The Hidden Cost of Climate Risk: How Rising Insurance Premiums Affect Mortgage, Relocation, and Credit *

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Abstract

As climate change exacerbates natural disasters, homeowners' insurance premiums are rising dramatically. We examine the impact of premium increases on borrowers' mortgage, relocation, and credit outcomes using new data on home insurance policies for 6.7 million borrowers. We find that higher premiums increase the probability of mortgage delinquency, as well as prepayment. The prepayment effect is mainly driven by relocation. Movers with larger pre-moving premium increases achieve larger premium reductions. The results hold using a novel instrumental variable. The delinquency effect is greater for borrowers with higher debt-to-income ratios. Both delinquency and prepayment effects are present across GSE and non-GSE mortgages. Beyond mortgages, higher premiums also increase credit card delinquency and deteriorate borrower creditworthiness. Our findings unveil a channel through which climate change can threaten household financial health and potentially impact the stability of the financial system.

JEL Classification: G21, G22, G5, G52, G53, R21, Q54, D14, R3

Keywords: climate risk, insurance, mortgage, delinquency, prepayment, relocation, credit card, creditworthiness

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1 Introduction

Climate change is intensifying natural disasters, making homeowners' insurance increasingly crucial for households' financial resilience. Insurance premiums in the U.S. have surged dramatically in recent years, with projections indicating further increases due to climate change. With average annual premiums exceeding $5,000 in some states, rising insurance costs can pose a growing financial burden on households. These rising costs represent a direct channel through which climate change strains household finances.

The impact on mortgages, which constitute 72% of household debt, warrants particular attention. As mortgage payments typically take priority over other obligations in household budgets, mortgage outcomes provide a unique window into households' financial health. Rising insurance premiums reduce households' available liquidity for mortgage payments, potentially increasing delinquency rates. Conversely, homeowners can mitigate the financial effects of premium increases by relocating to homes with lower insurance costs or prepaying their mortgages to avoid the required insurance, both of which will drive up prepayment rates. Given the significant role mortgages play in the financial market, rapid increases in insurance costs can have far-reaching ripple effects throughout the financial sector.

Moreover, as the cost of home insurance increases, it can restrict households' liquidity to meet other debt obligations, leading to financial strain across different types of debt. This makes credit card delinquency an important complementary outcome to examine, as it can shed light on the broad effect of rising insurance costs on households' balance sheets.

We study how insurance costs affect mortgage, relocation, and credit outcomes. Despite its importance, the impact of insurance costs on households' financial outcomes and relocation decisions remains largely unexplored. Two key obstacles have hindered research: limited data availability and identification challenges. To fill this critical gap in the literature, we use a newly available dataset linking detailed insurance policy infor-

mation with mortgage and other credit outcomes for 6.7 million borrowers. Moreover, to identify the causal effects of insurance premium increases, we construct a novel instrumental variable for insurance premium increases.

We confirm the findings in Keys and Mulder (2024) that climate risk is associated with larger insurance premium increases. Following that, we have a number of key findings. First, we demonstrate that rising insurance premiums are associated with higher probabilities of delinquency and prepayment within 12 months after premium changes at policy renewals. With zip fixed effects, we compare households within the same zip code who renewed insurance policies between July 2022 and June 2023, which controls for local economic factors correlated with mortgage defaults. The effect on delinquency is especially significant. When premiums increase by one standard deviation, the probability of 60-day delinquency rises by 0.14 percentage points, representing a 16% increase relative to the mean probability (0.9%). The estimate is larger for 30-day delinquency and smaller for 90-day delinquency, suggesting that households significantly cure their delinquencies associated with premium increases. This suggests that the majority of the short-term delinquencies are not strategic.

Importantly, these results are robust to an instrumental variable approach, which offers evidence of causality. We use two instruments for premium rate changes simultaneously. For each borrower, we first construct the average premium rate change at renewal across policies that renew in the same month within the same three-digit zip code. Rather than use the actual renewal month, we use each policy's expiration month from the previous year, to reduce concerns about endogenous renewal timing. We then regress these zip-by-renewal month averages on their 12-, 24-, 36-, and 48-month lagged values, as well as month fixed effects. The residual from this regression serves as our first instrument. This instrument represents the shock to the average insurance premium rate in a zip-month while controlling for month averages and the recent trajectory of premium changes for the same cohort of policies in the area. Our second instrument is created by

interacting the first instrument with each borrower's premium rate before renewal.

The relevance of our instruments is based on two mechanisms. First, premium increases follow location-level trends driven by insurers' risk assessments of that location (Keys and Mulder, 2024) and state regulator approvals (Oh, Sen and Tenekedjieva, 2022). Premium increases only affect homeowners at renewal, so a property's premium change should correlate strongly with premium changes that insurers implemented in the local area in the same month. Second, Keys and Mulder (2024) find that riskier zip codes have seen larger increases in premiums in recent years. We hypothesize that within a location, premium increases have also been larger for riskier properties, which we proxy using lagged premiums. Thus, the second instrument should also be relevant.

Our first instrument is likely exogenous. Since our instrumental-variable regressions include zip code fixed effects, we effectively compare borrowers within the same zip code who renew their insurance policies in different months between July 2022 and June 2023. The within-zip variation in the residualized local average premium changes likely stems from the timing of insurer premium changes and regulatory approvals, rather than factors related to individual borrowers' probability of delinquency or prepayment. In addition, insurance policy expiration/renewal timing is plausibly exogenous because it primarily depends on when homeowners initially purchased insurance. Given these arguments, our first instrument likely satisfies the exclusion restriction. Consequently, our second instrument—which interacts the first instrument with borrowers' predetermined, lagged premium rates—should also be exogenous. Furthermore, we control for each borrower's FICO score the month preceding their insurance policy renewal, consistent with our OLS regression, to further rule out endogeneity.

Our instruments are highly relevant, predicting borrower-level premium increases with high levels of statistical significance and large first-stage F-statistics. The second-stage results closely align with our OLS estimates with similar magnitudes, suggesting that premium changes causally influence the probabilities of mortgage delinquency and

prepayment.

Our second finding is on the mechanism of the prepayment effect. The majority of the effect is explained by borrowers prepaying their mortgages while relocating their residences. Specifically, we find a positive correlation between premium increases and the probability of moving. Moreover, movers experiencing larger pre-moving insurance rate increases achieve greater premium reductions, both in premium rates and total dollar amounts. These findings suggest that households perceive insurance premium savings from relocation as enhancing the overall benefits of moving, effectively shifting their decision-making in favor of relocation.

Third, the effect of premium increases on delinquencies is more pronounced among borrowers with high debt-to-income (DTI) or high loan-to-value (LTV) ratios. These borrowers are likely to have more limited liquidity to absorb the rising insurance costs. This result aligns with the hypothesis that higher insurance premiums strain household liquidity and adversely affect mortgage outcomes. In addition, the impact of premium increases on delinquencies varies dramatically by mortgage size. The effect is three times larger for non-jumbo compared to jumbo mortgages. Since jumbo borrowers are generally less liquidity-constrained, this is consistent with our previous finding that more constrained borrowers are more sensitive to premium increases in their delinquencies. Furthermore, the delinquency effect is widespread—appearing in private-label securitized mortgages, those held by banks, and GSE mortgages, indicating risks for the financial market and the Federal Government.

Fourth, we find that the impact of premium increases on prepayment only exists for non-jumbo loans. This could be because these loans have smaller outstanding balances and are easier to pay off. It could also be because these loans are tied to median- or low-value properties that are more liquid, making it easier for homeowners to sell and move.

Fifth, we find that the premium increases have a smaller effect on delinquencies if borrowers change their insurance coverage. When insurance premiums increase, home-

owners who increase coverage may do so in response to an increase in either actual or perceived disaster risk. Those who choose to enhance their coverage may have more liquidity, making them less likely to be delinquent due to rising insurance premiums. At the same time, borrowers who reduce coverage, which mitigates the effect of increasing premium rates, also experience a smaller delinquency effect.

Finally, we find that borrowers are also more likely to become delinquent on their credit card debt when home insurance premiums increase. At the same time, their credit card utilization increases and their creditworthiness worsens. This result suggests that the effect of premiums on mortgage delinquencies is not merely mechanical, such as households being inattentive to increased monthly payments. Rather, the credit card delinquency result indicates that rising insurance premiums constrain households' liquidity and have broad effects on households' financial conditions.

This paper has several important implications. Our findings underscore the significant impact of climate change on household financial resilience through the insurance market. As climate-driven disasters become more severe and frequent, they push insurance rates higher, which in turn increases households' risk of mortgage delinquency.

Importantly, our paper also highlights risks associated with insurance prices in mortgages and mortgage-backed securities, with implications for the stability of the financial sector. Since mortgages and mortgage-backed securities are central to the financial sector, increased delinquencies can destabilize financial institutions. Thus, climate change's impact on insurance rates represents an emerging threat to broader financial stability.

Our findings carry significant implications for policymakers grappling with the issue of insurance affordability. The results suggest that insurance costs are severely constraining households' liquidity, to the extent that some households are becoming delinquent on their mortgages as a result. Considering that mortgage defaults can have large spillover effects on the wider economy, our research underscores the potential benefits of policy

interventions, such as means-tested insurance subsidies[1] for existing homeowners. Such measures may have a limited net effect on the government budget, given that our results suggest that the Federal Government may be bearing much of the delinquency risk associated with rising insurance costs.

To the best of our knowledge, we are the first to identify the effect of property insurance premiums on households' financial outcomes. We contribute to the literature on property insurance and mortgages, which focuses on different perspectives. Sastry (2021) argues that lenders require higher downpayment for borrowers who under-insure, potentially due to concerns about post-disaster default. Sastry, Sen and Tenekedjieva (2023) find that mortgage defaults are higher in areas after disasters with higher levels of insurer insolvency. We find that increases in premiums alone, orthogonal to disasters, can also increase the risk of default. Ge, Lam and Lewis (2024) document that buyers of homes that experience exogenous flood insurance premium increases are less likely to take up mortgages. Our result can potentially explain their finding: banks may be concerned about default risks associated with higher insurance premiums. An, Gabriel and Tzur-Ilan (2024) explore the effect of wildfires on housing and mortgage outcomes and discuss the role of insurance. Cookson, Gallagher and Mulder (2024) find that a larger insurance coverage gap is associated with a lower post-disaster rebuilding probability. By highlighting the important effect of insurance premiums on mortgage outcomes, we also contribute to a growing literature studying trends and patterns in home and flood insurance pricing.[2] In addition to pricing, Jotikasthira, Kartasheva, Lundblad and Ramadorai (2025) uncover

[1] See a related proposal studied by the Congressional Budget Office, https://www.cbo.gov/publication/59918.

[2] Liao and Mulder (2021) study the effect of home equity on flood insurance demand. A few papers study the effect of insurance premiums on the housing market with mixed findings, including Georgic and Klaiber (2022) Hennighausen, Liao, Nolte and Pollack (2023), Gibson and Mullins (2020), Bakkensen and Barrage (2021), Nyce, Dumm, Sirmans and Smersh (2015), and Hino and Burke (2021). Papers on home insurance pricing include Keys and Mulder (2024), Boomhower, Fowlie, Gellman and Plantinga (2024), Oh et al. (2022), Sastry et al. (2023), and Blonz, Hossain and Weill (2024). Papers on the National Flood Insurance Program pricing include Wagner (2022a), Weill (2022), Mulder and Kousky (2023), and Mulder (2021). Marcoux and Wagner (2023) and Wagner (2022b) study insurance market design. Jung, Engle, Ge and Zeng (2023) measure insurers' exposure to climate risk.

claim payment delays as another response by insurers to losses.

Our study contributes to the growing body of literature examining the intersection of climate change, natural disasters, and mortgage markets. Prior papers explore the impact of disasters on mortgage delinquencies (Gallagher and Hartley, 2017; Kousky, Palim and Pan, 2020; Billings, Gallagher and Ricketts, 2022; Issler, Stanton, Vergara-Alert and Wallace, 2024; Biswas, Hossain and Zink, 2023), pricing of mortgage-related securities (Gete, Tsouderou and Wachter, 2024; Dice, Hossain and Rodziewicz, 2024), and securitization (Ouazad and Kahn, 2022). We highlight a different channel—insurance costs—through which disaster and climate risks can affect mortgage outcomes. In so doing, we also complement recent work on climate risk in housing markets (Bernstein, Gustafson and Lewis, 2019; Baldauf, Garlappi and Yannelis, 2020; Murfin and Spiegel, 2020; Keys and Mulder, 2020; Giglio, Maggiori, Rao, Stroebel and Weber, 2021; Lopez and Tzur-Ilan, 2023).

Our paper also contributes to the literature on how physical climate risk affects financial markets. Acharya, Berner, Engle, Jung, Stroebel, Zeng and Zhao (2023) summarize in their review of the literature that physical risks, such as rising sea levels, extreme weather events, and heat stress, can lead to direct damages to assets and disruptions to business operations, potentially resulting in loan defaults and losses for banks. We highlight a new channel, i.e., insurance premiums, through which climate change can impose substantial risks on the financial market.

