters in high seismic regions of the United States, especially California. Unfortunately, only a few disaster studies have examined how organizations are preparing for and mitigating disaster risks in a moderate seismic region like the New Madrid Seismic Zone (NMSZ). Evidence in the disaster literature suggests that

organizations in the NMSZ are not prepared for disasters. This study focuses on Memphis/Shelby County because of its high population (Shelby County is ranked 44 out of 3141 counties in the United States in 2000 (United States Census Bureau, 2001), proximity to the New Madrid Fault Zone, and low level of organization preparedness for disasters (Dahlhamer & D'Souza, 1997; Webb et al., 2000). These three conditions could make it possible for a moderate earthquake to cause substantial damage to organizations in Memphis/Shelby County. In addition, these conditions make Memphis/Shelby County an interesting case to study.

This study is important to disaster researchers and the emergency management community in the following ways: First, it is essential to know 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. Second, this study looks at how organizations are preparing for and mitigating different types of disasters in the NMSZ. Third, this study may be of practical use to the emergency management community, especially those in Memphis because it provides hard-to-find information on Memphis/Shelby County organizations' perceived actions regarding risks. Observations from preliminary interviews of Memphis/Shelby County organizations suggests that such rare information would be vital to the Memphis/Shelby County Emergency Management Agency's (EMA) plan to improve how organizations prepare for and mitigate disasters. Fourth, this study helps the Mid-America Earthquake (MAE) Center, Center for Earthquake Research and Information (CERI), Central United States Earthquake Consortium (CUSEC), and other

earthquake organizations by putting earthquakes into the broader context of other hazards in organizational decision-making.

This research question of interest in this study 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 good basis 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 other types of organizations? (iv) Does organizational size have a positive effect on mitigation and preparedness? In addition to this main research question, I explored these three questions. (i) Which disasters are organizations worried about? (ii) Which mitigation and preparedness activities do organizations typically engage in? (iii) Do organizations use disaster information in decision-making? The current study is pre-event, that is it examines what organizations are doing to mitigate and prepare for disasters before disasters strike. Knowing what organizations are doing can help policymakers know where organizations are vis-à-vis mitigation and preparedness and be able to devise necessary mitigation and preparedness policies to take organizations to where they want them to be.

Chapter II begins by discussing the controversies surrounding the definition of disaster and enumerates some examples of past disasters and their estimated losses. Then it presents a review of disaster research at the organizational level and an overview of emergency management in the United States. Next, it discusses the importance of

organizational survival, the determinants of mitigation and preparedness, and organizational obstacles. The chapter concludes with background information on Memphis.

Chapter III presents the methodology use in this study. It begins with the procedure for data collection and the strengths and limitations of the data. Then it presents a model of organizational mitigation and preparedness, the dependent and independent variables, the hypotheses to be tested, and the estimation techniques. Chapter III concludes with an outline of the Heckman approach to sample selection and a brief discussion of sample representativeness.

Chapter IV presents the results of the descriptive and quantitative analyses. This chapter begins with a description of individual respondents. Next, it answers three questions: (i) Which disasters are organizations worried about? (ii) What mitigation and preparedness activities do organizations typically engage in? (iii) Do organizations use disaster information in decision-making? Then, it presents the results of the bivariate analysis and the Tobit regression, which answers the question "what are the determinants of mitigation and preparedness at the organizational level?" Chapter IV concludes by discussing the results of the Heckman approach, the specification tests and results of other additional analyses.

Chapter V presents the conclusions and recommendations of this study. It begins by reiterating the research questions and summarizing the results. Next, it discusses the findings in the context of previous research and examines the policy implications of the results. Chapter V ends by discussing some limitations and recommendations for future research.

CHAPTER II: LITERATURE REVIEW

This chapter begins by discussing the controversies surrounding the definition of disaster and enumerates some examples of past disasters and their estimated losses. Then it presents a review of disaster research at the organizational level and an overview of emergency management in the United States. Next, it discusses the importance of organizational survival, the determinants of mitigation and preparedness, and organizational obstacles. The chapter concludes with background information on Memphis.

Disaster: A Controversial Concept

The word "disaster" is a complicated (Quarantelli, 1985) and vague (Kreps, 1984, 1985) concept. Establishing a clear conceptualization of an issue is important for public policy (Dynes & Drabek, 1994). For example, a clear understanding of the word disaster can provide guidance on proper classification of particular historical events as disasters (Kreps, 1985). Proper categorization is vital in policymaking, such as in disaster declarations and dispatching resources for response and recovery. Similarly, in organizations, an unambiguous understanding of the definition of disasters has implications for decision-making. For instance, having a clear understanding of what constitutes disaster would enable organizations to know the appropriate mitigation and preparedness measures to adopt, e.g., whether or not to tie down business equipment. In addition, it is important to have a good definition of disasters in order to improve data gathering and analysis (Quarantelli, 2003), be able to generalize the findings of disaster

research (Stallings, 2006), and advance theoretical understanding of disaster research (Quarantelli, 1985, 2003). The need for a clear conceptualization and definition of disaster is important in the disaster management literature that disaster researchers have spent much time on defining this concept (e.g., Kreps, 1984, 1985; Quarantelli, 1985, 1987; Auf der Heide, 1989; Mileti, 1999; Perry, 2006; Gerber, 2007). Furthermore, the *International Journal of Mass Emergencies and Disasters* devoted an issue to discussing disasters in 1995 (Mileti, 1999). The question-what is a disaster?-Has received much attention from disaster researchers, especially after the publication of Quarantelli's (1987) presidential address to the International Research Committee on Disasters. Before then, disaster researchers have generally avoided this topic (Quarantelli, 1985). Despite the attention and avoidance, there is no consensus on its definition and conceptualization (Quarantelli, 1985, 1987), to the extent that Quarantelli (1987) stated that disaster research might be at the threshold of a possible paradigmatic revolution. The following paragraph discusses some definitions of disasters to highlight the differences in meaning and conceptualization.

According to Perry (2006), one can trace early definition of disaster to the work of Carr (1932). Carr defines disaster as the "collapse of cultural protections" (Carr, 1932 p 211). This perspective sees disasters as a negative consequence event, a view still in existence today (Perry, 2006). Fritz defines disasters as "…an event, concentrated in time and space, in which a society or a relatively self-sufficient subdivision of a society, undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of essential function of the society is prevented." Cited in Quarantelli (1987 p 655).

According to Mileti (1999), most people agreed with Fritz's definition of disasters until recently when opinion began to diverge. The deviation has led to other definitions of disasters. For instance, Quarantelli (1985) views a disaster as an event in which the demand for action exceeds the capacity to respond. This perspective treats disasters as social "occasions" (Quarantelli, 1985 p 50). Nigg (1996) argues that social scientists define disaster based on social disruption and not on physical characteristics. She sees disasters occurring only "when the built and social environments are so disrupted that the resources of the social system are overwhelmed and the system is unable to meet the demands placed on it for goods and services that are routinely expected by its citizens" (Nigg, 1996 p 5). As a way forward, Quarantelli (1987) notes, among other suggestions, that having consensus on one definition of disaster is not important; clarity of the term and what the term refers to when the word is used are what is important. In the same vein, Perry (2006) recommends having a classification system that the disaster community can scrutinize with the goal of attaining some consensus (Perry, 2006).

My goal is neither to provide a final definition and conceptualization of this controversial word, nor to settle conceptual disagreements. Rather, the goal is to recognize the complexities and controversies surrounding the word and acknowledge the commendable efforts of disaster researchers on this topic. Recall that this study defines disasters as events, such as floods or earthquakes, which lead to major organizational disruption, loss of life, or property destruction. There are two important things to note about this definition. First, it emphasizes the unit of analysis, the organization. By incorporating the level of analysis in the definition of disaster, this study establishes a common context for respondent organizations. Second, this definition emphasizes

property damage and number of injured and fatalities in accordance to some definitions in the disaster literature (e.g., Kreps, 1984; Rotanz, 2007). Incorporating these components- property damage and number of injured and fatalities are a useful way of defining disasters to the target audience, the Memphis/Shelby County organizational representatives. Although, some disaster researchers disagree on the basis that using property damage and number of casualties and injured as criteria for defining disaster may be misleading (e.g., Auf der Heide, 1989).

Disasters as "Acts of God" or "Acts of Men"

There is a literature on disasters that focuses on the distinctions between natural and man-made/technological disasters (e.g., Quarantelli, 1987; Dynes & Drabek, 1994). Quarantelli (1987) provides a good historical account of disasters and traces the sources of disasters-to the stars, God, nature, men and women, and to society. The initial understanding of disasters was that they are "acts of God" (Dynes & Drabek, 1994 p 6). The occurrence of myriad natural disasters prompted many communities to see industrialization and technological advancements as solutions to the problems created by disasters (ibid). For instance, communities built dams to address flooding caused by natural systems. Unfortunately, technological solutions led to increased development and subsequently more disasters (ibid). This led to the realization that disasters may be "natural or technological" (Dynes & Drabek, 1994 p 7) / "acts of men" (Quarantelli, 1987 p 9).

I do not distinguish between natural or technological/man-made disasters because this study is about the determinants of mitigation and preparedness not about the causes

of disasters. Although, some may argue that the causes of disasters can affect how organizations mitigate and prepare for them. In other words, some organizations may mitigate differently depending on whether a disaster is natural or man-made. This study assumes that the distinction between natural and man-made disasters is not relevant in understanding the determinants of mitigation and preparedness.

Expected Losses from Disasters

Researchers have documented the pernicious nature of disasters (e.g., Auf de Heide, 1989). The following examples highlight the monumental losses that can result from 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 & O'Brien, 1992). The September 11 terrorist attacks caused 2973 fatalities (The 9/11 Commission Report, 2004). The estimate of economic losses from Hurricane Katrina is over $200 billion (Burby, 2006). The Midwest floods of June 2008 caused 24 fatalities, injuries to 150 people, destroyed 40,000 properties and 5 million acres of agricultural land (Munich Reinsurance Group, 2008). While these costs vary by year, a new study by FEMA in 2006 indicates that the Annual Estimated Losses (AEL) to the national building stock is $5.3 billion (FEMA, 2007). In the first six months of 2008, the United States has suffered 154 fatalities and about $20.3 billion in estimated total losses to disasters (Munich Reinsurance Group, 2008). Evidence from the disaster literature (e.g., Mileti, 1999; Waugh, 2000) and the insurance community (e.g., Munich Reinsurance Group, 2008) suggest continued increases in losses from disasters. The reasons for the expected

increases include but not limited to rising population density, more settlements in high-risk areas, and increases in technological risks (Auf der Heide, 1989).

Disaster Research at the Organizational Level: The Need for More

Extensive and systematic disaster research began in the early 1950s (Quarantelli, 2003). The focus then was on how individuals, households, communities, and public organizations like fire and police departments responded in the aftermath of disasters (Tierney, 1997). The field of disaster research has expanded since then, 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 & Major, 2000) or on surveys of policy elite active in a community (e.g., Drabek et al., 1983; Mushkatel & Nigg, 1987; Berke & Beatley, 1992; May & Birkland, 1994; Burby et al., 2000; Wood, 2004). Unfortunately, disaster researchers have largely neglected the organizational level (Tierney, 1997; Webb et al., 2000).

Tierney (1997) points out that in the last five years, notable disaster journals and crisis management journals have few articles on organizations and disasters. The few available articles focused on how public-sector organizations are dealing with a particular disaster and not on how the disaster affected businesses (ibid). The emergence of some journals (e.g., Disaster Recovery and Journal of Contingencies and Crisis Management), provides hope for more disaster research on organizations. While these journals are replete with useful information on disasters, many of their articles do not contain

information on the determinants of organizational preparedness (Dahlhamer & D'Souza, 1997) and many focus on single case studies and not on large-scale systematic research (Tierney, 1997). Single cases are not appropriate for generalizing findings from disaster research (Dahlhamer & D'Souza, 1997). The field of organizations has the potential of providing information on businesses and disasters. However, according to Tierney (1997) much of this literature deals with how to manage complex systems. Although, this literature is quite useful, its focuses on rare catastrophic events (e.g. Perrow, 1984), thus making it difficult to generalize findings to typical organizations. The neglect of disaster research at the organizational level may be because organizations are difficult to sample and survey in large numbers; the theoretical lines of inquiry usually direct research activities toward disaster awareness and response among regular citizen or among decision makers; and, some organizations are afraid of the potential consequences of divulging disaster information (Auf der Heide, 1989).

There is a body of disaster research at the business/organizational level on disaster recovery (e.g., Durkin, 1984; Kroll et al., 1991; Tierney et al., 1996; Dahlhamer & Tierney, 1998; Alesch et al., 2001). Some of these post-disaster studies have examined how disasters affect businesses in the short-term (e.g., Dahlhamer, 1998; Dahlhamer & Tierney, 1998) or the longer-term (e.g., W ebb et al., 1999). Others have studied programs aimed at helping businesses in disasters, such as the Small Business Administration loan (e.g., French et al., 1984; Dahlhamer, 1992). This federal loan provides financial assistance to small businesses affected by disasters. These studies are useful for providing insights into why some organizations survive and others do not.

Unfortunately, they cannot tell us about the determinants of mitigation and preparedness at the organizational level.

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 few years 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. Further, Barlow (1993) investigated the impact of Iben Browning earthquake prediction on 20 businesses in the St. Louis area. Dahlhamer & D' Souza (1997) investigated the determinants of business disaster preparedness in Memphis/Shelby County, Tennessee and Des Moines/Polk County, Iowa. 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. Aside from the Dahlhamer and D'Souza (1997) and the Webb et al. (2000) studies, no other disaster study in Memphis used systematic method of data collection to gather disaster information from typical organizations of various sizes representing different industries.

