Virtual Seminar on Climate Economics

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Climate Change and Commercial Real Estate: Evidence from Hurricane Sandy

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Virtual Seminar on Climate Economics
Federal Reserve Bank of San Francisco
May 19, 2022

Motivation

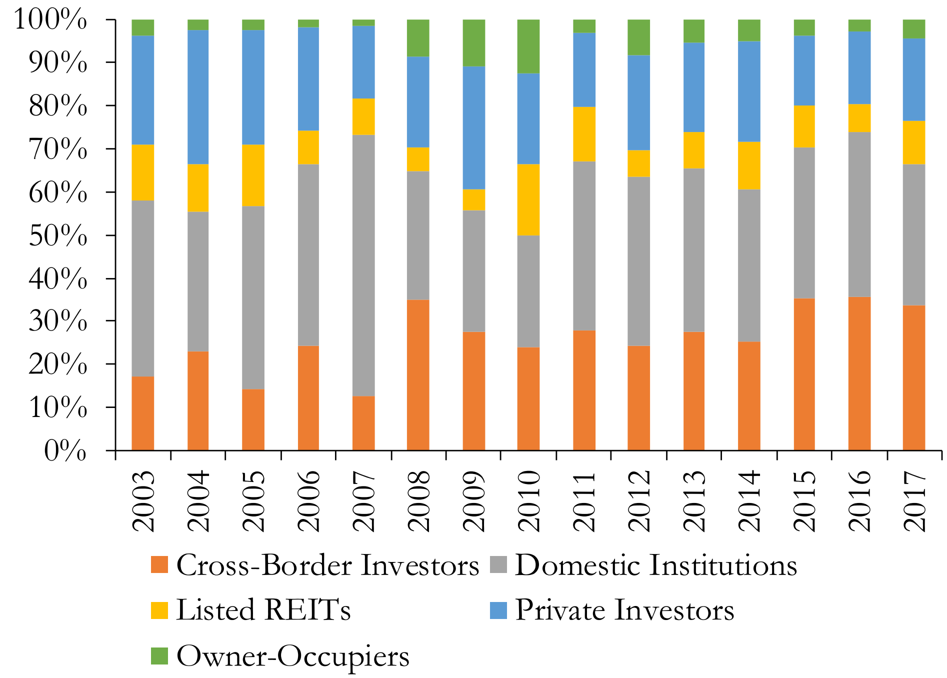
- Regulators, market participants worry about effects of environmental risks on real asset values (Carney, 2015, 2016)
- Empirical evidence on actual price discounts is mixed
  - Murfin and Spiegel (2020): Coastal property prices are insensitive to flood risk
  - Bernstein et al. (2019): Properties exposed to flood risk trade at significant discount
  - Baldauf et al. (2020): Price effects depend on buyers' beliefs about climate change
- Possible explanations?
  - Focus on residential properties, owned by uninformed households, for housing consumption
    - Price effects documented in Bernstein et al. (2019) driven by most sophisticated households
  - Focus on flood risk emanating from sea level rise: slow, gradual process
    - Effects stronger when salience of environmental risk shifts (Murfin and Spiegel, 2020; Giglio et al., 2020)
- **This paper:** Commercial properties, held by sophisticated agents for investment purposes, around sudden shift in flood risk salience

This Paper

- We study commercial real estate (CRE) instead of residential properties
  - U.S. CRE market is worth \$32.8 trillion (Goetzmann et al., 2021)
  - Assets mostly held by public/private institutions, professional investors

Composition of Annual U.S. Office Acquisition Volumes by Investor Types

Figure A.1



- 95% of U.S. office transactions over 2003–2017 period involve professional investors
- Marginal buyer is likely sophisticated agent

This Paper

- We study hurricane-related flood risk instead of sea-level rise
  - Change in hurricane patterns puts new locations at risk (Kossin et al., 2014; Reed et al., 2015)
  - Hurricane Sandy hit New York, caused significant damage, but spared locations further north
  - Discrete, unexpected event that has increased salience of flood risk in locations previously considered immune (Baldini et al., 2016)
  - Focus on New York (hit by Sandy), Boston (spared by Sandy but at risk), Chicago (unaffected due to in-land waterfront location)

Preview of Results

1. After Hurricane Sandy hit New York
   - **New York**: Properties 1 mile closer to coast experience 21.6% slower price appreciation over post-Sandy period
     → Effect partly driven by damage
   - **Boston**: Properties 1 mile closer to coast experience 9.5% slower price appreciation
     → Effect not contaminated by damage
   - **Chicago**: Nothing...
     → Effects unlikely to be driven by concurrent unrelated pricing trends in waterfront property
2. Price effects persist through time → Lasting level-shift in how fundamental property characteristics reflecting assets' flood risk exposures are priced
3. Price effects driven by cap rate, not operational performance (occupancy) → May reflect higher risk premia for exposed properties; investors more sensitive than occupants

