Executive Summary

Neglected No More:
Housing Markets, Mortgage Lending, and Sea Level Rise*

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Abstract

In this paper, we explore dynamic changes in the capitalization of sea level rise (SLR) risk in housing and mortgage markets. Our results suggest a disconnect in coastal Florida real estate: From 2013-2018, home sales volumes in the most-SLR-exposed communities declined 16-20% relative to less-SLR-exposed areas, even as their sale prices grew in lockstep. Between 2018-2020, however, relative prices in these at-risk markets finally declined by roughly 5% from their peak. Lender behavior cannot reconcile these patterns, as we show that both all-cash and mortgage-financed purchases have similarly contracted, with little evidence of increases in loan denial or securitization. We propose a demand-side explanation for our findings where prospective buyers have become more pessimistic about climate change risk than prospective sellers. The lead-lag relationship between transaction volumes and prices in SLR-exposed markets is consistent with dynamics at the peak of prior real estate bubbles.

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Is a U.S. coastal housing bubble bursting? And if so, how would we know it? As 42% of the U.S. population resides in a coastal shoreline county (Fleming et al., 2018), whether property and mortgage markets are already responding to climate risk is of crucial importance as homeowners, mortgage lenders, insurers, and policymakers try to predict how coastal real estate markets will evolve in the coming decades.

In this paper, we explore whether sea level rise (SLR) risk is reflected in housing and mortgage markets. Figure 1 presents the raw trends in home sales volume (top panel) and prices (bottom panel) between less-SLR-exposed and more-SLR-exposed tracts in coastal Florida normalized by their 2001-2012 mean.[1]

Prior to 2012, the two markets were on essentially identical volume paths. However, we document a sharp decline in transaction volume since 2013 in housing markets most exposed to SLR. Sales in these high-risk tracts have fallen in absolute terms since 2013, while sales in low-risk coastal tracts rose between 2013-2018. In contrast, relative home prices follow volumes with a lag, with a relative decline in the high-risk tracts only beginning to emerge in 2018.

This lead-lag relationship between real estate volumes and prices was last seen in these SLR-exposed tracts at the start of the housing bust. While sales volumes began a precipitous decline in 2005, it was only in 2008, after a decline in annual sales volumes of over 60% from the market peak, that prices started a similarly steep decline.

The staggered declines in sales volumes and prices in more-SLR-exposed markets relative to their less-exposed coastal neighbors, echoing the last housing market cycle, raise our two primary research questions. First, does the relative sales volume slowdown have a direct connection to SLR exposure, or is it more plausibly explained by differences between markets that are only indirectly correlated with SLR? Second, what are the mechanisms for and implications of this divergence between transaction volumes and home prices in SLR-exposed markets?

To assess whether the housing market trends in Figure 1 reflect a direct relationship with climate risk, we use matching estimators in a difference-in-difference framework to account for observable differences between markets with different SLR exposure. This empirical approach reflects the uncertainty and community-level effects of SLR risk, while allowing us to flexibly control for a large number of observable differences and pre-trends across markets.

By 2018, we estimate that the most-SLR-exposed census tracts in Florida had 16-20% lower transaction volumes from their 2001-2012 annual average relative to a matched sample of markets with low SLR exposure (see Figure 3). Our estimates imply that approximately 16,500 fewer home transactions took place from 2013-2018 among the 187 census tracts most exposed to SLR relative to counterfactual trends. On the other hand, we find no evidence of a strong relationship between changing home prices and SLR from 2013-2016. However, starting in 2016, prices in more-SLR-exposed tracts began to

[1] We define "more" and "less" exposed coastal tracts as those where more than 70% or less than 10% of developed land would be inundated at 6 feet of sea level rise, respectively. Figure 2 shows maps of the coastal communities included in the full sample, 771 tracts in all, that are within 1/2 mile of the coast.

relatively decline, reaching 5% below trend by 2020.

Next, we consider the potential mechanisms behind these changing market trends. First, we rule out the hypothesis that lender behavior can explain these patterns: We estimate similarly large relative declines in both cash home purchase and home purchase loan volumes (see Figure 4). We also document generally small changes in the rate of loan denial, securitization, or refinancing volume with respect to SLR exposure.