Overview of the United States Emergency Management System

In this section, I take a brief look at the history, phases, and the status quo of emergency management, especially the effects of the 9/11 terrorist attacks on emergency management in the United States. The United States emergency management system

developed in response to particular disasters with no capacity building to address the next disaster (Waugh, 2000). Since fire and flood have been the most common disasters in the United States, these disasters are the basis of the national emergency management system policies (ibid).

Before the 1900s, there were no organized responses to disasters; when disasters occur, individuals simply carried out response activities themselves, or sometimes with the help of family members and neighbors (Rubin, 2007). Volunteer fire brigades and people close to fire outbreaks battled fires using buckets and shovels (Waugh, 2000; Rubin, 2007). With more fire outbreaks, the number of volunteers available and the level of expertise became inadequate thus, leading to the establishment of professional fire departments in many communities (Rubin, 2007). The occurrence of major natural disasters that spanned many states prompted the federal government to create national level organizations, like the National Weather Service, consequently, paving the way for planned and systematic approaches to emergency management (ibid). The occurrence of major disasters in the 1900s (e.g., 1900 Galveston hurricane, the 1906 San Francisco earthquake, and the great Mississippi flood of 1927) overwhelmed individual capability to respond, thus leading to more governmental roles in disaster response (ibid). The federal government's increased interest in emergency management led to the passage of the *Disaster Relief Act of 1950*, which gave the federal government the authority to make disaster declarations (Waugh, 2000). The federal government was also interested in civil defense, particularly during the World War II. As a result, the federal government created the *Federal Civil Defense Act of 1950* (ibid). This act became even more relevant during the cold war with the Soviet Union. Amid the cold war, major disasters-Alaska

earthquake in 1964, Hurricane Betsy in 1965, Hurricane Camille in 1969, Hurricane Agnes in 1972, Three Mile Island nuclear mishap in 1979-drew public attention (ibid) and exposed the fragility of the current emergency management system (Rubin, 2007). Pressures from various quarters prompted President Jimmy Carter to create the Federal Emergency Management Agency (FEMA) in 1978 (Waugh, 2000). FEMA is the lead agency for emergencies in the United States and responsible for coordinating disaster efforts with states, local emergency, and nongovernmental agencies.

Although, disasters often wreak havoc whenever and wherever they occur, they provide us with lessons that can help to sinew our national emergency management system. One such disaster is the 9/11 terrorist attacks which changed the world of emergency management (Tierney, 2006; Rubin, 2007; Waugh, 2007). These attacks have altered the social and political context of emergency management (Waugh, 2007), so much so that Tierney (2006, p 406) describes the attacks of 9/11 as the "ultimate focusing event". Two vivid examples of social changes are the contracting out of emergency management services to private and nonprofit organizations and the increased participation of local governments in emergency management decisions (Waugh, 2007). On the political side, the most visible change is that FEMA was subsumed under the Department of Homeland Security in 2003 (Tierney, 2006; Rubin, 2007; Waugh, 2007). This reorganization has led to diminished capabilities to deal with natural disasters (Waugh, 2006; Gerber, 2007). For instance, the reorganization has resulted in the diversion of financial and human resources from other threats, such as hurricanes to securing the homeland (Tierney, 2006; Waugh, 2007).

According to Waugh (2000), the National Governors' Association developed the "all hazard" approach in the early 1970s (FEMA adopted this model afterwards). The assumption of this model is that disasters have some elements in common. Therefore, the expectation is that local, state, and federal emergency programs and policies can take advantage of the similarities by developing generic responses for different hazards. Emergency managers can design similar warning systems and use the same mass evacuation plan for different disasters. For example, local shelters could serve as a place of refuge for both earthquake and hurricane victims. Waugh (2004) enumerates some advantages of the "all hazards" approach-it reduces cost and saves time, standardizes some aspects of the four phases, provides a framework for organizing our thinking, easy to remember and follow during emergencies, and creates opportunities for risk managers to have broader perspectives on hazards and disasters. On the contrary, it may be sometimes difficult to identify common elements among the four phases for all types of disasters or emergencies. For instance, preparing for pandemic flu may have little or no similarities with preparing for an earthquake due to the air-borne nature of the former.

The all-hazard model divides all emergency management programs and policies into four activities: mitigation, preparedness, response, and recovery (Waugh, 2000). These four activities or phases constitute the disaster policy cycle (May, 1986). Mitigation includes those activities aimed at preventing or reducing losses from disasters (Waugh, 2000). These activities can be structural or non-structural. Structural mitigation activities include adopting building codes, building levees and including surveillance equipment in buildings to prevent terrorist attacks (ibid). Non-structural mitigation measures include instituting land-use regulations and zoning ordinances to prevent people

from building in floodplains. Preparedness is planning for response purposes and developing effective response capabilities before an emergency or disaster occurs (ibid). It encompasses all actions taken to allow social units to respond after disasters (Tierney et al., 2001). Preparedness activities include training responders, establishing warning systems, developing contingency plans, and acquiring equipment and supplies. Response entails reacting immediately to disasters or emergencies (Waugh, 2000). Response activities include detecting threats, issuing warnings, evacuating threatened populations (Tierney et al., 2001), supplying water to victims, covering building rooftops, providing shelter, and providing medical services. Recovery, which is typically the one-year after a disaster deals with long time restoration of a disaster-stricken community after an emergency or disaster (Fothergill & Peek, 2004). Recovery activities include restoring lifelines like power and telephones, providing counseling for responders, making small loans available for victims, removing debris, and facilitating long-term reconstruction of homes and businesses.

Disasters and Organizational Survival

An organization is "a social unit with some particular purposes" (Shafritz et al., 2005 p 1). One of the fundamental goals of organizations is survival (ibid).The survival of organizations is very important so much so that organizational theorists have devoted much time to studying how organizations manage to survive (e.g., Pfeffer & Salancik, 1978). Acquisition and maintenance of resources are vital to organizational survival (Alesch & Petak, 2001; Pfeffer & Salancik, 1978). Because no organization is self reliant, every organization must transact with its external environment for needed resources

(ibid). However, the external environment is not dependable and may sometimes threaten the survival of organizations. Disasters may cause organizational disruption (Lindell & Perry, 2007), loss of sales and property taxes (Tierney, 1994), and loss of services from public organizations and nonprofits, consequently, undermining the economy and support systems of communities (Lindell & Perry, 2007). For instance, earthquakes may destroy lifelines, like major highways, on which organizations depend for transporting raw materials and rendering services. Organizations cannot control the physical characteristics of disasters, such as magnitude and frequency (Nigg, 1996); they can however, reduce their impacts. Organizations can ameliorate disaster impacts by engaging in a number of mitigation and preparedness measures (Dahlhamer & D'Souza, 1997). In order to ensure survival, organizations should evaluate their vulnerability to various disasters and take appropriate preparedness and mitigation steps accordingly. In so doing, organizations would stand a better chance of remaining open and continuing their day-to-day operations during and after disasters.

The Importance of Mitigation and Preparedness

Mitigation and preparedness are crucial to the design of effective disaster policies (May, 1986). 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 & D'Souza, 1997) and serve as a first step in understanding recovery in organizations. In other words, mitigation and preparedness can assist researchers in understanding why some organizations fail and others survive disasters. For instance, researchers may gather pre-disaster information from a particular sample of organizations on mitigation and preparedness and then examine the same organizations post-disaster to understand the mitigation and preparedness strategies that were instrumental to survival and those that were not.

Determinants of Mitigation and Preparedness in Organizations

The overall objective of this section is to review the literature on the determinants of mitigation and preparedness in organizations. Due to limited studies on this topic, much of the information will emanate from the literature on how households and organizations mitigate and prepare for disasters.

A major preoccupation for researchers and practitioners involved in disaster management is developing an understanding of the factors leading to the adoption of mitigation and preparedness measures. At the household level, mitigation and

preparedness activities might include purchasing earthquake insurance, shutting off utilities, developing emergency plans, buying first aid kits, and storing food and water (e.g., Davis, 1989; Mileti & O'Brien, 1992; Edward, 1993; Farley et al., 1993). At the community level or policy subsystem level, they might include building codes, zoning ordinances, and land use planning (e.g., Olshansky, 1994; Flynn et al., 1999). Organizations can also engage in a number of mitigation and preparedness activities, such as bracing shelves and equipment, purchasing earthquake or flood insurance, developing an emergency plan, buying generators, and storing supplies (Dahlhamer & D'Souza, 1997).

At the household level of analysis, many disaster researchers have focused on the determinants of preparedness and mitigation. At this level, the story is clear; household preparedness depends, among other determinants on presence of children (Edwards, 1993), marital status (Dooley et al., 1992), education (Edwards, 1993; Bourque et al., 2006), concern about a disaster (Dooley et al., 1992), household income (Edwards, 1993; Bourque et al., 2006), and length of residence (Dooley et al., 1992). At the organizational level, the determinants are ambiguous and the number of research is limited. Some scholars have recognized the dearth of studies in this area and have called for more research on disaster preparedness and mitigation at the organizational level (e.g., Drabek, 1986; Dynes & Drabek, 1994). Drabek (1986) came to this conclusion after his review of the disaster literature unearthed only a few disaster studies on organizational disaster preparedness. He argues that more research in this field would enable disaster researchers document the determinants of disaster planning within the private sector (ibid). Some researchers have heeded Drabek's call. About a decade ago, Dahlhamer & D'Souza

(1997) studied the determinants of business disaster preparedness in Memphis/Shelby County, Tennessee and Des Moines/Polk County, Iowa. A few years later, Webb et al. (2000) used a series of surveys to explore the preparedness and recovery experiences of businesses in different parts of the country, including Memphis, Tennessee. The following paragraphs discuss the determinants of mitigation and preparedness in organizations.

Firm size is the most consistent (Dahlhamer & 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 did. 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 do. Such a resource argument is common in the literature on disasters at the household (Mileti, 1999), community (May & Birkland, 1994; Wood, 2004), and organizational level (Mileti et al., 1993; Dahlhamer & D'Souza, 1997; Tierney, 2006).

The next determinant is previous disaster experience. In a study of business preparedness among 20 St. Louis businesses, Barlow (1993) found that previous disaster experience was the best predictor of business preparedness. Similarly, Drabek (1994a,

1994b) found that businesses with more disaster experience engaged in more disaster evacuation planning than those with little or no experience of a disaster.

Another determinant of organizational mitigation and preparedness is own or lease business property. Although, this determinant has been found to be related to household preparedness (e.g., Turner et al., 1986), it has only been examined in relation to business preparedness about a decade ago by Dahlhamer & D'Souza (1997). These researchers found that businesses that owned their properties were more likely than those that leased their properties to engage in more preparedness. This result makes sense because owners of a business property would be more interested in the survival of the property than lessees would (Webb et al., 2000). In addition, owners of a property have the legal authority to make changes to it. For instance, the owner of a building can make structural changes, while a lessee would not have the legal authority to make such changes.

Evidence in the disaster literature indicates that some sectors engage in more mitigation and preparedness than others do. 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, in their study of 54 firms on preparedness for earthquakes in San Francisco, Mileti et al. (1993) found an indirect relationship between firm type and earthquake preparedness. Further, Dahlhamer & D'Souza (1997) found that businesses in the 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).

The age of an organization is the next determinant of interest. Drabek (1991) found that firms that have been in existence for at least six years were more likely to have more extensive disaster evacuation plans than younger firms were. On the contrary, Quarantelli et al. (1979) found that newer chemical firms were more likely than were older chemical firms to prepare for disasters. In sum, the findings regarding the effect of age on organizational preparedness are inconsistent (Dahlhamer & D'Souza, 1997).

Evidence in disaster research suggests that high level of concern over disaster impacts, such as loss of life and personal injury, may induce individuals to engage in preparedness activities (Nigg, 1986). 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. There is a body of research on risk and disaster visualizations, which suggests that information on the potential impacts of disasters can motivate people to reduce their risks (e.g., Sandman, et al., 1994).

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 did. 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 did. This finding may be due to the mandates given to local chapters by corporate headquarters to engage in disaster preparedness (Dahlhamer & D'Souza, 1997).

Organizational obstacles

Both internal and external obstacles confront organizations. This study focuses on internal organizational obstacles to disaster mitigation and preparedness, while recognizing that there are external organizational obstacles as well, such as competition from other organizations. By internal organizational obstacle, I mean factors inside the organization that inhibit organizations' ability to mitigate and prepare for disasters. For instance, lack of information on disasters can impede the adoption of mitigation and preparedness activities by organizations. This study examines three types of internal organizational obstacles and their relationship to mitigation and preparedness (i) lack of information (ii) lack of management and organizational members' support, and (iii) lack of financial resources. Because I consider internal obstacles only, the word "obstacle" implies internal organizational obstacles.

Information

Disasters can sometimes be beyond human control. We can however, mitigate and prepare using an important ingredient, the acquisition of information (Major, 1998). For instance, in making the choice to allocate resources toward disaster mitigation and preparedness, organizations need information about possible damages of potential disasters. This study does recognize that mere availability of information does not automatically guarantee the adoption of mitigation and preparedness activities by an organization. There may need to be changes in the belief of organizational members or changes in the political status quo, which may take several years to occur (Sabatier,

1999). This study refers to any information that is suppose to help or has the potential to help organizations mitigate and prepare for disasters as "disaster-related information". Disaster-related information can be in the form of hurricane, earthquake, and flood, forecasts. For example, hurricane forecasts can provide organizations with information on the path of a hurricane. Organizations can obtain disaster-related information from representatives of federal, state, and local governments, nonprofits, private sector, and research institutions. 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 & Mukerjee 1974; Sullivan et al., 1977; Palm, 1981; Turner, 1983; Russell et al., 1995; Flynn et al., 1999; Atwood & Major, 2000; Celsi et al., 2005). A notable example is the impact of Iben Browning's forecast that a major earthquake in the NMSZ would occur around December 3, 1990 (e.g., Farley et al., 1993; Showalter, 1993; Atwood & Major, 2000). This prediction led to an increase in household preparedness (Farley et al., 1993) and made households more prepared for future earthquakes (Showalter, 1993). I grouped the following three obstacles under lack of information: lack of information about the frequency and magnitude of disasters, lack of convincing information about the potential impacts of disasters, and unclear organizational benefits from disaster planning and mitigation.

