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Chairman Whitehouse, Ranking Member Grassley, and Members of the Committee: Thank you for inviting me to address how climate change is affecting insurance markets. My name is Ben Keys and I am an economist and Professor of Real Estate and Finance at the University of Pennsylvania's Wharton School. My research agenda examines how households interact with the financial system, and how the financial system manages risk.

In my remarks today, I would like to put a broader economic lens on issues in property insurance markets, emphasizing the effects on household well-being.

First, rising insurance costs are having a direct effect on households' pocketbooks. Across the country, average homeowners' insurance premiums rose by 40 percent from 2010 to 2019, the most recent data available.[1] In addition, private insurers are exiting certain markets, pushing households into public "insurers of last resort." The number of enrollees in these state-backed FAIR insurance plans rose by 29 percent between 2018 and 2021.[2] With rising climate-related risks, and the rising cost of reinsurance, insurers will continue to increase premiums and exit markets, leaving homeowners with fewer choices, less protection, and more financial distress.

Family budgeting is difficult as it is. And as homeowners' insurance premiums can change every year, it is nearly impossible for households to accurately budget for increasing climate risk. For instance, this January, Louisiana Citizens increased its property insurance rates by 63 percent.[3] Costs are also rising in the National Flood Insurance Program. In the first year of the Risk Rating 2.0 reform, 75 percent of primary residences experienced an increased premium of 18 percent, the statutory limit. Half of all NFIP policyholders will see their premiums more than double after 5 years.[4]. Sadly, these increases will lead many households to choose to go without insurance.

Rising insurance costs directly affect housing markets. Every additional dollar of premiums decreases the demand for a home, affecting the amount its owners can expect to receive when they sell. In more dire situations where homeowners cannot find insurance, lenders will not be willing to accept uninsured homes as collateral.

These concerns are not merely theoretical. Economic research shows that higher flood insurance premiums lower home prices and make it harder to get a mortgage.[5] My own research shows that the threat of future sea level rise lowers home prices today, as buyers don't want to be left with an uninsurable home down the road. In short, home prices have already started reacting to climate risk — even as we've realized only a fraction of the higher premiums

[1] Insurance Information Institute (2022) https://www.iii.org/table-archive/21407

[2] Insurance Information Institute (2022) https://www.iii.org/table-archive/20793

[3] https://www.ldi.la.gov/news/press-releases/10-10-22-ldi-approves-citizens-rate-increase-and-offers-tips-for-policyholders

[4] Congressional Research Service, "National Flood Insurance Program: The Current Rating Structure and Risk Rating 2.0," April 2022 https://crsreports.congress.gov/product/pdf/R/R45999

[5] Blickle and Santos (2022) https://www.newyorkfed.org/medialibrary/media/research/staff_reports/sr1012.pdf, Georgic and Klaiber (2022) https://www.sciencedirect.com/science/article/pii/S0095069621001170

and sea level rise expected in the coming decades.[6]

I want to briefly highlight why climate risks are so difficult to insure. After a massive fire in the city of Hamburg, Germany in 1842, local insurers failed.[7] Reinsurance markets arose for fire insurance because fires are idiosyncratic events, allowing providers to create a diversified risk pool and spread these risks widely and effectively.

Unlike the chances of a fire in a given city, climate risk is better described by the title of the latest Oscar winner: It's "Everything, Everywhere, All at Once." Climate change is simultaneously inducing heightened risk of flood, storm damage, chronic inundation, drought, excessive heat, and wildfires. These risks are difficult to diversify and spread to private entities. While reinsurance and the catastrophe bond market will continue to play a role in maintaining functioning insurance markets, there is no avoiding the fact that the increasing risk of large, global loss events will mean higher costs for consumers.[8]

The limitations of private insurance markets for insuring against climate risks points to a larger role for the government. State and federal insurance entities will bear more of these risks going forward as private insurers pull back. If we do not take action on climate adaptation and mitigation, then we can expect private markets for wildfire and wind coverage to increasingly resemble the National Flood Insurance Program and rely on public support. Further costs will be borne by Fannie, Freddie, and the FHA, who make up two-thirds of the current mortgage market, and by FEMA and other post-disaster aid sources.

