Flood Risk and Structural Adaptation of Markets: An Outline for Action

Michael D. Berman

Current flood risk assessment tools are too blunt and outdated to accurately measure flood risk and the impact of hazard mitigation investments. As the frequency and severity of floods in the U.S. continues to increase due to climate change, the shortcomings of our current tools will be increasingly insufficient to quantify flood risk. Financial institutions and property owners have always had flood risk in their portfolios. However, they have no accurate, standardized way of measuring and understanding that risk and uncertainty. Instead, they generally look exclusively to the Federal Emergency Management Agency's (FEMA) flood insurance rate maps (FIRMs) and make an annual decision whether to buy or require flood insurance. These maps are outdated, locally politicized, and inaccurate, as demonstrated most recently by the pluvial flooding from Hurricane Harvey (2017) and Hurricane Florence (2018), which have been classified by the National Weather Service as 500-year and 1,000-year events, respectively.[1] Further, these maps do not take into account climate change or other changing conditions, such as additional infrastructure on the ground.

Just as there are uniform engineering standards adopted to measure seismic risk, which include the specific resilience performance of structural components relative to the earthquake severity risk of a particular location, there should be a standard metric for evaluating flood risk for a specific building location with specific structural and material characteristics. These metrics should take into account structural vulnerabilities and corresponding resilience functionality and adaptive capacity of the buildings themselves. This new risk assessment tool would use the latest technology and corresponding performance standards to take into account not only building location, elevation, and the likelihood and severity of flooding, but also the extent of likely damage to a structure given its specific physical characteristics. For commercial properties, it should also account for some measure of business continuity disruption based on flooding events. Furthermore, this risk assessment tool should include a projection over the life of the investment of flood risk due to climate change and other changes in future physical conditions. Whether debt or equity, investment modeling of life-cycle analysis (LCA) should adapt to include future flood risk and potential impact on asset value and default risk. It appears that very few, if any, financial institutions or real estate owners currently analyze this LCA or life-of-investment risk, and there is certainly no standardized way of accomplishing that risk assessment. Armed with this new standard-

1 Irfran, U. "Hurricane Florence's '1,000-year' rainfall, explained," *Vox Media* (September 22, 2018), available at https://www.vox.com/2018/9/20/17883492/hurricane-florence-rain-1000-year.

ized risk assessment metric, lenders and insurers could provide various incentives and penalties to encourage prudent behavior by property owners who must learn to adapt and live with flood waters in new ways. This would also encourage a pathway for regional and municipal lawmakers to enact updated building codes and zoning ordinances, as well as to improve critical infrastructure. Further, these new standard metrics would create new opportunities for architects and building component manufacturers by increasing the markets for buyers and owners of properties who will prefer increased flood resilience functionality in their materials and building elements. Compare the current relative lack of action by lawmakers in flood prone areas to the proactive approach of lawmakers in California and Florida in revising building codes to address earthquake risk and wind risk, respectively. Fannie Mae and Freddie Mac (collectively, the GSEs), as well as the Federal Housing Administration (FHA) and major banks and other financial institutions, have an opportunity to engage with engineers, architects, environmental scientists, risk modelers, insurers, reinsurers, and other financial institutions to lead the way.

Major financial institutions should take four actions: (i) work together to articulate and advocate for the creation of these new standardized metrics, scoring systems, and risk assessment tools to be utilized at the time of mortgage origination, as well as in asset management for the life of loan and portfolio metrics; (ii) participate in and oversee the creation and updating of these metrics and tools; (iii) utilize these new metrics and tools to better understand the flood risk at the time of mortgage origination and in their portfolios over the life of each loan as future conditions change; and (iv) design and implement mortgage loan products that encourage prudent behavior in making property investments which increase resiliency. The result of these actions will catalyze a series of additional steps as municipalities, engineers, architects, and building materials manufacturers "follow the money" to promote behaviors and capture new markets to reduce flood risk, as public awareness is increased. The new initiatives will in turn reduce losses to property owners, lenders, insurers, municipalities as well as all of those who share in the direct and indirect losses from floods. The total positive impact on the social welfare of communities is truly beyond quantification.

The Problem and Current Prognosis

The Science—A Key Driver for Action

The scientific community is clear about the long-term trends for flood risk.[2] While a full description of the relevant literature is well beyond the scope of this article, a few findings should be articulated to set the frame. The estimated global sea level rise over the 20th century was an average of approximately 0.67 inches every ten years.[3] Yet, over the nine-year

2 Maxwell, K. et al. "Built Environment, Urban Systems, and Cities," *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Reidmiller, D.R. et al. [eds.]), U.S. Global Change Research Program (2018), pp. 438–478. doi: 10.7930/NCA4.2018.CH11

3 Solomon, S. et al. "Summary for Policymakers," *AR4 Climate Change 2007: The Physical Science Basis,* Contribution of Working Group I for the Intergovernmental Panel on Climate Change (IPCC) (2007), available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf.

period of 2007 to 2015, the sea level rise in Miami, Florida, progressed at the rate of approximately 3.6 inches. This measurement in Miami is an astounding rate of relative sea level rise which is nearly twice as fast as the prior 20 years at that same location.[4] Furthermore, this is over five times faster than the 100-year global rate. Importantly, this rate is predicted by many scientists to continue to accelerate.

