Assessing preparedness of small businesses for hurricane disasters: Analysis of pre-disaster owner, business and location characteristics

Anna Josephson^a, Holly Schrank^{b*}, Maria Marshall^{b1}

^aDepartment of Agricultural Economics, Purdue University, 403 West State Street, West Lafayette, Indiana 47907-2056

^bDepartment of Agricultural Economics, Purdue University, 403 W. State Street, West Lafayette, IN 47907-2056

josephsa@purdue.edu

schranks@purdue.edu

mimarsha@purdue.edu

*Corresponding author. Tel.: 765.743.0952; fax: 765.494.9176.

Abstract

Management decisions owners make to prepare their small businesses for hurricane events are strategic decisions that can affect the sustainability of their businesses. Therefore, there is value in understanding who prepares, what they do to protect their businesses, and in predicting these decisions from known demographics such as race, gender and business size. This study characterized the owners and businesses that did or did not undertake hurricane preparations and suggests education and policy strategies to assist these business owners. Small business owners in southern Mississippi participated in telephone interviews that provided data for the logit analyses in this study. The preparedness activities most practiced were risk transfer and structural mitigation. The least practiced activities were those related to protection of business operations and non-structural assets. Whether or not the business was located in a coastal county subject to surge highly predicted the use of certain types of preparation. Results demonstrate that preparation activities varied depending on the situation of the business (e.g. size, prior experience with disasters, property ownership) and characteristics of the owner (e.g. gender and education). However, differing threats to the business related to location (e.g. surge

¹ Tel.: 765.494.4268; fax: 765.494.9176.

prone or not) and factors such as mandated insurance, local zoning, and commercial versus home-based locations were important influences.

Keywords: disaster; hurricane, mitigation; preparedness; SME; location

1. Introduction

Piotrowski [22] points out that the management of a major disruption in an organization is largely neglected in the business school curriculum and is probably not high on the priority lists of most business executives. While larger companies may have the resources to create and implement planning for disruption, small business owners are likely quite limited in their ability and knowledge of how to plan for the unexpected. Spillan and Hough [28] reported that such planning gets little attention in small businesses, and then only after an actual crisis occurs.

Shreve and Kelman [27] point out that the reduction of disaster risk has a role in mitigating the negative impacts of natural hazards, yet few earthquake and flood prone households or businesses have adopted mitigation strategies that could reduce their risk. The lack of attention to preparing for adversity does not appear to be because of a dearth of readily available public sector information for small business owners, in fact the importance of preparedness in hurricane prone areas of the United States has been widely discussed in the popular and trade literature and information is readily accessible on the internet. It is not difficult to find recommendations for reinforcing a structure, protecting its contents, and especially for protecting human life from the forces of howling winds and rising waters. Recommendations range from permanent structural changes to property to last minute adjustments before the storm to protect life, property, and business operations. While these recommendations are extensive, the recommendations for small businesses, particularly for protecting business operations and

assets other than facilities are more limited. In addition, the research on whether these recommendations are practiced by business owners is relatively scant, but what has been reported suggests the same theme—small business owners are not utilizing many strategies to prepare for adversity. Perhaps recommendations not implemented are those that are not appropriate for the business situation, or researchers have not probed deeply enough to discern those strategies business owners have employed. What is clear, however, is that business owners make management decisions on a daily basis, and these decisions influence the survival, recovery, and success of their businesses during both normal and non-normal operations.

The present study is an exploration of responses of small business owners to the unique set of vulnerabilities that their individual businesses experienced in the face of Hurricane Katrina, however they perceived those vulnerabilities. What preparation did owners have in place? What owner, business, and location characteristics (if any) were associated with these preparations? If small business owners prepare differently based on pre-disaster owner, business or locational characteristics, then targeted educational efforts and policy changes can be developed that will better serve their needs. Previous work provides relatively little insight into the characteristics of owners and businesses that do or do not engage in disaster preparation. This paper will contribute to this literature by examining the influential characteristics of owners and businesses engaged in hurricane disaster preparation.

2. Literature review

Businesses are not immune to natural disasters but are subject to destruction, damage and interruption that can influence their ability to continue in operation. Hurricanes and tropical cyclones are very powerful natural hazards capable of damaging or destroying business assets, structures and critical infrastructure as well as human life. The deadliest tropical cyclone struck

Bangladesh in 1970 and caused a half million fatalities. Hurricane Katrina made landfall three times and was the costliest and one of the largest natural disasters in history in the United States. Damage was estimated at over \$81 billion and costs at more than \$160 billion [14]. This hurricane destroyed or damaged over 800,000 housing units, and in Louisiana alone, 11% of residences and 18% of businesses were destroyed or uninhabitable [24]. According to these numbers, business losses were higher than those of homeowners.

Other disasters also have significant impact on the regions where they occur. Potter et al. [23] reported that the 2020-2011 Canterbury earthquakes resulted in 185 deaths and damage to approximately three-quarters of the housing stock in the region. Businesses were differentially impacted depending on their location relative to the epicenter and fault line. By the time of the second quake, 11% of businesses in Canterbury alone had been forced to close at least temporarily and 1% permanently. The median time of closure after the second quake was 16 days. The estimated cost was NZ \$5 billion in repair and rebuilding costs and an additional capital cost estimate of NZ \$40 billion. Impacts varied by location, industry and firm size. While expensive and destructive, earthquake damage is usually confined to specific areas near fault lines while hurricanes can cause damage in much larger geographic areas and include the multiple hazards of wind and water.

Mitigation and preparedness measures have potential for reducing business losses and promoting sustainability of operations. Business owners can choose to protect their business interests through both short-term and long-term strategic management decisions. However, past research to be presented in the literature review shows that not all business owners take pre-disaster actions that could protect their businesses. If all businesses survive a disaster and do not suffer economic loss, perhaps the current level of preparation is sufficient, however, not all

businesses are able to survive a natural disaster and a large proportion of surviving businesses may be subject to economic losses during the recovery period. The following review of the literature will focus on two themes: first, an overview of general preparedness of small businesses; and secondly, the focus of this paper; the owner, business and location characteristics associated with preparedness.

2.1. General preparedness of small businesses.

Dahlhamer and D'Souza [6] reported that business owners surveyed in Des Moines, Iowa and Memphis, Tennessee did not take many steps to prepare for the unexpected, despite having endured the impact of a major flood in Des Moines and the threat of a potentially catastrophic New Madrid fault earthquake in Memphis. Other studies also cite evidence of a general lack of preparedness for earthquakes [19] [3] and emergencies in general [8]. A report on the preparedness of businesses that experienced the Loma Prieta earthquake in 1989 and Hurricane Andrew in 1992 also noted a similar lack of business preparedness among their respondents [35]. Tierney [32] reported on adoption of 16 specific preparedness actions taken by businesses before the 1994 Northridge, California earthquake. Of the 1,110 business owners surveyed, most business owners had done relatively little to prepare their businesses for earthquakes; the mean was 3.9 actions of a possible 16. Those businesses that had implemented a larger number of the preparation items tended to be older, to have more employees and to be more financially stable. A study by Webb et al. [24] of 1,700 businesses of all sizes in two earthquake zones, reported that fewer than 25% of businesses were prepared, which reinforces the evidence that few businesses actually do much to prepare. Alesch and Holly [1] reported that of 30 businesses damaged in the Northridge earthquake only one-third were housed in a building that was up to date in seismic standards. Only 13% of the owners had purchased earthquake insurance. The

most frequent preparations the businesses undertook before the earthquake were directed toward life safety rather than protection of the business itself [33] [35].