Topics surrounding insurance often feel remote or difficult to digest, but they impact everyday households. Far too many Americans are currently not protected from climate risks: FEMA estimates that only 35 percent of Florida households in flood zones have flood insurance.[9] And the First Street Foundation estimates that roughly 6 million households are at significant flood risk but lie outside of FEMA's outdated floodplain maps, making them likely unaware of their danger.[10]

Private insurers' aim to price their risks accurately, so we should pay close attention to the choices that they make. No matter your views on climate science, insurers are responding to the increased frequency of high-cost disasters and the latest scientific forecasts. The departure of insurers from property markets has serious implications for home values, the dominant store of wealth for the average household, and for communities that rely heavily on property taxes to provide basic services as well as defend against further climate-related damage. Now is the time to identify policy solutions to reduce American families', businesses', and taxpayers' exposure to climate risk.

Thank you again for the opportunity to testify.

[6] Keys and Mulder (2020) https://www.nber.org/papers/w27930

[7] Kopf (1929) https://www.casact.org/sites/default/files/database/proceed_proceed29_29022.pdf

[8] For more on disaster insurance, see the excellent primer by Kousky (2022): https://islandpress.org/books/understanding-disaster-insurance

[9] FEMA (2020) https://www.fema.gov/press-release/20230110/floridians-flood-insurance-sound-investment

[10] First Street (2020) https://firststreet.org/press/2020-first-street-foundation-flood-model-launch

Research on Climate Risk, Housing, Mortgage, and Insurance Markets

I began my career studying the implications and impact of the 2008 financial crisis, and in recent years my focus has turned to climate change as the most critical risk that faces consumers and our economy.

My ongoing research on coastal housing markets documents the emergence of a 5 to 7 percent price discount for Florida properties in neighborhoods that face the greatest exposure to sea level rise (see maps below in Figure 1).[11] The price discount on at-risk homes grew between 2016 and 2019, but actually manifested earlier in 2013 as a decline in the number of home sales (see Figure 2). Like the housing bust of 2008, when housing demand declines sellers are reluctant to cut prices. This reluctance leads to fewer transactions and a larger inventory of for-sale homes spending more time on the market. Eventually sellers lowered their list prices, and transaction prices declined. However, we find that transaction volumes remained substantially below that of less exposed properties, suggesting less liquidity in the housing market. We further examined the mortgage and flood insurance markets and found no evidence that these markets were driving the price discount or the lack of liquidity. These market dynamics were present prior to the COVID-19 housing boom, and whether they will re-emerge is an important question for understanding how sea level rise will affect coastal housing markets.

Other researchers studying how housing markets across the United States are responding to climate risk have also found that homes exposed to sea level rise sell at a discount compared to otherwise similar properties.[12] The literature on climate and real estate markets has several important takeaways for policymakers. First, new information about climate risk — and not just sea level rise but also flooding, wildfires, and hurricanes — is affecting property values today. Second, the capitalization of risk into home prices may not be a smooth process. When sellers are reluctant to cut prices or when they disagree with buyers about the risk of different climate scenarios, real estate markets can become less liquid and more volatile. As we are seeing once again, volatility and uncertainty in housing markets can affect not just individual buyers and sellers, but the stability of the wider financial system. Finally, due to barriers created by state- and federal-level policies, insurance markets and lenders are not pricing climate risk into their decisions, which may be keeping the prices of at-risk homes elevated even given the price discounts that have started to emerge.[13]

Below, I discuss the role of financial and real estate markets in transmitting climate risk across the economy, and discuss policies that can help to manage and reduce risk. To understand the potential consequences to property markets of climate change, it is illustrative to consider parallels between the growing climate risk that we face and the lessons learned from the last crisis in 2008.