Contributions

1. Effects of flood risk exposure on real estate values
   - Little evidence that natural disasters have sustained effects (Harrison et al., 2001; Bin and Landry, 2013; Atreya et al., 2013; Atreya and Ferreira, 2015)
   - Conflicting evidence on persistence of price effects on New York residential properties after Sandy (e.g., Ortega and Taspinar, 2016; Barr et al., 2017)
   - We show persistent price effects in CRE, less affected by amenity values (Atreya and Czajkowski, 2014), provide evidence on pricing channels
2. Effects on properties not directly impacted by flood
   - Papers on local properties that avoided damage (Atreya et al., 2013; Barr et al., 2017)
   - Our results include evidence of lasting price effects even for properties further afield
3. Role of investor sophistication, risk salience
   - See, e.g., Bernstein et al. (2019), Murfin and Spiegel (2020), Baldauf et al. (2020)
   - CRE markets—where sophisticated investors' perceptions of cash flows, risks likely outweigh personal beliefs about climate change—exhibit strong flood risk penalties
   - Persistent effects after Sandy complement prior evidence on importance of risk salience (Giglio et al., 2020), even among sophisticated investors

Outline

Data

- Real estate transactions data from Costar
  - Costar tracks U.S. CRE transactions, based on public records, SEC filings, news reports
  - As of 2017, Costar covered 3.2 million U.S.-based CRE deals, 80% of total market value
  - Office transactions from 2001:Q1 to 2017:Q4 in New York, Boston, Chicago (11,242 in total)
  - Data on transactions (dates, prices), properties (including address, property size, age, quality)
- Property-level flood risk data
  - Use address from Costar to geo-code location, measure distance to coast, elevation
  - Obtain FEMA flood maps to determine if property located in flood zone
- Data on actual hurricane damage
  - County-level data on $ value of damages from hurricanes from SHELDUS
  - Covers 1,273 U.S. East Coast counties hit by hurricanes over 1965–2012 period (pre-Sandy)
  - Used to validate property-level measures of flood risk (distance to coast, elevation)

County-Level Damage Data

Table 1, Panel A

	Mean	SD	Min	Max	N
Damage	55.74	501.35	0.00	12,129.93	4,888
Distance	89.26	97.18	0.00	605.78	4,888
Elevation	5.26	6.97	0.01	54.32	4,888
Population	127.00	260.00	0.04	3,980.00	4,888

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Population	127.00	260.00	0.04	3,980.00	4,888

County Characteristics and Hurricane Damage, 1965–2012

- Damages average approximately $56 million
- Counties hit by hurricanes have low distance to coast, low elevation, population of 127,000

Validating Flood Risk Measures

Table B.1

$$Damage_{l,t} = \beta_1 Proximity_l + \beta_2 Elevation_l + \beta_3 Population_{l,t} + \gamma_y + \theta_m + \delta_s + u_{l,t} \quad (1)$$

	(1)	(2)	(3)
Proximity	0.009***		0.009***
	(16.872)		(13.248)
Elevation		-0.075***	-0.000
		(-9.404)	(-0.022)
Population	0.164***	0.173***	0.164***
	(4.881)	(4.767)	(4.893)
Year–Fixed Effects	Yes	Yes	Yes
Month–Fixed Effects	Yes	Yes	Yes
State–Fixed Effects	Yes	Yes	Yes
Observations	4,888	4,888	4,888
Adj. R-squared	0.294	0.274	0.294

Validating Flood Risk Measures

Table B.1

$$Damage_{l,t} = \beta_1 Proximity_l + \beta_2 Elevation_l + \beta_3 Population_{l,t} + \gamma_y + \theta_m + \delta_s + u_{l,t} \quad (1)$$

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	(4.881)	(4.767)	(4.893)
Year–Fixed Effects	Yes	Yes	Yes

County-Level Hurricane Damage as Function of Flood Risk Measures

- Proximity, elevation both significant predictors of hurricane damage individually
- Estimates in column 3 show that proximity dominates elevation

Property Transactions Data

Table 1, Panel B

- Mean prices per square foot increased from pre- to post-Sandy period, consistent with broad price increases in CRE
- In New York, post-Sandy transactions slightly closer to coast, but at higher elevation, less likely to be in flood zone
- No changes in average property characteristics during pre- versus post-Sandy periods in Boston, Chicago, suggesting no shifts in composition of assets traded
- Empirical approach accounts for effects of property characteristics on transaction prices