General preparedness has been associated in a few studies with pre-existing owner, firm or location characteristics. Howe [13] studied small business preparation for hurricanes and reported that several firm characteristics were predictors of significant levels of preparedness of small business owners. These were whether customers were primarily local or non-local, number of full time employees, ownership of property and industrial sector. The age of the business was a weak predictor of precautionary action. Corporate structure, supplier location and gender of owner did not predict precautionary actions. Business location was a significant predictor of action although in an unexpected way: businesses with higher exposure to flooding (closer to the coast and lower elevation) were less prepared than businesses with lower exposure to flooding. Based on these studies, general preparedness of small businesses, regardless of the type of disaster faced, seems to be lacking.

The preparation needs of tenant businesses may be different from the needs of businesses operating in property the business owner controls. Preparation is also likely to be different for businesses operated in residential structures because of differences in zoning requirements between commercial and residential districts, as well as differences in the assets and people at risk.

In the United States, lack of preparation has been addressed with a wide variety of information resources that are available in popular, trade and government literature for both residential and business use to facilitate decisions about how to prepare for emergencies. Hurricane preparation recommendations for businesses range from inexpensive to costly, from simple-to-implement to those that require extended and complicated planning and/or outside

contractors. Some recommendations apply directly to the business operations while others may apply to the structure in which the business operates. Business focused recommendations can be conceptually grouped into four broad areas: 1) planning, defined as the assessment of risk and planning specific strategies to minimize it; 2) transfer of risk, defined as the purchase of insurance; 3) reinforcement of structures; and 4) protection of tangible business assets, business processes and operations. The following sections review the research on small business preparation within each of these four conceptual groups and presents the evidence on pre-existing owner, business and location characteristics that are associated with each type of preparedness.

2.2. Pre-existing characteristics associated with specific types of preparedness

2.2.1. Planning

Many business owners do not appear to have undertaken the planning process in any formal way. A National Federation of Independent Business (NFIB) survey of 752 independent small and medium-sized businesses (SMEs) in the U.S. with fewer than 249 employees found that only 38% have disaster emergency plans in place [8]. Spillan and Hough [28] also reported that few small business owners engage in disaster/crisis planning. Howe [13] found in Sarasota County, FL that 58% of businesses had developed a business emergency plan and 48% had business recovery plans in place while Tierney [32] reported that nearly one-third (30%) of businesses in earthquake zones had developed a business emergency plan and 14% had a business recovery plan. Pathak and Ahmad [20] reported that small and medium size enterprises surveyed in Thailand lacked planning for business continuity.

Researchers have reported that certain pre-existing characteristics are affiliated with preparedness planning. Herbane [13] pointed out that planning is not a dichotomous condition,

but a *process* of adaptation to new circumstances and perceived threats (most research to date assesses planning in a binary fashion). If this is the case, one might expect prior experience with natural disasters to be a predictor of a higher level of planning. However, Rincon, Linares and Greenberg [25] reported that this was not the case with homeowners. Homeowners who had experienced a prior hurricane were actually less willing to go to a shelter than those who did not have prior experience. Flynn [11] reported that newly started small businesses in Grand Forks, North Dakota were more likely to have disaster plans than the existing businesses that had experienced the great flood of 1997. These results suggest that experience with flooding and/or storm surge might not be an effective planning motivator for business owners in hurricane prone areas.

Certain characteristics of businesses were associated with greater likelihood of having disaster preparedness plans, in particular, industry sector, owning the business property rather than leasing, and business size. Cole et al. [4] reported the extent to which manufacturing plants had any pre-disaster planning in place, and only 8.6% reported they had a business continuity plan. The report did not associate planning practices with pre-existing characteristics of owner or firm (with the exception of single vs multiple production location and a specific industrial sector). In addition, Dahlhamer and D'Souza [6] also reported that industry sector influenced whether business owners planned for disaster: finance, real estate and insurance businesses were more likely to have preparedness plans in place than were other types of businesses. Corey and Deitch [5] reported that larger organizations were more likely to have an emergency response plan in place than were smaller organizations while Dennis noted that the smaller the firm size, the lower the percent of firms that reported they had an emergency plan in place [8]. Herbane

[13], however, suggests that firm age rather than firm size is a determinant of the propensity to plan.

2.2.2. Transfer of property risk

Purchase of property insurance is one of the most common preparation practices. Yoshida and Deyle [36] found that the majority of businesses in their study had general commercial property insurance coverage, implying that a high proportion of business owners took steps to transfer the risk of property loss to insurance carriers. Additional windstorm coverage was reported by 36%, and flood coverage by 26% [36]. Pathak and Ahmad [20] reported that small and medium size enterprises surveyed in Thailand did not utilize risk transfer mechanisms to protect their businesses from flooding. Howe [13] reported that 51% of Sarasota County business owners interviewed had purchased flood insurance for their businesses. Tierney noted that of the small businesses in an earthquake zone, only 18% had purchased an earthquake insurance rider [32]. Although not reported directly in the literature, purchase of property insurance coverage in the United States may be more likely to be undertaken by owners of the business structure who have a mortgage obligation for that property since this is usually mandated by mortgagors to protect *their* investment. Pre-existing characteristics of business owners and firms have typically not been included analysis of property insurance purchase, nor various riders available, but by extrapolation some characteristics to be considered as potential predictors would be tenant/non-tenant business and whether the business property is mortgaged or not.

2.2.3. Structural preparation

Protection of business structural property refers to both short and long term activities that business owners might undertake to reduce the physical vulnerability of the structure to disaster damage caused by hurricane wind and water. Long-term activities may involve retrofitting

building structures. Examples of retrofitting include permanent actions such as strengthening roofs, installing hurricane clips, regular termite inspection and control to maintain structural integrity, as well as temporary actions such as the use of hurricane shutters or other window covers.

Some business owners take steps to protect their building structures. Of Sarasota County business owners, 46% had taken action to wind-proof or flood-proof their facilities [13]. A slim 14% of small businesses in an earthquake zone had had their business buildings structurally assessed [32]. Yoshida and Deyle [36] indicated the extent to which several mitigation measures that involved elevating were adopted: electric utility box (47%), HVAC unit (40%) and the first floor of the structure (26%). Only about half of the county where they conducted their study is subject to flooding and storm surge so it is possible that among those businesses in known surge prone locations the percentages indicated could be higher.

Asgary, Anjum and Azimi [2] reported on surviving small businesses that experienced the 2010 flood in Pakistan. Although ninety percent had reopened within six months after the flood, the majority were operating in the red. Pre-existing characteristics that influenced recovery included past disaster experience, financial resources, the amount of damage to the business, and damage to lifelines.

What owners do in regard to home property protection may suggest actions they are likely to consider at their business location. Peacock [21] focused on the use of shutters and envelope coverage statewide for 1,500 owner occupied, single-family homes in Florida. Only one quarter of these residential structures was optimally protected from hurricane force winds. Peacock's findings indicated that homeowner characteristics including knowledge of risk, prior hurricane experience, influence of neighbors, location of residence, income and race/ethnicity

influenced adoption of hurricane shutter strategies. These results suggest that the use of shutters or other forms of envelope coverage on commercial business structures may not be a priority with business owners. In fact, Corey and Deitch [5] asked New Orleans business owners about whether they had boarded up their businesses prior to Katrina and only 46% reported they had done so. While owners of business properties may opt for some sort of shuttering or boarding up, it is likely that business owners who lease their operating space do not undertake certain structural preparations because they do not own the structure.