Property markets played a central role in the last crisis. A key feature of the property boom of the 2000s was overoptimism surrounding commercial property and home prices, fueled by declining lending standards and secondary mortgage markets that created distance between those who originated mortgages and the final holders of the mortgages' risk. A central lesson from the boom and bust is that expectations matter and prices can deviate substantially from fundamentals for long periods of time. A second lesson is that both property owners and financial markets, largely left to their own devices, reached valuations that were unrealistic and unsustainable. The direct risks of lending were underappreciated, and there was a fundamental lack of awareness about the broader risks in the financial system, with spillovers ultimately to the entire economy.

As in 2008, there is a lack of information and awareness regarding the true scope of climate risk. Taking flood risk as an example, far too many households are uninsured or underinsured from flood hazards. Ninety-eight percent of U.S. counties have experienced a flooding event, and floods have caused over $155 billion in property damages in the last decade.[14]. Yet among households, there are few, if any, mechanisms or incentives that raise homeowners' concerns consistent with the growing risk. This lack of awareness is especially acute in the insurance market. A 2021 survey of homeowners conducted by the NAIC found that 56 percent believe their homeowners' policy covers flood damage, even though flood is not covered under standard policies; In fact, only 4 percent of the homeowners in their

[11] Keys and Mulder (2020) https://www.nber.org/papers/w27930

[12] See, for instance, Bin and Landry (2013) https://doi.org/10.1016/j.jeem.2012.12.002, Bernstein et al. (2019) https://doi.org/10.1016/j.jfineco.2019.03.013, Hino and Burke (2021) https://www.pnas.org/doi/full/10.1073/pnas.2003374118, and Bakkensen and Barrage (2022) https://academic.oup.com/rfs/article/35/8/3666/6424922.

[13] Oh, et al. (2022) https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3762235

[14] Grimm (2020) https://www.fema.gov/fact-sheet/michael-grimm-testimony-committee-science-space-and-technology

sample actually had flood insurance. [15] Over 50 percent of the flood losses from Hurricane Ian were uninsured.[16]

A lack of awareness and information can lead to the mis-pricing of assets. A recent study published in Nature Climate Change convincingly argues that increased costs of flood risk are not fully captured in property values.[17] The authors estimate that residential properties are overvalued by between 120 and 240 billion dollars. Mis-pricing is not limited to the properties themselves, but also applies to the cost of insurance. The NFIP has recently implemented Risk Rating 2.0, a new rating methodology which is gradually increasing flood insurance premiums. While this much needed innovation is moving prices of flood insurance toward their actuarially fair levels, FEMA models include neither heavy rainfall nor climate change effects in their flood maps. These omissions are consequential: The non-profit First Street Foundation identifies 14.6 million properties currently at significant flood risk, of which nearly 6 million lie outside of FEMA floodplain boundaries[18]

Mortgage markets are also failing to directly price climate-related risks. In earlier research, my co-authors and I examined the consequences of Fannie Mae and Freddie Mac choosing not to price predictable spatial default risk.[19]. As macroeconomic conditions like unemployment rates and house price fluctuations are persistent in the short run, there are predictable differences in default risk across areas that the GSEs could include in their prices. However, they price mortgage credit uniformly across the country based on individual- and property-level characteristics (like FICO score and loan-to-value ratio). We find that this policy choice leads to substantial cross-subsidization from safer areas to riskier ones. The same logic applies to climate-related risks: If they were priced separately, mortgages in areas exposed to climate risks would face higher interest rates to account for their heightened chance of default and larger losses given default. Add in generous disaster aid programs, and when combined, the mis-pricing of properties, subsidized insurance policies, and mortgage rates can lead to a substantial distortion, driving more economic activity and more building to high-risk areas.

