Who evacuates when hurricanes approach? The role of risk, information, and location*

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Research questions

- What are the determinants of evacuation behavior?
- How does risk perception influence evacuation decision as a function of individuals' location inside and outside official designated evacuation areas?
- And what, if any, corrective strategies might be employed to achieve greater success with government ordered or recommended evacuations?

Thesis

- The evacuation behavior of all evacuees is not shaped by a common set of determinants.
- Evacuees from officially designated areas for evacuation respond to a different set of information cues, incentives and risk factors than evacuees residing in areas not designated for evacuation

Literature review: The role of risk

Risk - perceived and 'real' - as determinants of evacuation behavior (Baker 1979; Baker 1991; Perry 1994; Dow and Cutter 1998; Aguirre 2000; Whitehead et al 2000; Whitehead 2005).

$$R=C \times P_f,$$

P_f is the probability of failure or more generally the likely vulnerability to hazards.

C denotes the consequences given materialization of the vulnerability

Perceived and 'real' risk

- Subjective evaluations of risk rival scientifically estimated risk (e.g., location in a storm surge area) in predicting evacuation behavior (Whitehead et al 2000 Aguirre 2000; Baker 2000; Dash 2002) .

Why?

- Perceived risk assessments are more accurate assessments of the risks individuals actually confront during severe weather events than blanket official risk area denominations (Peacock et al 2004) .

The multi-dimensional nature of risk

"One important finding is that a single warning concept will not equally serve the requirements of all hazards (Sorensen 2000: 120)."

The expectation of this work is that shadow evacuations are related to the lack of congruence between an individual's perceived risk and the risk criteria used by local governments for defining evacuation areas.

The role of information

Evacuation decisions among residents of non-evacuation areas influenced by: local information, knowledge from experience, and information from neighbors with whom they share perceived risk.

Conversely official advisories may not be sufficiently germane and salient to shadow evacuees because shadow evacuees do not share the same dimension of risk on which evacuation orders are based (i.e., storm surge.)

The neighbor effect

- Contagious and cascading effect of neighbors' evacuation behavior (Bikhchandani et al 1992)

- Individuals who share space share other experiences, perceptions and behavior (i.e., Tiebout model)

Hypotheses: Perceived risk

- **H1:** Compared to residents inside official evacuation zones, evacuation decisions by residents outside official evacuation zones will be more influenced by perceived risk from wind and/or rainfall flooding hazards.

- **H2:** Perceived risk from storm surge will not be significantly related to the evacuation decisions of residents outside official evacuation zones.

Hypotheses: Information sources

- **H3:** Compared to residents inside official evacuation zones, evacuation decisions by residents outside official evacuation zones will be less influenced by news media and more influenced by the evacuation behavior of their neighbors.

- **H4:** Compared to residents outside official hurricane evacuation zones, evacuation decisions by residents inside official evacuation zones will be less influenced by whether they correctly know the evacuation status of their neighborhood.

Hypotheses: Social and demographic

- **H5:** Older individuals will be less likely to evacuate than younger individuals.

- **H6:** Individuals living with children under the age of 18 will be more likely to evacuate than individuals without children under the age of 18 in the household.

- **H7:** Whites will be more likely to evacuate than Non-Whites.

Research design

- RDD telephone interviews with 651 households in eight County Houston Metropolitan area immediately after Hurricane Rita made landfall (9/21/05 – 9/24/05).

- Self reported evacuation behavior among residents of evacuation and non-evacuation areas.

Independent variables

- Perceived risk

  Now consider the risks of [wind, flood, storm surge] from hurricane Rita. In your opinion was your residence/home located in a high (=3) risk, a medium (=2) risk or a low (=1) risk area for [wind, flood, storm surge] from hurricane Rita?"
- Knowledge of evacuation zone status
- Socio-demographic
  - Children in the household
  - Age
  - Anglo
- Neighbors behavior

  Did all, most, some or none of your neighbors evacuate?
- Media influence

  How much of your decision to evacuate or remain in your community was based on information you received from the media

Logit estimates for evacuation behavior by location in evacuation zone (Standard error)

Variable	Outside Evacuation Zone.	Inside Evacuation Zone
Perceived surge risk	-.024	.488
	(.318)	(.304)
Perceived flood risk	.227	-.209
	(.244)	(.304)
Perceived wind risk	.549*	.302
	(.204)	(.291)
Kids	.024	.266
	(.308)	(.4160
Age	-.206	-.105
	(.110)	(.144)
White	.223	.257
	(.316)	(.451)
Media influence	.525*	.795*
	(.191)	(.246)
Neighbors	1.100*	.960*
	(.208)	(.257)
Aware of evacuation zone	-1.388*	.987*
	(.374)	(.434)
Constant	4.148*	3.056*
	(1.038)	(1.136)
Pseudo R-square	0.288	0.284
% cases correctly predicted	75%	84%
-2 × Log likelihood Ratio	125.5	69.9
N	318	223

*P < 0.05

Estimated probabilities and change in probabilities of evacuating by location in evacuation zone

Perceived risk	Low	Medium	High	Δ in Prob.
Surge				
Outside	0.44	0.43	0.43	-0.01
Inside	0.76	0.83	0.87	+0.11
Flood				
Outside	0.42	0.46	0.50	+0.08
Inside	0.86	0.83	0.77	-0.09
Wind				
Outside	0.38	0.48	0.58	+0.20
Inside	0.77	0.82	0.86	+0.09

Probabilities are estimated using the program *Clarify* in STATA. Probabilities for each value of perceived risk are calculated with estimates reported in Table 1 holding all other independent variables to their mean values.

Estimated probabilities and change in probabilities of evacuating by evacuation area from the effects of media, neighbors and awareness of evacuation zone

		Evacuation Area	
		Outside	Inside
Media influence on evacuation decision			
	Not at all	0.26	0.61
	Partially	0.41	0.78
	Completely	0.51	0.89
	Δ Probability	0.25	0.28
Neighbors who evacuated			
	None/some	0.38	0.66
	Most	0.65	0.83
	All	0.84	0.92
	Δ Probability	0.46	0.26
Knowledge of evacuation status			
	Ignorant	0.68	0.7
	Knowledgeable	0.35	0.82
	Δ Probability	-0.33	0.12

Probabilities are estimated using the program *Clarify* in STATA. Probabilities for each value of perceived risk are calculated with estimates reported in Table 1 holding all other independent variables to their mean values.

Rice storm risk calculator

http://mystormrisk.com/