Limited research was found regarding retrofitting of commercial buildings and none that was specific to the pre-existing characteristics of owners who retrofitted their commercial buildings to improve hurricane resistance. In some jurisdictions in the United States, retrofitting (e.g. elevation of the structure) may be mandated at the time of rebuilding by revised building codes or written into insurance policies [15] but is otherwise likely to be voluntary. Similarly, no research was found examining the pre-existing characteristics of owners and their firms regarding the extent to which business owners practiced regular termite inspection and repairs as a means of preserving the structural integrity of their business facilities. Because of the prevalence of termites in the southern United States, failure to treat can severely weaken structures making them more vulnerable to storms, potentially negating property insurance coverage [31].

2.2.4. Protection of business operations

Businesses that are not damaged by a specific natural hazard may still experience significant disruption to their income flow due to customer displacement, loss of suppliers, loss of utility lifelines and rapidly changing market needs. A few studies have offered insights into the nature of hurricane preparations for business operational continuity. Preparation falls into

three broad types: transfer of the risk of income loss, employ strategies to minimize “down time” and physically protect business assets.

Purchase of business interruption insurance transfers the risk of income loss due to certain circumstances as specified in the insurance policy and can replace some income lost during the period of disruption. Tierney [32] found that only 24% of businesses surveyed after a major earthquake had business interruption policies in place. Similar results were indicated by Yoshida and Deyle [36] who indicated 27% of business owners interviewed had purchased business interruption insurance and Howe [13], 32% of owners respectively. These studies did not provide data on the pre-existing characteristics of owners or businesses that purchased or did not purchase.

Strategies to minimize down time include installation of a generator to provide electrical power during a loss of utility lifelines. Business owners in Sarasota had stored water (36%), fuel or batteries (40%), and critical inputs (59%), and 29% had obtained a generator to supply electric power [13]. Only 11% of business owners in Texas had purchased generators [18]. These researchers did not report pre-existing characteristics associated with this type of action; however, one might speculate that prior experience with power outages may be a likely factor.

The third type of preparation for disruption of business operations focuses protection of the physical operating assets of the business such as inventories, supplies, equipment and records. Such preparations might include getting business supplies, inventories and records out of harm’s way, as well as stocking up on necessary inputs to enable business operations to continue despite loss of critical utilities. The majority of Sarasota County business owners (92%) reported that they had backed up their computer data [13], thus protecting their business records. Yoshida and Deyle [36] indicated that 54% of business owners they interviewed had elevated

business records and supplies and 51% had elevated business equipment. Sarasota owners reported that they arranged to move their businesses to another location in case of damage (30%), although only 7% had proactively moved their business location to reduce their risk [13]. To protect business equipment and people, 26% of small businesses in an earthquake zone had braced shelves and equipment [32].

In summary, owners have a variety of strategies at their disposal to protect business assets, and there is a wide range of utilization of those strategies. The research evidence provides limited insight into the pre-existing characteristics of owners and businesses that do or do not utilize these business strategies to enhance business continuity. The evidence does suggest however, that pre-disaster factors such as location, industry sector and number of employees may predict some activities intended to protect business operations such as moving or elevating important business assets. This paper contributes to the literature by examining to what extent the characteristics of small business owners and their businesses affected the level of disaster preparation before Hurricane Katrina struck them. The next section details the data and methods used for this examination.

3. Data and method

3.1. Sample and research design

A population of 17,060 for-profit small businesses with 200 or fewer employees and headquarters located in Mississippi was identified for this study. The population was deliberately limited geographically to south Mississippi. The ten chosen counties (Hancock, Harrison, Jackson, Lamar, Forest, Pearl River, Stone, George, Green and Perry) were almost entirely to the right of the storm track, and therefore in the right front quadrant of Hurricane Katrina (see Figure

1). This choice was made in order to ensure that the majority of businesses were exposed to the hurricane event.

A sample of 5,500 randomly selected firms was drawn from this population, of which 2,610 were eligible for the study and had good contact information. Eligibility was verified to determine that the business had not closed prior to Hurricane Katrina nor opened after Katrina, that it had operated within the defined geographic area and that the owner was the person being interviewed. One objective was to include businesses that had ceased operations as well as those that had continued operating. More detail about the sampling strategy has previously been published in Schrank et al. [26] and Marshall et al. [17].

Figure 1. Map of Mississippi counties showing the Hurricane Katrina disaster area (light gray shading) [16] and 10 counties included in the present study (outlined in black).

Telephone interviews were conducted by the University of Wisconsin Survey Research Center between January and October of 2013. These interviews collected information on the small business as well as on the owner and community. Data were also collected with mailed surveys one and two years after the initial interview. Business information collected included pre-disaster characteristics of the firm, preparedness and disaster impacts over time. The data for the present analysis is taken from the telephone interviews. The response rate to the telephone interviews was 19.12%, providing a sample size of 499 small businesses and of these 497 employed fewer than 75 employees. Of the 499 businesses, 373 were still operating at the time of the interview and the remainder had ceased operations.

3.2. Variables

3.2.1. Dependent variable

Multiple regressions were used in this study. In the first regression, amount of preparation is the dependent variable and the independent variables of pre-existing characteristics of owner, business and location are utilized to predict who prepares. Subsequent regressions utilize the same independent variables, but include each individual preparation strategy as a dependent variable.

In order to assess the preparation of small businesses for Katrina, strategies for this analysis were selected from each of four general categories: planning, risk transfer, structural reinforcement and protection of business operations and assets. While there are numerous questions that would be worth exploring, it was necessary for space reasons to limit the list. The ten questions chosen enabled an assessment of a variety of business related preparations across categories. The questions asked and the categories represented are indicated in Table 1.

Table 1: Frequency of use of business preparedness/mitigation actions pre- Katrina in descending order of practice, and preparation categories of each action

	% Yes (of all owners)	Frequency (N=499)	Preparation Category
Did you have property or casualty insurance policy in force on your business property, equipment and/or inventory?	85.17	425	Transfer of risk
Were there regular termite inspections and repairs as needed?(on the building the where business operated)	77.35	386	Structural
Did the building structure meet the current hurricane wind standards at that time?	64.53	322	Structural
Prior to Katrina did you keep key business and legal records in a secure location away from the business, or have them in electronic form so you could get access from some other location?	52.51	262	Business operations
Were any of the following elevated: your business records, equipment or supplies?	41.08	205	Business operations
Were any of the following elevated: the utility box, HVAC equipment or generator?	20.64	103	Structural
Prior to Hurricane Katrina did your business have a written emergency plan in place?	20.24	101	Planning
Did anyone shut off the utilities prior to Katrina's landfall?	18.84	94	Structural
Was your business inventory elevated?	18.44	92	Business operations
Prior to Hurricane Katrina did you have a flood insurance policy in force?	7.41	37	Transfer of risk

The percentage of business owners who reported using each of the ten activities is shown in Table 1. The most widely reported preparedness action (85%) that small business owners had taken was to purchase property insurance to transfer the risk of loss of their business property. Owners were relatively vigilant about having regular termite inspection and doing repairs as

needed (77% had done so). Business owners operating in commercial structures reported that 65% met current hurricane wind standards at the time of Katrina. Far fewer owners (21%) reported that the utility box, HVAC equipment, or generator of their business building was elevated.

Keeping key business records in a secure location away from the business or having them in electronic form was reported by 53% of respondents, and 41% reported that they had elevated business records, equipment or supplies. Owners were asked whether they had a written emergency plan in place for their businesses prior to Katrina and only 20% reported that they did. Only 19% reported that building utilities had been shut off prior to landfall, and only 18% reported they had elevated their inventories. The least reported action was the purchase of a flood insurance policy (7%).

3.2.2. Independent variables

The independent variables for the first model are pre-existing characteristics that describe the owner, business and location traits prior to Katrina. Owner demographics included gender, race, veteran status, education level, marital status, size of household, whether the owner worked full time in the business, and the number of years the owner had owned the business. Marital status and size of household offer the opportunity to assess both potential demands on business owners in times of crisis and potential assets that may be available in times of demand (e.g. free labor and expertise).