Further, the number of serious floods that we have experienced in the U.S. in coastal and inland locations from rain storms and hurricanes is increasing and will likely continue to increase. In just the two-year period of 2016 and 2017, we have had ten floods, causing over $1 billion of damage per occurrence.[5] States experiencing these floods include Texas, Florida, California, North Carolina, Illinois, Missouri, Arkansas, Louisiana, and West Virginia plus Puerto Rico.[6] This is an alarming baseline that includes riverine and pluvial flooding, in addition to the more commonly reported hurricane storm surge flooding.

A recent study found that from 1949 to 2016, hurricanes have decreased their speed in the North Atlantic by 20 percent resulting in a proportional increase in rainfall from these storms.[7] That is, a 20 percent slowdown in hurricane speed produces about 20 percent more rainfall. The study further suggests that global warming is causing this slowdown along with increased rainfall, slowing wind currents, and warmer areas of the Atlantic Ocean. "The unprecedented rainfall totals associated with the "stall" of Hurricane Harvey over Texas in 2017 provide a notable example of the relationship between regional rainfall…" and hurricane speed.[8] As Hurricane Harvey stalled over Texas for more than a week, it dumped upwards of 50 inches of rainfall on Houston in just five days, and in other locations, 24 inches of rain in just two days. As these tropical storms continue the trend of slowing down over population centers, the increased rainfall will cause an increase in flood risk. This is in addition to the broader set of observations associated with greater inundation from day-to-day rain events as the atmosphere warms and collects and holds more water.[9] The continued warming of the ocean waters, predicted by many global climate scientists, implies that we will have rain storms and hurricanes which will be more frequent and more severe, resulting in more dramatic losses. In addition, sea level rise will cause less severe storms to breach existing sea walls and flood barriers more frequently causing an increasing number of floods and flood damage in coastal communities.

Absent new assessment tools and standardized metrics, we are likely to be stuck in our current frame of assessing flood risk utilizing the 100-year floodplain (Special Flood Hazard Areas, or SFHAs)–an outdated assessment tool which reflects a political negotiation and the

4 McNoldy, B. "Observations and Projections of Sea Level Rise in Miami," Presentation to the Miami Design Preservation League (February 16, 2016), available at http://andrew.rsmas.miami.edu/bmcnoldy/papers/MDPL_17Feb2016.pdf.

5 National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI). "U.S. Billion-Dollar Weather and Climate Disasters" (2018), available at https://www.ncdc.noaa.gov/billions/.

6 Ibid.

7 Kossin, J.P. "A global slowdown of tropical-cyclone translation speed," *Nature*, 558 (2018), pp. 104-107.

8 Ibid, p. 104.

9 Maxwell, K. "Built Environment, Urban Systems, and Cities" (2018).

state of technology of the 1970s and not the best available scientific knowledge today. This historically-based metric is ill-suited to the dynamics of climate change, flood risks from tidal and pluvial flooding, and current advances in technology. Furthermore, by its own internal standards, it is inaccurate due in part to lack of federal funding and in part to the local politicization of many designated SFHAs. So not only are many of the flood zone demarcations wrong in historical terms, but the assessments do not take into account various types of changes in flood risk due to expected future conditions tied to sea level rise and climate change.

Potential Disruption in the Mortgage and Property Markets

A recent study demonstrates that the rate of price appreciation of single-family properties in Miami-Dade County over the period 1971 to 2017 is "positively related to and correlated with incremental measures of higher elevation."[10] It was also observed that properties at lower elevations appreciated at lower rates. Furthermore, this study found that since 2000, "as a reflection of an increase in observed tidal nuisance flooding and relative sea level rise" single-family properties in the lowest elevation cohorts "[have] not kept up with the rates of appreciation of higher elevation cohorts."[11]Another study of over 460,000 single-family property sales between 2007 and 2016 demonstrates that U.S. coastal properties sell for approximately seven percent less, if they are located where scientists project there will be an impact from long-term relative sea level rise of approximately six feet or more.[12] Interestingly, non-owner occupied, single-family properties sell for an approximate ten percent discount. This seems to reflect a more dispassionate view of the risk, since the intangibles of lifestyle and community engagement are generally not present in these investor property transactions.[13]

When these findings are combined with expected continued increases in sea level rise, as well as increases in flood insurance rates, as discussed below, this may well point to more pronounced consumer preferences that may have increasingly substantial impacts on the relative and absolute value of properties where there is perceived increased risk of flooding. Actual flood losses experienced, as well as perceived future flood risk impacting property values in these locations, may adversely impact the tax base of municipalities at the time when more tax revenue is needed for flood mitigation infrastructure and other adaptation investments. The confluence of these conditions could influence lenders to "blue-line" certain locations for unacceptable flood risk. At some point in the next 20 to 30 years, absent substantial new approaches to reducing and managing flood risk, there may be a threat to the availability of the 30-year mortgage in various vulnerable and highly exposed areas.

Given the fact that the average life of a 30-year loan is typically seven or eight years, the amortization of such loans to relatively smaller balances in later years may not be deter-

10 Keenan, J.M., Hill, T., and Gumber, A. "Climate Gentrification: From Theory to Empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5), 054001 (2018). doi: 10.1088/1748-9326/aabb32

11 Ibid.

12 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the horizon: the price effect of sea level rise," *Journal of Financial Economics* (2018), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3073842.