Stress Testing Housing and Property Markets Against Climate Risk

Considering two tail-risk scenarios is potentially useful for "stress testing" our complex and opaque system of risk management in property markets. My first scenario is a large-scale disaster. The frequency of "billion dollar" disasters has increased six-fold since the 1980s.[20] Going forward, climate change will lead hurricanes to produce more rainfall and more extreme coastal storm surges.[21]

A disaster hitting a major metropolitan area along the eastern seaboard would be catastrophic, with the potential for loss of life and other health outcomes. The destruction could easily surpass previous levels of damage, given the number of people and the amount of development in these areas. Imagine a 20 foot storm surge in New York City, for instance.[22] The destruction of property means the devaluation of collateral, which would have ripple effects through the financial system. The size of the ripple would depend on the solvency of counterparties in the housing and mortgage market. For instance, many insurers would potentially be unable to pay massive claims, as we are already seeing in Florida, and state-level backstops through guaranty associations may be insufficient.[23] Many mortgage borrowers would default, leaving the banks and especially Fannie Mae, Freddie Mac, and the FHA on the hook for enormous losses. The additional layers of insurance in the system, such as re-insurance for the insurers and private mortgage insurance for the GSEs, would be further stressed.

[15] https://content.naic.org/sites/default/files/CIPR%20Consumer%20property%20ins%20report%208-21_0.pdf

[16] https://www.corelogic.com/press-releases/corelogic-analysis-shows-final-estimated-insured-and-uninsured-damages-for-hurricane-ia

[17] Gourevich, et al. (2023) https://www.nature.com/articles/s41558-023-01594-8

[18] Eby (2023) https://www.budget.senate.gov/imo/media/doc/Mr.%20Matthew%20Eby%20-%20Testimony%20-%20Senate%20Budget%20Committee.pdf

[19] Hurst, et al. (2016) https://www.aeaweb.org/articles?id=10.1257/aer.20151052

[20] 1980s average: 3.1/year; last three years' average: 20/year. See https://www.ncei.noaa.gov/access/billions/summary-stats

[21] https://climate.nasa.gov/news/3184/a-force-of-nature-hurricanes-in-a-changing-climate/

[22] See research suggesting that hurricanes will form and intensify at higher latitudes in coming years: https://www.nature.com/articles/s41561-021-00859-1

[23] Florida Office of Insurance Regulation (2023) https://floir.com/docs-sf/default-source/property-and-casualty/stability-unit-reports/january-2023-isu-report.pdf?sfvrsn=27217354_2

In the event of a large-scale disaster, there would additional costs to federal, state, and local governments offering support to affected households and businesses. I want to pause here and note the complexity of who bears the actual risk in the event of a disaster. Homeowners, insurers, re-insurers, banks, the GSEs, private mortgage insurers, state guaranty funds—all of these groups bear at least a portion of climate risk. But attributing risk to each group is challenging given how opaque the system is and how dependent each entity is on the others. I would therefore encourage regulators to focus on the ability of each entity in the chain to withstand losses from an unprecedentedly large climate-related disaster. As the recent experience of Silicon Valley Bank has taught us, the mark-to-market balance sheets of these entities may be weaker than previously believed given recent swings in interest rates.

My second scenario does not involve a direct disaster, so there are fewer health or mortality consequences and no immediate destruction, but the costs could nonetheless be enormous. Forecasts of sea level rise are highly uncertain, but the latest NOAA "Intermediate Scenario" forecast is 1.3 feet by 2050 and about 4 feet by 2100.[24] However, recent research suggests that the Arctic region is warming four times faster than the rate of the rest of the world.[25] The risks are only increasing in one direction: More melting of the ice sheets and more rapid sea level rise.[26]

As a thought experiment, suppose instead that scientists convincingly documented further deterioration of global ice, and revised their forecasts upward such at the sea level rise forecast was 5 feet by 2050 and 10 feet by 2100. While 10 feet of sea level rise may seem like an extreme scenario, and it is, I want to put this higher range in context.[27] NASA estimates that if all of the world's glaciers and ice sheets melted, global sea level would rise by around 200 feet.[28] So we are still talking about a small fraction of the global ice melting, but melting at a faster rate than currently forecast.

