Responding to Natural Hazards:

The Effects of Disaster on Residential Location Decisions and Health Outcomes

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Analyses Overview

1. Residential Sorting and the Value of Hazard Risk Reduction
2. County Migration Patterns and the Risk of Natural Hazards
3. Determinants of Mental Health & Displacement Following Hurricanes Katrina and Rita

Residential Sorting

- Current Efforts:
  - Improve Disaster Risk Management (DRM) investments
  - Attempts to quantify the benefits and costs of DRM interventions
- Objective: Estimate WTP for reductions in hazard risk within the United States

Previous Literature

- Theoretical Framework
  - Ehrlich and Becker (1972)
  - Berger et al. (1987)
- Hedonic Housing Analyses
- Residential Sorting
  - Timmins (2007)
  - Bayer et al. (2009)

Theoretical Model

- Two-Stage Optimization Problem
  1. Determine the optimal allocation of income between consumption goods
  2. Select the location that maximizes utility, taking into account location-specific attributes

- Assumptions
  - Knowledge of markets and amenities at each location
  - Labor and housing market equilibrium
  - Costly migration

Theoretical Model (cont.)

- Expected Utility Function and Budget Constraint

$$E(U_{ij}) = (1-\pi)U_{ND}(C_i, H_i; X_j, M_{ij}) + \pi U_D(C_i, H_i; X_j, M_{ij})$$

$$I_{ij} = C + \rho_j H$$

C = Composite Numeraire Good

H = Housing Services

X = Location - Specific Attributes

M = Migration Cost

π = Probability of Hazard Occurance

I = Household Income

ρ = The Price of Housing Services

Theoretical Model (cont.)

- Indirect Expected Utility Function

$$E(V_{ij}) = (1-\pi)V_{ND}(I_{ij}^{ND}, \rho_j^{ND}; X_j^{ND}, M_{ij}) + \pi V_D(I_{ij}^{D}, \rho_j^{D}; X_j^{D}, M_{ij})$$

- Select Optimal Location

$$E(V_{ij}) > E(V_{ik}) \quad \forall \quad j \neq k, \quad k = 1,2,\ldots,j$$

Empirical Model

- Utility Function and Budget Constraint

$$U_{ij} = C_i^{\beta_C} H_i^{\beta_H} e^{X_j^{\beta_X} + M_{ij} + \xi_j + \eta_{ij}}$$

$$I_{ij} = C + \rho_j H$$

- Demand Functions

$$C_i = \left(\frac{\beta_C}{\beta_C + \beta_H}\right) I_{ij} \qquad \mathrm{H}_\mathrm{i} = \left(\frac{\beta_H}{\beta_C + \beta_H}\right) \frac{I_{ij}}{\rho_j}$$

Empirical Model (cont.)

- Indirect Utility Function

$$\ln\left(V_{ij}\right) = \alpha + \beta_I \ln\left(I_{ij}\right) - \beta_H \ln\left(\rho_j\right) + \beta_X X_j + M_{ij} + \xi_j + \eta_{ij}$$

where $\alpha = \beta_c \ln\left(\frac{\beta_c}{\beta_I}\right) + \beta_H \ln\left(\frac{\beta_H}{\beta_I}\right)$

and $\beta_I = \beta_C + \beta_H$

- Marginal Willingness-to-Pay

$$MWTP_i = \frac{MU_X}{MU_I} = \frac{\beta_X}{\beta_I} I_{ij}$$

Empirical Model (cont.)

- Indirect Utility Function

$$\ln\left(V_{ij}\right) = \alpha + \beta_I \ln\left(I_{ij}\right) - \beta_H \ln\left(\rho_j\right) + \beta_X X_j + M_{ij} + \xi_j + \eta_{ij}$$

where $\alpha = \beta_c \ln\left(\frac{\beta_c}{\beta_I}\right) + \beta_H \ln\left(\frac{\beta_H}{\beta_I}\right)$

and $\beta_I = \beta_C + \beta_H$

$$\ln\left(I_{ij}\right) = \ln\left(\hat{I}_{ij}\right) + \psi_{ij}$$

$$\rho_j = \rho^*_j$$

$$M_{ij} = \beta_{MS} M^S_{ij} + \beta_{MD} M^D_{ij} + \beta_{MR} M^R_{ij}$$

Empirical Model (cont.)

- Indirect Utility Function

$$\ln(V_{ij}) = \alpha + \beta_I \ln(\hat{I}_{ij}) - \beta_H \ln(\rho^*_j) + \beta_X X_j + \beta_{MS} M^S_{ij} + \beta_{MD} M^D_{ij} + \beta_{MR} M^R_{ij} + \xi_j + \beta_I \psi_{ij} + \eta_{ij}$$

- Indirect Utility Function

$$\ln(V_{ij}) = \beta_I \ln(\hat{I}_{ij}) + \beta_{MS} M^S_{ij} + \beta_{MD} M^D_{ij} + \beta_{MR} M^R_{ij} + \theta_j + \nu_{ij}$$

where $\theta_j = \alpha - \beta_H \ln(\rho^*_j) + \beta_X X_j + \xi_j$

and $\nu_{ij} = \beta_I \psi_{ij} + \eta_{ij}$

Empirical Model (cont.)

- Conditional Logit Model

$$P[\ln(V_{ij}) \geq \ln(V_{ik})] = \frac{e^{\beta_I \ln\left(\circ_{ij}\right) + \beta_{MS} M_{ij}^{S} + \beta_{MD} M_{ij}^{D} + \beta_{MR} M_{ij}^{R} + \theta_j}}{\sum_{k=1}^{j} e^{\beta_I \ln\left(\circ_{ij}\right) + \beta_{MS} M_{ij}^{S} + \beta_{MD} M_{ij}^{D} + \beta_{MR} M_{ij}^{R} + \theta_j}}$$

Empirical Model (cont.)

