Virtual Seminar on Climate Economics

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The Local Economic Impact of Natural Disasters

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Virtual Seminar on Climate Economics
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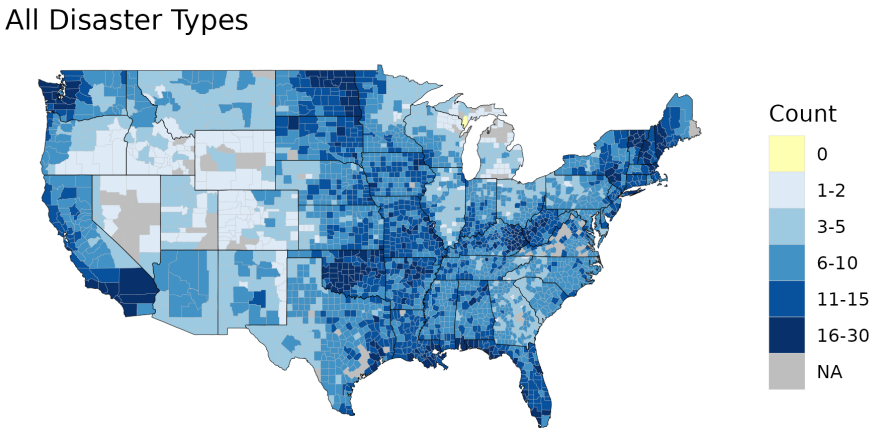
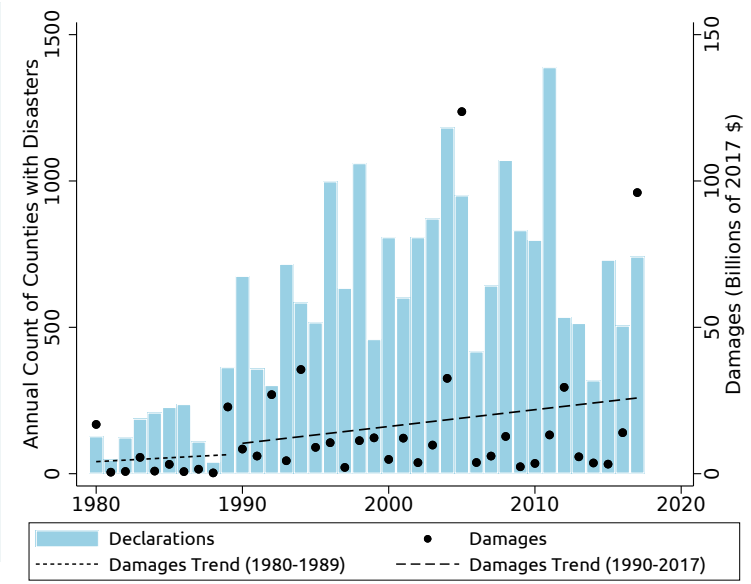
1. Federal Reserve Bank of San Francisco. The views expressed in this presentation are those of the authors and do not necessarily represent the views or policies of the Federal Reserve Bank of San Francisco or its staff.

Natural disasters are widespread, with prevalence and costs having increased in recent decades

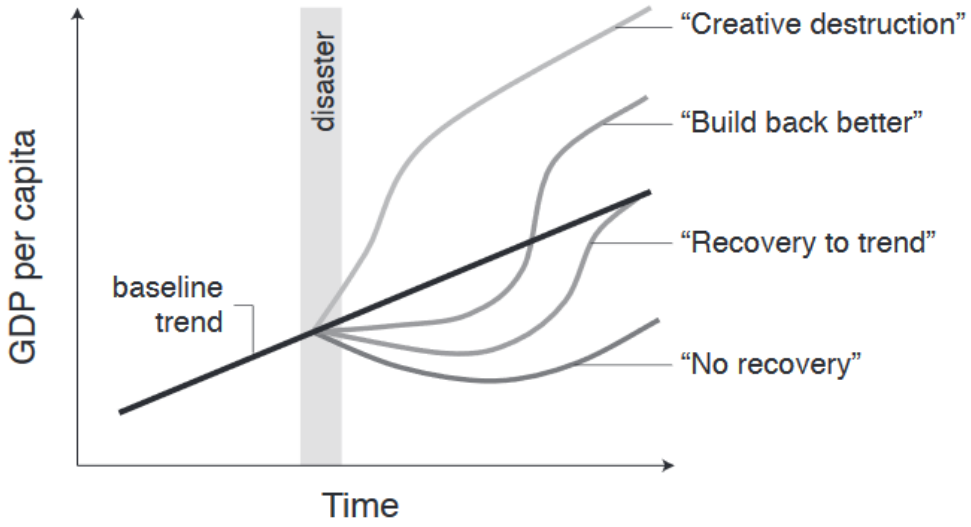




Source: FEMA, SHELDUS, Census

Understanding Economic Impact of Disasters is Critical

Potential Paths Considered in the Literature:



Source: Hsiang and Jina (2014)

Understanding Economic Impact of Disasters is Critical

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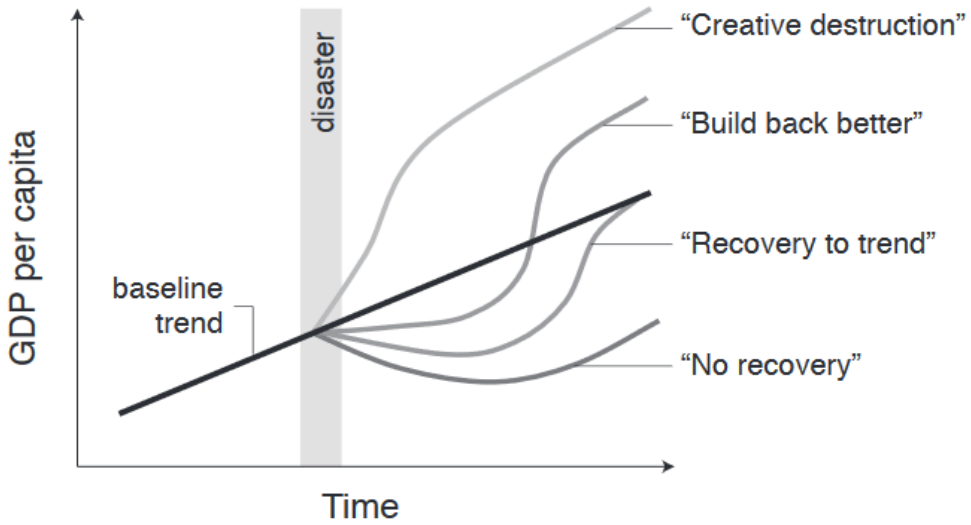


Source: Hsiang and Jina (2014)

No Consensus in Empirical Literature

- Empirical studies vary by geography, disaster type, methodology
- Results support diverse paths
- Belasen & Polacheck (2008), Strobl (2011), Hsiang & Jina (2014), Deryugina (2017), Lackner (2019), Sawada & Sachs (2019), Groen, Kutzbach, & Polivka (2020), Jerch, Kahn, & Linn (2023)

Several potential mechanisms could drive a range of outcomes

- **Solow growth model:** one-time capital depreciation shock → higher investment and output growth as economy transitions back to steady state
- **Standard Neoclassical model of labor supply:** one-time neg wealth shock ⇒↑ MU of consumption ⇒↑ labor supply ⇒↑ employment, income
- **Hornbeck and Keniston (2017):** disasters could ↑ property values in growing areas (where externalities → underinvestment)
- **Local labor markets models (Rosen (1979), Roback (1982), Hsieh and Moretti (2019)) :**
  - + **shocks to local amenities:** ↑ demand for local housing
  - + **shocks to local productivity:** ↑ local labor demand which can lead to relative gains in population, house prices, employment, and wages
  - **Elasticities of housing, labor supply** ⇒ whether shocks affect Q (population, housing stock, employment) and/or P (house prices, wages)

Disasters: negative shocks to household wealth, public/private capital stocks

- Rebuilding could ↑ amenities and productivity, depending on expectations

Our approach

- Estimate **dynamic impact** of FEMA disasters on U.S. **counties** from 1980-2017 using panel data
- Estimate **heterogeneous** impacts, examine **mechanisms**
- Estimate **spatial spillover** effects and broader geographies
- Analysis does **not** examine welfare effects

Contributions

- Consider **broad range** of economic outcomes on **comprehensive set of disasters** using **common methodology and data sample** $\rightarrow$ unified picture of economic impact of disasters
- Estimate **dynamics** using local projections
- Uncover **strong economic recovery** from disasters in US context (US aid, insurance) that **could explain continued investment** in areas facing high natural hazard risks
- Reveal significant heterogeneity in responses to **different types of disasters**, raising concerns about **external validity** of studies focused on one disaster type

Data

Disaster Indicator / "Treatment" Variable

- Disasters: FEMA major disasters
  - Extensions: SHELDUS (ASU)

Outcomes / Dependent Variables (monthly, quarterly, annual)

- Personal Income Per Capita (BEA)
- Employment: Total Nonfarm, Construction (BLS QCEW)
- Average Weekly Wages (BLS QCEW)
- House Prices (CoreLogic)
- Population (Census)

Methodology: panel version of local projections (Jordà 2005)

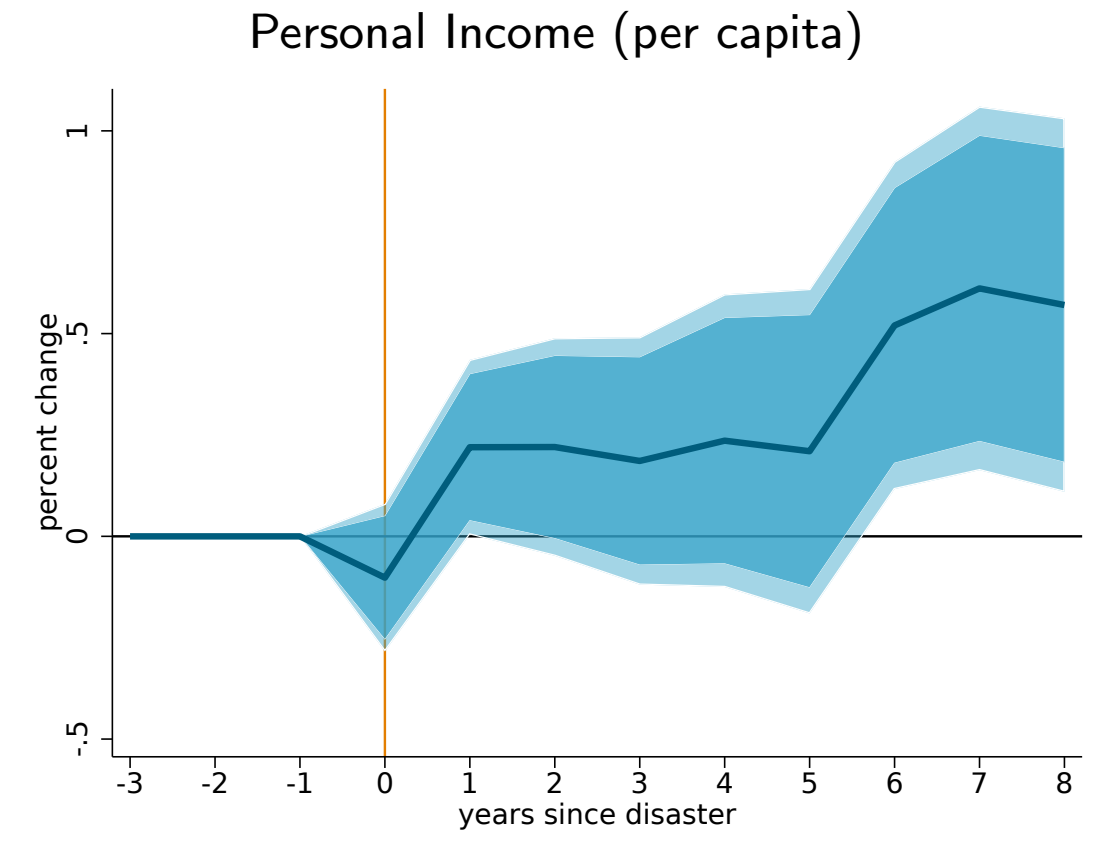
Estimate separately for each horizon h, from 0 to 8 years after disaster:

$$y_{c,t+h} - y_{c,t-1} = \beta^h D_{c,t} + \alpha_{r(c),t} + \alpha_{c,m(t)} + X'_{ct}\gamma^h + \varepsilon_{c,t+h}$$

