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Does the Mortgage Market Price in Physical Risk?

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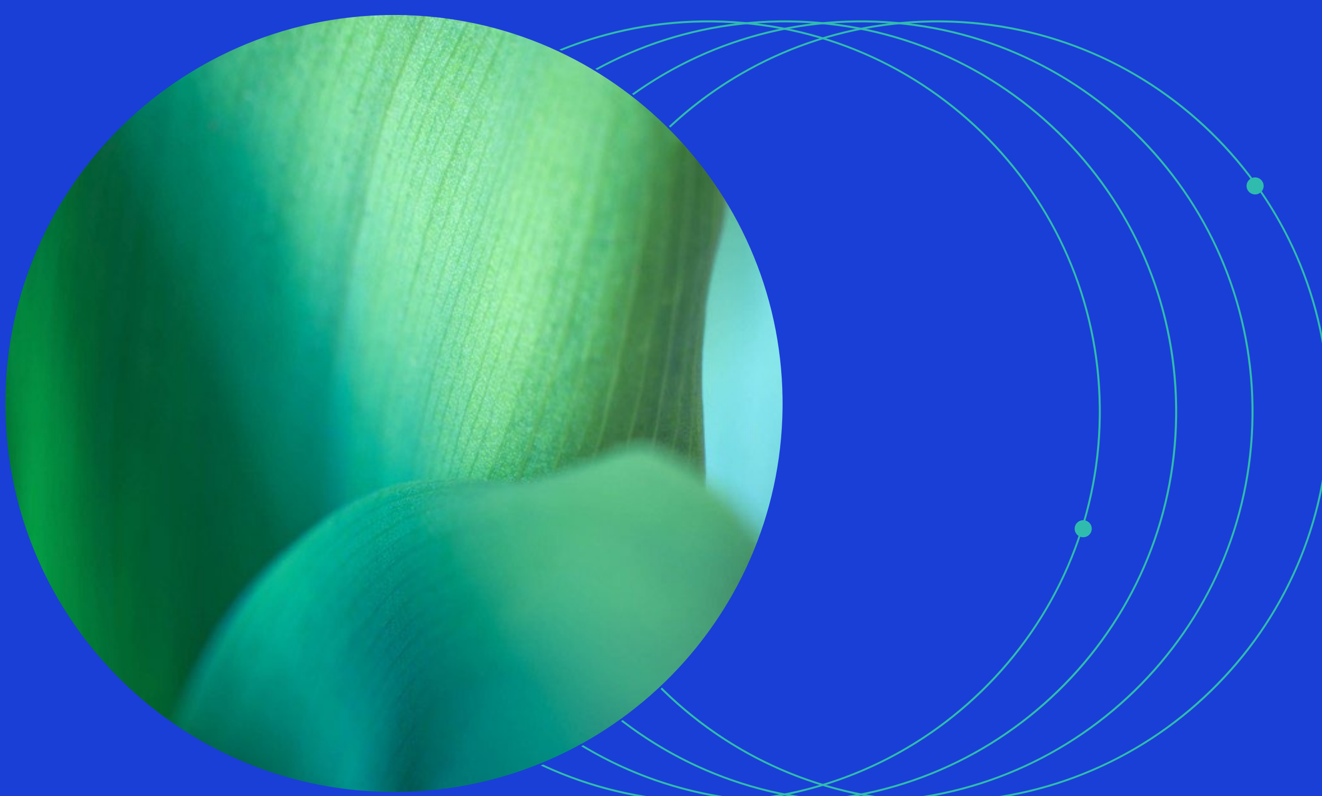


Natural disasters and the mortgage market

Natural disasters are increasingly causing widespread damage and economic disruptions. How would these physical risks impact residential mortgage and residential mortgage-backed securities (RMBS) — one of the largest asset classes in the U.S. and globally? To quantify these risks, we applied MSCI GeoSpatial Asset Intelligence to the U.S. agency RMBS market, which, at approximately USD 9 trillion, finances about two-thirds of outstanding mortgage debt in the U.S.