- Quality-of-Life Decomposition

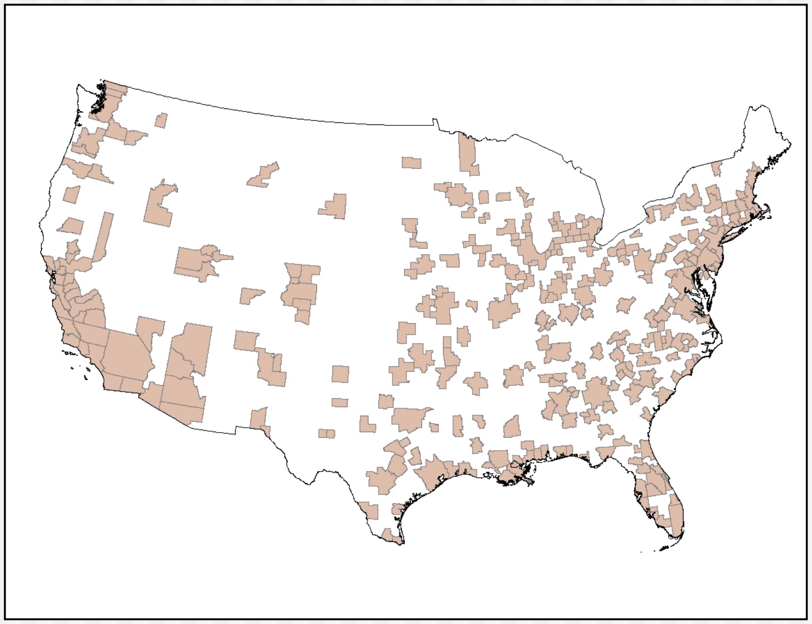
$$\theta_j = \alpha - \beta_H \ln\left(\rho^*_j\right) + \beta_X X_j + \xi_j$$

$$\mathrm{H_i} = \left(\frac{\beta_H}{\beta_C + \beta_H}\right)\frac{I_{ij}}{\rho_j} \quad \Rightarrow \quad \beta_H = \beta_I \frac{\rho_j H_i}{I_{ij}}$$

$$\theta_j + \beta_H \ln\left(\rho^*_j\right) = \alpha + \beta_X X_j + \xi_j$$

Data

- 2005-2009 American Community Survey
  - Housing services regression
  - Wage regressions
  - Conditional logit model

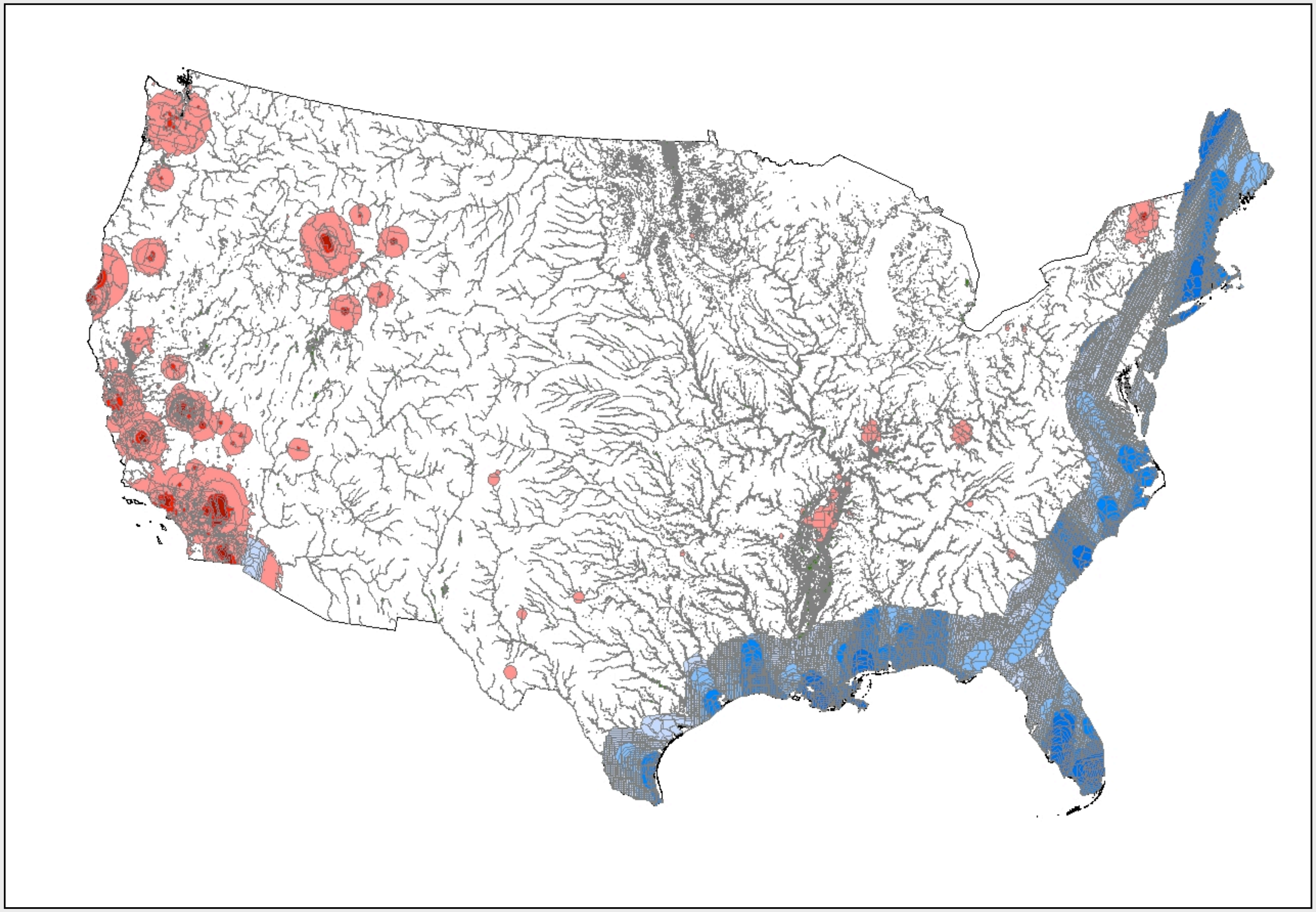


Data (cont.)