New York Boston Chicago

Identification Strategy

- Require variation in exposure of properties to flood risk
  - Primarily function of distance to coast (and elevation)
  - Same characteristics also capture amenity value (Albouy et al., 2016)
  - Shift in salience of flood risk over time $\rightarrow$ **Hurricane Sandy**
- Control for damage
  - Sandy caused severe damage when it hit $\rightarrow$ **New York**
  - May confound effects of damage, potential price impact of exposure to future flood risk
  - Require data from location that has been spared but is likely exposed to future flood risk $\rightarrow$ **Boston**
- Control for concurrent price trends in waterfront property
  - CRE market experienced price boom after financial crisis
  - Require data from waterfront property that was unaffected by shift in salience of flood risk $\rightarrow$ **Chicago**
- **Identifying assumption**
  - Change in hedonic price of distance to coast from pre-Sandy to post-Sandy period is due to change in investor perception of flood risk exposure

Empirical Approach

- Ideal empirical experiment: Repeat sales analysis
  - *Same* property sold pre-/post-Sandy, estimate price difference as function of flood risk exposure
  - Insufficient transactions ☹
- Feasible empirical experiment: Pseudo repeat sales analysis (Guo et al., 2014)
  - *Comparable* properties sold pre-/post-Sandy, matched on flood risk exposure
  - Estimate baseline hedonic pricing coefficients from pre-Sandy transactions

$$Price_i = \beta_1 \mathbf{Hedonics_i} + \beta_2 \mathbf{Proximity_i} + \gamma_t + \delta_z + \epsilon_{i,t} \tag{2}$$

  - Analyze price difference in matched pairs of properties

$$Price_a - Price_b = \beta_1(\mathbf{Hedonics_a} - \mathbf{Hedonics_b}) + (\beta_{2a} - \beta_{2b})\mathbf{Proximity_a} + \gamma_t + \delta_z + u_{i,t} \tag{3}$$

$$(Price_a - \beta_1 \mathbf{Hedonics_a}) - (Price_b - \beta_1 \mathbf{Hedonics_b}) = (\beta_{2a} - \beta_{2b})\mathbf{Proximity_a} + \gamma_t + \delta_z + u_{i,t} \tag{4}$$

$$Adjusted\ Price\ Difference_i = \alpha_1 \mathbf{Proximity}_i + \gamma_t + \delta_z + u_i \tag{5}$$

  - Also allow for differential impact of flood zone status (insurance), local establishments (demand)

Hedonic Pricing Model

Table 2

	New York (1)	Boston (2)	Chicago (3)
Proximity	-0.034	0.036*	0.022
	(-0.678)	(1.843)	(0.930)
Flood Zone	-0.097	0.002	-0.201*
	(-1.059)	(0.035)	(-1.815)
Size	-0.167***	-0.205***	-0.207***
	(-11.523)	(-13.145)	(-10.574)
Age	-0.070***	-0.101***	-0.176***
	(-3.934)	(-5.225)	(-8.328)
Stories	0.006**	0.023***	0.012***
	(1.971)	(5.675)	(4.736)
Class A	0.300***	0.444***	0.396***
	(4.238)	(6.818)	(4.833)
Class B	0.183***	0.145***	0.088**
	(5.793)	(4.501)	(2.088)
Year-Quarter–Fixed Effects	Yes	Yes	Yes
Zip Code–Fixed Effects	Yes	Yes	Yes
Observations	3,114	2,017	1,550
Adj. R-squared	0.518	0.450	0.354

Hedonic Pricing Model

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	New York (1)	Boston (2)	Chicago (3)
Proximity	-0.034	0.036*	0.022
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Transaction Prices as Function of Property Characteristics

- Price sensitivity to proximity, flood zone status is low
- Low amenity value for waterfront CRE, investors paid little attention to flood risk exposure