This news would have immediate repercussions to exposed areas. Almost 30,000 square miles of land, currently home to 12 million people, would anticipate being inundated with 10 feet of sea level rise.[29] Property prices should respond well before water is lapping onto doorsteps. Properties are durable assets that should be priced today based on their future livability or usability (present discounted rents). This principle of forward-looking pricing means that changing perceptions of risk rather than an acute disaster should immediately drive asset values downward. Some homeowners or investors may dismiss these types of climate risks for the reason that their impacts are largely "beyond their investment window." In making that claim, they are ignoring the simple fact that at the end of their window, they need to find a buyer of the asset. If buyers incorporate this risk into their valuations, then asset values will be substantially smaller when the current owners attempt to exit their position.

A shock to house prices would lead some homeowners to stop paying their mortgages, putting stress on the banking system and holders of mortgage-backed securities. Insurers would leave the area, unwilling to insure properties at any price. Without insurance, it is virtually impossible to obtain a mortgage, so financing for these properties would dry up. Unlike 2008, when the shock to home prices felt large but ultimately temporary, rising sea levels would induce permanent shocks.

A key difference between these two scenarios is the role that insurance can play in the first but not the second. Insurance is written on annual contracts and helps with immediate extreme events with limited duration. The basic principle is that risks are sufficiently idiosyncratic that they can be pooled and insured against. However, insurance alone generally cannot solve long-term issues or insure against systemic risks. For instance, insuring against long-term sea level rise would require multiyear policies that are not currently offered in the marketplace. Further, insurers are mobile in ways that homeowners are not. When risks increase, we should expect that insurers will retreat much faster than homeowners, as is happening now in California.

[24] Contiguous U.S. intermediate forecast: https://oceanservice.noaa.gov/hazards/sealevelrise/sealevelrise-tech-report.html

[25] Rantanen, et al. (2022) https://www.nature.com/articles/s43247-022-00498-3

[26] See, for instance, last year's report that Greenland's glaciers are melting six or seven times faster than they were 25 years ago: https://www.jpl.nasa.gov/news/nasa-greenland-mission-completes-six-years-of-mapping-unknown-terrain

[27] Some groups are already recommending using this 10 foot threshold to evaluate new property planning and permitting, see e.g. https://www.scientificamerican.com/article/prepare-for-10-feet-of-sea-level-rise-california-commission-tells-coastal-cities/

[28] https://sealevel.nasa.gov/understanding-sea-level/global-sea-level/ice-melt

[29] https://www.climatecentral.org/news/us-with-10-feet-of-sea-level-rise-17428

Concluding Thoughts

In sum, the consequences of re-pricing "neglected" climate risks could have an enormous impact on property, insurance, and mortgage markets. While I have emphasized flood risk in my brief remarks today, other climate-related risks such as wildfires, droughts, or extreme heat could potentially follow similar patterns. These risks are not yet fully internalized by households, banks, the GSEs, or insurers. In addition, these risks are disproportionately borne by lower income groups and racial minorities, who may already live in riskier areas and lack access to financial resources for ex ante preparation or ex post repairs.

In the face of potential disaster, the government can play a critical role in regulating these entities and ensuring that they are sufficiently capitalized to withstand significant climate-related shocks. Government agencies can also further move prices to better align with risks in the markets they directly influence, like flood insurance and mortgages. With flood insurance, the government can draw more accurate maps, more aggressively promote take-up, and develop a means-tested assistance program to help needy households protect their homes.[30] With mortgages, the GSEs can conduct stress tests that better assess the stability of their counterparties to climate-induced shocks, and can incorporate climate risk into their pricing models to end one implicit subsidy for at-risk development. Providing price signals through these markets would also promote investment in adaptation by homeowners and local governments — an area where the federal government also has a role facilitating investments in under-served communities. Finally, the government can help to manage expectations through better disclosure and assessment of climate risks. Potential property owners and homeowners deserve loud and crystal clear warnings of climate-related risks, especially if prices are not providing a sufficient signal on their own.

