The Effects of Adaptation Measures on Hurricane Induced Property Losses

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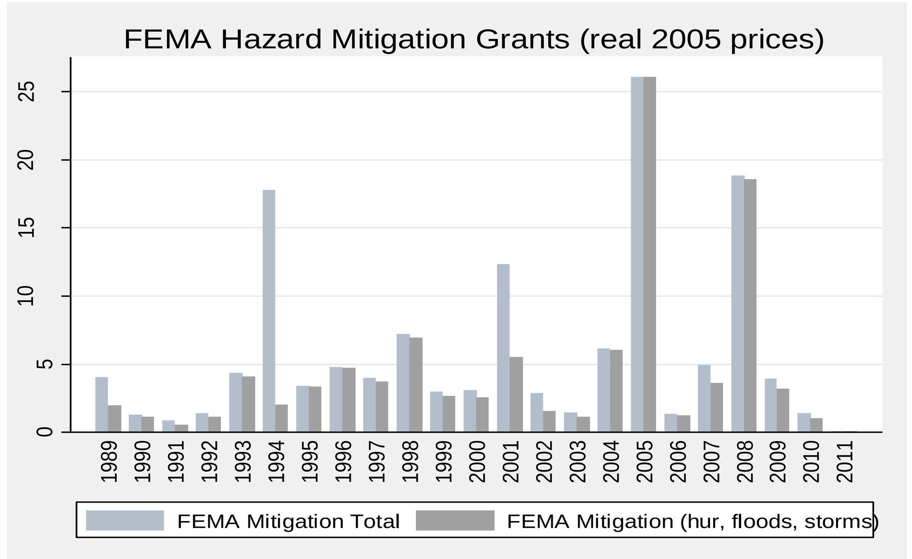
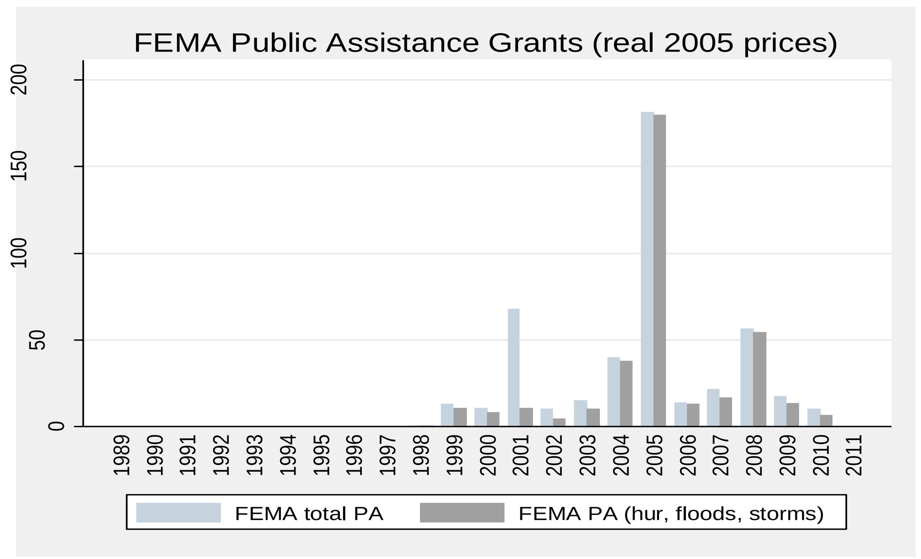
MOTIVATION