Quantifying physical risk exposures of mortgages

MSCI GeoSpatial Asset Intelligence covers 11 physical risk hazard types, covering both chronic and acute physical risks, such as floods, storms and heat waves, in over two million locations globally. It also provides estimates for hazard loss rate for residential properties with location data in the U.S. We complemented these further with natural hazard data from the U.S. Federal Emergency Management Agency (FEMA). The table below highlights the data combination for the granular physical risk types used for this study, and the composite hazard loss rate map shown at county level.[1] The hazard loss rate is defined as the product of annualized hazard frequency or probability and property loss ratio given hazard occurrence (in basis points, or bps), for current environment, based on historical data. [2]

Physical risk types covered by FEMA and MSCI GeoSpatial Asset Intelligence

FEMA	***MSCI***
Coastal flooding	***Coastal flooding***
Riverine flooding	***Fluvial flooding***
Hurricane	***Pluvial Flooding***
	Tropical cyclones -wind
Wildfire	*Wildfire*
Earthquake, hail, tornado, avalanche, cold wave, heat wave, ice storm, landslide, lightning, strong wind, tsunami, volcanic activity, winter weather	*River low flow, extreme heat, extreme cold, wind gusts, heavy rain, heavy snowfall*

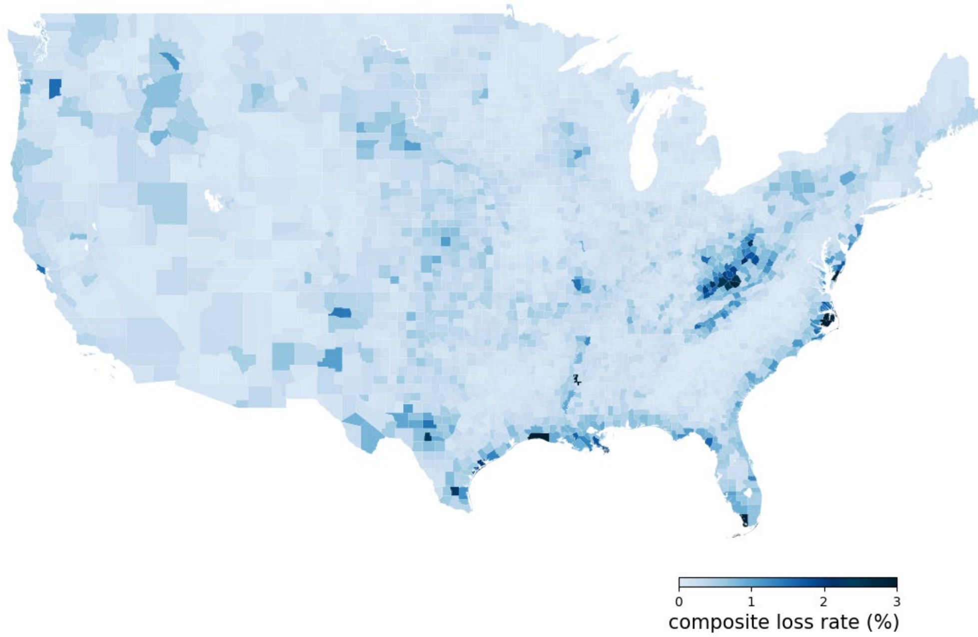
Note: Boldfaced rows indicate hazard types used in the composite hazard loss rate analysis.

Source: MSCI, FEMA, as of year-end 2023.

[1] Data selection is based on comparison of detailed definition of the physical risk type and analysis of data quality.

[2] MSCI GeoSpatial Asset Intelligence Methodology; National Risk Index Technical Documentation.