[30]For additional NFIP policy proposals see testimony by Kousky (2022): https://www.congress.gov/117/meeting/house/114847/witnesses/HMTG-117-BA04-Wstate-KouskyC-20220525.pdf

Figures

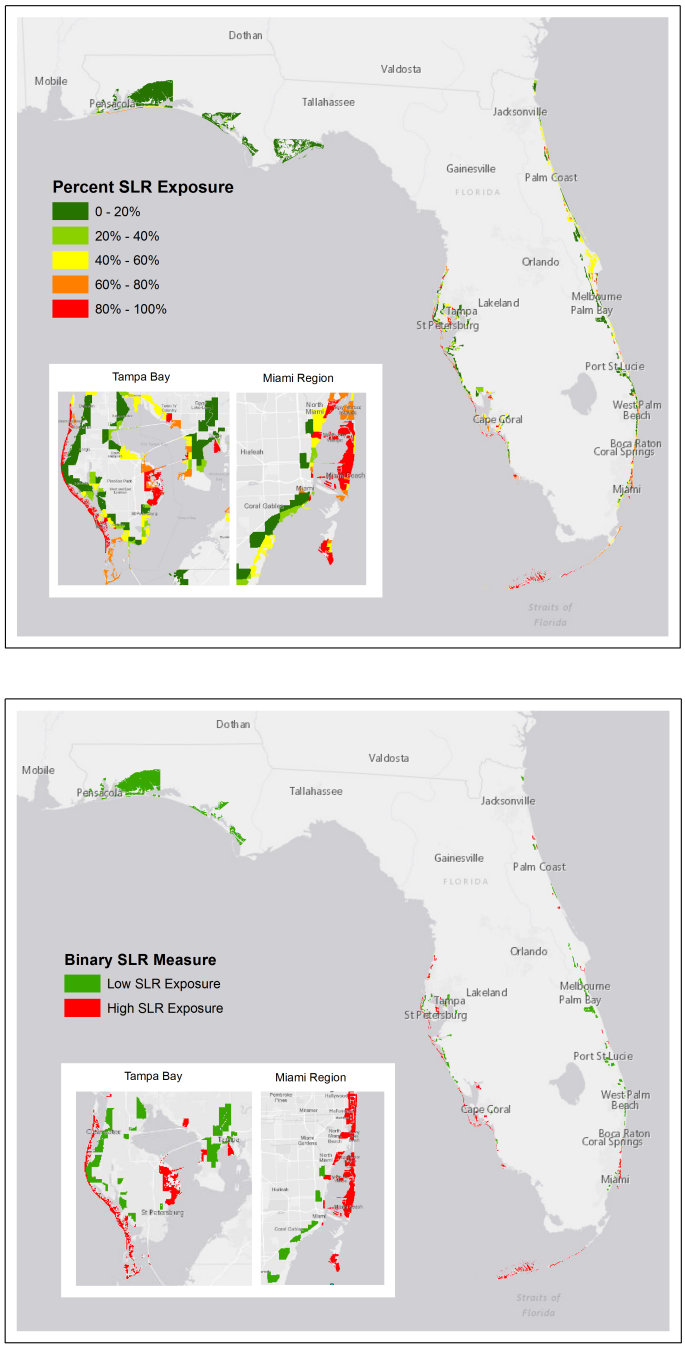

Figure 1: From Keys and Mulder (2020). Maps show SLR exposure for the sample of 771 coastal Florida census tracts. The top panel shows the share of each tract's developed land in 2000 that would be chronically inundated at six feet of SLR. The bottom panel shows the subsample of tracts categorized as either "more-SLR-exposed" ($>$ 70% exposure, 187 tracts) or "less-SLR-exposed" ($<$ 10% exposure, 217 tracts). Sources: NOAA