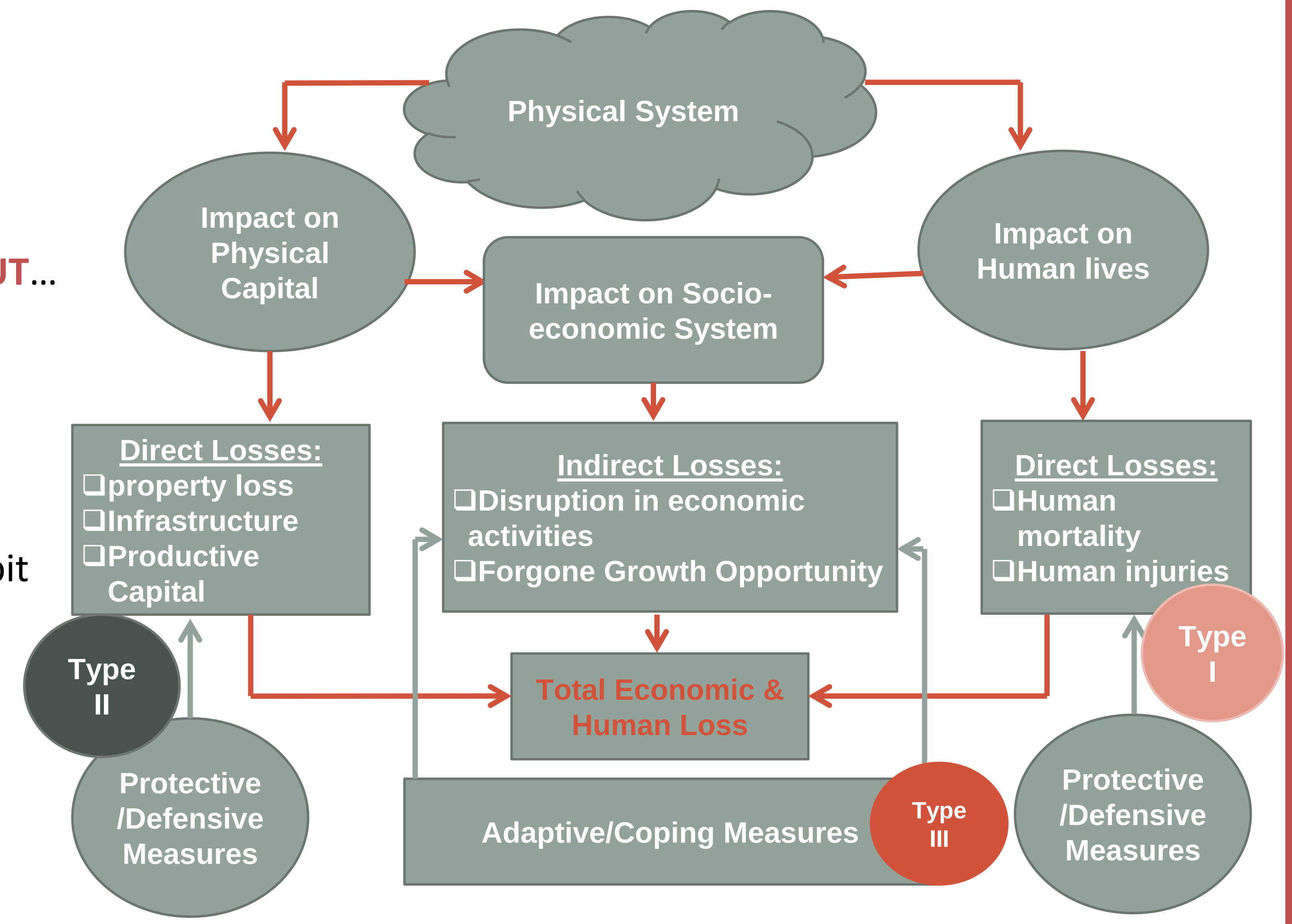
- ❑Continued rise in tolls from disasters
  - ❑Direct losses
  - ❑Indirect losses
- ❑Increased burden to taxpayers to provide relief to disaster victims
- ❑Changing physical environment due to global climate change
- ❑Gap between theory and empirics about adaptation impacts on natural disasters
- ❑"The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





