



WHITE PAPER

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- Large-scale hurricanes can lead to a decline of commercial properties values in hurricane-damaged area, compared to undamaged area.
- The price discount is mainly observed outside the FEMA floodplain. Investors could use realized flooding to learn about their flood risk. The price discount is larger when the particular buyer has more climate awareness and has a more spatially diverse portfolio.

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QUANTIFYING THE IMPACTS OF CLIMATE SHOCKS IN COMMERCIAL REAL ESTATE MARKET

Climate risks are rapidly emerging as a factor relevant not just to policymakers, but also to the investment community and financial markets. Due to the immobility of assets, (commercial) real estate markets are especially vulnerable to climate risks. Climate shocks, including hurricanes, floods, storms, and wildfires, pose a significant risk to existing assets and the health of the local economy. With more frequent and severe climate events serving as a tangible reminder, investors are increasingly assessing the effects of climate risk on commercial real estate values. As natural disasters continue to damage commercial buildings and markets, the capitalization of such adverse conditions in commercial real estate prices becomes more salient.

These incidents are part of a larger global trend of increasing consequences of climate change. While the media and research focus on the impacts of sea level rise and floods on the residential market, we estimate the capitalization of climate shocks in commercial real estate owned and operated by sophisticated investors (relative to the common household owners of residential real estate), using the two most destructive billion-dollar hurricanes in the recent history of US. Besides quantifying the price effect, we identify the underlying mechanisms through which commercial real estate investors respond to those climate shocks.

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Current studies on climate risk and the real estate industry

Climate risk is rapidly emerging as a significant factor to be considered in real estate industry. With more frequent and severe climate events threatening real estate assets, the capitalization of such adverse conditions in real estate prices is becoming more prominent. Previous studies have documented the effect of sea-level rise and flooding events on the transaction price of exposed buildings. However, most of these studies focus on the capitalization of these risks in the residential market (Bin and Landry, 2013; Zhang, 2016; Ortega and Tapinar, 2018; Bernstein et al., 2019; Bauldalf et al., 2020), and little is known about the response of the commercial real estate market to climate shocks and the underlying mechanisms. Among the limited number of studies, Addoum et al. (2021) analyze commercial real estate transactions in New York, Boston, and Chicago after Hurricane Sandy, and document that investors respond rationally to heightened flood risk by bidding down the prices of exposed assets. Fisher and Rutledge (2021) examine the impact of 19 storms that occurred in the U.S. since 1988 on commercial real estate values and find that the effect of hurricanes peaks three years after landfall and dissipates over the subsequent two years.

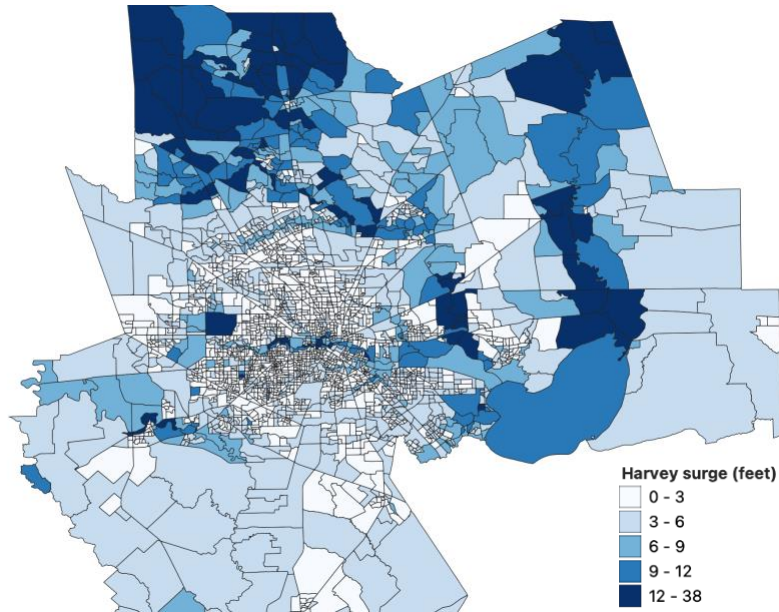
This study complements existing research by estimating the capitalization of climate shocks in commercial real estate owned and operated by sophisticated investors (relative to the common household owners of residential real estate). We focus on two of the most destructive billion-dollar climate events in the recent history of the U.S. – Hurricane Sandy and Hurricane Harvey – and conduct the study in New York and Texas. Specifically, we address the following two research questions: First, we quantify the impact of hurricanes on the transaction prices of commercial real estate in the U.S.; Second, to identify the underlying mechanisms through which sophisticated commercial real estate investors respond to those climate shocks.

