

Soaked:

A Policy Agenda to Prepare for a Climate-Triggered Housing Crash

REPORT BY **DR. LINDSAY OWENS**

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Introduction

Climate change has started to batter the residential real estate market, and policymakers are out to sea. Climate risk is not adequately priced into the housing market: It's almost nowhere to be found in current home prices, mortgage insurance rates, or guarantee fees in the secondary mortgage market (Flavelle 2019a). Publicly backed insurance schemes like the National Flood Insurance Program (NFIP) are undersubscribed and underfunded, and the market for private insurance is anemic (Swanson 2017). Stunningly, Fannie Mae and Freddie Mac, which collectively guarantee the majority of residential mortgages, don't formally account for the risks that climate change poses to their portfolio in their capital requirements. In the absence of a major course correction, any climate-induced housing market crash—caused, say, by yet another “once every hundred years flood”—will leave individual homeowners, and entire communities, underwater.

Fannie Mae and Freddie Mac, which collectively guarantee the majority of residential mortgages, don't formally account for the risks that climate change poses to their portfolio in their capital requirements.

The reason policymakers aren't equipped to address this looming crisis is simple: Climate risk isn't yet written into the rules of our housing market. The challenge that lies ahead for policymakers is to use the regulatory apparatus (and legislation, where required) to incorporate climate risk into residential real estate markets to encourage adaptation and transition, without forcing existing homeowners, particularly those in frontline communities, to bear all of the risk. Property value declines driven by natural disasters, or by policy choices that encourage retreat but increase the cost of purchasing in areas at risk of severe weather events, have the potential to substantially undercut the primary source of wealth for many Americans. Frontline communities of color will be especially hard-hit (Milligan 2018). But it will be impossible to implement policies to redistribute equity fairly if policymakers don't get ahead of the storm, and that starts by taking a hard look at where the greatest impacts are likely to be and who is likely to bear the brunt of the devastation.

In this paper, I consider our current, limited options for stemming a potential climate-induced housing crash and propose a suite of new policy options for federal officials to consider. The policies in the paper rely heavily on changes that could be made through

the Federal Housing Finance Administration’s conservatorship of Fannie Mae and Freddie Mac, both because FHFA can act now and because Congress is unlikely to address the risks climate change poses to the residential mortgage market any time soon. Congressional action would require elected representatives to act against their short-term political interests by negatively impacting their local housing markets in the near future to promote resilience and retreat longer-term. The fact that Congress rolled back the NFIP reforms they managed to make in the wake of Hurricane Katrina just two years after their passage due to public backlash against the reforms suggests that pursuing administrative action is a better bet.

Climate risk isn’t yet written into the rules of our housing market.

While many of these policy options could quickly be pursued by a progressive administration even without congressional action, others require a broader rethinking; policymakers and community leaders should begin the process of convening stakeholders—including those who will be directly impacted—to weigh the costs and benefits of different approaches.

First, the federal government should invest in high-quality, asset-level data on all sources of climate risk, including floods, wildfires, sea-level rise, and others. Advances in climate science have begun to make this kind of data collection possible, and companies that provide this data have seen a market beginning to emerge (Shieber 2019). Sophisticated financial institutions like hedge funds are already buying this data (Tett 2019). It is homeowners, less sophisticated banks and financial institutions, and taxpayers who are often unaware of the risks. This data should also be made available to the public, who have a right to know their climate risk, and could be housed in the National Mortgage Database (Appraisal Institute 2012).

Second, regulators must assess the current climate risk in the federal housing portfolio—starting with the more than \$5 trillion in mortgage debt held or guaranteed by the government-sponsored enterprises (GSEs), Fannie Mae and Freddie Mac. According to recent research, Fannie and Freddie may be acting, inadvertently, as a backstop for the declining NFIP: Despite the increasing risk of flooding, the number of Americans with flood insurance remains well below its level a decade ago (Ouazad and Kahn 2019; Flavelle 2019b). To prepare for the possibility of substantial losses at the GSEs over the coming years due to weather events, the Federal Housing Finance Agency should work

with the audit committees at Fannie Mae and Freddie Mac to immediately undertake a climate audit of their single- and multi-family mortgage portfolios and conduct stress tests for climate change scenarios of varying types, severities, and frequencies.

Third, policymakers must consider how existing subsidies designed to encourage homeownership (a place-based asset class) should be modified in light of the intensifying climate crisis. The GSEs currently play a substantial role in facilitating access to homeownership for millions of Americans by providing liquidity for the secondary mortgage market. Armed with good data, and using their existing tools (e.g., guarantee fees), they can shape mortgage pricing and loan terms to encourage prospective homeowners and key stakeholders across all parts of the residential real estate market (e.g., mortgage insurers, lenders, and developers) to better adapt to climate change.

Responses should address two immediate concerns: how to redistribute equity to address the disparate impact of climate change on frontline communities and how to manage retreat by encouraging homeowners to relocate out of geographies that face increasing (and continuous) climate risk.

Finally, Congress and federal regulators must quickly consider a suite of options to assist homeowners in certain at-risk geographies given the no-longer-remote possibility of a major climate-induced housing crash. These responses should address two immediate concerns: how to redistribute equity to address the disparate impact of climate change on frontline communities and how to manage retreat by encouraging homeowners to relocate out of geographies that face increasing (and continuous) climate risk.

A comprehensive accounting of climate risk facing the residential mortgage market will likely produce some frightening results. The release of this information could have immediate impacts on the stock market, and even relatively immediate effects on house prices in certain geographies. But the largest and savviest financial institutions are increasingly aware of these risks and are beginning to make moves to offload or counterbalance them (Tett 2019). It is individual homeowners and taxpayers who are in the dark and who will ultimately bear the risk. If the current pandemic has taught us anything, it is that policymakers should move quickly to put a plan in place for a climate-induced housing crash. The time to plan for a crisis is before it happens.

