



Prof. Matthew E. Kahn
Bloomberg Distinguished Professor of Economics and Business
Director, 21st Century Cities Initiative

100 Wyman Park Dr.
Baltimore, MD 21211
Tel: (410) 516-4913

Prof. Amine Ouazad
Associate Professor of Economics at HEC Montreal
Senior Fellow, 21st Century Cities Initiative

Written Remarks: Identifying and assessing climate and natural disaster risk to
Enhance FHFA's supervisory and regulatory framework.

The Federal Housing Finance Agency was created in 2008 by the *Housing and Economic Recovery Act*, in a year when the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation each experienced losses above 50 billion dollars. A number of recent papers suggest that rising climate risk may cause an increase in mortgage delinquencies and default, including for, but not limited to, mortgages guaranteed by the Government Sponsored Enterprises. **Our research** (Ouazad and Kahn, 2019)¹ has focused on the transfer of climate risk by bank and non-bank lenders towards Fannie Mae and Freddie Mac. Such loan-level empirical analysis should have important implications for FHFA's supervisory role towards the enterprises.

FHFA plays a key role in guiding US homeowners through the challenge of climate change adaptation. In this note, we outline our research agenda, which should help FHFA (i) ensure equal and transparent **information** across borrowers, lenders, securitizers, and third parties, (ii) provide lenders with **incentives** to use their **human capital** and their information to screen applicants and their collateral, (iii) **price** mortgage guarantees to accurately reflect climate risk, (iv) **transfer** risk to private counterparties to protect the American taxpayer against tail events, (v) **pool** climate risk across diversified securities to turn systemic risk into idiosyncratic risk, (vi) ensure **broad and equal access to mortgage lending** for all Americans regardless of their neighborhood, race, color, national origin, disability, age, sex, and religion. We believe that FHFA can be the "*Adult in the Room*" that guides present and future homeowners through the challenge of climate change adaptation in a fair and equitable way.

Flood insurance requirements have typically relied on FEMA's flood maps. An expanding industry (Jupiter, First Street Foundation, 427, Coastal Risk Consultants) provides local, parcel-level forecasts of flood, wildfire, drought, heat island, and storm surge risk. As climate risk is ambiguous (Knight, 1921), no single method will provide unambiguous forecasts that are correct both across locations (the spatial dimension) and across time (the longitudinal dimension). We believe that climate risk forecasts **from multiple sources** will inevitably be benchmarked, evaluated, and **combined** in a dynamic fashion after each season. FHFA, rather than relying on a single forecasting provider, may be acting as the umpire of forecasts rather than picking a single source. Such approach is popular in other fields of science (Lock and Gelman, 2010) and will be in climate risk forecasting. We also believe that households' and policymakers' risk preferences play a role in weighing flood maps' type I and type II errors. Risk is **non-stationary**, and expressions such as the "100-year floodplain" convey the message that flood risk is the realization of an independent annual draw with a known probability. Moving away from such nomenclature is key to a good communication of the rising nature of climate risk. Risk is **continuous rather than binary** (Nobre et al, 2011): the sharp boundaries of the 100-year floodplain should likely be adapted to reflect the uncertainties about such boundary.

Bank and non-bank lenders possess a **wealth of information on borrowers and their homes**, through the network of more than 75,000 bank branches and the big data of monthly loan performance and household information. FHFA

¹ The [latest version, updated in February 2021](#), features an analysis of CRTs, break-even guarantee fees, presents results on the securitization of wildfire risk, and a range of robustness checks.

could incentivize lenders to communicate such private information during the mortgage securitization process. Our interviews with large mortgage investors and with commercial banks suggest that the private sector has been investing in climate risk monitoring technology since at least hurricane Harvey. This hurricane is considered a unique event that overturned the conventional wisdom that hurricanes cause prepayments rather than defaults. In the words of a major fixed income investor, “*more hurricanes like hurricane Harvey would change our beliefs about post-disaster defaults.*” Kousky et al. (2020) indeed suggests that mortgage defaults increased after Harvey. Recent academic work (Keys and Mulder, 2020) suggests that local housing markets are pricing in climate risk: in coastal Florida, neighborhoods exposed to sea level rise experienced significant declines in transaction volumes followed by significant declines in prices.

Our review of 10 years of guarantee fee reports suggests that the Enterprises’ guarantee fees do not typically price in climate risk. This implies a redistribution towards households in climate-exposed neighborhoods from households in climate-safe neighborhoods. **Pricing** climate risk in mortgage guarantee fees would incentivize both borrowers and lenders to consider the decision to purchase a home in a home at risk of wildfires, riverine floods or hurricane storm surges. Guarantee fees could depend smoothly on climate risk probabilities rather than discontinuously at the floodplain boundary. By providing “*forward guidance*” about future guarantee fees, FHFA could use this powerful tool to lead the housing finance industry to safety.

Borrowers in the FEMA 100-year floodplain are required to purchase **flood insurance**. Federal involvement in the NFIP is likely to have crowded out the private insurance sector’s development in investing resources in the human capital and drone and satellite surveillance capacity to measure spatial flood risk. The challenge of NFIP deficits bears resemblance to the challenge of providing affordable health insurance: a broad flood insurance mandate with wide flood insurance zones may pool low and high climate risk. Our analysis suggests that lenders should be able to supply **bundles of both flood insurance and residential mortgages**. As these two products are complementary, economic analysis suggests that this would (i) make both mortgages and flood insurance premia more affordable (Matutes and Regibeau, 1992) as lenders internalize the externalities of flood insurance take-up on mortgage performance. This would also (ii) increase lenders’ incentives to screen loans. If the flood insurance industry had such a broad flood insurance mandate and if insurers could charge premia without competing with the NFIP, then they would have strong incentives to research fire and flood risk and offer non-linear contracts to incentivize self-protection.