Business characteristics included pre-Katrina sales (log) and number of employees; these two characteristics are commonly used in the literature to assess firm size. Business age and legal form were included as independent variables as was industry sector (based on NAICS) of the business. Past research has demonstrated that whether the owner's spouse worked in the business

influences management decisions [10] and therefore spousal participation (copreneurship) was included as an independent variable in the present study. Additionally, whether or not the business had been temporarily closed for 24 hours or longer by a previous disaster or had cash flow problems prior to Hurricane Katrina were included. Prior adversity may serve to educate business owners about the impact of damage to their property and the loss of lifelines and customers. Eiser et al. [9] indicated that the decision of people to protect against a risk is multi-dimensional. It is not only the severity of the risk that is key to decision making, but also the ability of the person to do something about the risk. Previous cash flow problems and prior business closure of 24 or more hours could be considered as evidence of prior adversity from which owners may have gained crisis management experience. Finally, perceived success of the business before Katrina was included as a measure of business success.

Finally, two locational variables were included: 1) whether the business operated from a property owned or leased; and 2) whether the county was coastal or non-coastal. Whether the business was home-based could not be included as an independent variable in the logit analysis because it was strongly correlated with property ownership.

3.3. Data analysis

Four steps were undertaken to analyze the data. First, scores were determined for each firm by assigning each activity undertaken with a score of one and then summing the scores for each firm. This allowed assessment of firms based on what type of mitigation they had done, and how much overall mitigation each had done. The total scores range from 0 to 10, where firms with a 0 score undertook no preparedness activities and firms with a score of 10 undertook all of the preparedness activities included in the measure. In the case of home-based businesses (32% of the sample), the owners reported on their residential properties and this information was used

to determine total business mitigation score. The questions were the same for both home-based and non-home-based except for the location (business or residence) designated in the question. Frequency statistics were computed to determine the extent to which the ten mitigation actions were adopted and the percentages of businesses reporting the use of those actions. This initial analysis provided a profile of the mitigation activities that were used by the respondents.

Second, firms were assigned scores based on the number of mitigation activities each reported (0-10). Businesses that undertook three or fewer activities were designated as low mitigators (about 41% of businesses). The array of scores was divided at the mid-point and firms reporting low mitigation (0-3 activities) were assigned a score of 1, while all other firms were assigned a 0, creating a binary outcome used as the dependent variable. A summary of these scores is provided in Table 2. Very few business owners (<10%) reported implementing more than six of the mitigation activities. Further, more than half reported they had implemented fewer than four activities (>60%). The mode was three activities and the median score was four. The average number of activities was just over four (4.05). The distribution is skewed left (low).

Table 2. Number of mitigation activities reported by 499 small business owners

Number of Activities	Owners Using Frequency	Owners Using Percent	Cumulative Percent
0	4	0.80%	0.80%
1	29	5.81%	6.61%
2	60	12.02%	18.64%
3	113	22.65%	41.28%
4	104	20.84%	62.12%
5	87	17.43%	79.56%

6	53	10.62%	90.18%
7	29	5.81%	95.99%
8	15	3.01%	99.00%
9	3	0.60%	99.69%
10	2	0.40%	100.00%

Third, a logit regression was conducted to determine the pre-existing owner, business characteristics and locational traits associated with low mitigation. In the logit regressions, nineteen independent variables, as well as eight industry and ten county indicators, were included. These variables addressed pre-existing characteristics of owners and their businesses at the time of Hurricane Katrina as well as locational variables. Finally, the logit regression analysis was repeated for each of the preparation activities individually to determine the owner, business, and locational characteristics associated with each activity. The descriptive statistics for the variables used in the analysis are shown in Table 3.

Table 3: Descriptive statistics of characteristics prior to Hurricane Katrina

Owner Characteristics	Frequency	Percent
female	157	31.46
non-white	37	7.41
veteran	97	19.48
some college	187	37.47
college or higher	218	43.69
married	418	83.77
full time	415	83.17
	Mean	SD
household size	2.75	1.37
years of ownership	22.99	10.59
Business Characteristics	Frequency	Percent
sole proprietor	228	45.69
copreneurial	115	23.05
prior closure 24 hr+	168	33.67
very successful	278	55.71
cash flow problems	256	51.30
	Mean	SD
pre-Katrina sales (log)	567,117	2,178,319

no. of employees	6.00	12.71
business age	28.66	16.83
ind.: agriculture	21	4.21
ind.: manufacture	20	4.01
ind.: construction	38	7.62
ind.: transport	15	3.01
ind.: wholesale	25	5.01
ind.: retail	95	19.04
ind.: finance	44	8.82
ind.: services	169	33.87
Location Traits	Frequency	Percent
property ownership	369	73.95
coastal county	337	67.54
home based	156	31.26

In order to address potential heteroscedasticity in the regression, the Gauss-Markov homoscedasticity assumption was relaxed, allowing for the existence of different co-variances across groups. Clustering was done on two levels, based on whether a business was located in a coastal county or not.

4. Results

4.1. Low mitigators

Results of the logit regression assessing low mitigation are shown in Table 4. The results suggest that several owner, business, and locational characteristics affect whether a business owner will be a low mitigator. Two owner characteristics were significantly and positively associated with low mitigation. Those working full time in the business and those with more years of ownership were more likely to be low mitigators. However, female business owners and those with a college education or higher were less likely to be low mitigators. Businesses with more employees, experience with past disasters, cash flow problems before Katrina, those with high success before Katrina, those who owned their property and those operating in a coastal county were less likely to be low mitigators. Sole proprietors and businesses in the construction

and wholesale industries were more likely to be low mitigators; however, businesses in the retail industry were less likely to be low mitigators.

Table 4. Logit regression results for factors associated with being a low mitigator

	<i>Low Mitigators</i>	
	Coefficient	Clustered Std. Error
<i>Owner Characteristics</i>		
female	-0.502***	0.114
non-white	0.205	0.737
veteran	-0.130	0.246
some college	-0.072	0.140
college or higher	-0.517***	0.031
married	-0.300	0.463
household size	0.105	0.087
full time	0.443***	0.143
years of ownership	0.011**	0.005
<i>Business Characteristics</i>		
pre-Katrina sales (log)	0.020	0.050
number of employees	-0.027***	0.005
business age	-0.0001	0.0003
sole proprietor	0.015***	0.001
copreneurial	-0.057	0.409
prior closure 24 hr+	-0.310***	0.051
cash flow problems	-0.271***	0.032
very successful	-0.383***	0.144
ind.: agriculture	-0.467	0.356
ind.: manufacture	-0.331	0.271
ind.: construction	0.406***	0.084
ind.: transport	0.121	0.278
ind.: wholesale	0.536***	0.150
ind.: retail	-0.447***	0.146
ind.: finance	-0.219	0.297
ind.: services	0.015	0.240
<i>Location Traits</i>		
owned property	-0.763***	0.177
coastal county	-13.802***	1.618
	N = 495	

County controls are included, but not reported for parsimony. (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.)

4.2. Preparation activities

Results of the logit regressions with individual preparation activities as the dependent variable and the same independent variables as listed above are reported in Tables 5, 6 and 7. The nine activities are 1) written plan, 2) property insurance, 3) wind standards, 4) termite, 5) elevated utilities, 6) shut off utilities, 7) elevated records and equipment, 8) records off site, and 9) elevated inventory. Only 7.22% of business owners reported they had flood insurance, too few to achieve convergence in the regression; thus flood insurance could not be included in the following logit analysis.

