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Disentangling Environmental and Economic Risks in Mortgage Default: A Spatio-Temporal Modelling and Stress-Testing Framework with Capital Implications

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Abstract

This paper develops and empirically validates a spatio-temporal framework that integrates extreme weather events and climate-related risk drivers with conventional borrower, loan and macroeconomic variables to explain and predict mortgage default risk. We use discrete-time survival models ranging from linear specifications to flexible general additive models with P-splines, time-varying coefficients and interaction surfaces. We contribute to the literature in three ways. First, unlike existing literature we investigate the predictive efficacy of models with time-varying coefficients and with coefficients dependent on other risk drivers. Second, we explore linear effects, nonlinear effects and nonlinear interactions between a wide range of weather drivers of default and between macroeconomic drivers of default, which have not been incorporated into credit risk models before. Third, we assess the relative contribution to the required economic capital of uncertainty over weather events and uncertainty of the macroeconomy. We do this by building time series models for weather and for macroeconomic variables. The omission of weather events results in significant underestimation of the capital required, especially under joint macroeconomic and weather stress. The approach is validated using mortgage defaults and wildfires in California. Recent wildfire occurrences across the world make our methodology particularly appropriate for risk modellers in banks.

Keywords: credit risk; climate stress-testing; wildfires; mortgages; regulatory capital estimation

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