TYPES OF ADAPTAION & MAJOR HYPOTHESIS

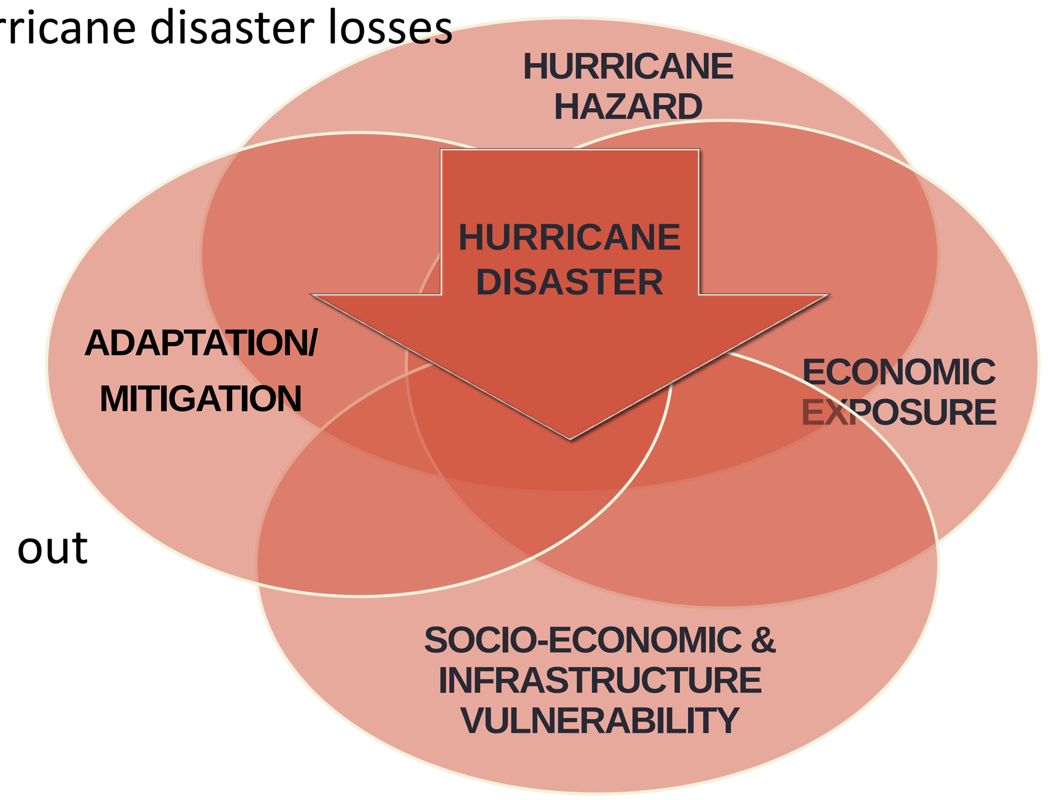
- ❑**Type I** minimize disaster losses, **BUT** …
  - ❑"Syndrome of natural hazard", (Kunreuther, 2001)
- ❑**Type II** adaptation mostly loss-reducing, **BUT**…
  - ❑Capacity limit (Mileti, 1999)
  - ❑Induced development (Kousky et al., 2006)
- ❑**Type III** minimize disaster losses …
  - ❑Disaster relief & 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)?



