DETERMINANTS OF HOUSEHOLD HURRICANE EVACUATION CHOICE IN FLORIDA

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Abstract

In this study we implement a set of econometric models to analyze the determinants of household hurricane evacuation choice for a sample of 1,355 households in Florida. This article contributes to the literature by accounting for two issues normally neglected in previous studies; namely, time and space. The empirical results suggest that households living in risky environments (mobile home and flooding areas) are more likely to evacuate. In addition, households with kids and those who have experience the treat of a hurricane also display higher probabilities to evacuate. Conversely, homeowners and households with pets are less likely to evacuate than their counterparts. Regional differences in propensity to evacuate are also clearly demonstrated, with households in southeast Florida less likely to evacuate than those in northwest Florida.

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1. Introduction

Hurricanes are the most costly natural disasters in the U.S. and they are especially harmful to coastal areas (NSC, 2007). For instance, the 2005 Atlantic hurricane season -the most active and harmful in recorded history- had an estimated direct social cost of approximately 2,300 deaths and record damages of over $130 billion (NHC, 2006). The economic losses associated with this hurricane season on the fishing, agricultural and industrial sectors are also considerable, and the full recovery of these sectors is expected to take decades (Myles and Allen, 2007). In addition, the disruption of the transportation system in the affected areas is predicted to disturb the prices of basic commodities for many years (Lara-Chavez and Alexander, 2006).

In an effort to mitigate the social and private costs associated to extreme weather events, federal agencies have financed weather research programs designed to improve the accuracy of weather forecasting and to enhance the dissemination of timely and accessible weather information (NOAA, 2005). Although these programs will not stop the natural devastation of high-intensity hurricanes, precise and timely forecasts could give individuals and decision-makers the much needed information to better prepare and reduce the economic and social impacts of these types of natural events. In this respect, one value of hurricane forecasting can be linked directly to its ability to influence human behavior; namely, evacuation choice (Williamson et al., 2002).

During the last decade there have been great advances in the sciences of climate and weather forecasting. However, hurricane prediction is still not an exact science. Inaccuracies in predicting the storm's path, intensity, and time of landfall may affect people's trust and reliance on hurricane warnings and tracking information (Dow and Cutter, 1998). This lack of credibility could hinder evacuations with potentially devastating consequences if a hurricane does strike the area (Smith, 1999). The literature also shows that peoples' decision-making process under hurricane risk is a very complex issue influenced by many other factors (Gladwin et al., 2001). Therefore, a thorough understanding of the determinants of household evacuation behavior is important for emergency managers to improve the effectiveness of evacuation orders and decrease the chances for human losses.

Previous studies demonstrate that household evacuation behavior depends not only on information regarding the hurricane characteristics (i.e., path, intensity, timing, etc.) but also upon household socioeconomic and demographic characteristics.[1] Although these studies offer useful insight to the evacuation decision process, generally they have been conducted, using data for a single event within very specific geographical areas. By doing so, they miss a time and space component and overlook the possibility that households may learn from their own experience.

This study constitutes a natural extension of previous studies by comparing two distinct regions and four separate hurricane events during the 2005 season; adding both time and space components to our analysis. More precisely, the studied sample includes 1,355 households living in the northwest panhandle (NW) and the southeast peninsula (SE) of Florida (FL), who have experienced the threat of major hurricane events in 2005. Information on household composition and socioeconomic characteristics, home ownership, past hurricane experience, evacuation expenses, sources of forecast information and several other variables are used to develop a better understanding of household evacuation behavior. Specifically, a set of econometric models are

[1] An up-to-date review of the literature on hurricane evacuation can be found in Dash and Gladwin (2007). Baker (1991) presents a review of studies on hurricane evacuation decision published between 1961 and 1989.

developed to analyze the impact of these variable and their marginal effect on influencing household evacuation choices.

The rest of this article is organized as follows. Section two presents the conceptual framework and literature review, followed by a presentation of the empirical model, a description of survey design and data, and a brief description of the hurricane events. Then, we present and discuss the empirical results. The last section contains some concluding remarks along with some suggestions for further research.