The Risk

Climate change has increased the frequency and severity of extreme weather events such as wildfires, hurricanes, and tornadoes (NOAA 2019). According to the National Oceanic Atmospheric Association (NOAA), between 1980 and 2019, the average number of inflation-adjusted “billion-dollar” weather events (those causing at least a billion dollars in economic destruction) per year was 6.5 (NOAA 2020). In 2019 alone, there were 14 billion-dollar weather and climate disaster events (three flooding events, eight severe storm events, two tropical cyclone events, and one wildfire event) (NOAA 2020). Between 2015 and 2019, billion-dollar disasters cost the United States more than \$525 billion, a record. This increasingly costly disaster trajectory is only expected to grow in the coming years, as policymakers fail to stem global greenhouse gas emissions and warming continues.

Weather events can cause substantial economic losses, a large part of which stem from damage to residential real estate. Approximately 40 percent of Americans reside in counties that lie directly on the shoreline and bear the brunt of severe storm events (NOAA 2013). On top of those at risk of coastal flooding, an additional 41 million Americans are at risk from flooding rivers (Floodlist 2018). Indirect climate effects, such as wildfires, pose credible risks as well. Warming temperatures have lengthened the fire season and set new records (Milman 2018). Twenty-nine million Americans live in locations at high risk of wildfires (Pierre-Lewis 2018).

The population at risk of experiencing a major weather event in the coming years is clearly vast. Yet it is difficult to predict the full extent of climate-induced economic losses to the residential real estate market because policymakers lack good data on property-level climate risk. Even in the absence of comprehensive risk estimates, though, it is clearly a matter of when, not if, the storm will hit.

The mortgage market’s exposure to flooding alone “could be as large as the losses due to the subprime crisis”.

There are some rough estimates of the damage sea-level rise and flooding will cause to the residential real estate market in the US. The chief economist at Freddie Mac recently estimated that sea-level rise alone could destroy “billions of dollars in property” and

displace millions of people with impacts greater than those experienced during the housing crisis and Great Recession (Peterson 2019). Susan Wachter, a professor of real estate and finance at the University of Pennsylvania's Wharton School has said that the mortgage market's exposure to flooding alone "could be as large as the losses due to the subprime crisis" (Flavelle 2019c).

Sharper estimates of the risk posed by sea-level rise and flooding are starting to be produced for coastal properties. According to a conservative estimate from a 2018 report by the Union of Concerned Scientists, in the contiguous US, sea-level rise alone—even absent heavy rains or storms—will put more than 300,000 homes and commercial properties (valued at about \$136 billion) at risk of chronic, disruptive flooding by 2045 (within the life of a traditional 30-year mortgage issued today) (UCS 2018, 2). This figure is expected to increase exponentially, with close to 2.5 million residential and commercial properties, collectively valued at \$1.07 trillion in today's dollars, at risk of flooding by the century's end (UCS 2018, 2). These properties house an estimated 4.7 million people, the equivalent of the entire population of Louisiana, with economic losses equivalent to the entire gross domestic product of Florida (Sisson 2018).

Estimates of even more granular locations predict deeper destruction, bigger economic hits, and quicker timelines. According to a recent study by Jupiter Intelligence examining the climate risk posed to the residential real estate market in Miami-Dade County over just the next decade, "Miami-Dade County as a whole will see a 26 percent increase in properties affected by moderate flooding . . . and a 59 percent rise in properties damaged by extreme floods . . ." To put a finer point on it, the authors of this report are predicting a massive increase in climate-driven property damage in the next decade in the seventh most populous county in the US (Jupiter Intelligence 2020, 2). They expect this damage will result in significant economic losses, including drops in property values, pressure on mortgage approvals and loan rates, and significant strains on municipal finances.

Legacy properties (those built before we had a better understanding of the risks of sea-level rise) constitute the majority of properties at risk of weather-related damage. According to the Union of Concerned Scientists report, "fifteen to twenty percent of the at-risk homes . . . in both Florida and New Jersey were built after the year 2000 . . . and roughly 2,600 of the coastal New Jersey homes . . . were built or rebuilt after Hurricane Sandy devastated the region in 2012" (UCS 2018, 7). The NFIP actually incentivizes so-called "repetitive loss" (or rebuilding homes in the same location after a

major storm) because the program does not cap the number of claims that can be filed on an individual property. In fact, repetitive loss properties (those the NFIP has paid at least two claims on) and severe repetitive loss properties (those the NFIP has paid at least four claims on) make up a disproportionate share of NFIP claims and in some cases have received NFIP payments totaling more than the value of the property (The Pew Charitable Trusts 2016). These perverse incentives are setting us up for a climate-induced housing crash, and unless we make changes soon, continued development in regions with the highest level of climate risk will only exacerbate our already precarious financial position.

Perverse incentives are setting us up for a climate-induced housing crash.

RISK TO THE GSES

The climate crisis poses considerable risk to the residential mortgage market, and the risk will be borne by a diverse array of players throughout the entire residential real estate ecosystem, from municipalities that will see their property tax base shrink, to individual borrowers, to the GSEs. According to recent research by Amine Ouazad and Matthew Khan, Fannie Mae and Freddie Mac, which collectively hold or guarantee more than \$5 trillion in mortgage debt, have likely become an “implicit” insurer for the most at-risk properties in the face of a declining National Flood Insurance Program (Ouazad and Kahn 2018, 3). Unlike commercial banks, which can screen and price mortgages for flood risk, Fannie and Freddie determine whether to acquire a single-family loan from lenders to securitize according to rules set by the Federal Housing Finance Agency, which oversees them. They do not currently price or decline to buy mortgages based on climate risk, aside from guidelines that prohibit them from securing loans that are located in so-called special flood hazard zones that are not insured by the NFIP (and those policies can lapse after the GSEs purchase the mortgage) (Ouazad and Kahn 2018).

