

The Economic Effects of Sea-Level Rise: New York and Beyond

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Outline

1. (My take on the) Economics literature
2. Economic effects of hurricane Sandy on NYC
3. Beyond New York
4. Final thoughts

Literature

Literature on Hurricanes

- Large literature on economic effects of **Hurricanes** and **Flooding events**
- On a variety of outcomes:
 - Economic activity around the globe measured using night lights (Kocornik-Mina et al. 2015, Michaels and Rauch 2016)
 - Housing values (Harrison et al 2001, Bin and Landry 2013, Zhang 2016, ...)
 - Flood insurance take-up (Gallagher 2014)
 - Employment (Belasen and Polacheck 2008)
 - Household income (Deryugina et al. 2018)
- Negative effects that **vanish quickly** (< 2 years)

Literature on SLR

- Large estimated economic cost of **Sea-level Rise** (SLR)
 - Neumann et al. (2015) estimate \$1 Trillion loss for US up to year 2100
 - Actual costs will be much lower **if** businesses and households will relocate, Desmet, Nagy and Rossi-Hansberg (2015)
- Home prices in flood zones around the country are falling due to SLR exposure
 - Bernstein et al (2019) estimate 7% discount for properties that will inundate with SLR below 6 feet
 - Keenan et al (2018) find relative appreciation of elevated properties close to coast in Miami-Dade
- Negative and **persistent** effects of hurricane Sandy in NYC
 - On property values: Ortega and Taspinar 2018, Ellen and Metzler 2019, Gibson, Mullins and Hill 2019
 - On establishment employment and wages: Indaco, Ortega and Taspinar 2019

The Persistence Puzzle

- Why persistent effects of some hurricanes but not others?
- New news vs. Old news
- Some hurricane-driven flooding is common in Florida. No change in beliefs
- However, flooding in NYC during Sandy was abnormal
- Direct experience led households and businesses to update beliefs over flood risk
- Change in fundamentals with persistent effects (as in Koszłowski et al. 2015)
- Due to SLR, expect trend to continue

Hurricane Sandy

- Property Values
- Business establishments

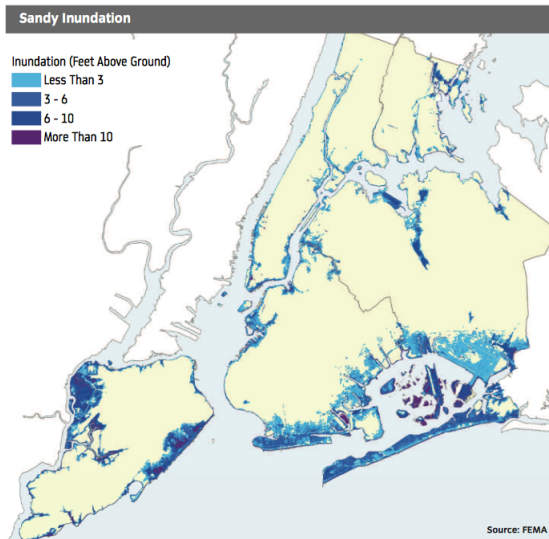
Sandy: Impact on NYC

- Largest Atlantic hurricane on record, and second costliest (behind Katrina) in US history
- Enormous impact on the city
 - 19 billion dollars in damage
 - 17% of the city flooded and 44 deaths
 - Nearly 90,000 residences damaged by flooding
 - Over 55,000 were 1 or 2-family homes
- Floodplain communities
 - Over 400,000 people live in the city's high-risk floodplain
 - Largely, working and middle class
 - Already reeling from subprime crisis

Data I: FEMA

- FEMA damage-point data for hurricane Sandy
- Identifies which buildings suffered (flooding) damage
- Mostly (estimated) surge depth points
- Measure of damage combining aerial imagery with field-verified inundation damage assessment
- Major damage suffered by about 20% of buildings in inundation zone

Sandy Surge



Sandy Damage Points



Data II: Property Sales

- Merge FEMA damage-points with with Property Sales Data (NYC DoF)
- PLUTO as crosswalk (building footprints and BBL)
- Universe of housing sales (except condos)
 - Over 800k sales
 - 67k buildings in inundation zone in NYC
 - > 60% 1-3 family homes
- Percent properties affected
 - > 5% of sales in buildings damaged by Sandy
 - HEZ: A 3.3%, AB 11%, ABC 26%

Findings - Housing

- Regression-based comparison of price trajectories for units affected by Sandy to unaffected
- Substantial reduction in price post-Sandy for affected properties, relative to similar unaffected properties
- Non-damaged properties in the flood zone experienced gradual drop in price. Close to 10% in 2017
- Damaged properties suffered large drop in price after Sandy, partially recovering and converging to same discount
- No signs of vanishing