Composite hazard loss rate at the county level

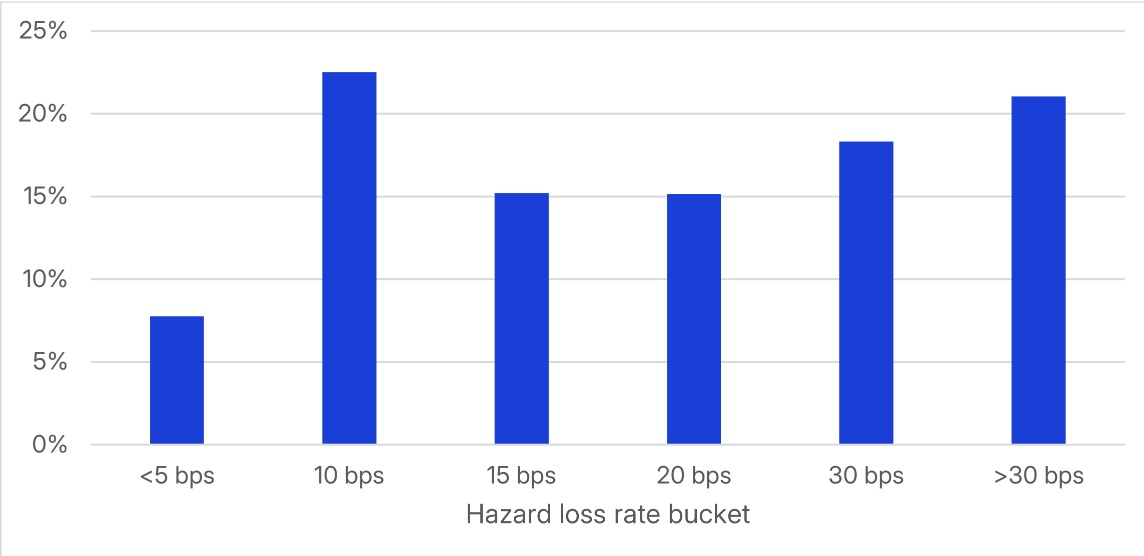


Source: MSCI, FEMA, as of year-end 2023

We then mapped the properties' underlying mortgages in the agency RMBS universe to the composite hazard loss rates we created. While agency RMBS securities typically provide underlying loan location data at the state level, we applied advanced data mapping models to increase the granularity down to the census tract or three-digit ZIP code levels.

The chart below shows the distribution of current outstanding agency RMBS volume over their property physical risk hazard loss rates. The weighted average hazard loss rate for the properties underlying the USD 9 trillion agency RMBS universe was about 25 bps across the 18 hazard types. About 20% of the mortgages (weighted by outstanding balances) are in the areas with property hazard loss rates over 30bps. The average hazard loss rate for this group was 55 bps.

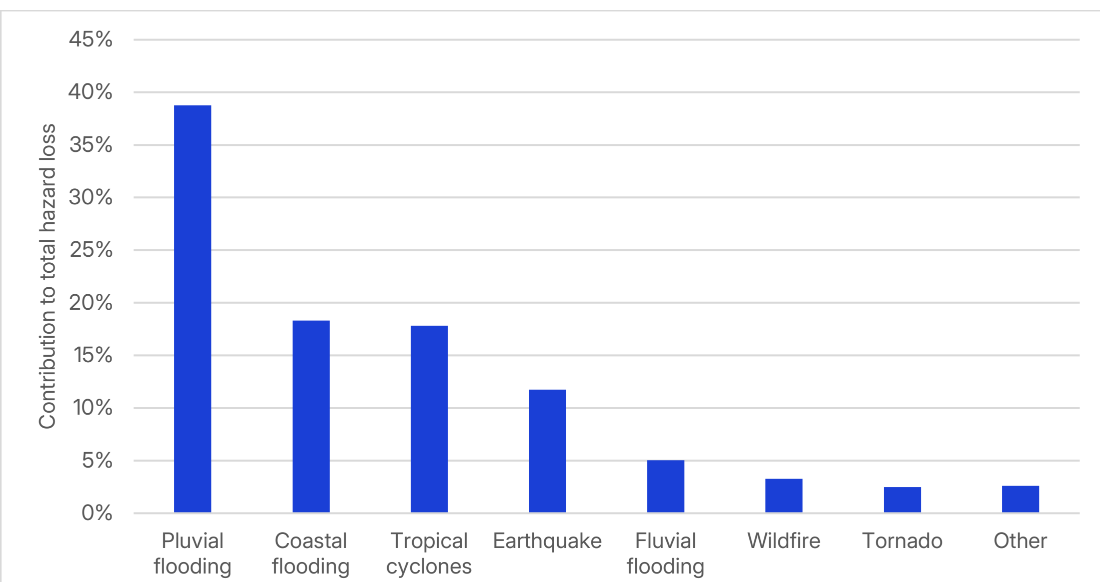
Distribution of current outstanding agency RMBS volume over physical risk hazard loss rates