A Comprehensive Approach to Quantify the Price Effect and Mechanisms of Hurricanes

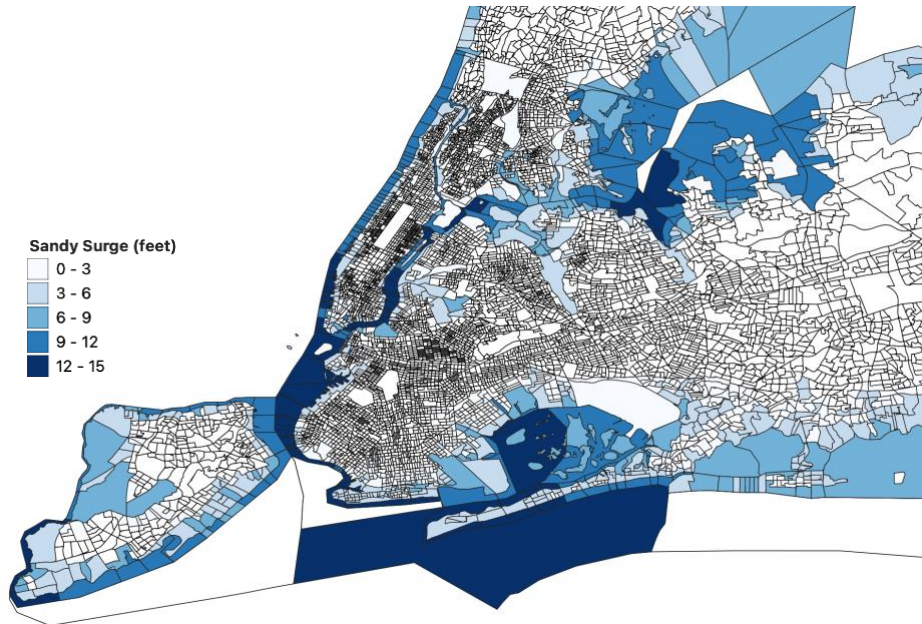
Our analysis combines commercial property transaction data, information on the geographical areas affected by Hurricanes Harvey and Sandy, FEMA flood zone designation information, and local economic indicators. We employ the quasi-experimental econometric method of Difference-in-Differences (DID) to explore causal inferences regarding the capitalization of climate shocks into commercial property prices. We find clear evidence of a decline in transaction prices in hurricane-damaged areas after the hurricane made landfall, compared to unaffected areas, and the effect lasts for about one year in New York, after which the transaction prices revert to pre-hurricane levels. In Texas, the effect lasts for a longer period and shows a sign or reversion to their previous levels four years after Hurricane Harvey.

We explore the mechanisms of these price effects from three perspectives by looking at the temporal variation in commercial real estate transaction prices, and investigating two sources of heterogeneity. First, we decompose the price effect into a risk premium channel (as reflected in the capitalization rate) and operating income channel (indirectly reflected in occupancy rates). We find that while the capitalization rate in both New York and Texas shows no sign of significant changes, we document a decline in occupancy rates for properties in Texas, reflecting a lower current demand for assets prone to flood risk.

Figure 1: Inundation zone of Hurricane Harvey and Sandy



(a)



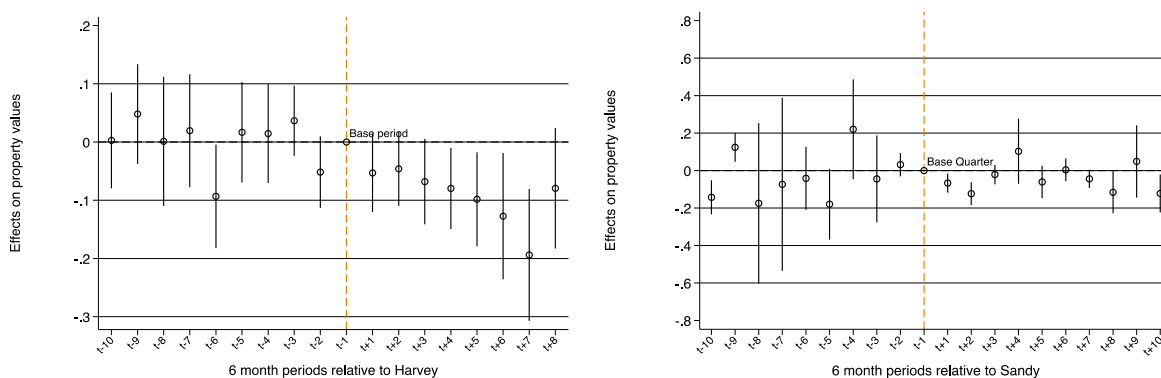
(b)

Notes: Panel (a) shows the surge level of inundation area by Census block group in Texas, with a focus on Houston. Panel (b) shows the surge level of inundation area by Census block group in New York, with a focus on New York City. The blue shades indicate surge level (feet).