Variable	Description	Units	Mean	Std. Dev.
ASC	Alternative specific constant adjusted for housing costs	INDEX	2.430	1.112
lnPOP	MSA Population	ln(POPULATION)	12.856	1.039
UNEMP	Unemployment rate	UNEMP/LF	0.052	0.016
PCTAX	Per capita tax rate	TH$/PER	1.075	0.368
VCRIME	Violent crime rate	CRM/100TH. PER	0.422	0.213
PHYSICIANS	Physicians rate	PHY/TH. PER	3.024	1.762
ARTINDEX	Arts and entertainment index	INDEX	0.000	1.314
SUBWAY	MSA maintains subway or light-rail system	0/1	0.098	0.298
TEACHERS	Student teacher ratio	STU/TEACHER	16.179	2.431
DROPOUT	High school dropout rate	DROPOUT/ENROLL	0.037	0.020
VOTERS	Voter participation rate	VOTERS/ELIGIBLE	0.569	0.088
TEMP	Climate normal: average temperature	ºF	56.351	8.169
PRECIP	Climate normal: average precipitation	INCHES	39.585	14.195
OCEAN	MSA adjacent to ocean	0/1	0.260	0.439
EMISSIONS	Annual emissions per capita	LBS/PER	0.031	0.017
NPLSITES	National Priority List sites	ABS	3.071	8.287
PARKS	Percentage of MSA area designated as local park	PARK AREA/AREA	0.004	0.007
HRISK	Expected number of hazard events per 1000 years	EVENTS	10.986	25.317
REG1	MSA located in Northeast census region	0/1	0.257	0.438
REG3	MSA located in South census region	0/1	0.409	0.492
REG4	MSA located in West census region	0/1	0.209	0.408

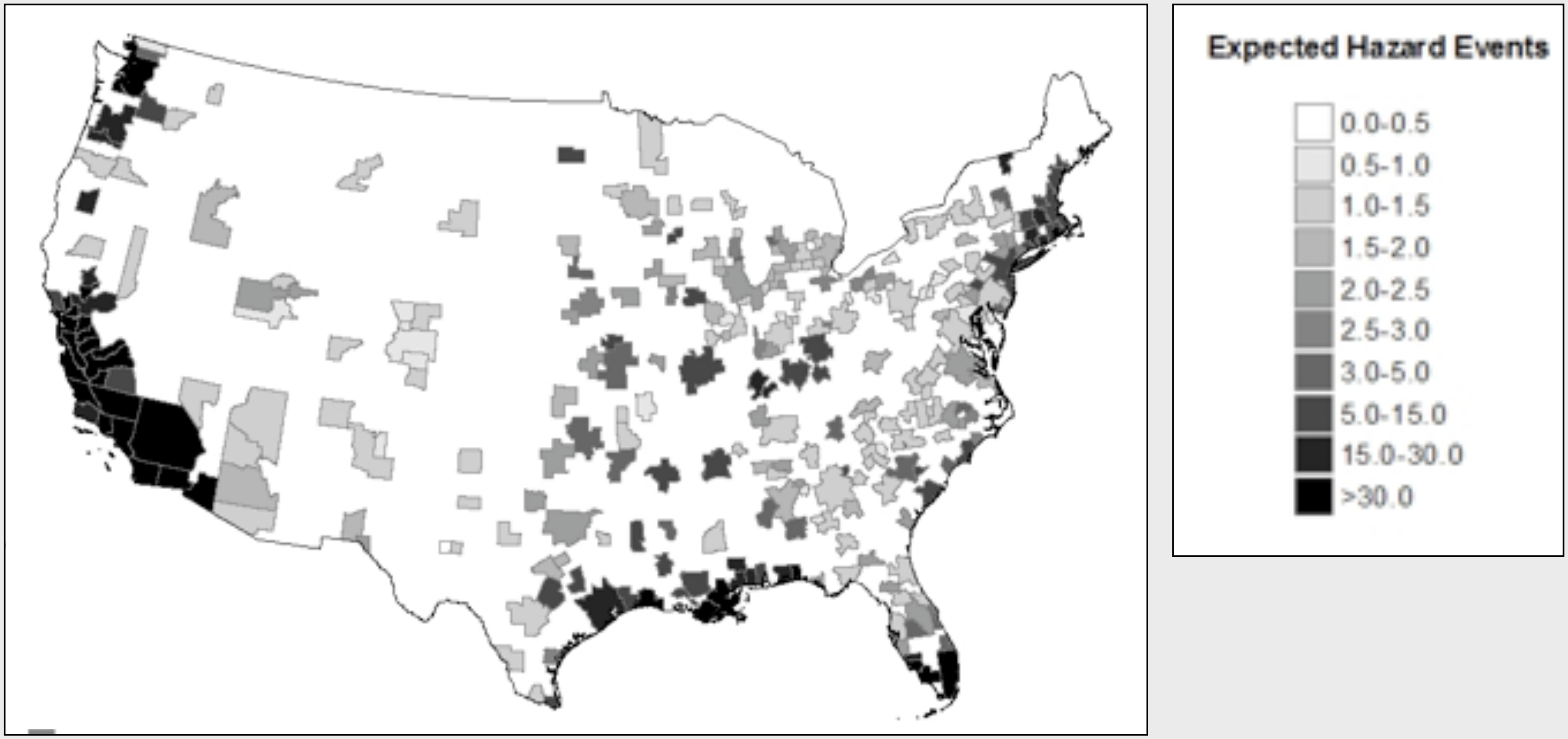
Data (cont.)

- Expected Number of Disaster Events



Data (cont.)

- Expected Number of Disaster Events by MSA



Results: Conditional Logit

	Specification 1		Specification 2	
Variable	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.
ln(I)	0.7835***	0.0883	1.1371***	0.1035
Mig1			-2.8127***	0.0216
Mig2			-0.7015***	0.0250
Mig3			-0.5054***	0.0211
Log-Likelihood	-113833.67		-72356.34	

* p<0.1 ** p<0.05 *** p<0.01

N=50,000

Results: Quality-of-Life Index

Top MSAs		Bottom MSAs	
Rank	MSA	Rank	MSA
1	Phoenix-Mesa-Glendale, AZ	282	Lebanon, PA
2	Atlanta-Sandy Springs-Marietta, GA	283	Barnstable Town, MA
3	Dallas-Fort Worth-Arlington, TX	284	Mansfield, OH
4	Washington-Arlington-Alexandria, DC-VA-MD-WV	285	Jackson, MI
5	Denver-Aurora-Broomfield, CO	286	Vineland-Millville-Bridgeton, NJ
6	Seattle-Tacoma-Bellevue, WA	287	Monroe, MI
7	Los Angeles-Long Beach-Santa Ana, CA	288	Hanford-Corcoran, CA
8	Las Vegas-Paradise, NV	289	Napa, CA
9	Houston-Sugar Land-Baytown, TX	290	Odessa, TX
10	Tampa-St. Petersburg-Clearwater, FL	291	Glens Falls, NY
11	Chicago-Joliet-Naperville, IL-IN-WI	292	Flint, MI
12	New York-Northern New Jersey-Long Island, NY-NJ-PA	293	Kingston, NY
13	Orlando-Kissimmee-Sanford, FL	294	El Centro, CA
14	Nashville-Davidson--Murfreesboro--Franklin, TN	295	Madera-Chowchilla, CA
15	Portland-Vancouver-Hillsboro, OR-WA	296	Ocean City, NJ

