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 Koszlowksi 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 Inundation

Inundation (Feet Above Ground)
- Less Than 3
- 3 - 6
- 6 - 10
- More Than 10

Source: FEMA
Data II: Property Sales

- Merge FEMA damage-points 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
Figure: By-year point estimates $HEZAB$
• 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.
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 $\leq 6$ 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