We subsequently investigate heterogeneity in the price discount based on the extent to which investors respond to the climate shocks. Investors might update their beliefs regarding the likelihood of natural disasters in a certain location, which would lead to a change in transaction values. Information provided by FEMA 100-year floodplain maps serves as the major information source of pre-existing flood risk for investors. However, while some of the inundated areas are located within flood zones, a large proportion of the damaged areas are located outside flood zones, indicating a discrepancy between ex-ante information

on flood risk and ex-post real damages. Our results indicate that being located outside a flood zone is associated with a much larger and more significant discount in transaction values after Hurricanes Harvey and Sandy. This may be attributed to mandatory insurance requirements linked to flood zone designations, which enable asset owners to safeguard against climate shocks. We observe that when investors are confronted with new information about flooding in areas not previously considered at risk (non-floodplain), they rapidly revise their perceptions of flood risk and incorporate these considerations into asset values. As such, the hurricanes serve as an important belief update to investors about future flood risk.

Figure 2: Transaction price increment over time



a. Hurricane Harvey and Texas market

b. Hurricane Sandy and New York market

Notes: This Figure presents how the transaction price of commercial properties in Texas and New York is affected pre- and post-hurricanes. These point estimates are based on regression estimates. Each dot represents the point estimate; the whiskers represent a 95% confidence interval.

Next, we explore how hurricanes' impact on transaction values vary among different groups of investors. Environmental awareness of investors can influence their climate change beliefs and how they react to climate-related events. Investors with varying portfolio sizes could price climate risks differently in their investment. On the other hand, given the same level of climate shock, if a property (and the associated location) is less replaceable in the investor's location choice set, prospective buyers may be willing to accept a smaller price discount due to limited alternatives. This observation is linked to the connection between portfolio diversity and the discount rate from investors' standpoint – if an investor can mitigate climate risk through a more dispersed portfolio, they will likely assign a lower discount rate attributable to climate risk. Moreover, we follow Zheng et al. (2012) to propose a Google Green Index to measure investors' "greenness", and find that the hurricane discount is only significant for investors that are considered "greener." To look at whether the spatial distributions of investors' portfolio influence the documented price effect, we record the number of different locations (county-level) that the investors have operated in and use it as a footprint diversity measure in the surrounding area. For investors with a more geographically diverse footprint, it is easier to relocate their investment activity to more climate-resilient locations and put higher priority on climate considerations in their portfolio management. The result indicates that relative to investors who operate in a limited geographic area, those with broader transaction experience responds to climate shocks with a larger price discount. A combination of climate risk awareness and more diverse investment

experience shapes the observed climate shock discount. Providing reliable information on future climate risk in a certain location in addition to FEMA flood plain maps could aid the market in accurately pricing climate risk in commercial real estate transactions.

Final Thoughts

Overall, this paper provides evidence of a decline in transaction prices in hurricane-damaged areas after the hurricane made landfall, compared to unaffected areas. Our study carries several implications. First, the presence of climate risk does impact commercial real estate markets in a comprehensive way. Real estate investors are starting to incorporate various strategies to price and manage climate risks, yet clearly there is still a big information gap and more sophisticated climate risk evaluations are needed. Second, as investors do update their risk perceptions in response to climate events, it is crucial for policy makers and government agencies to provide more accurate information on climate risk to aid the decision-making process of all stakeholders and improve market efficiency. Our findings highlight the importance of efficient climate risk pricing in mitigating potential losses in real estate value arising from future climate events.

References

- Addoum, J. M., Eichholtz, P. M. A., Steiner, E., & Yönder, E. (2021). Climate Change and Commercial Real Estate: Evidence from Hurricane Sandy. SSRN Electronic Journal. <https://doi.org/10.2139/SSRN.3206257>
- Baldauf, M., Garlappi, L., & Yannelis, C. (2020). Does climate change affect real estate prices? Only if you believe in it. *The Review of Financial Studies*, 33(3), 1256–1295.
- Bernstein, A., Gustafson, M. T., & Lewis, R. (2019). Disaster on the horizon: The price effect of sea level rise. *Journal of Financial Economics*, 134(2), 253–272.
- Bin, O., & Landry, C. E. (2013). Changes in implicit flood risk premiums: Empirical evidence from the housing market. *Journal of Environmental Economics and Management*, 65(3), 361–376.
- Fisher, J. D., & Rutledge, S. R. (2021). The impact of Hurricanes on the value of commercial real estate. *Business Economics*, 56(3), 129–145.
- Ortega, F., & Taşpınar, S. (2018). Rising sea levels and sinking property values: Hurricane Sandy and New York's housing market. *Journal of Urban Economics*, 106, 81–100.
- Zhang, L. (2016). Flood hazards impact on neighborhood house prices: A spatial quantile regression analysis. *Regional Science and Urban Economics*, 60, 12–19.
- Zheng, S., Wu, J., Kahn, M. E., & Deng, Y. (2012). The nascent market for “green” real estate in Beijing. *European Economic Review*, 56(5), 974–984.