- county c, time t (month, quarter, or year)
- $y_{c,t+h} - y_{c,t-1}$: Cumulative change in dependent variable
- $D_{c,t}$: Disaster treatment indicator
- Controls:
  - time-by-region fixed effects
  - county-by-month (or quarter) fixed effects
  - control vector (X'_{ct}) includes 3 years of pretrends and intervening disasters
- Standard errors clustered by county and by state-time

Main Result

Per capita personal income response is consistent with "Build back better" scenario



Source: BEA, FEMA, SHELDUS

- Consistent with Solow growth model, neoclassical labor supply models

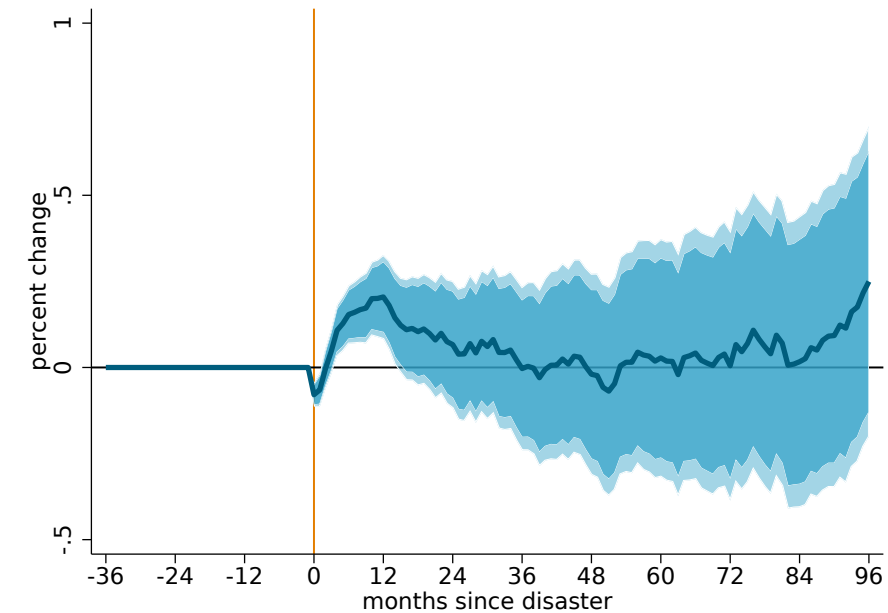
Result is robust to:

- Dropping counties with very high or low number of disasters
- Using only disasters with recorded damages (from SHELDUS)
- Using Conley Standard Errors
- Controlling for political alignment of state governor and US President
- Using same sample for all horizons
- Replacing individual lags of dependent variable with cumulative lag or county time trend
- Extending data back to 1970

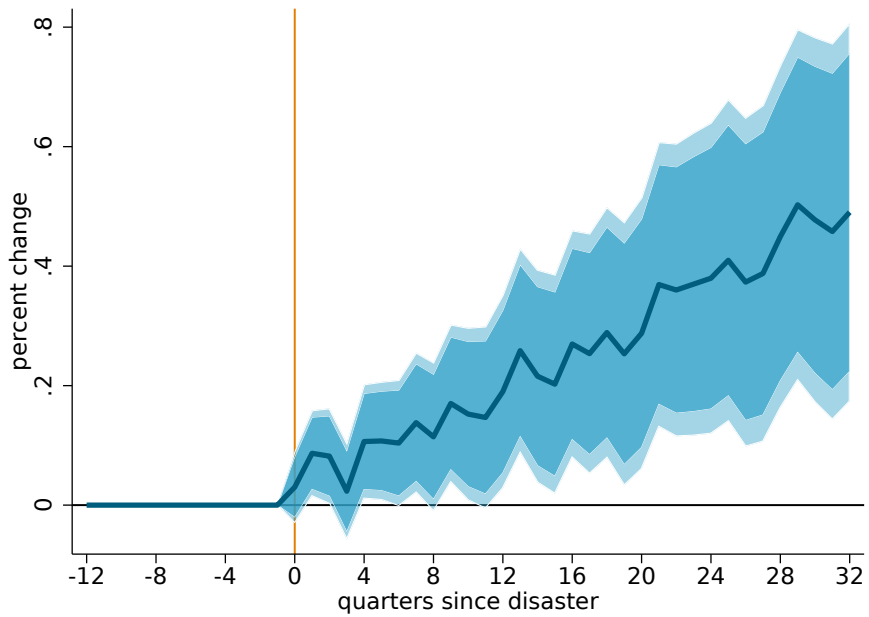
Mechanisms

Short-run personal income increase due to employment, longer-run due to higher average wages

Total Nonfarm Employment



Average Weekly Wages

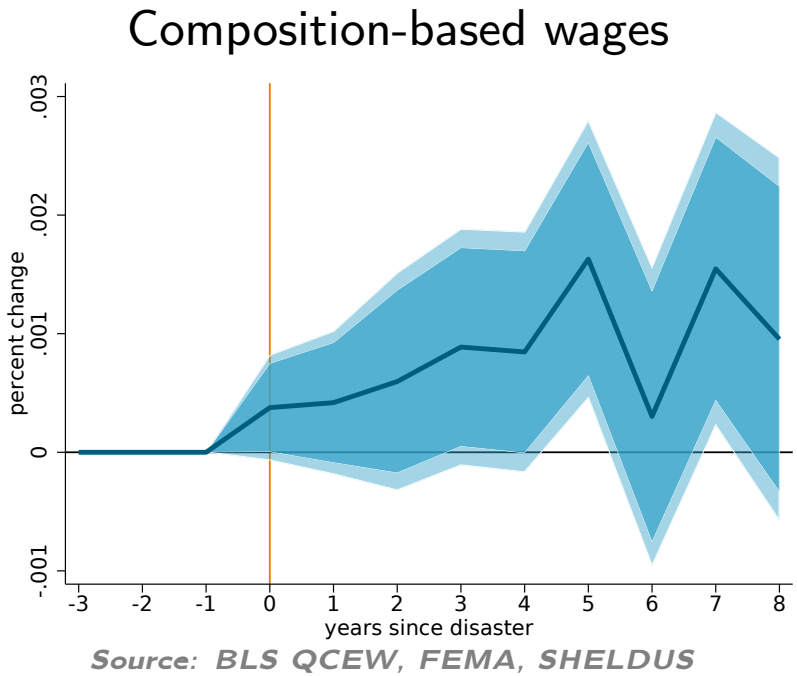


Source: BLS QCEW, FEMA, SHELDUS

- Consistent w/productivity gains from improved local capital stock
- Two potential explanations: 1) inelastic labor supply, 2) composition shift

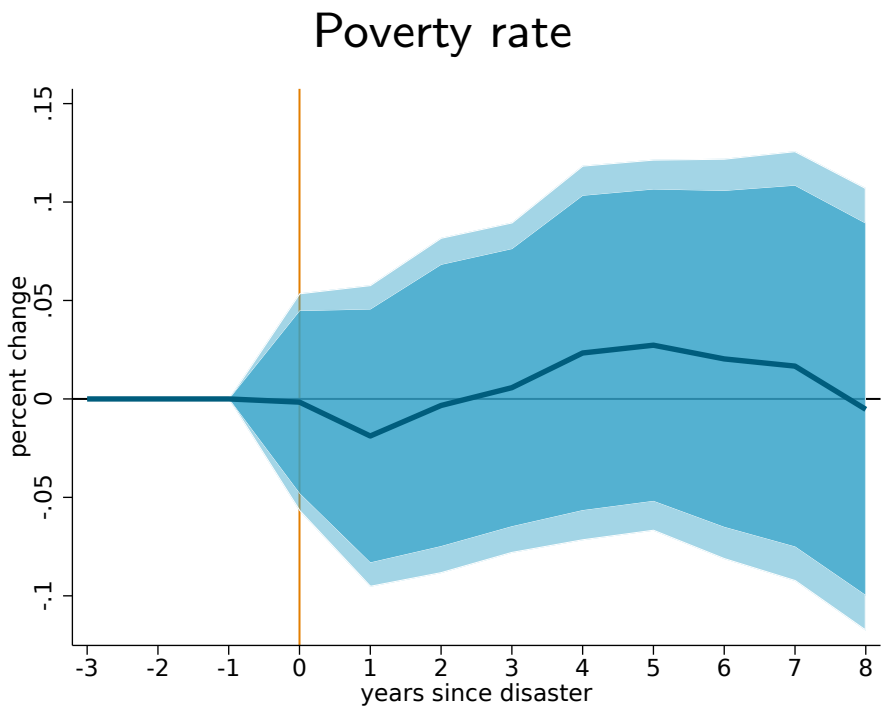
Composition shift may help explain higher wages

- "composition-based wages" = local emplmt shares $\times$ nat'l industry wages



- Composition-based wages do not rise like actual wages
- Suggests relatively elastic labor supply (if higher wage workers migrate to areas hit by disasters)