13 Ibid.

minative in the ultimate decision to make a 30-year guarantee in these high-risk locations. For example, if one projects a 30-year mortgage made in 2030, loans made in certain flood-prone locations may well have unacceptable flood risk characteristics if actuaries incorporate projected increased flood risk by 2060. Even a 10-year or 15-year balloon mortgage may become unacceptable to mortgage lenders and guarantors in some markets in the next 20 years due to the exit risk analysis of lenders, as they consider the time horizon of the next owner and/or lender for a given property. Note that the GSEs, banks, and other holders of this flood risk may protect themselves, in part, by purchasing reinsurance on their portfolios, as NFIP has done in 2016, 2017, and 2018.[14] However, at some point such reinsurance may be uneconomic for flood risk, and it is ineffective for exit and valuation risk. Furthermore, the GSEs and banks have a duty to serve and corporate responsibility to promote prudent flood mitigation actions–reinsurance simply masks that responsible engagement.

From December 2017 to July 2018, the author of this article conducted a series of unstructured interviews with over 20 national and regional participants in the mortgage and real estate industry. No lender, asset or portfolio manager, or buyer of commercial mortgage-backed securities (CMBS) first loss B-Pieces interviewed accounts for flood risk at the transaction date or over the life of the asset, other than determining whether a property requires flood insurance solely because it is in the 100-year floodplain at the initial transaction date. When specifically asked, no participant takes into account any of the following potential life of investment risk factors: (i) increases in flood insurance premiums, which may be substantial in light of the new FEMA risk rating system expected in 2020; (ii) adverse impacts on asset values and business interruption due to projected or actual increased flooding;[15] or (iii) increases in local real estate taxes, as municipalities and counties increase spending on infrastructure to mitigate flood risk and/or sea level rise. For instance, no respondent had taken into account substantial new and/or projected infrastructure costs such as the $500 million of bonds for flood mitigation in Miami Beach or the estimated multi-billion dollar cost of converting from septic to sewerage systems in Miami-Dade County.

There is a real possibility that real estate values in some communities will be decreasing due to increased flood risk just as the real estate tax base is being relied on for funding of new flood mitigation infrastructure. Furthermore, if and when a 30-year mortgage is no longer available in a particular neighborhood due to flood risk (or the prohibitive price or lack of availability of flood insurance), property values will undoubtedly be substantially adversely impacted. This can be disastrous for a homeowner whose house is their largest asset and a substantial portion of their net worth. This will have a disproportionate adverse impact on low- and moderate-income (LMI) households. Obviously, this can result in a downward spiral

14 Horn, D. and Brown, J. "Introduction to the National Flood Insurance Program (NFIP)," Congressional Research Service (April 2018), available at https://fas.org/sgp/crs/homesec/R44593.pdf.

15 Keenan, J.M. "Adaptive Capacity of Commercial Real Estate Firms to Urban Flooding New York City," *Journal of Water and Climate Change*, 6(3) (2015), pp. 486-500. doi: 10.2166/WCC.2015.097; and Union of Concerned Scientists. "Underwater: Rising Seas, Chronic Floods, and the Implications for the U.S. Coastal Real Estate" (June 2018), available at https://www.ucsusa.org/underwater.

of property values for such communities. While this is unlikely to be a substantial issue in the near term, the adverse impact on real estate portfolios of the GSEs, banks and other financial institutions may be substantial in the long run.

The Uneven Influence of Flood Insurance and FEMA Programs

The National Flood Insurance Program (NFIP) and FEMA have the potential to increase their influence on the behavior of owners of properties, as well as lawmakers to act more prudently in addressing flood risk. The NFIP has over five million insurance policies in place.[16] Examples of FEMA's behavioral incentives include NFIP flood insurance premium discounts, as well as claims payments issued under certain circumstances for elevating properties above the Base Flood Elevation (BFE). In addition, FEMA has various grant and assistance programs for state and local governments for flood mitigation action. NFIP's Community Rating System (CRS) is doing important work in the area of future flood risk mitigation by offering up to 45 percent discounts on flood insurance premiums if a community takes various flood mitigation actions. However, it remains an open question whether activities taken under the CRS model sufficiently warrant such a reduction. Furthermore, the actions by the NFIP and FEMA need substantial enhancements to adequately address the risk and influence wide-spread change of behavior.

Furthermore, the economic performance of the NFIP has been increasingly challenged, as it continues to pay claims in excess of its revenues, and it needs to borrow increasing amounts of funds from the U.S. Treasury in order to meet its obligations to pay insurance claims. On September 22, 2017, after borrowing $5.825 billion to fund claims from Hurricanes Harvey, Irma and Maria, the NFIP had reached its maximum U.S. Treasury borrowing authority of $30.425 billion in program debt. On October 26, 2017, Congress cancelled $16 billion of NFIP debt–the first time in the history of the NFIP that has occurred. Then on November 9, 2017, the NFIP borrowed another $6.1 billion to fund additional 2017 losses, including additional losses from Hurricanes Harvey, Irma and Maria.[17] New legislation is currently being debated on Capitol Hill to reform the program, as a series of short-term extensions have been passed in the last several months. But, there does not appear to be a consensus on Capitol Hill as to how to reform the NFIP.