2. Conceptual framework and literature review

Burton et al. (1993) and Viscusi (1995) present the theoretical basis to analyze human behavior under environmental risk (the threat of a hurricane in our case). In general, these authors contend that individuals make choices under the uncertainty of future environmental threat by maximizing their expected utilities, and that they might be willing to sacrifice their wealth (e.g., earning income, capital, etc.) in order to reduce those threats. Furthermore, Burton et al. (1993) state that under the threat of environmental hazard an individual's response is affected by four major elements: (1) prior experience with the specific environmental hazard; (2) an individual's wealth; (3) their intrinsic characteristics; and (4) their interaction with society.

With respect to hurricane risk, Letson et al. (2007) present a review of the economic theory concerning individuals' utility-maximizing behavior accounting for hurricane forecasts and evacuation choices. Letson et al. (2007) indicate that in studying behavior under hurricane threat it is important to consider hurricane forecasts data, since this information may act as a decision aid to reduce uncertainty. Smith (1999) adds that during hurricane a season the dissemination of information regarding a storm's path and intensity is commonly preformed by the mass media. Thus, this type of information can play an important role in affecting evacuation choices. A note of caution is presented by Dow and Cutter (1998). These authors argue that inaccurate forecasts may reduce household reliance on forecast information and reduce their perception of a hurricane threat and, consequently, reduce evacuation rates.

From an empirical point of view, individuals (or households) subject to the risk of a hurricane event face a dichotomous decision: stay at home or evacuate to a safer area. Previous studies has shown that this decision is influenced by several factors including social characteristics, economic constraints, storm characteristics and planned evacuation destination and costs (e.g., Fu and Wilmot, 2004; Whitehead, 2003; Whitehead et al., 2000; Dow and Cutter, 1998; among others).

For instance, Dash and Gladwin (2007) argue that risk perception and previous experience with hurricanes are vital factors in explaining evacuation decisions. Whitehead (2003) explains that the main goal of an evacuation is to reduce the risk of injury or death. In this respect, people facing more risk, such as those living in weak structures like mobile home or in areas affected by flooding, have proved to have a higher probability to evacuate (Whitehead 2003; Smith, 1999). In addition, Baker (1991) reports that people living in areas previously affected by a major storm are also more willing to evacuate.

Wealth is another factor that effects evacuation decisions. Although, it might be reasonable to think that high income households will be more willing to evacuate since they have all the necessary means to evacuate in a smooth and rapid way; previous studies have found that households with higher income tend to display lower probabilities to evacuate (Whitehead 2003; Smith, 1999). This contradictory result could be explain by the fact that the wealthy, on average, own more capital goods (e.g., electronics, collectables, art, etc.) and they may prefer to stay with their house to protect their belongings from post-storm looting.

The influence of demographic characteristics has been mixed. For instance, Dow and Cutter (1998) and Baker (1991) suggest that demographic characteristics such as age, race/ethnicity and gender are not associated with the household evacuation choice. Conversely, opposite arguments are presented by Dash and Gladwin (2007), Whitehead et al. (2000) and Smith (1999), among others. With respect to household composition, Dash and Gladwin (2007) reported that households with children display a higher probability of evacuation, while Gladwin et al. (2001) found the inverse relationship for large households and households with elderly. Lower probabilities of evacuation are also found for households with pets (Whitehead, 2003; Whitehead et al., 2000; Smith, 1999). Lastly, education has displayed mixed results in the literature (Whitehead, 2003; Smith, 1999).

The impact of the society on individual's evacuation behavior has been studied by analyzing the impact of hurricane warning and other sources of information (Sorensen, 2000). In general, these studies have focused on evaluating different characteristics of hurricane warning (e.g., type of message, language used, timely, etc.). However, Dash and Gladwin (2007) criticize this approach by indicating that a warning by its self has no value since it is affected by its credibility, interpretation and an individual's aversion to risk. Smith (1999) and Lindell et al. (2005) add that mass media spend significant amounts of time disseminating this kind of information during hurricane season, making warnings and hurricane information available without restriction to the population. Consequently, social interactions can help individual better digest the available information; making social interactions more important than the warning *per se*.

Lastly, Whitehead et al. (2000) and Smith (1999) argue that the evacuation destination and expected expenses are also important factors in evaluating the decision to evacuate or not. Specifically, evacuation destination pattern (i.e., preference to evacuate to a hotel, shelter or friend/relative house) and expected evacuation expenses may account for unobserved information affecting household evacuation choice.

