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

Potential Paths Considered in the Literature:

No Consensus in Empirical Literature

- Empirical studies vary by geography, disaster type, methodology
- Results support diverse paths
Several potential mechanisms could drive a range of outcomes

- **Solow growth model**: one-time capital depreciation shock $\rightarrow$ higher investment and output growth as economy transitions back to steady state

- **Standard Neoclassical model of labor supply**: one-time neg wealth shock $\Rightarrow \uparrow$ MU of consumption $\Rightarrow \uparrow$ labor supply $\Rightarrow \uparrow$ employment, income

- **Hornbeck and Keniston (2017)**: disasters could $\uparrow$ property values in growing areas (where externalities $\rightarrow$ underinvestment)

- **Local labor markets models (Rosen (1979), Roback (1982), Hsieh and Moretti (2019))**: 
  - $+$ shocks to local amenities: $\uparrow$ demand for local housing
  - $+$ shocks to local productivity: $\uparrow$ local labor demand which can lead to relative gains in population, house prices, employment, and wages
  - **Elasticities of housing, labor supply** $\Rightarrow$ 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 $\uparrow$ 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** → 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

Consistent w/productivity gains from improved local capital stock

Two potential explanations: 1) inelastic labor supply, 2) composition shift

Source: BLS QCEW, FEMA, SHELDUS
Composition shift may help explain higher wages

- “composition-based wages” = local emplmt shares × nat’l industry wages

Composition-based 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

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

Source: Census Bureau’s Small Area Income and Poverty Estimates program, FEMA, SHELDUS
Despite composition shifts, total population size generally unaffected

*Source: Census, FEMA, SHELDUS*
Higher home prices and construction employment consistent with “build back better” model

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

Home Prices

- Relatively elastic supply
- Relatively inelastic supply

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
- Consistent w/ underinvestment-based prediction in Hornbeck & Keniston (2017)
Exploring Heterogeneity
Boost to personal income driven by a few disaster types

Personal Income (Per Capita)

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
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

\[ y_{c,t+h} - y_{c,t-1} = \beta^h D_{c,t} + \sum_{b \in B} \pi^{h,b} D_{c,t}^b \]

\[ + \alpha_{r(c),t} + \alpha_{c,m(t)} + X'_{ct} \gamma^h + \epsilon_{c,t+h} \]

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

Net effect estimated as

\[ \hat{\beta}^h \bar{D}_{c,t} + \sum_{b \in B} \hat{\pi}^{h,b} \bar{D}_{c,t}^b \]
Spatial lag analysis: additional treatment is share of population in donuts surrounding a county that has been affected by disasters.

Counties 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

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

Personal Income (Per Capita)

(a) Disasters up to 199 Miles Away
(b) Disasters 200-399 Miles Away
(c) Disasters 400-599 Miles Away
(d) Net Effect Within 600 mile range

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

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

Source: QCEW, Census, CoreLogic, BEA, FEMA, and SBA.
Example of Hurricane Katrina

New Orleans Parish Personal Income

Source: BEA, 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.

**Source:** BEA, FEMA, SHELDUS
Wind speed to measure severity

Personal Income (per capita)

Source: BEA, FEMA, SHELDUS

25th 50th 75th 90th 95th 97th 98th 99th
Most severe disasters increase in and out-migration; Typical disasters decrease in- and out- migration

Source: Census, FEMA, SHELDUS
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)
Though disasters may increase inequality, boost in personal income not exclusive to higher income counties.

Personal Income (Per Capita)

Source: BEA, FEMA, SHELDUS

- Significant government transfers and insurance support broad recovery