The NFIP is clearly not properly pricing flood risk, nor is it adequately influencing prudent behavior by property owners and municipalities to sufficiently reduce or otherwise mitigate this risk. FEMA is working on a new risk rating system to be effective in 2020. This new rating system, known as Risk Rating 2.0, is expected to include repricing of premiums based on flood risk at the property level–an important step.[18] Stated objectives of the new

16 Horn, D. and Webel, B. "Private Flood Insurance and the National Flood Insurance Program," Congressional Research Service (July 2018), available at https://fas.org/sgp/crs/homesec/R45242.pdf.

17 Horn, D. and Brown J. "Introduction to the National Flood Insurance Program (NFIP)" (April 2018).

18 Federal Emergency Management Agency (FEMA). "National Flood Insurance Program (NFIP)," Community Risk Rating System (2018), available at https://www.fema.gov/national-flood-insurance-program-community-rating-system.

system include communication to homeowners of flood risks, steps that may be taken to mitigate risk, as well as a readily available "flood safety score" for each property.[19] However, because the final Risk Rating 2.0 has not yet been released, it is uncertain whether and to what extent those objectives will be achieved. In the FEMA 2018-22 Strategic Plan, FEMA is proactively working to build preparedness and help the nation deal more effectively with catastrophic disasters. In that regard, it has announced that it has a "moonshot" goal of doubling its flood insurance policies in place by 2022.[20] Among other foundational points, FEMA cites a recent study by the National Institute of Building Sciences that for every dollar that the federal government invests in flood hazard mitigation, taxpayers save an average of six dollars of future disaster recovery spending.[21]

It is also noteworthy that some proposals under consideration on Capitol Hill begin to promote prudent behavior in flood prone areas, but those proposals alone are not adequate. Private flood insurance, which is being encouraged by legislators in the current debate, is becoming increasingly expensive with rates in some flood prone areas escalating by alarming amounts in the last seven-to-ten years. While these steps should be incrementally helpful in shaping prudent behavior, they are not sufficient.

Municipal Building Codes and Zoning Ordinances

Relative to the substantial number of municipalities with heightened flood risk, there are only a few coastal communities and communities abutting inland waterways that have moved forward with implementing building codes or zoning ordinances that mandate appropriate building elevations, hazard mitigation components and other designs and standards that advance the resilience of buildings and the adaptation of land use locations. It is interesting and instructive to compare the pro-active approach to reforming and hardening building codes demonstrated by state and local lawmakers in both earthquake zones in California, and hurricane wind zones in Florida (following Hurricane Andrew in 1992), juxtaposed to the relative inactivity in addressing flood risks. There appears to be an aversion of municipalities to amending building codes and zoning regulations despite demonstrable heightened flood risk and increasing losses. However, in the opinion of this author, some of the blame rests with the real estate development and building industries which have influenced state legislatures and others to weaken standards in favor of their own economic self-interests.

19 Federal Emergency Management Agency (FEMA). "Insurance for Floodplain Managers–Where are we going?" (2016), available at http://www.floods.org/Files/Conf2016_ppts/E3_NealCecilStearrett.pdf.

20 Federal Emergency Management Agency (FEMA). "FEMA Strategic Plan 2018-22," U.S. Department of Homeland Security (2018).

21 National Institute of Building Sciences (NIBS) Multihazard Mitigation Council. "Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study" (Porter, K. [principal investigator]), National Institute of Building Sciences (2017), available at https://www.nibs.org/news/381874/national-institute-of-building-sciences-issues-new-report-on-the-value-of-mitigation.htm and https://www.nibs.org/page/ms2_dwnload.

Four Steps and Programs: A Path Forward

Flood risk mitigation and adaptation investment analysis needs to evolve to a new frame in order to effectively change behaviors of the key players: (i) property owners; (ii) regional, state, and local government officials; (iii) financial institutions, including banks, the GSEs, and flood insurers; (iv) architects; (v) engineers, and (vi) building materials manufacturers. One important goal of policy makers in this arena is to find a pathway for these critical behavioral changes. How can we enable municipalities to enact new building codes and zoning ordinances to encourage prudent behavior by owners and developers of real estate –both single-family and commercial/multifamily properties? The major financial institutions in the U.S. have the opportunity to lead the way in creating new ways to measure and promote prudent behavior to reduce and mitigate flood risk and flood losses through a series of steps, including new programs, products, and pricing. The lawmakers, architects, engineers, and building materials manufacturers will then find it easier to act by adopting various approaches where they "follow the money."

For the GSEs, analogous programs exist in the multifamily earthquake context, as well as the green and affordable housing contexts, where "good behavior" is measured, encouraged and rewarded. The institutions in the strongest position to lead the way in setting new standards for this arena are the GSEs, the FHA, and major banks. While these institutions can model future flood risk and simply purchase reinsurance for this risk, that course of action would miss the opportunity to move the market toward prudent behavior which would also mitigate their risk. And reinsurance would not address valuation risk due to flooding. The path taken by the GSEs and FHA in the "green" arena is a prime example of this strategy. The GSEs, FHA, and major banks can and should take the following steps:

(i) articulate and advocate for the creation of new standardized tools to: (a) identify when a property needs to be assessed for flood risk, then (b) measure flood risk at the specific property level both at the time of mortgage loan origination as well as for the life of each loan taking into account future changing conditions;

(ii) oversee the creation of three new standardized assessment tools and scoring systems at a major university which has expertise in this arena: (a) a desk-top assessment tool and scoring system for single-family properties for mortgage loans under $500,000, (b) an assessment tool and scoring system for engineering inspections of commercial/multi family properties and larger single-family properties working with ASTM International, and (c) an assessment tool for life of loan risk, taking into account future changing conditions;

(iii) adopt these new standardized tools to assess flood risk and property resiliency at the time of mortgage origination and in monitoring flood risk in mortgage portfolios for the life of each loan; and

(iv) create first and second mortgage loan programs using the new flood risk-resiliency scoring systems to promote flood resiliency at the property level through various incentives, such as first mortgage programs that allow higher loan-to-value ratios; loan

programs that have lower guarantee fees (G Fees) and interest rate spreads; and, special purpose second mortgage programs to retrofit existing properties for flood resiliency.