4.2.1. *Planning and risk transfer*

Results for factors associated with planning and risk transfer activities are shown in Table 5. Gender, race, education level, marital status, number of employees, firm age, whether the business was copreneurial, and if it was located in a coastal county had a positive and statistically significant effect on having a written emergency plan. This indicates, for example, that business owners who are female, non-minority, or married are more likely to have a written plan. However, two owner characteristics: working full time in the business and years of ownership were negative and statistically significant. Industry results were mixed. Agriculture, construction, transportation, retail, finance, and services were significantly and positively associated with having a plan; wholesale was significantly and negatively associated with having a plan.

Female ownership, owner's college education, household size, businesses with more employees, having experience with a prior closure, being a property owner and having a location in a coastal county were positively associated with the use of property insurance to transfer risk. Only length of ownership was negatively and significantly associated with transferring risk.

Results on industries and counties were again mixed. Several industry dummies had positively and statistically significant effects on use of property insurance, including agriculture, transportation, and retail, while wholesale was negatively and statistically significant.

Table 5. Logit regression results for factors associated with having a written plan and transferring risk.

	<i>Written plan</i>		<i>Property insurance</i>	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
female	0.784***	0.124	1.122*	0.675
non-white	0.607**	0.265	-1.099	0.746
veteran	0.181	0.253	0.204	0.290
some college	0.508***	0.128	0.319	0.218
college or higher	0.438***	0.163	1.824***	0.107
married	0.325***	0.142	0.311	0.477
household size	-0.010	0.106	0.012***	0.003
full time	-0.647**	0.313	-0.638	0.443
years of ownership	-0.031***	0.007	-0.010***	0.004
pre-Katrina. sales (log)	0.015	0.064	-0.013	0.135
no. of employees	0.057***	0.003	0.182***	0.022
business age	0.001**	0.0004	0.0004	0.0003
sole proprietor	-0.183	0.204	0.047	0.127
copreneurial	0.262***	0.059	-0.279	0.383
prior closure 24 hr+	0.217	0.188	0.386**	0.182
cash flow problems	-0.138	0.370	0.326	0.397
very successful	0.086	0.347	0.744	0.713
ind.: agriculture	0.596***	0.074	0.303***	0.053
ind.: manufacture	-1.060	1.035	omitted	
ind.: construction	0.506***	0.179	-0.412	0.296
ind.: transport	1.359*	0.763	0.121***	0.004
ind.: wholesale	-0.538***	0.117	-0.560*	0.317
ind.: retail	0.285***	0.109	0.378***	0.072
ind.: finance	1.256*	0.742	-0.417	0.671
ind.: services	0.544***	0.742	-0.129	0.032
<i>Location Characteristics</i>				
owned property	-0.145	0.180	1.433***	0.334
coastal county	13.743***	1.130	1.281***	0.199
N	495		464	

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

Some terms are reported as “omitted”. In this case the dummy predicts success perfectly and is therefore dropped from the regression. County controls are included, but not reported for parsimony.

4.2.2. Structural mitigation

Logit results for factors associated with doing structural mitigation are shown in Table 6. Businesses owned by minorities or veterans, businesses with more employees, businesses operated as a copreneurship, and businesses with prior experience with adversity (past 24 hour or more closures and cash flow problems), as well as those that were very successful before Katrina were more likely to be operating from structures that met wind standards. In addition, businesses operating from property owned by the business owner, and properties in coastal locations were more likely to operate in structures that met wind standards. Owner education (some college and a college degree or higher) had a negative and significant effect on meeting wind standards, as did sole proprietorship. Several industries were also statistically significant: manufacturing, transportation, finance, and retail were all positive and significantly associated with meeting wind standards.

Female ownership, owners who had a college education or higher, higher pre-Katrina revenues, more employees, cash flow problems before Katrina, high success before Katrina, property ownership, and coastal location had a positive and statistically significant effect on doing regular termite check and repair. Older and copreneurial businesses were significantly less likely to report they did regular termite mitigation. Industry results were mixed, indicating that finance was positively associated with doing termite remediation, while transportation and construction were negatively associated.

Owner characteristics including gender and education had a significant and positive effect on elevation of building utilities. Business characteristics including business age, sole

proprietorship, previous experience with 24 hour or more closure, cash flow problems before Katrina, and greater business success before Katrina had a statistically significant and positive effect on whether or not the building utilities were elevated. Of the locational traits, only property ownership had a statistically significant and positive effect on utility elevation. Non-white owners, veterans, and owners with more years of ownership were less likely to elevate building utilities, as were those reporting higher pre-Katrina sales. Industry results were mixed, but indicating again that businesses in the construction sector were significantly less likely to elevate utilities.

Several characteristics such as work in the business full-time, business age, past experience with 24 hour or longer closure, cash flow problems before Katrina and property ownership had a significant and positive effect on utility shut-off. Higher education and sole proprietorship had a negative and significant effect. Two industries were also positive and statistically significant: agriculture and manufacturing.

Table 6. Logit regression results for factors associated with structural mitigations

	<i>Wind standards</i>		<i>Termite</i>		<i>Elevated utilities</i>		<i>Shut off utilities</i>	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
female	0.151	0.330	0.883** *	0.229	0.509** *	0.171	-0.019	0.449
non-white	0.455**	0.191	0.100	0.934	-1.166*	0.641	0.419	0.877
veteran	0.242**	0.120	0.437	0.408	- 0.158** *	0.023	0.173	0.206
some college	- 0.411**	0.172	0.340	0.289	0.394** *	0.137	- 0.657** *	0.251
college or higher	- 0.339** *	0.038	1.045**	0.476	0.208** *	0.017	- 0.496** *	0.156
married	-0.493	0.456	0.165	0.215	-0.081	0.070	-0.604	0.488
household size	-0.019	0.063	-0.062	0.122	-0.072	0.165	0.036	0.101
full time	-0.061	0.174	-0.097	0.241	0.110	0.338	0.683** *	0.151

years of ownership	-0.006	0.019	-0.014	0.012	-0.022** *	0.0002	-0.007	0.010
pre-Katrina sales (log)	-0.017	0.041	0.090** *	0.017	-0.160** *	0.039	-0.056	0.060
no. of employees	0.029**	0.015	0.035** *	0.011	-0.012	0.016	-0.023	0.022
business age	0.0001	0.0004	-0.001** *	3.0E-05	0.007** *	0.001	0.0004* **	8.7E-5
sole proprietor	-0.368**	0.149	0.244	0.255	0.075**	0.031	-0.306** *	0.113
copreneurial	0.147**	0.060	-0.289** *	0.026	-0.386	0.294	-0.179	0.174
disaster experience	0.384** *	0.057	-0.247	0.198	0.456** *	0.052	0.204* *	0.113
cash flow problems	0.047** *	0.016	0.339**	0.160	0.322** *	0.102	0.487** *	0.102
very successful	0.450**	0.180	0.750**	0.367	0.170*	0.104	-0.085	0.284
ind.: agriculture	0.177	0.773	0.019	0.324	-0.161	0.311	0.487** *	0.142
ind.: manufacture	0.667** *	0.169	-0.238	0.755	1.163** *	0.132	0.891* *	0.504
ind.: construction	0.242	0.339	-0.424**	0.225	-0.113** *	0.030	0.106	0.214
ind.: transport	0.153** *	0.011	-0.987**	0.417	0.706**	0.350	-0.113	0.214
ind.: wholesale	-0.456	0.555	-0.119	0.573	0.552*	0.310	-0.822	1.043
ind.: retail	0.414** *	0.130	0.195	0.040	0.663**	0.267	0.163	0.161
ind.: finance	0.551** *	0.083	1.632**	0.712	-0.100	0.491	-0.103	0.370
ind.: services	0.089	0.690	0.050	0.115	0.025	0.052	-0.371	0.464
owned property	0.469** *	0.048	1.130** *	0.374	0.806** *	0.243	0.834** *	0.124
coastal county	13.196* **	1.446	14.697* **	1.289	0.665	1.928	0.495	1.633
N	495		493		476		487	

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$.