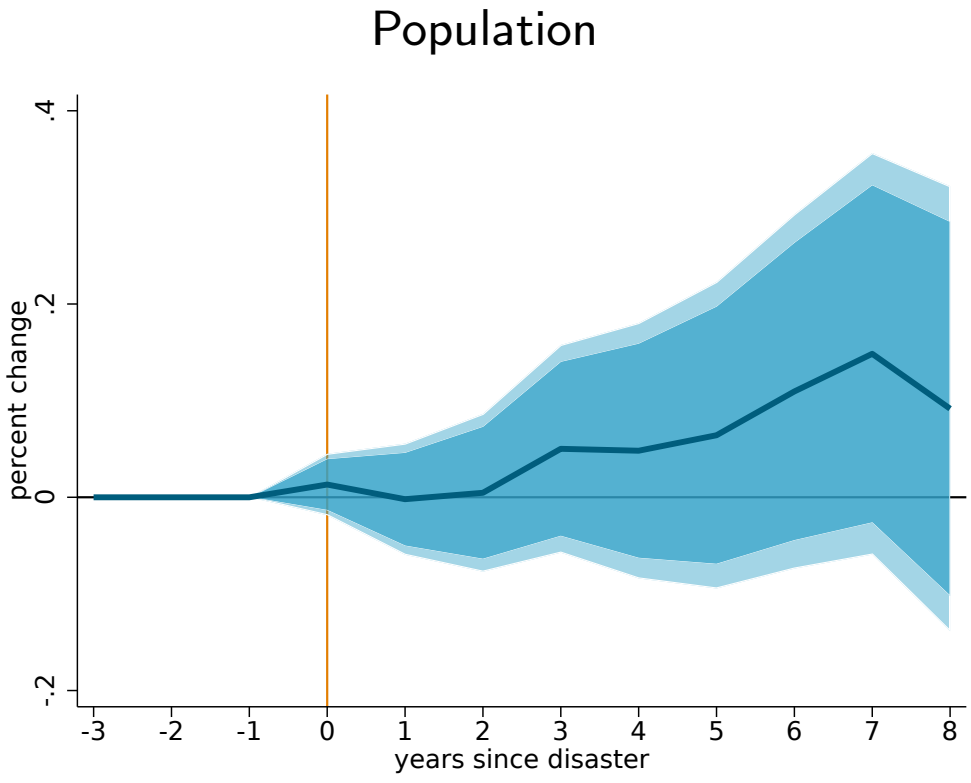
Higher income per capita not accompanied by decline in poverty



Source: Census Bureau's Small Area Income and Poverty Estimates program, FEMA, SHELDUS

- Composition shift unlikely to be driven by out-migration of lowest income households
- Suggests rising inequality ▸ Income heterogeneity

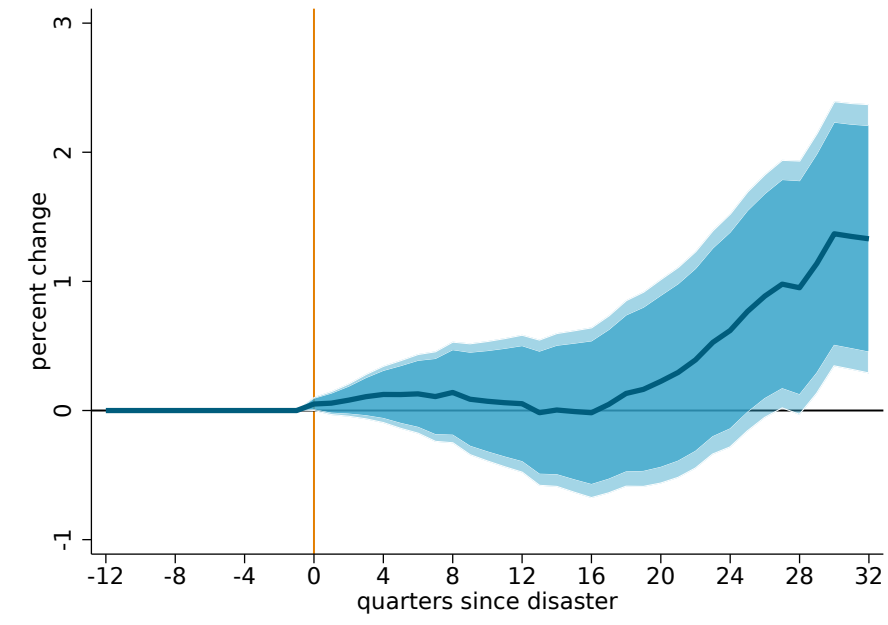
Despite composition shifts, total population size generally unaffected



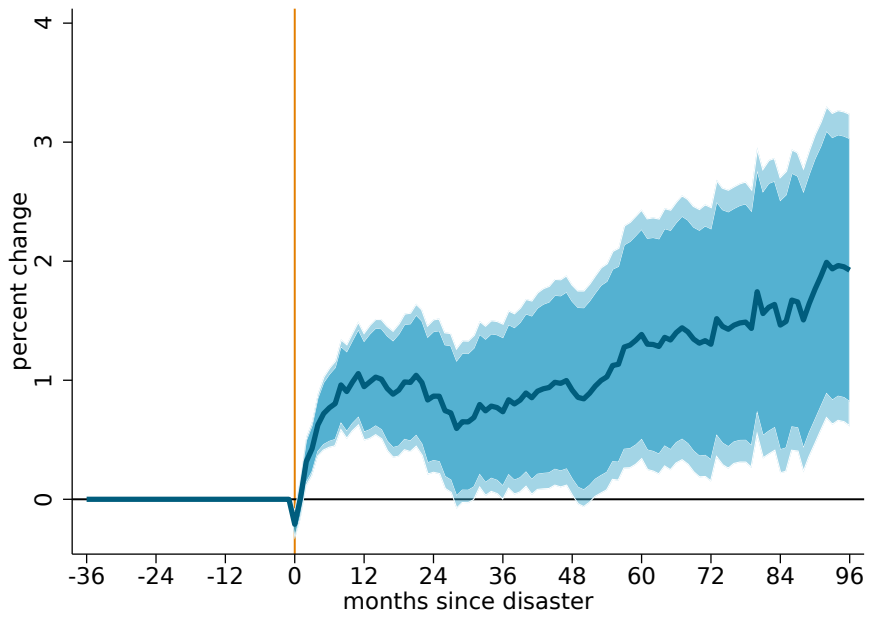
Source: Census, FEMA, SHELDUS

Higher home prices and construction employment consistent with "build back better" model

Home Prices



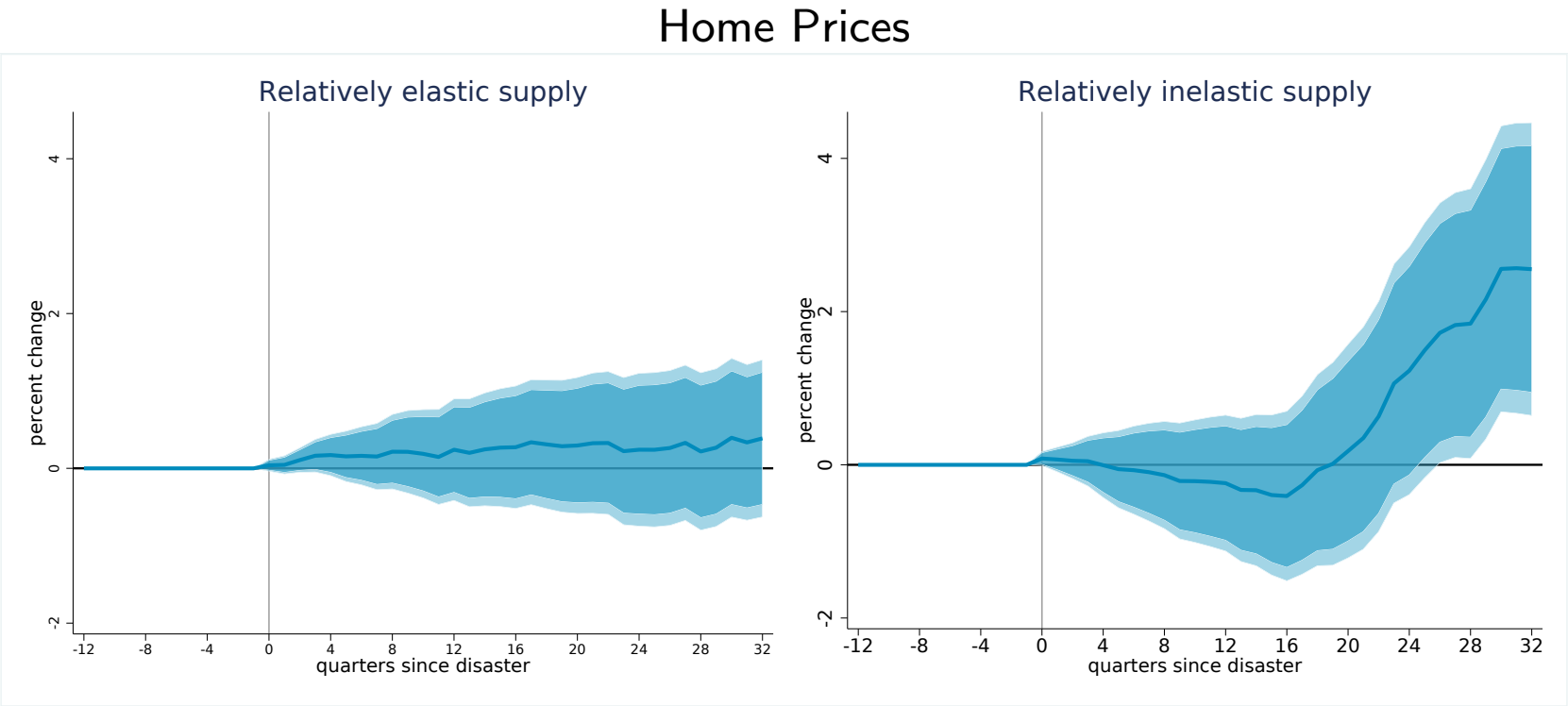
Construction Employment



Source: Corelogic, BLS QCEW, FEMA, SHELDUS

- Consistent with: substantially improved local capital stock, inelastic housing supply, underinvestment prior to disaster