If the GSEs, FHA, and major financial institutions take these steps, then other financial institutions will follow their lead, including flood insurers and reinsurers. And, if the major financial institutions join in this approach to flood resiliency and climate adaptive planning, local municipalities will build on these standards by enacting new building codes and zoning ordinances that will promote prudent risk management behavior to encourage market adaptation, resilience performance and the mitigation of flood risk. At the same time, architects and building materials manufacturers will create more flood resilient designs and products at increasingly affordable prices. While these steps and programs obviously cannot solve the flood risk issues facing our real estate sector or our economy, they can be important incremental steps to increase the adaptive capacity of high-risk markets in the coming decades.

New Standards to Measure Flood Risk

Today, the key tool used to determine flood risk in the single-family residential and commercial-multifamily real estate arenas is the 100-year floodplain established by FEMA. Each flood map designates those areas with a one percent chance of flooding in any given year. These are also called SFHAs and indicate the required BFE–based, for instance, on the estimated height of waters in a "100-year flood" event. Statistically, during a 30-year mortgage, there is about a one-in-four chance of experiencing a 100-year flood. The FEMA mapping is based on a system adopted in the 1970s which relies on historical flood data and property elevation mapping. Although the maps are updated from time to time, this effort is under-funded and much of the U.S. mapping is now out of date. This process is sorely in need of augmentation. In the lending context of programs sponsored by the GSEs and FHA, there is a binary determination of whether a property is in or out of the 100-year floodplain, and flood insurance is required only if a property is in that floodplain. Most other lenders follow this same protocol.

In the aftermath of Hurricane Harvey in August 2017, approximately 80 percent of homeowners in the Houston area who experienced flood losses were uninsured, according to FEMA and a *Washington Post* study of FEMA data.[22] Importantly, other reports indicated that a large share of those uninsured properties were located outside of the 100-year floodplain.[23] This finding is a critically important example illustrating the inadequacy of the 100-year

22 Long, H. "Where Harvey is hitting hardest, 80% lack flood insurance," *The Washington Post* (August 29, 2017), available at https://www.washingtonpost.com/news/wonk/wp/2017/08/29/where-harvey-is-hitting-hardest-four-out-of-five-homeowners-lack-flood-insurance/?utm_term=.a79c788c28e4.

23 Condon, B. and Sweet, K. "About 80% of Hurricane Harvey victims do not have flood insurance, face big bills, *The Associated Press* (August 29, 2017), available at https://www.usatoday.com/story/money/2017/08/29/hurricane-harvey-houston-flood-insurance-damages-claims/611910001/.

floodplain tool.[24] FEMA has stated in its 2018 Fact Sheet entitled "Why Buy Flood Insurance," that 98 percent of counties in the US have experienced a flood, and more that 20 percent of flood claims come from properties outside the high-risk flood zone.

Also, since the 100-year floodplain is based on historical data (even if it is updated) and is subject to local political negotiations, there is generally no element of projected future conditions included in these maps. Even progressive cities like New York City have negotiated a political compromise to lessen the effect of sea level rise in the FIRMs. Furthermore, currently risk modelers in financial institutions generally do not factor any future flood risk in their loss analysis. Both lenders and property owners largely ignore these risks as well as the locally negotiated changes in the flood maps and, instead, assume that flood insurance will be adequate based on the 100-year floodplain–a determination which is inadequate both today and over any long time period. Projections of sea level rise, storm surge, tidal flooding, riverine flooding, and rain storm events as well as local infrastructure changes that impact flood risk need to be taken into account in any tool which relates to flood risk over the term of a 10, 20, or 30-year mortgage. A standardized assessment tool is needed for both individual properties as well as portfolio modeling.

An important impetus for this life of loan modeling may come, in part, from the new Current Expected Credit Loss (CECL) accounting standard adopted by the Financial Accounting Standards Board (FASB). This new standard is scheduled to be effective in 2020 for SEC registrants and in 2021 for non-SEC registrants.[25] The standard will significantly change the way in which financial institutions account for loan and credit losses. These institutions will be required to include reasonable forecasts estimating expected losses over the life of each loan. Accounting industry practices are expected to include more reliance on robust loan level data and various new methodologies for forward-looking modeling.[26] It would seem obvious that flood risk should be part of this modeling.