Some terms are reported as “omitted”. In this case the dummy predicts success perfectly and is therefore dropped from the regression. County controls are included, but not reported for parsimony.

4.2.3. Business operations protection

Results of the logit models analyzing factors associated with protection of business operations are shown in Table 7. Several owner and business characteristics were significantly and positively associated with elevation of business operating assets such as records and equipment: female ownership, having more employees, operating as a sole proprietorship, and cash flow problems before Katrina. Being a minority business owner, working full time in the business and greater business success before Katrina were negatively associated with elevating business assets. Businesses in agriculture, wholesale, and service sectors were significantly and positively associated with elevating business assets.

Table 7. Logit regression results for factors associated with protection of operations

	<i>Elevated records, equipment</i>		<i>Records off-site / electronic</i>		<i>Elevated inventory</i>	
	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>Coefficient</i>	<i>Std. Error</i>
female	0.529***	0.068	0.103	0.121	0.499	0.392
non-white	-0.761***	0.216	-0.762	0.727	-0.293	0.551
veteran	0.039	0.140	0.453***	0.155	-0.354***	0.026
some college	0.109	0.385	0.079	0.110	-0.399***	0.091
college or higher	-0.034	0.154	0.069*	0.036	-0.483***	0.121
married	0.134	0.386	0.449***	0.158	0.509	0.335
household size	-0.093	0.134	-0.083*	0.016	-0.144*	0.087
full time	-0.322***	0.006	-0.166***	0.016	0.130***	0.011
years of ownership	-0.005	0.006	0.012	0.017	-0.004	0.015
pre-Katrina sales (log)	-0.018	0.027	-0.021*	0.012	0.119***	0.037
no. of employees	0.010**	0.004	0.024**	0.011	0.011	0.010
business age	-0.0001	0.0003	-0.013***	0.003	0.001***	0.0002
sole proprietor	0.198***	0.056	-0.598***	0.062	-0.268***	0.026
copreneurial	0.057	0.356	-0.081	0.111	0.171	0.192

prior closure 24 hr+	0.162*	0.090	0.227	0.205	0.211	0.304
cash flow problems	0.495***	0.130	0.020	0.086	0.475	0.312
very successful	-0.217*	0.123	-0.006	0.252	-0.040	0.142
ind.: agriculture	0.549***	0.135	-0.254	0.480	0.163***	0.057
ind.: manufacture	0.393	0.354	-0.467	1.154	0.242	0.319
ind.: construction	0.088	0.560	0.094	0.111	-0.326	0.834
ind.: transport	0.393	0.878	-0.082	0.487	-1.054	2.346
ind.: wholesale	0.547**	0.243	-0.315	0.635	-0.677	0.465
ind.: retail	0.387	0.365	0.461***	0.159	0.673	0.655
ind.: finance	0.124	0.234	0.033	0.454	-0.662**	0.317
ind.: services	0.299***	0.134	0.473***	0.029	-0.141	0.722
owned property	0.112	0.082	-0.146***	0.024	-0.969***	0.079
coastal county	0.599	2.419	0.728***	0.158	-0.568	2.456
N	493		493		485	

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$

Some terms are reported as “omitted”. In this case the dummy predicts success perfectly and is therefore dropped from the regression. County controls are included, but not reported for parsimony.

Being a veteran owner, having a college education or higher, being married, having more employees, and operating in a coastal location had a positive and significant impact on keeping records offsite. Working full time in the business, larger household size, pre-Katrina sales revenues, older business age, sole proprietorship and property ownership were negatively associated with keeping records offsite. Two industry sectors had a positive and significant effect on keeping business records offsite: retail and services.

Working full time, reporting higher pre-Katrina sales and older business age, had a positive relationship with inventory elevation. Conversely, owner education, veteran status, household size, sole proprietorship and property ownership had a negative and statistically significant effect on elevating inventory. The agriculture industry had a positive and statistically significant effect on elevating inventory while finance had a negative and statistically significant effect.

5. Discussion

The literature indicates that relatively few preparation activities are reported by businesses despite the threat of natural disasters. Previous research has also reported that the primary preparation activities practiced by residents and business owners are activities oriented to human survival. Because research studies have investigated different actions and categories of actions, it is difficult to compare adoption rates across studies. While comparisons across studies will inevitably be made, the conclusions drawn from such comparisons must be cautious ones. Furthermore, since the time of many of these research studies, especially those undertaken prior to 2000, there have been significant changes in public understanding of possible threats because of extensive media coverage in the United States of severe earthquakes, the Asian tsunami, many hurricanes and terrorism events such as 9/11. Federal, state, and local governments have increased response to disasters, and perhaps the public is more aware of external threats and more likely to take steps to prepare than they were 20 to 30 years ago.

About 42% of Mississippi business owners who participated in the present study reported that they had undertaken three or fewer preparation measures, which is slightly less than reported by Dahlhamer and D'Souza [6]. The difference in number of preparation activities may be attributed to differences in the nature of the disaster, differences in building codes, general differences in business characteristics, perceived vulnerabilities, or the questions asked about what owners did to prepare. Whatever the reason, when examined through the lens of overall *quantity* of mitigation, the picture still suggests that owners *may not be* adequately preparing their businesses for potential external threats.

The particular activities that were most and least reported by the respondents suggest that whether or not owners undertake some activities to protect their businesses may not be totally in their control. For example, purchase of a general property insurance policy is likely necessary for

property that is mortgaged since most mortgage lenders require insurance coverage to protect the lender's investment, thus the high proportion of insurance coverage probably reflects this requirement. This supposition is supported by the fact that 74% of owners of businesses in this study owned their property. The same rationale might be applied to the high frequency of termite inspection and repair, since it may also be mandated by insurers or mortgage lenders. In addition, the application of business building elevation and structure wind standards may be mandated by local building codes. Without such incentives or mandates, small business owners may not choose to utilize these preparation activities on behalf of their businesses. In this study, length of ownership was negatively associated with purchase of insurance, perhaps indicating that older businesses may have paid off their mortgages and dropped their property insurance coverage, thus validating the importance of incentives.

The activities less frequently used are primarily those that apply to individual business operations and assets (protecting records, key business assets such as inventory and equipment, and planning). That these actions were less frequently reported suggests some possible interpretations. First, some businesses do not implement what they perceive to be not appropriate or too expensive to protect their particular business operations. Second, what is not mandated may not be done even if it is useful to do, especially for businesses with relatively few labor and financial assets. Third, tenant businesses may not report on structural protection because those activities would be in the control of the property owner from whom the business owner leases space. Fourth, owners seem to understand the need to protect structural property, but they do not make a similar effort to protect business operations and assets. It is possible they do not understand what else they could be doing to enhance the sustainability of their businesses, instead assuming structures will protect their business assets. Business owners who owned the

property where their business operated (and thus had probably insured that property) were significantly more likely to be operating following Katrina [17]. In the present study, insuring of business property was the most reported strategy and was practiced by 85% of business property owners.