On the other hand, the most-SLR-exposed tracts in counties where the most residents are worried about climate change also saw the largest price and volume declines (see Figure 5). These findings suggest that it is homebuyers, and in particular the ones most concerned about climate risk, whose demand in SLR-exposed areas began to wane in 2013.

Notably, transaction volumes begin to diverge in 2013 as a confluence of events focused public attention on climate risk. These events include Hurricane Sandy striking the East Coast in October 2012, the release of the Intergovernmental Panel on Climate Change (IPCC) AR5 report which increased worst-case SLR projections, and the release of the 2014 National Climate Assessment which documented SLR exposure in the United States (Stocker et al., eds, 2013; Georgakakos et al., 2014). These reports spurred local news coverage of climate risk, with headlines like "Florida Communities Prepare for Rising Seas," and an apparent increase in public interest (Gibson, 2014).[2]

Given these changing beliefs around sea level rise, we view our findings as most consistent with a framework where the increased salience of climate change has led prospective buyers to become more pessimistic about future home prices in SLR-exposed areas than current homeowners. However, as at the start of the housing bust in 2005, sellers remain optimistic about demand and are unwilling to cut prices (DeFusco et al., 2017). Under this framework, our results would suggest that declining volume (a 'quiet' phase for transactions) will precede falling prices in high SLR exposure markets.

If heightened SLR risk awareness has made prospective homebuyers more wary of at-risk coastal markets, why have lenders been relatively unresponsive? Our interpretation, informed by conversations with multiple lenders and industry participants, is that lenders are protected by federal programs that actively mis-price climate risk. First, for mortgage loans held on balance sheets, the National Flood Insurance Program (NFIP) offers generous coverage at subsidized prices below actuarial fairness (Kousky et al., 2017). Second, for securitized loans, Fannie Mae, Freddie Mac, and the FHA, which insure over half of the U.S. mortgage market, do not price predictable regional variation in default risk, including climate risk (Hurst et al., 2016). Thus, while lenders may have more sophisticated risk assessment capabilities relative to homebuyers, their incentives are not aligned to internalize SLR risk, and if anything may exploit the mis-pricing of risk at the federal level (Ouazad and Kahn, 2020).

[2]For examples of local media coverage, see Frago (2014), Reiser (2014), and *Elevation zero: Rising seas in South Florida* (2013).