2 Institutional background

2.1 Background

Homeowners' insurance is a critical component of the U.S. housing market. Sastry, Sen, Tenekedjieva and Scharlemann (2024) estimate that 80% of homeowners hold such policies. This high adoption rate is likely driven by mortgage lenders requiring insurance coverage as a precondition for loans. Around 30% of homeowners reported being impacted

by weather events in the last 5 years, highlighting the importance of such coverage.[3]

The most common policy for owner-occupied residences is the "HO-3" type, which provides comprehensive coverage, including the structure, contents, legal expenses, and temporary living costs if the home becomes uninhabitable due to damage. These multi-peril policies typically have one-year terms with automatic renewal, subject to potential changes in rates or terms communicated through annual statements. However, it's crucial to note that standard policies often exclude certain perils, such as floods and earthquakes. Specialized policies are available to cover these excluded risks.[4] In areas where private insurance is difficult to obtain, homeowners may resort to state-sponsored "insurers of last resort," such as Citizens Property Insurance in Florida or the California FAIR plan.

2.2 Coverage

Homeowners' insurance policies typically include several key components that define the scope and extent of coverage.

Coverage types in a standard policy usually include dwelling coverage (for the structure of the home), personal property coverage (for belongings), liability protection, and additional living expenses.[5] In terms of structure coverage, there are two dominant types: "Actual Cash Value" (ACV) and "Replacement Cost Value" (RCV). ACV reimburses policyholders for the depreciated value of damaged property, meaning it deducts for age and wear. For example, if a 10-year-old roof is damaged, ACV would pay the current market value of that roof, not the cost of a new one. In contrast, RCV covers the full cost to repair or replace the damaged property without depreciation deductions. This means that a policyholder would receive enough to replace the old roof with a new one of similar quality. Overall, RCV typically provides higher payouts but comes with higher

[3] See Homeowners Perception of Weather Risks 2023Q2 Consumer Survey, https://www.iii.org/sites/default/files/docs/pdf/2023_q2_ho_perception_of_weather_risks.pdf.

[4] See https://content.naic.org/sites/default/files/publication-hoi-pp-consumer-homeowners.pdf.

[5] See https://content.naic.org/sites/default/files/publication-hmr-zu-homeowners-insurance.pdf.

premiums compared to ACV policies.

Deductibles are the amount the policyholder must pay out-of-pocket before insurance coverage kicks in. In our data, many policyholders choose a deductible of 0.5% of the total insured value. The total insured value represents the maximum amount the insurer will pay in the event of a total loss, typically set to the estimated cost to rebuild the home.Homeowners can often customize their policies by adjusting coverage limits, adding endorsements for specific valuables, or opting for higher deductibles to lower premiums.

2.3 Pricing

The cost of homeowners' insurance is primarily determined by location-specific risks, with states prone to natural disasters such as hurricanes, tornadoes, and wildfires typically having higher premiums. For instance, Florida and Louisiana have some of the highest average annual premiums, exceeding $5,700, while states like Hawaii and Vermont have much lower average costs, around $500 to $800 per year.[6] Other factors affecting pricing include the home's age, construction materials, proximity to fire stations, and the homeowner's claims history and credit score. Insurance companies use complex actuarial models to assess risk and set premiums, leading to variations in pricing among different insurers (Boomhower et al., 2024). Homeowners' insurance rates in the United States are subject to regulatory oversight and approval processes, which vary by state. Insurance companies must typically submit rate change requests to state insurance departments or commissions for review and approval before implementing new premiums.

[6] See https://www.bankrate.com/insurance/homeowners-insurance/home-insurance-statistics/.

3 Data

3.1 Residential Mortgage Servicing (ICE McDash Analytics)

The Residential Mortgage Servicing Database contains information from ICE McDash data. The data comprise mainly the servicing portfolios of the largest residential mortgage servicers in the US. It covers approximately two-thirds of installment-type loans in the residential mortgage servicing market. Loan-level attributes include borrower characteristics (credit scores, owner occupancy, documentation type, and loan purpose); collateral characteristics (LTV, property type, zip code); and loan characteristics (product type, loan balance, and loan status). We restrict our sample to loans secured by single-family homes with non-missing zip code, occupancy, origination date, LTV, DTI, and credit score.

We use two loan outcomes from this dataset. The first is whether a mortgage is delinquent for at least 30 days. The second is whether a mortgage is prepaid. It is important to note that we focus on voluntary payoffs. This measure does not include foreclosures. We drop loans that were transferred to a different servicer during our sample period or that were terminated for an unknown reason. Voluntary prepayment, in principle, includes refinancing. However, given that we examine mortgage outcomes between July 2022 and June 2024, a period characterized by high interest rates, the proportion of borrowers opting to refinance during this time would likely be minimal. Indeed, in the first half of 2023, refinancing activity is the lowest in almost 30 years.[7] We anticipate that the response to a premium increase should primarily reflect the borrower selling the property or repaying without taking out a new loan.

In order to include a loan in our sample, we need to be able to compute the change in premium between policy renewals. As the insurance data is provided along with December loan performance data, a loan that was prepaid in June after a premium increase in March, say, would be dropped from the dataset. Figure A1 plots the share of mort-

[7] See, https://www.freddiemac.com/research/pdf/Freddie_Mac_Outlook_August_2023.pdf.

gages that are prepaid reported by the calendar month of the insurance policy expiration date. The share is approximately 7% for policies renewing in January, dropping down to around 1% for February renewals, then rises monotonically to more than 6% for December renewals. It is very unlikely these patterns are due to actual prepayment ratios changing with the insurance renewal month. Thus, we interpret the pattern in Figure A1 as being due to under-reporting of prepayment that is more severe between February and August. Therefore, in our empirical analyses, we report the results using samples with different policy renewal months and choose those with Sep-Jan renewal month as our main sample for the prepayment analysis.[8] Figure A2 plots the share of mortgages that are delinquent reported by the calendar month of the insurance policy expiration date. Note that the delinquency reporting does not have this issue.

3.2 ICE McDash Credit Risk Insights Servicing Module (CRISM)

This dataset merges anonymized mortgage servicing records with borrower credit outcomes. Equifax matches the aforementioned ICE McDash mortgage servicing records to its credit bureau data. This merger adds other credit market outcomes for borrowers, such as the performance of their credit card debt. Since credit card performance is only available until the end of 2022, we construct *Premium Rate Increase* as the change of premiums from the previous policy year for policies that were renewed between February 2021 and January 2022, so that we have 12 months to observe the credit outcomes for those whose insurance policies renewed in January 2022. The data offer Risk Scores (different from FICO scores), which measure borrowers' creditworthiness.

3.3 ICE McDash Property Insurance Module

We obtain data on insurance at the loan level from ICE McDash. The property insurance module contains a loan identifier allowing insurance information to be matched with

[8] In a previous draft, we do not make this sample restriction.

ICE McDash Residential Mortgage Servicing Data. Insurance data are obtained from a subset of mortgage servicers who agreed to participate and cover around three-quarters of mortgages in the servicing data.

If insurance coverage is not maintained, the servicer is liable for any damages that may result. Because of these legal responsibilities and liability risks, servicers maintain detailed data on insurance coverage and enter these data into the servicing system. When a mortgage is closed, and every year thereafter, borrowers must submit proof of homeowner's insurance.

The ICE McDash Property Insurance data include the following variables: Coverage amount per loan, deductible amount, the date when the policy expires, and "Replacement Cost Value" coverage flag, which indicates the primary insurance coverage type. We restrict our sample to loans with annual insurance policies that also appeared in the ICE McDash sample in the previous calendar year. We further require that the loan is current in the month before the insurance policy expires.

3.4 CoreLogic Climate Risk

The CoreLogic Climate Risk Data contains structure-level data on measures of current and future climate risk for properties in the U.S. CoreLogic uses their proprietary climate model to generate measures of climate risk on nine perils. For each structure within a parcel or property, the data include a measure of Average Annual Loss (AAL) at various return periods. AAL is the expected annual loss to structure and contents generated by simulating many possible iterations of a given year and then calculating the average loss across all iterations. Thus, AALs account for the magnitude of damage resulting from events of different severity as well as the likelihood of events of different severity occurring. CoreLogic reports AALs as a share of total insurable value (TIV), which can be understood as the replacement cost of the structure (Amornsiripanitch and Wylie, 2023).

These risk measures are estimated under four climate scenarios. First is the base sce-

nario, which reflects current climate conditions. Estimates calculated using the base scenario give measures of current climate risk. The other three are based on Representative Concentration Pathway (RCP) scenarios which are greenhouse gas concentration trajectories that are published by the Intergovernmental Panel on Climate Change (IPCC). CoreLogic uses RCP 2.6, RCP 4.5, RCP 8.5 as the three future scenarios, with RCP 2.6 being the least and RCP 8.5 being the most severe scenarios of greenhouse gas concentration trajectories, corresponding to higher levels of global temperature rise through time. For more details, see IPCC (2014).[9]

4 Climate Risk Associated with Larger Premium Increases and Larger Coverage Reductions

In Figure 1, we examine how premiums have evolved in recent years. We estimate the following regression at the zip-by-year level.

$$\Delta(Premium\ Rate)_{z,2014\ to\ t} = \gamma_z + \delta_{c,t} + \sum_{t=2015}^{2023} \beta_t \log(ClimateRisk_z) + \alpha_t Controls_z + \epsilon_{z,t},$$

where z denotes zip code, c denotes the county, and t the year. The dependent variable is the cumulative change relative to 2014 in premium rate (total premiums relative to the total insured value, in percentages), averaged at the zip-year level. The main independent variable is CoreLogic's composite measure of climate risk aggregated at the zip level (AAL). Since we observe the zip codes, but not the street address of households in the insurance data, we take the average of the climate risk measure across the primary structures in a zip code. We control for zip and county-by-year fixed effects. We use only policies with deductibles being 0.5% of total insured value (TIV) in this analysis so that

[9]The AAL Risk Score transforms specific values of AAL into scores of 1-100 representing "quasi-quantile" bins and 0 representing AAL = 0. The "quasi-quantile" bins are delineated using base scenario AAL distribution within the peril and risk score group. Thus, the scores can be used to compare across timeframes and RCP scenarios within perils and risk score groups.

changes in deductibles do not drive the results. Figure 1 plots the estimates of β_t. The figure suggests that starting in 2021, insurance premiums have experienced faster growth in areas with higher levels of climate risk, consistent with Keys and Mulder (2024).

In Figure 2, we replace the dependent variable with the cumulative change since 2014 in the percentage of homes with "Replacement Cost Value" coverage at the zip-year level. Homes without this type of coverage have "Actual Cash Value" coverage instead, which deducts depreciation from claim payouts and thus provides less comprehensive protection.[10]. We again plot the estimates of the coefficients, β_t. Figure 2 suggests that starting from 2021, in areas with higher levels of climate risk, more households opted for "Actual Cash Value" coverage. This is consistent with the idea that increases in insurance costs impose financial burdens on households, echoing those in Sastry et al. (2024). The subsequent analyses evaluate the impact of premium increases on mortgage outcomes.

5 Effects of Premiums on Mortgage Outcomes

5.1 OLS Results

5.1.1 Mortgage Delinquency

Table 2 estimates the following OLS regression using the cross section of households by regressing their mortgage outcomes in the 12 months following the insurance reset that occurred between July 2022 and June 2023.

$$Mortgage\ Outcome_i = \beta \times Premium\ Rate\ Increase_i + Controls + FEs + \epsilon_i,$$

where i indexes households. We first examine mortgage delinquency as the outcome. The dependent variable is an indicator of whether the household is delinquent on the mortgage for at least 30 days in Column (1), 60 days in (2), and 90 days in (3). The main

[10]While mortgage servicers may occasionally mark "Replacement Cost Value" flag as zero when the coverage type is unknown, it is unlikely that this "unknown" classification would correlate significantly with climate risk.

independent variable is the increase in premiums per dollar of coverage from the prior to the current policy for each household. This variable is set to zero if a policy's premium decreased or remained unchanged. Importantly, we control for the borrowers' FICO score in the month prior to the insurance renewal. We also control for loan age, defined as the number of months since the mortgage origination.[11] We control for zip-by-insurance renewal year-month fixed effects. Thus, we effectively compare households within the same zip and renewed their insurance policies in the same month. We also control for a battery of fixed effects: mortgage origination year, insurance policy renewal year-month (labeled as "Start Month"), loan-to-value ratio bin, FICO at origination bin, and debt-to-value ratio bin.

The coefficients on premium changes are consistently positive, suggesting that when premiums increase, households are more likely to be delinquent on their mortgages. When premiums increase by one standard deviation, the probability of 60-day delinquency rises by 0.14 (=0.07×0.02) percentage points (pp), which represents a 16% increase relative to the mean probability (0.9%). The coefficient estimate is larger for 30-day delinquency and smaller for 90-day delinquency, suggesting that households significantly cure their delinquencies associated with premium increases. This suggests that the majority of the short-term delinquencies induced by premium rate increases are not strategic. The increase in delinquency rate is approximately half of this size, if we interpret the economic magnitude based on the average premium increase homeowners experienced between July 2022 and June 2023. With a total of 51 million mortgages outstanding in the U.S.,[12] the average premium increase is associated with around 92,000 mortgages being delinquent within 12 months after the premium increase. The First Street Foundation projects that insurance premiums will rise by 29.4% by 2055 on average in the U.S., absent regulatory frictions. Such an increase would lead to an additional 357,000 mortgages becoming

[11] Because we control for mortgage origination year fixed effects, the estimated coefficient on loan age is identified using variation of mortgages that originated within the same year, but different months and/or renewed their insurance policies in different months.