Management Support

Researchers have documented the pivotal role policy entrepreneurs or champions play in the policymaking process (e.g., Kingdon, 1984; Prater & Lindell, 2000; Wood, 2004; Olshansky, 2005). These entrepreneurs are willing to, among other strategies, mobilize support for their issues if necessary (Berke & Beatley, 1992). 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. In order to make structural changes to an organization's building, the support of upper level management is paramount. This study is interested in knowing whether organizations consider lack of support from upper-level management and lack of support from mid- and lower-level organizational members as obstacles to disaster planning.

Financial Resources

Mitigating and preparing for disasters require time, money, and effort (Wyner & Mann, 1986). Lack of financial and technical resources can constrain the adoption of earthquake mitigation policies (Bostrom et al., 2006). This study focuses on whether organizations consider lack of financial resources as an obstacle to disaster planning.

Study Location: Memphis/Shelby County and Disasters

Memphis is the largest city in Tennessee with a population of about 650 thousand people. Its location on the banks of the Mississippi River provides access to river navigation and protection from pernicious floods. 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 United States (magnitude 7.0-8.1) occurred in the NMSZ (Memphis/Shelby County were not a settlement then) between December 16, 1811 and February 7, 1812 (United States Geological Survey (USGS), 2008a). While many dispute the characterization of the risk, 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. In comparison to California, the USGS (2008b) notes that the odds of a

magnitude 6.7 or larger earthquake in the next 30 years in California is more than 99 percent. In general, the seismic risks from the NMSZ are of low probability and high consequences (Olshansky, 1994).

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 occurrence of major earthquakes (what Birkland, 1997, refers to as *focusing event*) can induce organizations to adopt mitigation and preparedness measures. Absence of such disasters makes organizations apathetic and reluctant to adopt such measures (May, 1986; Lindell & Perry, 2007). In addition, a vast majority of studies on earthquakes and disasters exist on the west coast and, especially, California (e.g., Jackson & Mukerjee, 1974; Kiecolt & Nigg, 1982; Mulilis & Duval, 1995; Argothy, 2003; May & 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 & Nigg, 1987; Olshansky, 1994; Farley, 1998; Major, 1998; Atwood & Major, 2000). Finally, studies on organizational preparedness suggest that organizations in

Memphis/Shelby County do little to prepare for disasters (e.g., Dahlhamer & D'Souza, 1997; Webb et al., 2000).

CHAPTER III: METHODOLOGY

The goal of this chapter is to present the methodology of this study. It begins with the procedure for data collection and the strengths and limitations of the data. Then it presents a model of organizational mitigation and preparedness, the dependent and independent variables, the hypotheses to be tested, and the estimation techniques. The chapter concludes with an outline of the Heckman approach to sample selection and a brief discussion of sample representativeness.

Data Collection

The data used in this study comes from the collective effort of a group of researchers and graduate students (I was one of the graduate students) studying the influence of organizational structures on earthquake decision-making in Memphis/Shelby County, Tennessee. I will refer to this data as the organizational survey data and this group of researchers as the research team.

The research team collected disaster information from a stratified random sample of public, private, and non-profit organizations involved in disaster risk issues and organizations that a major disaster will significantly affect. The target organizations included, but were not limited to utility companies, schools, health facilities, chemical companies, pharmaceutical companies, financial institutions, religious institutions, transportation, and restaurants. The data gathering procedure occurred in two phases: Interview phase and survey phase. In addition to these two methods, the research team

used publicly available documents and reports, such as newspaper articles. Table 3.1 shows the research schedule, which started in fall 2005 and ended in spring 2007.

Table 3.1. Research schedule

Task	Schedule
Analyze publicly available documents and reports	Fall 2005-Spring 2007
Identify stakeholders, private and public organizations	Fall 2005
Develop interview instrument and conduct interviews with organizational representative(s)	Spring 2006
Develop survey instrument and conduct surveys	Summer 2006-Fall 2006
Analyze data	Fall 2006-Spring 2007
Prepare stakeholder report	Spring 2007

Interview Phase

In this 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 typed up the interviews and sent them back to the interviewees to ensure the accuracy of the information provided.

Survey Phase

This phase consisted of a survey administered in fall 2006. The interviews informed the survey questions, which 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. Since the number of organizations in categories with less than 100 employees far exceeded the number of organizations in categories with hundreds of employee, the research team stratified the population by employee size to allow organizations of all sizes in the Memphis Metropolitan Area to be surveyed and represented in sufficient numbers to analyze. There were 11 categories, which ranged from one employee to over 9999 employees. 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 6 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 Dillman's total design method (Dillman, 2000). Dillman's method emphasizes a systematic series of remailings and follow-ups to achieve an optimum response rate (ibid). This method is common among disaster researchers (e.g., Palm, et al., 1990; Edwards, 1993; Showalter, 1993; Tierney, 2000). The research team mailed a letter on University letterhead to each of the 733 organizations. This letter described the study and sought their participation. The research team then mailed the first batch of surveys and followed-up with postcards,

and then the second batch of surveys. The research team received organizational characteristics recorded in *ReferenceUSA*, such as name, address, city, and Zip Code. The research team removed all identifying information (including names and addresses) and duplicates from this dataset and merged it with information from the survey to generate the organizational survey data. Table 3.2 shows all the organizational characteristics and their descriptions.

Table 3.2. Organizational characteristics and their descriptions

Organizational Characteristic	Description
NAME	Company Name
ADDRESS	Address of company
CITY	City location of company
ST	State location of company
ZIPCODE	Zip code
ZIP4	Postal code for geographic segment
COUNTY	County location of company
MSA	Metropolitan Service Area
PHONE	Phone number
FAX	Fax number
EMP_SIZE	Number of employees
SALES	Category for amount of sales
BUS_STATUS	Branch, single location, subsidiary
PARENT_COMPANY_NAME	Name of company that owns business
LASTNAME	Last Name of person liable
FIRSTNAME	First Name of person in liable
TITLECODE	Title of person liable
GENDER	Male or female
CREDIT_RATING	Companies credit rating – descriptive category
URL	Internet address
NAICS	North American Industry Classification System
NAICS_DESCRIPTION	Type of Company
CREDIT_RATING_SCORE	Credit rating scale based on alphabet
CREDIT_NUMERIC_SCORE	Numeric credit score
SQUARE_FOOTAGE	Physical space of building in square feet
OWN_OR_LEASE	Site owned or leased
WORK-AT-HOME	Home based business
YEAR_ESTABLISHED	Year business was established
LATITUDE	Latitude coordinates
LONGITUDE	Longitude coordinates
PSICCODE	Primary Standard Industrial Classification Code
PRIMARY_SIC_DESCRIPTION	Description of Standard Industrial Classification Code

Source: Adapted from *ReferenceUSA*

Of the 733 organizations, 227 Memphis/Shelby County organizations returned the survey, giving a response rate of about 31% (10 organizations declined to participate in the study for various reasons, e.g. business is not fully operational and due to private nature of business). Although, this response rate may appear low, there is evidence that similar response rates are common in disaster research. For instance, Showalter's (1993) earthquake study at the household level obtained a response rate of 30%. Some researchers actually think a response rate of 30% is high in earthquake research (e.g., Davis, 1989). The low response could be because the research team addressed the surveys to the owners or risk managers of organizations. Owners of organizations, especially those whose organization do not have risk managers may not have the time to answer our surveys. Nevertheless, what is more important about this response rate is the extent to which it provides a balanced sample of the original population, which I discuss later in this study.

In addition to the interviews and surveys, the research team analyzed publicly available documents and reports. Memphis newspapers were particularly helpful in providing historical background on disasters in the Memphis Area. Equally useful were the USGS and FEMA reports that provided geologic and historical information on the NMSZ.

Data Strengths and Limitations

Data Strength

The organizational survey data is unique in two ways. (i) It contains 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, 1998). One of the reasons given for not wanting to answer the survey is the fear of divulging information to the public. In addition, most studies on disasters have focused on levels other than organizations (Tierney, 1997; Webb et al., 2000). (ii) It contains information on organizational mitigation and preparedness for many types of disasters in a moderate seismic region. 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 Disaster Research Center (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 regions, like California, only a small number of researchers have surveyed organizations in the NMSZ.

Data Limitation: Internal Validity

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 to understand how Memphis/Shelby County organizations are coping with disasters. These interviews helped the research team understand the issues of interest and the way Memphis organizations conceptualize these issues. For instance, the research team gained insights on what Memphis/Shelby County organizations understand by the word “disasters”. Their understanding of the word seems to emphasize mainly natural disasters like earthquakes, tornadoes, and hurricanes. This helped the research team to define relevant

concepts properly prior to administering the surveys. However, this study recognizes 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 already knew what issues were of interest to the research team from the preliminary interviews. Fortunately, the research team interviewed only 15 organizations.

Data Limitation: Data Entry Errors and Reliability

Reliability relates to questions of stability and consistency (Singleton & Straits, 1999). Two graduate students, including myself entered and coded the organizational survey data separately. The other coder and I resolved a few discrepancies, which were mainly typographical in nature. The objective is to make sure that both coders using same coding and data entry instruments obtain equivalent results (ibid).

Data Limitation: Missing Values

The organizational survey data has a number of missing values: Total number of mitigation and preparedness activities (19), disaster impact (21), and organizational obstacle (55). I recoded missing values as zeroes for the dependent variable, total number of mitigation and preparedness activities. The recoding has implication for interpreting this dependent variable when it has a value of zero. A value of zero for this variable now represents respondents that did not engage in any mitigation and preparedness activity or that did not provide an answer to this question. In addition, I recoded missing values and "not applicable" responses as zeros for the independent variables, disaster impact and organizational obstacle. Similarly, this recoding changes the way I interpret these independent variables when they have a value of zero. A value of zero for both

independent variables represent respondents that selected not applicable or respondents that did not answer either of the two questions on these independent variables. 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 one. After the recoding exercise, the sample size went up from 146 to 215. Later in this study, I carry out some analyses using 146 and 215 observations and compare the results. The goal is to ascertain if the recoding has any effects on the results.

Data Limitation: Selection Bias

One of the potential problems of any survey is selection bias. The organizational survey dataset is not immune from this problem. Each organization in the sample population (733) may not have an equal chance of answering the survey. For instance, organizations that responded to the survey may be those that actually care about disasters and may already be mitigating and preparing for disasters. Others not interested in disasters and not doing anything to mitigate and prepare may be less apt to answer the survey. The implication is that the sample may not be representative of the general population of organizations in Memphis/Shelby County. If I run OLS on a sample that suffers from selection bias, the sample coefficients will be biased (Giles, 2001). There are some ways of addressing selection bias problems including the Heckman's approach and the bounding method. Later in this study, I use the Heckman approach to correct potential selection bias problems.

Unit of Analysis

Disaster researchers have studied disasters at levels other than the organization. In fact, many studies in the disaster management literature focus either on household surveys (e.g., Davis, 1989; Dooley et al., 1992; Edwards, 1993; Farley, 1998; Atwood & Major, 2000) or on surveys of policy elites active in a community (e.g., Drabek et al., 1983; Mushkatel & Nigg, 1987; Berke & Beatley, 1992; May & Birkland, 1994; Burby et al., 2000; Wood, 2004). Due to the relative shortage of disaster research at the organizational level compared to other levels of analysis, some researchers (e.g., Tierney, 1997; Webb et al., 2000) have called for more research at the organizational level. The unit of analysis in this study is the organization. The potential for organizations to mitigate and prepare for disasters is immense. This study recognizes this huge potential and hopes to make policy recommendations aimed at capitalizing on the potentials of organizations in mitigating and preparing for disasters.

A Model of Organizational Mitigation and Preparedness

In this section, I present a model of mitigation and preparedness at the organizational level of analysis. This model was developed based on prior research on business disaster preparedness (e.g., Quarantelli et al., 1979; Dahlhamer & D'Souza, 1997; Webb et al., 2000) and earthquake preparedness at the household level (e.g., Nigg, 1986; Showalter, 1993). This study assumes that the relationships that exist at the organizational level between the dependent variable and the independent variables will also exist at the household level.