Home price increases are driven by supply-constrained areas

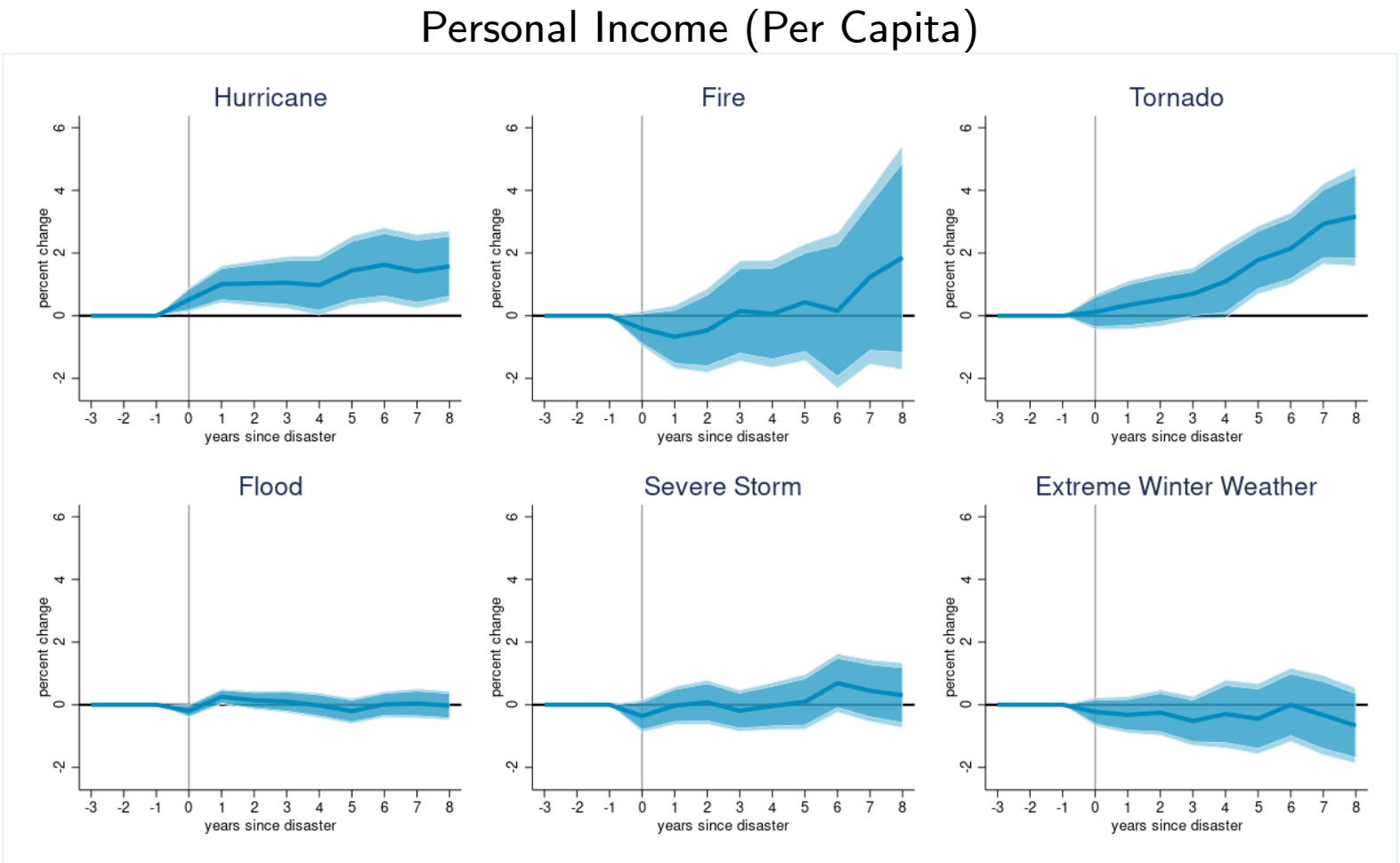


Source: Corelogic, BLS QCEW, FEMA, SHELDUS

- Population increasing in relatively elastic counties, flat in relatively inelastic counties
- Home price growth also driven by counties with already growing prices ▸ results
- Consistent w/ underinvestment-based prediction in Hornbeck & Keniston (2017)

Exploring Heterogeneity

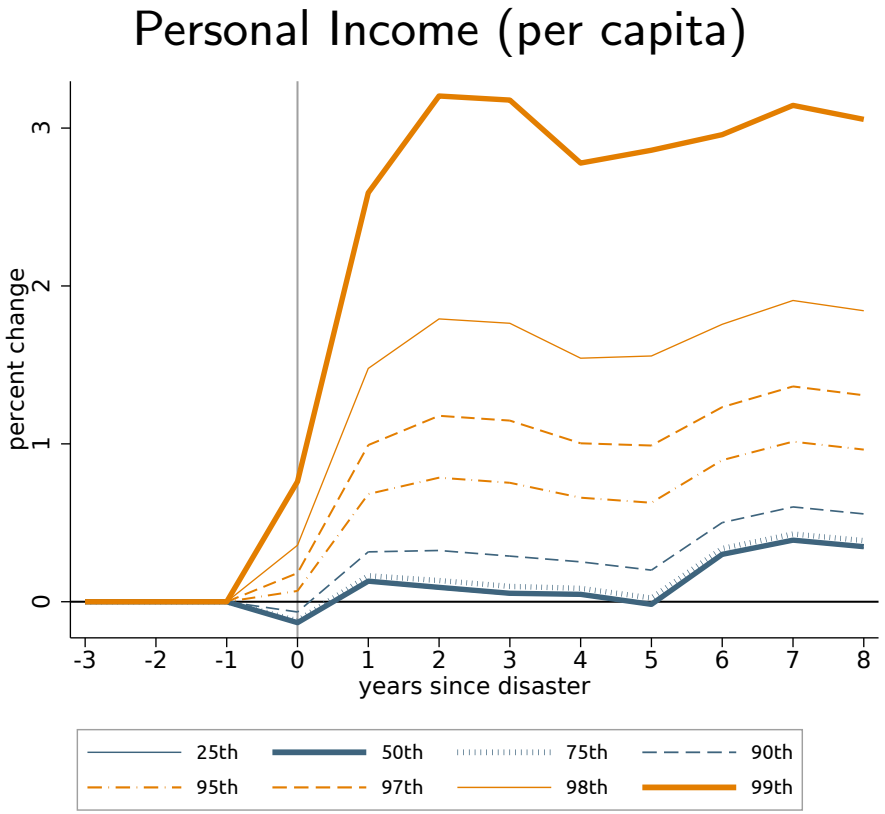
Boost to personal income driven by a few disaster types



Source: BEA, FEMA, SHELDUS

- Could be due to severity or likelihood of repeat disasters

Most severe disasters yield larger boosts to personal income

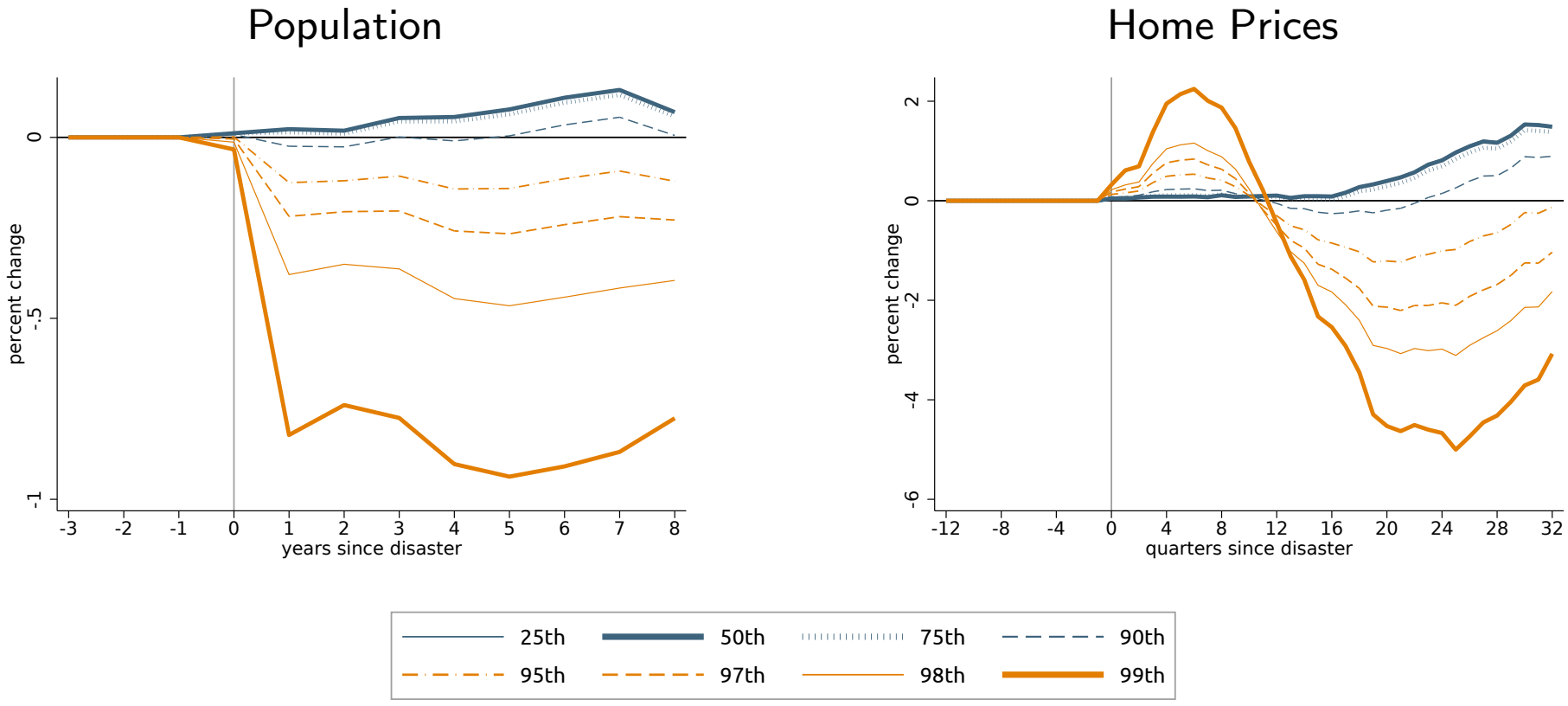


Source: BEA, FEMA, SHELDUS

- Consistent w/role of rebuilding, underinvestment

▸ **Severity by hurricane wind speed**

Most severe disasters ⇒ different equilibria as population & home prices fall in medium to longer run

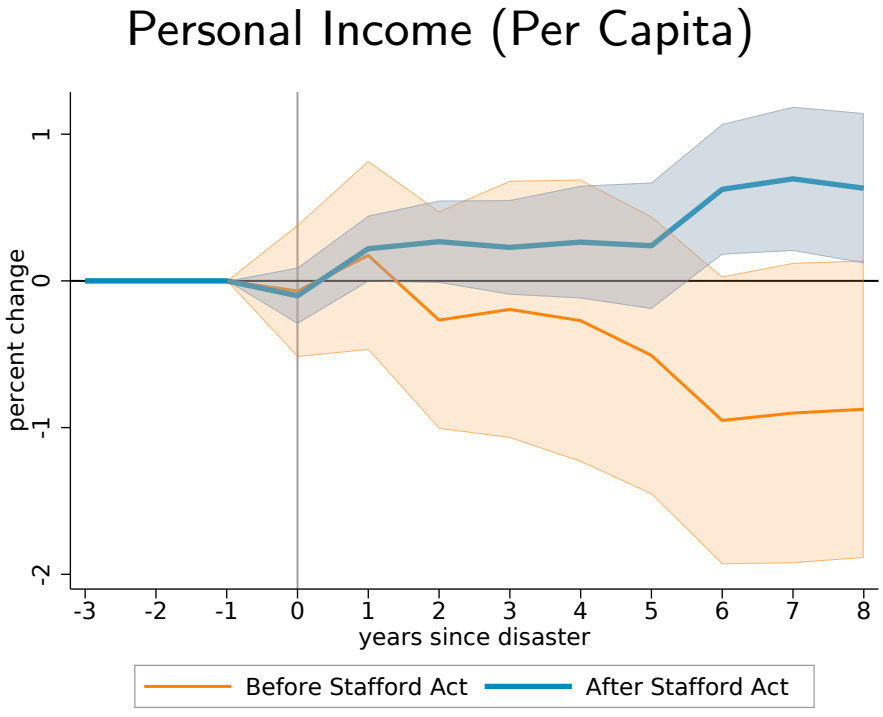


Source: Corelogic, Census, FEMA, SHELDUS

- Long-run severe pattern consistent w/Boustan, Kahn, Rhode, & Yanguas (2017)
- Severe finding consistent with falling amenity values

▸ **Migration by severity**

Boost to income driven by second half of sample



Source: BEA, FEMA, SHELDUS

- Consistent with increasing severity of disasters...
- ... and/or effects of Stafford Act (1988)