Figures

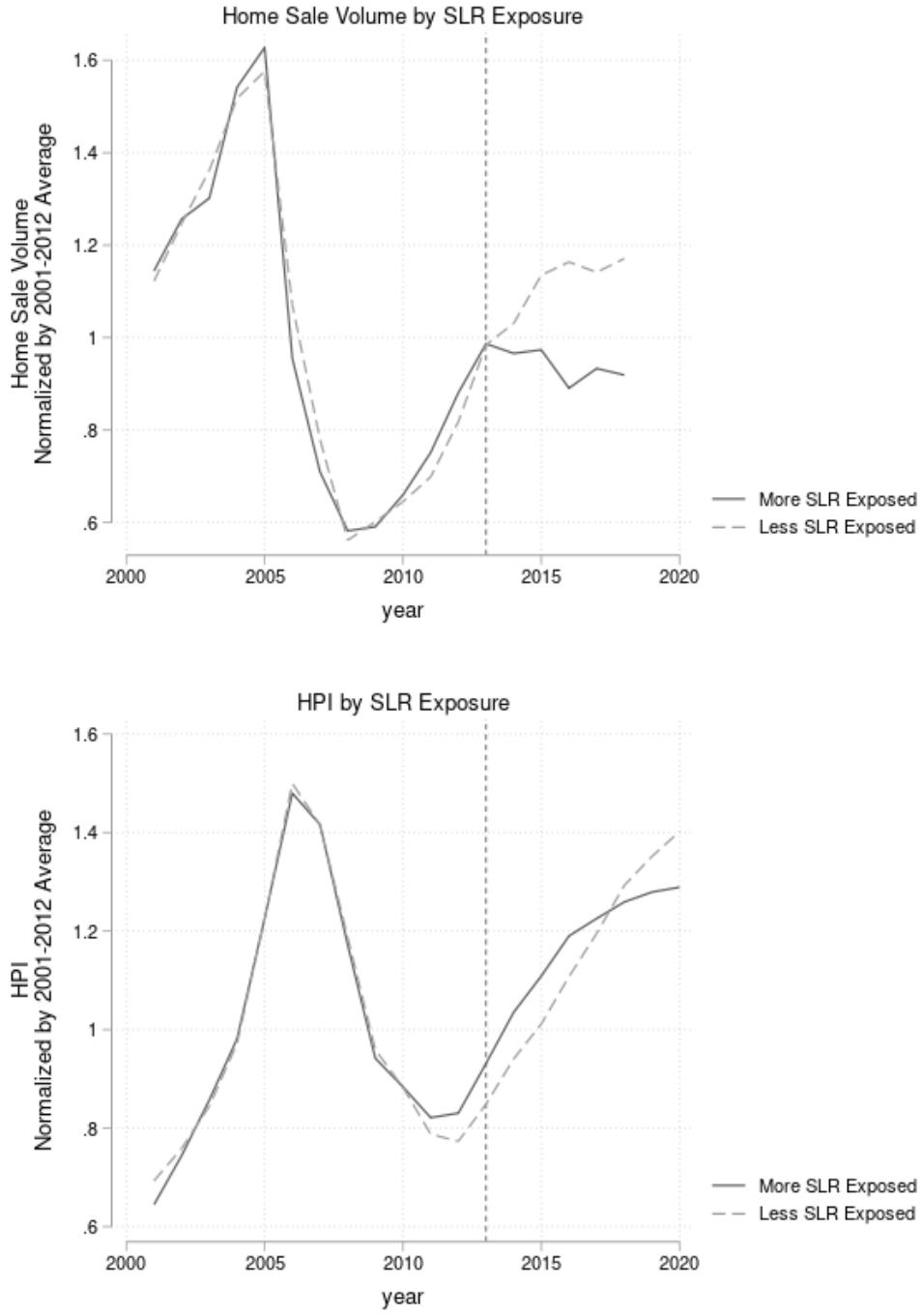

Figure 1: Housing transaction volume (top panel) and home price (bottom panel) trends in coastal Florida census tracts with high versus low SLR exposure. Housing volume and home price index are normalized by their 2001-2012 mean. Sources: Zillow Home Value Index, CoreLogic, Authors' calculations