Source: MSCI, FEMA, Recursions Co, as of December 2024

We then looked at the percentage contribution of various physical risk types to the total agency RMBS hazard loss dollar volume (USD 9 trillion x 25 bps hazard loss rate). (Here we use mortgage outstanding balances, instead of property values, ignoring the Loan-to-Value ratios.) The most significant contribution to the overall risk was from flooding, tropical cyclones, earthquakes, wildfires and tornadoes, as shown below.

Contribution of hazard types to the total agency RMBS hazard loss volume



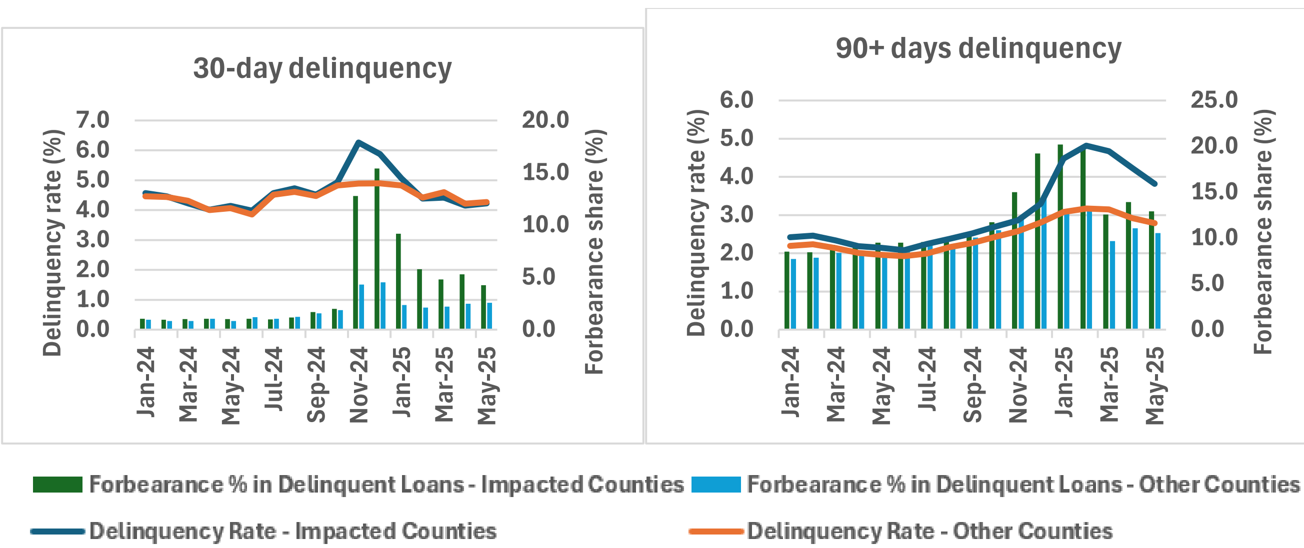
Source: MSCI, FEMA, Recursions Co, as of December 2024

Quantifying physical risk impact on mortgages: loan performance and potential insurance leakages

Property damages and economic impacts from natural disasters (e.g., business and personal income losses) may reduce the ability and willingness of borrowers to continue to pay their mortgages. We examined two recent examples of loan performance impact, by comparing impacted counties versus other counties in the mortgage pools.