The engineering, technology, and scientific communities, flood modeling enterprises, as well as the flood insurance and reinsurance players have developed and continue to develop new tools that can provide the foundation of new standards to measure flood risk. Importantly, these tools include improved flood inundation mapping and LIDAR mapping. The most recently developed metrics and flood models currently in use are based on storm surge, severe rain events, river flooding, and tidal flooding–taking projected sea level rise into account. However, the risk rating methodologies of the flood risk modelers and private

24 Handy, R.M. and Osborne, J. "Thousands of Houston-area homeowners faced Harvey with no flood insurance," *The Houston Chronicle* (September 2, 2017), available at https://www.chron.com/news/article/Thousands-of-Houston-area-homeowners-faced-Harvey-12168384.php.

25 Office of the Comptroller of the Currency. "Current Expected Credit Loss (CECL) Methodology" (2018), available at https://www.occ.treas.gov/topics/bank-operations/accounting/cecl/current-expected-credit-loss-model.html.

26 ALLL Regulations. "CECL Model Changes: Life of Loan Concept" (2018), available at https://www.alll.com/alll-regulations/fasb-cecl/life-of-loan/.

insurers have no standardized scoring metrics. Furthermore, while these stakeholders can add substantial expertise to creating tools for the industry, they have generally been reluctant to be transparent in their rating metrics due, in part, to competitive differentiation.

Important steps also include the recent work of FEMA in updating the CRS, as well as the NFIP's current risk rating redesign project, Risk Rating 2.0. This new NFIP risk rating system scheduled to be announced in 2019 and to be implemented in 2020 could be an important foundational step in establishing risk and resilience metrics for property specific features. Until announced and implemented that remains uncertain, and it is also unclear whether a private sector initiative might be more effective at measuring and communicating flood risk and resilience when compared to this public sector NFIP initiative. Additional key steps are reflected in the research in North Carolina led by Professor Howard Kunreuther (Wharton School's Risk Management Center of the University of Pennsylvania) and John Dorman (North Carolina Division of Emergency Management) with regard to the impact of a building's base elevation on flood risk and fair pricing of flood insurance.[27]

However, while these are critically necessary elements, even these improved tools are not sufficient to address the totality of the hazards, understood as both shocks and stresses to buildings.[28] Current standards are almost exclusively a function of how high a flood might be relative to building structure elevation and, in some cases, the lowest point of water intrusion into a structure. While this is the single most important data point in predicting flood risk, these metrics do not adequately relate to the specific building components of a particular property and their resilience functionality in the case of a flood of any given particular severity. Just as building design and materials can provide resilience to seismic and wind risk, certain of these elements can be modified and adapted to provide substantial mitigation to flood risk and losses.

In part, as a reaction to the damage in New York City to affordable multifamily housing communities by Superstorm Sandy, Enterprise Community Partners has done some very instructive work in creating a manual for multifamily properties in New York City.[29] This manual serves as an audit tool to: (i) help owners identify flood risk; (ii) assess that risk to the physical vulnerabilities of the property, as well as the functional vulnerabilities effecting residents; and (iii) understand the implications for the continuity of programs operating within the property and in the community at large.[30] Resilience and adaptation strategies to protect, modify and create system redundancies are all considered in this manual. Of course, this approach can be adapted for all other property types–commercial as well as single-

27 Kunreuther, H. et al. "Structure of Specific Flood Risk Based Insurance: Proof of Concept and Preliminary Analysis," *Journal of Extreme Events*, 4(3), 1750011 (2017).

28 Kurth, M. et al. "Defining Resilience for the Building Industry for the U.S." *Building Research and Information*, 47(4), (2018) pp. 480-492. doi: 10.1080/09613218.2018.1452489

29 Enterprise Community Partners. "Ready to Respond: Strategies for Multifamily Building Resilience" (2015), available at https://www.enterprisecommunity.org/resources/ready-respond-strategies-multifamily-building-resilience-13356.

30 Ibid.

family—and it can serve as a guidepost for creating a scoring system for the risk and resilience performance of a property.

In contrast to the flood arena, there is a uniform standard adopted to measure seismic risk, which includes the specific resilience performance of structural building components of a particular property relative to earthquake severity. Fannie Mae, Freddie Mac, CMBS lenders, and many life insurance company lenders have incorporated special conditions for a loan on any multifamily or commercial property located in high risk areas determined by the latest technology measuring "peak ground acceleration." A certified engineer must perform a specific protocol inspection to generate a Probable Maximum Loss (PML) assessment score and a Scenario Expected Loss (SEL) score assuming the Design Basis Earthquake, in accordance with ASTM E2026-16A and ASTM E2557-16A.[31] The updated protocols using the latest technologies call for a locational heightened risk determination that is specific to a particular property, which is more precise than the old Zone 4 mapping criteria. The PML or SEL assessment takes into account the proximity of faults within the geographic area of a subject property, assumed magnitude of a seismic event, as well as the resilience design of the property. The property level resilience assessment takes into account the type of construction, building materials, design, and physical positioning of the property. The PML or SEL score determined by the engineer represents an estimate of the percentage loss in terms of the cost to restore the structure to pre-seismic event conditions. If the engineer finds that the score is 20 or greater, then the loan is generally conditioned on obtaining earthquake insurance and/or making structural modifications to the property so that the score is reduced below 20.