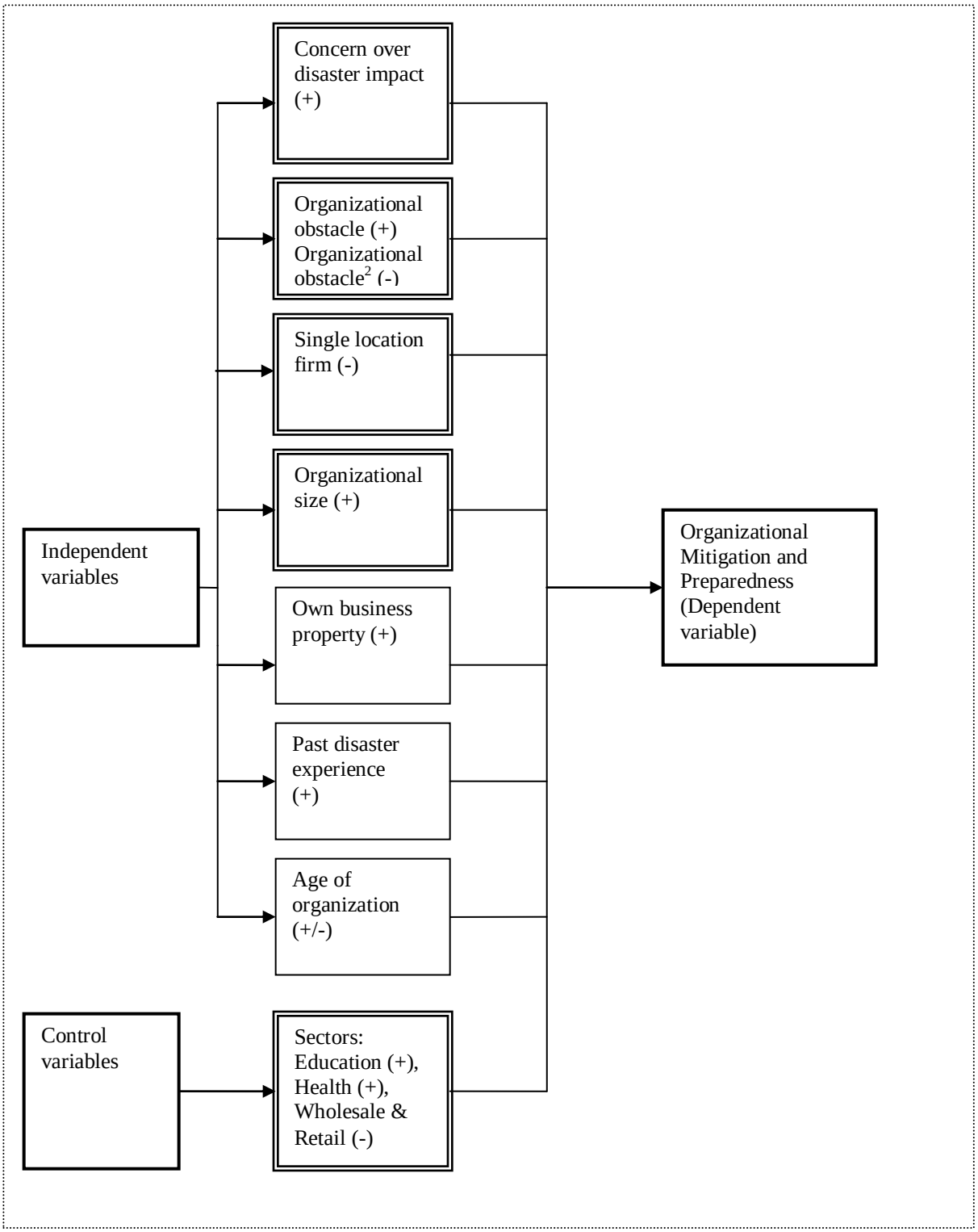

Figure 3.1. A model of organizational mitigation and preparedness.
Source: Author

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 (Figure 3.1). Double borders represent independent variables that this study analyzes. Single borders represent independent variables that this study does not analyze due to unavailability of information (e.g., past disaster experience) and missing values (e.g., own business property and age of organization). Efforts to fill the gaps have not yielded positive results. For instance, I have visited the websites of some of the organizations who did not specify the year their organization was established in the hope of finding this information. I was successful for a few, but many did not indicate this information on their websites.

Variable Measurement

Dependent variable

This study defines the dependent variable, total number of mitigation and preparedness activities as organizational 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: (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 non-structural 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. I created 10 dummy variables, each coded 1 for those organizations who said they engaged in that particular activity over the year and 0 otherwise. I added the responses for each respondent to arrive at the total number of mitigation and preparedness activity, *totactivity* for each observation. This ten-item index is very reliable (Cronbach's alpha = .88). Adding mitigation and preparedness activities together is a simple and convenient way of creating an index, but it does have its own problems. First, the addition implies that each activity is equally weighted. Based on effort, for example, 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. The lower and upper bounds create problems for Ordinary Least Square (OLS) regression technique. I discuss the implication of these bounds for OLS later in the study.

This study examines two other proxies for mitigation and preparedness. The first is use of disaster information. The survey question states "Do you use disaster-related information to help make decisions in your organization?" Respondents could answer either a yes or a no. This dependent variable is dichotomous and I coded it as follows: yes

= 1 and no = 0. The second proxy for mitigation and preparedness is presence of risk manager. The survey question asks respondents; "Does your organization have a risk manager?" Respondents could answer either a yes or a no. This dependent variable is also dichotomous and coded: yes = 1 and no = 0.

This study examines briefly another construction of the dependent variable-*active* and *passive measures* to address disaster risks. *Active measures* are those activities that involve an organization actually doing something to address disasters not just discussing about actions to take (activities i, iii, vi, vii, viii, ix, & x). *Passive measures* are activities that involve an organization simply discussing or mentioning potential actions in an organizational meeting (activities ii, iv, & v).

Independent variables

This study explains mitigation and preparedness using the following independent variables: (i) Concern over disaster impacts, (ii) organizational obstacles, (iii) ownership patterns of organizations, and (iv) organizational size. In addition, this study includes three variables as controls for organizational sector: education, health, and wholesale/retail trade. Table 3.3 shows the independent variables, their operational measures and scales of measurement, and the theoretical justification for their inclusion.

Table 3.3. Independent variables, operational measures, coding scheme, and theoretical justification

Independent Variables	**Operational Measure**	**Coding Scheme**	**Causal Explanation/ Theory**
Concern over disaster impact	An index of 13 measures of disaster impact	Likert scale: 1=Minor Adverse Impact to 5=Major Adverse Impact	(Nigg, 1986; Showalter, 1993)
Organizational obstacles	An index of 6 measures of organizational obstacle	Likert scale: 1= Minor obstacle to 5=Major obstacle	(Major, 1998; Wood, 2004; Bostrom et al., 2006)
Single location organization	Obtained from Memphis Regional Chambers of Commerce	0= "other" organizational type, 1=single location organization,	(Quarntelli et al., 1979; Drabek, 1991, 1994a, 1994b, 1995)
Organizational size	Obtained from Memphis Regional Chambers of Commerce	Continuous: Number of employees	(Quarantelli et al., 1979; Dahlhamer & D'Souza, 1997; Webb et al., 2000)
Sector-Education, Health, and Wholesale/ Retail trade.	Obtained from Memphis Regional Chambers of Commerce	Dichotomous: 0= "other" sector, 1= Educational sector 0= "other" sector, 1= Health sector 0= "other" sector, 1= Wholesale/Retail sector	(Drabek, 1991, 1995 ; Dahlhamer & D'Souza, 1997)

Concern over Disaster Impacts

As discussed in chapter two, disasters are capable of inflicting different types of impacts, from loss of life to property destruction. 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 (e.g., Nigg, 1986; Showalter, 1993). Although, these examples are at the household level, I expect similar relationship between concern over disaster impact and mitigation and preparedness at the organizational level. In other words, organizations that are concerned about disaster impacts are likely engage in mitigation and preparedness activities. For example, organizations concerned over loss of employee life will be more likely to engage in mitigation and preparedness activities than organizations that are not. I measure 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 and 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, (xiii) transportation disruption. The scale of the variables is 1 to 5 (minor to major adverse impact). For simplicity, I consider scales1and 2 to be minor adverse impact, scale 3 to be moderate adverse impact, and scales 4 and 5 to be major adverse impact. I create a new independent variable, *meanimpact*, 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

I measure this independent variable by the survey question "Please indicate the extent to which 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 lover-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). For simplicity, I consider scales1and 2 to be minor obstacle, scale 3 to be moderate obstacle, and scales 4 and 5 to be major obstacle. I developed an index, *meanobstacle* the mean of all the obstacles by adding the values for all the obstacles together (Cronbach's alpha = 0.85) and dividing by six. I generated a new variable, $meanobstacle^2$ in Stata by squaring *meanobstacle*. This new variable takes care of the non-linear relationship between the dependent variable, *totactivity* and the independent variable, *meanobstacle*.

Ownership Pattern of Organizations

As discussed previously, by ownership pattern I mean whether an organization is a single firm or a franchise. Evidence in the disaster literature indicates that franchises do more to mitigate and prepare for disasters than single firms (e.g., 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 & D'Souza, 1997). This study operationalizes this variable by the number of employees in an organization. Table 3.4 shows the seven organizational size categories, the codes, frequencies, and percent for each category. More than half of the organizations in the sample have less than one hundred employees. Memphis Regional Chambers of Commerce provided the information on organizational size.

Table 3.4. Employee size categories

Employee size	**Code**	**Frequency**	**%**
1-9	1	37	17.21
10-19	2	22	10.23
20-49	3	30	13.95
50-99	4	32	14.88
100-249	5	47	21.86
250-499	6	33	15.35
>=500	7	14	6.51
Total		**215**	**100**

Organizational Sector

Disaster researchers have found a significant relationship between organizational sector and engaging in preparedness activities (Drabek, 1991; Mileti et al., 1993; Drabek, 1995; Dahlhamer & D'Souza, 1997). I introduce 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 if otherwise. I obtained the information on organizational sector from Memphis Regional Chambers of Commerce.

Disaster Worry Levels for Different Disasters

This variable is not part of the regression but I discuss it in the descriptive analysis. The survey question states, "Using the thermometer scale below, please indicate the extent to which you perceive the following disasters are a worry for your organization", on a scale of 100 (a great deal of worry), 50 (moderate worry), and 0 (no worry at all). The survey enumerated 15 disasters (Bird flu/pandemics, chemical spills, drought, earthquakes, extreme heat, extreme winds/tornadoes, fires, flooding, hurricanes, ice storms, severe storms, terrorist attacks, toxic releases, violent crimes, and water pollution). In the "other" category, respondents indicated that they were concerned about economic problems, racism, food contamination, blackout, vandalism and theft, airplane crash, work stoppage (e.g. strikes), intruders, air pollution, and food poisoning.

Hypotheses

Recall that the main objective of this study is to answer the question "what are the determinants of organizational mitigation and preparedness?" To answer this research questions, I explore sub-questions i-iv below using alternative hypotheses 1-4 respectively (the null hypotheses is that there is no relationship between each of the independent variables and the dependent variable). In addition, I use descriptive analysis to address sub-questions (v-vii).

i. Does concern over disaster impact lead to more mitigation and preparedness?
ii. What is the relationship between organizational obstacles and mitigation and preparedness?

iii. Do single location organizations engage in less mitigation and preparedness than other types of organizations?

iv. Does organizational size have a positive effect on mitigation and preparedness?

v. Which disasters are organizations worried about?

vi. Which mitigation and preparedness activities do organizations typically engage in?

vii. Do organizations use disaster information in decision-making?

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 firms will be less likely to engage in mitigation and preparedness activities than other types of organizations.

Hypothesis 4: There is a positive relationship between engagement in mitigation and preparedness activities and organizational size.

Estimation Methodology

Tobit Analysis

In this section, this study uses Tobit analysis to answer the question "What are the determinants of organizational mitigation and preparedness?" This study assumes that there are some organizations in the sample that are against the adoption of mitigation and preparedness activities. This study regards these organizations as having negative values for mitigation and preparedness activities. Similarly, this study assumes that there are

some organizations in the sample that engaged in more than 10 mitigation and preparedness activities over the past year. For instance, some organizations might have stored water and food in addition to the 10 activities.

Unfortunately, I have 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. This means that I cannot observe organizations that are below 0 or above 10. Tobit is the appropriate technique for analyzing censored samples because it will take in to account organizations that engage in negative and above 10 mitigation and preparedness activities.

OLS assumes normality meaning that the cumulative density function (CDF) sums to one. However, due to the lower and upper bounds, the CDF does not sum to one. Under this scenario, OLS is inappropriate. If I use OLS, the coefficients will be biased and inconsistent. Tobit analysis corrects the omitted variable bias and accounts for the fact that the expected values of the errors are changing. The Tobit model in this study takes the form:

Organizational Mitigation and Preparedness (Y_i*) = β_0 + β_1 (disaster impact) - β_2 (organizational obstacle) + β_3 (organizational obstacle^2) + β_4 (single location) + β_5 (organizational size) + β_6 (educational sector) + β_7 (health sector) - β_8 (wholesale/retail sector) + ε

Organizational Mitigation and Preparedness (Y_i) = β_0 + β_1 (disaster impact) - β_2 (organizational obstacle) + β_3 (organizational obstacle^2) + β_4 (single location) + β_5 (organizational size) + β_6 (educational sector) + β_7 (health sector) - β_8 (wholesale/retail sector) + ε, 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.

Additional Analytical Techniques

In addition to using Tobit regression, this study uses Logit and OLS. It also employs reliability analysis to construct indices for total number of mitigation and preparedness activities, obstacles, and concern over disaster impacts. Lastly, it uses the Heckman approach to correct for potential selection problems and the RESET and LINK tests to test for misspecification of the organizational mitigation and preparedness model.

Sample Selection

One way to ascertain if there is sample selection in the organizational survey data is to compare the distribution of respondents and non-respondents on observable characteristics, such as zip code, organizational size, and organization type. If there is statistical evidence that the two sub-populations are different on observable characteristics, this may be evidence of sample selection. If otherwise, there may not be sample selection. In the absence of sample selection, I can use OLS on the sub-population of respondents to predict organizational mitigation and preparedness for the entire population of organizations in the sample. If otherwise, it will result in biased OLS estimates. My a priori expectation is that the two sub-populations are statistically different because the research team addressed the surveys to owners and risk managers of businesses. Organizations with risk managers may be more likely to answer the survey than organizations without risk managers. Risk managers that engaged in mitigation and

preparedness in the past year may see the survey as an opportunity to display their mitigation and preparedness strategies.

Heckman Approach

In this section, I outline the Heckman approach to correct for selection bias in the organizational survey data. I start by stating some Heckman assumptions.

1. The errors are normally distributed.

2. There is at least one more variable in the survey participation equation (selection equation) than the organizational mitigation and preparedness equation (outcome equation).

3. The covariance between the errors of the organizational mitigation and preparedness and survey participation equations is not zero.