[12] See, https://www.fhfa.gov/data/dashboard/nmdb-aggregate-statistics.

delinquent.[13] The equivalent nationwide average 0.7 percentage point increase in delinquency rate also masks the large increase some places will experience due to their much more drastic projected increase in premiums, such as Miami with a projected 322% in premiums. This back-of-envelope calculation overlooks the large increase in flood insurance premiums that First Street also projects.

Figure 3 illustrates the response of 30-day mortgage delinquency to premium increases over time. The figure reveals that the impact of premium increases intensifies as more time passes since policy renewal. This pattern aligns with the idea that financial strain from elevated insurance premiums accumulates gradually. Figure 4 presents bin-scatter plots illustrating the relationship between 30-day delinquency probability and premium changes. The upper figure uses premium increases in dollars, while the lower figure uses increases in premiums as a percentage of total insured value. We incorporate fixed effects identical to those employed in Columns (1)–(3) in Table 2. Both figures demonstrate a positive relationship between delinquency probability and premium changes, supporting our regression results.

Two different mechanisms can explain the observed increase in mortgage delinquency. First, rising insurance costs may cause households' liquidity constraints to be more binding, potentially leading to higher delinquency rates. Second, as Ge et al. (2024) document, house prices, on average, decrease in response to exogenous increases in insurance premiums. Consequently, a decline in house market value could induce strategic default, although this channel is arguably less important as we find that households significantly cure their delinquencies associated with premium increases over time.

[13] See, https://www.realtor.com/news/trends/biggest-home-insurance-premium-hikes/. The premium to total insured value has an average of 0.48% in our sample. A 29.4% increase translates to an increase in premium to total insured value of 0.14 percentage points (0.48×0.29), which is associated with a 0.7 percentage points (0.14×0.05) increase in the 30-day delinquency rate.

5.1.2 Mortgage Prepayment

We also hypothesize that to mitigate the financial effect of rising premiums, homeowners can relocate to homes with lower insurance costs or prepay their mortgages to avoid the required insurance, both of which will drive up prepayment rates. Next, we test the relationship between insurance premiums increase and mortgage prepayment rates. As discussed in Section 3.1, because the insurance data are provided along with December loan performance information, loans that are prepaid prior to December are typically missing insurance data for that year. This issue should have little effect on our estimates for loans with policies renewing in December and January, and only a modest effect on renewals late in the year.

In Table A1, we repeat Column (1) of Table 2, replacing the dependent variable with an indicator of whether the mortgage is prepaid. We use the full sample in Column (1), borrowers who renewed insurance policies between September and January in (2), and those who renewed in December in (3)—the most accurate sample. The estimated coefficient on *Premium Rate Increase* is much smaller using the full sample, and highly similar between Columns (2) and (3). However, the effect is similar across the three samples as a percentage of the corresponding average prepayment rate, since the full sample also has a much downward-biased average. Since the larger sample used in Column (2) provides us with more power, we use that as our main sample.

In Column (3) of Table 2, we present the prepayment result using borrowers with renewal months between September 2022 and January 2023 (repeating Column (2) of Table A1). Our estimate indicates that a one-standard-deviation increase in premiums is associated with the probability of prepayment increases by 0.2 percentage points, corresponding to 4% of the mean. Because we use a much smaller sample in Column (3) with insurance renewal timing within a 5-month period, we replace the zip-by-insurance renewal month fixed effects with zip fixed effects.

Figure 5 plots the dynamic response of mortgage prepayment to premium increases

over time.[14] The figure suggests that the effect of premiums on prepayment also becomes larger with time elapsed since the insurance policy renewal. This pattern likely reflects the practical constraints households face when responding to higher premiums through paying off mortgages—whether through home sales or accumulating sufficient liquidity to prepay their mortgages—processes that inherently require time to execute. Figure 6 replicates Figure 4, substituting delinquency with prepayment probability. These visualizations indicate a positive relationship between prepayment probability and premium changes, with the slope largely driven by larger premium increases.

5.2 Instrumental Variables for Premium Increase

One may be concerned that the observed OLS relationship between higher insurance premiums and increased mortgage delinquencies could be attributed to omitted variables. For instance, households experiencing financial distress may be more likely to have homes in disrepair and exhibit lower credit scores. These factors could potentially lead insurers to charge such households higher insurance premiums. At the same time, households' financial distress may also independently contribute to mortgage delinquency. We mitigate such endogeneity concerns by controlling for FICO score in the month preceding insurance policy renewal and fixed effects such as zip-by-insurance renewal month. To further address the identification challenge, we instrument for premium changes.

We employ two instruments for premium rate changes simultaneously. For each borrower, we first calculate the average premium rate change at renewal across policies that renew in the same month within the same three-digit zip code. To address potential endogeneity in renewal timing, we use each policy's expiration month from the previous year rather than the actual renewal month. We then regress these zip-by-renewal month averages on their 12-, 24-, 36-, and 48-month lagged values and month fixed effects, as

[14] Given the data limitation discussed above, Figure 5 uses only loans with December or January policy renewal months to avoid biasing the prepayment response at short horizons.

follows.

$$Avg\ Prem\ Rate\ Chg_{l,t} = \beta_1 \times Avg\ Prem\ Rate\ Chg_{l,t-12} + \beta_2 \times Avg\ Prem\ Rate\ Chg_{l,t-24}$$
$$+ \beta_3 \times Avg\ Prem\ Rate\ Chg_{l,t-36} + \beta_4 \times Avg\ Prem\ Rate\ Chg_{l,t-48} + \lambda_t + \epsilon_{l,t},$$

where l indexes 3-dig zip codes, t indexes the insurance policy renewal month. We present the results of this regression in Table A2. The R-squared is 0.388, suggesting substantial unexplained variation.

The residual from the regression above, $\epsilon_{l,t}$, constitutes our first instrument, representing the shock to average insurance premium rates in a zip-month while controlling for month averages and recent premium change patterns for the same policy cohort in that area. The month fixed effects control for potential seasonality in the composition of buyers, for example, if those financially better off tend to purchase houses and thus renew insurance in certain months. Our second instrument is the interaction between the first instrument and each borrower's pre-renewal premium rate.

Our instruments should satisfy the relevance restriction for the following reasons. First, premium increases follow location-level trends driven by insurers' risk assessments (Keys and Mulder, 2024) and state regulatory approvals (Oh et al., 2022). Since premium changes only affect homeowners at renewal, a property's premium change should correlate with premium adjustments implemented by insurers in the same local area and month. Second, (Keys and Mulder, 2024) and our Figure 1 suggest that zip codes with high levels of climate/disaster risks have experienced larger premium increases in recent years. We hypothesize that within a given location, premium increases have been proportionally larger for higher-risk properties, which we approximate using lagged premiums. Thus, the second instrument should also be relevant.

Our first instrument likely satisfies the exclusion restriction for two reasons. Our instrumental-variable regressions include zip code fixed effects, effectively comparing borrowers within the same zip code who renew their insurance policies in different months

between July 2022 and June 2023. The within-zip variation in residualized local average premium changes likely reflects the timing of insurer pricing adjustment and regulatory approval rather than factors related to individual borrowers' mortgage outcomes. Insurance policy expiration/renewal timing further supports exogeneity, as it primarily depends on when homeowners initially purchased their insurance. These arguments suggest our first instrument likely satisfies the exclusion restriction. By extension, our second instrument—which interacts the first instrument with borrowers' predetermined, lagged premium rates—should also be exogenous. Additionally, we control for each borrower's FICO score in the month preceding their insurance policy renewal, consistent with our OLS approach, to further mitigate endogeneity concerns.

5.3 Instrumental Variable Results

Table 3 presents the instrumental-variable regression results. By controlling for five-digit zip fixed effects, we use the variation in our instruments across borrowers within the same zip code who renewed insurance from July 2022 to June 2023. Columns (1) and (3) present the first-stage results, where the dependent variable is *Premium Rate Increase*—the same as the main independent variable in the OLS regression. Both instruments described in the previous section predict premium increases with positive and statistically significant coefficients. The results indicate that borrowers face larger premium increases when their three-digit zip code experiences higher average premium increases in the same month. This effect is amplified for borrowers with higher previous premiums, which likely reflect greater physical risks. The large Kleibergen-Paap Wald F statistics suggest that the instruments are sufficiently strong.

Column (2) presents the second-stage result, where the dependent variable is an indicator for 60-day mortgage delinquency. The coefficient on the instrumented premium increase is positive and significant, suggesting that premium changes cause an increase in mortgage delinquency. The estimated coefficient on the instrumented *Premium Rate*

Increase is 0.018, highly similar to that in OLS, indicating minimal bias in our original OLS approach.

The instrumental-variable estimate indicates that a two-standard-deviation increase in premium rates (equivalent to a $650 increase in annual insurance payments for the average total insured value) corresponds to a 0.25 percentage point increase in the 60-day delinquency rate ($0.07 \times 5 \times 0.018$). This sensitivity is 8.7 times as large as that reported by Di Maggio, Kermani, Keys, Piskorski, Ramcharan, Seru and Yao (2017), who found that a $940 decrease in monthly mortgage payments reduced delinquency rates by 0.5 percentage points.

The difference in magnitudes likely stems from the asymmetric effects between payment increases and decreases. Di Maggio et al. (2017) studied borrowers who qualified for mortgages at higher interest rates, suggesting these households could already afford the higher payments absent negative income shocks. Consequently, substantial payment reductions had small effects on their delinquency rates. In contrast, our study examines borrowers who initially qualified for mortgages with lower insurance payments. For these households, insurance payment increases could potentially push total monthly obligations beyond some borrowers' payment capacity. Supporting this interpretation, our analysis below reveals that delinquency effects are more pronounced among borrowers with high initial debt-to-income ratios, who typically have smaller financial buffers to absorb increased insurance payments. This asymmetry could explain the heightened sensitivity observed in our setting compared to Di Maggio et al. (2017).

Turning to the prepayment effects, in Column (4), we replace the dependent variable with an indicator for mortgage prepayment. The estimated coefficient on the instrumented *Premium Rate Increase* is 0.038, highly similar to OLS, again suggesting minimal OLS bias. The increase in mortgage prepayment can also be attributed to two different mechanisms. First, when insurance becomes more costly, the overall costs of home ownership increase. This may prompt some homeowners to sell their current properties and

transition to smaller homes or those with lower disaster risks, thereby reducing insurance costs. Second, as insurance costs rise, households may reduce their demand for insurance. Given that mortgage lenders typically require home insurance, borrowers may be incentivized to prepay their mortgages to avoid the increased insurance costs. We next further investigate these mechanisms.

6 Effects of Premium Increases on Mortgage Prepayment: Mechanisms

Our analysis reveals that higher insurance premiums lead to increased mortgage prepayment rates. Since multiple mechanisms can drive prepayment behavior, we utilize Equifax Credit Risks Insight Servicing (CRISM) data to identify the specific channels underlying this relationship.

Table 4 presents the analyses. Column (1) repeats our baseline specification for prepayment probability as in Column (3) from Table 2, using the matched ICE McDash–Equifax Credit Risks Insight Servicing (CRISM) sample. The result is highly similar to our benchmark prepayment result. Column (2) examines whether residential moving drives repayment. The outcome variable equals one if borrowers changed addresses within 12 months following the policy reset, based on credit bureau data.

We further decompose prepayment into distinct categories across Columns (3)-(6). In Column (3), the outcome variable is an indicator that equals one if the borrower paid off the mortgage without a replacement mortgage within the 12 months following the policy reset. Column (4) identifies purchase mortgages, either directly observed in ICE McDash loan purpose data or imputed when we detect both residential relocation and new mortgage origination in Equifax Credit Risks Insight Servicing data. Column (5) examines cash-out refinancing, which we identify through either ICE McDash loan purpose codes or by imputing cases where non-movers increase their outstanding balance by at least

$10,000 over the 12 months.[15] In (6), the outcome variable captures all other refinancing activities not classified as cash-out under the above criteria.

The coefficients on *Premium Rate Increase* are positive and statistically significant, suggesting premium increases are associated with increased probability of each prepayment outcome. The magnitudes of the coefficients suggest that the majority of the prepayment effect is explained by borrowers prepaying their mortgages while relocating their residences. This could be consistent with the idea that premium increases prompt borrowers to relocate to homes with lower insurance costs. The second largest driver for the prepayment effect is through households paying off mortgages, which relieves them of the insurance requirements. A one-standard-deviation increase in premium rate corresponds to an increase in relocation probability by 0.2 pp and an increase in the probability of paying off mortgages by 0.1 pp, both corresponding to 3% of their respective averages. Results also suggest larger premium increases correspond to a higher refinancing rate. We discuss this result in Section 6.2.

6.1 Relocation

Since our analysis reveals that moving primarily drives prepayment effects, we now examine relocation outcomes for movers. We hypothesize that homeowners experiencing larger pre-moving premium increases can reduce their insurance costs by relocating to lower-risk areas or more resilient homes. We test this hypothesis in Table 5 by analyzing how pre-moving premium increases affect two key outcomes among movers: (1) changes in premium rates and (2) changes in the natural logarithm of total premiums, both measured as changes from pre-moving to post-moving.