Why is there no up-to-date parallel risk and engineering resilience measuring tool, scoring system, and protocol in the flood risk arena? After interviewing numerous industry leaders from the single-family, and multifamily/commercial industries over several years, this author has concluded that there is no good answer, especially given the relative number of floods and flood losses in the U.S. compared to potential seismic events and losses in the U.S. Why do financial institutions rely solely on the outdated FEMA maps of the 100-year floodplain—a construct based on the best thinking and engineering of the 1970s? A standard protocol parallel to the uniform engineering standard adopted to measure seismic risk should be a created and adopted for measuring flood risk for specific building structural characteristics and their resilience performance to floods over the life of the asset (or investment). This new assessment system would take into account, not only proximity to the coast or a river, building elevation, and the likelihood and severity of flooding, but also the extent of likely damage to the structure given its specific physical and design characteristics.

31 ASTM International. "ASTM E2026-16a, Standard Guide for Seismic Risk Assessment of Buildings," available at https://www.astm.org/Standards/E2026.htm. doi: 10.1520/E2026-16A; ASTM International. "ASTM E2557-16a, Standard Practice for Probable Maximum Loss (PML) Evaluations for Earthquake Due-Diligence Assessments," available at https://www.astm.org/Standards/E2557.htm. doi: 10.1520/E2557-16A

Standards would need to be established for assumptions for the height, volume, and velocity of flood waters, as well as the duration of the flood condition at a given site, all of which are analogous to the accepted seismic standards in the relevant ASTMs. Examples of additional factors to be incorporated into the new metric include materials used for flooring on the first finished floor exposed to substantial flood risk (e.g., wood vs. carpet vs. tile on concrete), placement of HVAC systems and electric outlets and other utilities systems relative to elevation, materials used for walls (e.g., sheet rock vs. tile) up to a certain height on first floors subject to high flood risk, drainage from the first finished floor, water barriers, water pumps, back-flow valves, site grading, soil conditions, and the like. The new resilience metrics should even take into account local and regional flood mitigation projects which impact flood risk at the specific property location.

A two-tier rating system should be established. First, an inexpensive desk-top flood risk rating tool should be designed for single-family residences–much like a FICO credit report today. Adding a few data fields to the standard single-family appraisal regarding building elevation and materials could make this assessment tool more helpful. This enhancement of data could be mandated by the GSEs. For a very modest cost (say $25 to $75) and virtually no added processing time, this tool would be a significant improvement over the current state. A second, more granular assessment tool, which includes a specified engineering inspection should be designed for multifamily and commercial properties, as is the case in the seismic arena, with a cost similar to the seismic ASTM protocol performed by licensed engineers. Furthermore, these tools could be the basis for life-of-asset portfolio modeling, LCA, and CECL modeling.

Clearly, this is a complex undertaking requiring the coordination of public, private, and civic stakeholders. Ultimately, a new engineering standard should be developed by the National Institute of Standards and Technology (NIST) at the U.S. Department of Commerce. A major university could be the convener and lead the research necessary to begin to create these standards by bringing together environmental scientists, engineering, and architectural experts working with Fannie Mae, Freddie Mac, FHA, other major financial institutions, flood insurers and reinsurers, modelers and other important players using the most current technologies. Then ASTM International should create a universally accepted standard. As with sustainability, these standards are most effective with the federal government internalizes the standards into their own construction and asset management. There are many examples of industry groups working to create standards, including the work of the environmental and architecture industries in the context of the ASTM metrics for seismic events, LEED standards for energy efficiency, and vapor metrics for radon, as well as the work of the Mortgage Bankers Association work on the Mortgage Industry Standards Maintenance Organization (MISMO) in the mortgage data standard-setting context. It is noteworthy that there is already an ASTM for testing building materials used in construction below the base flood elevation: “Standard Test Method for Water Immersion and Drying for Evaluation of

Flood Damage Resistance."[32] This ASTM could be one part of the proposed new standard. The industry is not starting from scratch. The goal is to expand, amplify and institutionalize. Creating a new standard metric and scoring system for an accepted flood risk assessment tool is critical for creating and driving financial incentives in the form of new lending programs, insurance premium discounts, insurance claims payment incentives, and new flood resilient architectural designs and building materials, as steps toward promoting prudent behavior. Ultimately, this could be the catalyst for the adoption of new building codes, zoning ordinances, and land use planning in areas exposed to heightened flood risk over the long term.

Minimum Requirements for Certain Loans Collateralized by Properties with Elevated Flood Risk

The GSEs, FHA, banks, and other lenders should approach flood resilience in a manner similar to their approach to seismic risk in the multifamily and commercial property loan context as described above. This would be a standard of the GSEs, FHA and banks. Many lenders in the commercial real estate context have seismic requirements which are similar to those of the GSEs, and it is likely that these lenders would also follow the lead of the GSEs, FHA, and major banks in the flood risk arena. Flood risk, which in the last 50-plus years has demonstrated substantially more incidents of loss and more total losses than seismic risk, should require a modernized assessment approach that is at least as rigorous as that in the seismic context. A new flood risk scoring report prepared by a qualified engineer should be mandated in specified high risk flood locations. In order to qualify for inclusion in any multifamily or commercial loan program, when a designated score for flood risk is breached, the lender should require flood insurance or impose various flood mitigation retrofits to the property. As a condition of loan closing, if the property is covered by the requisite flood insurance or is modified to have such flood resilient building characteristics to lower the flood risk score to an acceptable level, then the loan qualification is achieved. Otherwise, the property will not qualify for the loan program.