3. Empirical model

Based on the theory proposed by Burton et al. (1993) and Viscusi (1995) and previous empirical studies the evacuation decision under the risk of a pending hurricane event can be modeled as follows:

$$E_i = f(R_i, W_i, I_i, S_i, O_i) \qquad [1]$$

where E represents the dichotomous choice variable equal to 0 if individual i decides to stay home or equal to 1 if they decide to evacuate and is a function of the following exogenous variables: (1) R a vector of factors that represent an individual's perception of risk and their previous hurricane experience; (2) W a vector of factors tied to wealth and/or income; (3) I a vector of household demographics; (4) S a vector of measures of social interaction and sources of information; and (5) O a vector of other variables such as evacuation expenditures.

Since the dependent variable is dichotomous in nature we estimated our models using a probit procedure. A probit model is a nonlinear procedure developed to relate the choice probability P_i (evacuation choice in our case) to a set of explanatory variable. By using this approach we force the probability to remain within the [0 (or stay at home), 1 (or evacuate)] interval. The probability of evacuation is estimated as follows:

$$P_i = F(X_i \beta) \qquad [2]$$

where F is the cumulative distribution function, X is the vector of exogenous variables, β are the estimated parameters (Greene, 2002).

The variables included in the empirical model were selected based on the literature and the data availability. Tables 1 and 2 display, respectively, the definition and descriptive statistics for all the variables included in the evacuation model. The data on Table 2 has been presented for the entire sample as well as for the four studied storms. Table 3 presents basic information on the studied storms.

4. Brief history of 2005 hurricane events in Florida

To examine the influence of time and space on hurricane evacuations three hurricanes, with four landfall events, will be examined. In chronological order they are Dennis (NW FL), Katrina (NW and SE FL) and Wilma (SE FL). For more details on these storms, see the National Hurricane Center's Tropical Cyclone Reports at http://www.nhc.noaa.gov/2005atlan.shtml.

The first hurricane event begin July 4, 2005 as tropical depression number 4 just west of the Windward Islands, hurricane Dennis quickly grew to a category 4 storm (on the Saffir-Simpson scale) as it passed through the southern Caribbean, making landfall on July 10th near Pensacola, FL as a category 2 storm with winds in excess of 100 mph. The northwest region of FL was under a variety of both mandatory and volunteer evacuation orders. Generally counties closer to the eventual area of landfall (Pensacola) were under mandatory evacuations for coastal areas and mobile homes. Counties further east were more likely to have volunteer orders for mobile homes and low-lying areas.

The second and third hurricane events involved hurricane Katrina. Starting August 23, 2005 just off the east coast of FL as tropical depression twelve, Katrina barely managed to reach hurricane force (winds > 74 mph) as it came ashore along the Broward-Miami-Dade county line on August 25^{th} (SE FL). Mandatory evacuation orders were issued for residents of mobile homes and voluntary evacuation orders were issued for people in low-lying areas. Katrina then moved across peninsula FL entering the Gulf of Mexico where it quickly intensified into a category 5 storm. It moved toward the Louisiana – NW FL coastline as very large and dangerous storm, coming ashore on the Mississippi coast on August 25^{th} as a category 3 event. Several NW FL counties called for mandatory evacuations of barrier islands (Escambia, Santa Rosa, Okaloosa and Gulf) and mobile homes (Gulf). Others called for voluntary evacuations of low-lying areas (Gulf and Franklin).

The fourth hurricane event began October 15, 2005 as tropical depression 24 just west of Jamaica and grew into hurricane Wilma, a category 4 storm has it passed around Cuba, striking southwest FL October 24^{th} as a category 3 storm and passing northeastward over the Broward and Palm Beach counties (SE FL) reentering the Atlantic just north of Palm Beach. Hurricane force winds in excess of 100 mph (category 2 force winds) were experienced throughout much of SE FL. Mandatory evacuation orders were issued for residents of mobile homes in the Broward, Miami-Dade and Palm Beach area and a voluntary evacuation order was issued for residents of low-lying areas.