The magnitudes indicate that movers experiencing a one-standard-deviation (0.06 pps) larger pre-moving premium increase achieve a post-moving premium rate reduction of 0.06 pps (0.06×1.03) and a total premium reduction of 7% (0.06×1.23). For a policy with

[15] This threshold aligns with a notable discontinuity in cash-out refinance probability observed in ICE McDash loan data.

a $500,000 total insured value, the premium rate reduction translates to annual savings of $300 per year. For context, movers reduce their premium rates by 0.07 percentage points on average, equivalent to $350 in annual savings for a total insured value of $500,000. These findings suggest that households see insurance premium savings from relocation as adding to the overall benefits of moving, which makes them more likely to decide to relocate.

We also investigate additional relocation outcomes in Table A3, replacing dependent variables with pre- to post-moving changes in: (1) log of mortgage principal and interest payments, (2) log of mortgage plus insurance payments, (3) log of mortgage balance and (4) log of property appraisal value. Across all four outcomes, the *Premium Rate Increase* coefficients are statistically insignificant, suggesting minimal impact on these outcomes.

6.2 Refinancing

Column (5) in Table 4 suggests that larger premium increases correspond to a larger increase in the probability of refinancing with cash out. A one-standard-deviation larger premium increase corresponds to a 1.4% increase in the probability of refinancing with cash out. This could be consistent with the idea that as premiums increase, households could use the cash from refinancing to relieve their liquidity shortage temporarily.

Column (6) in Table 4 suggests the probability of refinancing without cash out also increases with premium hikes. A one-standard-larger premium increase corresponds to a 1.5% increase in the probability of refinancing without cash out. Studies such as Andersen, Campbell, Nielsen and Ramadorai (2020) find that psychological and behavioral factors can delay optimal refinancing. As premiums increase by more, it can push households' liquidity to bind and trigger them to refinance. Indeed, Column (5) in Table A3 reports that on average, those who refinanced without cash-out achieve a lower mortgage rate by 0.9 basis points. However, borrowers experiencing a larger premium increase achieve a smaller rate decrease. Although the effect is insignificant, the quantitative direc-

tion suggests that the financial pressure from premium increases causes these borrowers to be willing to refinance with a smaller rate reduction.

7 Delinquency Effect Larger for More Constrained Households

If insurance premium increases present a negative liquidity shock to households, and thus lead to more delinquencies, we would expect the effect to be stronger for more liquidity constrained households. We examine this hypothesis in Table 6.

We use the debt-to-income (DTI) ratio at mortgage origination to proxy for households' liquidity constraints. Column (1) uses the subsample of households with DTI ratios above 40%, while Column (2) uses the rest of the sample. The estimated coefficient for the high-DTI subsample is 67% larger than that of the low-DTI subsample. In Column (3), we assess the statistical significance of this difference by analyzing the entire sample and adding an interaction term between premium change and a high-DTI indicator. The estimated coefficient is positive and statistically significant on the interaction term, suggesting that the difference between the two subsamples is statistically significant.

Our findings above demonstrate that increased premium payments create stronger liquidity constraints for households already dedicating a substantial portion of their income to mortgage-related expenses. In Table A4, we examine the differential delinquency response between households with loan-to-value (LTV) ratios exceeding 80% at origination and the rest. The delinquency effect in this high-LTV group is roughly double that observed in the low-LTV group. These findings align with the hypothesis that rising insurance premiums impose significant financial pressure on households, especially those that are financially more constrained.

8 Delinquency & Prepayment Effects Driven by Non-Jumbo Mortgages

In Table 7, we split the sample into mortgages above and below the conforming loan limit and repeat the structure of tests as in Table 6. Column (1) uses the sample of jumbo mortgages, and (2) uses non-jumbo mortgages. We find that the effect of premiums on mortgage delinquencies is driven by non-jumbo mortgages. Because non-jumbo borrowers are, on average, more financially constrained, this result is consistent with our previous finding that more constrained borrowers respond more strongly to premium increases.

Table 8 repeats Table 7, replacing the dependent variable with the prepayment indicator. The estimates indicate that the effect of premium increases on prepayment is predominantly observed among non-jumbo borrowers. There are several potential reasons for this. First, non-jumbo mortgages are smaller in size. Thus, it may be easier for borrowers to come up with the cash to repay compared to jumbo mortgages for borrowers within the same LTV, FICO, and DTI bins as specified by our fixed effects. Second, the real estate associated with jumbo mortgages may exhibit lower liquidity, potentially impeding the ability of jumbo borrowers to sell their properties and relocate in response to premium increases. Third, jumbo borrowers may be better able to absorb an increase in insurance expenses, consistent with the smaller delinquency effect in Table 7.

9 Delinquency & Prepayment Effects Across Investors

A natural question is whether the effect of insurance premiums on mortgage delinquencies is present for GSE loans. This would imply a risk for the federal government, particularly if insurance premiums keep rising. We investigate this question in the following analysis.

In Table 9, we repeat our main analysis on mortgage delinquencies across different types of mortgages. We use mortgages guaranteed by Ginnie Mae in Column (1), by

Fannie Mae in (2), by Freddie Mac in (3), private mortgages that are securitized in (4), and those remain in banks' portfolios in (5). The results suggest that the effect exists in each subsample. It is the largest for mortgages guaranteed by Ginnie Mae and for private mortgages that are securitized, and the smallest for those guaranteed by Freddie Mac. The fact that the delinquency effect exists for loans guaranteed by the GSEs implies a risk for the GSEs and the federal government from rising insurance premiums. Banks and investors in private-label MBS are similarly exposed. Mortgages that are privately securitized and held in banks' portfolios also experience increased delinquency in response to higher premiums, suggesting a risk to the financial markets.

Table 10 repeats Table 9, using mortgage prepayment as the outcome variable. The coefficients on *Premium Rate Increase* are positive and statistically significant in all columns except (4). In Column (4), the magnitude of the estimate is within the range of the other columns. The lack of statistical significance could be due to a much smaller sample. The results suggest that the prepayment effect is much larger for mortgages guaranteed by the GSEs than those held in banks' portfolios.

10 Delinquency Effect is Smaller When Coverage Changes

When borrowers switch from Replacement Cost Value to Actual Cash Value coverage, they likely aim to minimize the financial impact of premium increases. We hypothesize that borrowers who reduce coverage may experience smaller delinquency increases. Table 11 support this hypothesis, though the premium's effect on delinquency remains substantial for such borrowers—65% of the benchmark effect shown in Table 2.

This finding challenges an alternative explanation that delinquencies stem from borrowers' inattention to premium increases and subsequent failure to adequately fund their escrow accounts that pay for both mortgages and insurance. The result that delinquency effects remain substantial even when borrowers actively reduce their coverage suggests that delinquencies reflect the financial pressure due to rising premiums rather than simple

oversight.

11 Effects of Premium Increases on Credit Card Delinquency, Credit Utilization, and Credit Worthiness

Rising home insurance costs may impair households' ability to service non-mortgage debts, while also lead them to borrow more. In this section, we examine the effects of premium increases on credit card delinquency and utilization, as well as borrower creditworthiness. This can provide a complementary window into how rising insurance costs affect households' broader financial health. We use the CRISM data to examine borrowers' credit outcomes.

Column (1) of Table 12 repeats our benchmark analysis in Column (1) of Table 2 using the CRISM sample. While this sample is smaller than in Table 2 due to the joint requirement of insurance and credit card data, Column (2) shows that the mortgage delinquency effects remain consistent with our main results, suggesting this subsample is similar to our main sample.

Column (2) replaces the dependent variable with an indicator for credit card delinquency in the 12 months post-insurance renewal. The estimated coefficient on premium increases is positive and statistically significant, suggesting that rising home insurance premiums increase borrowers' probability of credit card delinquency. Column (3) replaces the outcome variable with the share of credit lines that are delinquent for each borrower, taking the maximum within the 12 months following insurance policy renewals. The coefficient estimates in the credit card/line delinquencies are smaller than that in the mortgage result. This aligns with the fact that with a small minimum payment, borrowers can avoid being delinquent on credit card debt. A standard deviation increase in premiums corresponds to a 0.11 percentage point rise in credit card delinquency probability (0.058×0.019), representing 3.4% of the baseline rate.

In Column (4), we replace the dependent variable with credit card utilization, measured as the peak utilization percentage in the 12 months post-renewal minus pre-renewal utilization. The positive and significant coefficient on \textit{Premium Increase} suggests households respond to premium hikes by drawing more heavily on credit cards, consistent with tightening liquidity constraints. A standard deviation increase in premiums corresponds to a 0.15 percentage point (0.058×2.665) rise in credit card utilization, representing 1.3% of the mean utilization change.

Increased mortgage delinquency rates and higher credit utilization can harm borrowers' creditworthiness, which can further restrict borrowers' access to liquidity when insurance costs constrain households' finances. In Column (5), we replace the outcome variable with changes in borrowers' risk scores, measured as the minimum score in the 12 months post-renewal minus the pre-renewal score. The coefficient on *Premium Rate Increase* is negative and statistically significant, suggesting that borrowers' creditworthiness declines following premium increases. A standard deviation increase in premiums corresponds to a 0.38 drop in risk score (0.058×6.506), representing 2.6% of the average change in credit score in our sample.

This broader impact suggests that premium increases affect mortgage payments through more than just mechanical channels, such as inattention to higher monthly obligations. Instead, the credit card findings indicate that higher insurance costs create liquidity constraints that ripple across households' financial positions.

12 Conclusion

As climate change intensifies the frequency and severity of natural disasters, homeowners' insurance premiums are rising sharply. This study investigates how increasing insurance premiums influence households' financial outcomes by using novel data linking insurance policies to mortgage outcomes of 6.7 million borrowers. First, our analysis shows that higher premiums significantly increase the chances of mortgage delinquency,

as well as prepayment. These findings are robust to using an instrumental variable for premium increases. Second, the majority of the prepayment effect is explained by borrowers prepaying their mortgages while relocating their residences. Movers experiencing larger pre-moving insurance rate increases achieve greater premium reductions, both in premium rates and total dollar amounts. Third, the effect of delinquency is more pronounced for mortgages with higher DTI ratios, while the prepayment effect is smaller for these loans. Additionally, we find that delinquency effects are present in both GSE and non-GSE mortgages, implying risks for both the Federal Government and the private financial sector. Finally, we find that borrowers facing larger premium increases are more likely to become delinquent on their credit card debt and experience deterioration of their creditworthiness, indicating a broad impact of insurance costs on households' financial outcomes.

Our findings highlight an understudied effect of climate change on household financial resilience. As more severe disasters linked to climate change push insurance premiums higher, we demonstrate that households are at greater risk of financial distress, especially those that are more financially constrained. This underscores the considerable financial strain that climate change imposes on homeowners.

The paper also points to the risks that rising insurance costs pose for mortgages and mortgage-backed securities. Delinquencies represent negative shocks for mortgage holders, a significant portion of the financial sector. Thus, our findings not only illustrate the direct impact on households, but also uncover broader implications for financial stability as insurance costs rise due to climate change.

For policymakers addressing the issue of insurance affordability, our findings carry critical implications. The results suggest that increasing insurance premiums severely limit household liquidity, driving some to mortgage delinquency. Given the broader economic consequences of mortgage defaults, our research underscores the potential value of policy measures like means-tested insurance subsidies to mitigate these effects.

Stroebel and Wurgler (2021) find that 60% survey respondents believe the stock market underprices climate risk. Insurance costs may facilitate the incorporation of climate risks into financial markets. Some follow-up questions are worth studying. First, do mortgage lenders incorporate the observed delinquency and prepayment effects of insurance premiums into their pricing and approval decisions for new mortgages? Second, does the Mortgage-Backed Securities (MBS) market adequately price risks related to insurance costs?

Fourth, considering mortgage financing's crucial role in property transactions, how do insurance premiums impact the prices and liquidity of housing?[16] Finally, our results suggest that insurance costs disproportionately burden financially constrained households. Could these differential impacts drive demographic shifts in climate-risky areas, replacing financially constrained households with more resilient ones?

[16] Ge et al. (2024) demonstrate that house prices decline with an exogenous change in insurance premiums in the National Flood Insurance Program.

References

Acharya, Viral V, Richard Berner, Robert Engle, Hyeyoon Jung, Johannes Stroebel, Xuran Zeng, and Yihao Zhao, "Climate stress testing," *Annual Review of Financial Economics*, 2023, *15* (1), 291–326.

Amornsiripanitch, Natee and David Wylie, "Who bears climate-related physical risk?," *Available at SSRN*, 2023.

An, Xudong, Stuart A Gabriel, and Nitzan Tzur-Ilan, *Extreme Wildfires, Distant Air Pollution, and Household Financial Health*, Research Department, Federal Reserve Bank of Philadelphia, 2024.

Andersen, Steffen, John Y Campbell, Kasper Meisner Nielsen, and Tarun Ramadorai, "Sources of inaction in household finance: Evidence from the danish mortgage market," *American Economic Review*, 2020, *110* (10), 3184–3230.

Bakkensen, Laura A and Lint Barrage, "Going underwater? Flood risk belief heterogeneity and coastal home price dynamics," *The Review of Financial Studies*, 2021.

Baldauf, Markus, Lorenzo Garlappi, and Constantine Yannelis, "Does Climate Change Affect Real Estate Prices? Only If You Believe in It," *The Review of Financial Studies*, 2020, *33* (3), 1256–1295.