Given the GSE’s inability to decline to buy mortgages that otherwise meet the GSE’s credit rating and size standards, Ouazad and Kahn set out to test whether commercial banks are selling their worst flood risk to Fannie and Freddie, without any financial penalties. They did this by examining whether there was an increase in lenders’ sales of mortgages with loan amounts right below the so-called conforming loan limit (the loan amount

over which Fannie and Freddie cannot purchase the mortgage) following billion-dollar weather events (as determined by NOAA). They found that there was indeed a significant increase in securitization activity at or around the conforming loan level in the years following a disaster (Ouazad and Kahn 2018, 1). They further determined that this activity was higher in regions where there was a new disaster (versus regions with a history of hurricanes). In other words, Fannie and Freddie are buying the riskiest mortgage debt, incentivizing continued lending in high-risk areas (or, alternatively, providing no incentive to lenders or households to choose safer locations in the face of increasing climate risk) (Ouazad and Kahn 2018).

Fannie and Freddie are buying the riskiest mortgage debt, incentivizing continued lending in high-risk areas (or, alternatively, providing no incentive to lenders or households to choose safer locations in the face of increasing climate risk).

The study also suggests that banks are shielding themselves from climate risk by passing the riskiest loans—those in coastal areas with higher likelihoods of experiencing damage from flooding—along to taxpayers. A second recent study finds that local lenders are selling off coastal mortgages fastest, moving the highest-risk properties off their balance sheets (Keenan and Bradt 2020). This shell game is familiar to students of the 2008 housing crash, in which banks privatized the gains from an overly hot mortgage market by profiting off of fee income on originations and securitizations, and ultimately passed the losses along to homeowners and taxpayers. The primary difference is that the declining property values during the crash were likely to rebound. Many of the properties in this study population—including the \$60 to \$100 billion in new mortgages for coastal properties issued each year—will literally be underwater (Ouazad and Kahn 2018).

These studies are alarming given the recent memory of the subprime crisis, but it points to another critical issue that needs to be addressed in order to manage the fallout from a climate-driven housing crash: information asymmetries. Smaller local banks, who have more familiarity with local geography, are actually selling off coastal mortgages fastest (Keenan and Bradt 2020). Small banks are relying on detailed geographic knowledge only known to locals, large banks are buying sophisticated climate data, and the federal government is in the dark. This asymmetry is setting

taxpayers up to be the patsy when the next housing downturn strikes. Ultimately, the federal government will have to step in, as any major stress to Fannie and Freddie could result in serious liquidity challenges for the secondary mortgage market—effectively grinding the primary market to a halt.

Further, given that FHFA Director Calabria plans to privatize the GSEs and has hired an adviser to help with that process, there is a very real risk that current profits will be privatized and flow to new shareholders while taxpayers are still on the hook for climate risk because of the GSEs' continuing implicit guarantee from the federal government.

RISK TO INDIVIDUAL HOMEOWNERS

The GSEs are not the only entity that will bear the risk of a climate-induced housing downturn. Homeowners will too. In the absence of robust public or private flood insurance coverage, most homeowners will not have the resources to repair damage to their homes. In the wake of Hurricane Harvey, the average dollar amount of assistance from FEMA for homeowners who were not insured by the NFIP was \$4,000—not enough to replace an HVAC system, yet alone cover substantial property damage (Gromowski 2018).

Many homeowners will not consider repairing the damage worthwhile given the likelihood of a subsequent weather event or declines in property values. These homeowners will stop paying their mortgages, stop investing in repairs, and walk away from their homes. There is some evidence that individuals are beginning to structure coastal mortgages to make it easier to walk away (Flavelle 2020). Still other homeowners will rebuild in the same location, largely because the NFIP incentivizes this, once again positioning themselves in harm's way. Although FEMA does offer a buyout program, these transactions move too slowly (i.e., over the course of years) to be a viable option in the aftermath of a storm (Poon 2019).

Property devastation from storms and fires causes a surge in mortgage delinquencies and defaults, including among homeowners whose homes aren't damaged but who experience income disruption, frequently as a result of business closures and resulting layoffs. According to research in the wake of Hurricane Harvey, there was a 205 percent increase in the 90-day delinquency rate for properties that experienced damage and a 167 percent for those homes that did not experience damage but were in FEMA-designated counties (Gromowski 2018).

Increases in foreclosures follow increases in delinquencies, and blight is not far behind. Because mortgage defaults caused by weather events are correlated, even a relatively small number of foreclosures and abandoned properties in an area can result in substantial price drops for neighboring properties, eventually impacting local markets more broadly (Hartley 2010). Vacancy rates also have independent, and negative, effects on property values (Sisson 2019). Properties in “chronically inundated” areas will continue to see further price drops.

Damage to even a small number of residential properties can have substantial spillover effects. This was a significant reason the housing market didn’t recover as quickly as policymakers had hoped during the 2008 housing crash. During the crash, however, there was an expectation that housing values would eventually recover, incentivizing homeowners to continue paying their mortgages. In areas impacted by increasingly frequent and severe floods and climate-driven weather events, there is likely to be no such similar expectation, increasing the likelihood that homeowners will stop making mortgage payments altogether and driving a vicious cycle of foreclosures, vacancies, and declining property values.

A century of racist housing policies including restrictive covenants, redlining, and segregation put Black and brown homeowners in the lowest-lying areas.

Communities of color are even more likely to be impacted by climate change and to experience blight and abandonment, as they are less likely than white communities to be aided and rebuilt. In part, this is because a century of racist housing policies including restrictive covenants, redlining, and segregation put Black and brown homeowners in the lowest-lying areas. But it is also because local and federal responses to disasters have been incredibly unequal. In the wake of Hurricane Katrina, grants offered to homeowners in order to rebuild were based on preexisting home values. Families that lived in predominantly Black neighborhoods were more likely to have lower home values, in part because of the history of discriminatory redlining, and therefore received less grant money. This money was frequently less than the cost of actual repairs, leading Black families to abandon their homes and relocate.

RISK TO MUNICIPALITIES

Local property values have spillover effects that extend beyond housing prices. According to one report, at-risk properties may represent more than 20 percent of local tax bases (UCS 2018, 5). Lost property values translate directly into lost property tax revenue, further straining local governments that need resources to rebuild lost infrastructure and try to make existing infrastructure more resilient by pursuing critical adaptation measures (UCS 2018, 3). Declining revenue will also impact the ability of a city to pay back municipal bondholders, a fact that rating agencies like Moody's are beginning to take into account when determining a city's credit rating, and thus its future financing costs (Flavelle 2019a).

