Efficiency and Fairness in Homeowners Insurance Risk Classification

Judson Boomhower & Meredith Fowlie*

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Escalating losses from windstorms, wildfires, and other weather disasters are upending property insurance markets. Average premiums are increasing and the availability of homeowners insurance and other privately-provided insurance products has shrunk. These outcomes challenge household budgets and threaten to disrupt real estate markets. While the incidence of insurance market upheaval across households and regions is partly driven by the underlying pattern of rising climate risk, it also depends importantly on the tools that insurers use to price insurance contracts. By their nature, weather disasters occur too infrequently to price with traditional actuarial methods. Expected losses for a given property are instead assessed using simulation-based engineering models. As weather-related claims have grown in recent decades, insurers have found it profitable to invest in more sophisticated models that promise more accurate and granular expected loss predictions. In California, for example, the granularity of wildfire risk pricing by homeowners insurers has evolved from a few dozen geographic territories twenty years ago to many thousands today. Today's pricing models also differentiate premiums according to construction materials and nearby vegetation. These new tools imply greater variance of prices. In the old regime, prices for all households were close to population-average expected loss. In the new regime, property owners in locations with high predicted risk face dramatically higher prices.

This extended abstract describes a companion project to accompany our current work on homeowners insurance and wildfire risk (Boomhower et al. 2024). That existing paper takes insurers' adoption of risk models as given and explores the implications for adverse selection and market regulation. This proposed project would tackle the complementary question of

*Boomhower: jboomhower@ucsd.edu. Fowlie: fowlie@berkeley.edu. Boomhower gratefully acknowledges funding via an Andrew Carnegie Fellowship from the Carnegie Corporation of New York. Neither author has any relevant or material financial relationships that relate to this research.

whether increasingly sophisticated risk classification is desirable from an efficiency and/or distributional perspective. We will build on foundational work on costly risk classification in competitive insurance markets (e.g., Abraham 1985; Crocker and Snow 1986). We expect that the results will be of interest to policymakers and researchers grappling with how to balance fairness, affordability, and availability of insurance in an environment of rapidly changing climate risk. We also expect the broad lessons of the research to generalize from the wildfire context to other weather perils covered by private insurance, including hurricane winds, severe convective storms, and hail.

Efficiency and Fairness in Risk Modeling

To the extent that more advanced disaster risk modeling better aligns premiums with scientific predictions of expected losses, these new tools more appropriately signal the value of risk-reducing behaviors by homeowners. The resulting efficiency benefits depend on the price elasticity of self-protection. When prices more closely reflect expected losses at the household level, do homeowners make more appropriate decisions about how and where to build and maintain homes? This is ultimately an empirical question.

However, homeowner behavior is not the only efficiency consideration. Developing more advanced disaster risk pricing models is a costly undertaking. So is integrating those models into the firm's operations. An insurer in a competitive market can increase its own profits by investing heavily in risk models that enable it to cream-skim relatively low-cost customers. Relative to a socially efficient outcome, the competitive equilibrium outcome in such a market may involve excessive spending on risk classification tools and unnecessarily high insurance premiums to cover the costs of these tools (Crocker and Snow 1986; Borenstein 1989).

The market's move towards increasingly sophisticated risk modeling also raises questions of fairness and distribution. More targeted risk classification changes the distribution of natural disaster costs, loading much more of the burden of disaster losses on high-hazard customer classes. Whether this is desirable depends on values-based questions about the goals of insurance and risk sharing (Chamberlin 1985). It may also depend on the correlation of predicted disaster risk with socio-economic characteristics. New innovations in machine learning, catastrophe modeling, and "big data" are underscoring these questions about efficiency and fairness (Einav, Finkelstein, and Mahoney 2021; Eling, Gemmo, and Guxha 2024).

Plan of the research

This project will build off of the datasets that we assembled in Boomhower et al. (2024). Those data include rich historical information on wildfire pricing from insurer rate filings with the California Department of Insurance and structure-level predictions of wildfire expected losses from a state-of-the-art wildfire catastrophe model for a large sample of California homes. This project will be bolstered by the ability to observe extremely granular, structure-level loss predictions from a model that is actually used by insurers for pricing.

In the proposed paper, we plan to use the data to measure the following for wildfire risk in California homeowners insurance.

1. The historical evolution of wildfire pricing practices reported by major insurers in their rate filings, from coarse geographic territories in the early 2000's to parcel-level wildfire scores in the 2010's, and to frontier stochastic catastrophe models in more recent years.

2. The within-customer-class variation in expected wildfire losses when risk classes are defined according to coarse geographic territories, zip codes, wildfire risk scores, or fine spatial grids. Under the more granular price schedules, how much closer are expected losses for the customer class to individual expected losses on average?

3. Counterfactual distributions of customer-level insurance prices if the market were to price wildfire risk using coarse geographic territories, zip codes, wildfire risk scores, or fine spatial grids, under the stylized assumption that the price for a given customer class equals expected cost of serving customers in that class.

4. The potential implications of these various price schedules for self-protective investment by homeowners, drawing behavioral elasticities from the literature, including values from an ongoing field experiment by Boomhower and co-authors.

5. Correlations between income, race, and other socio-economic characteristics and the modeled insurance prices under each pricing regime (coarse geographic territories, zip codes, wildfire risk scores, or fine spatial grids).

We will integrate these components into a policy-focused article that discusses the efficiency and distributional implications of increasingly granular risk classification in U.S. homeowners insurance, with California as the empirical application. We will also consider the economics of related policy options such as the decision to prohibit the use of certain variables in insurance pricing.

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