Results: Quality-of-Life Decomposition

Variable	Model 3: OLS		Model 4: 2SLS	
	Coefficient	Robust Std. Err.	Coefficient	Robust Std. Err.
Constant	-10.892***	1.024	-10.602***	1.076
lnPOP	1.008***	0.036	0.974***	0.069
UNEMP	-9.632***	3.428	-9.821***	3.234
PCTAX	-0.239**	0.100	-0.215**	0.103
VCRIME	-0.461***	0.137	-0.434***	0.137
PHYSICIANS	0.024	0.016	0.025	0.015
ARTINDEX	0.073***	0.027	0.069**	0.028
SUBWAY	0.067	0.096	0.108	0.125
TEACHERS	-0.049***	0.018	-0.045**	0.019
DROPOUT	-0.728	1.675	-0.795	1.601
VOTERS	0.465	0.485	0.486	0.472
TEMP	0.019*	0.010	0.019**	0.009
PRECIP	0.010***	0.003	0.010***	0.003
OCEAN	-0.125*	0.064	-0.124**	0.062
EMISSIONS	-0.002*	0.001	-0.003**	0.001
NPLSITES	-0.006***	0.002	-0.005**	0.002
PARKS	-4.076	4.384	-3.549	4.489
HRISK	-0.007***	0.002	-0.007***	0.002
REG1	-0.450***	0.097	-0.441***	0.099
REG3	0.239**	0.093	0.244***	0.091
REG4	0.940***	0.127	0.936***	0.125
Adjusted R^2	0.860		0.860	

* p<0.1 ** p<0.05 *** p<0.01 N=296

Results: WTP Estimates

Variable	MWTP (Median Income)
TEMP (°F)	$759
PRECIP (Inches)	$383
EMISSIONS (Lb/Per)	($154)
NPLSITES (Sites)	($213)
HRISK (Events/1000 Years)	($275)

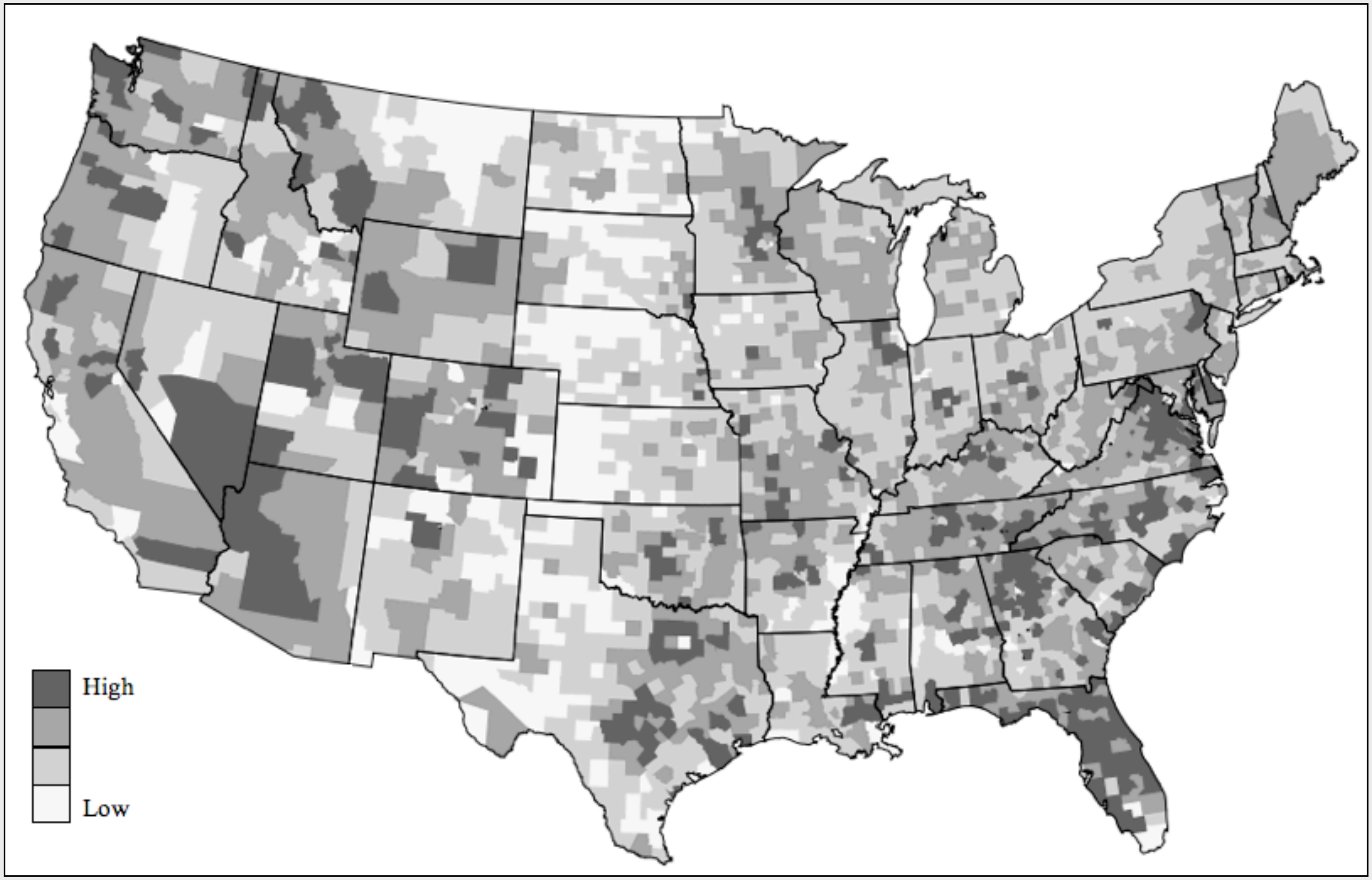
Conclusions

- Residential location decisions are partially determined by high-consequence low-probability events
- Households are WTP $275 annually for a marginal reduction in the number of expected hazard events per 1000 years.

Net Migration

- The spatial equilibrium model suggests household select their residential location so as to maximize utility--taking into account economic conditions and amenities
- Objectives:
  - Quantify the relationship between county-level migration rates and natural hazard risk
  - Identify possible spatial heterogeneity in the migration-risk relationship

U.S. Migration (cont.)