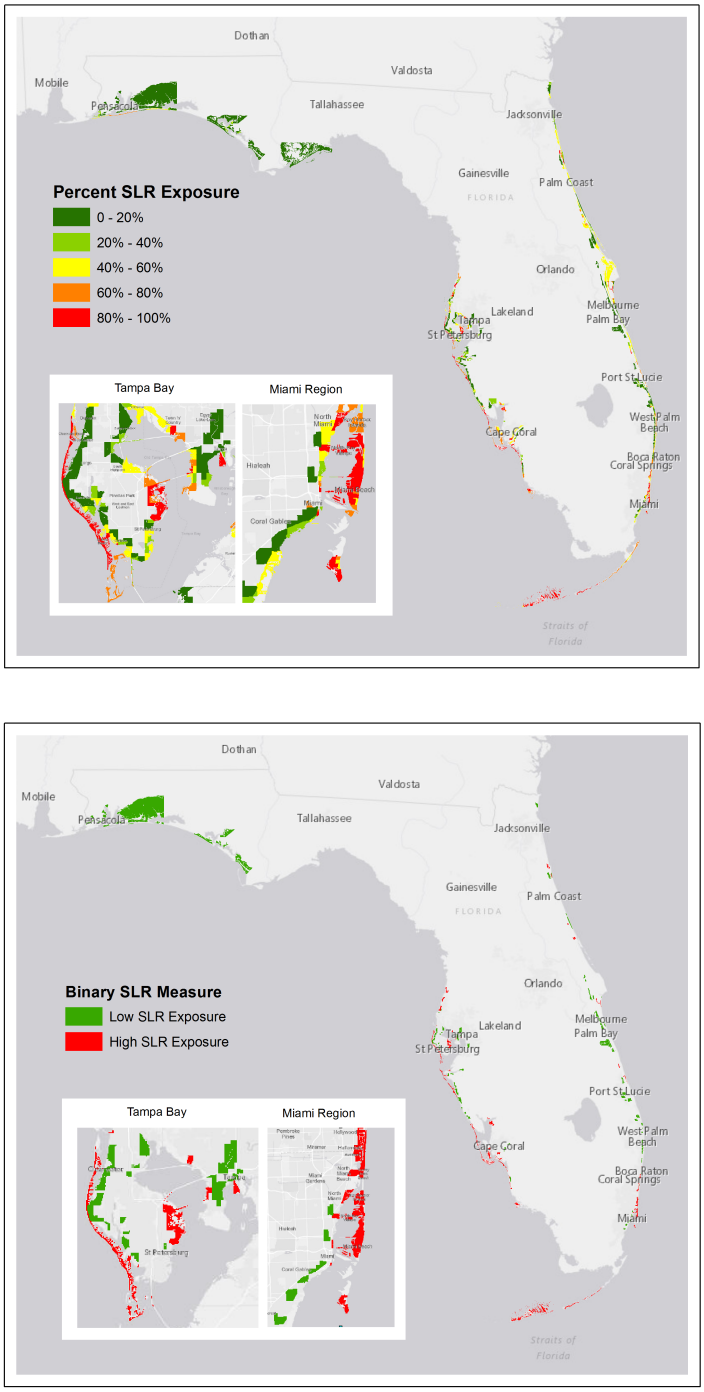

Figure 2: Maps show SLR exposure for the sample of 771 coastal Florida census tracts. The top panel shows the share of each tract's developed land in 2000 that would be chronically inundated at six feet of SLR. The bottom panel shows the subsample of tracts categorized as either "more-SLR-exposed" ($> 70\%$ exposure, 187 tracts) or "less-SLR-exposed" ($< 10\%$ exposure, 217 tracts).

