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Explaining Subjective Risks of Hurricanes and the

Role of Risks in Intended Moving and Location Choice Models

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Introduction

In the fall of 2005 two major hurricanes hit the Gulf Coast region resulting in devastating impacts, particularly for residents of New Orleans. As is well known, the majority of residents of New Orleans were forced to evacuate, moving to several alternative locations across the U.S. At the time we write this (early in 2007), most of the people who evacuated have still not moved back to New Orleans.

In this manuscript we report on findings from a quasi-field experiment of a small group of subjects displaced by the 2005 hurricanes, Katrina and Rita.[1] The sampled group, though small, is remarkable in that they all were deeply and personally affected by the hurricanes. All of the people in our sample evacuated from their homes and were still away months after the hurricane. The homes of a majority of the sample were severely damaged and almost a third of the sample lost a family member in the hurricane. Our research evaluates the risk perceptions and explains stated intentions to move back to the area they left during the hurricanes, as well as location choices presented to each subject in a stated choice experiment.

We will report here on three issues related to risk perceptions and preferences of the sampled evacuees. First, we consider the question of their perceptions of hurricane risk. In a short survey that subjects take, we ask each respondent his or her perceptions of risk. The first time the subject is asked, no information is presented, and on subsequent questions information is given. As more information is provided, respondents may update

their prior assessment of risks that they brought with them to the interview. We regress their stated probabilities on characteristics and experiences the subjects had during the hurricane to evaluate how perceptions of risk are affected by the impacts. Of particular interest, consistent with a model of ambiguity aversion, we find that uncertainty about the true probability leads the group to increase their "best guess" as to the probability of a hurricane. The results of this model are then used in a test of whether risk perceptions affect an individual's interest in moving back to the Gulf coast.

We also report the results of a model that explains stated intention to move back to the area they left, which is analyzed as a function of the subjects' subjective risks and other relevant individual specific variables. Second, we report results of a choice experiment in which we can evaluate the trade-offs between given levels of risks and income presented to the subject, controlling for amenities and other characteristics of the location. We find that risks, though calculated differently in each of these models, play a significant role. This abstract presents the conceptual foundations of our chosen explanatory models, and discusses previous literature regarding stated choice modeling and subjective risk perceptions pertinent to this study. No empirical results are reported as a second round of data collection is currently being conducted.

Background Literature on Risk Perceptions and Choice Modeling

It is widely recognized in other disciplines such as psychology (eg., Slovic 1987), now often spreading over into economics, that if we wish to explain behavior or stated preferences, appealing to subjective risk assessments likely works better than reliance on so-called expert risk assessments. However, the problems that arise for economists when subjective risk estimates are used are potentially numerous and can not be fully

enumerated here. Among these are key issues related to the incorporation of subjective risks into a decision framework commonly used by economists (see Shaw, Jakus and Riddel 2005 for discussion of some of these), such that theoretical axioms of preference are not violated. Most often the formal modeling framework is the expected utility model (EUM); use of the subjective risks in such a framework may be deemed the subjective EUM (SEUM).

The EU framework has guided most analysis of decisions in situations of risks with known probabilities and the SEUM of Savage (1954) can handle some situations where probabilities are unknown. These models have been successful not only because of their compelling axiomatic foundations and ability to describe economic choices, but also for the purely practical reason that their mathematical structure facilitates both theoretical and empirical analysis.

A problem may arise when subjective risk estimates of the public are hugely different from the expert (science community) assessment. For example, in the work on nuclear/radioactive waste risks, the experts deem mortality risks to be on the order of 2 in 10 million, while a sample of subjects thought these to be thousands of times higher (see Riddel and Shaw 2006). To make matters still worse, some people simply cannot reduce the uncertainty about the risks they face in order to reveal a unique probability distribution. This situation, often referred to as ambiguity, frequently leads to behavior that is inconsistent with either the EUM or SEUM (e.g., Ellsberg 1961). In other instances where people make decisions they do so as if they place nonlinear weights on the probabilities. A classic outcome is their overweighting of very low probabilities and underweighting much more likely events (e.g., Allais 1953; Prelec 1999; Gonzalez and

Wu 1999). When there are large differences between personal and expert probabilities or when ambiguity is pervasive the axioms consistent with the EU and SEU frameworks are frequently violated. Though we do not formally test these axioms here, as will be seen below, we ask questions of the subjects that help us discern whether they remain ambiguous about hurricane risks, even when they are given information which might conflict with their prior assessment of such risks.

The Models

In this section we describe two simple models applied in this study. In the first, we simply estimate a model of the subject's stated risk of a hurricane striking New Orleans. The second is a stated choice model that includes attributes of labeled locations. Note that results based on a standard discrete choice (probit) model of stated intentions to move back to their area of origin are also included below, but all readers are assumed familiar with this procedure, so it is not discussed in any detail here. Together these models will allow us to explore the risk attitude and preferences over risky prospects faced by hurricane victims.

