The Effects of Adaptation Measures on Hurricane Induced Property Losses

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**MOTIVATION**

- Continued rise in tolls from disasters
- Direct losses
- Indirect losses
- Increased burden to taxpayers to provide relief to disaster victims
- Changing physical environment due to global climate change
- Gap between theory and empirics about adaptation impacts on natural disasters
- “The United States has been — and still is — creating for itself increasingly catastrophic future disasters” (Mileti, 1999)

**TYPES OF ADAPTAION & MAJOR HYPOTHESIS**

- **Type I** minimize disaster losses, BUT ...
  - “Syndrome of natural hazard”, (Kunreuther, 2001)
- **Type II** adaptation mostly loss-reducing, BUT ...
  - Capacity limit (Mileti, 1999)
  - Induced development (Kousky et al., 2006)
- **Type III** minimize disaster losses ...
  - Disaster relief & clean-up exhibit shock-smoothing effect
  - Zoning & relocation → out of harm’s way
- Public programs could crowd-out private adaptation

**RESEARCH QUESTION**

The role of adaptation measures in addressing hurricane disaster losses

- What type of adaptation measures are most effective in terms of reducing property losses?
- Do certain measures exacerbate damages?
- Does public provision of protection crowd out private incentives to self-protect?
- Moral Hazard (Charity hazard)?

**MAJOR FINDINGS & POLICY IMPLICATIONS**

- Non-structural projects provide less-costly solutions to costly disasters
  - Encourage local/private level adaptation via incentive based mechanism
- Restrict development
  - Regulate land use & zoning
- Hazard identification & studies
  - Public provision of protection could crowd-out market adaptation initiatives
- Effective Adaptation
  - Building codes & engineering studies
  - Effective enforcement of codes
- Improved warning & forecasting systems make hurricanes SAFER!

**ESTIMATION METHODOLOGY**

The standard Pooled Panel Tobit model

\[ y^*_i = \frac{x_i \beta + u_{it}}{P_{pop_i}} + \frac{u_i}{P_{pop_i}} + \frac{u_{it}}{P_{pop_i}} + \beta \Delta P_{pop_{it-1}} + \beta_1 \text{Hur}_{it-1} + \beta_2 \text{Unemp}_{it-1} + \beta_3 \text{Unemp}_{it} + \beta_4 \text{Hur}_{it} + \beta_5 \text{Hur}_{it-1} + \beta_6 \text{Hur}_{it-2} + \beta_7 \text{Hur}_{it-3} + \text{Other} + \epsilon_i \]

**RESULTS**

- Dependent Variable: real per capita property loss
- ME on E(Y|X, Y>0)
- ME on E(Y|X, Y>0; Y<0)

| Variable | ME on E(Y|X, Y>0) | ME on E(Y|X, Y>0; Y<0) |
|----------|-------------------|------------------------|
| Log of per capita income | 7879.299*** | 7680.522*** |
| Log of per capita income squared | -369.0715*** | -360.0464*** |
| Log of population change | 0.0002701*** | 0.0004006*** |
| Log of establishment change | 0.0085622*** | 0.0118015*** |
| Per capita vulnerable housing | 958.8799*** | 1021.9508*** |
| Unemployment rate | 8.198265*** | 6.438758*** |
| Hurricane hits cat. 1-5 | 331.2485*** | 136.9125*** |
| Dummy for Major Hurricanes | 62.71808*** | 55.43633*** |
| Dummy for coastal county * tropical storms | 22.35104*** | 22.31925*** |
| Log of cumulative hurricane hits cat. 1-5 | -1.666263*** | -1.026806*** |
| Log of other types of disasters declared | -13.54604*** | -13.79754*** |
| CRS total credit points | -0.0276393*** | -0.0307382*** |
| Building codes and engineering design studies | -13.55664*** | -7.44604*** |
| BCGS (county with CRS class 7 or lower) | -15.79538*** | -20.54466*** |
| Type I (Warning and forecasting systems) | -21.87399*** | -34.26248*** |
| Type II (Structural & Infrastructure Projects) | 12.02885*** | -38.04224*** |
| Type III (adaptive/responsive measures) | -13.55664*** | -6.67522*** |

**SELECTED REFERENCES**

- Webster, W. D., 2010: The Economics of Hurricanes and Implications for Global Warming. The Ohio State University