Price Impact of Flood Risk

Table 3

	Main Effect			By Transaction Year		
	New York	Boston	Chicago	New York	Boston	Chicago
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity	-0.216***	-0.095***	-0.004	-0.193**	-0.114***	-0.020
	(-2.579)	(-3.346)	(-0.082)	(-2.250)	(-3.974)	(-0.432)
× *Year=2014*				-0.020	0.026*	0.017
				(-1.039)	(1.857)	(0.971)
× *Year=2015*				-0.043**	0.039***	0.036**
				(-2.223)	(2.681)	(1.979)
× *Year=2016*				-0.024	0.017	0.052***
				(-1.164)	(1.076)	(2.667)
× *Year=2017*				-0.020	0.045**	0.011
				(-0.884)	(2.428)	(0.547)
Flood Zone	-0.434***	0.175*	-0.687**	-0.473***	0.171*	-0.705***
	(-2.697)	(1.730)	(-2.448)	(-2.953)	(1.674)	(-2.615)
Local Establishments	-0.157	1.739	0.781	0.069	1.285	0.677
	(-0.149)	(1.362)	(0.762)	(0.061)	(1.008)	(0.661)
Year–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Zip Code–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,216	1,394	951	2,216	1,394	951
Adj. R-squared	0.190	0.200	0.286	0.190	0.205	0.291

Price Impact of Flood Risk

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	Main Effect			By Transaction Year		
	New York	Boston	Chicago	New York	Boston	Chicago
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Price Effects of Flood Risk Exposure by Location

- **New York**: Properties 1 mile closer to coast experience 21.6% slower price appreciation
- **Boston**: Properties 1 mile closer to coast experience 9.5% slower price appreciation
- **Chicago**: No significant effects

Price Impact of Flood Risk

Table 3

	Main Effect			By Transaction Year		
	New York (1)	Boston (2)	Chicago (3)	New York (4)	Boston (5)	Chicago (6)
Proximity	-0.216***	-0.095***	-0.004	-0.193**	-0.114***	-0.020
	(-2.579)	(-3.346)	(-0.082)	(-2.250)	(-3.974)	(-0.432)
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Local Establishments	-0.157	1.739	0.781	0.069	1.285	0.677

Price Effects of Flood Risk Exposure by Transaction Year

- **New York**: Effects persist over time, even increase in magnitude
- **Boston**: Some evidence that initial negative effect is reversed
- **Chicago**: If anything, waterfront property becomes more valuable over time

Channels of Price Impact

Results for Cap Rates, Vacancy (Table 4)

	Capitalization Rate		Vacancy	
	New York (1)	Boston (2)	New York (3)	Boston (4)
Lowest-Decile Distance	0.867***	1.572**	4.940	-5.473
	(2.639)	(2.030)	(1.040)	(-1.081)
Flood Zone	1.216**	-1.262***	-6.850	-4.339
	(2.280)	(-3.000)	(-1.043)	(-1.150)
Local Establishments	-0.819***	-0.737**	-4.272***	-0.082
	(-6.030)	(-2.338)	(-3.959)	(-0.034)
Year–Fixed Effects	Yes	Yes	Yes	Yes
Observations	192	113	714	364
Adj. R-squared	0.302	0.124	0.026	-0.005

Channels of Price Impact

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	(2.280)	(-3.000)	(-1.043)	(-1.150)
Local Establishments	-0.819***	-0.737**	-4.272***	-0.082
	(-6.030)	(-2.338)	(-3.959)	(-0.034)
Year–Fixed Effects	Yes	Yes	Yes	Yes
Observations	192	113	714	364

Price Effects of Flood Risk Exposure by Performance Metric

- Properties closest to coast in New York, Boston, experience higher capitalization rates
- Operational performance (vacancy) unaffected $\rightarrow$ Higher risk premia for exposed properties?

Channels of Price Impact

Local Economic Contagion Effects

- Literature emerging on implications of natural disasters for local enterprise
  - Hurricane strikes affect economic prospects of local businesses (see, e.g., Basker and Miranda, 2017; Indaco et al., 2020; Meltzer et al., 2021)
  - Decisions by neighbors affect propensity of businesses to reopen after a disaster (LeSage et al., 2011)
- Study local economic contagion in CRE market
  - Compute CAR of U.S. public firms with HQ in New York, Boston during 5-day period around Sandy
  - Run analysis of adjusted price difference for properties sold pre- versus post-Sandy that are located in direct vicinity of firm headquarters that experienced negative CAR during Sandy

Channels of Price Impact

Results for Economic Contagion (Table 5)

	New York		Boston	
	0.5 miles (1)	0.25 miles (2)	0.5 miles (3)	0.25 miles (4)
Negative CAR	-0.271	-0.757**	-0.624**	-0.688*
	(-0.915)	(-2.156)	(-1.986)	(-1.750)
$\times$ *Year=2014*	3.553	2.806	6.087*	6.095
	(1.634)	(1.131)	(1.861)	(1.331)
$\times$ *Year=2015*	-0.098	1.604	1.099	1.792
	(-0.089)	(1.356)	(0.345)	(0.392)
$\times$ *Year=2016*	3.136*	3.251	2.951	3.120
	(1.740)	(1.598)	(0.911)	(0.606)
$\times$ *Year=2017*	2.405	2.141	-4.300	-4.478
	(1.032)	(0.601)	(-0.720)	(-0.298)
Flood Zone	-0.126	-0.130	0.005	0.112
	(-0.789)	(-0.809)	(0.038)	(0.691)
Local Establishments	2.349	2.234	2.970	2.976
	(1.443)	(1.091)	(1.628)	(1.080)
Year–Fixed Effects	Yes	Yes	Yes	Yes
Observations	1,128	831	383	248
Adj. R-squared	0.198	0.172	0.238	0.145