Bernstein, Asaf, Matthew T. Gustafson, and Ryan Lewis, "Disaster on the Horizon: The Price Effect of Sea Level Rise," *Journal of Financial Economics*, 2019, *134* (2), 253–272.

Billings, Stephen B, Emily A Gallagher, and Lowell Ricketts, "Let the rich be flooded: the distribution of financial aid and distress after hurricane harvey," *Journal of Financial Economics*, 2022, *146* (2), 797–819.

Biswas, Siddhartha, Mallick Hossain, and David Zink, "California wildfires, property damage, and mortgage repayment," *Federal Reserve Bank of Philadelphia Working Paper*, 2023, (23-05).

Blonz, Joshua A, Mallick Hossain, and Joakim Weill, "Pricing Protection: Credit Scores,

Disaster Risk, and Home Insurance Affordability," *Disaster Risk, and Home Insurance Affordability*, 2024.

Boomhower, Judson, Meredith Fowlie, Jacob Gellman, and Andrew Plantinga, "How are insurance markets adapting to climate change? risk selection and regulation in the market for homeowners insurance," Technical Report, National Bureau of Economic Research 2024.

Cookson, J Anthony, Emily Gallagher, and Philip Mulder, "Coverage Neglect in Homeowners Insurance," *Available at SSRN 5057551*, 2024.

Dice, Jacob, Mallick Hossain, and David Rodziewicz, "Flood Risk Exposures and Mortgage-Backed Security Asset Performance and Risk Sharing," *Available at SSRN 4854082*, 2024.

Gallagher, Justin and Daniel Hartley, "Household Finance after a Natural Disaster: The Case of Hurricane Katrina," *American Economic Journal: Economic Policy*, 2017, *9* (3), 199–228.

Ge, Shan, Ammon Lam, and Ryan Lewis, "The Effect of Insurance Premiums on the Housing Market and Climate Risk Pricing," *Available at SSRN 4192699*, 2024.

Georgic, Will and H Allen Klaiber, "Stocks, flows, and flood insurance: A nationwide analysis of the capitalized impact of annual premium discounts on housing values," *Journal of Environmental Economics and Management*, 2022, *111*, 102567.

Gete, Pedro, Athena Tsouderou, and Susan M Wachter, "Climate risk in mortgage markets: Evidence from Hurricanes Harvey and Irma," *Real Estate Economics*, 2024, *52* (3), 660–686.

Gibson, Matthew and Jamie T Mullins, "Climate risk and beliefs in New York floodplains," *Journal of the Association of Environmental and Resource Economists*, 2020, *7* (6), 1069–1111.

Giglio, Stefano, Matteo Maggiori, Krishna Rao, Johannes Stroebel, and Andreas Weber,

"Climate change and long-run discount rates: Evidence from real estate," *The Review of Financial Studies*, 2021, *34* (8), 3527–3571.

Hennighausen, Hannah, Yanjun Liao, Christoph Nolte, and Adam Pollack, "Flood insurance reforms, housing market dynamics, and adaptation to climate risks," *Journal of Housing Economics*, 2023, *62*, 101953.

Hino, Miyuki and Marshall Burke, "Internet Appendix to The effect of information about climate risk on property values," *Proceedings of the National Academy of Sciences*, 2021, *118* (17), e2003374118.

IPCC, A, "Ipcc fifth assessment report—synthesis report," *IPPC Rome, Italy*, 2014.

Issler, Paulo, Richard Stanton, Carles Vergara-Alert, and Nancy Wallace, "Mortgage Markets with Climate-Change Risk: Evidence from Wildfires in California," *Working Paper*, 2024.

Jotikasthira, Chotibhak, Anastasia Kartasheva, Christian T Lundblad, and Tarun Ramadorai, "Strategic Claim Payment Delays: Evidence from Property and Casualty Insurance," 2025.

Jung, Hyeyoon, Robert F Engle, Shan Ge, and Xuran Zeng, "Measuring the climate risk exposure of insurers," Technical Report, Staff Report 2023.

Keys, Benjamin J and Philip Mulder, "Neglected no more: Housing markets, mortgage lending, and sea level rise," Technical Report, National Bureau of Economic Research 2020.

_ and _ , "Property Insurance and Disaster Risk: New Evidence from Mortgage Escrow Data," Technical Report, National Bureau of Economic Research 2024.

Kousky, Carolyn, Mark Palim, and Ying Pan, "Flood Damage and Mortgage Credit Risk: A Case Study of Hurricane Harvey," *Journal of Housing Research*, 2020, *29* (S1), S86–S120.

Liao, Yanjun and Philip Mulder, "What's at Stake? Understanding the Role of Home Equity in Flood Insurance Demand," 2021.

Lopez, Luis A and Nitzan Tzur-Ilan, "Air pollution and rent prices: Evidence from wildfire smoke," *Available at SSRN 4537395*, 2023.

Maggio, Marco Di, Amir Kermani, Benjamin J Keys, Tomasz Piskorski, Rodney Ramcharan, Amit Seru, and Vincent Yao, "Interest rate pass-through: Mortgage rates, household consumption, and voluntary deleveraging," *American Economic Review*, 2017, *107* (11), 3550–3588.

Marcoux, Kendra and Katherine RH Wagner, "Fifty years of us natural disaster insurance policy," 2023.

Mulder, Philip, "Mismeasuring risk: The welfare effects of flood risk information," *URL https://faculty. wharton. upenn. edu/wp-content/uploads/2017/07/MismeasuringRisk_Mulder2021. pdf*, 2021.

_ and Carolyn Kousky, "Risk rating without information provision," in "AEA Papers and Proceedings," Vol. 113 American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203 2023, pp. 299–303.

Murfin, Justin and Matthew Spiegel, "Is the Risk of Sea Level Rise Capitalized in Residential Real Estate?," *The Review of Financial Studies*, 2020, *33* (3), 1217–1255.

Nyce, Charles, Randy E Dumm, G Stacy Sirmans, and Greg Smersh, "The capitalization of insurance premiums in house prices," *Journal of Risk and Insurance*, 2015, *82* (4), 891–919.

Oh, Sangmin, Ishita Sen, and Ana-Maria Tenekedjieva, "Pricing of climate risk insurance: Regulation and cross-subsidies," *Available at SSRN 3762235*, 2022.

Ouazad, Amine and Matthew E. Kahn, "Mortgage Finance and Climate Change: Securitization Dynamics in the Aftermath of Natural Disasters," *The Review of Financial Studies*, 2022, *35* (8), 3617–3665.

Sastry, Parinitha, "Who Bears Flood Risk? Evidence from Mortgage Markets in Florida," 2021.

_ , Ishita Sen, Ana-Maria Tenekedjieva, and Therese C Scharlemann, "Climate Risk and

the U.S. Insurance Gap: Measurement, Drivers and Implications," *Available at SSRN 4909444*, 2024.

_ , _ , and _ , "When insurers exit: Climate losses, fragile insurers, and mortgage markets," *Fragile Insurers, and Mortgage Markets (December 23, 2023)*, 2023.

Stroebel, Johannes and Jeffrey Wurgler, "What do you think about climate finance?," *Journal of Financial Economics*, 2021, *142* (2), 487–498.

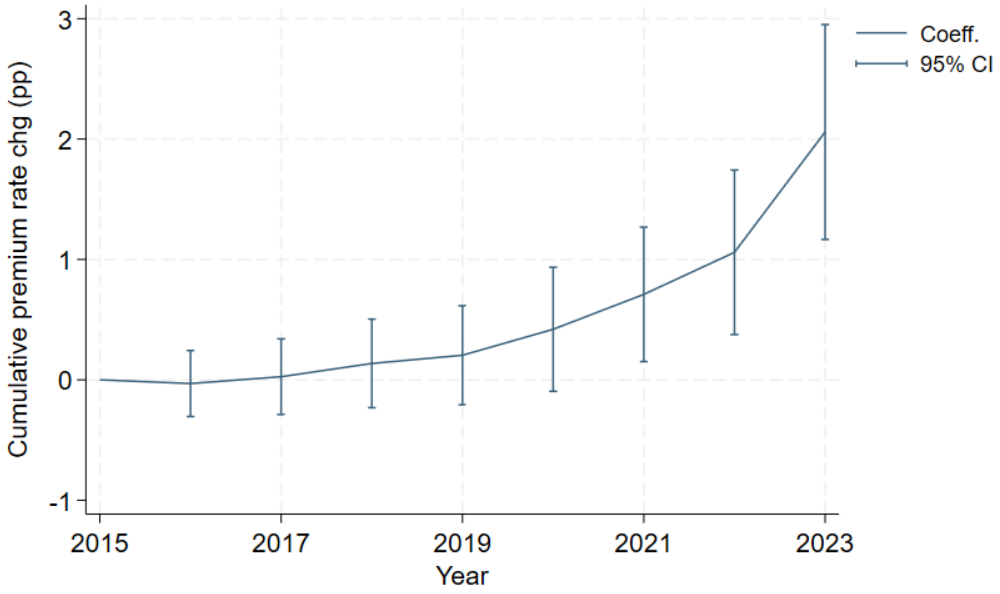
Wagner, Katherine RH, "Adaptation and adverse selection in markets for natural disaster insurance," *American Economic Journal: Economic Policy*, 2022, *14* (3), 380–421.

_ , "Designing insurance for climate change," *nature climate change*, 2022, *12* (12), 1070–1072.

Weill, Joakim, "Perilous flood risk assessments," *Available at SSRN 4143914*, 2022.

FIGURE 1

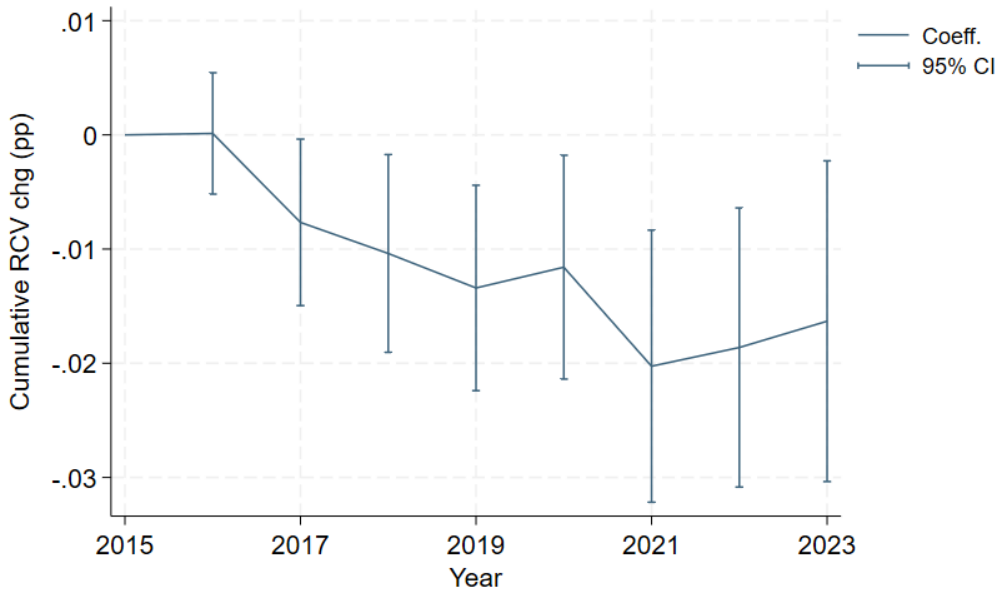
PREMIUMS HAVE INCREASED MORE IN HIGH-CLIMATE-RISK AREAS



NOTES: Source: ICE McDash, decennial census (controls).
In Figure 1, we examine how premiums have evolved in recent years. We estimate the following regression at the zip-by-year level. $\Delta(Premium\ Rate)_{z,2014\ to\ t} = \gamma_z + \delta_{c,t} + \sum_{t=2015}^{2023} \beta_t \log(ClimateRisk_z) + \alpha_t Controls_z + \epsilon_{z,t}$, where z denotes zip code, c denotes the county, and t the year. The dependent variable is the cumulative change relative to 2014 in premiums relative to the total insured value (in percentages), averaged at the zip-year level. The main independent variable is CoreLogic's composite measure of climate risk averaged across primary structures at the zip level. We use only policies with deductibles being 0.5% of total insured value (TIV) in this analysis so that changes in deductibles do not drive the results. The figure plots the estimates of β_t and the corresponding 95% confidence interval. We require the deductible (as a percentage of % TIV) and coverage type (ACV or replacement cost) do not change. This measure is constructed using within-loan changes in premium only.