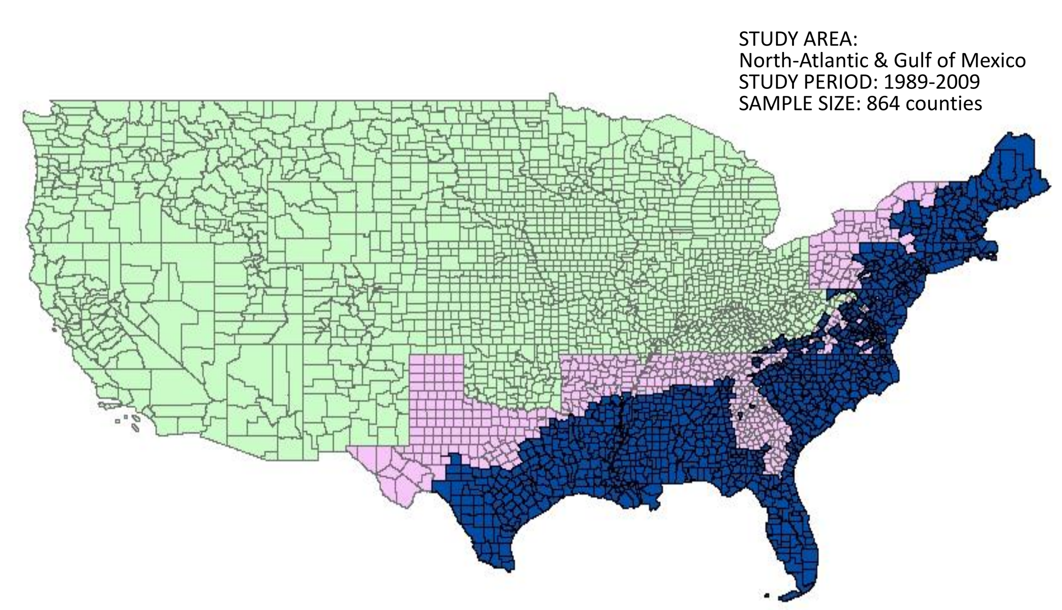
MAJOR FINDINGS & POLICY IMPLICATIONS

- ❑Non-structural projects provide less-costly solutions to costly disasters
  - ❑Restrict development
  - ❑Regulate land use & zoning
  - ❑Hazard identification & studies
- ❑Effective Adaptation
  - ❑Building codes & engineering studies
  - ❑Effective enforcement of codes
- ❑Improved warning & forecasting systems make hurricanes SAFER!
- ❑ Encourage local/private level adaptation via incentive based mechanism
- ❑Public provision of protection could crowd-out market adaptation initiatives
- ❑The effective federal policy mix is one that entices local level adaptation behavior rather than crowding out or distorting it.

ESTIMATION METHODOLOGY

The standard Pooled PanelTobit model

$$y_{it}^* = x_{it}\beta + u_{it}, \quad u_{it}|x_{it} \sim N(0, \sigma^2)$$
$$y = \max(0, y_{it}^*) = \max(0, x_{it}\beta + u_{it})$$



$$\frac{Loss_{i,t}}{Pop_{i,t}} = \beta_0 + \beta_1 ln\left(\frac{Inc_{i,t}}{Pop_{i,t}}\right) + \beta_2\left[ln\left(\frac{Inc_{i,t}}{Pop_{i,t}}\right)\right]^2 + \beta_3 \Delta Pop_{i,t-1} + \beta_4 \Delta Bus.Est_{i,t-1} + \beta_5 \frac{Unemp_{i,t}}{Pop_{i,t}} + \beta_6 \frac{Vul.Inf_{i,t}}{Pop_{i,t}} + \beta_7 Hur_{i,t} + \beta_8\left(\sum_{t_0}^{t-1} Hur_{i,t}\right) + \beta_9 MH_{i,t} + \beta_{10} Dis_{i,t-1} + \beta_{11}(dc * ts_{i,t}) + \beta_{12} ln\left(\sum_{t_0}^{t-2}\left[\frac{Tipe\ I_{i,t}}{Pop_{i,t}}\right]\right) + \beta_{13} ln\left(\sum_{t_0}^{t-2}\left[\frac{Tipe\ II_{i,t}}{Pop_{i,t}}\right]\right) + \beta_{14} ln\left(\sum_{t_0}^{t-2}\left[\frac{Tipe\ III_{i,t}}{Pop_{i,t}}\right]\right) + \beta_{15}\, ln\left(\sum_{t_0}^{t-2}\left[\frac{BC\ \&\ Des_{i,t}}{Pop_{i,t}}\right]\right) + \beta_{16} BCEGS_{i,t} + \beta_{17}(CRS_{i,t}) + \mu_i + \lambda_t + \varepsilon_{i,t}$$

RESULTS

Dependent Variable: real per capita property loss	ME on E(Y|X, Y>0) (2-year lagged cum. adaptation)	ME on E(Y|X, Y>0) (1-year lag difference in cum. adaptation)
Log of per capita income	7879.299***	7680.522***
Log of per capita income squared	-369.0715***	-360.0463***
Lag of population change	0.0007201***	0.0004004***
Lag of establishment change	0.008562***	0.0118015***
Per capita vulnerable housing	998.8789***	1021.98***
Unemployment rate	8.198969***	6.438758***
Hurricane hits cat. 1-5	111.2485***	116.9171***
Dummy for Major Hurricanes	62.71808***	55.43653***
Dummy for coastal county * tropical storms	22.35104***	22.11925***
Lag of cumulative hurricane hits cat. 1-5	-1.666263***	-1.026806***
Lag of other types of disasters declared	-13.54604***	-13.7974***
CRS total credit points	-0.0276939***	-0.0357285***
Building codes and engineering design studies	-13.55664***	-7.486047***
BCEGS (county with CRS class 7 or lower)	-15.79538***	-20.54468***
Type I (Warning and forecasting systems)	-21.87539***	-34.26248***
Type II (Structural & Infrastructural Projects)	12.02885***	-38.04243***
Type III (adaptive/responsive measures)	-13.55664***	-6.675527***

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