Y = Organizational Mitigation and Preparedness (dependent variable)

X = Disaster impact, organizational obstacles, single location, organizational size, educational sector, health sector, and wholesale/retail sector (independent variables)

Organizational Mitigation and Preparedness Equation (outcome equation):

$Y = \beta_0 + \beta_1$ (disaster impact) - β_2 (organizational obstacle) + β_3 (organizational obstacle^2) + β_4 (single location) + β_5 (organizational size) + β_6 (educational sector) + β_7 (health sector) - β_8 (wholesale/retail sector) + ε,

if z = 1

Y = 0, if z = 0

Survey Participation Equation (Selection Equation):

Z = {1 if an organization answers survey, ($\alpha_0 + \alpha_1 + \mu = 1$)}

Z = {0 if an organization does not answer survey, ($\alpha_0 + \alpha_1 + \mu = 0$)}

$\alpha_0 + \alpha_1 + \mu$, is a measure of the organizational cost for mitigation and preparedness. This measure is observable when an organization decides to answer the survey and unobservable otherwise. The two errors, ε & μ will be normally distributed with mean of zero, variance of σ_ε^2 and σ_μ^2 respectively and $\rho = \text{Cov}(\varepsilon, \mu) \neq 0$. There is need to correct for the non-zero covariance by including a Heckman correction term in the organizational mitigation and preparedness equation. The correction term is:

$\rho\,[\varphi(\alpha_0 + \alpha_1 + \mu) / \Phi(\alpha_0 + \alpha_1 + \mu)]$ (The inverse Mill ratio)

Where φ and Φ are the values of the probability density and cumulative functions at f (attributes) respectively. OLS on this new equation below will yield unbiased coefficients.

Organizational Mitigation and Preparedness = $\beta_0 + \beta_1$ (disaster impact) - β_2 (organizational obstacle) + β_3 (organizational obstacle^2) + β_4 (single location) + β_5 (organizational size) + β_6 (educational sector) + β_7 (health sector) - β_8 (wholesale/retail sector) $+ \rho\,[\varphi(\alpha_{0i} + \alpha_{1i} + \mu_i) / \Phi(\alpha_{0i} + \alpha_{1i} + \mu_i)]$

The instrumental variable for the Heckman is zip code. This study assumes that the zip code in which an organization is located does not affect its ability to engage in mitigation and preparedness activities, but it affects the probability that an organization will answer the survey. It seems logical to think that organizations located in zip codes with bad postal services may not receive the survey (e.g., the survey may be lost) and thus will not be able to answer it. This instrument is not perfect because one can argue that zip code may be a proxy for proximity to an earthquake fault. In that case, zip code may have an effect on mitigation and preparedness.

This study groups zip codes by their fourth digits. For instance, 38150, 38152, and 38157, all belong to the same cluster (the fourth digit is 8). I removed zip code clusters with only one organization (four in total), because one organization in a cluster will perfectly predict zip code in that cluster. There were six clusters of zip codes and I create five dummy variables for five of them. Below are the null hypothesis and the alternate hypothesis for the Heckman.

H0: There is no selection bias

H1: There is selection bias

Sample Representativeness

In this section, I look at how representative the organizational survey data is vis-à-vis employee size. An understanding of how representative this sample is will give me an idea of the extent to which I could generalize the findings of this study. Before, I proceed, it is important to say that the intention of the research team is not to make the organizational survey sample representative. Rather, the objective is to make the sample contain enough large firms. The response rate for the organization survey is 31%. This means that 69% of the organizations sampled did not respond to the survey.

This study examines whether the organizational survey sample is representative of the population vis-à-vis employee size. There is no way of knowing if this sample is representative on non-observables like the mitigation and preparedness activities that non-respondents could have engaged in over the past year. This study conducts a difference of means tests to know if the sample mean (μ_1) is different than the population mean (μ_2). Below are the null and alternative hypotheses.

H0: $\mu_1 - \mu_2 = 0$

H1: $\mu_1 - \mu_2 \neq 0$.

CHAPTER IV: EMPIRICAL RESULTS

Chapter IV presents the results of the descriptive and quantitative analyses. This chapter begins with a description of individual respondents. Next, it answers three questions: (i) Which disasters are organizations worried about? (ii) What mitigation and preparedness activities do organizations typically engage in? (iii) Do organizations use disaster information in decision-making? Then, it presents the results of the bivariate analysis and the Tobit regression, which answers the question "what are the determinants of mitigation and preparedness at the organizational level?" This chapter concludes by discussing the results of the Heckman approach, the specification tests and the results of other additional analyses.

Descriptive Statistics of Respondents

Table 4.1. Minimum, maximum, mean, and standard deviation for individual respondents

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

Table 4.1 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. The average age is 50 years. The

youngest respondent is 22 years old while the oldest respondent is 84 years old. The mean number of years in Memphis is 33 years and the mean number of years in current position within the organization is 12 years. Some respondents have been in their current positions within their organizations less than a year while one respondent has been in a current position for 52 years. The average educational level for the respondents is 16 years.

Disaster Worry Levels among Memphis/Shelby County Organizations

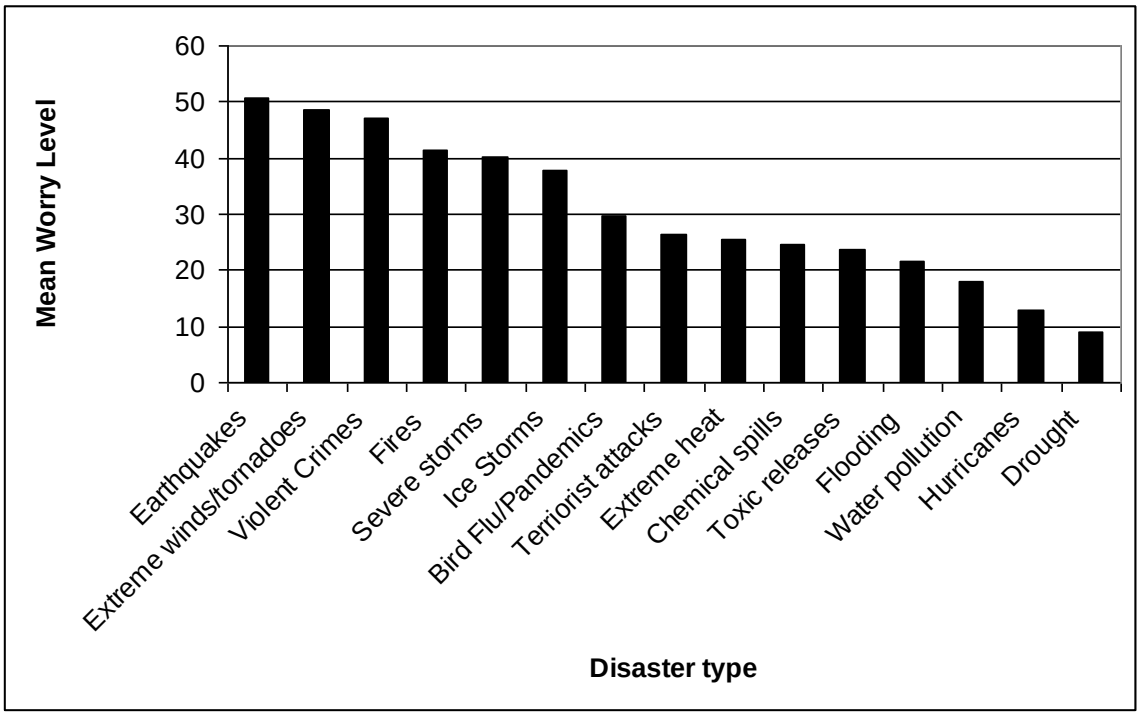

Figure 4.1. Mean worry levels for different disasters.

Figure 4.1 shows the perceived mean worry level of Memphis/Shelby County organizations for 15 different disasters. According to Figure 4.1, the perception is that Memphis/Shelby County organizations are most worried about earthquakes. The threat

posed by the New Madrid Fault may be one of many reasons for this result. The mean worry level for earthquakes is 50.6 (out of a possible 100). One possible explanation for this result is that Memphis/Shelby organizations are aware of USGS prediction of more than 90% probability of a moderate earthquake (magnitude 6-7) hitting the NMSZ within the next 50 years (USGS, 1998). Another interpretation is that this result may be an indication of response bias. In other words, respondent organizations may have inflated their responses regarding disaster worry levels for earthquakes because they may be aware that the research team was interested in earthquake issues. After earthquakes, an average Memphis/Shelby County organization is worried about extreme winds/tornadoes and violent crimes. Conversely, an average Memphis/Shelby County organization is least worried about drought, hurricanes, and water pollution.

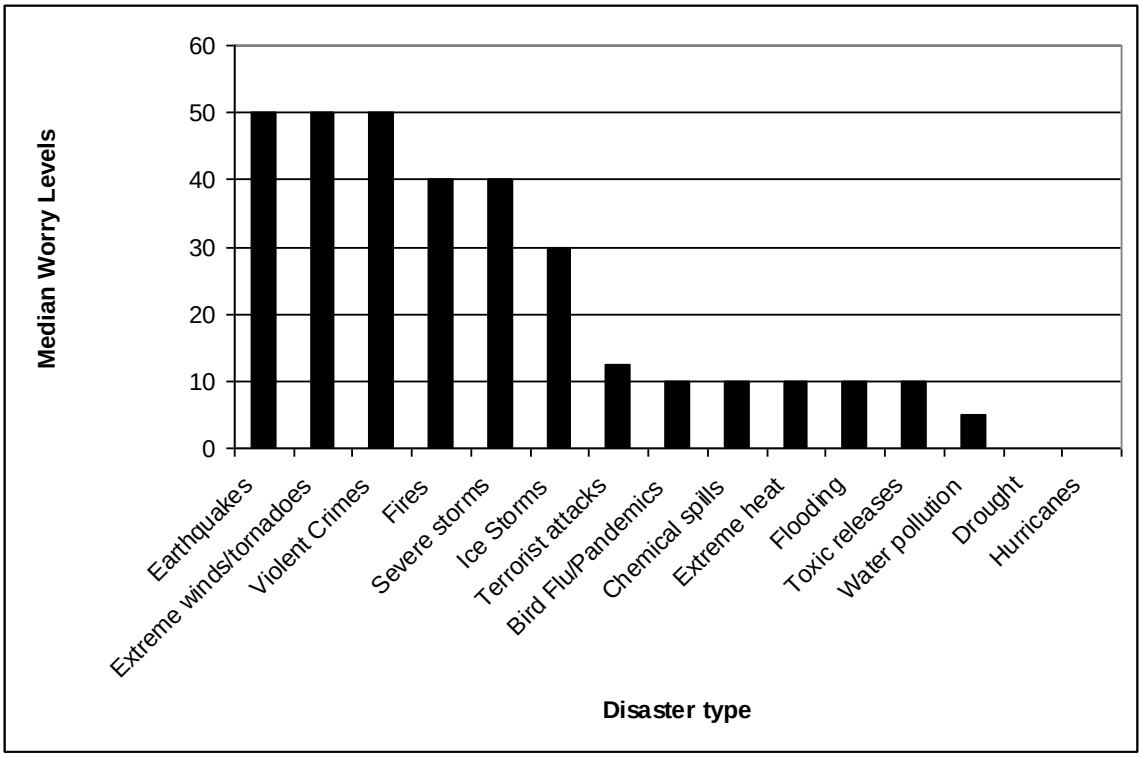

Figure 4.2. Median worry levels for different disasters.

Figure 4.2 shows the perceived median worry level for all 15 disasters. Half of respondents are above the median worry level for earthquakes, extreme winds/tornadoes, and violent crimes. All the respondents reported a median worry level of zero for hurricanes and droughts.

Table 4.2. Disaster types and worry levels among Memphis/Shelby County organizations.

Disaster Type	**No worry at all (%)**	**Moderate worry (%)**	**A great deal of worry (%)**	**Mean**	**95% Conf. Interval**	
Earthquakes	12	20	15	50.6	46.0	55.2
Extreme winds/tornadoes	11	20	9	48.5	44.2	52.7
Violent Crimes	13	15	13	47.2	42.6	51.7
Fires	19	17	8	41.3	36.8	45.8
Severe storms	15	21	6	40.1	36.1	44.1
Ice Storms	14	17	4	37.8	33.7	41.8
Bird Flu/Pandemics	33	14	6	29.8	25.4	34.2
Terrorist attacks	30	12	5	26.3	22.4	30.2
Extreme heat	33	11	2	25.4	21.5	29.3
Chemical spills	40	10	4	24.7	20.6	28.8
Toxic releases	38	7	4	23.8	19.8	27.8
Flooding	38	11	1	21.5	18.0	25.0
Water pollution	43	8	4	18.1	14.6	21.6
Hurricanes	64	3	3	12.9	9.5	16.3
Drought	59	4	0	8.9	6.7	11.2

Note: N=224

Table 4.2, which takes a closer look at the variance of worry levels for the 15 disasters reveals that 15% and 13% of respondents reported that earthquakes and violent crimes are a great deal of worry to their organizations respectively. About 21% of respondents say that severe storms pose moderate worry to their organizations. Furthermore, 64% of respondent organizations say their organizations are not worried at all about hurricanes while 59% say they are not worried at all about droughts.