5. Survey design

In March of 2007 and January of 2008 an internet-based survey was administered to a panel of FL households.[2] This panel was part of a larger nation-wide household database maintained by Survey Sampling International Inc. The panel focused on SE FL (Miami/Dade, Broward and Palm Beach counties) and NW FL (all FL counties west of the Apalachicola River). Participants were asked if they had experienced a hurricane during the 2005 season. Hurricane experience was defined as:

> *"People can experience hurricanes or tropical storms in a variety of ways. Some endure physical impacts, such as flooding or downed tree limbs, while others may miss time at work evacuating from or preparing for a storm that may not necessarily come their way. Did you experience any hurricanes or tropical storms during 2005?*

If they answered yes, those living in SE FL were queried about hurricanes Katrina and Wilma and households in NW FL were questioned about hurricanes Dennis and Katrina. They were asked a series of questions regarding their previous experience with hurricanes, sources of hurricane forecast information, their level of confidence in the forecast media, home ownership, type and condition of their home (including if their home was a mobile home and/or located in flood zone), any preparation they took for the hurricane(s), evacuation plans and experiences

[2] In the current article we focus on studying the prevalence of behaviors rather than conducting qualitative analysis of how specific communities behave. In this respect the use of internet sampling has been granted as a good alternative for information gathering (see Cameron et al. (2005) for details). Of course the two modes of research inform one another and are complementary.

(including evacuation site and distance/time required to get there), their household demographics (including level of education, gender and age of household members and if they owned a pet), household income, their post-hurricane outcome (including losses) and if they were satisfied with their pre-hurricane choices concerning hurricane preparation and evacuation.[3]

Of the 3,134 households contacted, 2,571 (82%) experienced one or more storms in 2005. The sample was further reduced to only those households living in our study areas (NW and SE FL) during the 2005 hurricane season and who experienced Katrina, Wilma or Dennis and answered variables key to our analysis. Thus, the final dataset encompasses a total of 1,355 households.

6. Results and discussion

Four evacuation models are estimated to evaluate the determinants of households' evacuation behavior for each storm included in the analysis (i.e., Katrina SE, Wilma, Dennis and Katrina NW). In addition, an aggregated model (i.e., model ALL) including the whole sample is also estimated. This last model is used to evaluate any significant differences among the households located in the two distinctive studied geographical areas (i.e., SE and NW FL).

Table 4, presents the empirical results of our analysis. This table presents the estimated coefficient and the marginal effects (ME) for each of the exogenous variables. In our case, ME measure the percent change in the probability of evacuation due to a one unit change in an exogenous variable. ME for the continuous variables are computed as $\mathrm{ME} = \phi(\beta X)\beta$, where ϕ is the probability density function, X is the vector of exogenous variables, β are the estimated parameters, and all regressors are set at their mean values (Greene, 2002). The MEs for the

[3] The questionnaire administered in this study is available by the author upon request.

dummy variables are measured by taking the difference between the value of the prediction when the dummy equals 1 and when it equals 0, holding all other variables at their respective means (STATA, 2003).

Overall, the estimated evacuation models perform fairly well and consistently across the storms considered. Specifically, the null hypothesis that all coefficients are simultaneously zero is rejected consistently at the 1% significance level. Individually, approximately 55.6% of all parameters are statistically different from zero and their signs are generally consistent with expectations. In addition, the percentages of correctly predicted responses are high (between 72.4% for model ALL and 61.6 for Hurricane Wilma).

The variables associated to risk perception (i.e., MOBILE and FLOOD) have a significant and positive association with evacuation. Indeed, MOBILE display the highest ME in all five models, suggesting that households living in mobile homes are, on average, 36.3% more likely to evacuate than households living in more secure homes. This large difference is not surprising since, as reported by Baker (1991), emergency managers tend to target mobile home residents in their evacuation procedures. On the other hand, households located in flooding areas display on average, an 8.6% higher probability to evacuate than those living in non-flooding zones. In addition, those households that have experienced the treat of a major hurricane in the past also display higher probabilities to evacuate.

Household wealth presents some interesting results. On the one hand, home ownership significantly reduces the probability of evacuation in all estimated models. In fact, owning a house decreases the probability of evacuation from 3.4% for Katrina (SE) to 17.7% for Katrina (NW). It is worth noticing that homeowners in SE FL show lower probabilities to evacuate than homeowners in NW FL. In contrast, INCOME is not statistically different from zero in all estimated models. Mixed results on the impact of income on evacuation choice have been previously reported in the literature. For instance, Whitehead et al. (2000) found a positive association between income and evacuation for coastal residents in North Carolina. Conversely, in a different study, Whitehead (2003) and Smith (1999) found, respectively, a negative or a not significant relationship between income and evacuation rates also for coastal residents in North Carolina.