Risk Model

To evaluate subjective risk perceptions of Hurricane Katrina evacuees, we use a latent risk model as formulated by several psychologists and economists in past work. In such a model the dependent variable is the individual's stated risk and the independent variables are demographic characteristics and other variables that might affect an individual's subjective probability. As a recent example, Riddel and Shaw (2006) evaluated a sample member's perceptions of the risks of a nuclear accident and find that gender, insurance coverage, age, distance from the area of the highest hazard, and other

demographic factors can influence a person's risk assessment. For our exploration we use the expected hurricane strike risk for New Orleans as the dependent variable. Since probabilities are bounded by zero and one, ordinary least squares (OLS) estimates are problematic so instead we use a standard truncated (tobit) regression approach with bounds imposed of the zero and one.

The Stated Choice Model

Stated choice models and the experiments accompanying them are now standard in much marketing, transportation, environmental economics, health economics, and other economics-related literature involving discrete choices (e.g. Bennett and Blamey 2001; Louviere, Hensher and Swait 2000). There are many variants, ranging from experiments that are essentially paired choice conjoint experiments to ranking several alternatives or choices, or assigning ratings using some numerical scale to indicate the strength of preference. As the number of choices people face is limited, the usual econometric approach involves use of multinomial logit or probit methods or their variants, depending on the type of choice experiment that was performed. The models are thus also classified as random utility models (RUM) because an individual's conditional utility (V) after choosing alternative i is compared to her utility conditional on choice j (V_j). As researchers we do not observe everything that the individual does, and we are thus left with the usual investigator error (ε_i), which generates the usual randomness in the model.

Let the vector of attributes be X, income be Y, the price of the alternative be P, and demographic variables be vector Z. The conditional indirect utility function is typically specified such that net income (Y-P) is the argument in the utility function

involving money. Note that in the individual choice model, if components of Z do not vary across the alternatives (such as gender), they only influence choices if they enter the utility function in non-linear form, or when interacted with variables that do vary across alternatives.

With this formulation the choice data are assumed to flow from a decision process in which the individual maximizes utility (assuming no uncertainty from their perspective) by choosing alternative i ($i \neq j$)when:

$$V_i(Y_i - P_i, X_i, Z) + \varepsilon_i > V_j(Y_j - P_j, X_j, Z) + \varepsilon_j$$

When the errors are Type I extreme value distributed, the resulting econometric model is the conventional conditional binomial logit (or multinomial conditional logit if there are more than two alternatives). There are many trade-offs between exact approaches in the experiment. Perhaps the key difficulty in choice experiment design is that the number of combinations of choices expands very quickly when attributes of the alternative are added. The model ideally must include all relevant attributes, or a mis-specification issue arises, but by including too many, the choice experiment becomes intractable. A related issue is that the attributes must be bundled in such a way as to avoid correlation problems. (see discussion in Louviere, Hensher and Swait 2000). Another trade-off involves how many alternatives the subject must evaluate at once. On one end, the researcher desires presenting each subject with all possible alternatives simultaneously, however, it is thought that when there are many alternatives that this is too difficult a conceptual task for many subjects to perform (Bennett and Adamowicz, 2001). If subjects are highly educated (e.g., college students) they might be given difficult mental tasks. If not, it may be better to find an easier type of experiment. A

simpler choice alternative approach is to present each subject with a single pair of alternatives at a time (A and B), let them make a choice between A, B, or neither, then proceed to another pair of alternatives (C and D), etc. We follow this pair-wise choice approach.

The choice options used in the experiment in this study asked individuals to indicate whether they would prefer to location A, location B, or whether "Neither of these choices sounds appealing." The hypothetical locations consisted of three main characteristics: housing cost, monthly income, and risk of damage from a hurricane. A fourth attribute, which captures the host of other characteristics that define a city, was described to subjects by including text that said:

"Weather, culture, dining, entertainment and recreation opportunities [that] are much like [either] New Orleans [Houston, or College Station.]"

We expected that one or more of these three cities would be familiar to all of the subjects in a sample group. Through the choices selected over the two options provided, it is possible to estimate the relative weights given to these attributes.

Summary

The analysis in this paper is based on a small sample of people who were displaced by Hurricane Katrina or Rita in the fall of 2005. Though the sample size used in cross-sectional statistical models is somewhat small (and indeed data collection for the second round is presently being conducted), the analysis represents a special opportunity to examine victims of Katrina in detail: a great deal of data on their risk preferences was collected. Preliminary results indicate that displaced hurricane victims have difficulty in processing information about so-called "expert" hurricane risks, when interviewed just

after hurricanes Katrina and Rita. We have also found that individuals are risk averse in their stated relocation choices, often choosing the location with the lower level of hurricane risk. Furthermore, there is convincing evidence in our initial data assessment that individuals with arbitrarily high subjective risk estimates are very unlikely to chose locations with a risk level labeled "high," often accepting a significant reduction in monthly income to reduce the likelihood of hurricane events. Once second round data collection is completed formal econometric models will be fully implemented, and results will be presented at the UCOWR annual meeting in Boise, ID (July, 2007).

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