The impacts of shrinking tax bases and tightening purse strings aren't felt equally by all groups. Low-income residents and residents of color are particularly hard-hit as cities cut services, impose regressive new taxes (like sales tax increases), and privatize essential services like garbage, sewers, and parking, passing costs along to residents. Public sector furloughs also hit Black workers disproportionately, as they are 30 percent more likely to be employed by the public sector than other workers. Cities also ramp up fines and fees, including court fees, incentivizing over-criminalization that also hits Black and brown residents hardest because of racial discrimination throughout policing and law enforcement agencies. It's clear that the direct and indirect effects of a climate-induced housing crash on communities of color are substantial and outsized.

As we saw in the 2008 housing crash, when a substantial number of mortgage delinquencies and property value declines occur, the ramifications are felt throughout the economy. In addition to the impact on homeowners and municipal governments, and the strains placed on FEMA and the NFIP, climate-induced housing price declines will also impact private insurance carriers, mortgage lenders, reinsurance carriers, commercial and community banks, private investors, private securitizations, the GSEs, and other federal agencies including Ginnie Mae, the Federal Housing Administration, and the Veterans Administration. As we learned in the 2008 crash, the backstop for all of these players is the federal government.

Policy Solutions

As the climate crisis continues, weather events will be more frequent and more severe. It is abundantly clear that climate change poses a serious threat to residential real estate markets in many geographies, with homeowners in frontline communities especially vulnerable to its impacts. Billions of dollars in property damage are imminent, and the consequences of this damage will result in foreclosures, vacancies, and blight that will reverberate throughout the economy, impacting individual homeowners, municipal tax bases, small and large banks and financial institutions, and the federal government.

Property damage is expensive to repair, and absent significant changes in private and public insurance markets, most homeowners will not be able to cope with the fallout from these disasters on their own. Further, given substantial disclosure and data limitations, many homeowners are wholly unaware of the climate risks they face. It is also unclear whether insuring individual properties is a prudent recourse in light of the expected increase in frequency of many perils and the highly correlated nature of climate risk. If the wildfire insurance market in California is a guide, a market for private homeowner's insurance may be no match for the scale and scope of the crisis we face. Furthermore, public insurance schemes, primarily the NFIP, insure only a fraction of the at-risk population, and are actually incentivizing continued investment in the highest-risk geographies, exacerbating the economic devastation for these homeowners and jeopardizing the solvency of the program. It is past time for policymakers to assess the risks posed to homeowners and taxpayers by climate change and to take steps to mitigate those risks by implementing policies that encourage equitable adaptation and transition.

INVEST IN ASSET-LEVEL DATA ON COMMON PERILS

Policymakers should consider a different approach, one that starts with significant investments in high-quality, asset-level data on the future risks posed by specific perils. Before we can develop sound policy to stem the real estate losses posed by weather events, we must have a decent handle on the scale and scope of the problem. Companies like Jupiter Intelligence are generating this data, and sophisticated financial institutions are buying it.

The Federal Housing Finance Agency should work with NOAA and FEMA to purchase this data or develop similar data in-house. Fannie and Freddie are widely considered to have market-leading data and technology, so it was stunning when Mark Calabria, the Director of FHFA, admitted this past February that Fannie and Freddie do not have the capacity to analyze the flood risk on their books, yet alone the risk from other perils including wildfire and wind (Colman 2020). Calabria has put in place a new Division of Research and Statistics, tasked with collecting initial data on the topic, but there is no indication yet of how comprehensive this data will be or how long it will take FHFA to procure it.

Everyone should have a right to know their climate risk.

Once this data is available, it should also be used to update FEMA's flood risk maps, so that they reflect the probability of future risks, not just historical risks. But this data should also ultimately be made publicly available to homebuyers, lenders, and investors, so they have an accurate picture of the risks posed by sea-level rise, coastal and river flooding, wildfires, and other perils before they invest. Everyone should have a right to know their climate risk. This data could be housed in the National Mortgage Database, which was developed in partnership with FHFA and the Consumer Financial Protection Bureau. Good data—followed by the implementation of national standards for disclosure for all residential real estate transactions—would make coastal and inland real estate markets more transparent, and ultimately facilitate adaptation and importantly, retreat, through more accurate pricing of climate-related risks.

PERFORM A CLIMATE AUDIT OF THE GSES

Once we have high-quality, asset-level data at our disposal, federal regulators will have the raw materials they need to assess the current climate risk in the federal housing portfolio. Recent research has made clear that the GSEs are acting as an implicit insurer, securitizing the loans at greatest risk of weather-related default, and effectively cross-subsidizing at-risk homeowners with homeowners who live out of harm's way. Given that these entities (along with FHA and VA) hold about 60 percent of the \$11 trillion in mortgage debt in the US, they could possess substantial exposure in the face of the increasing frequency and severity of climate-related disasters.

Fannie and Freddie should immediately undertake a “climate audit” to properly account for the financial risk the GSEs have assumed by securitizing loans at varying risk of weather-related default, including exposure to storm surges, increased nuisance flooding, sea-level rise, and wildfires. To limit the potential impact of this audit on share prices, this should happen while Fannie and Freddie are still in conservatorship. These audits should be jointly overseen by FHFA and by Fannie and Freddie’s audit committees, which are composed of independent directors charged with overseeing the accounting and financial practices of the entities, including their financial statements. They should contract with outside auditors, climate experts, and actuaries to undertake this audit. The audit should also include a series of stress tests to determine the potential economic fallout they face under a variety of different best- and worst-case scenarios across geographies and time horizons (e.g., a summer with multiple major storms and fires hitting major metropolitan areas in quick succession).

Fannie and Freddie should immediately undertake a “climate audit” to properly account for the financial risk the GSEs have assumed by securitizing loans at varying risk of weather-related default.