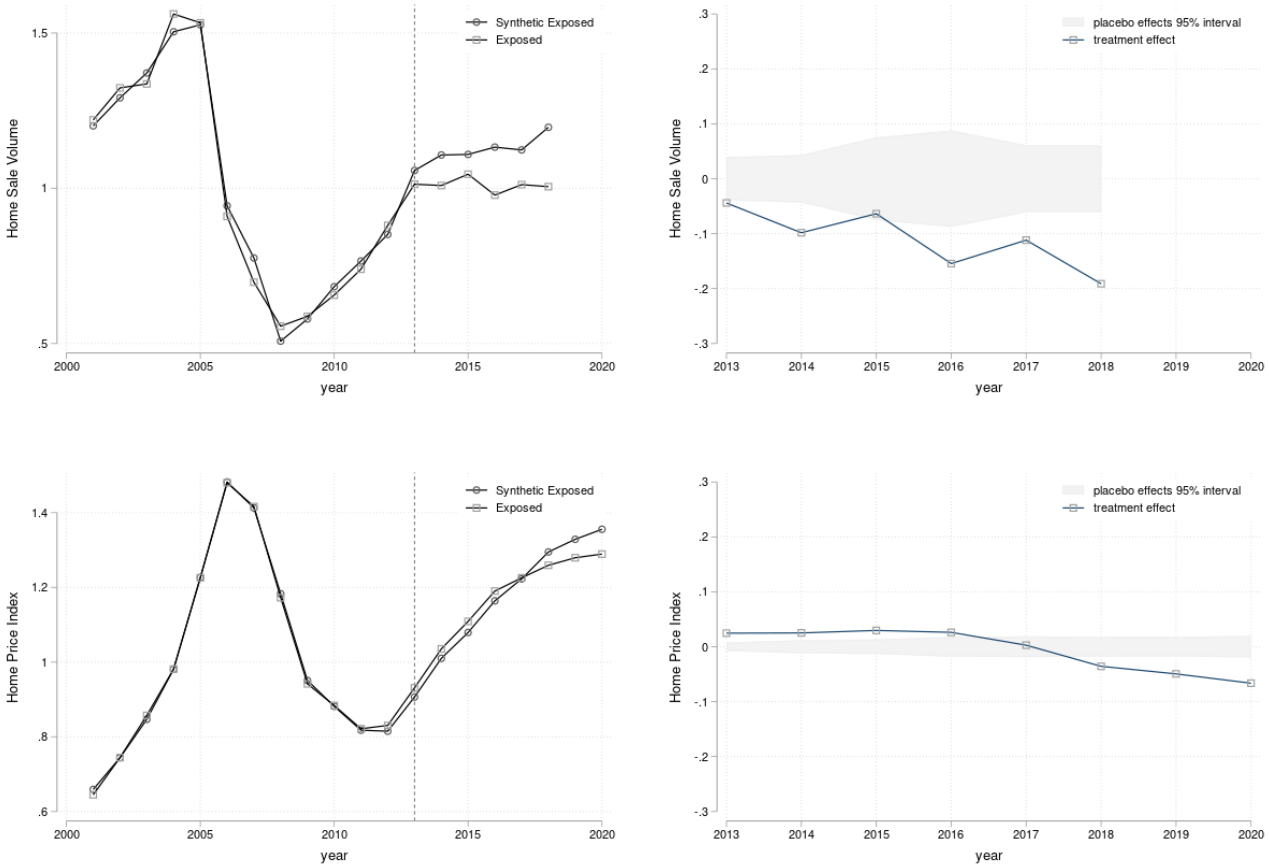

Figure 3: Synthetic control results for housing transaction volume and home prices. Left column shows outcome for SLR-exposed tracts alongside synthetic counterparts, right column shows treatment effects with two-sided 95% interval of placebo effect estimates in gray.