Channels of Price Impact

Results for Economic Contagion (Table 5)

	New York		Boston	
	0.5 miles	0.25 miles	0.5 miles	0.25 miles
	(1)	(2)	(3)	(4)
Negative CAR	-0.271	-0.757**	-0.624**	-0.688*
	(-0.915)	(-2.156)	(-1.986)	(-1.750)
× *Year=2014*	3.553	2.806	6.087*	6.095
	(1.634)	(1.131)	(1.861)	(1.331)
× *Year=2015*	-0.098	1.604	1.099	1.792
	(-0.089)	(1.356)	(0.345)	(0.392)
× *Year=2016*	3.136*	3.251	2.951	3.120
	(1.740)	(1.598)	(0.911)	(0.606)
× *Year=2017*	2.405	2.141	-4.300	-4.478
	(1.032)	(0.601)	(-0.720)	(-0.298)
Flood Zone	-0.126	-0.130	0.005	0.112
	(-0.789)	(-0.809)	(0.038)	(0.691)

Price Effects of Proximity to Firms Adversely Affected by Sandy

- Slower price appreciation for properties closer to HQ of firms with negative CAR during Sandy
- Effect increases in proximity, reverses swiftly over time
- Decline in property prices after disaster due to (temporary) slowdown in local economic activity

Robustness Tests

Alternative Assumptions

- We assume that proximity is most important determinant of flood risk $\rightarrow$ Re-estimate Eq. (4), interacting proximity, elevation
  - Main effects of elevation, interaction coefficients statistically insignificant
  - Proximity coefficients for New York, Boston remain significant, magnitudes close to main results
- We assume that *only* price impact of proximity changes post-Sandy $\rightarrow$ Re-estimate Eq. (4), including hedonic characteristics
  - Hedonic characteristic coefficients mostly insignificant
  - Inclusion does not affect coefficient estimates of proximity, validating our main assumption
- We assume coastal proximity captures flood risk from hurricane exposure $\rightarrow$ Re-estimate Eq. (4), excluding properties likely affected by sea-level rise
  - Bernstein et al. (2019) document impact of sea-level rise on house prices (0.25 miles from coast)
  - Restriction does not affect results, sea-level rise priced separately from hurricane-related flood risk
- **Results confirmed**

Table 6

Robustness Tests

Alternative Specifications

- We match properties based on coastal proximity, flood zone status → Expand matching criteria to include county, building class
- Include flood zone status in matching to account for flood insurance → Alternatively, drop all properties located in flood zones
- **Results confirmed**

Table 7

Robustness Tests

Alternative Difference-in-Differences Approach

- Alternative empirical experiment: Difference-in-differences model
  - Observe properties with different coastal proximity, sold pre- and post-Sandy; regress prices on coastal proximity×post-Sandy indicator, property FE, location×year FE
  - Also requires repeat-sales observations pre-/post-Sandy ☹
- We can implement matched difference-in-differences model (Gupta et al., 2020)
  - Match properties on coastal proximity, flood zone status; regress prices on proximity of matched properties, post-Sandy indicator, interaction, covariates for property, transaction characteristics
  - Can check for parallel trends pre-Sandy, divergence post-Sandy (Table 9, illustrated in Figure 3)
  - Pooling across locations, can estimate triple diff-in-diff
- **Results confirmed**

Table 8 Figure 3 Table 10

Conclusion

- Document price effects of flood risk exposure among sophisticated investors in commercial property markets that have not yet experienced major hurricane-related flood damage
  1. After Sandy hit New York, prices for properties at risk of flood damage in Boston negatively affected
  2. Price impact of flood risk exposure persists through time in New York, decays in Boston
  3. Price effect operates through cap rate, not operational performance of properties
  4. Contagion analysis suggests impact beyond damage, flood risk perception, via local economic activity

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Property Transactions Data New York