Congress should demand that FHFA begin collecting data and auditing their books for climate risk as soon as possible. Because the GSEs are in conservatorship, FHFA has the mandate to pursue this type of analysis, and the control over the officers, directors, and shareholders of the GSEs to ensure that it happens. Given the critical role the GSEs play in providing liquidity to the mortgage market, any major shock to their solvency would have serious consequences for financial and real estate markets. Once the risk has been identified, the GSEs may need to take immediate steps to increase their reserves, and Congress should hold them accountable until they do so.

WRITE CLIMATE INTO HOUSING RULES

Data will not be a panacea, however. Even in regions like Miami-Dade, where flood risk is relatively well understood, the risk is not yet adequately priced into markets; developers continue to build, and buyers continue to buy (Jupiter Intelligence 2020; Warren 2019). If places facing significant, immediate, weather-related risks aren’t

yet adapting to climate change, something has to give. According to a new working paper from the National Bureau of Economic Research, homes in floodplains may be overvalued by as much as \$34 billion (Hino and Burke 2020). This is why once regulators have assessed the scope and severity of climate risk to the federal housing portfolio, the GSEs should use their enormous leverage to incorporate that risk into the rules governing the housing market.

The GSEs operate according to a few clear rules. First, they can only purchase conforming loans. Conforming loans are loans that are less than the “conforming loan limit,” a cap for the mortgage amount above which the GSEs cannot secure a mortgage.¹ Second, Fannie and Freddie charge lenders guarantee-fees (g-fees) when they acquire their single-family loans. G-fees include up-front fees (one-time fees when the lender sells the loan to the GSEs) and ongoing fees (paid each month over the life of the loan). Since 2007, Fannie and Freddie have also been required by FHFA to charge “loan-level pricing adjustments” as part of the g-fees. The LLPAs vary by borrower FICO score, the loan-to-value ratio for the home, and by mortgage product type.

G-fees are critical for ensuring the safety and soundness of Fannie and Freddie—and they cover four important costs of providing the credit guarantee. These costs include the expected costs of default, a small (10 basis points) fee that goes to the Treasury, the costs of administrative expenses, and the costs of holding the capital necessary to protect against the potential of catastrophic losses from loan defaults. The final cost is by far the most significant and a clear lever for pricing based on climate risk.

Stakeholders interested in climate change and the residential real estate market should submit comments encouraging FHFA to include climate risk in capital requirements, carrying this risk through to g-fees, and therefore prices.

At the end of 2019, FHFA announced they would be re-proposing the so-called Enterprise Capital Rule, which determines the amount of capital the GSEs should hold to properly support their risk and ensure that taxpayers will not have to foot the bill in another economic downturn. When FHFA notices this rulemaking, they should

¹ This cap can vary based on geography (it increases in more expensive real estate markets).

encourage the solicitation of comments on what kind of capital would be required to cover a climate-induced housing crash. Stakeholders interested in climate change and the residential real estate market should submit comments encouraging FHFA to include climate risk in capital requirements, carrying this risk through to g-fees, and therefore prices. Ensuring that mortgage pricing reflects climate risk will begin the process of adaptation and retreat, in part by decreasing the cost of purchasing in areas with the lowest climate risk.

FHFA also has another lever for facilitating pricing based on climate risk—their control of private mortgage insurance standards. To insure loans acquired by Fannie Mae and Freddie Mac, private mortgage insurers must meet FHFA’s Private Mortgage Insurer Eligibility Requirements (PMIERS). PMIERS include a requirement to ensure that insurers have adequate liquidity (and the ability to pay claims) during periods of economic stress (i.e., a capital requirement) and a requirement to identify, measure, and manage exposure (Freddie Mac 2018). Once FHFA finalizes their Enterprise Capital Rule to include an accounting of climate risk, they should carry this through to the mortgage insurance market by repurposing the capital rules for PMIERS.

Pricing for climate risk is a form of geographic risk-based pricing and should be undertaken thoughtfully and cautiously, with an eye toward minimizing disparate impacts. The notice-and-comment process for rulemaking can be a good forum for ensuring that many parties have the ability to comment on this proposal, including fair housing experts and advocates, climate scientists, and local officials from areas that would be most impacted by this type of pricing. Members of frontline communities should provide input as well. FHFA and commenters should also consider whether climate pricing should be fixed or variable across different geographies and perils and whether the fee should be administered on a one-time or ongoing basis.

Ensuring that climate risk is priced into the mortgage insurance and secondary mortgage markets will have a considerable impact on prices in the residential real estate market. Although (appropriate) risk-based pricing isn’t the only tool at regulators’ disposal for managing adaptation and retreat, it is a critical one. All market actors, from developers to lenders to investors to homeowners, will immediately respond to price increases, decreasing the likelihood that new properties will be built and purchased in areas at risk of chronic coastal and river flooding, wildfires, and other perils. Although risk-based pricing may facilitate retreat in some of the most at-risk communities, it can also facilitate investment. Accurate pricing based on climate risk implies discounted

rates for properties at certain elevations and in safer geographies, making new investments in those areas more cost-effective. It also reverses the current trend of homeowners in safer areas subsidizing homeowners in riskier areas. FHFA could even begin to incentivize properties that meet certain construction standards (like California has for seismic activity) using g-fees, facilitating the proliferation of adaptation and resilience measures throughout the industry. These types of incentives could be facilitated by incorporating climate readiness into appraisal standards in the Uniform Appraisal Dataset at the GSEs.

Accurate pricing based on climate risk implies discounted rates for properties at certain elevations and in safer geographies, making new investments in those areas more cost-effective.