Household composition also presents an interesting finding. The number of children (KIDS) in the household is statistically significant and positively associate with evacuation. In fact, one additional child in the household increases the probability to evacuate on approximately 5%. Family size (FAMSIZE) is negative but not significantly correlated with evacuation. Lastly, households with pets (PETS) have also lower rates of evacuation. Specifically, owning a pet decreases the average probability to evacuate in 11.2%. This last result agrees with Whitehead et al. (2000) who suggested that establishing pet-friendly shelters could significantly increase the evacuation rates among coastal residents in North Carolina.

Although approximately one-third of the sample indicated that the opinion of friends and/or the information from NOAA radio was used to make their evacuation choice, the coefficient for these two variables are not statistically different than zero in any of the empirical models. These outcomes suggest that there are other (unobserved) sources of information that have higher weights in the household's evacuation choice. In fact, almost all the surveyed households (96%) indicated that they used information from national television in their evacuation decision-making process. However, we are unavailable evaluate the impact of information from mass media on the present study since a dummy variable for television will display an almost perfect correlation with the intercept coefficient. One way to solve this issue could be to disaggregate this variable (information from television) into the specific programs or channels that the households watch (e.g., national television, local news, the weather channel, etc.). However, this disaggregated information is not currently available. Thus, this is an area that deserves further research.

The total cost for the household evacuation preparation plan (EXPENSES) is negative and statistically significant associate with evacuation. The variable EXPENSES include household expenditures on the following actions and/or items: removed items from the deck and yard; boarded up windows and doors; purchased large ticket items (e.g., generators, chainsaws etc); purchasing building materials (e.g., plywood, nails, etc); purchased extra supplies (e.g., food, water, candles, etc.); filled up auto/truck with gas; boarded pets; secured boat, RV’s, etc; and other expenses. On average, an extra dollar expended in the evacuation preparation plan decreases the probability of evacuation in a 3%. This result indicates that households with higher cost of evacuation preparation present a lower probability to evacuate.

An important goal of this study is to evaluate explicitly the influence of time and space on hurricane evacuations. Even though all estimated models display similar patterns, the magnitude of the estimated coefficients presents some variation among models. These differences reflect important structural features for the people living in the two studied geographical areas. The geographical variation is confirmed by the statistically significance of the variable SFL in model ALL. More precisely, the ME for SFL suggest that households living in SE FL are 24.2% less like to evacuate than people living in NW FL, presumably because of the greater difficulty in the former of avoiding coastal hazards. This outcome is of significant importance in developing evacuation policies. Fu and Wilmot (2004) state that accurate information at the local level could provide the authorities the necessary information to develop better evacuation plans based on the specific characteristic of the population.

Lastly, we tested the influence of time by analyzing whether the coefficient of variables affecting the evacuation behavior changed or not within households living in the same geographical area. To do so, we use a Chow-type test as suggested by Greene (2002, p. 826). Specifically, the Chow test measures whether the coefficients in two probit models estimated for each geographical area are statically equal or not. The results of the Chow test suggests that households living in NW FL behaved in the same way for the two studied storms; that is, no time variation. Conversely, households living is SE FL did change their behavior through time. These results agree with the pattern found for the variable EXPERINCE. While previous experience with a major storm was statistically different from zero among households in SE FL, EXPERINCE shows non-significance among NE FL residents.

7. Concluding remarks

This study analyzes the determinants of household hurricane evacuation choice for a sample of 1,355 households in Florida. This article contributes to the literature by accounting for two issues normally neglected in previous studies. First, we account for spatial variability by selecting households from two distinctive geographical areas in Florida (i.e., SE and NW Florida). In addition, we also include a temporal factor by evaluating the household evacuation behavior for four major storms that impacted Florida during the 2005 season. To reach our goal and to offer estimates with analytical robustness we implemented a set of econometric models.

In general our empirical results suggest that households living in risky environments (mobile home and flooding areas) are more likely to evacuate. In addition, households with kids and those who have experience the treat of a hurricane also display higher probabilities to evacuate. In contrast, homeowners and households with pets are lees likely to evacuate than their counterparts.