In October 2024, Hurricane Milton, a Category 5 storm, made landfall in Florida where it caused approximately USD 34.3 billion in damage, as one of the most destructive hurricanes of the 2024 Atlantic hurricane season. Like the aftermath from other major storms in recent years, serious delinquencies peaked at modestly higher levels three to four months following the disaster, compared with unaffected areas, then gradually tapered off, though in many cases remained modestly elevated a year after the event.

FHA loans after Hurricane Milton in October 2024

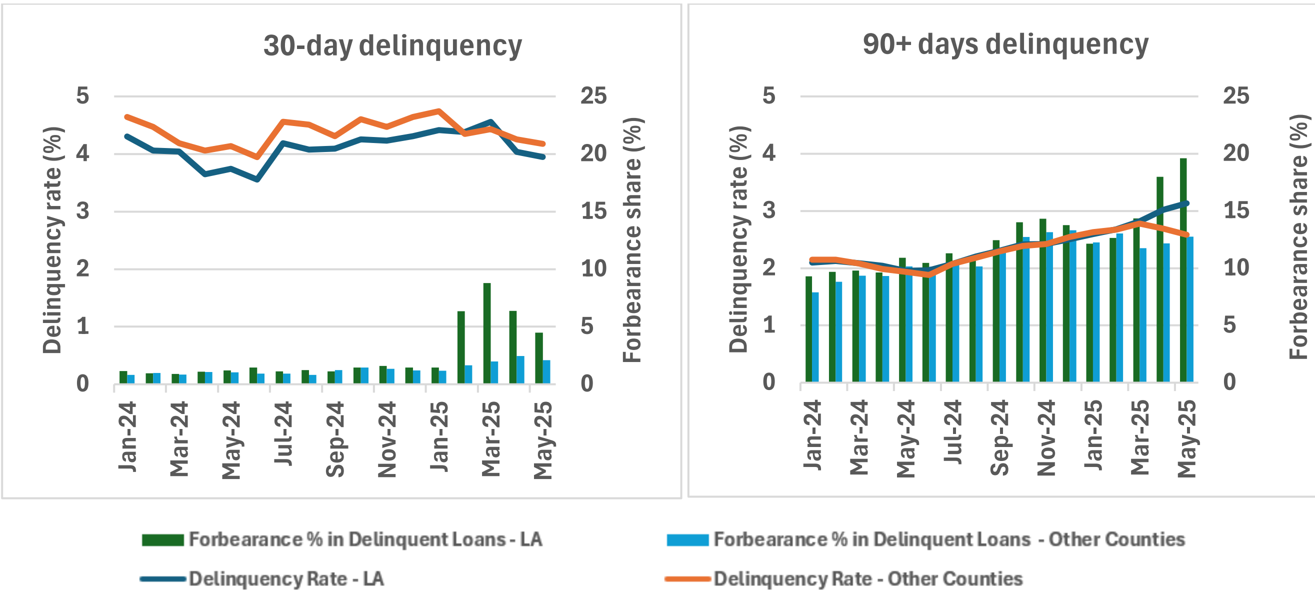


Note: "Impacted counties" includes the counties designated by FEMA that are eligible for individual assistance. "Other counties" includes rest of counties in Florida.

Source: MSCI, Recursion Co., Ginnie Mae, HMDA, FEMA

In January 2025, Southern California faced devastating wildfires fueled by extreme Santa Ana winds and dry conditions. The fires forced the temporary evacuation of over 200,000 residents and destroyed more than 18,000 structures. The Los Angeles area has begun to see modestly higher serious mortgage delinquencies compared with unaffected areas.