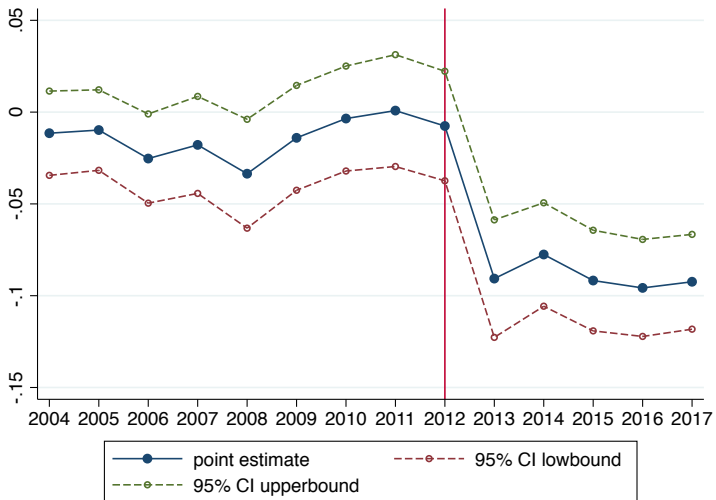
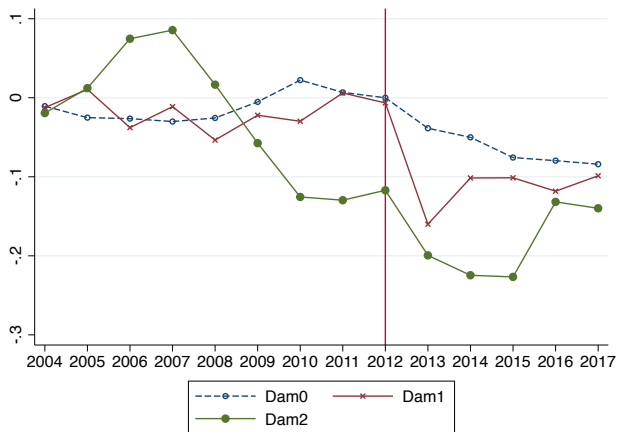
Figure: By-year point estimates *HEZAB*

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Data II: Business Establishments

- We turn now to Businesses in NYC
- Administrative data containing all business establishments
 - Quarterly Census of Employment and Wages (BLS and NYS-DoL)
 - Employment, Wages
 - Exact address
- Merged with FEMA damage-point data
 - PLUTO crosswalk

Empirical Strategy

- Unit of observation are **buildings**
- Hurricane damage shocks specific buildings, not companies
- Building's income-generating potential may be reduced
- We aggregate data by building, adding up all establishments
 - About 80k buildings
 - Median 1 establishment per building
 - On average 2.5 establishments per location (5.1 in MH)
 - 17.4 workers per establishment and wage bill of \$1.3 Mn
- Balanced panel at the building level
 - Almost 12 Mn building-quarter observations
- DiD estimation of Sandy damage in model with building fixed-effects and FZ-specific trends

Findings - Businesses

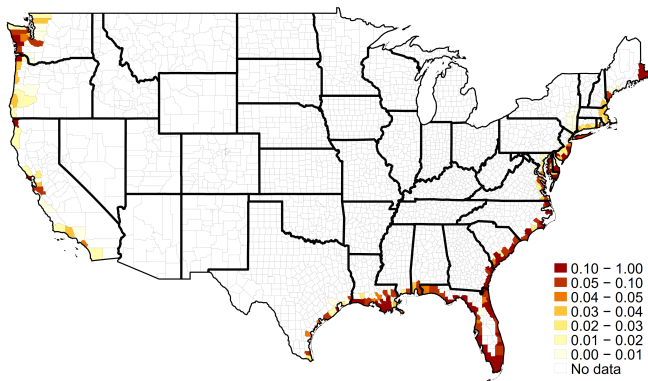
- 2 percent drop in employment in damaged buildings citywide
- Heterogeneous effects across boroughs
- In BK and QN, businesses in damaged buildings lost 6% of employment and about 25% of wage income
 - Relative to no-damage, same building
 - No effect in MH. More resilient building structures
 - Imprecise estimates for BX. Unavailable estimates for SI
- Persistent effects. No sign of vanishing 5 years after Sandy
- Reduced probability of remaining in damaged location

Beyond NYC: Housing values USA

Exposure to SLR (Bernstein et al. 2019)

Figure 1: Sea Level Exposures by County

Figure 1 Displays the proportion of exposed transactions in coastal counties within the continental United States. Exposure is measured as an indicator variable that takes a value of 1 if a property will be effected by 0-6 feet of sea level rise. (No Data) refers to any counties without any transacting properties with exposure to SLR of 6 feet or less.



Bernstein, Gustafson and Lewis 2018

- The impact of SLR exposure on real estate prices
- Combine data from Zillow Transactions and Assessment Dataset (ZATRX) with NOAA SLR calculator
 - Elevation and distance from coast
 - Includes natural and man-made protections
- Contains 480k residential sales within 0.25 miles from the coast in 2007-2016
- Comparison of properties inundated with SLR of ≤ 6 feet relative to similar properties with lower SLR exposure
 - same type of property
 - similar distance to coast and elevation
- Finding: SLR exposed properties sell at a 7% discount
 - Much higher discounts for properties with higher SLR exposure
 - Non-owner occupied housing (sophisticated buyers)

Beyond NYC: Coping with Harvey

Borrowing. Del Valle, Scharlemann and Shore 2019

- Flooding in Houston during Harvey
- Unexpected financial shock to households. Need to borrow
- Merge credit card accounts (CCAR Y-14M) and flooding depth (at zip+4)
- Comparison response in areas differentially affected by flooding
- Credit used intensively by a small number of borrowers (with good credit)
- Dramatic increase in credit card originations
- Done using teaser cards and paid off within 6 months, before rate hike
- Bridge loan pending FEMA insurance reimbursement

Final Thoughts

Falling property values in FZ

- Financial markets respond to updates in SLR projections (Hong et al. 2017, Schlenker and Taylor 2019)
- But heterogeneity in flooding beliefs among homeowners
 - Sorting and inattention (Bakkensen and Barrage 2017)
- Direct experience can trigger belief updating
- SLR increases severity of flooding events
 - Property values likely to continue falling in flood-prone areas
 - Probably compounded by increasing flood insurance premia
 - Elevation and infrastructure protect property values

Gradual business migration out of FZ

- SLR entails a negative economic shock to affected neighborhoods
- Silver lining: business adaptation
 - Gradual migration of businesses through resizing of establishments. Also some relocation
- Will mitigate economic costs
- No evidence so far on migration of households
 - Reasons: sticky beliefs, flood insurance, expectation of FEMA rescue