Empirical Model: SAC

- Spatial Simultaneous Autoregressive

$$\mathbf{M} = \rho\mathbf{WM} + \mathbf{E}\beta_E + \mathbf{D}\beta_{\mathbf{D}} + \mathbf{A}\beta_{\mathbf{A}} + \mathbf{u}$$

$$\mathbf{u} = \lambda\mathbf{Wu} + \mathbf{e}$$

$\mathbf{M}$ = Net In - Migration Rate

$\mathbf{E}$ = Economic Characteristics

$\mathbf{D}$ = Demographic Characteristics

$\mathbf{A}$ = Environmental Amenities

$\mathbf{W}$ = Spatial Weight Matrix

Empirical Model: SAC (cont.)

- Net Inmigration Rate

$$Net\ Inmigration\ Rate_i = \left[\frac{\sum_{t=2001}^{2009} Net\ Domestic\ Migration_{it}}{\left(\frac{1}{9}\right) * \sum_{t=2001}^{2009} Population_{it}} \right] * 100$$

- Spatial Weight Matrix

$$W_{ij} = \frac{d_{ij}}{\sum_{i=1}^{n} d_{ij}} \qquad where\ \ d_{ij} = \begin{cases} 1 & if\ counties\ i\ and\ j\ are\ neighbors \\ 0 & otherwise. \end{cases}$$

Results: SAC

Variable	ML ST Fixed-Effects
Constant	-54.928*** (3.28)
EXPINC	0.293*** (0.03)
PCTAX	-1.765*** (0.21)
IND_CONST	0.950*** (0.06)
IND_MNF	0.013 (0.02)
IND_TRADE	0.577*** (0.05)
IND_TRANS	-0.018 (0.07)
IND_FIN	0.411*** (0.10)
POPDEN	-1.100*** (0.19)
POPDEN^2	0.021*** (0.00)
URBAN	0.764** (0.35)
SUBURBAN	0.947** (0.37)
HSEDU	0.200*** (0.03)
MEDAGE	0.075** (0.04)
VCRIME	-0.012 (0.05)

Variable	ML ST Fixed-Effects
ARTREC	-0.003 (0.39)
WINTEMP	0.134*** (0.04)
TEMPERATE	0.383*** (0.08)
PRECIP	0.098*** (0.03)
OCEAN	-0.644 (0.55)
lnWATER	0.255 (0.21)
lnPARKS	0.006 (0.19)
TOPO	0.778*** (0.19)
EMISSIONS	-5.725*** (1.34)
EMISSIONS^2	1.429*** (0.30)
NPLSITES	-0.602*** (0.11)
DISAREA	-0.611 (0.92)
EFREQ	-0.027* (0.01)
HFREQ	-0.242*** (0.04)
FFREQ	-0.115*** (0.03)

* p<0.1 ** p<0.05 *** p<0.01

N=3107

Empirical Model: GWR

- Geographically Weighted Regression

$$M_i = \beta_{iE} E_i + \beta_{iD} D_i + \beta_{iA} A_i + \varepsilon_i \qquad \varepsilon \sim \text{i.i.d. N}(0,\sigma^2)$$

- Estimate Parameter Values

$$\widehat{\beta}_i = (\mathbf{X}_i' \mathbf{W}_i \mathbf{X}_i)^{-1} \mathbf{X}_i' \mathbf{W}_i \mathbf{Y}_i$$

- Weight Matrix

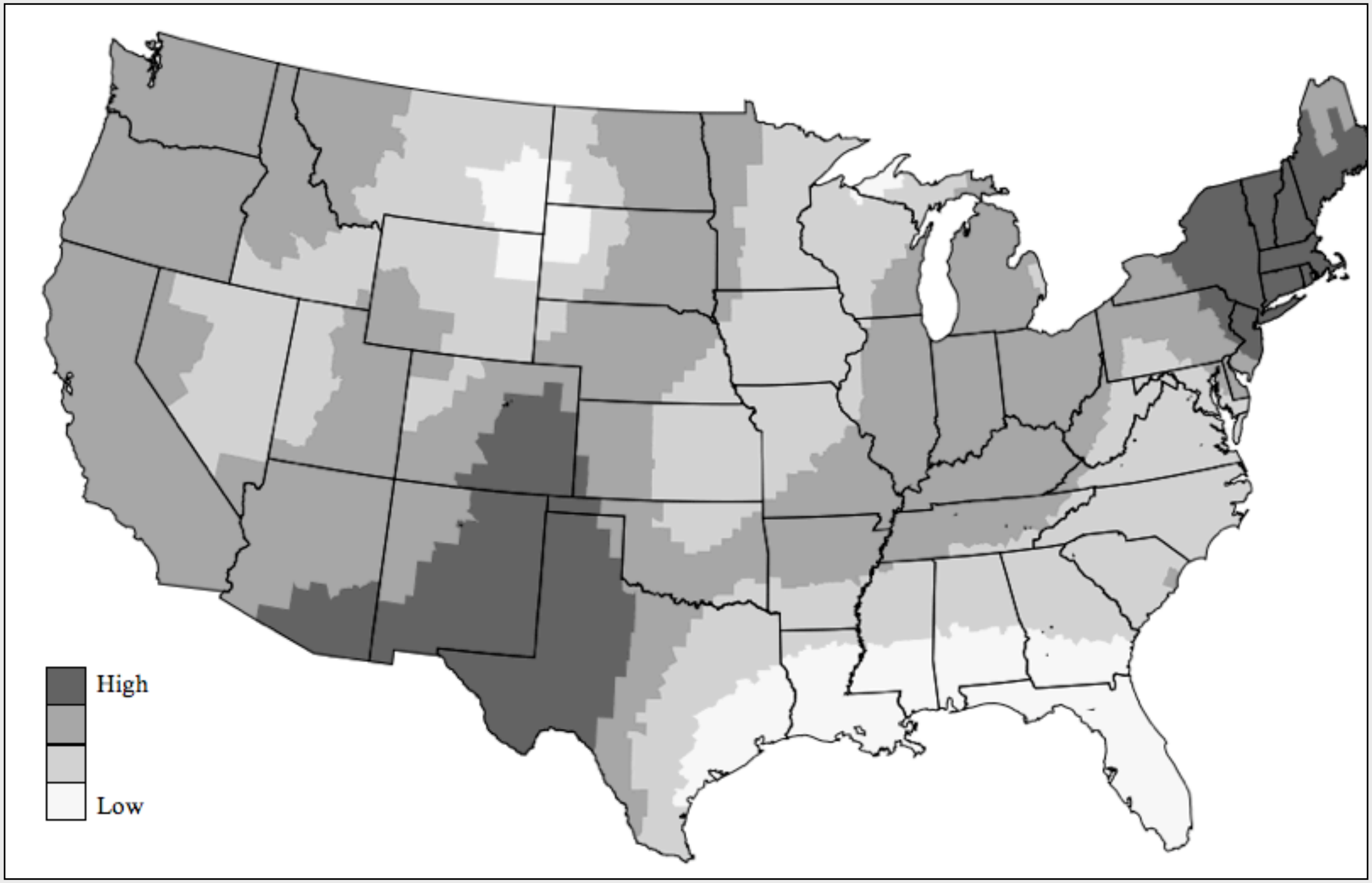
$$W_{ik} = \exp\left(\frac{-d_{ik}}{b^2}\right)$$