Spatial lags

Spatial lag analysis to examine reallocation

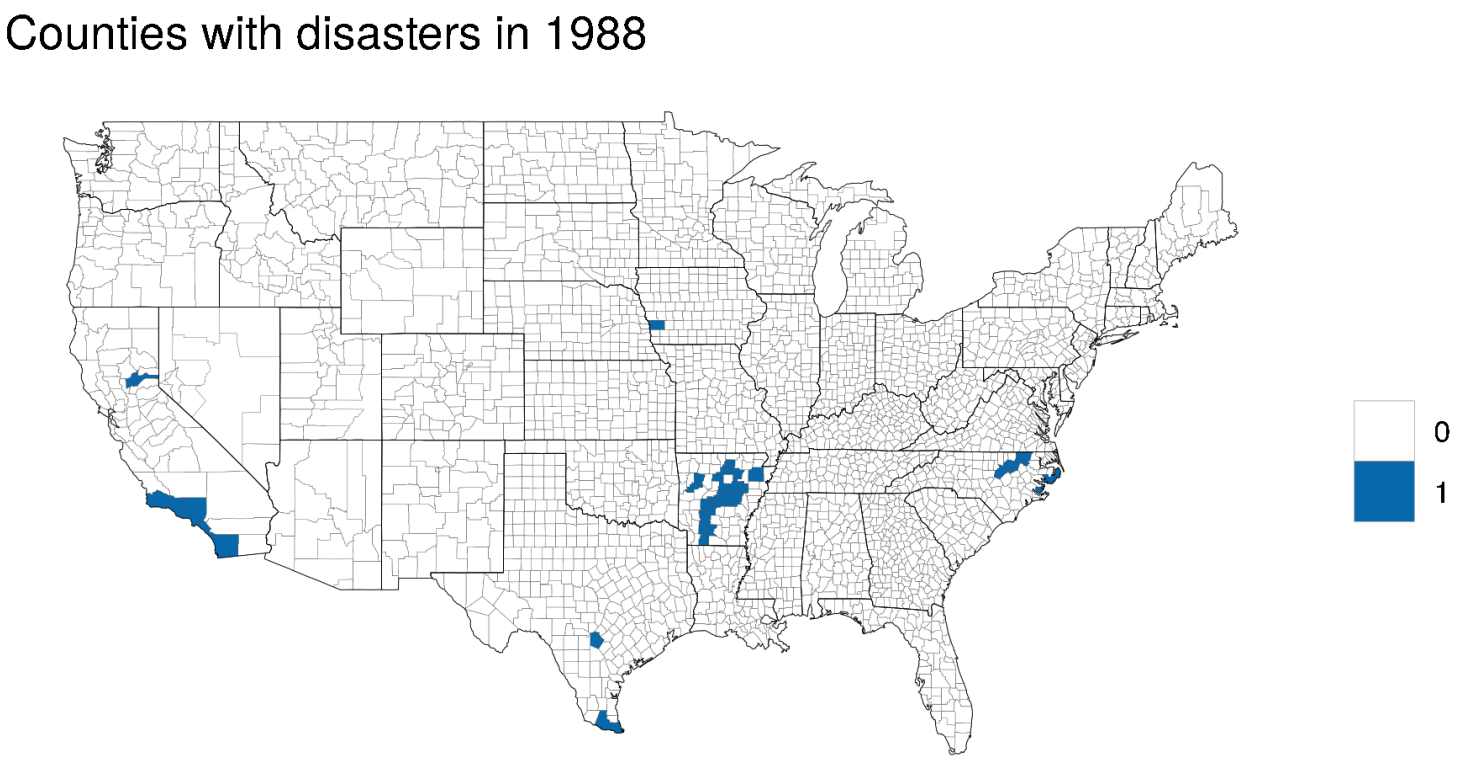
$$y_{c,t+h} - y_{c,t-1} = \beta^h D_{c,t} + \sum_{b \in B} \pi^{h,b} D^b_{c,t} + \alpha_{r(c),t} + \alpha_{c,m(t)} + X'_{ct}\gamma^h + \varepsilon_{c,t+h}$$

- $D_{c,t}$: Original disaster treatment indicator
- $D^b_{c,t}$: share of population within band b living in county that experienced a disaster in period t

Net effect estimated as

$$\hat{\beta}^h \bar{D}_{c,t} + \sum_{b \in B} \hat{\pi}^{h,b} \bar{D}^b_{c,t}$$

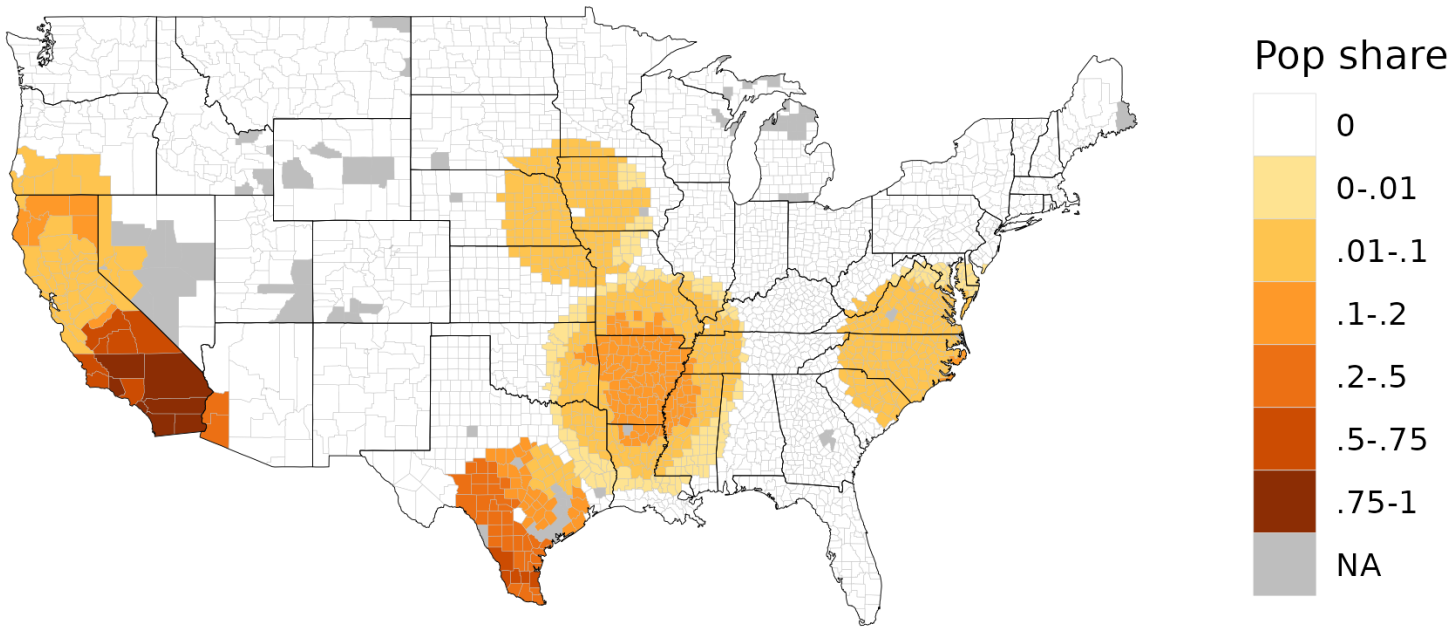
Spatial lag analysis: additional treatment is share of population in donuts surrounding a county that has been affected by disasters



Source: FEMA, SHELDUS, Census

Spatial lag analysis: additional treatment is share of population in donuts surrounding a county that has been affected by disasters

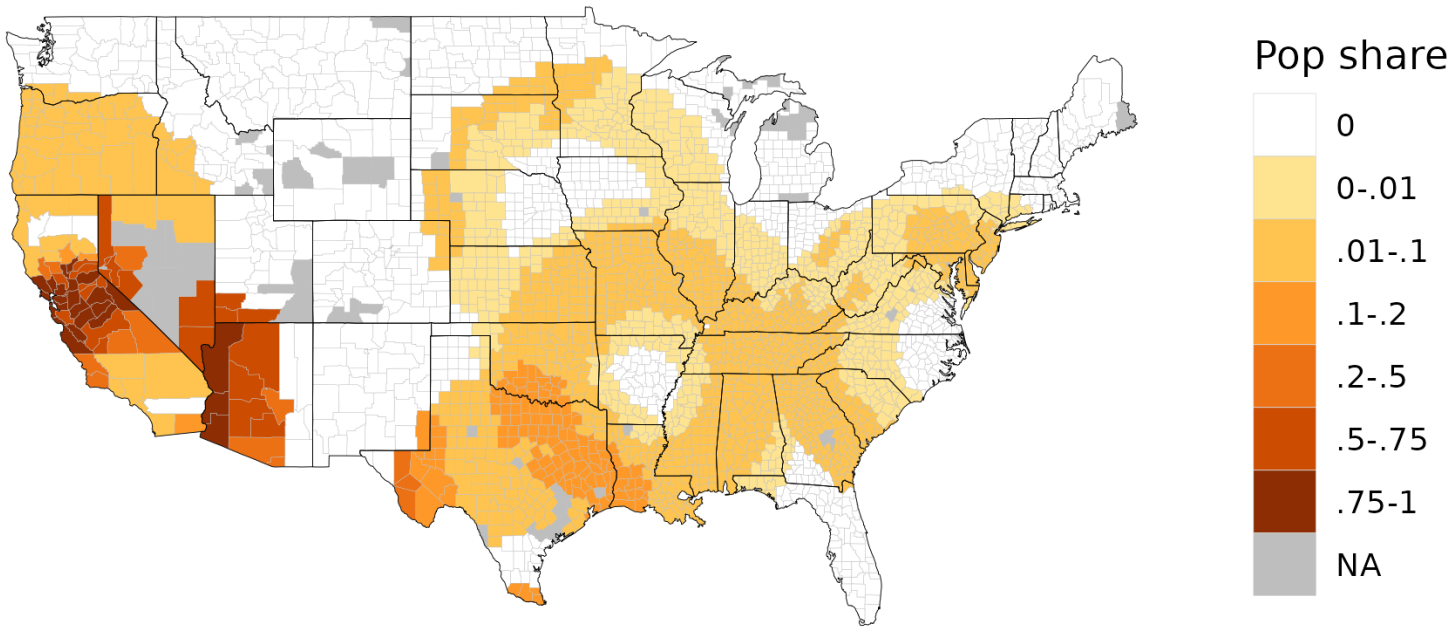
0 - 199 mile population share with disasters in 1988



Source: FEMA, SHELDUS, Census

Spatial lag analysis: additional treatment is share of population in donuts surrounding a county that has been affected by disasters