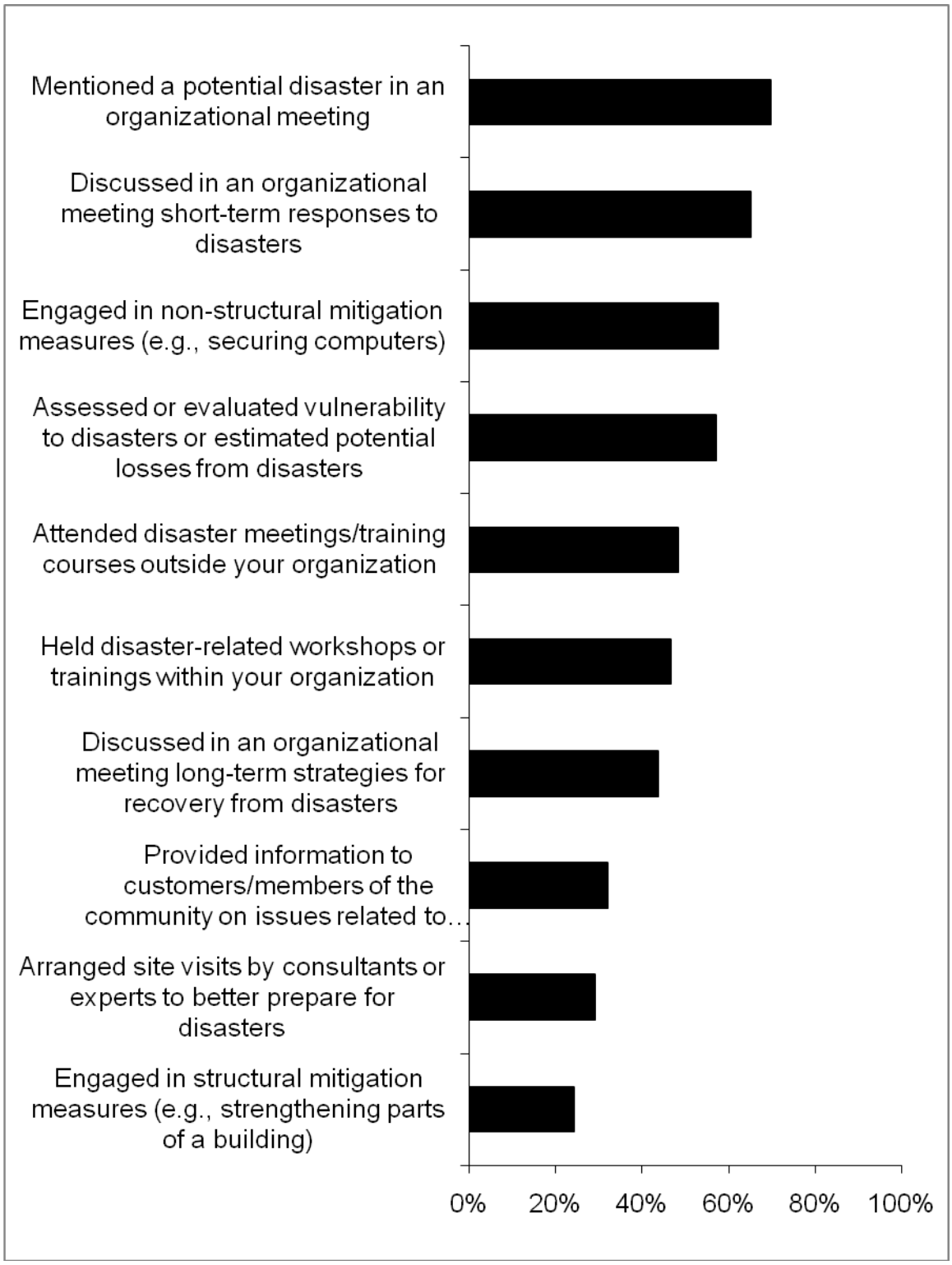

Figure 4.3. Mitigation and preparedness activities taken by organizations in Memphis/Shelby County, Tennessee.

Mitigation and preparedness Activities in Organizations

Figure 4.3 shows the 10 disaster mitigation and preparedness activities ranked in a descending according to the proportion of responding organizations that engaged in each activity. The activities engaged in most by Memphis/Shelby County organizations over the past year are "mentioned a potential disaster in an organizational meeting" (69%) followed by "discussed in an organizational meeting short-term responses to disasters" (64%). These two activities involve low effort. This result is consistent with that of Dahlhamer and D'Souza (1997) who found that almost 4 in every 10 respondents attended meetings/received written information.

About 57% of these organizations engaged in non-structural mitigation (e.g., securing computers) over the past year. The same number assessed or evaluated vulnerability to disasters or estimated potential losses from disasters over the past year. These two activities seem to require high level of effort. The least mentioned activity is "engaged in structural mitigation measures", which is probably the most effort-demanding measure, with about 25% reported engagement in this activity over the past year.

Organizations and Use of Disaster Information

Out of the 733 organizations surveyed, 216 of them responded to the question regarding the use of disaster information. About 61% of respondents said they use disaster-related information in making decisions. This number seems high and may be an indication of selection bias.

Descriptive Statistics for Dependent and Independent Variables

Table 4.3. Descriptive statistics for dependent and independent variables with recoded values

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

Note: I replaced non-responses with zeroes for total number of mitigation and preparedness activities. In addition, I replaced non-responses and "not applicable" responses with zeroes for mean disaster impact and mean obstacles.

Table 4.3 shows the descriptive statistics for dependent and independent variables. On average, Memphis/Shelby County organization engaged in 4.3 of the 10 possible mitigation and preparedness activities (43%). On the one hand, my 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 & D'Souza, 1997). On the other hand, this result may have been inflated due to sample bias. In other words, the organizational survey data may show a preponderance of organizations that engaged in mitigation and preparedness activities over those that did not.

Table 4.4. Variance of different types of disaster impact

Types of Disaster Impact	0	1	2	3	4	5	Obs
Damaged reputation	7	14	10	13	20	37	213
Disruption in supplies and deliveries	4	5	8	21	19	43	217
Inability to communicate with employees	2	5	4	18	37	34	218
Inadequate number of employees	2	10	7	23	29	29	217
Loss of commercial goods	12	14	18	23	16	17	217
Loss of customers	5	10	5	12	17	51	219
Loss of data	0	5	7	19	33	36	218
Loss of life	1	2	5	9	16	66	217
Loss of life support (food, water, etc.)	3	5	7	10	25	50	215
Loss relative to competitor's loss	16	17	13	28	16	10	216
Power outage	0	3	7	21	28	41	219
Structural damage	0	2	3	21	32	42	217
Transportation disruption	0	7	9	24	29	31	217

Note: All the values are percentages. The column for zero represents the percentage of respondents that said the impact was not applicable to their organizations or those that did not answer the question.

Table 4.4 takes a closer look at disaster impact. Recall in the previous chapter that scales1and 2 represent minor adverse impact, scale 3 represents moderate adverse impact and scales 4 and 5 represent major adverse impact. This table indicates that 7% of organizations reported that damaged reputation is not applicable to their organization or simply did not answer this question. However, among respondents, 24% (categories 1 & 2) and 13% of respondent organizations said that damaged reputation has minor and moderate adverse impacts on their organizations respectively. Furthermore, 57% (categories 4 & 5) reported that damaged reputation has a major adverse impact on their organizations. The disaster impact with the highest percentage on major adverse impact is

loss of life (82%) followed by loss of life support (75%), while that with the lowest percentage is loss relative to competitor's loss (26%) followed by loss of commercial goods (33%).

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%). However, this number is different from the 31% found by Dahlhamer & D'Souza (1997). About 8% of respondent organizations belong to the educational sector. Twice this number belongs to the health sector and 15% of respondent organizations constitute the wholesale/retail sector. In contrast to Dahlhamer & D'Souza's (1997) study, 27% of organizations belonged to the wholesale/retail sector.

Table 4.5. Variance of organizational obstacles

Independent Variables (Obstacles)	0 %	1 (Minor) %	2 %	3 %	4 %	5 (Major) %	**Total %**
Lack of financial resources to prepare for disasters	9	17	17	24	11	21	**99**
Lack of convincing information about the potential impacts of disasters	13	24	12	23	18	10	**100**
Lack of information about the frequency and magnitude disasters	13	23	16	24	13	10	**99**
Unclear organizational benefits from disaster planning and mitigation	14	28	16	20	13	10	**101**
Lack of support from mid- and lower-level organizational members	20	35	20	18	4	3	**100**
Lack of support from upper-level management within your organization	19	42	16	12	4	7	**100**

Note: The total percentages for some of the obstacle do not sum to 100 because of rounding. The zero column represents the percentage of respondents that said the obstacle was not applicable to their organizations or those organizations that did not answer the question. N=225

In this section, I take a closer look at the descriptive statistics for organizational obstacle. Table 4.5 shows the variance and means for the six organizational obstacles. Recall in the previous chapter that scales1and 2 represent minor obstacle, scale 3 represents moderate obstacle, and scales 4 and 5 represent major obstacles. This table indicates that 9% of organizations reported that lack of financial resources to prepare for disasters is not applicable to their organization or simply did not answer this question. However, among respondents, 34% (categories 1 & 2) and 24% of respondent organizations said that lack of financial resources to prepare for disasters is a minor and

moderate obstacle to disaster planning within their organizations respectively. Furthermore, 32% (categories 4 & 5) reported that it is a major obstacle to disaster planning within their organizations. About 55% of organizations said lack of support from mid- and lower-level organizational members and about 58% said lack of support from upper-level management within the organization are minor obstacles to disaster planning.

In general, one in every three respondents perceives lack of financial resources to prepare for disasters are major obstacles to disaster planning within their organization. While one in four respondents perceives lack of convincing information about the potential impacts of disasters are major obstacles to disaster planning within their organization. At least, one in every three respondents says all six obstacles pose a minor problem to disaster planning in their organizations.

Correlation between the Dependent and Independent Variables

Before discussing the results of the multivariate regression, I discuss 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 4.6. Pairwise correlations between dependent and independent variables

	Totactivity	Observation
Meanimpact	0.218***	225
Meanobstacle	0.084	225
Meanobstacle^2	-0.015	225
Single	-0.270***	218
Empsize	0.485***	215
Education	0.188***	225
Health	0.120*	225
Wholesale/retail	-0.273***	225

***significance at 0.01 level
**significance at 0.05 level
*significance at 0.1 level

Table 4.6 shows that there is a positive association between mitigation and preparedness and disaster impact, organizational obstacles, employee size, organizations in the educational sector, and organizations in the health sector. Conversely, there is a negative association between mitigation and preparedness and organizational obstacle^2, single location organizations as well as organizations in the wholesale/retail sector. All the correlation coefficients are significant except for the correlation coefficient on organizational obstacle and organizational obstacle^2.

Results of the Tobit Analyses

Table 4.7. Summary of results

Total number of mitigation & preparedness activities (DV)	Tobit with recoded Values (Base model) (n=215) Pseudo R^2= 0.107	Tobit with missing values (n=146) Pseudo R^2 = 0.115	OLS with recoded values (n=215) R^2 = 0.413	OLS with missing values (n=146) R^2 = 0.433
Mean disaster impact	0.53 (0.20)***	0.17 (0.37)	0.35 (0.15)**	0.17 (0.30)
Mean obstacle	1.03 (0.54)*	-1.35 (1.45)	0.76 (0.41)*	-0.90 (1.19)
Mean obstacle^2	-0.33 (0.14)**	0.12 (0.27)	-0.25 (0.10)**	0.06 (0.22)
Single location organization	-2.71 (0.61)***	-2.89 (0.63)***	-2.13 (0.47)***	-2.38 (0.53)***
Employee size	0.84 (0.13)***	0.85 (0.15)***	0.66 (0.10)***	0.69 (0.12)***
Educational sector	3.02 (0.89)***	2.59 (0.85)***	2.49 (0.69)***	2.26 (0.71)***
Health sector	1.71 (0.67)**	0.92 (0.77)	1.22 (0.52)**	0.73 (0.64)
Wholesale/ Retail sector	-2.20 (0.70)***	-3.50 (0.79)***	-1.54 (0.51)***	-2.50 (0.62)***

Note: Figures in parentheses are standard errors.
***significance at 0.01 level
**significance at 0.05 level
*significance at 0.1 level

This section presents the results of the base Tobit model with recoded values (sample size = 215). Table 4.7 indicates that this model and all the independent variables are statistically significant. I cannot interpret the Tobit coefficients as effect sizes. Therefore, I focus on the signs and significance of the coefficients in the following

paragraphs. Later, I interpret the marginal effects of the independent variables on the dependent variable. The Tobit result suggests that there is a positive significant association between mitigation and preparedness and concern over disaster impacts, organizational obstacle, employee size, and organizations in the educational and health sectors.

Employee size is the most significant predictor of mitigation and preparedness in this study. 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. For instance, Quarantelli et al. (1979) found that larger companies were more likely to engage in more planning than smaller companies did. 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 did. 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 or institute mitigation and preparedness measures (Dahlhamer & D'Souza, 1997).

Memphis/Shelby County organizations that were concerned about disaster impacts engaged in mitigation and preparedness activities over the past year. 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 is 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. Furthermore, past disaster studies at the household level have found similar positive relationships. For instance, 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. Furthermore, organizations in the educational and health sectors are more likely to engage in mitigation and preparedness than organizations in other sectors.

The coefficients on meanobstacle and meanobstacle^2 show that there is a positive association between mitigation and preparedness and organizational obstacles until meanobstacle peaks at 1.56 and then the association becomes negative. 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.

$$\textit{Mitigation and preparedness} = 1.03\ \textit{meanobstacle} - (0.33)\ \textit{meanobstacle}^2$$
$$\Delta\ \textit{mitigation and preparedness}/\Delta\ \textit{meanobstacle} = 1.03 - 2(0.33)\ \textit{meanobstacle}$$
$$\Delta\ \textit{mitigation and preparedness}/\Delta\ \textit{meanobstacle} = 1.03 - 0.66\ \textit{meanobstacle}$$
$$1.03 - 0.66\ \textit{Meanobstacle} = 0$$
$$\textit{Meanobstacle} = 1.03/0.66 = 1.56$$

The result also indicates that mitigation and preparedness activities are negatively associated with single location organizations. This result is in line with that of previous research. 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 did. Similarly, Quarantelli et al. (1979) found that national chemical companies engaged in more preparedness than single local chemical firms did. This finding may be due to the

mandates given to local chapters by corporate headquarters to engage in disaster preparedness (Dahlhamer & D'Souza, 1997).