FIGURE 2

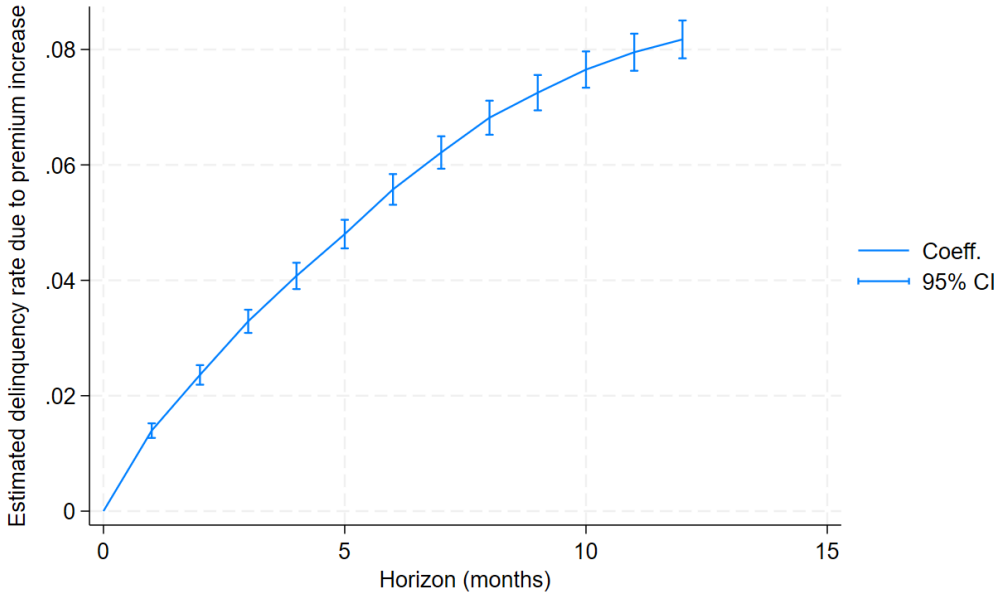
DECLINING PREVALENCE OF REPLACEMENT COST VALUE COVERAGE IN HIGH-CLIMATE-RISK AREAS



NOTES: Source: ICE McDash, decennial census (controls).
Figure 2 repeats Figure 1, replacing the dependent variable with cumulative change since 2014 in the percentage of homes with "Replacement Cost Value" coverage at the zip-year level as our dependent variable. We again plot the estimates of the coefficients, β_t.

FIGURE 3

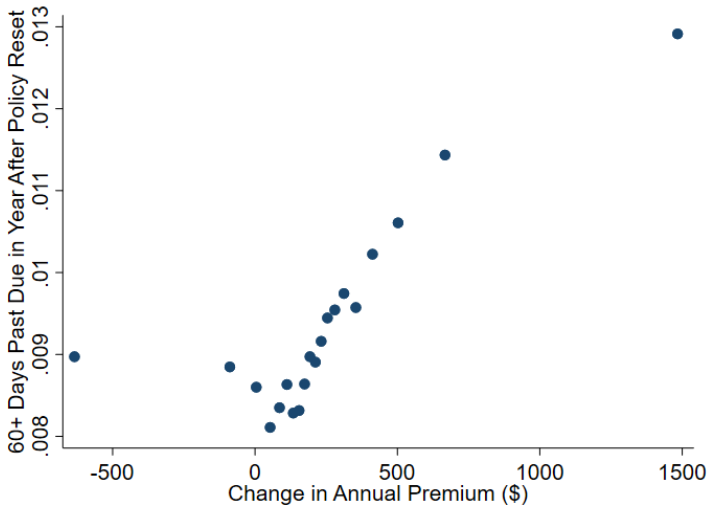
MORTGAGE DELINQUENCY DYNAMIC RESPONSE TO PREMIUM INCREASES



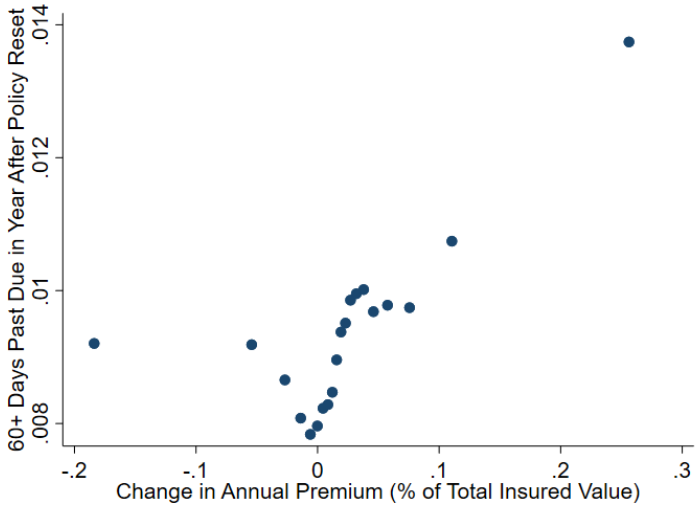
NOTES: Source: ICE McDash.
This figure plots the dynamic response of 30-day mortgage delinquency to insurance premium increases by the number of months after the insurance policy renewal. We plot the coefficients and the confidence interval.

FIGURE 4
MORTGAGE DELINQUENCY AND PREMIUM INCREASES

Panel A. Delinquency Increases with Change in Premium ($)



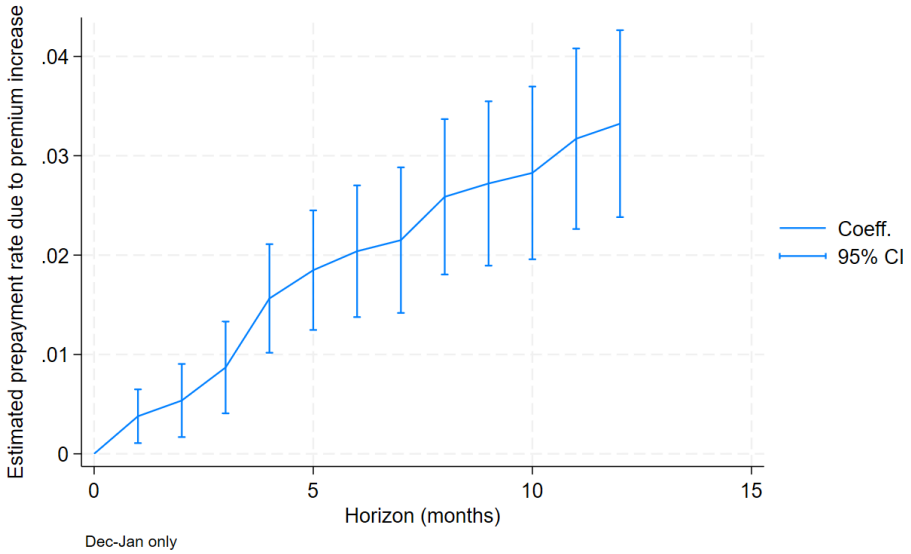
Panel B. Delinquency Increases with Change in Premium (% of Total Insured Value)



NOTES: Source: ICE McDash.
These figures are bin-scatter plots of 60-day mortgage delinquency against changes in annual insurance premiums in dollars (top figure) and delinquency against changes in annual insurance premiums as a percentage of total insured value (bottom figure). We control for FICO score in the month preceding insurance renewal, loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. We drop loans where the servicing is transferred within a year of policy reset and where the loan was not current as of the reset month.

FIGURE 5

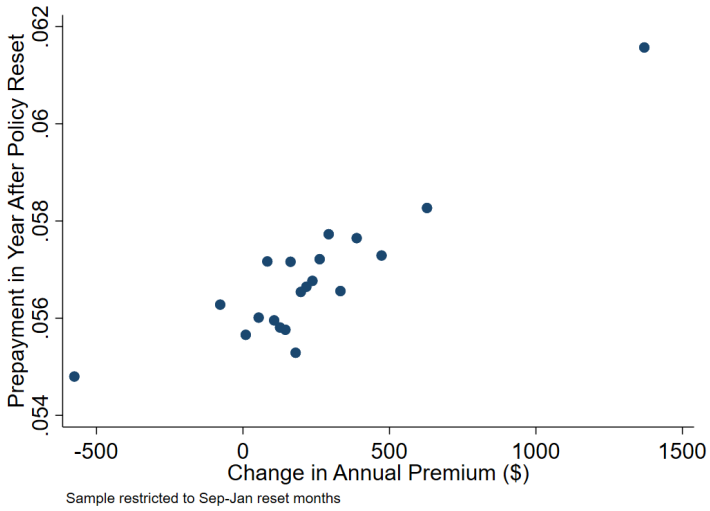
MORTGAGE DELINQUENCY DYNAMIC RESPONSE TO PREMIUM INCREASES



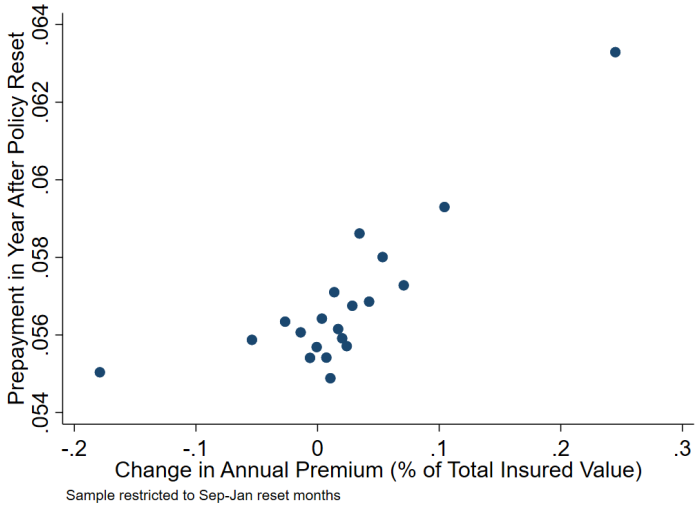
NOTES: Source: ICE McDash.
This figure plots the dynamic response of mortgage prepayment to insurance premium increases by the number of months after the insurance policy renewal. We plot the coefficients and the confidence interval.

FIGURE 6
MORTGAGE PREPAYMENT AND PREMIUM INCREASES

Panel A. Prepayment Increases with Change in Premium ($)



Panel B. Prepayment Increases with Change in Premium (% of Total Insured Value)



NOTES: Source: ICE McDash.
These figures are bin-scatter plots of mortgage prepayment against changes in annual insurance premiums in dollars (top figure) and prepayment against changes in annual insurance premiums as a percentage of total insured value (bottom figure). We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. We drop loans where the servicing is transferred within a year of policy reset and where the loan was not current as of the reset month.

TABLE 1
SUMMARY STATISTICS

	Mean	SD	25 Pctl	Median	75 Pctl
30-Day Delinquent	0.036				
60-Day Delinquent	0.009				
90-Day Delinquent	0.005				
Prepayment (all months)	0.038				
Prepayment (Sep–Jan)	0.057				
Zip Avg Prem Chg (unresidualized) in 12 months before Renewal	0.02	0.12	-0.01	0.01	0.04
Premium Rate Increase	0.04	0.08	0.00	0.01	0.04
Annual Premium (dollars)	1,926.41	1,659.83	1,068.00	1,524.00	2,268.00
Climate Risk	0.18	0.15	0.10	0.13	0.21
Risk Score	780	56	754	801	822
DTI	33.26	10.79	25.00	34.00	42.00
FICO	741.54	65.73	705.00	756.00	789.00
LTV	71.51	19.54	59.01	75.00	86.27
Income	44,230.74	14,850.20	33,964.00	41,189.00	50,883.00
Home Value	406,938.72	313,038.26	211,100.00	312,600.00	483,200.00
Minority	0.23	0.22	0.07	0.15	0.32
Replacement Change	0.02	0.24	0.00	0.00	0.00
Deductible Change	-0.03	0.18	0.00	0.00	0.00
Premium Rate (% of TIV)	0.48	1.19	0.28	0.39	0.57
TIV ($)	465,203.59	779,429.82	267,555.00	365,000.00	514,000.00

NOTES: Source: ICE McDash, CoreLogic Climate, Census ACS., S&P Capital IQ Pro, Claritas Financial CLOUT.
This table presents summary statistics of relevant variables.

TABLE 2
DELINQUENCY AND PREPAYMENT PROBABILITIES INCREASE WITH PREMIUMS, OLS

	Delinquency			Prepayment
	30-Day	60-Day	90-Day	
	(1)	(2)	(3)	(4)
Premium Rate Increase	0.052***	0.021***	0.012***	0.037***
	(29.96)	(20.38)	(15.83)	(12.24)
Method	OLS	OLS	OLS	OLS
Sample	All	All	All	Sep-Jan
FICO Before Renewal	Y	Y	Y	Y
Loan Age (months)	Y	Y	Y	Y
Zip FE	N	N	N	Y
Zip× Start Month FE	Y	Y	Y	N
Orig Yr FE	Y	Y	Y	Y
Start Month FE	N	N	N	Y
LTV FE	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y
Y Mean	0.037	0.009	0.005	0.060
X Mean	0.036	0.036	0.036	0.033
N	5082643	5082643	5082643	1967427

NOTES: Source: ICE McDash.
This table presents correlation between mortgage delinquency (prepayment) and premium increases at the borrower level. The dependent variable is an indicator for whether the mortgage is delinquent in Columns (1)-(2) and is repaid in Columns (3)-(4). The main independent variable is the change in premium as a % of TIV. In Columns (1) and (3), we control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. In Column (2), we replace zip FE with zip-by-insurance policy start month FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 3
INSTRUMENTAL VARIABLE RESULTS ON MORTGAGE DELINQUENCY AND PREPAYMENT

	Prem Rate Increase	60-Day Delinquency	Prem Rate Increase	Prepayment
	(1)	(2)	(3)	(4)
Premium Rate Increase		0.018**		0.038**
		(2.31)		(2.13)
Zip Avg Prem Rate Chg (Residual)	0.519***		0.271***	
	(13.64)		(4.54)	
Zip Avg Prem Rate Chg (Residual)	0.882***		0.975***	
× Lagged Premium Rate	(5.46)		(4.05)	
Lagged Premium Rate	0.013***	0.001**	0.012***	-0.000
	(5.61)	(2.58)	(4.27)	(-0.19)
2SLS Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Sample	All	All	Sep-Jan	Sep-Jan
FICO Before Renewal	Y	Y	Y	Y
Loan Age	Y	Y	Y	Y
Zip FE	Y	Y	Y	Y
Orig Yr FE	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y
Y Mean	0.036	0.009	0.033	0.060
X Mean	-0.001	0.036	-0.000	0.033
X SD	0.016	0.074	0.014	0.070
N	5132619	5132619	1967345	1967345
Kleibergen-Paap Wald F stat		99		53

NOTES: Source: ICE McDash.
This table presents instrumental variable regression results, demonstrating the causal effect premium increases on mortgage delinquency and prepayment. Observations at the borrower level. Column (1) presents the first-stage result. The dependent variable is premium increase as a percentage of total insured value. The two instruments are the average premium change at the three-digit zip level in the 12 months immediately before each policy's renewal, as well as its interaction with the lagged house-level premiums. Columns (2) and (3) present the second-stage results. The dependent variable is an indicator for whether the mortgage is delinquent in Column (2) and is repaid in Column (3). We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, state FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1. "K-P Wald F stat" stands for Kleibergen-Paap Wald F statistic.