FHA loans after Los Angeles wildfire in January 2025



Note: “Other Counties” includes all counties other than LA in California

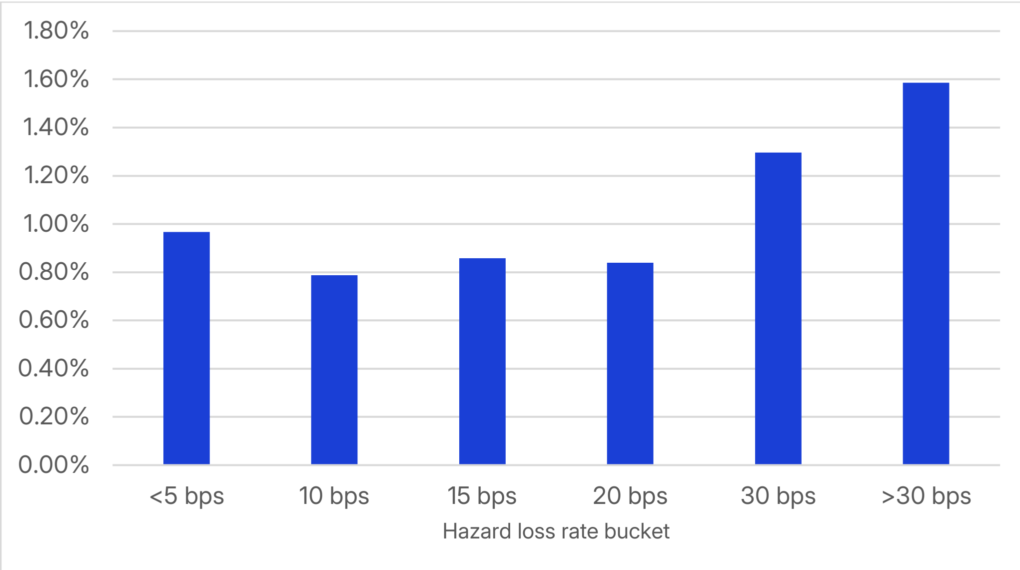
Source: MSCI, Recursion Co., Ginnie Mae, HMDA, FEMA

The modest impact on loan performance is primarily due to the financial support from property insurance, which is typically required for mortgages.[3] After payment of insurance claims, the delinquency rates generally start to decline, as shown in previous examples above. Furthermore, RMBS usually have geographic diversification across their underlying loan portfolios. As a result, the impact on security level risk/return is relatively small.

However, our research shows emerging risks in insurance support for mortgage physical risk. Annual non-renewal rates for property insurance have reached 1.6% for high hazard areas (hazard loss rate > 30 bps), double the rate from areas with hazard loss rates below 20 bps.

[3] In addition, governments also provide various forms of disaster related financial assistance. For example, FEMA provides two primary forms of federal assistance following presidential disaster declaration: Individual Assistance directed to individuals and households, and Public Assistance directed to local governments and nonprofits' community support.