Furthermore, this study finds a negative significant relationship between mitigation and preparedness and organizations in the wholesale/retail sector. Dahlhamer & D'Souza (1997) also found a negative but insignificant relationship between organizations in the 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 education followed by single, then wholesale/retail. The independent variable with the smallest marginal effect is disaster impact followed by employee size.

A unit increase in the level of disaster impact leads to 0.53 unit increase in expected mitigation and preparedness holding other variables at their means. Each additional increase in the level of organizational obstacle from minor obstacle to major obstacle increases expected mitigation and preparedness by 1.03 units until organizational obstacle peaks at 1.56, after which additional increases in organizational obstacle lead to a decrease in expected mitigation and preparedness, holding other variables at their means. Holding all other variables at their means, single location organizations decrease expected mitigation and preparedness by about 2.71 units. A unit increase in employee size leads to 0.84 unit increase in expected mitigation and preparedness holding other variables at their means. While organizations in the wholesale/retail trade decrease expected mitigation and preparedness by about 2.20 units, organizations in the educational sector and health sector increase expected mitigation and

preparedness by about 3.02 and 1.71 units respectively, holding other variables at their means.

Comparing the Tobit Results from the Initial and Final Samples

In this section, I compare the outputs from two Tobit models (see Table 4.7). The first output is from the base Tobit model and the second is from the initial sample with missing values (sample size = 146). The reason for comparing these two outputs is to ascertain if the recoding has any effect on the relationships between the dependent and independent variables.

The independent variables from both outputs have the same signs except for organizational obstacle and organizational obstacle2. Organizational obstacle is positive in the base model and negative in the second Tobit while the reverse is the case for organizational obstacle^2. Although, both models are significant, they are different in some respects. First, the variables disaster impact, organizational obstacle, organizational obstacle^2, and health sector are significant in the base model and not in the second Tobit. After the recoding, there appears to be an increase in the standard errors of the second Tobit coefficients (except the standard error on educational sector). The smaller sample size (n=146) and more restricted variation in the independent variables (I replaced the actual values, which may range from 1-5, with zeroes) are two possible reasons for the increased standard errors in the second Tobit output.

In sum, the recoding resulted in sign changes and made four independent variables become significant. It is difficult to say which of the two Tobit models is better.

However, it is clear that based on the value of the Pseudo R^2 the Tobit model with missing values has a slightly better fit.

Comparing the Tobit Output with the OLS Regression Output

In this section, I compare the output of the base model and that of the OLS regression (Table 4.7) based on the sample with recoded values (sample size = 215). The reason for this comparison is to know if OLS could have yielded similar result. The results from both analyses are quite similar. In general, both models are significant and all the independent variables from both models have the same signs. Furthermore, all the independent variables in both models are significant. However, the coefficients from the base model are larger than the respective ones from the OLS regression.

I also compare the second Tobit model and the OLS regression outputs based on the original data with missing values (N=146). These two models are significant and the same dependent variables in both models are significant. Similarly, the same dependent variables are insignificant. All the Tobit coefficients are larger than their OLS counterparts except for the coefficients on disaster impact.

Result of the Heckman Approach

Table 4.8. Heckman output

Number of obs = 645 Censored obs = 448 Uncensored obs = 197 Wald chi2(7) = 125.02 Log likelihood = -854.6438 Prob > chi2 = 0.0000		
Total number of mitigation and preparedness activities (DV)	**Coefficient**	**Std. error**
Mean disaster impact	0.43 ***	0.15
Mean obstacle	-0.18	0.14
Single location organization	-1.49*	0.88
Employee size	.82***	0.13
Educational sector	2.43***	0.74
Health sector	1.50***	0.55
Wholesale/Retail sector	-1.58***	0.57
Select		
Zip1	0.22	0.81
Zip2	0.24	0.82
Zip3	0.17	0.83
Zipp4	0.44	0.80
Zip5	0.49	0.85
Empsize	0.05*	0.03
Single	0.42***	0.12
_cons	-1.27	0.83
LR test of indep. eqns. (rho = 0): chi2(1) = 0.27 Prob > chi2 = 0.6030		

***significance at 0.01 level
**significance at 0.05 level
*significance at 0.1 level

Based on the results of the descriptive statistics my initial expectation was that organizations that engaged in mitigation and preparedness activities are more likely to

answer the survey than organizations that did not engage in mitigation and preparedness activities. To correct this potential problem, this study uses the Heckman approach.

Table 4.8 shows that the result of the Heckman is generally consistent with that of the base Tobit model discussed earlier. Both models are significant and all the independent variables from both models have the same signs. In addition, all the independent variables in both models are significant except for organizational obstacle, which is significant in the base model and insignificant in the Heckman model.

The effect of more employees increases the probability of selection (answering a survey) and the predicted engagement in mitigation and preparedness activities conditional on participating in the survey. The effect of being a single location organization increases the probability of selection (answering a survey) and decreases the predicted engagement in mitigation and preparedness activities conditional on answering in the survey.

The null hypothesis for the Heckman model is that there is no selection bias in the sample. The likelihood-ratio test of independent equations (rho = 0) is not significant, meaning that I fail to reject the null hypothesis. In sum, while the descriptive statistics may have suggested sample bias, the Heckman result did not indicate that this problem exists in the organizational survey data.

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 employee size alone. However, I cannot say anything about the representativeness of the organizational survey sample based on unobservable characteristics like the mitigation and preparedness activities adopted.

Result of the Specification Test: Non-linearity

I performed 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 non-linear. I started by creating the squared term for all 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 $meanobstacles^2$ belongs in the model. Consequently, I adjusted my model by including $meanobstacles^2$.

Result of the Specification Test: Omitted Variable

This study performs a LINK test to 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 my model is specified properly, there should not be any additional determinant(s) that would be significant in my model except by chance. What

the LINK test does is to rebuild my model using the linear predicted values (_hat) and the linear predicted value squared (_hatsq). The result of the linktest 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.

Results of the Additional Analyses

I employed two additional variables - use of disaster information and availability of a risk manager - in the organizational survey data as proxies for the dependent variable. The correlation between the initial dependent variable, total number of mitigation and preparedness activity and use of disaster information and availability of risk manager are 0.63 and 0.57 respectively. Organizations that used disaster information are coded 1 and those that did not are coded 0. Similarly, organizations that have a risk manager are coded 1 while those that do not have a risk manager are coded 0. I ran two Logit regressions, one for each of the two proxies, on the same dependent variables as in the previous analyses. Logit is the appropriate model because of the dichotomous nature of these proxies.

Table 4.9. Comparing the results from three different models

	Base model (n=215) Total number of mitigation & preparedness activities (DV)	Logit (n=189) Use of disaster information (DV)[a]	Logit (n=198) Presence of risk manager (DV)
Mean disaster impact	0.53 (0.20)***	0.29 (0.15)*	0.08 (0.15) **0.10**
Mean obstacles	1.03 (0.54)*	0.35 (0.39)	0.51 (0.38) **0.57**
Mean obstacle squared	-0.33 (0.14)**	-0.06 (0.09)	-0.14 (0.10) **-0.55**
Single location organization	-2.71 (0.61)***	-1.94 (0.53)***	-1.78 (0.43)*** **-0.42**
Employee size	0.84 (0.13)***	0.30 (0.10)***	0.27 (0.09)*** **0.38**
Educational sector	3.02 (0.89)***	----[b]	2.27 (0.70)*** **0.48**
hHealth sector	1.71 (0.67)**	1.33 (0.52)***	0.49 (0.45) **0.12**
Wholesale/Retail sector	-2.20 (0.70)***	-.2.74 (0.68)***	-1.10 (0.56)* **-0.24**

[a] Stata could not produce the predicted probabilities for use of disaster information.
[b] Stata dropped educational sector for predicting success perfectly.
Note: Figures in parentheses are standard errors and predicted probabilities in bold print. The Tobit coefficients are the same as the marginal values.
***significance at 0.01 level
**significance at 0.05 level
*significance at 0.10 level

Table 4.9 compares the results from these two Logit models with that of the base model and shows the predicted probabilities for the risk manager model. The result of the first Logit analysis with use of disaster information as the dependent variable indicates that the model is significant. All the significant variables in the base model are also significant in the first Logit analysis, except organizational obstacle and organizational obstacle^2. Stata dropped educational sector for predicting success perfectly. In addition, all the independent variables have the same signs in both models. In general, the sizes of the coefficients are smaller in the Logit output except the coefficient on wholesale/retail sector.

The result of the second Logit analysis with risk manager as the dependent variable shows that the model is significant. In the base model, all the independent variables are significant. However, in the second Logit output four independent variables-disaster impact, organizational obstacle, organizational obstacle2, and health sector-are insignificant. Furthermore, all the independent variables have the same signs in both models and the Logit coefficients are smaller than their counterparts are in the base model.

Table 4.10. Comparing the outputs from the active, passive, and base models

Total number of mitigation & preparedness activities (DV)	Tobit with recoded Values (Base model) (n=215)	Active measures (n=199)	Passive measures (n=205)
Mean disaster impact	0.53 (0.20)***	0.24 (0.16)	-0.00 (0.08)
Mean obstacle	1.03 (0.54)*	0.10 (0.39)	0.32 (0.21)
Mean obstacle^2	-0.33 (0.14)**	-0.10 (0.10)	-0.10 (0.05)*
Single location organization	-2.71 (0.61)***	-1.68 (0.42)***	-1.12 (0.23)***
Employee size	0.84 (0.13)***	0.61 (0.10)***	0.31 (0.05)***
Educational sector	3.02 (0.89)***	1.92 (0.63)***	0.94 (0.34)***
Health sector	1.71 (0.67)**	0.20 (0.47)	0.77 (0.26)***
Wholesale/ Retail sector	-2.20 (0.70)***	-2.24 (0.50)	-0.85 (0.28)**

***significance at 0.01 level
**significance at 0.05 level
*significance at 0.10 level

Table 4.10 presents the outputs from active, passive, and the base models. In the base model, all the independent variables are significant. However, when the 10 mitigation and preparedness activities were grouped into active and passive measures and two Tobit regressions were run, the results are different. The following variables are insignificant in the active measure model-concern over disaster impact, organizational obstacles, organizations in the health sector and organizations in the wholesale/retail sector. In other words, these four independent variables are not significant determinants of active measures to address disaster risks in organizations. In the passive measure

model, concern over disaster impact and organizational obstacles are not significant determinants of passive measures to address disaster risks in organizations.

In addition to the above analyses, I examine each of the mitigation and preparedness activities individually using the same independent variables as in the previous analyses. The aim is to gain a deeper understanding of the relationships between each of the mitigation and preparedness activity and each of the independent variables. Table 4.11 shows changes in the predicted probabilities from 10 Logit models for all the mitigation and preparedness activities. I arranged the mitigation and preparedness activities from top to bottom in a decreasing order of significance and the dependent variables from left to right in a decreasing order of significance. Table 4.11 indicates that the most significant dependent variable is employee size followed by single location. In fact, employee size is significant and positive in all the 10 activities. Single location is significant in all but one activity and has a negative sign in all the activities. At the bottom of the table are organizational obstacle, organizational obstacle^2, and disaster impact, which are insignificant in all but one activity each. A unit increase in employee size leads to a 69 percentage point increase in the probability of holding workshops/training courses, holding all other variables constant at their means.

In sum, these results differ from that of the base model. Recall that in the base model, all the independent variables are significant. In this Logit models, only four of the eight independent variables (employee size, single location, wholesale/retail, and education) are significant in at least 5 of the 10 mitigation and preparedness activities.

Table 4.11. Changes in Predicted Probabilities for disaster mitigation and preparedness activities from Logit models

	Emp size	Single	Whole. /Retail	Educ.	Health	Mean impact	Mean obst.^{2}	Mean obst.
Held workshops	0.69 ***	-0.29 ***	-0.41 ***	0.30 **	0.11	-0.05	-0.69 **	0.72 *
Long-term Recovery	0.64 ***	-0.43 ***	-0.40 ***	0.29 **	0.13	-0.03	-0.57	0.55
Mentioned Disaster	0.41 ***	-0.24 ***	-0.23 **	0.19 *	0.21 **	0.02	-0.55	0.33
Vuln. Ass't	0.39 ***	-0.24 **	-0.36 ***	0.35 **	0.01	0.19	-0.57`	0.28
Attended Meeting	0.63 ***	-0.25 **	-0.37 ***	0.27 *	0.20 *	0.13	-0.37	0.31
Short-term Response	0.56 ***	-0.31 ***	-0.13	0.20 *	0.22 **	0.03	-0.7	0.43
Site Visit	0.40 ***	-0.30 ***	-0.18 **	0.22 *	-0.06	0.05	-0.33	0.2
Provided Info.	0.22 **	-0.22 **	-0.24 **	0.53 ***	-0.09	0.18	0.57	-0.36
Non-Structural Mitigation	0.41 ***	-0.19 **	-0.09	0.1	0.15	0.33 **	-0.28	0.17
Structural Mitigation	0.25 ***	-0.09	-0.20 **	0.03	-0.05	0.00	-0.13	-0.07

Note: The numbers indicate changes in predicted probability of the dependent variable as the independent variables change from their minimum to their maximum holding other independent variables at their means.
***significance at 0.01 level
**significance at 0.05 level
*significance at 0.10 level

Finally, I replaced mean disaster obstacle with each of the 13 disaster impacts and ran 13 different Tobit regressions on the same independent variables as in the base model. Only four of the 13 disaster impacts are significant with the expected positive signs-inability to communicate with employees, inadequate number of employees, loss of life, and transportation disruption.