Table 1, Panel B

	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	
	Before Sandy					After Sandy					Difference
Price	455.44	347.17	9.44	1,565.73	3,114	621.85	432.77	9.44	1,565.73	2,216	166.41***
Distance	8.20	2.97	0.18	20.00	3,114	7.95	3.28	0.15	20.00	2,216	-0.25***
Elevation	5.23	4.84	0.00	43.96	3,114	5.67	5.72	0.00	46.26	2,216	0.44***
Flood Zone	0.03	0.16	0.00	1.00	3,114	0.02	0.12	0.00	1.00	2,216	-0.01
Size	137.00	239.00	1.16	1,100.00	3,114	120.00	228.00	1.16	1,100.00	2,216	-17.00***
Age	68.49	32.10	1.00	203.00	3,114	72.09	33.96	1.00	216.00	2,216	3.60***
Stories	9.43	9.95	1.00	102.00	3,114	8.95	9.71	1.00	60.00	2,216	-0.48*
Class A	0.14	0.35	0.00	1.00	3,114	0.13	0.33	0.00	1.00	2,216	-0.01
Class B	0.41	0.49	0.00	1.00	3,114	0.42	0.49	0.00	1.00	2,216	0.01
Class C	0.45	0.50	0.00	1.00	3,114	0.45	0.50	0.00	1.00	2,216	0.00

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Property Transactions Data Boston

Table 1, Panel B

	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	
	Before Sandy					After Sandy					Difference
						New York					
Price	455.44	347.17	9.44	1,565.73	3,114	621.85	432.77	9.44	1,565.73	2,216	166.41***
Distance	8.20	2.97	0.18	20.00	3,114	7.95	3.28	0.15	20.00	2,216	-0.25***
Elevation	5.23	4.84	0.00	43.96	3,114	5.67	5.72	0.00	46.26	2,216	0.44***
Flood Zone	0.03	0.16	0.00	1.00	3,114	0.02	0.12	0.00	1.00	2,216	-0.01
Size	137.00	239.00	1.16	1,100.00	3,114	120.00	228.00	1.16	1,100.00	2,216	-17.00***
Age	68.49	32.10	1.00	203.00	3,114	72.09	33.96	1.00	216.00	2,216	3.60***
Stories	9.43	9.95	1.00	102.00	3,114	8.95	9.71	1.00	60.00	2,216	-0.48*
Class A	0.14	0.35	0.00	1.00	3,114	0.13	0.33	0.00	1.00	2,216	-0.01
Class B	0.41	0.49	0.00	1.00	3,114	0.42	0.49	0.00	1.00	2,216	0.01
Class C	0.45	0.50	0.00	1.00	3,114	0.45	0.50	0.00	1.00	2,216	0.00

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Property Transactions Data Chicago

Table 1, Panel B

	Mean	SD	Min	Max	N	Mean	SD	Min	Max	N	
	Before Sandy					After Sandy					Difference
Price	142.47	112.33	9.44	1,439.69	1,500	145.81	141.59	9.44	1,565.73	951	3.34
Distance	4.89	4.29	0.50	19.20	1,500	5.03	4.39	0.57	19.19	951	0.14
Elevation	4.92	3.72	0.66	15.75	1,500	4.81	3.67	0.66	14.76	951	-0.11
Flood Zone	0.01	0.10	0.00	1.00	1,500	0.01	0.10	0.00	1.00	951	0.00
Size	122.00	224.00	1.16	1,100.00	1,500	113.00	226.00	1.16	1,100.00	951	-9.00
Age	50.67	33.33	1.00	156.00	1,500	58.48	34.64	3.00	144.00	951	7.81***
Stories	7.68	11.81	1.00	110.00	1,500	6.99	11.23	1.00	110.00	951	-0.69
Class A	0.11	0.31	0.00	1.00	1,500	0.10	0.30	0.00	1.00	951	-0.01
Class B	0.42	0.49	0.00	1.00	1,500	0.48	0.50	0.00	1.00	951	0.06***
Class C	0.47	0.50	0.00	1.00	1,500	0.42	0.49	0.00	1.00	951	-0.05**