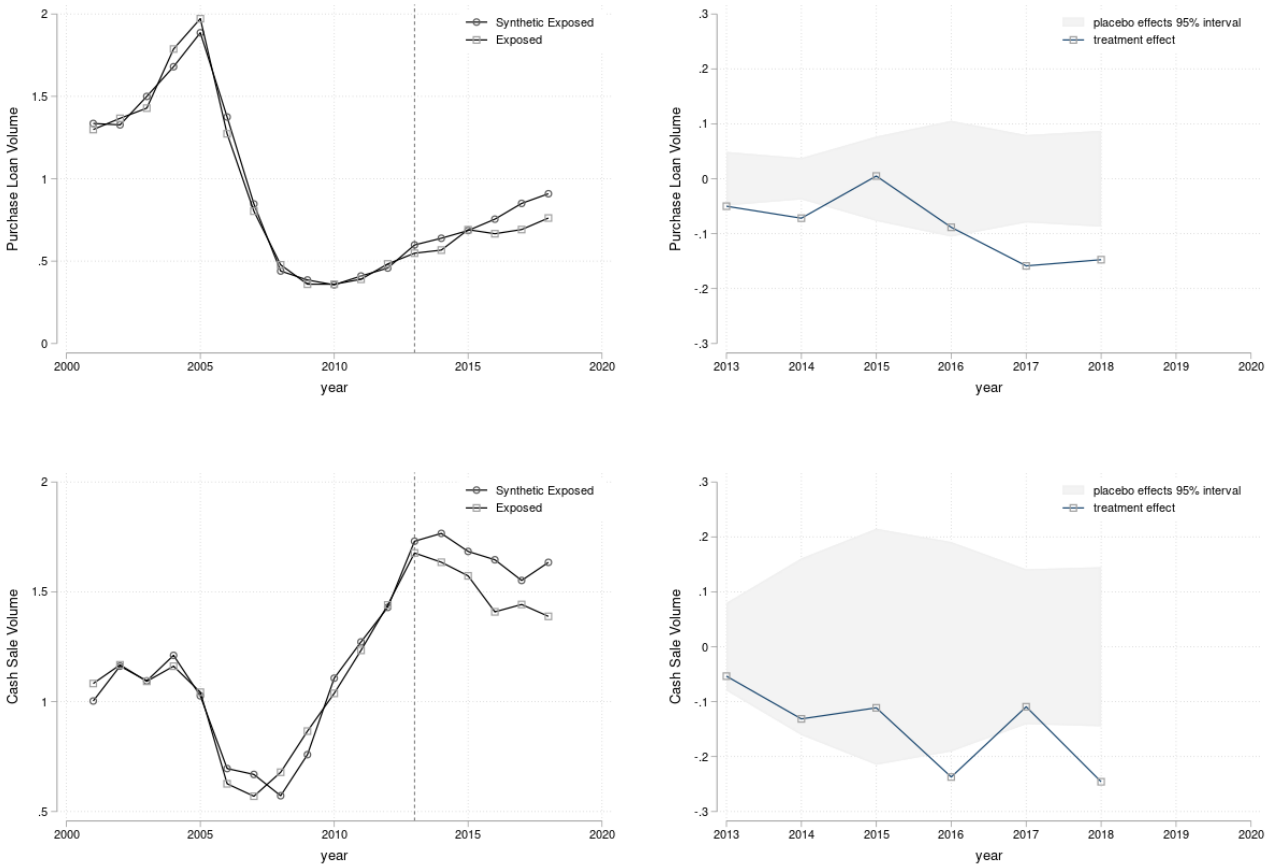

Figure 4: Synthetic control results for housing transaction loan and cash purchase volumes. Left column shows outcome for SLR-exposed tracts alongside synthetic counterparts, right column shows treatment effects with two-sided 95% interval of placebo effect estimates in gray.