Prior disaster experience or prior experience with adversity seems to be an important factor in determining who is a low mitigator. Owners whose businesses had been temporarily shut down because of a past hurricane event or who had experienced previous business cash flow problems were less likely to be low mitigators than those who had not had that prior experience with adversity. These results are consistent with those of Spittal et al. [29] who reported that small business managers were unlikely to undertake crisis planning unless their businesses had experienced a previous crisis event. Prior adversity may serve business owners by demonstrating that they could manage adversity in the past and, therefore, could manage it in the present as well. These results are consistent with Marshall et al. [17] who reported that businesses that had closed for more than 24 hours because of a disaster event prior to Katrina demonstrated a greater ability to continue operations after a subsequent hurricane.

Three additional characteristics that influenced mitigation activity were female ownership, ownership of the property where the business operated and coastal location. All three characteristics were negatively associated with low mitigation and positively associated with certain individual preparations. Female ownership was positively associated with more than half of the mitigation activities, indicating that women business owners were more likely to undertake business preparedness activities, particularly structural mitigation. Sydnor et al. [30] noted that female owned businesses were no more likely than male businesses to suffer catastrophic damage and closure, but they were more likely to reopen after Katrina and then cease operations

later than to remain in operation. This suggests that either female owned businesses experienced degradation failure or that their owners had a different set of challenges post-Katrina than did male owners.

The association of ownership of the property where the business operated with various activities supports the notion that mandated protection activities have great value in motivating business owners to protect their properties. These same owners mostly did little else to protect their other business assets and operations.

The importance of a coastal location suggests that the choice of activities utilized may be different for businesses operating in geographic areas that experience wind and flood damage than in areas where wind damage is the primary threat. In that case, businesses that anticipate different threats within a given hurricane event would potentially prepare for those anticipated threats and not for all possible threats.

While it is helpful to look at the overall adoption rates of mitigation activities across the sample of respondents, examining the frequency with which activities are reported does not provide a complete picture. Mitigation is not necessarily a “one size fits all” decision since the nature of the business, whether the business property is owned or leased, whether the business is located in a commercial or residential district, and whether the business had inventory and equipment assets are factors that likely impact adoption of various mitigation activities. In addition, it is intuitive to assume that mitigation activities intended to protect against flooding and surge would be less likely to be adopted by businesses not located in flood prone areas. It is also unlikely that tenant business owners could insure property they are leasing or that they would undertake the expense of retrofitting the structure to meet hurricane standards. The

examination of individual preparation activities sheds information on both the nature and level of preparation these business owners reported.

6. Conclusions

The results of this study suggest that small business owners in this study were selective in which preparation activities they practiced and that owner, business and locational characteristics were significantly associated with those choices. This suggests that the benchmark of overall *quantity* of preparation may not be universally appropriate. Instead, researchers should assess overall *adequacy* of preparation with an eye toward what is appropriate for the individual business situation. For example, elevation activities are probably not needed outside of flood prone areas and therefore not an appropriate benchmark for businesses operating outside of these areas. Similarly, elevating inventory is not an appropriate benchmark for businesses that typically have little or no inventory. Researchers may be able to tease out meaningful results if businesses operating in owned versus leased property could be examined separately with respect to structural mitigation. Thus, a more complete picture might be developed if owners were asked a wider variety of questions about the preparation and asked to indicate which they thought were appropriate for their particular business, and of those that were appropriate, which they had done.

It is important that preparation be appropriately measured and assessed and that business owner practices are compared to the norms for their particular situations – as opposed to a single norm for a particular disaster event type. Business situations present complexities that are not necessarily revealed by assessing quantity of preparation or by any single preparation strategy. In addition, even nearby geographic locations can present significantly different challenges depending on storm surge patterns, just as businesses located in earthquake prone regions are likely to differ in their exposure to known fault lines and shaking intensity. The results of this

study demonstrate that small business preparedness is probably not a “one size fits all” situation, but in fact may vary widely based on owner, business and locational characteristics. Thus, it is clear that planning is an essential element of risk management and reduction, yet only 20% of the businesses in this study reported that they had a written plan.

In addition to the notion of establishing appropriate benchmarks, this study also provides some results of interest for assisting particular groups of business owners to enable them to better assess their risk and implement the appropriate strategies to mitigate those risks. It is clear from the analysis of property owners that strategies that are mandated by mortgagers and local zoning have a positive impact on structural preparation. However, tenant businesses may or may not be aware of what the property owner has done or not done, and probably do not routinely ask about such matters at the time they lease the property. Therefore, tenant businesses might benefit from mentoring or other educational efforts to help them understand non-structural ways in which they can effectively protect their business assets as well as criteria to consider when leasing space for their businesses.

Owner gender was clearly associated with implementing more of the activities reported in this study. One implication of this finding is that while female owners generally had higher preparation scores, yes their businesses were less likely to recover [30]. Female owners may need to be targeted for education and assistance in managing recovery. It is likely that other factors also played a significant role in influencing whether their businesses were continued. The role of family and business management challenges may come into play in the decisions of women business owners but is not addressed in the present study, however, there may be business challenges of female owners that could be addressed with educational efforts focused on management challenges during recovery. In addition, small businesses with non-white and

veteran owners were also less likely to continue operating. Educational efforts and mentoring programs targeted to minority and veteran owners may help them better identify their risks, prepare for disaster and manage recovery. In addition, financial grant programs or a community “work day” might be targeted to these firms to provide them with the resources necessary to increase their protection against disaster.

Business characteristics that influenced adoption of preparation activities included the size of business as measured by number of employees, and specific industries. Small businesses are important to the economy yet they have not prepared themselves for disasters. Local workshops might be valuable to address preparation for disaster and solutions adaptable to very small businesses with few employees. Perhaps some sort of certificate and financial assistance program might be developed to provide incentive for small businesses to become “storm ready”. These programs may need to be industry specific and focused on business operating assets.

Businesses in the present study were generally not prepared for Katrina’s surge. Efforts to increase the level of preparation for businesses located in flood prone areas should be made, particularly in those areas near coastlines and waterways that also have surge potential. These efforts should not only address what the businesses do to prepare, but also the fundamental location choices they make, and the pros and cons of property ownership which may limit the ability of a business to be flexible in terms of location. Communities need to revisit commercial zoning on a routine basis in order to ensure that commercial interests are not subject to undue hazards that could be avoided by utilizing different locations or different zoning standards.

This study demonstrates that preparation activities vary depending on the situation of the business (e.g. size, prior experience with disasters, property ownership) and characteristics of the owner (e.g. gender and education). However, differing threats to the business related to location

(e.g. surge prone or not) and factors such as mandated insurance, local zoning, and commercial versus home-based locations were also important influences.

Acknowledgements

This article reports results from Purdue University Project “Small Business Survival and Demise after a Natural Disaster”. This project was funded by National Science Foundation Grant #0856221– Civil, Mechanical and Manufacturing Innovation Division. The role of the funding source was limited to funding.