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Alternative Assumptions

Table 6

	Elevation Interaction Effects			Post-Sandy Hedonics		
	New York (1)	Boston (2)	Chicago (3)	New York (4)	Boston (5)	Chicago (6)
Proximity	-0.232***	-0.078***	-0.006	-0.222***	-0.088***	0.001
	(-2.705)	(-2.627)	(-0.095)	(-2.645)	(-3.104)	(0.030)
× Elevation	-0.001	0.001	-0.001			
	(-0.734)	(0.969)	(-0.215)			
Elevation	-0.003	-0.003	0.024			
	(-0.171)	(-0.186)	(0.489)			
Flood Zone	-0.452***	0.193*	-0.676**	-0.431***	0.157	-0.686**
	(-2.783)	(1.880)	(-2.405)	(-2.579)	(1.485)	(-2.464)
Zip Code-Level Establishments	-0.133	1.785	0.790	-0.006	1.665	0.786
	(-0.127)	(1.395)	(0.769)	(-0.006)	(1.288)	(0.768)
Size				-0.007	0.006	0.046
				(-0.253)	(0.216)	(1.642)
Age				-0.044	-0.068	-0.054
				(-1.236)	(-1.610)	(-1.081)
Stories				-0.006	-0.015**	-0.002
				(-1.203)	(-2.062)	(-0.630)
Class A				0.135	0.023	0.042
				(1.103)	(0.220)	(0.313)
Class B				-0.132***	-0.143**	0.057
				(-2.658)	(-2.328)	(0.888)
Year–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Zip Code–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,216	1,394	951	2,216	1,394	951
Adj. R-squared	0.190	0.201	0.284	0.195	0.206	0.290

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Alternative Specifications

Table 7

	Additional Matching Criteria			Flood-Zone Properties Excluded		
	New York	Boston	Chicago	New York	Boston	Chicago
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity	-0.178***	-0.075**	0.016	-0.224***	-0.098***	-0.001
	(-2.611)	(-2.525)	(0.348)	(-2.749)	(-3.291)	(-0.015)
Flood Zone	-0.446**	0.105	-0.852**			
	(-2.473)	(1.198)	(-2.482)			
Zip Code-Level Establishments	-0.964	1.451	0.377	0.357	2.021	0.834
	(-0.981)	(1.139)	(0.335)	(0.320)	(1.469)	(0.799)
Year–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Zip Code–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,199	1,378	945	2,181	1,292	942
Adj. R-squared	0.131	0.193	0.277	0.183	0.199	0.283

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Matched Difference-in-Differences Model

Table 8, abbreviated

	New York (1)	New York (2)	Boston (3)	Boston (4)	Chicago (5)	Chicago (6)
Proximity	-0.034	-0.046	0.048	0.046	0.028	0.024
	(-0.395)	(-0.536)	(1.405)	(1.336)	(0.716)	(0.596)
× *Post-Sandy*	-0.221**	-0.200**	-0.081**	-0.079*	0.046	0.053
	(-2.215)	(-1.999)	(-1.996)	(-1.935)	(0.924)	(1.059)
Flood Zone	-0.036	0.281*	0.036	-0.061	-0.544***	0.005
	(-0.367)	(1.663)	(0.584)	(-0.574)	(-3.266)	(0.016)
Size	-0.184***	-0.230***	-0.166***	-0.182***	-0.147***	-0.157***
	(-14.185)	(-9.576)	(-10.862)	(-6.893)	(-9.064)	(-5.528)
Age	-0.064***	-0.067**	-0.113***	-0.108***	-0.221***	-0.217***
	(-3.738)	(-2.348)	(-5.407)	(-3.429)	(-9.073)	(-5.981)
Stories	0.005*	0.008*	0.015***	0.021***	0.007***	0.007*
	(1.821)	(1.947)	(2.933)	(2.831)	(3.149)	(1.776)
Class A	0.331***	0.323***	0.410***	0.398***	0.360***	0.328***
	(5.557)	(2.982)	(6.322)	(3.747)	(4.834)	(2.688)
Class B	0.115***	0.142***	0.086**	0.187***	0.061*	0.022
	(4.108)	(2.702)	(2.431)	(3.007)	(1.708)	(0.352)
Characteristic × Post-Sandy Interactions	No	Yes	No	Yes	No	Yes
Year-Quarter–Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Post-Sandy × Zip Code Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,157	3,157	2,107	2,107	1,457	1,457
Adj. R-squared	0.540	0.541	0.505	0.505	0.491	0.492