Changing capital requirements is not a small feat, and lobbying efforts by those with short-term financial stakes in the status quo will be vociferous. But the task is made somewhat easier by the fact that the GSEs are under the conservatorship of FHFA, which regulates underwriting and lending decisions, obviating the need for Congress to pass legislation to allow the GSEs to begin making these critical moves. FHFA has a statutory obligation to 1) ensure the safety and soundness of the enterprises and 2) foster a liquid national housing market (Federal Housing Finance Agency 2015). Any attempts to better understand their climate exposure and any moves they might make to better price climate risk into the mortgage market would surely meet these statutory objectives. To ensure that FHFA prioritizes incorporating climate risk into the rules for mortgage insurance and guarantee fees, Congress should continue to exercise their oversight authority over FHFA. These changes will help to prepare homeowners, taxpayers, the mortgage market, and the GSEs for a climate-induced housing crash.

FRONTLINE EQUITY REDISTRIBUTION AND INVESTMENT FUND

Accurate pricing based on climate risk will result in substantial home price declines in certain areas and is likely to precipitate broader disinvestment in those neighborhoods and communities as well. But so too will increasingly frequent and severe storms. Federal and local policymakers must prepare for oncoming blight, defaults, foreclosures,

abandoned properties, and shrinking tax bases. Many homeowners will be literally, and financially, underwater. Even homeowners who narrowly escape physical damage to their properties could still see their hard-earned equity vanish as neighboring vacancies drive down prices. But simply implementing risk-based pricing to encourage retreat won't be enough. Policymakers must pair pricing changes with robust investments in infrastructure in new communities and with a program to redistribute equity fairly to homeowners in frontline communities that will be most impacted by these pricing changes and may have the least ability to leave.

Policymakers must pair pricing changes with robust investments in infrastructure in new communities and with a program to redistribute equity fairly to homeowners in frontline communities that will be most impacted by these pricing changes and may have the least ability to leave.

One option for ensuring that individuals who have built equity over decades don't see their wealth evaporate after the storm is to set up a well-resourced, federally financed and administered frontline equity redistribution and investment fund to give some equity back to these homeowners if they are willing to relocate. Frontline Equity Redistribution and Investment (FERI) program funding could be loosely based on the Hardest Hit Fund the Obama administration set up in the wake of the housing crash in 2011 to help assist communities with particularly high rates of unemployment (above the national average) and house price depreciation (at least 20 percent). These funds went to 18 states and the District of Columbia and were used for principal reduction, blight elimination, and to assist homeowners who were transitioning out of their homes and into more affordable residences.

Homeowners in areas where sea-level rise renders houses uninhabitable or where the continued frequency of disasters like wildfires and floods makes rebuilding illogical would be eligible for the program, but only residents who were located in these regions prior to the creation of FERI would be eligible for funding to prevent any moral hazard. Funding could be used to allow the federal government to buy out homeowners in markets at risk of being hit hard by climate change. To ensure that these homeowners could recoup some of their lost equity, the government would buy these homes at

a price point between the current market value and the price the home would have been expected to sell for prior to climate-induced price declines. This equity recovery premium would incentivize retreat but do so in an equitable way to help homeowners and families relocate to safer and more secure housing.

The design details of this type of program will be incredibly important, and federal housing officials, members of Congress, climate justice leaders, fair housing authorities, climate scientists, homeowners in frontline communities, and city officials should develop them jointly to ensure that the voices of all stakeholders are heard. Though the devil will be in the details, the program's "North Star" should be simple: ensure that the funds are used to redistribute equity in a way that addresses the disparate impact of climate change on low-income communities and communities of color, based on the preferences of members of those communities.

A fund of this nature can—and should—be set up now, to manage retreat before a storm hits by compensating homeowners for relocating out of geographies that face increasing (or continuous) risk. The fund would have precisely the opposite incentives of the NFIP, which effectively protects the equity of an investment on the back end by allowing homeowners to rebuild in the same location after a weather event. After a storm hits, FERI can still be used to redistribute equity and to assist homeowners in relocating.

Managing retreat out of at-risk geographies is not enough. We must also invest in the success of these families and homeowners in their new locations. To ensure that homeowners have real economic opportunity and the ability to own homes again once they relocate, the FERI program would also invest in infrastructure and new construction in new locales and provide low- or no-cost relocation financing. Subsidized relocation financing moves beyond just managing the fallout of retreat in an equitable way by giving homeowners a leg up in their new community. It is also relatively inexpensive in the current interest rate environment. The program could also go further, offering homestead grants to relocating families, facilitating a significant redistribution of wealth to members of communities who have been the victims of a century of racist housing policies that put them in harm's way in the first place.

Leaving long-standing communities is emotionally and financially difficult, and rebuilding social and economic ties will not happen overnight. Making concerted federal investments in areas that are more resilient to climate change, and ensuring that any new infrastructure or housing built in these locales is energy-efficient and resilient,

as well as affordable, will help facilitate the process of adaptation and move the housing market and our communities onto surer footing.

Homeowners in safer locales are already subsidizing homeowners in riskier ones. Pricing based on climate risk will help to level the playing field.

Although critics may argue that a federally funded equity redistribution fund socializes some of the risks of climate change, our current system does too. As in the aftermath of the housing crash, taxpayers will still be the ones on the hook for any funding issues at the GSEs, and the taxpayers living in areas less impacted by climate change will be paying the same as those who living in hard-hit areas. Additionally, absent major reforms to the NFIP, taxpayers who do not live in floodplains will continue to supplement and subsidize inadequate funding for those who do. In other words, homeowners in safer locales are already subsidizing homeowners in riskier ones. Pricing based on climate risk will help to level the playing field, and managing retreat in an equitable way will ensure that the effects of those price changes don't hit frontline communities disproportionately.

Neither Public Nor Private Insurance Can Sufficiently Restructure The Housing Market

Historically, policymakers who want to address the risks climate change pose to the residential mortgage market have focused on reforming the NFIP, not the GSEs. Admittedly, the policy solutions in this paper rely heavily on FHFA's conservatorship of the GSEs and the GSEs' existing authorities (e.g., g-fees, PMIERS) in the secondary mortgage and mortgage insurance markets given their market share. But another reason to rely on FHFA is that Congress is unlikely to address the risks climate change poses to the residential mortgage market any time soon, since it would require a number of members to act against their short-term political interest by imposing on their local housing markets discipline that could dampen house prices.