Net Migration

Results: GWR (Environmental Variables)

Variable	Global Model	Minimum	Lower Quartile	Median	Upper Quartile	Maximum
WINTEMP	0.160*** (0.02)	-0.418	0.015	0.143	0.272	0.644
TEMPERATE	-0.196*** (0.05)	-1.808	-0.725	-0.39	0.238	2.877
PRECIP	0.044*** (0.01)	-0.783	-0.039	0.056	0.142	0.36
lnWATER	0.658*** (0.20)	-2.196	-0.036	0.455	1.171	5.333
lnPARKS	0.352* (0.19)	-4.538	-0.408	0.032	0.656	3.515
TOPO	1.348*** (0.16)	-5.548	0.188	0.73	1.194	2.798
EMISSIONS	-5.534*** (1.46)	-49.984	-15.579	-7.953	-1.506	21.751
EMISSIONS^2	1.637*** (0.33)	-38.818	-0.619	2.883	5.875	128.763
NPLSITES	-0.496*** (0.11)	-3.428	-0.307	-0.189	-0.012	1.236
MultiFreq	-0.083*** (0.01)	-0.335	-0.117	-0.063	-0.038	0.806

Results: GWR (Hazard Risk)



Conclusions

- County migration patterns are negatively correlated with hazard risk
- Hurricane and flood risk have a substantially greater affect on migration than earthquake risk
- There is significant spatial heterogeneity in the relationship between migration and hazard risk
- This migration-risk relationship is greatest along the Gulf Coast

Determinants of Mental Health and Displacement

- Hurricanes Katrina and Rita devastated parts of the Gulf Coast in 2005
  - Mass displacement
  - $191 billion in property damage
  - Extreme physical and psychological stress
- Objectives:
  - Evaluate the effects of post-disaster stress on long term mental health status
  - Identify determinants of displacement and displacement duration

Data

- Panel Survey of Income Dynamics
  - 2005 and 2007
  - Supplemental questionnaire for residents of hurricane-affected areas
- Federal Emergency Management Agency
  - Geospatial data regarding hurricane damage

Empirical Model: Mental Health

- Simultaneous Equations Model

$$MH_i = f(E_i, B_i, SS_i, PDVI_i)$$

$$PDVI_i = f(E_i, B_i, SS_i, DS_i)$$

$MH =$ Mental Health Indicator

$E =$ Socioeconomic Characteristics

$B =$ Behavioral and Health Characteristics

$SS =$ Social Support Index

$PDVI =$ Post Disaster Vulnerability Index

DS = Disaster Severity

Empirical Model: Mental Health

- Post-Disaster Vulnerability Index
  - Displacement Duration
  - Property Damage
  - Food Shortages
  - Water Shortages
  - Unsanitary Conditions
  - Loss of Electricity

Data (cont.)

Variable	Description	Mean	Std. Dev.
FEMALE	Gender (female=1, male=0)	0.71	0.454
BLACK	Race and ethnicity (black=1, otherwise=0)	0.8	0.4
AGE	Age (10 years)	4.195	1.421
EDU	Educational attainment (10 years)	1.268	0.214
MARRIED	Marital status (married or cohabitating=1, otherwise=0)	0.439	0.497
CHILD	Children in household (children=1, otherwise=0)	0.536	0.499
UNEMPLOY	Employment status (unemployed=1, otherwise=0)	0.086	0.28
HHINC	Household income in 2006 (ln$)	10.202	1.115
OWNHOME	Household tenure status (homeowner=1, otherwise=0)	0.568	0.496
SMOKE	Smokes cigarettes (yes=1, no=0)	0.227	0.42
DRINK	Regularly drinks alcohol (yes=1, no=0)	0.074	0.262
INACTIVE	Physically inactive (yes=1, no=0)	0.232	0.423
CHRONIC	Chronic health condition (yes=1, no=0)	0.181	0.385
TRAUMA	Experienced prior traumatic event (yes=1, no=0)	0.03	0.171
SSI	Social support index	2.697	0.902
PDVI	Post-disaster vulnerability index	0	1.77

Results and Conclusions: Mental Health

- Several socioeconomic variables are correlated with adverse mental health outcomes
- The SSI is negatively correlated with adverse mental health outcomes
- The PDVI is positively correlated with adverse mental health outcomes