It is also important to indicate that the results obtained in the estimated models may be a useful tool to identify the willingness to evacuate for broad demographic groups. This information may help emergency managers to target resources more efficiently focusing not only on those individuals with higher risk but also on those groups with lower probabilities to evacuate. Nevertheless, further research is needed to test the validity of the model and its variability across different geographical areas.

Presently, it appears that the source of forecast information and the relative importance of media origin are not significant factors to the evacuation decision, yet Lindall et. al. (2005) assert that social interaction is important. While this research is inconclusive, the importance of information in the process of deciding to incur a large expense (evacuate) while facing an uncertain event (hurricane) is certainly complex and should be the subject of further study.

Regional differences in propensity to evacuate are clearly demonstrated, with households in SE Florida less likely to evacuate than those in NW Florida. This knowledge could prove helpful to policy makers in allocating their evacuation efforts in the future.

On the other hand, looking across storms within SE Florida, a level of sophistication emerges. Household experience with hurricanes prior to the 2005 season proved a positive influence on evacuation and may be contrary to the anecdotal evidence of evacuation fatigue. Wilma, while a more powerful storm than Katrina (as a SE event), was less threatening to the SE region because of its eastward path, removing the danger of ocean flooding. Households responded to this storm by evacuating at lowers rates than they did Katrina and by showing less concern about the danger of flooding.

Paradoxically, the data suggest the more people spend on storm preparation the less likely they are to evacuate. Households might consider storm preparation as a risk mitigation measure and feel more secure remaining behind with their home. The highly visible efforts to encourage households to prepare for hurricanes could increase the numbers of people remaining behind. This may be a counterproductive strategy if the overall public policy is to reduce the loss of human life.

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Table 1. Variable Definition.

Variable	Definition
Dependent variable	
EVACUATION	*Dummy* variable equal 1 if the household evacuated their house during the studied storm, 0 otherwise.
Prior experience and risk perception	
EXPERIENCE	*Dummy* variable equal 1 if the household has had previous experience with hurricanes, 0 otherwise.
MOBILE	*Dummy* variable equal 1 if the household lives in a mobile home, 0 otherwise.
FLOOD	*Dummy* variable equal 1 if the household lives in an area with flood risk, 0 otherwise.
Wealth	
INCOME	Combined household income (US $).
OWN	*Dummy* variable equal 1 if the household owns their house, 0 otherwise.
Household characteristics	
FAMSIZE	Number of people living in the household.
KIDS	Number of kids in the household (less than 18 yeas of age).
PETS	*Dummy* variable equal 1 if the household owns a pet, 0 otherwise.
Interaction with society	
FRIENDS	*Dummy* variable equal 1 if the decision to evacuate was influenced by friends
NOAA	*Dummy* variable equal 1 if the household uses the NOAA radio, 0 otherwise.
Others	
EXPENSES	Total cost (US $) for the household evacuation preparation plan
SFL	*Dummy* variable equal 1 if the household is located in South East Florida, 0 otherwise.

Table 2. Descriptive Statistics.

Variable (unit)	All		SE Florida				NW Florida			
			Katrina SE		Wilma		Dennis		Katrina NW	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
EVACUATION (%)	0.43	0.49	0.34	0.48	0.32	0.47	0.60	0.49	0.60	0.49
EXPERIENCE (%)	0.73	0.44	0.65	0.48	0.64	0.48	0.88	0.33	0.89	0.32
MOBILE (%)	0.11	0.31	0.08	0.26	0.08	0.26	0.18	0.38	0.16	0.37
FLOOD (%)	0.28	0.45	0.37	0.48	0.33	0.47	0.14	0.35	0.18	0.39
INCOME (US $,000)	55.71	16.43	59.37	19.56	62.21	18.87	53.43	15.11	55.53	15.29
OWN (%)	0.72	0.45	0.71	0.46	0.75	0.44	0.70	0.46	0.70	0.46
FAMSIZE (Number)	2.64	1.28	2.55	1.30	2.50	1.25	2.86	1.29	2.85	1.26
KIDS (Number)	0.57	0.95	0.50	0.90	0.48	0.89	0.74	1.03	0.68	0.99
PETS (%)	0.65	0.48	0.62	0.49	0.63	0.48	0.71	0.45	0.70	0.46
FRIENDS (%)	0.30	0.46	0.31	0.46	0.29	0.45	0.30	0.46	0.32	0.47
NOAA (%)	0.26	0.44	0.24	0.43	0.23	0.42	0.29	0.45	0.33	0.47
EXPENSES (US $)	317.43	1,053.95	333.89	1,271.61	363.35	1,292.87	260.83	420.89	252.77	351.99
Cases	***1,355***		***360***		***506***		***305***		***184***	