TABLE 4
INSURANCE PREMIUM AND PREPAYMENT: MECHANISMS

	(1) Prepayment	(2) Moved	(3) Mtg Paid Off (Not Replaced)	(4) New Purchase Mtg	(5) Refi: Cash Out	(6) Refi: No Cash
Premium Increase	0.031***	0.029***	0.014***	0.006***	0.004***	0.006***
	(10.85)	(11.95)	(7.72)	(5.63)	(3.30)	(3.87)
Method	OLS	OLS	OLS	OLS	OLS	OLS
Sample	All	All	All	All	All	All
Zip FE	Y	Y	Y	Y	Y	Y
Zip×Start Month FE	N	N	N	N	N	N
Orig Yr FE	Y	Y	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y	Y	Y
Y Mean	0.086	0.058	0.033	0.012	0.017	0.024
Y SD	0.280	0.233	0.177	0.107	0.131	0.152
X Mean	0.026	0.026	0.026	0.026	0.026	0.026
X SD	0.058	0.058	0.058	0.058	0.058	0.058
N	3600220	3600220	3600220	3600220	3600220	3600220

NOTES: Source: ICE McDash and Equifax Credit Risks Insight Servicing (CRISM).
This table presents results analyzing the effect of premium increases on prepayment and different reasons/categories of prepayment. The outcome variable in Column (1) measures whether the mortgage is prepaid within 12 months following the policy reset. Column (2) tracks residential relocation through address changes recorded in credit bureau data within 12 months of policy reset. Column (3) captures mortgage payoffs within 12 months of policy reset where no replacement mortgage is identified. Column (4) identifies home purchases through either observed purchase mortgages in ICE McDash within 12 months of policy reset or the combination of residential relocation with new mortgage origination. Column (5) measures cash-out refinancing, defined as either observed cash-out refinances in ICE McDash or cases where mortgage balance increases by $10,000 over 12 months post-reset without residential relocation. Column (6) captures all other refinancing activity not meeting the cash-out criteria in Column (5), identified through either ICE McDash loan purpose codes or concurrent mortgage origination without relocation. The sample uses borrowers for which credit card performance and insurance information is available. Since credit card performance is only available until December 2022, we construct *Premium Increase* as the change of premiums from the previous policy year for policies that renewed between December of 2021 and Jan 2022. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 5
PRE-MOVING PREMIUM INCREASE AND POST-MOVING PREMIUM CHANGE

	(1) Premium Rate Chg	(2) Log Prem Chg
Pre-Moving Premium Increase	-1.028***	-1.225***
	(-21.63)	(-10.59)
Method	OLS	OLS
Sample	Movers	Movers
Zip FE	Y	Y
Orig Yr FE	Y	Y
Start Month FE	Y	Y
LTV FE	Y	Y
FICO FE	Y	Y
DTI FE	Y	Y
Y Mean	-0.074	0.119
Y SD	0.271	0.568
X Mean	0.028	0.029
X SD	0.057	0.059
N	10678	10733

NOTES: Source: ICE McDash and Equifax Credit Risks Insight Servicing (CRISM).
This table presents results analyzing the effect of pre-moving premium increases on post-moving premium changes for movers. We identify movers as borrowers in Equifax that have prepaid a mortgage and purchased a new home with another mortgage. Since credit card performance is only available until December 2022, we construct *Pre-Moving Premium Increase* as the change of premiums from the previous policy year for policies that renewed between December of 2021 and Jan 2022. The outcome variable is the difference in premium rate (in Column 1) and in log of total premiums (in Column 2) between the insurance policy reported on the new mortgage and the one reported on the old mortgage. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit pre-moving zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 6
DELINQUENCY EFFECT IS LARGER FOR HIGH-DTI MORTGAGES

	60-Day Delinquent		
	(1)	(2)	(3)
Premium Increase	0.026***	0.016***	0.014***
	(13.64)	(15.27)	(13.51)
Premium Increase × High DTI			0.017***
			(8.63)
High DTI			0.000
			(.)
Method	OLS	OLS	OLS
Sample	DTI >= 40	DTI < 40	All
Loan Age (Month)	Y	Y	Y
FICO Before Renewal	Y	Y	Y
Zip FE	Y	Y	Y
Orig Yr FE	Y	Y	Y
Start Month FE	Y	Y	Y
LTV FE	Y	Y	Y
FICO FE	Y	Y	Y
DTI FE	Y	Y	Y
Y Mean	0.014	0.007	0.009
Y Mean	0.015	0.007	0.009
X Mean	0.039	0.034	0.036
X SD	0.080	0.072	0.074
N	1626893	3502123	5132864

NOTES: Source: ICE McDash.
This table presents results testing whether the effect of premium increases on mortgage delinquency differs between High- and Low-LTV mortgages. The dependent variable is an indicator for whether the mortgage is delinquent in the 12 months after insurance policy renewal. The main independent variable is the change in premium as a % of TIV. Column (1) uses the sample of mortgages with DTI ratios higher than the median. Column (2) uses those with DTI lower than the median. Column (3) uses the full sample. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 7
DELINQUENCY EFFECT IS LARGER FOR NON-JUMBO MORTGAGES

	60-Day Delinquent		
	(1)	(2)	(3)
Premium Rate Increase	0.001	0.019***	0.019***
	(0.45)	(19.61)	(19.63)
Premium Rate Increase × Jumbo			-0.016***
			(-6.06)
Jumbo			0.001**
			(3.28)
Method	OLS	OLS	OLS
Sample	Jumbo	Non-Jumbo	All
Loan Age (Month)	Y	Y	Y
FICO Before Renewal	Y	Y	Y
Zip FE	Y	Y	Y
Orig Yr FE	Y	Y	Y
Start Month FE	Y	Y	Y
LTV FE	Y	Y	Y
FICO FE	Y	Y	Y
DTI FE	Y	Y	Y
Y Mean	0.002	0.009	0.009
X Mean	0.028	0.036	0.036
X SD	0.064	0.075	0.074
N	167584	4936239	5105733

NOTES: Source: ICE McDash.
This table presents results testing whether the effect of premium increases on mortgage prepayment differs between conforming and jumbo mortgages. The dependent variable is an indicator for whether the mortgage is prepaid in the 12 months after insurance policy renewal. The main independent variable is the change in premium as a % of TIV. Column (1) uses jumbo mortgages. Column (2) uses conforming mortgages. Column (3) uses the full sample. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 8
PREPAYMENT EFFECT IS LARGER FOR NON-JUMBO MORTGAGES

	Prepayment		
	(1)	(2)	(3)
Premium Increase	-0.013	0.035***	0.036***
	(-0.84)	(11.55)	(11.68)
Premium Increase × Jumbo			-0.035**
			(-2.50)
Jumbo			0.001
			(0.81)
Method	OLS	OLS	OLS
Sample	Jumbo	Non-Jumbo	All
	(Sep-Jan)	(Sep-Jan)	(Sep-Jan)
Loan Age (Month)	Y	Y	Y
FICO before Policy Renewal	Y	Y	Y
Zip FE	Y	Y	Y
Orig Yr FE	Y	Y	Y
Start Month FE	Y	Y	Y
LTV FE	Y	Y	Y
FICO FE	Y	Y	Y
DTI FE	Y	Y	Y
Y Mean	0.034	0.061	0.060
X Mean	0.027	0.033	0.033
X SD	0.059	0.070	0.070
N	63783	1902013	1967427

NOTES: Source: ICE McDash.
This table presents results testing whether the effect of premium increases on mortgage prepayment differs between conforming and jumbo mortgages. The dependent variable is an indicator for whether the mortgage is prepaid in the 12 months after insurance policy renewal. The main independent variable is the change in premium as a % of TIV. Column (1) uses jumbo mortgages. Column (2) uses conforming mortgages. Column (3) uses the full sample. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 9
DELINQUENCY EFFECT ACROSS INVESTOR TYPES

	60-Day Delinquent				
	(1)	(2)	(3)	(4)	(5)
Premium Rate Increase	0.033***	0.015***	0.011***	0.023**	0.019***
	(10.47)	(11.35)	(9.57)	(2.18)	(6.36)
Method	OLS	OLS	OLS	OLS	OLS
Sample	GNMA	FNMA	FHLMC	Private Securitized	Portfolio
FICO Before Renewal	Y	Y	Y	Y	Y
Zip FE	Y	Y	Y	Y	Y
Orig Yr FE	Y	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y	Y
Y Mean	0.025	0.006	0.005	0.017	0.010
X Mean	0.046	0.035	0.034	0.036	0.031
X SD	0.089	0.073	0.071	0.084	0.068
N	6.68e+05	1.93e+06	1.75e+06	53359	6.87e+05

NOTES: Source: ICE McDash.
This table presents the effect premium increases on mortgage delinquency across investor types. Column (1) uses mortgages guaranteed by Ginnie Mae, (2) by Fannie Mae, (3) by Freddie Mac, (4) private mortgages that are secularized, and (5) those remain in banks' portfolio. The main independent variable is the change in premium as a % of TIV. In Columns (1) and (3), we control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 10
PREPAYMENT EFFECT ACROSS INVESTOR TYPES

	Prepayment				
	(1)	(2)	(3)	(4)	(5)
Premium Increase	0.024***	0.043***	0.038***	0.003	0.019**
	(3.68)	(8.12)	(6.84)	(0.08)	(2.32)
Method	OLS	OLS	OLS	OLS	OLS
Sample	GNMA (Sep-Jan)	FNMA (Sep-Jan)	FHLMC (Sep-Jan)	Private Securitized (Sep-Jan)	Portfolio (Sep-Jan)
Zip FE	Y	Y	Y	Y	Y
Orig Yr FE	Y	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y	Y
Y Mean	0.054	0.066	0.060	0.065	0.050
X Mean	0.043	0.032	0.031	0.031	0.029
X SD	0.084	0.069	0.066	0.076	0.064
N	2.54e+05	7.43e+05	6.68e+05	12590.000	2.64e+05

NOTES: Source: ICE McDash.
This table presents the effect premium increases on mortgage prepayment across investor types. Column (1) uses mortgages guanrateed by Ginnie Mae, (2) by Fannie Mae, (3) by Freddie Mac, (4) private mortgages that are secularized, and (5) those remain in banks' portfolio. The main independent variable is the change in premium as a % of TIV. In Columns (1) and (3), we control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE 11
DELINQUENCY EFFECT IS SMALLER WHEN COVERAGE DECREASES

	60-Day Delinquent	
	(1)	(2)
Premium Increase	0.013***	0.019***
	(4.23)	(17.31)
Premium Increase × Cov Decreased		-0.005*
		(-1.79)
Cov Decreased		0.000
		(1.16)
Method	OLS	OLS
Sample	Cov Decreased	All
FICO Before Renewal	Y	Y
Zip FE	Y	Y
Orig Yr FE	Y	Y
Start Month FE	Y	Y
LTV FE	Y	Y
FICO FE	Y	Y
DTI FE	Y	Y
Y Mean	0.009	0.009
Y SD	0.092	0.094
X Mean	0.060	0.035
X SD	0.119	0.073
N	159175	4267389

NOTES: Source: ICE McDash.
This table presents results testing whether the effect of premium increases on mortgage delinquency differs between borrowers who increased coverage and the rest. The dependent variable is an indicator for whether the mortgage is delinquent in the 12 months after insurance policy renewal. The main independent variable is the change in premium as a % of TIV. Column (1) uses borrowers who changed coverage from "Replacement Cost Value" to "Actual Cash Value". Column (2) uses the full sample. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