Empirical Model: Displacement

- Probit-Weibull Hurdel Model

$$x_{1j} = f(H_j, DS_j, E_j^h, B_j^h, SS_j)$$

$$x_{2j} = f(H_j, DS_j, E_j^h, B_j^h, SS_j)$$

$H =$ Housing Damage

$\mathrm{DS} =$ Disaster Severity

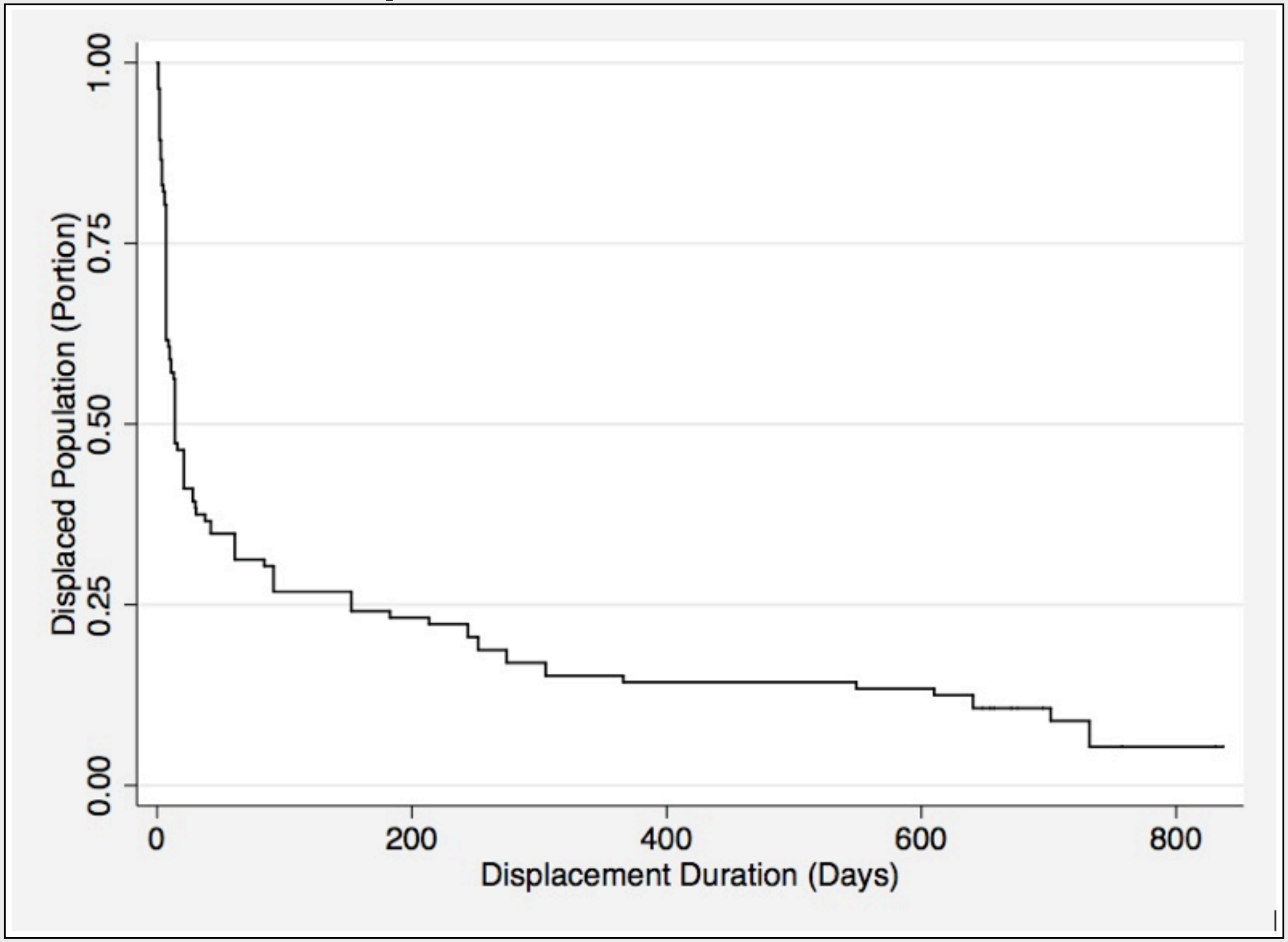
$E =$ Socioeconomic Characteristics

$B =$ Behavioral and Health Characteristics

$SS =$ Social Support Index

Displacement Duration

- Plot of Kaplan-Meier Estimator



Results and Conclusions: Displacement

- Housing damage is positively correlated with both displacement and displacement duration
- Most socioeconomic variables are not significantly correlated with displacement
- The SSI is positively correlated with displacement and negatively correlated with displacement duration
- Remittances from family are negatively correlated with displacement duration

Questions?

Exposure to Natural Hazards

- Major hazard events since 2000
  - 3740 (Globally)
  - 246 (United States)
- Exposure to natural hazards is rapidly increasing
  - Population growth within hazard-prone areas
  - Climate Change

Theoretical Model (cont.)

		Division of Residence								
Birth Division		New England	Mid-Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
	New England	64.79	5.66	2.38	0.7	14.35	0.91	2.24	3.11	5.88
	Mid-Atlantic	3.59	62.24	3.42	0.69	18.16	0.99	2.37	3.16	5.38
	East North Central	0.97	2.13	65.51	2.76	11.03	2.52	3.93	4.91	6.25
	West North Central	0.79	1.51	6.98	55.9	7.33	1.68	7.36	9.12	9.34
	South Atlantic	1.3	4.33	3.53	0.88	77.63	3.14	3.25	2.19	3.76
	East South Central	0.63	1.57	8.68	1.4	16.37	59.79	5.95	2.06	3.55
	West South Central	0.51	1.11	2.63	2.06	6.47	2.44	74.22	4.19	6.37
	Mountain	0.75	1.43	2.8	2.39	5.45	1.02	6.59	63.33	16.23
	Pacific	0.8	1.42	2.23	1.46	5.13	0.97	4.16	8.78	75.05

Empirical Model (cont.)

- Conditional Logit Model

$$P[\ln(V_{ij}) \geq \ln(V_{ik}) \quad \forall\, j \neq k] = \frac{e^{V_{ij}(I_{ij},\rho_j;X_j,M_{ij})}}{\sum_{k=1}^{j} e^{V_{ik}(I_{ij},\rho_j;X_j,M_{ij})}}$$

Empirical Model (cont.)

- Price of Housing Services Estimates

$$\ln(UC_{ij}) = \delta_0 + \ln(\rho_j) + \delta_D D + \omega_{ij}$$

UC = User Cost

ρ = MSA fixed - effects

D = Dweling Characteristics

- Income Estimates

$$\ln(W_{ij}) = \sigma_0 + \sigma_S S_{ij} + \sigma_P P(R_B, R_D \mid SC) + \sigma_P P(R_B, R_D \mid SC)^2 + \zeta_{ij}$$

W = Hourly Wage Rate

S = Socioeconomic Charateristics

P(•) = Probability that Person Born in R_B resides in R_D

Data (cont.)