Table 3. Summary Statistics for the Studied Tropical Storms

Storm	Saffir-Simpson Category in the Study Area	Landfall area in the U.S.	Landfall day in the U.S.
Dennis	2	Santa Rosa Island, FL	June 10
Katrina SE	1	Aventura, FL	August 25
Katrina NW	3	Buras-Triumph, LA	August 29
Wilma	2	Cape Romano, FL	October 23

Table 4. Probit analysis of evacuation decision.

Variable	All		Katrina SE		Wilma		Dennis		Katrina NW	
	Coef.	**ME**	**Coef.**	**ME**	**Coef.**	**ME**	**Coef.**	**ME**	**Coef.**	**ME**
CONSTANT	0.136	--	-0.259	--	**-0.411**	--	-0.189	--	-0.231	--
	0.153		*0.262*		*0.230*		*0.356*		*.474*	
EXPERIENCE	**0.162**	0.062	**0.409**	0.161	**0.205**	0.083	0.108	0.039	0.060	0.021
	0.084		*0.228*		*0.125*		*0.151*		*0.129*	
MOBILE	**0.899**	0.344	**1.098**	0.420	**1.031**	0.438	**0.751**	0.322	**0.701**	0.291
	0.131		*0.347*		*0.268*		*0.214*		0.291	
FLOOD	**0.234**	0.100	**0.557**	0.187	**0.237**	0.086	0.082	0.031	**0.073**	0.028
	0.083		*0.178*		*0.146*		*0.223*		*0.019*	
INCOME	0.013	0.005	-0.013	-0.005	0.057	0.020	0.025	0.009	0.057	0.021
	0.031		*0.057*		*0.050*		*0.076*		0.100	
OWN	**-0.254**	-0.100	**-0.473**	-0.175	**-0.482**	-0.177	**-0.093**	-0.034	**-0.279**	-0.102
	0.082		*0.177*		*0.225*		*0.053*		*0.143*	
FAMSIZE	-0.032	-0.012	-0.099	-0.036	-0.067	-0.023	0.013	0.005	-0.014	-0.005
	0.043		*0.080*		*0.076*		*0.094*		*0.119*	
KIDS	**0.106**	0.041	**0.187**	0.069	**0.165**	0.059	**0.121**	0.047	**0.144**	0.053
	0.057		*0.113*		*0.106*		*0.017*		*0.021*	
PET	**-0.219**	-0.084	**-0.487**	-0.166	**-0.354**	-0.119	**-0.260**	-0.101	**-0.228**	0.091
	0.091		*0.193*		*0.161*		*0.146*		*0.108*	
FRIENDS	0.076	0.030	0.086	0.032	0.111	0.040	0.041	0.015	0.105	0.040
	0.078		*0.157*		*0.132*		*0.171*		*0.213*	
NOAA	-0.073	-0.028	-0.130	-0.047	-0.046	-0.016	0.120	0.046	-0.046	-0.018
	0.083		*0.173*		*0.149*		*0.122*		*0.213*	
EXPENSES	**-0.055**	-0.021	**-0.091**	-0.034	-0.032	-0.012	**-0.097**	-0.039	**-0.073**	-0.028
	0.021		*0.052*		*0.1349*		*0.045*		*0.031*	
SFL	**-0.596**	-0.242	--		--		--		--	
	0.078									
Model χ^2 [df]	***168.98** [12]*		***124.48** [11]*		***153.25** [11]*		***126.62** [11]*		***119.58** [11]*	
% of Correct	*72.38*		*62.48*		*61.61*		*67.23*		*69.15*	

Note: The dependent variable is a *dummy* variable equals 1 is the household evacuated the house. Values in *Italic* are standard error. Coefficient in **Bold** are statistically significant at least 10%. The marginal effect for the dummies variables is computed as Pr[y| x=1]-Pr[y| x=1]. Correction for heteroscedasticity was performed using the White's heteroscedasticity-robust covariance matrix.