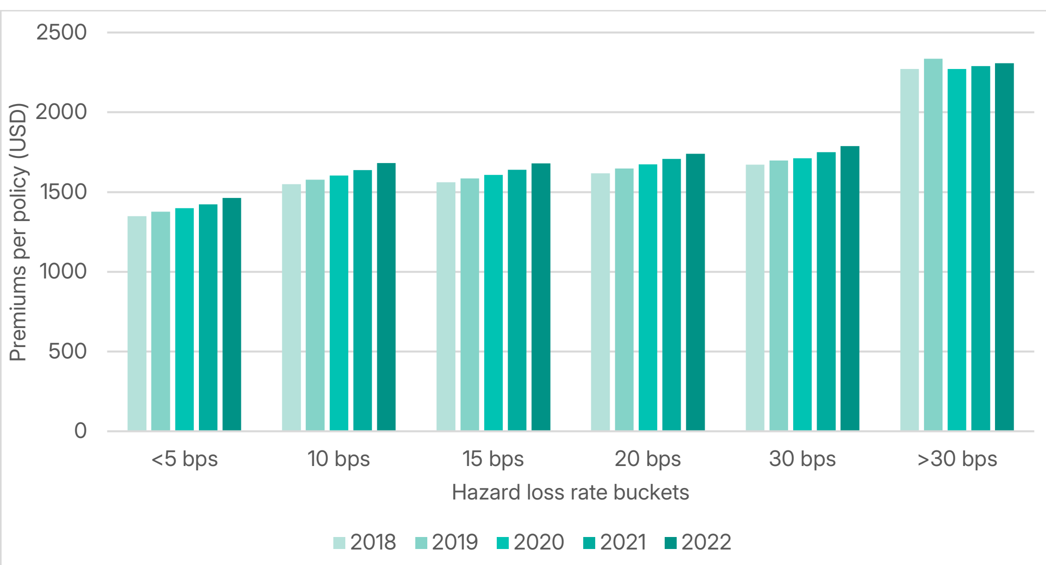
Property insurance non-renewal rates vs hazard loss rates



Source: MSCI, FEMA, Senate Budget Committee as of 2023

The strength of existing insurance may also be at risk. As seen below, insurance premiums have generally increased in recent years for all hazard loss rates groups, except for the high hazard areas (hazard loss rates > 30 bps), flagging the potential risk in insurance adverse selection, which may lead to inadequate coverage for underlying mortgage physical risk.

Average insurance premium trends vs hazard loss rates



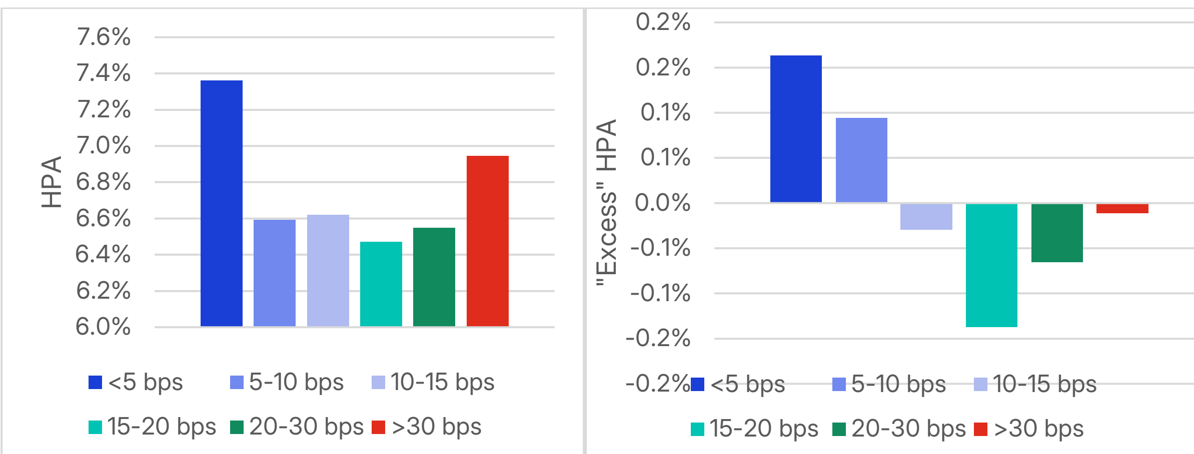
Source: MSCI, FEMA, U.S. Department of the Treasury

Quantifying long-term risk from mortgage physical risk

Rising physical risk may lead to higher insurance costs, which in turn could elevate borrowers' credit risk and borrowing costs by pushing up debt-to-income ratios. It could also negatively impact local economy and employment and may lead to reduced preference for homeownership for high hazard areas. Our regression analysis between zip-code level home price appreciation (HPA) rates and hazard loss rates suggests a 0.4% reduction in annual HPA rate for high hazard loss rates over the past decade.