- Data Sources for Location-Specific Attributes
  - City and County Database
  - Core of Common Data
  - County Business Patterns
  - National Climate Data Center
  - Environmental Protection Agency
  - Global Risk Data Platform

Results: Housing Regression

Variable	Coefficient	Robust Std. Err.
Constant	6.2975***	0.0160
ACRE>1	0.1519***	0.0009
UNITS1	0.7166***	0.0021
UNITS2	0.6491***	0.0025
UNITS3	0.7867***	0.0032
UNITS4	0.6719***	0.0034
UNITS5	0.8747***	0.0038
NOHEAT	-0.091***	0.0064
NOKITCH	-0.0544***	0.0107
NOPLUMB	-0.0026	0.0092
ROOMS	0.1063***	0.0003
BEDROOMS	0.0714***	0.0006
YBL1	-0.0169***	0.0018
YBL2	-0.0862***	0.0017
YBL3	-0.1872***	0.0017
YBL4	-0.2773***	0.0017
YBL5	-0.3061***	0.0018
YBL6	-0.3305***	0.0018
YBL7	-0.3563***	0.0021
YBL8	-0.3223***	0.0019

* $p<0.1$ ** $p<0.05$ *** $p<0.01$

N=1,599,627
R^2=0.6047

Results: Wage Regression

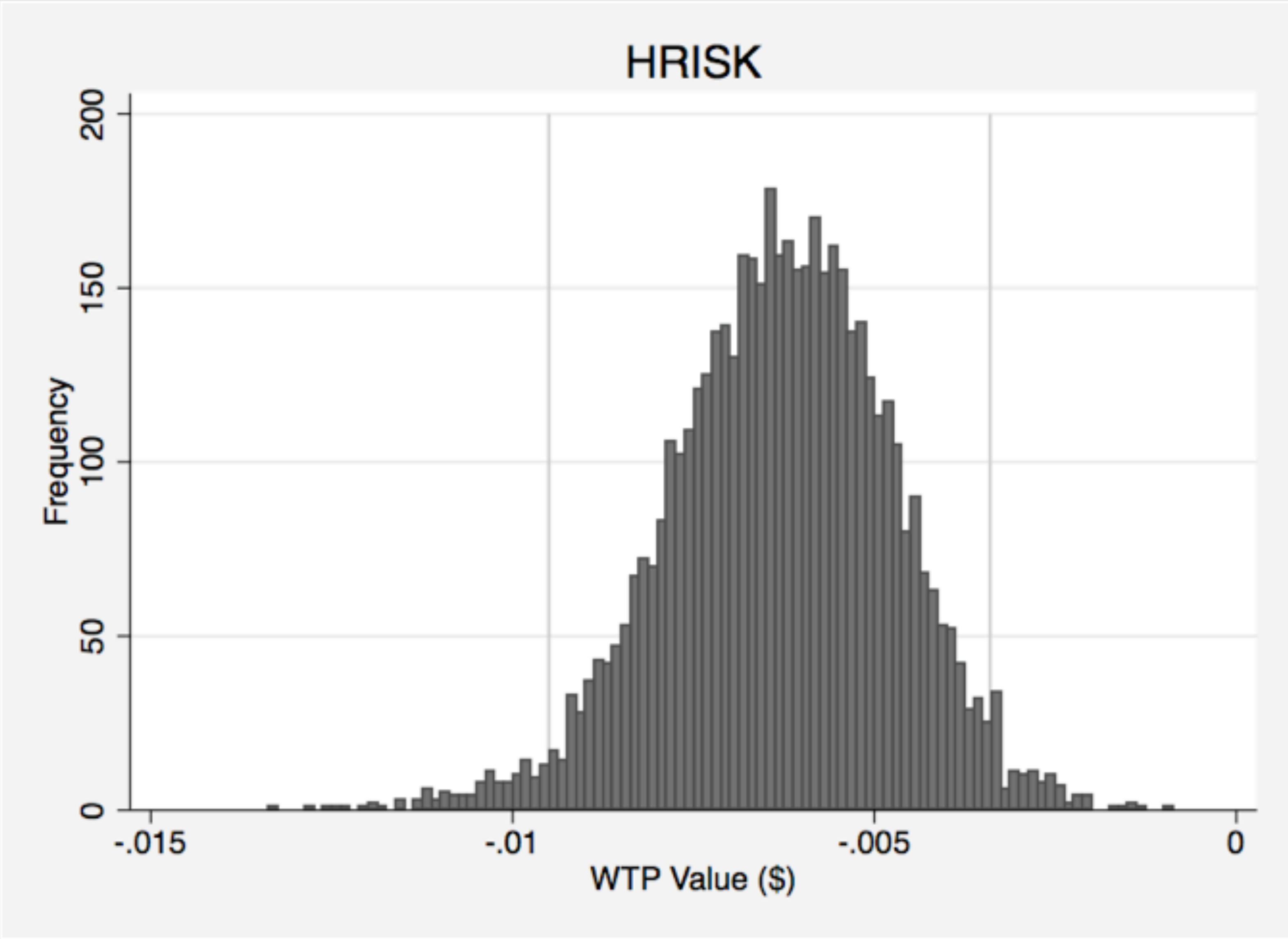
Variable	Coefficient	Robust Std. Err.
Constant	1.5327	0.1448
AGE	0.0598	0.0064
AGE_SQ	-0.0596	0.0075
FEMALE	-0.2336	0.0228
MARRIED	0.1076	0.0217
WHITE	0.0894	0.0375
NOHS_DEG	-0.1637	0.0472
SOME_COLL	0.1421	0.0328
COLL_DEG	0.3433	0.0476
GRAD_DEG	0.4892	0.0620
OCC1	-0.3586	0.0363
OCC2	-0.2001	0.0292
OCC3	-0.1345	0.0380
OCC4	-0.2328	0.0366
PMIG	-0.4498	0.3871
PMIG_SQ	0.6022	0.5073

88.4% of coefficients are significant at $p<0.1$

N: Mean=5405
Max.=99324 Min.=547

R^2: Mean=0.373
Max.=0.517 Min.=0.238

Results: WTP Estimates



U.S. Migration

Region/Division	Total Migration	Average Annual Migration	Average Annual Rate (Migration/1000 People)
Northeast	-2,488,084	-276454	-5.1
New England	-353,914	-39324	-2.8
Middle Atlantic	-2,134,170	-237130	-5.9
Midwest	-1,719,445	-191049	-2.9
East North Central	-1,546,573	-171841	-3.7
West North Central	-172,872	-19208	-1.0
South	3,803,776	422642	3.9
South Atlantic	2,767,011	307446	5.5
East South Central	392,560	43618	2.4
West South Central	644,205	71578	2.1
West	403,753	44861	0.7
Mountain	1,513,828	168203	8.3
Pacific	-1,110,075	-123342	-2.6

Results: GWR (Emissions)