The Enterprises are at a turning point of their 84-year and 51-year histories. Since 2013, the **Credit Risk Transfer program** has transferred billions of dollars of loans back to private sector counterparties. Thus, CRTs turn the enterprises from holders of risk into intermediaries that facilitate an efficient risk-sharing between risk-averse lenders and investors. Such investors may have either a greater ability to monitor climate risk or a greater appetite for climate risk. CRTs also have the benefit of pricing climate risk (Gete, Tsouderou, Wachter, 2020). Our own analysis of climate risk and CRT issuances (Kahn and Ouazad, 2019) suggests that climate risk may not be fully transferred. First, we find that there is a negative correlation between the volume of CRT issuances as a percentage of mortgage originations and long-term historical hurricane risk (as measured using NOAA’s Atlantic Hurricane data set). This suggests negative selection into CRTs. Second, CRT issuance volumes seem to be procyclical rather countercyclical: the decline of CRT issuances during the 2020 Covid-19 pandemic suggests that enterprises may need to put a greater emphasis on expanding the program during downturns. CRTs are a promising tool to transfer climate risk from the American taxpayer to private counterparties.

The Enterprises play a key role in **pooling** idiosyncratic default risk due to unemployment, income shocks, or family events into Mortgage-Backed Securities. Similarly, the Enterprises can **use their financial expertise to turn the systemic “fault line” of climate shocks into a diversified idiosyncratic risk**. Our own current work delves into the geography of mortgages pooled in MBSs to pinpoint where climate risk sits in the US financial network. Providing granular geography at finer level than the state would enable buyers and sellers of pools to “see through” *before a natural disaster* to anticipate the impact of future events on prepayment rates. It would also enable the American taxpayer to identify its exposure to risk.

Fannie Mae and Freddie Mac have a duty to serve underserved markets and **facilitate access to homeownership for all Americans**. In this context, the enterprises face the delicate task of reducing exposure to and pricing climate risk while reducing wealth inequalities across communities. Our work matching detailed demographic information with granular storm surge risk simulations (Ouazad 2020) suggests that households and residents exposed to hurricane storm surges have lower income, are more likely to be minorities, and are less likely to have health insurance. This reality emerges when analyzing granular storm surge simulations rather than when considering FEMA’s current 100-year

floodplain. Our research suggests that the goals of protecting Americans from climate risk should be achieved while ensuring broad and fair access to mortgage credit.

In the face of true uncertainty about new climate risks, we continue to seek to create a set of “*rules of the game*” that help America's citizens achieve their life goals. Such individuals want to be healthy and to build up wealth to help their families achieve their life goals. For decades, real estate wealth has been a bedrock for achieving these goals.

A resilient U.S housing policy will simultaneously encourage more Americans to become homeowners while providing incentives for them to take increased precautions to increase their own and their community's climate resilience. By building stronger institutions, we will face less risk from the next Texas Freeze and other inevitable shocks that will occur.

During a time of great concern about income inequality and racial disparities, it is crucial to design good rules that promote investment in capital, communities and resilience. In our Big Data age, it is possible to monitor in real time whether we are successfully achieving these equally important goals.

Prof. Matthew E. Kahn

Prof. Amine Ouazad

Gete, P., Tsouderou, A. and Wachter, S.M., 2020. Mortgage Stress without GSEs. Lessons from Hurricanes and the Credit Risk Transfers. *Lessons from Hurricanes and the Credit Risk Transfers*.

Kahn M.E., and Ouazad, A., 2019, When Climate Change Leads to Mortgage Defaults, Simple steps to make sure lenders and homebuyers — not taxpayers — bear the risk, *Bloomberg Opinion*.

Keys, B.J. and Mulder, P., 2020. Neglected No More: Housing Markets, Mortgage Lending, and Sea Level Rise (No. w27930). *National Bureau of Economic Research*.

Knight, F.H., 1921. *Risk, uncertainty and profit* (Vol. 31). Houghton Mifflin.

Kousky, C., Palim, M. and Pan, Y., 2020. Flood Damage and Mortgage Credit Risk: A Case Study of Hurricane Harvey. *Journal of Housing Research*, 29(sup1), pp.S86-S120.

Lock, K. and Gelman, A., 2010. Bayesian combination of state polls and election forecasts. *Political Analysis*, 18(3), pp.337-348.

Matutes, C. and Regibeau, P., 1992. Compatibility and bundling of complementary goods in a duopoly. *The Journal of Industrial Economics*, pp.37-54.

Nobre, A.D., Cuartas, L.A., Hodnett, M., Rennó, C.D., Rodrigues, G., Silveira, A. and Saleska, S., 2011. Height Above the Nearest Drainage—a hydrologically relevant new terrain model. *Journal of Hydrology*, 404(1-2), pp.13-29.

Ouazad, A. and Kahn, M.E., 2019. Mortgage finance in the face of rising climate risk (No. w26322). *National Bureau of Economic Research*.

Ouazad, A., 2020. Coastal Flood Risk in the Mortgage Market: Storm Surge Models' Predictions vs. Flood Insurance Maps, *arXiv working paper*.