In the single-family context, earthquake insurance is not generally required by the GSEs, FHA, and banks, except for single-family buildings in Puerto Rico. Accordingly, it is less clear that the GSEs, FHA, and banks would apply this same logic and protocol. A cost-benefit analysis would need to be performed. Lenders may well impose the proposed desk-top protocol given the substantial flood losses in the single-family arena. In the single-family lending context as well as the multifamily and commercial lending context, this protocol would be a significant improvement compared to today's simple binary yes-no based solely on property location in a SFHA, as shown on FEMA's 100-year flood maps, with exceptions only for properties with elevations above the BFE. Further, given the poor out-of-date quality of

32 ASTM International. "ASTM E E3075-18, Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance," available at https://www.astm.org/Standards/E3075.htm. doi: 10.1520/E3075-18

FEMA flood maps, engineering reports should be required in a much broader set of property locations. As noted above, in the last few years, a substantial amount of flood damage has been outside of the 100-year floodplain (e.g., Hurricane Harvey in Texas), the only zone in which flood insurance is required. Given the availability of technology which can assess flood risk outside of the 100-year floodplain and can also take into account future projections of flood risk in light of climate change, financial Institutions, including the GSEs and the buyers of their first loss risk in the Credit Risk Transfer (CRT) context should not be subject to this significant incremental risk of losses posed by the current flood insurance protocols.

Create Special Second Mortgage Program

New second mortgage programs for flood resilient building features should be established by the GSEs and FHA parallel to the existing multifamily second mortgage programs for energy efficiency or "green" second mortgages. In the green context, second mortgage proceeds are used to increase energy efficiency in order to reduce operating costs and property expense volatility. In the flood risk context, in order to encourage flood loss mitigation which would reduce both property valuation risk and default risk to the loan guarantor, new second mortgage programs should be created where the proceeds are specifically used for installation of flood resilience features. Just as is the case with the green second mortgage program, the Guarantee Fees (G Fees) or Mortgage Insurance premiums (MIP), as applicable, for such flood resiliency second mortgages should be reduced to reflect the lower risk. Further, as in the green lending programs at the GSEs, an extra five percent of loan proceeds could be made available to property owners. The new flood risk metric would be used to determine the requisite improvement in flood resilience performance.

Lower Premiums, G Fees, and MIP for Qualified Properties

In order to reflect reduced risk to the GSEs, FHA, as well as flood insurers, and as a public policy matter, to encourage prudent risk management behavior in designing building structures, the pricing of G Fees, MIP, and flood insurance premiums, should be reduced for properties in heightened flood risk locations that have specified resilience characteristics. Inclusion of specific flood resiliency building structural characteristics adds additional risk mitigation that reduces the risk of loss to the guarantor and insurer. The NFIP already discounts premiums based on certain building elevation conditions within the 100-year floodplain, but NFIP should have a much more robust premium discount program reflecting other important flood mitigation and resiliency building features. This is expected to be part of the new Risk Rating 2.0. As noted above, in an analogous area, multifamily green programs at the GSEs and FHA have been created which encourage conservation and reflect lower risk. For example, a green loan for a multifamily property from the GSEs may qualify for G Fees of 30 to 35 basis points below a standard loan pricing. Again, the new flood risk metric proposed in this article would be used to determine the requisite flood resiliency score for the reduced loan pricing available in such a program.

Conclusion

Given that the flood risks and losses in many coastal and inland areas are increasing and are likely to continue to increase at accelerating rates over the coming decades, we need policies and financial programs and products that can promote prudent behavior by property owners subject to these risks. Although some efforts have begun, most state and local municipalities have not moved forward in this arena. There is an important opportunity for the GSEs, FHA, and major banks to lead the way, along with flood insurers and reinsurers. These key stakeholders should work together with the industries of engineering, architecture, risk modeling, and environmental science using the latest technologies to:

(i) articulate and advocate for the creation of a new set of standardized property-based assessment tools and scoring systems for flood risk and resilience;

(ii) oversee the creation of these new standardized assessment tools and metrics;

(iii) adopt these new standardized tools to assess flood risk at the time of mortgage origination, for life of loan portfolio analytics, and as an asset management tool; and then

(iv) create mortgage loan programs and other financial incentives which encourage and/or mandate prudent risk mitigation behavior.

This will also require consideration of the equitable distribution of the costs and benefits of these programs and the extent to which LMI households are assisted in making these market transitions.

Once standardized protocols and metrics are established, other major financial institutions will follow, as will state and local governments in changing building codes, zoning ordinances, and land use plans. At the same time, the architecture and building materials industries will invest in creating new designs and materials to increase flood resilience functionality of buildings. While, obviously, these actions alone cannot stop tidal or storm event flooding, they can play an important incremental role in increasing awareness and educating those who are in a position to mitigate flood risk, thereby reducing losses to property owners and the associated risk of loan default and insurance claims. These steps have the potential to not only catalyze new approaches in the public and private sectors, but they will also help maintain liquidity and accessibility in the capital markets for housing and commercial real estate, as they mitigate future default risk and losses to property owners and financial institutions over the next several decades. The steps advocated in this article are not just sound economics–they are sound practices for the advancement of social welfare for generations to come.

Michael D. Berman is the principal of Michael Berman Consulting, LLC, and has served as a fellow at both the Harvard Joint Center for Housing Studies and the Wharton-Penn Institute for Urban Research. He is the former CEO of CW Capital, chairman of the Mortgage Bankers Association, and senior advisor to HUD Cabinet Secretary Shaun Donovan.