As we've seen from Congress's attempts to reform the NFIP, this is an incredibly unlikely scenario. Though Congress did finally make decades-overdue reforms to the NFIP in 2012 to stop subsidizing building in flood-prone areas, they went on to reverse themselves in 2014, largely in response to outcries by coastal homeowners who saw their insurance rates skyrocket. A full explanation of the NFIP is beyond the scope of this paper, and many state, local, and federal policymakers and community members are working to try to reform this program. Nonetheless, given that the NFIP is the nation's largest source of weather-related insurance, it is worth explaining why the program is no match for the scope of this problem.

There are a number of issues with the NFIP. First, the flood maps used to determine coverage areas are outdated and inaccurate and rely on historical data that doesn't take climate change projections and trajectories into account. The pace of climate change is quickening, and relying on historical data will not suffice. Flawed maps have resulted in incredibly low coverage rates for recent storms. For example, only 20 percent of homeowners impacted by Hurricane Harvey had flood insurance. Although FEMA is undertaking an updated mapping program, it is too early to tell whether the updated maps will better align with flood incidence. Further, the most significant difficulty municipalities face when updating their maps is a political one: Flood insurance drives up the price of buying a house in Special Flood Hazard Areas (SFHAs), incentivizing developers, realtors, and even homeowners to keep map coverage limited.

Second, although federal financial regulatory agencies will not secure loans without flood insurance coverage in SFHAs, coverage rates are still very low. Recent research suggests that only about 30 percent of homeowners in SFHAs are covered by flood insurance (Kousky 2018). According to the most recent data from FEMA, there are currently about 5 million flood insurance policies in effect nationwide, representing about \$1.27 trillion in coverage (Federal Emergency Management Agency 2019). There are about 41 million people living in SFHAs. Some of this coverage gap is the result of lax enforcement, but a big part of it is that homeowners let their coverage lapse (flood insurance needs to be renewed every year, but many homeowners fail to do so). Additionally, nonbank mortgage lenders do not have to require that homeowners in SFHAs purchase flood insurance since they are not regulated under the safety and soundness requirements of federal regulators (Klimkiewicz, Hood, and Lim 2017).

Finally, the National Flood Insurance Program is woefully underfunded. Congress has passed 14 short-term extensions of flood insurance, and there is no emerging consensus on how to reform the program. Not surprisingly, claims are on the rise: More than \$10 billion in claims were paid out from Hurricane Sandy in 2012, and more than \$20 billion were paid in 2017 for Hurricanes Harvey, Irma, and Maria. The flood insurance program loses about \$1.4 billion every year and is currently about \$20 billion in debt (Sigaud 2018). This is largely because the program's premiums don't accurately reflect the risk properties face (in part, because of outdated maps), leading to shortfalls. FEMA is currently poorly equipped to price risk given data limitations, and until recently, because there was only a limited market for private flood insurance, commercial vendors had not invested resources in developing better risk modeling.

Although the flood insurance program should be modernized by using better risk-based pricing, updated maps, and predictive modeling, it is not ready to meet the enormous challenges climate change poses to the residential real estate market, and it is strictly limited to covering flood damage. Further, although the NFIP also requires participating communities to adopt and enforce minimum construction standards and land regulations to increase resilience, it is primarily a backstop (as insurance typically is) for property damage and has not yet been used to effectively incentivize communities to adapt to climate change. Perhaps most importantly, the program perversely incentivizes rebuilding in high-risk areas (a form of moral hazard) at a time when policymakers should be considering best practices for encouraging and managing retreat.

Given the political challenges at both the federal and local levels of reforming the NFIP, some analysts have suggested that Congress replace or supplement the NFIP with a private market for flood insurance. This would be a mistake. First, state insurance regulators are not up to the task of adequately protecting policyholders. Early evidence out of the pandemic suggests that state regulators are considering new rules requiring insurers to offer business interruption insurance coverage for COVID-19 claims because so many policies had virus exclusions. It would have been better for state regulators to have anticipated this type of scenario in the first place (Hay 2020).

Second, there is not a robust private insurance market covering any of the major climate-driven perils that put residential real estate at risk. There is a small market for private flood insurance, but these policies are largely concentrated in Florida and primarily cover high-value homes (with property values in excess of the NFIP coverage cap of \$250,000) (Carollo 2020). Standard homeowner's insurance provides some coverage against damage from perils including tornadoes, some wind damage, hail, lightning, and fires, but does not typically cover floods or earthquakes, and policies contain a number of exclusions that can limit coverage from major weather events (Insurance Information Institute 2020). Relying on the private market for weather-related insurance would require a massive scaling up by the private sector and assumes that there is ready capital for this kind of project—something the very recent history of the market for wildfire insurance in California raises serious doubts about.

The California experience calls into question the wisdom of relying on private insurance markets for weather events that are becoming increasingly destructive and expensive. After paying out more than \$24 billion in losses for wildfires in California in 2017 and 2018, insurers began dropping policyholders, all but admitting they'd massively underestimated the cost of climate change. This was a stunning admission from an industry whose profit model is entirely based on accurately predicting risk. But insurance actuaries rely on historical data to predict future risks and simply aren't equipped to predict the results of the relatively rapid changes occasioned by climate change. According to the *New York Times*, the wildfires of 2017 and 2018 alone wiped out a full quarter-century of the industry's profits (Plumer and Flavelle 2019).

Worries about dropped policies were so concerning that this past December, California instated a one-year moratorium on insurers dropping customers in certain wildfire zones covering about a million homes statewide (Serna 2019). California policymakers are in a bind: They can allow insurers to raise prices (though state law only allows them

to raise prices based on historical data, not predictions about the quickening pace of future losses), potentially making insurance policies unaffordable for homeowners; or they can let the insurers drop out of the market or go bankrupt, leaving homeowners with no backstop, which would have devastating ripple effects on California's economy.

The California experience calls into question the wisdom of relying on private insurance markets for weather events that are becoming increasingly destructive and expensive.