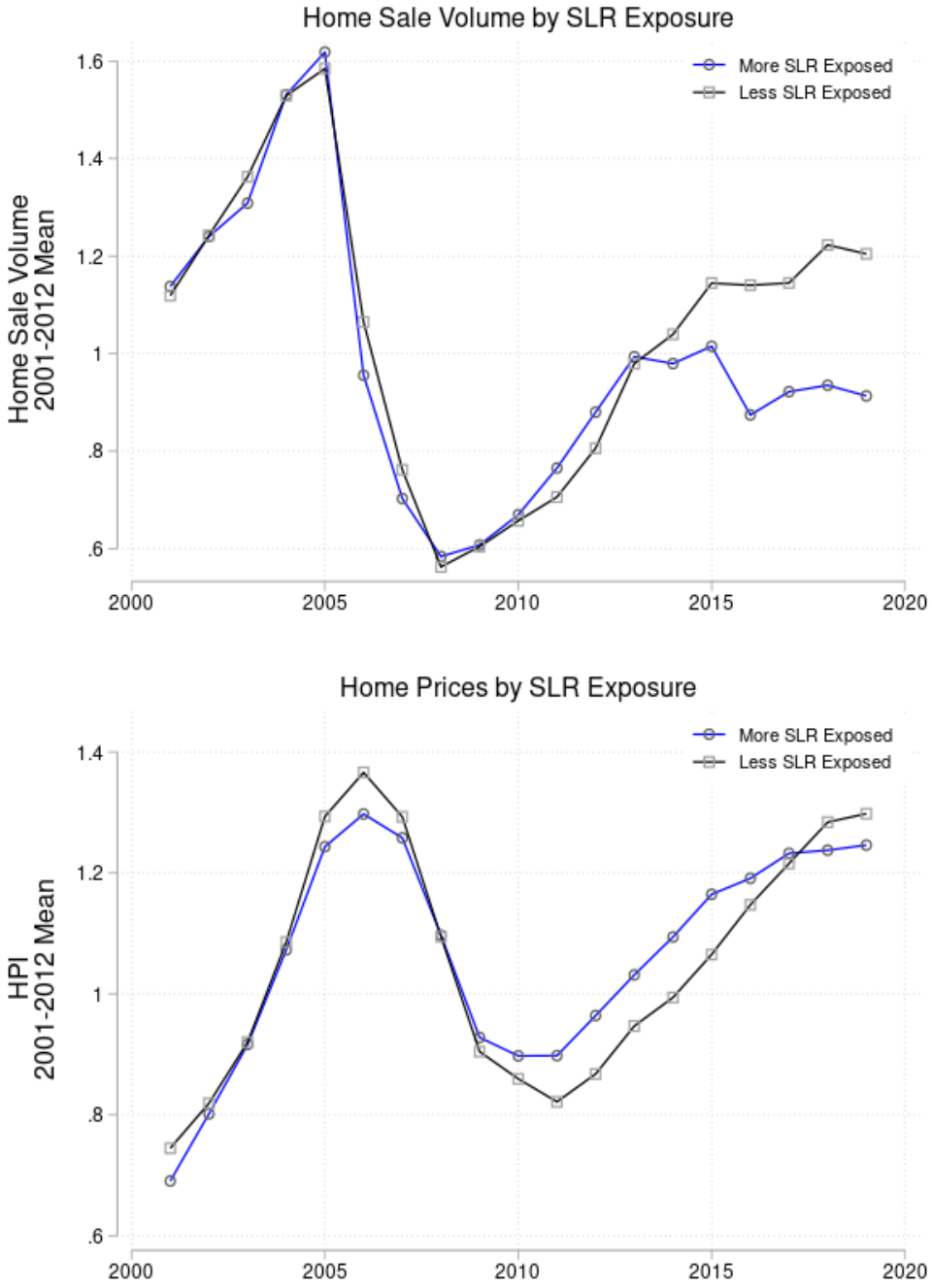

Figure 2: From Keys and Mulder (2020). Housing transaction volume (top panel) and home price (bottom panel) trends in coastal Florida census tracts with high (blue circles) versus low (black squares) SLR exposure. Housing volume and home price index are normalized by their 2001-2012 mean. Sources: NOAA, CoreLogic, Authors' calculations.