Home price appreciation patterns are heavily driven by many local socioeconomic and demographic factors, such as the local economy and employment growth, and population movement during COVID-19. For illustration, the chart below shows the annual HPA rates and "excess" HPA rates across hazard loss rates groups, for the 2014-2024 period. We define the "excess" HPA rate as a zip code level value subtracted by corresponding average value from surrounding areas, in order to isolate the potential effect due to physical risk.

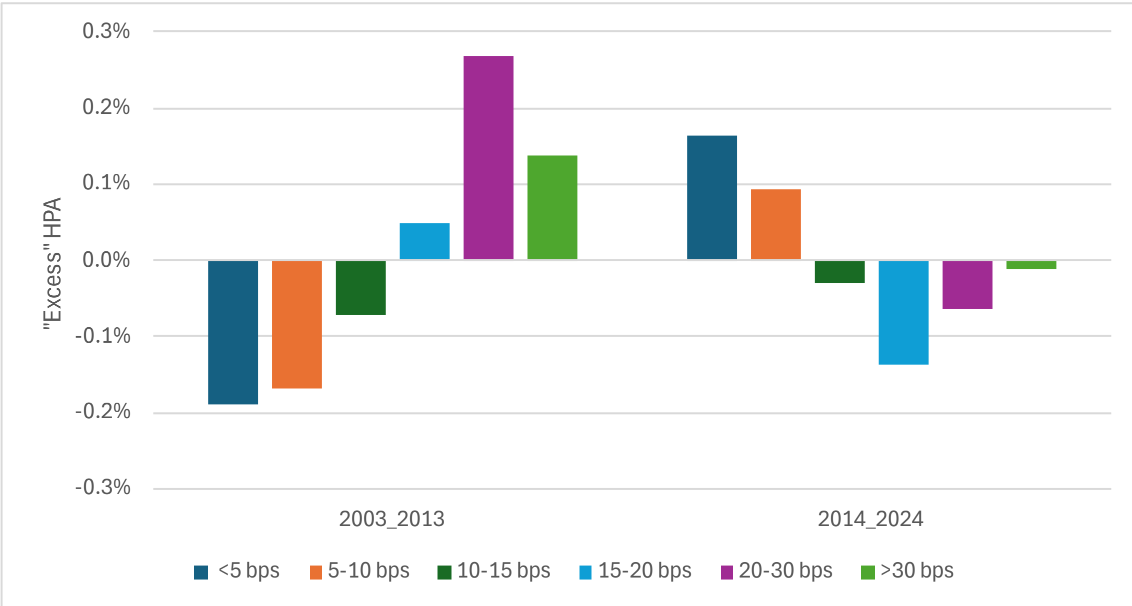
Annual HPA and excess HPA rates vs hazard loss rates, for 2014-2024



Source: MSCI, FEMA, Zillow.com

We saw a very different patten, however, for the earlier 10-year period of 2003-2013. Although various negative factors associated with higher physical risk may reduce location desirability, these effects are often offset by hedonic values associated with high-risk areas, such as the scenery value. The emerging trend of HPA shortfalls related to physical risk in recent decades may be driven by a combination of rising insurance premiums, growing costs from natural disasters and increased public awareness of physical risks.

Excess HPA vs. hazard loss rates for 10-year periods of 2003-2013 and 2004-2014



Source: MSCI, FEMA, Zillow.com

Conclusion

For mortgages and RMBS, physical risk exposure is mostly from the underlying property collaterals. There are additional marginal risks due to the physical-risk impact on operations of the servicers and issuers. Currently, insurance coverages mitigate large parts of these risks, leading to the modest impact on loan performance. The residual risks are borne by guarantors, issuers and investors. However, insurance-coverage risks are increasing, as shown by our analysis on insurance lapse rates and potential insurance adverse selection issues. Long term credit risks may also be rising as home prices are impacted by physical risk. All mortgage stakeholders, especially those with geographic concentrations, may need to analyze and quantify these emerging physical risks.

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