References

- [1] Alesch, Daniel J. and Holly, James N. (1996) How to survive the next disaster: Lessons for small business from Northridge victims and survivors. Paper presented at the Pan Pacific Hazards 96 Meeting, Vancouver, B.C. July 29-Aug. 2.
- [2] Asgary, Ali, Anjum, Muhammad I. and Azimi, Nooreddin (2012) Disaster recovery and business continuity after the 2010 flood in Pakistan: Case of small businesses. *Int. J. Disaster Risk Reduction* 2:46-56.
- [3] Barlow, H. D. (1993) Safety officer accounts of earthquake preparedness at Riverside industrial sites. *Int. J. Mass Emer. Disasters* 11:421-435.
- [4] Cole, Matthew A., Elliott, Robert J. R., Okubo, Toshihiro and Strobl, Eric (2017) Pre-disaster planning and post-disaster aid: Examining the impact of the great East Japan Earthquake. *Int. J. Disaster Risk Reduction* 21:291-302.
- [5] Corey, Christy M. and Deitch, Elizabeth A. (2011) Factors affecting business recovery immediately after Hurricane Katrina. *J. Contingencies Crisis Manag.* 19: 169-181.
- [6] Dahlhamer, James M. and D’Souza, Melvin J. (1997) Determinants of business-disaster preparedness in two U.S. metropolitan areas. *Int. J. Mass Emer. Disasters* 15:265-281.
- [8] Dennis, William J. Jr. (ed.) (2004) *Disasters*. NFIB National Small Business Poll Vol 4, issue 5. Washington, DC: NFIB.
- [8] Drabek, Thomas E. (1994) New study shows that growing tourist industry is inadequately prepared for emergencies. *Hazards Technology* 14: 17, 21.
- [9] Eiser, J. Richard, Bostrom, Ann, Burton, Ian, Johnston, David M., McClure, John, Paton, Douglas, van der Pligt, Joop, and White, Matthew P. (2012) Risk interpretation and action: A conceptual framework for responses to natural hazards. *Int. J. Disaster Risk Reduction* 1: 5-16.

- [10] Fitzgerald, Margaret and Muske, Glenn (2002) Copreneurs: An exploration and comparison to other family businesses. *Fam. Bus. Rev.* XV: 1-16.
- [11] Flynn, David T. (2007) The impact of disasters on small business disaster planning: a case study. *Disasters* 31: 506-515.
- [12] Herbane, Brahim (2015) Threat orientation in small and medium-sized enterprises: Understanding differences toward acute interruptions. *Disaster Prevention Manag.* 25: 583-595.
- [13] Howe, Peter D. (2011) Hurricane preparedness as anticipatory adaption: A case study of community businesses. *Global Environ. Change* 21:711-720.
- [14] Hurricane Science and Society (nd) Katrina Impacts. Accessed March 13, 2017 from www.hurricanesociety.org/history/studies/katrinacase/impacts
- [15] Insurance Information Institute (November 2016) Hurricane and windstorm deductibles (<http://www.iii.org/issue-update/hurricane-and-windstorm-deductibles>)
- [16] Map of Mississippi Counties, noting disaster declaration areas (yellow...en.wikipedia.org/wiki/effect_of_hurricane_katrina_on_mississippi). Retrieved on Oct 24 from <http://www.bing.com/images/search?q=mississippi+map+of+katrina-disaster+areas&view=detailv2&&id=60AD74D05F29AE5F595F54238224FD5FE8952109&selectedIndex=1&ccid=WZRufWIX&simid=608c> and further modified for this paper to highlight the geographic area of this study.
- [17] Marshall, Maria I., Sydnor, Sandra, Niehm, Linda and Schrank, Holly (2015) Predicting small business demise after a natural disaster: An analysis of pre-existing conditions. *Nat. Hazards*. DOI: 10.1007/s11069-015-1845-0
- [18] Mayer, Bradley W., Moss, Jimmy and Dale, Kathleen (2008) Disaster and preparedness: Lessons from Hurricane Rita. *J. Contingencies Crisis Manag.* 16:14-23.
- [19] Mileti, Dennis S. and Darlington, JoAnne D. (1995) Societal response to revised earthquake probabilities in the San Francisco Bay area. *Int. J. Mass Emerg. Disasters* 13:119-146.
- [20] Pathak, Shubham and Ahmad, Mokbul M. (2016) Flood recovery capacities of the manufacturing SMEs from floods: A case study in Pathumthani province, Thailand. *Int. J. Disaster Risk Reduction*. Accessed July 22, 2016 from <http://dx.doi.org/10.1016/j.ijdrr.2016.07.001>
- [21] Peacock, Walter G. (2003) Hurricane mitigation status and factors influencing mitigation status among Florida's single-family homeowners. *Nat. Hazards Rev.* 4:149-158.
- [22] Piotrowski, Chris (2006) Hurricane Katrina and organization development: Part 1. Implications of chaos theory. *Org. Dev. J.* 24:10-19.

- [23] Potter, S. H., Becker, J.S., Johnston, D. M. and Rossiter, K. P. (2015) An overview of the impacts of the 2010-2011 Canterbury earthquakes. *Int. J. Disaster Risk Reduction* 14:6-14.
- [24] Richardson, James (August 28, 2015) as quoted in Hurricane Katrina: Costliest natural disaster in US history in numbers. Accessed from <https://www.rt.com/usa/313725-hurricane-katrina-cost-disaster/>
- [25] Rincon, Elizabeth, Linares, Marc Y-R and Greenberg, Barry (2001) Effect of previous experience of a hurricane on preparedness for future hurricanes. *Amer. J. Emerg. Med.* 19: 276-279.
- [26] Schrank, Holly L., Marshall, Maria I., Hall-Phillips, Adrienne, Wiatt, Renee F. and Jones, Nicole E. (2013) Small-business demise and recovery after Katrina: rate of survival and demise. *Nat. Hazards* 65:2353-2374. DOI: 10.1007/s11069-012-0480-2
- [27] Shreve, C.M. and Kelman, I. (2014) Does mitigation save? Reviewing cost-benefit analyses of disaster risk reduction. *Int. J. Disaster Risk Reduction* 10: 213-235. DOI: 10.1016/j.ijdr.2014.08.004
- [28] Spillan, John and Hough, Michelle (2003) Crisis planning in small businesses: Importance, impetus and indifference. *European Manag. J.* 21:398-407. doi:10.1016/S0263-2373(03)00046-X
- [29] Spittal, Matthew J., Walkey, Frank H., McClure, John, Siegert, Richard J. and Ballantyne, Kimberley E. (2006) The earthquake readiness scale: The development of a valid and reliable unifactorial measure, *Nat. Hazards* 39: 15-29. DOI: 10.1007/s11069-005-2369-9
- [30] Sydnor, Sandra S., Niehm, Linda, Lee, Yoon, Marshall, Maria and Schrank, Holly (2017). Analysis of post-disaster damage and disruptive impacts on the operating status of small businesses after Hurricane Katrina. *Nat. Hazards* 85:1637-1663. DOI:10.1007/s11069-016-2652-y.
- [31] Termites.com (nd) Termite activity in Mississippi. <http://www.termites.com/local/mississippi>. Accessed November 4, 2015.
- [32] Tierney, Kathleen J. (1997) Business impacts of the Northridge earthquake. *J. Contingencies Crisis Manag.* 5; 87-97. DOI: 10.1111/1468-5973.00040
- [33] Tierney, Kathleen J. and Dahlhamer, James M. (1997) Business disruption, preparedness and recovery: Lessons from the Northridge earthquake. DRC Preliminary Paper, Disaster Research Center, University of Delaware. <http://udspace.udel.edu/handle/19716/657>. Accessed June 4, 2001.
- [34] Webb, Gary R., Tierney, Kathleen J. and Dahlhamer, James M. (2000) Business and disaster: empirical patterns and unanswered questions. *Nat. Hazards Rev.* 1:83-90. 10.1061/(ASCE)1527-6988(2000)1:2(83), 83-90.
- [35] Webb, Gary R., Tierney, Kathleen J. and Dahlhamer, James M. (2002) Predicting long-term business recovery from disaster: a comparison of the Loma Prieta earthquake and

- Hurricane Andrew. Global Environ. Change Part B: Environ. Hazards 4:45-58. doi:10.1016/S1464-2867(03)00005-6
- [36] Yoshida, Kaori and Deyle, Robert E. (2005) Determinants of small business hazard mitigation. Nat. Hazards Rev. 6:1-12. DOI: 10.1061/(ASCE)1527-6988(2005)6:1(1), 1-12.