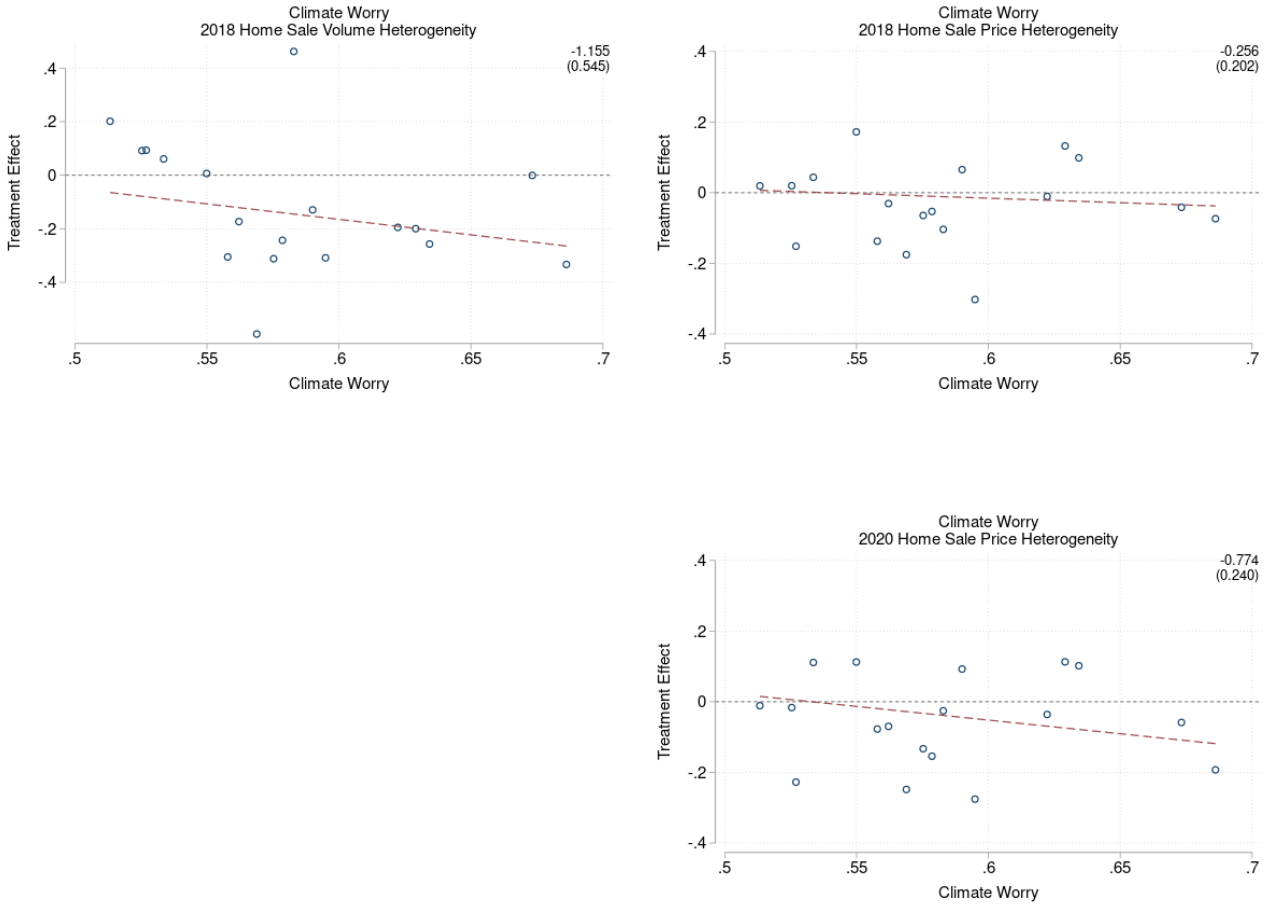

Figure 5: Summarizes treatment effect heterogeneity from nearest neighbor matching estimator for 2018 home sale volume (top left), 2018 home prices (top right), and 2020 home prices (bottom right) by county-level concern about climate change. Each point is a county with the average treatment effect of its more-SLR-exposed on the y-axis and the estimated share of adults in the county worried about climate change from the 2018 Yale Climate Opinion Survey on the x-axis. The dashed red line indicates the best-fit linear line through the points, with the coefficient and standard error from the tract-level regression of the worry measure over the estimated treatment effects indicated in the upper-right corner. Outcomes are normalized by the tract-level 2001-2012 mean.

References

DeFusco, Anthony A, Charles G Nathanson, and Eric Zwick, "Speculative dynamics of prices and volume," Technical Report, National Bureau of Economic Research 2017.

Elevation zero: Rising seas in South Florida

***Elevation zero: Rising seas in South Florida**, WLRN-Miami Herald News 2013.* `https://www.wlrn.org/elevation-zero`.

Fleming, Elizabeth, Jeffrey Payne, William Sweet, Michael Craghan, John Haines, Juliette Finzi Hart, Heidi Stiller, and Ariana Sutton-Grier, *"Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II," Technical Report, U.S. Global Change Research Program 2018.*

Frago, Charlie, *"St. Petersburg to look into expected sea level rise in waterfront master plan," Tampa Bay Times, 2014.* `https://www.tampabay.com/news/environment/st-petersburg-to-look-into-expected-sea-level-rise-in-waterfront-master/2201748/`.

Georgakakos, Aris, Paul Fleming, Michael Dettinger, Christa Peters-Lidard, Terese C Richmond, Ken Reckhow, Kathleen White, and David Yates, *"Ch. 3: Water Resources. Climate change impacts in the United States: The Third National Climate Assessment," Technical Report, US Global Change Research Program Washington, DC 2014.*

Gibson, William E, *"Florida communities prepare for rising seas," South Florida Sun Sentinel, 2014.* `https://www.sun-sentinel.com/news/fl-xpm-2014-04-20-fl-preparing-for-rising-seas-20140418-story.html`.

Hurst, Erik, Benjamin J Keys, Amit Seru, and Joseph Vavra, *"Regional redistribution through the US mortgage market," American Economic Review, 2016, 106 (10), 2982–3028.*

Kousky, Carolyn, Brett Lingle, and Leonard Shabman, *"The pricing of flood insurance," Journal of extreme events, 2017, 4 (02), 1750001.*

Ouazad, Amine and Matthew E Kahn, *"Mortgage finance in the face of rising climate risk," 2020. National Bureau of Economic Research Working Paper No. 26322.*

Reiser, Emon, *"7 infrastructure ideas that could combat sea level rise in South Florida," South Florida Business Journal, 2014.* `https://www.bizjournals.com/southflorida/news/2014/10/01/7-infrastructure-ideas-that-could-combat-sea-level.html`.

Stocker, T F, D Qin, G-K Plattner, M Tignor, S K Allen, J Boschung, A Nauels, Y Xia, V Bex, and P M Midgley, eds, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, 2013. Chapter 13.*