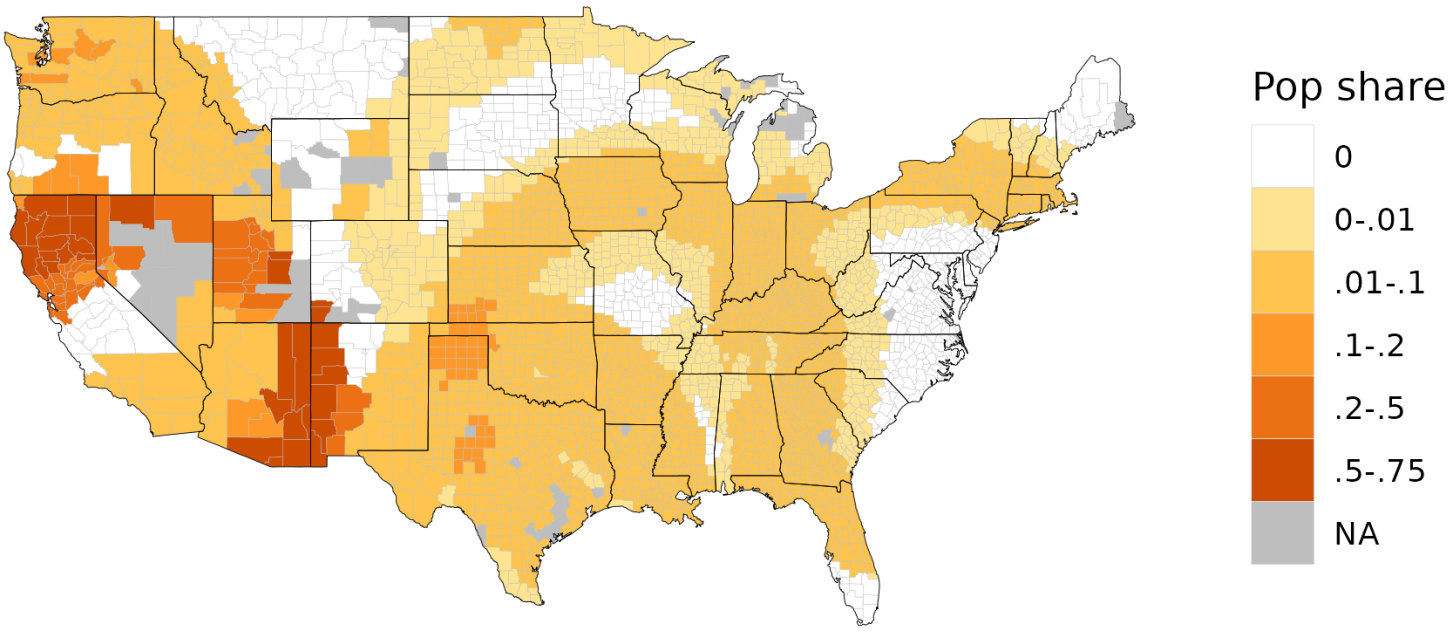
200 - 399 mile population share with disasters in 1988



Source: FEMA, SHELDUS, Census

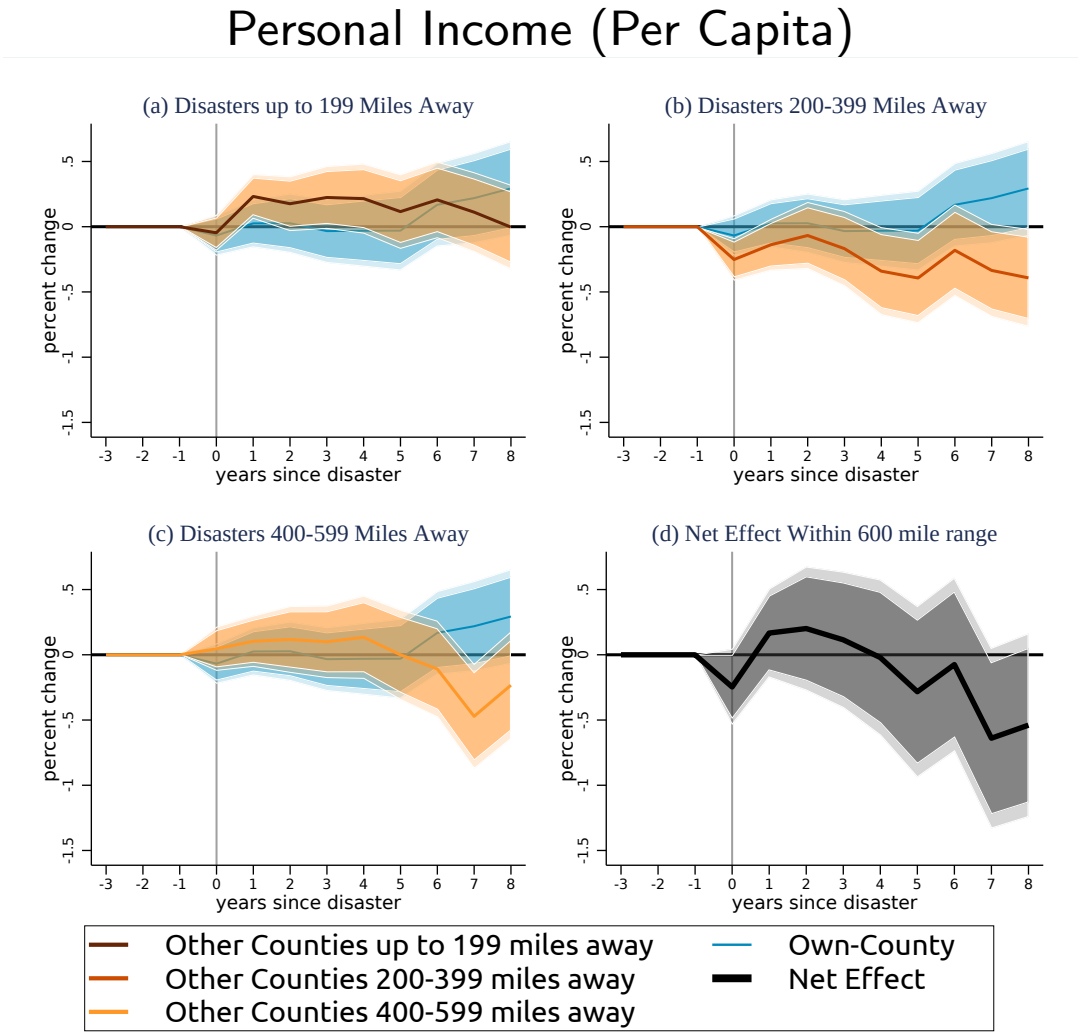
Spatial lag analysis: additional treatment is share of population in donuts surrounding a county that has been affected by disasters

400 - 599 mile population share with disasters in 1988



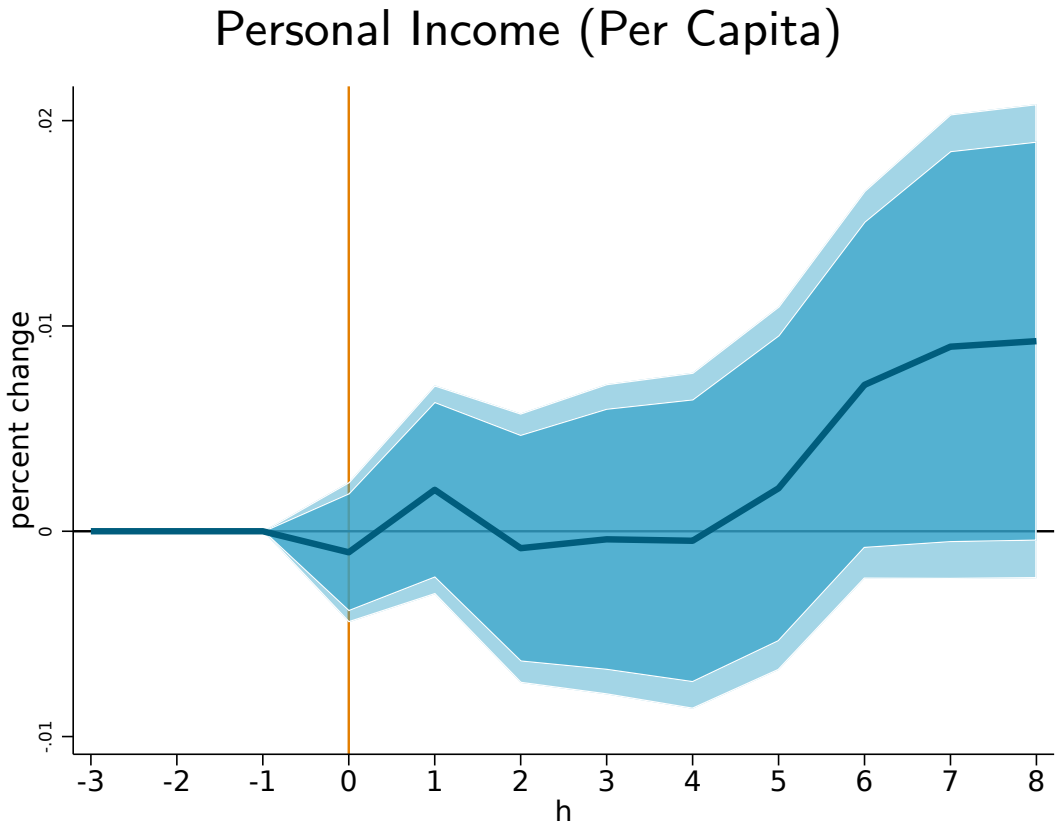
Source: FEMA, SHELDUS, Census

Negative longer run personal income effect on counties over 200 mi away suggests negative net regional effect, could reflect reallocation



Source: BEA, FEMA, SHELDUS

Results from state level analysis not significant



Source: BEA, FEMA, SHELDUS

Treatment: share of state population in a county with a disaster at $t = 0$

- Consistent w/ reallocation of resources to areas hit with disasters

Summary

- Using U.S. county panel data, we find average response of income per capita after disasters is *positive* over longer run
  - Roughly consistent with "Build back better"
- Consistent with improvements to local capital stock, prior underinvestment
- Disasters spur investment / improvements funded by insurance and aid
- Important caveats:
  - Composition shifts due to productivity and amenity gains coupled with housing supply constraints
  - Suggestive of rising inequality
  - Moral hazard and expectations about future growth and disasters
  - Reallocation from other areas in region
  - Positive average effect masks substantial heterogeneity