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the conclusions and recommendations of this study. It begins by reiterating the research questions and summarizing the results. Next, it discusses the findings in the context of previous research and examines the policy implications of the results. The chapter ends by discussing some limitations and recommendations for future research.

The main goal of this study is to answer the question "what are the determinants of mitigation and preparedness at the organizational level?" The following four sub-questions provide good basis for exploring this 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 other types of organizations? (iv) Does organizational size have a positive effect on mitigation and preparedness? In order to answer the question regarding the determinants of mitigation and preparedness in organizations, this study utilizes four independent variables - concern over disaster impacts, organizational obstacles, ownership patterns of organizations, and organizational size. In addition, this study includes three variables as controls for organizational sector: education, health, and wholesale/retail trade. In addition to this main research question, I explore three other questions. (i) Which disasters are organizations worried about? (ii) Which mitigation and preparedness activities do organizations typically engage in? (iii) Do organizations use disaster information in decision-making?

Disaster Worry Levels among Memphis/Shelby County Organizations

The perception according to respondents is that earthquakes pose the greatest threat to Memphis/Shelby County organizations. This suggests that Memphis/Shelby County organizations may be aware of the danger that can result from the New Madrid Fault Zone. Another interpretation is that this result may be an indication of response bias; respondents may have inflated their responses regarding disaster worry levels for earthquakes because they may be aware that the research team was interested in earthquake issues. Conversely, more than half of responds reported that they are not worried at all about hurricanes and drought. In addition, severe storms pose moderate worry to Memphis/Shelby County organizations.

Half of respondents are above the median worry level for earthquakes, extreme winds/tornadoes, and violent crimes. All the respondents reported a median worry level of zero for hurricanes and droughts.

Mitigation and Preparedness Activities in Organizations

The activities engaged in most by Memphis/Shelby County organizations during the past year involve meetings. In particular, these organizations are most likely to mention a potential disaster or discuss short-term responses to disasters in an organizational meeting over the past year. These activities involve low effort. This result is consistent with that of Dahlhamer and D'Souza (1997) who found that attending meetings/receiving written information is common among Memphis organizations.

Approximately 6 out of every 10 organizations engaged in non-structural mitigation (e.g., securing computers) over the past year. The same number assessed or

evaluated vulnerability to disasters or estimated potential losses from disasters during the past year. These two activities require higher level of effort when compared to holding meetings. The least activity Memphis/Shelby County organizations engaged in during the past year is structural mitigation, which is probably the most effort-demanding measure. An average organization in Memphis/Shelby County engaged in about half of the mitigation and preparedness activities over the past year. This result refutes the claim by prior research on the low level of preparedness in Memphis (e.g., Dahlhamer & D'Souza, 1997). It is noteworthy that this result may have been inflated as a result of sample bias.

Organizations and Use of Disaster Information

Six out of every 10 Memphis/Shelby County organizations use disaster-related information to make decisions within their organizations. This result suggests that Memphis/Shelby County organizations are receptive to disaster-related information that can aid them in their disaster plans.

Descriptive Statistics for Dependent and Independent Variables

On average, Memphis/Shelby County organization engaged in 4.3 of the 10 possible 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 & D'Souza, 1997).

Respondents reported that disaster impacts have a moderate adverse impact on their organizations (3.29). The disaster impact with the highest percentage on major adverse impact is loss of life (82%) followed by loss of life support (75%), while that

with the lowest percentage is loss relative to competitor's loss (26%) followed by loss of commercial goods (33%). 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 belongs to the health sector and 15% of respondent organizations constitute the wholesale/retail sector. In contrast to Dahlhamer & D'Souza's (1997) study, 27% of organizations belonged to the wholesale/retail sector.

In general, 1 in every 3 respondents perceives lack of financial resources to prepare for disasters are major obstacles to disaster planning within their organization. While one in four respondents perceives lack of convincing information about the potential impacts of disasters are major obstacles to disaster planning within their organization. At least, 1 in every 3 respondents says all 6 obstacles pose a minor problem to disaster planning in their organizations.

The Result of the Correlation Analysis

Before discussing the results of the multivariate regression, I briefly examine the result of the correlation analysis between the dependent variable and the independent variables. This study finds that there is a positive association between mitigation and preparedness and disaster impact, organizational obstacles, employee size, organizations in the educational sector, and organizations in the health sector. In addition, there is a negative association between mitigation and preparedness and organizational obstacle[2],

single location, as well as organizations in the wholesale/retail sector. All the correlation coefficients are significant except for the correlation coefficient on organizational obstacle and organizational obstacle^2.

The Determinants of Organizational Mitigation and Preparedness

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 adopted. This finding is in accordance with that of previous research (e.g., Quarantelli et al., 1979; Drabek, 1994a, 1994b, 1995; Dahlhamer & 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 fact, this resource argument is common in the literature on disasters at the household (Mileti 1999), community (May & Birkland 1994; Wood, 2004), and organizational level (Mileti et al., 1993; Dahlhamer & D'Souza, 1997; Tierney, 2006). That is smaller organizations do not have the resources to invest in mitigation and preparedness. For example, smaller organizations may not be able to hire a risk manager.

This study also finds that concern over disaster impact is a significant positive determinant of mitigation and preparedness among Memphis/Shelby County organizations. Ownership pattern of organizations is a significant determinant of mitigation and preparedness in organizations. In other words, 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 for this finding is the mandates given to local chapters by corporate headquarters to engage in disaster preparedness (Dahlhamer & D'Souza, 1997). Recall that about 8 in every 10 organizations in the sample is a single-location organization. The preponderance of single-location organizations may have contributed to the moderate level of mitigation and preparedness in Memphis/Shelby County.

This study finds a significant positive relationship between organizations in the educational and health sectors and mitigation and preparedness. One interpretation of this result is that educational and health sector organizations are more likely to engage in mitigation and preparedness activities because they usually deal with vulnerable populations like children, the old, and the sick. Conversely, there is a 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 & D'Souza (1997) also found a negative insignificant relationship between preparedness and organizations in the wholesale/retail sector. Furthermore, the coefficients on meanobstacle and meanobstacle^2 show that there is a positive association between mitigation and preparedness and organizational obstacles until organizational obstacle peaks and then the association becomes negative. Based on the results of the Tobit regression, I reject the null hypotheses that there is no relationship between each of the independent variables and the dependent variable.

The marginal effects are the same as the Tobit coefficients. The independent variable with the biggest marginal effect is education followed by single, then wholesale/retail. The independent variable with the smallest marginal effect is disaster impact followed by employee size.

Result of the Heckman Approach

Based on the results of the descriptive statistics my initial expectation was that organizations that engaged in mitigation and preparedness are more likely to answer the survey than organizations that did not engage in mitigation and preparedness. To correct this potential problem, this study uses the Heckman approach. The result of the Heckman analysis confirms that the organizational survey data does not suffer from selection bias as earlier suggested by descriptive statistics.

Results of the Sample Representative Test and the Specification Tests

There is no statistical difference between the population mean and the sample mean. This means that the organizational survey sample is representative of the population based on employee size alone.

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 non-linear. The result of the F-test reveals that $meanobstacles^2$ belongs in the model. Therefore, I added $meanobstacle^2$ to the model.

After the addition of $meanobstacle^2$, this study performs a LINK test to ascertain if Tobit is the appropriate function to use and if other determinants belong in the model.

The result indicates that the model uses the appropriate function and there are no omitted variables. It is important to note that passing these tests does not guarantee that the model is properly specified.

Results of the Additional Analyses

I employed two variables - use of disaster information and availability of a risk manager - within the organizational survey data as proxies for the dependent variable. The correlation between the initial dependent variable, total number of mitigation and preparedness activity and use of disaster information and availability of risk manager are 0.63 and 0.57 respectively. I ran two Logit regressions, one for each of the two proxies, on the same dependent variables as in the previous analysis.

The result of the first Logit analysis with use of disaster information as the dependent variable indicates that the model is significant. All the significant variables in the Tobit analysis are also significant in this Logit analysis, except organizational obstacle and organizational obstacle^2. In addition, all the independent variables have the same signs in both models. In general, the sizes of the coefficients are smaller in the Logit output except the coefficient on wholesale/retail sector.

The result of the second Logit analysis with risk manager as the dependent variable shows that the model is significant. In the Tobit output, all the independent variables are significant. However, in the Logit output four independent variables-disaster impact, organizational obstacle, organizational obstacle2, and health sector-are insignificant. Furthermore, all the independent variables have the same signs in both models and the Logit coefficients are smaller than those of the Tobit regression.

In addition to the above analyses, I examine each of the mitigation and preparedness activities individually using the same independent variables as in the previous analyses. The aim is to gain a deeper understanding of the relationships between each of the mitigation and preparedness activity and each of the independent variables. The most significant dependent variable is employee size followed by single location. In fact, employee size is significant and positive in all the 10 activities. Single location is significant in all but one activity and has a negative sign in all the activities. At the bottom of the table are organizational obstacle, organizational obstacle^2, and disaster impact, which are insignificant in all but one activity each. In sum, these results differ from that of the Tobit model.

Finally, using total disaster impact instead of mean disaster impact did not change the initial Tobit result. Similarly, the results of the analyses involving each of the 13 disaster impacts in lieu of mean disaster impact show that four of the 13 disaster impacts are significant with the expected positive signs-inability to communicate with employees, inadequate number of employees, loss of life, and transportation disruption.

In the base Tobit model, all the independent variables are significant. However, when the 10 mitigation and preparedness activities were grouped into active and passive measures, the results are different. The following variables are insignificant in the active measure model-concern over disaster impact, organizational obstacles, organizations in the health sector and organizations in the wholesale/retail sector. In the passive measure model, concern over disaster impact and organizational obstacles are not significant determinants of passive measures to address disaster risks in organizations.

Contributions to the Literature

In Chapter II, this study highlights the contributions made by previous disaster studies and emphasizes the gap in the disaster literature regarding the determinants of organizational mitigation and preparedness. The discussion reveals that there is no theory to guide research on the determinants of mitigation and preparedness at the organizational level of analysis. 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 Chapter III, this study develops a theoretical model from prior research on business disaster preparedness (e.g., Quarantelli et al., 1979; Dahlhamer & D'Souza, 1997; Webb et al., 2000) and earthquake preparedness at the household level (e.g., Nigg, 1986; Showalter, 1993). This theoretical model has its strengths and weaknesses. A cursory look at its strengths reveals that it is simple, clear, and logical. This model is a simple representation of reality. The relationships between the independent variables and the dependent variable are clear and easy to understand. The expected signs of the relationships between the dependent and independent variables are logical. For example, it is reasonable to expect a positive relationship between mitigation and preparedness and concern over the disaster impact. Based on the RESET and LINK tests, it does appear that the model is properly specified. A weakness of this model is the uncertainty surrounding how it will behave when used to analyze other datasets. The limitation of this model notwithstanding, I am optimistic it can aid future research in gaining a deeper

understanding of the factors that motivate organizations to mitigate and prepare for disasters.

Although, this study is guided by prior research, it extends previous studies by investigating a new variable as a determinant of organizational mitigation and preparedness for disasters. This variable is organizational obstacle.

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 type of disaster losses, such as loss of live and property. This result is interesting in the context of research on risk and disaster visualizations. FEMA and The Mid-America Earthquake Center, for example, have invested heavily in Hazus and MAEviz respectively (FEMA 2008; MAE 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 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 activities.

Policy Discussion

The results of the descriptive statistics do show that in general, Memphis/Shelby County organizations discuss disaster issues in organizational meetings. The implication for policy is that Memphis/Shelby County governments may be able to use organizational meetings as outlet for disseminating disaster-related information and discussing disaster issues with Memphis/Shelby County organizations. Structural mitigation is the mitigation and preparedness activity Memphis/Shelby County organizations engaged in the least over the past year. Policymakers can devise policies that could make it easier for organizations to adopt structural mitigation measures. Policy intervention might include incentives, such as tax breaks and subsidies for organizations that engage in structural mitigation.

Limitations

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. Independent variables left out of the analyses include past disaster experience, age of the organization, and whether an organization leases or owns its business property (Dahlhamer & D'Souza 1997; Mileti 1999). Second, the findings of this study are perceptual. In other words, I really do not know what Memphis/Shelby County organizations are actually doing to mitigate and prepare for disasters. If perceived organizational actions regarding mitigation and preparedness are substantially different

from the actual organizational actions, the reliability of my results may be threatened. My hope is that the organizational representatives were able to give accurate information about their organizations. Third, there were missing values on some of the variables that prompted me to recode these variables. The recoded values are not the actual values of the missing data. Fourth, adding mitigation and preparedness activities together implies that each activity is equally weighted. This may not be a reasonable assumption. For instance, 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". Fifth, respondent organizations may have inflated their responses regarding disaster worry levels for earthquakes because the study in general may have given them an indication that the research team was interested in earthquake issues. Lastly, I can only say that this study is representative of the population concerning organizational size. I cannot say whether this study is representative on unobservable characteristics, such as the mitigation and preparedness activities adopted. All these limitations engender words of caution in generalizing the results of this study.

Recommendations for Future Research

This study suggests several next steps in understanding the determinants of organizational mitigation and preparedness. First, more research is needed to understand why organizations mentioned that they engaged in an activity that seem to require high effort (engaging in non-structural mitigation measures) over those that require low effort (e.g., attending disaster meetings/training courses within the organization). Second, it may interest the research community to investigate why

organizations are not interested in adopting structural mitigation measures despite substantial investment by the federal government in mitigation programs. Third, further research in needed that can incorporate the independent variables that this study is missing to understand fully the relevant determinants of mitigation and preparedness in organizations. Fourth, it might interest some researchers to investigate the relative costs and benefits of each of the mitigation and preparedness activities. Lastly, it might be interesting to disaggregate some of the indices and take a closer look at each component separately.

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