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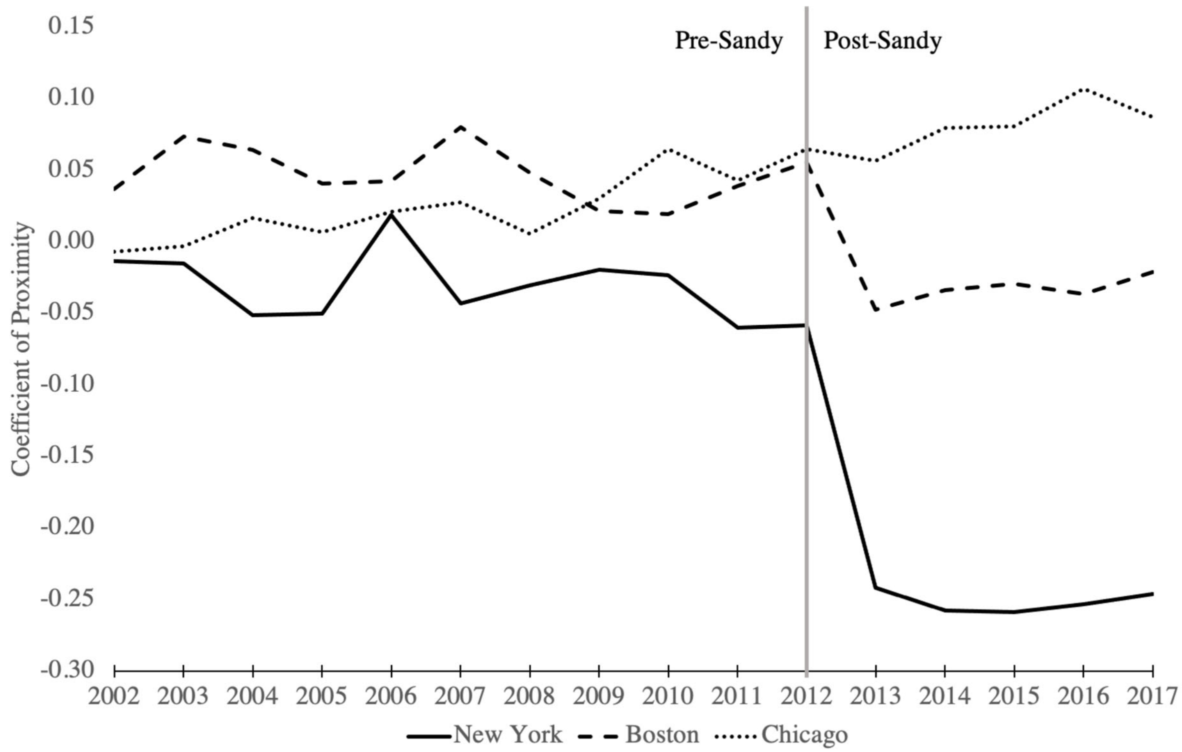
Parallel Trends for Matched Difference-in-Differences

Table 9, illustrated in Figure 3



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Triple Difference-in-Differences Model

Table 10, split

	(1)	(2)	(3)
Proximity	0.008	0.004	0.019
	(0.196)	(0.095)	(0.484)
× New York	-0.044	-0.045	
	(-0.485)	(-0.483)	
× Boston	0.044		0.030
	(0.825)		(0.587)
× Post-Sandy	0.061	0.066	0.053
	(1.141)	(1.203)	(1.021)
× Post-Sandy × New York	-0.282***	-0.272**	
	(-2.596)	(-2.465)	
× Post-Sandy × Boston	-0.149**		-0.131**
	(-2.212)		(-2.017)
Flood Zone	0.001	0.201	-0.061
	(0.017)	(1.387)	(-0.641)
× Post-Sandy	-0.074	-0.523***	0.045
	(-0.708)	(-2.945)	(0.378)
Samples Included			
New York Properties	Yes	Yes	No
Boston Properties	Yes	No	Yes
Chicago Properties	Yes	Yes	Yes
Property Characteristics	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes
Post-Sandy × Zip Code FE	Yes	Yes	Yes
Observations	6,721	4,614	3,564
Adj. R-squared	0.660	0.677	0.519

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Alternative Difference-in-Differences Model

Table 10, split

	(1)	(2)	(3)
New York Coastal	0.252*	0.241	
	(1.756)	(1.619)	
× Post-Sandy	-0.455***	-0.429***	
	(-3.561)	(-3.230)	
Boston Coastal	0.182		0.229
	(0.835)		(1.143)
× Post-Sandy	-0.365*		-0.363**
	(-1.826)		(-1.979)
Flood Zone	-0.041	0.126	-0.099
	(-0.477)	(0.828)	(-1.064)
× Post-Sandy	-0.012	-0.411**	0.054
	(-0.124)	(-2.282)	(0.501)
Samples Included			
New York Properties	Yes	Yes	No
Boston Properties	Yes	No	Yes
Chicago Properties	Yes	Yes	Yes
Property Characteristics	Yes	Yes	Yes
Year-Quarter FE	Yes	Yes	Yes
Zip Code FE	Yes	Yes	Yes
Post-Sandy × Metro Area FE	Yes	Yes	Yes
Observations	4,934	3,523	2,661
Adj. R-squared	0.592	0.608	0.524

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