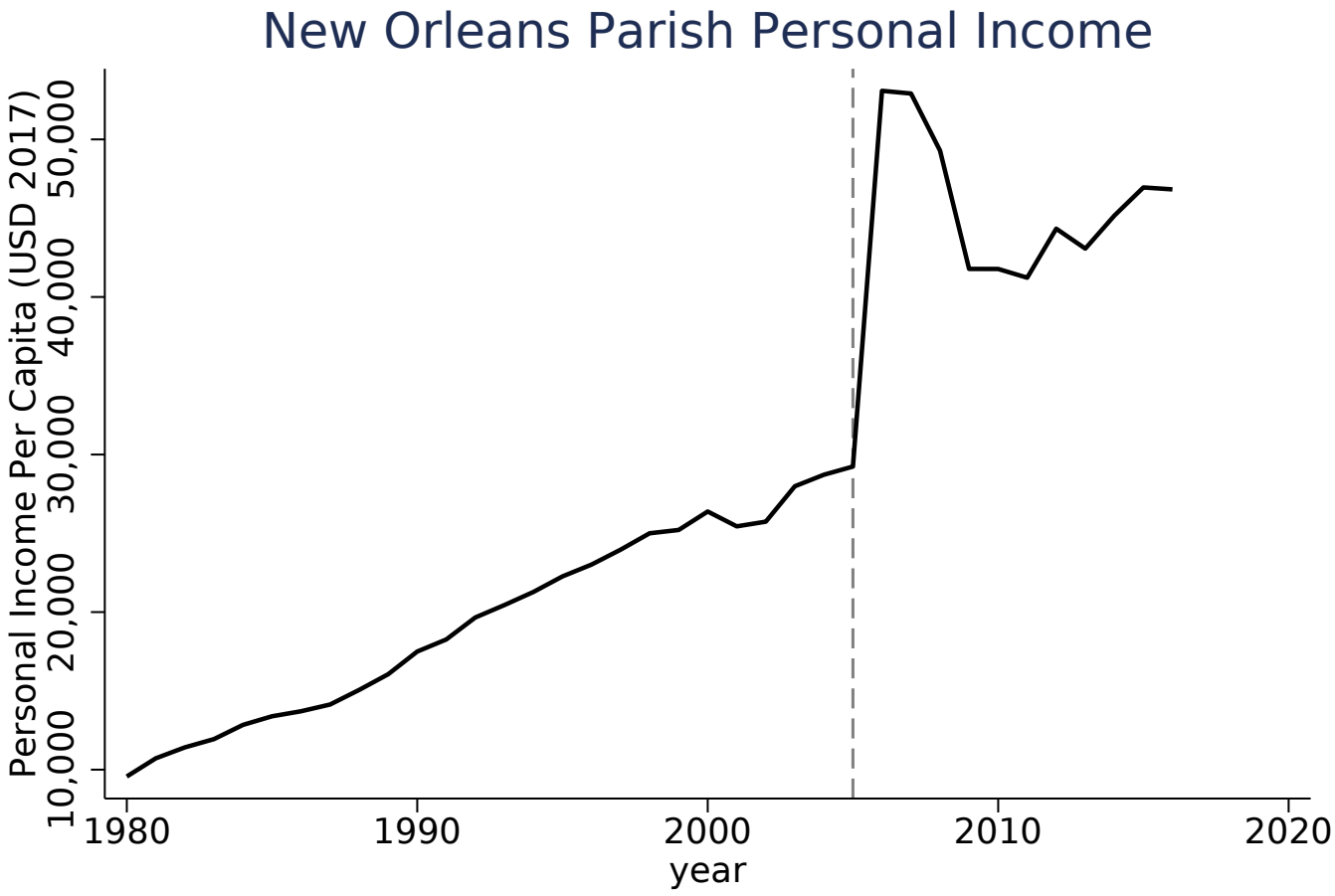
Thank you!

Summary Statistics

	Mean	Std Dev	Min	Max	N
Personal income p.c.	23,201	11,991	2583	204,67	111,516
Total nonfarm employment	30,501	117,547	0	3,875,009	1,317,168
Construction employment	2,566	7,609	0	181,710	662,688
Average weekly wages	460	190	0	8,456	441,523
House price index	102	44	19	369	186,560
Population	89,195	290,606	55	10,163,510	116,581
Government transfers p.c.	4,512	2,751	218	18,223	111,516
Income maintenance transfers p.c.	434	328	8	2,995	111,516
UI transfers p.c.	113	104	8	2,995	111,516
FEMA IHP aid p.c.	3	47	0	6,548	116,581
SBA disaster loans p.c.	5	100	0	14,282	92,037
NFIP payouts p.c.	5	151	0	34,950	116,581
Wage & salary income p.c.	9,385	7,449	710	272,927	111,516

Source: QCEW, Census, CoreLogic, BEA, FEMA, and SBA.

Example of Hurricane Katrina

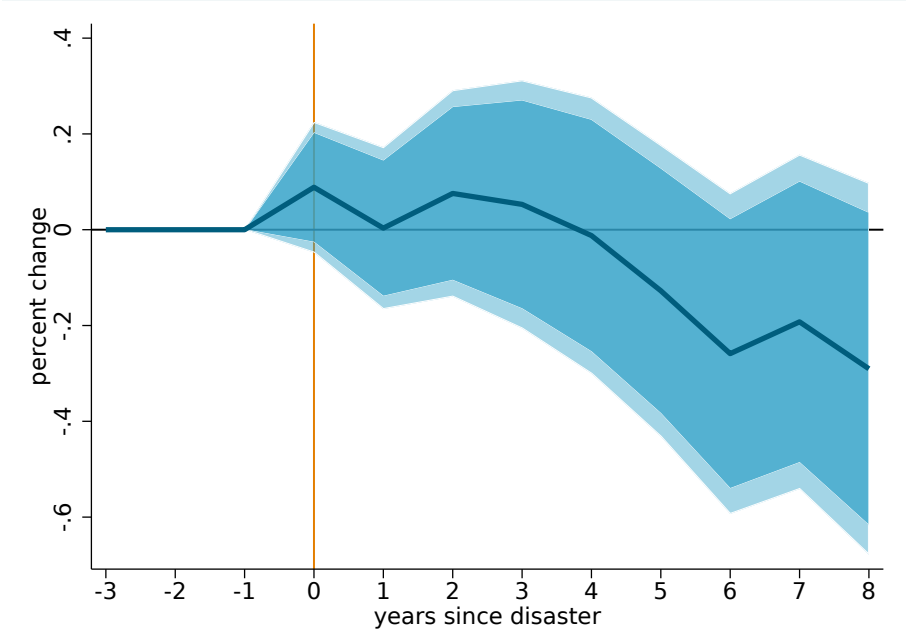


Source: BEA, Census.

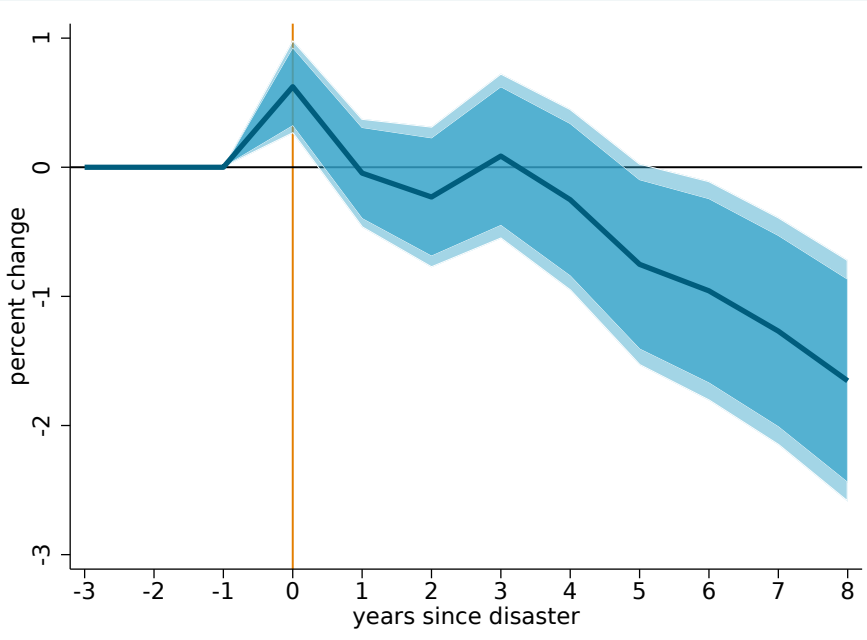
Source: BEA and Census.
Note: Vertical red line indicates 2005, the year of Hurricane Katrina.

Transfer income from federal, state, & local government may increase in near-term but decrease over longer run