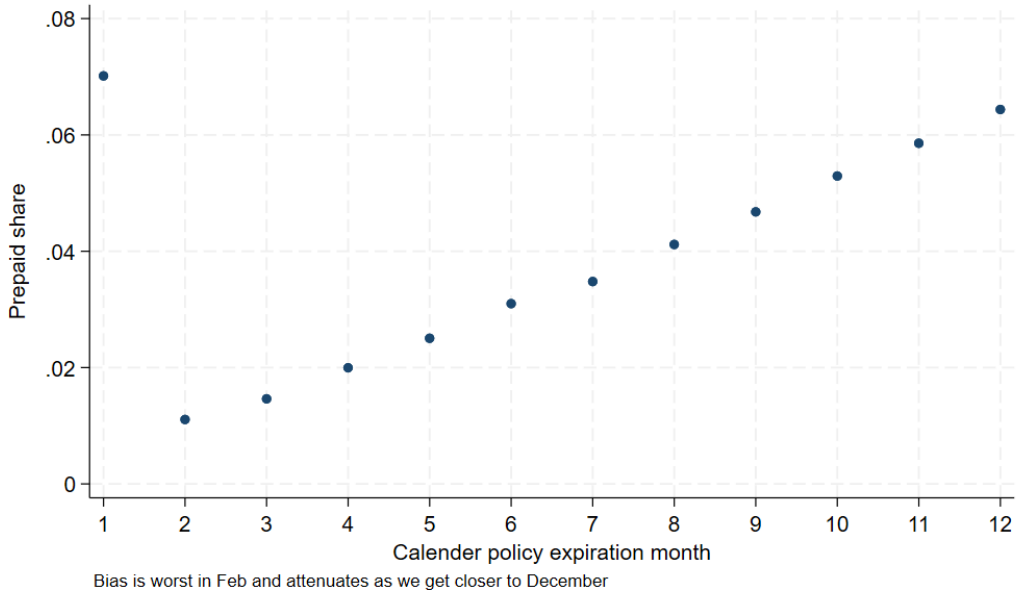
TABLE 12
INSURANCE PREMIUM INCREASES AND CREDIT OUTCOMES

	(1) Credit Card Delinquency	(2) Mortgage 30-Day Delinquency	(3) Utilization (max - initial)	(4) Risk Score (min - initial)	(5) Any 1st Mtg Delinquent	(6) Share Lines Delinquent
Premium Increase	0.018***	0.023***	2.629***	-6.426***	0.008***	0.010***
	(10.25)	(22.26)	(16.06)	(-21.23)	(6.94)	(14.70)
Method	OLS	OLS	OLS	OLS	OLS	OLS
Sample	All	All	All	All	All	All
Zip FE	Y	Y	Y	Y	Y	Y
Risk Score Before Renewal	Y	Y	Y	Y	Y	Y
Orig Yr FE	Y	Y	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y	Y	Y
Y Mean	0.032	0.010	11.602	-14.693	0.012	0.017
Y SD	0.175	0.101	15.849	29.582	0.109	0.074
N	3525330	3525330	3523618	3525327	3444455	3525330

NOTES: Source: ICE McDash and Equifax Credit Risks Insight Servicing (CRISM).
This table presents results analyzing the effect of premium increases on credit card and mortgage delinquencies. The dependent variables in Table 12 are: (1) an indicator for mortgage delinquency using ICE McDash data; (2) an indicator for credit card delinquency in the 12 months after insurance renewal; (3) the maximum share of delinquent credit lines per borrower in 12 months post-renewal; (4) the change in credit card utilization, measured as peak utilization percentage in 12 months post-renewal minus pre-renewal utilization; (5) the change in risk score, measured as minimum score in 12 months post-renewal minus pre-renewal score. The main independent variable is the change in premium as a % of TIV. The sample uses borrowers for which credit card performance and insurance information is available. Since credit card performance is only available until Dec 2022, we construct *Premium Increase* as the change of premiums from the previous policy year for policies that renewed between Feb 2021 and Jan 2022. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. Standard errors are corrected for clustering at the zip code level.
***p<0.01, **p<0.05, *p<0.1.

FIGURE A1

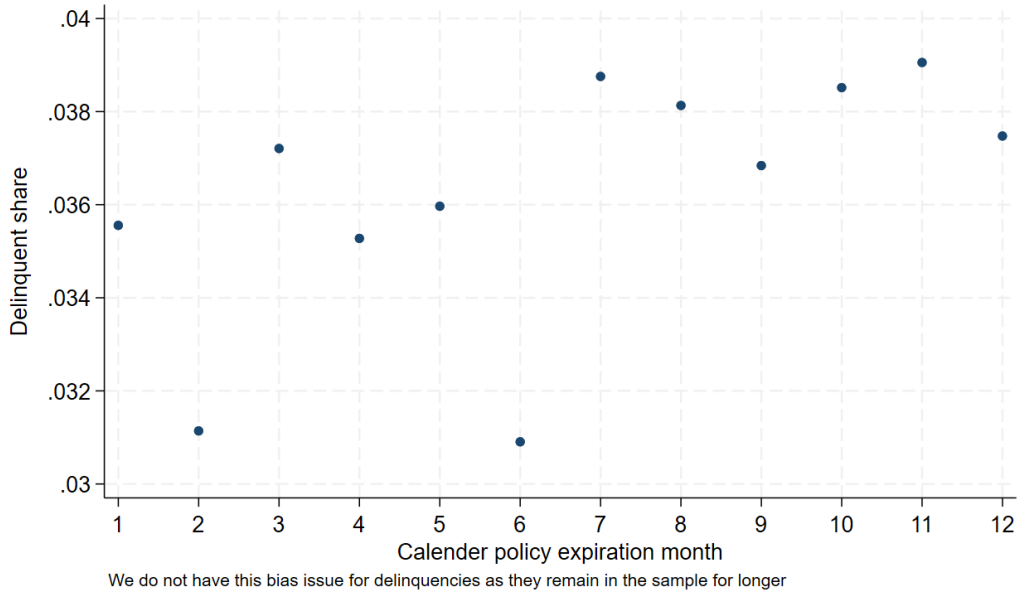
SHARE OF PREPAID MORTGAGES REPORTED BY INSURANCE RENEWAL MONTH



NOTES: Source: ICE McDash.
This figure plots the share of mortgages that are prepaid reported by the calendar month of the insurance policy expiration date.

FIGURE A2

SHARE OF DELINQUENT MORTGAGES REPORTED BY INSURANCE RENEWAL MONTH



NOTES: Source: ICE McDash.
This figure plots the share of mortgages that are delinquent reported by the calendar month of the insurance policy expiration date.

TABLE A1
ACCURACY IN PREPAYMENT REPORTING: EFFECT OF PREMIUM INCREASES ON PREPAYMENT IN DIFFERENT SAMPLES

	Prepayment		
	(1)	(2)	(3)
Premium Increase	0.018***	0.034***	0.033***
	(15.40)	(13.56)	(5.61)
Loan Age	0.006***	0.016***	0.008***
	(21.27)	(33.69)	(7.03)
Method	OLS	OLS	OLS
Sample	All	Sep-Jan	Dec
Zip FE	Y	Y	Y
Zip×Start Month FE	N	N	N
Orig Yr FE	Y	Y	Y
Start Month FE	Y	N	N
LTV FE	Y	Y	Y
FICO FE	Y	Y	Y
DTI FE	Y	Y	Y
Y Mean	0.038	0.057	0.064
Y SD	0.191	0.231	0.246
X Mean	0.036	0.033	0.035
N	6719309	2517168	492868

NOTES: Source: ICE McDash.
This table presents the effect premium increases on mortgage prepayment using different samples. Column (1) uses the entire sample. Column (2) uses the sample with Sep-Jan policy expiry dates. Column (3) uses the sample with Dec policy expiry dates. The main independent variable is the change in premium as a % of TIV. In Columns (1) and (3), we control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. In Columns (2) and (4), we replace zip FE with zip-by-insurance policy start month FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE A2
REGRESSION TO OBTAIN RESIDUAL AVERAGE PREMIUM RATE CHANGE AT THE 3-DIGIT-ZIP-MONTH LEVEL

	Avg Prem Rate Chg
12-Month Lag Avg Prem Rate Chg	0.434***
	(87.31)
24-Month Lag Avg Prem Rate Chg	0.242***
	(42.23)
36-Month Lag Avg Prem Rate Chg	0.127***
	(21.16)
48-Month Lag Avg Prem Rate Chg	0.062***
	(11.89)
Insurance Policy Renewal Month FE	Y
N	61,046
Adjusted R-Squared	0.388

NOTES: Source: ICE McDash.
For each borrower, we first calculate the average premium rate change at renewal across policies that renew in the same month within the same three-digit zip code. To address potential endogeneity in renewal timing, we use each policy's expiration month from the previous year rather than the actual renewal month. We then regress these zip-by-renewal month averages on their 12-, 24-, 36-, and 48-month lagged values and month fixed effects, as follows.

$$Avg\ Prem\ Rate\ Chg_{l,t} = \beta_1 \times Avg\ Prem\ Rate\ Chg_{l,t-12} + \beta_2 \times Avg\ Prem\ Rate\ Chg_{l,t-24} + \beta_3 \times Avg\ Prem\ Rate\ Chg_{l,t-36} + \beta_4 \times Avg\ Prem\ Rate\ Chg_{l,t-48} + FE_t + \epsilon_{l,t},$$

where l indexes 3-dig zip codes, t indexes the insurance policy renewal month. The residual from this regression, $\epsilon_{l,t}$, constitutes our first instrument.

TABLE A3
EFFECT OF PREMIUM INCREASES ON MOVER OUTCOMES

	(1) Log (Mtg Payment) Δ	(2) Log(Mtg+Prem) Δ	(3) Log Balance Δ	(4) Log Appraisal Δ	(5) Rate (pp) Δ	(6) Rate (pp) Δ	(7) Rate (pp) Δ
Premium Increase	0.127	-0.171	-0.009	-0.015	-0.058	0.123	0.005**
	(1.39)	(-1.50)	(-0.08)	(-0.23)	(-0.34)	(1.18)	(2.05)
Method	OLS	OLS	OLS	OLS	OLS	OLS	OLS
Sample	Movers	Movers	Movers	Movers	Movers	Refi - No Cash	All
Zip FE	Y	Y	Y	Y	Y	Y	Y
Zip×Start Month FE	N	N	N	N	N	N	N
Orig Yr FE	Y	Y	Y	Y	Y	Y	Y
Start Month FE	Y	Y	Y	Y	Y	Y	Y
LTV FE	Y	Y	Y	Y	Y	Y	Y
FICO FE	Y	Y	Y	Y	Y	Y	Y
DTI FE	Y	Y	Y	Y	Y	Y	Y
Y Mean	0.440	0.422	0.595	0.543	0.259	-0.883	-0.015
Y SD	0.543	0.482	0.681	0.487	1.219	1.009	0.246
X Mean	0.030	0.029	0.030	0.030	0.030	0.027	0.026
X SD	0.062	0.060	0.061	0.062	0.062	0.059	0.058
N	14564	8916	13780	18191	18312	35655	3411633

NOTES: Source: ICE McDash and Equifax Credit Risks Insight Servicing (CRISM).
Columns (1)-(4) in this table present results analyzing the effect of pre-moving premium increases on post-moving changes for movers. We identify movers as borrowers in Equifax that have prepaid a mortgage and purchased a new home with another mortgage. Since credit card performance is only available until December 2022, we construct *Pre-Moving Premium Increase* as the change of premiums from the previous policy year for policies that renewed between December of 2021 and Jan 2022. The outcome variables are pre- to post-moving changes in: (1) log of mortgage principal and interest payments, (2) log of mortgage plus insurance payments, (3) log of mortgage balance and (4) log of property appraisal value. We also examine changes in mortgage rates among those who refinanced without cash-out (Column 7) and the full sample (Column 8). We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit pre-moving zip FE. Standard errors are corrected for clustering at the zip code level. ***p<0.01, **p<0.05, *p<0.1.

TABLE A4
DELINQUENCY EFFECT IS LARGER FOR HIGH-LTV MORTGAGES

	Delinquent		
	(1)	(2)	(3)
Premium Increase	0.026***	0.011***	0.006***
	(14.68)	(12.23)	(7.19)
Premium Increase $\times$ $LTV \geq 80$			0.026***
			(14.87)
$LTV \geq 80$			0.000
			(.)
Method	OLS	OLS	OLS
Sample	LTV$\geq$80	LTV$<$80	All
FICO Before Renewal	Y	Y	Y
Loan Age (Month)	Y	Y	Y
Zip FE	Y	Y	Y
Orig Yr FE	Y	Y	Y
Start Month FE	Y	Y	Y
LTV FE	Y	Y	Y
FICO FE	Y	Y	Y
DTI FE	Y	Y	Y
Y Mean	0.017	0.004	0.009
Y SD	0.129	0.063	0.095
X Mean	0.042	0.031	0.036
X SD	0.082	0.069	0.074
Sort Var Mean	90.431	60.316	71.977
Sort Var SD	7.130	15.925	19.754
N	1974880	3126991	5105733

NOTES: Source: ICE McDash.
This table presents results testing whether the effect of premium increases on mortgage delinquency differs between High- and Low-LTV mortgages. The dependent variable is an indicator for whether the mortgage is delinquent in the 12 months after insurance policy renewal. The main independent variable is the change in premium as a % of TIV. Column (1) uses the sample of mortgages with LTV ratios higher than the median. Column (2) uses the those with LTV lower than the median. Column (3) uses the full sample. We control for loan age (the number of years since mortgage origination), and the following fixed effects (FE): insurance policy start month FE, mortgage origination year FE, LTV bin FE, DTI bin FE, FICO bin FE, 5-digit zip FE. In Columns (2) and (4), we replace zip FE with zip-by-insurance policy start month FE. Standard errors are corrected for clustering at the zip code level. ***p$<$0.01, **p$<$0.05, *p$<$0.1.