Given the substantial losses that climate-driven weather events are poised to have on the residential real estate market, it's sheer fantasy to expect that a private market for insurance will solve this problem. Ultimately, insurance only works well (i.e., is profitable) when there are a small number of uncorrelated claims spread across a large pool of policyholders. As weather events increase in frequency, the model quickly falls apart because of the high correlation of losses from weather events affecting thousands of policyholders simultaneously. As a result, insurers are largely looking for the exit—not a new market.

Alternatively, some private insurers are looking to cherry-pick the lowest-risk properties across the NFIP portfolio and leave the highest-risk properties in a distressed federal NFIP pool—an option FEMA has facilitated under President Trump by allowing private insurers that write NFIP policies to compete with the NFIP on their own book of business. In the absence of a robust private market for climate change insurance (or in the presence of a private insurance market that is only creaming the lowest-risk policyholders), and given the limited likelihood that Congress will reform the NFIP to the extent that is needed given the political difficulties of doing so, beginning to address these problems with the tools of FHFA is appropriate. It may be time to abandon the NFIP altogether.

This is not to say that adjusting home prices to reflect climate risk won't have its own growing pains. For decades, our public policy has encouraged homeownership as the primary means of building wealth and community stability in the US, and we've subsidized homeownership in a number of ways to accomplish this goal. Viewed through this lens, declines in property values driven by the increased cost of purchasing in areas at risk of severe weather have the potential to severely undercut the primary source of wealth for Americans in heavily impacted areas. But these same areas will

also see price drops because of actual devastation from weather events and if pricing changes are well targeted, they will make buying homes in lower-risk areas cheaper, facilitating more resilient investments.

Encouraging retreat through pricing is certainly a big shift. But if policymakers pair these changes with programs to redistribute equity fairly, and also begin investing in communities in safer geographies, they can minimize the impacts of these changes, and even begin the process of developing more resilient communities and markets. Ultimately, policymakers must balance their desire to encourage homeownership with their duty to ensure that Americans are not living in harm's way. We can no longer afford to conduct business as usual. We have to consider policies that manage retreat away from the highest-risk geographies.

Ultimately, policymakers must balance their desire to encourage homeownership with their duty to ensure that Americans are not living in harm's way.

That said, pricing based on climate risk is largely determined geographically, raising the specter and dark history of redlining. Climate-based blue-lining is also cause for some concern, particularly because communities of color are already living in the highest-risk geographies, due in part to racist housing policies. On top of this, communities of color consistently experience disparities in access to sound infrastructure and other public goods (Solomon, Maxwell, and Castro 2019, para.7). In the event of a natural disaster, the road to recovery as it currently stands will be long and hard for these already underfunded communities (Milligan 2018), and if history is any guide, local and federal recovery efforts will come with disparate impacts of their own.

This is not a reason to do nothing; homeowners of color will almost certainly experience the deepest economic destruction in the wake of a climate-induced housing crash and they are less likely to have insurance or the resources to rebuild. But this is why it is so important to design a just transition that redistributes housing wealth fairly and begin the process of retreat and relocation now, in the light of day. It's also why any changes to pricing should be paired with significant investments in new infrastructure and heavily-subsidized housing opportunities for frontline communities on higher ground and out of harm's way.

Even before FHFA considers price changes, the results of a climate audit alone could be startling for policymakers, homeowners, and the market. Experts on real estate finance have suggested that the size of the risk could exceed that of the subprime crisis (Flavelle 2019c). The GSEs might determine that it no longer makes sense to securitize 30-year mortgages in certain parts of the country once their climate exposure is fully understood. This could send shockwaves through the financial markets and is one reason why the audit should be undertaken while the GSEs are in conservatorship.

But hurdling forward blindly, as the federal regulators did in the housing crash of 2006, left Washington flat-footed, deepening the severity of the crisis. The reason the GSEs are under federal conservatorship is because they were unprepared for the housing crash, and Congress wanted to ensure that they were not the next time. A climate-driven housing crash may well be “next time.” The GSEs are already exposed to the risk of climate change; it is incumbent upon them to understand the degree of their exposure, acknowledge it, and then work to address it by accurately pricing and managing the risks of climate-related disasters (Keys 2020).

Finally, the types of ad hoc policies bandaged together in the wake of a crisis are especially unlikely to address the disparate impact of climate change on frontline communities of color. The opposite is more likely. It will be impossible to put in place policies to redistribute equity fairly if we don’t take a hard look at where the greatest impacts are likely to be and who is likely to bear the brunt of the devastation.

Conclusion

There is no one policy that will manage the fallout from the increased frequency and severity of climate-driven natural disasters on the residential real estate market. First and foremost, we need to substantially curb greenhouse gas emissions. But we also need to think through our current suite of policy responses to housing crashes and determine which responses are likely to help homeowners and ensure that a climate-driven housing crash doesn't result in a recession—exacerbating the already devastating economic impacts of natural disasters. Short of that, solutions that also encourage managed retreat should be preferred to those that incentivize continued habitation in high-risk geographies.

Although this isn't an area that has been well-researched, this paper suggests that there is much that federal regulators can do to address climate change with their existing tools and through conservatorship of the GSEs, supplementing the NFIP. The FHFA should start by collecting and disclosing the data needed to evaluate the scope of the problem. Then they can go even further, by using their centrality and leverage in the housing market to encourage resilience and adaptation. If mortgage pricing reflects true expected losses, incentives to move away from riskier areas and toward safer areas will follow, particularly if they are paired with adequate investments in new infrastructure and a well-resourced, federally financed and administered frontline equity redistribution fund.

A balance between housing affordability and the continuation of incentives for individuals to live and invest in harm's way must be struck soon. These changes are likely to be unpopular, but the costs of doing nothing are significant, and the consequences of inaction could be devastating for homeowners and communities. We shouldn't wait for the next housing crash to act. If our lack of preparedness for the pandemic has taught us anything, it's that keeping our heads buried in the sand won't be an effective mitigation strategy. That's even more true in a storm surge.

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