Total Government Transfers

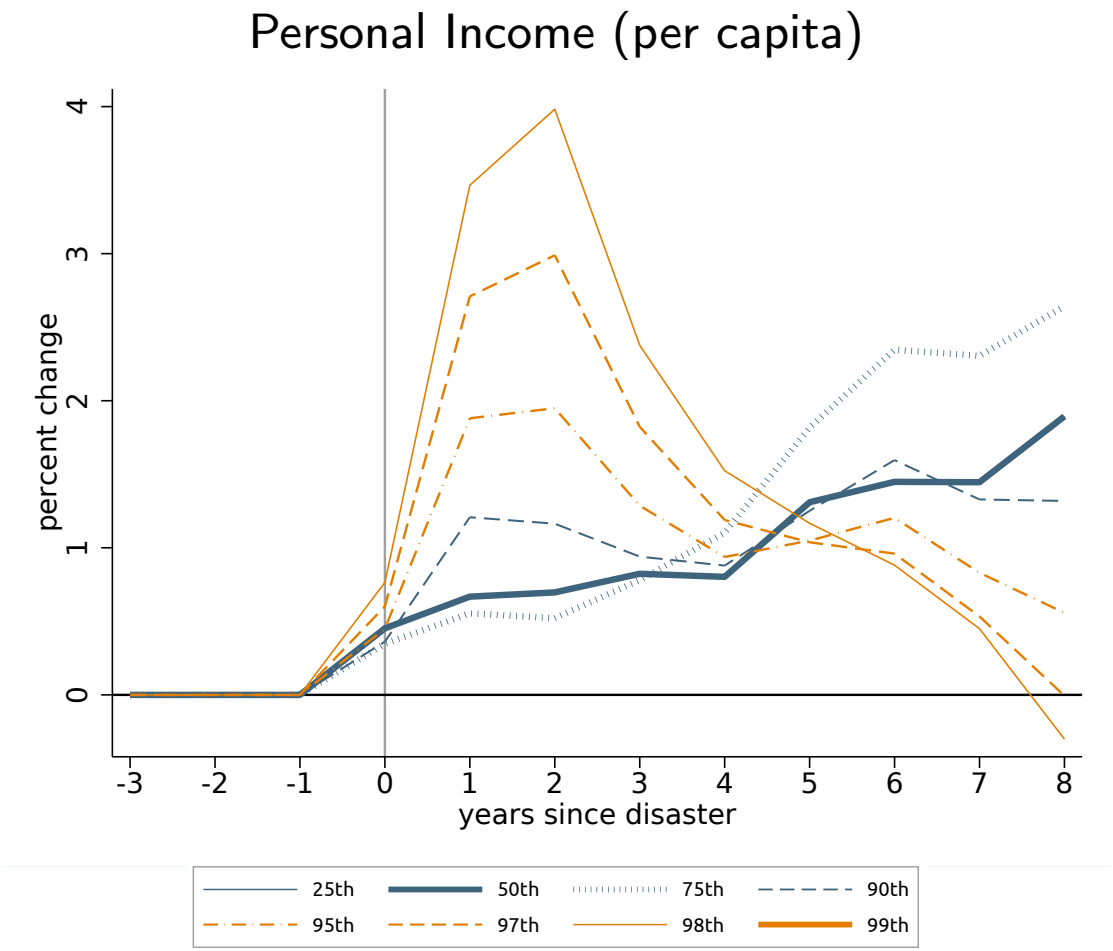


Income Maintenance



Source: BEA, FEMA, SHELDUS

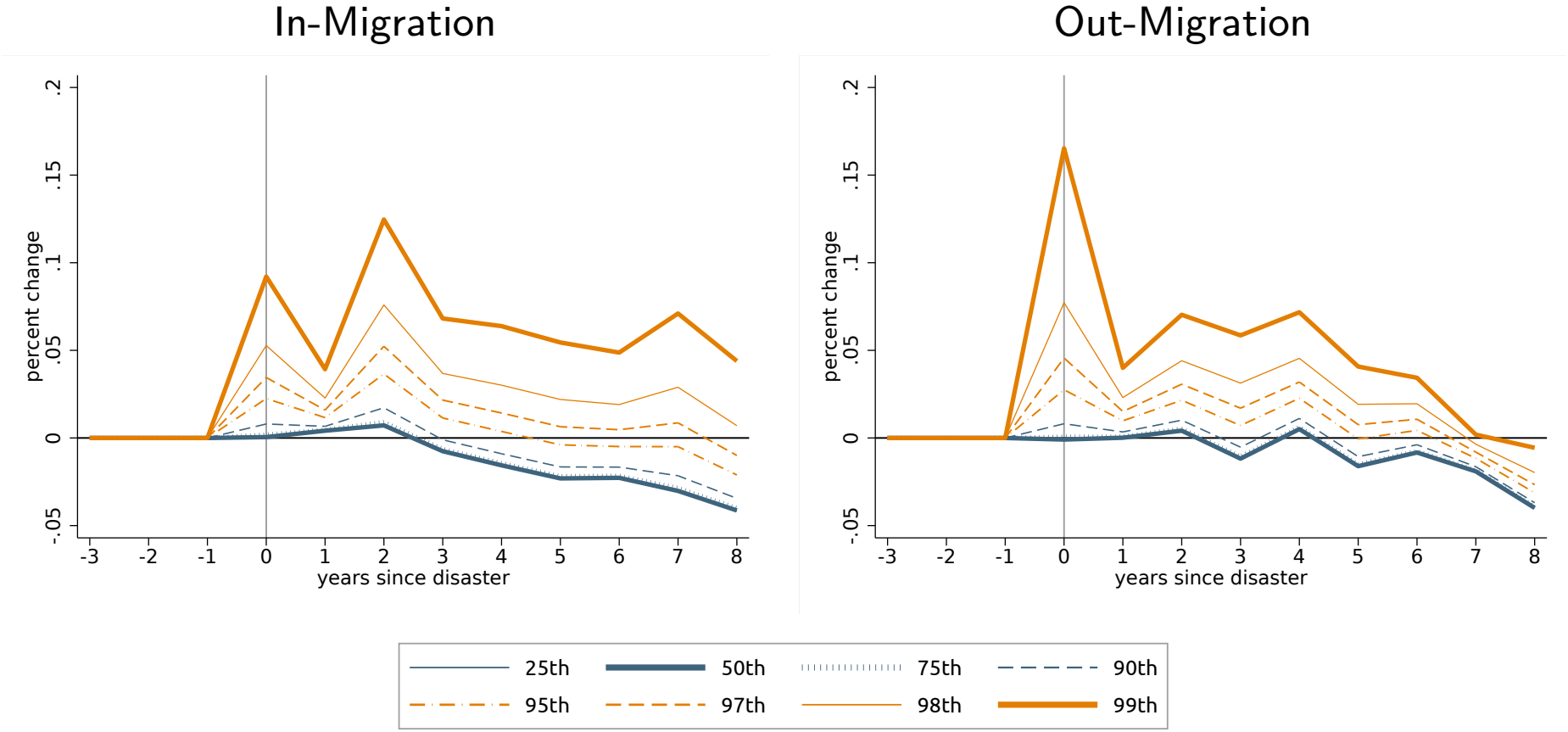
Wind speed to measure severity



Source: BEA, FEMA, SHELDUS

back

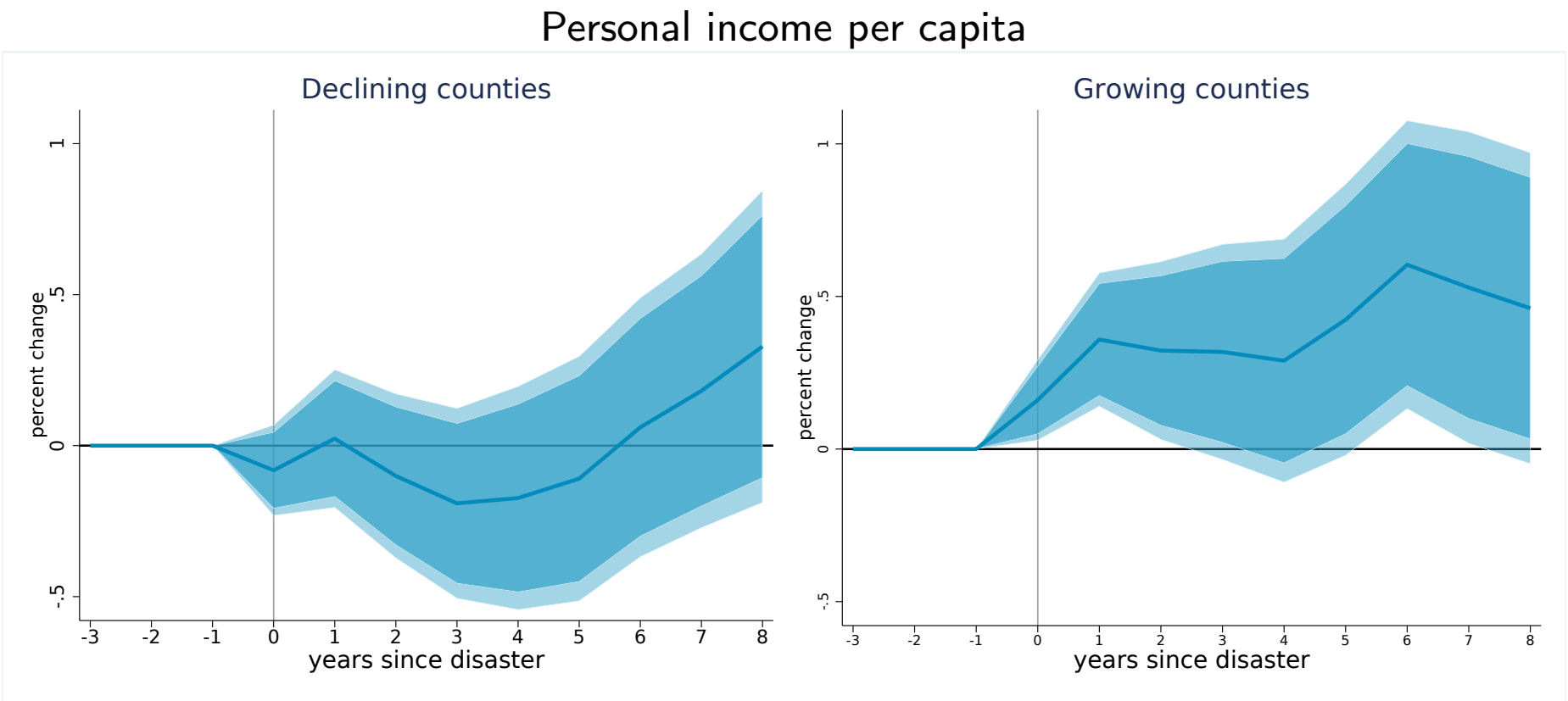
Most severe disasters increase in and out-migration; Typical disasters decrease in- and out- migration



Source: Census, FEMA, SHELDUS

back

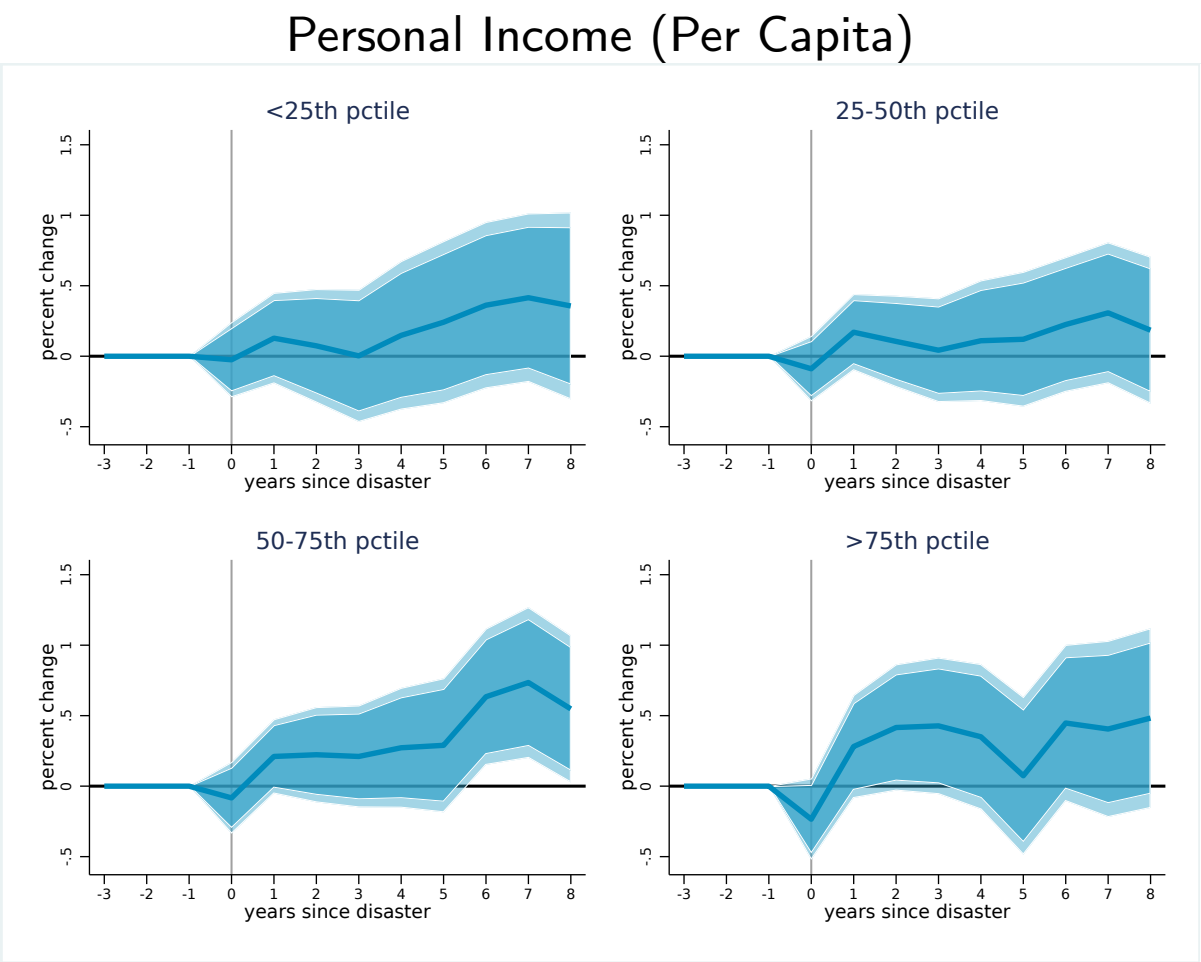
The post-disaster income per capita increase is driven by already-growing counties



Source: Corelogic, BLS QCEW, FEMA, SHELDUS

- Consistent w/ underinvestment-based prediction in Hornbeck and Keniston (2017) ▸ back

Though disasters may increase inequality, boost in personal income not exclusive to higher income counties



Source: BEA, FEMA, SHELDUS

- Significant government transfers and insurance support broad recovery

back