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 lager 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

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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, premium increases can also drive up prepayment rates if some homeowners opt to prepay their mortgages to avoid the required insurance or relocate to homes with lower insurance costs. 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 information 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 delinquency rises by 0.6 percentage points, representing a 16% increase relative to the mean probability (3.7%). If interpreted based on the average premium increases experienced by homeowners during this period, the rise in the delinquency rate is roughly half as large.

Importantly, these results are robust to our instrumental variable analyses, which offer strong evidence of causality. We use two instruments simultaneously in the first stage. For each borrower, the first instrument is the average premium rate change within the same three-digit zip code among policies that reset in the same month. Our second instrument is an interaction between the first one with each borrower's lagged premium rate.

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 recent premium changes that insurers implemented in the local area. Second, within a location, premium increases have typically been larger for riskier properties, which we proxy using lagged premiums (Keys and Mulder 2024).

The exclusion restriction of our first instrument relies on two assumptions. First, insurance policy expiration dates are plausibly exogenous because they are largely determined by when homeowners initially purchased their insurance. Second, changes in local average premiums prior to policy renewals are unrelated to individual borrowers' likelihood of delinquency or prepayment. This second assumption is reasonable because premium changes typically reflect factors such as insurers' assessment of local risk and regulatory rate approvals, rather than individual borrower characteristics. Given these assumptions, our first instrument satisfies the exclusion restriction. Consequently, our second instrument—which interacts policy timing with borrowers' lagged premium rates—should also be exogenous, since both components are predetermined.

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, 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. Movers experiencing larger pre-moving insurance rate increases achieve greater premium reductions, both in premium rates and total dollar amounts.

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 burden of rising insurance costs. This result aligns with the hypothesis that higher insurance premiums strain household liquidity and adversely affect mortgage outcomes.

Fourth, 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.

Fifth, we find that the impact of premium increases 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.

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

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

growing literature studying trends and patterns in home and flood insurance pricing.[2]

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] 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 (2022), Weill (2022), Mulder and Kousky (2023), and Mulder (2021). A few other papers study other effects of flood insurance reform, including Wagner (2022) and Mulder (2021). Jung, Engle, Ge and Zeng (2023) measure insurers' exposure to climate risk.

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:

[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.

"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 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

pdf.

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

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.

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

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

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 mortgages 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 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

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

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 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, 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 scenario, 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

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

$$\log(\textit{Premium Rate})_{z,t} = \gamma_z + \delta_{c,t} + \sum_{t=2016}^{2023} \beta_t \log(\textit{ClimateRisk}_z) + \alpha_t \textit{Controls}_z + \epsilon_{z,t},$$

where z denotes zip code, c denotes the county, and t the year. 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. The dependent variable is premiums relative to the total insured

[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.

value, which we refer to as *Premium Rate*, averaged at the zip-year level. 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 changes in deductibles do not drive the results. Panel A plots the estimates of β_t.

Panel B repeats A, replacing the dependent variable with the cumulative change, relative to 2014, in the premium as a percentage of TIV for policies where the deductible (as a percentage of % TIV) and coverage type (ACV or RCV) do not change. This measure is constructed using within-loan changes in premium only. The figures show 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 percentage of homes with "Actual Cash Value" as coverage in Panel A[10] and average deductible as a percentage of total insured value in Panel B. "Actual Cash Value" policies subtract depreciation in claim payouts and are thus considered to offer less coverage. Both dependent variables are at the zip-year level. We again plot the estimates of the coefficients, β_t.

Figure 2 suggests that starting from 2021, households in areas with higher levels of climate risk experienced a larger drop in coverage—more households opted for "Actual Cash Value" coverage and the average deductibles increased by more. This is consistent with the idea that increases in insurance costs impose financial burdens on households. Our results echo those in Sastry et al. (2024). The subsequent analyses evaluate the impact of premium increases on mortgage outcomes.

[10]We identify such homes by the "Replacement Cost Value" flag being set to zero. While mortgage servicers may occasionally mark this flag as zero when the coverage type is unknown, it is unlikely that this "unknown" classification would exhibit a statistically significant correlation with premium rate increases.

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 insurance reset that occured between July 2022 and June 2023.

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

where i indexes households. In Columns (1) and (2), the dependent variable is an indicator of whether the household is delinquent on the mortgage for at least 30 days. The main independent variable is the increase in premiums per dollar of coverage from the prior to the current policy for each household. This variable is assigned a value of zero if a policy's premium decreased or remained unchanged. We control for loan age, defined as the number of months since the mortgage origination.[11] In Column (1), we control for a battery of fixed effects: zip code, 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. In Column (2), we replace the zip-fixed effects with 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.

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 delinquency rises by 0.6 (=0.07×0.08) percentage points, which represents a 16% increase relative to the

[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.

mean probability (3.7%). 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 an increase of around 149,000 mortgages being delinquent within 12 months after the premium increase.

Figure 3 illustrates the response of mortgage delinquency to premium increases over time. The figure suggests that the effect of premiums becomes larger as more time passes since the policy renewal. Figure 4 presents bin-scatter plots illustrating the relationship between 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 controls identical to those employed in Columns (1) and (3) as described previously. Both figures demonstrate a positive relationship between delinquency probability and premium changes.

5.1.2 Mortgage Prepayment

Next, we test our hypothesis that when insurance premiums increase, borrowers are more likely to prepay their mortgages to lower their cost of insurance. As discussed in Section 3.1, because the insurance data is 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 Increase* is much smaller using the full sample, and highly similar between

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

Columns (2) and (3). Since the larger sample used in Column (2) provide 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 do not use the zip-by-insurance renewal month fixed effects as in Column (2).

Figure 5 plots the response of mortgage prepayment to premium increases over time. The figure suggests that the effect of premiums again becomes larger as more time passes since the insurance policy renewal. 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. 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 Variable for Premium Increase

Our OLS results do not establish a causal relationship. The observed association 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, the households' financial distress may also independently contribute to mortgage delinquency. To address this identification challenge and mitigate potential endogeneity concerns, we instrument for the premium changes households face.

We create two instrumental variables that we simultaneously use in the same first stage. (1) For each borrower, the first instrument is the average change in premium rate at renewal in the same three-digit zip code among policies that reset in the same month. We only include policies with unchanged deductibles and coverage types when calculating this average to reduce confounding factors. Furthermore, to eliminate any effect stemming from endogenous renewal timing, we use the expiration date of the previous year's policy, although, for simplicity, we often refer to this as the renewal timing. (2) Our second instrument interacts is the interaction between the first instrument and the household's lagged premium rate.

The relevance of our instruments builds on two mechanisms. First, premium increases follow location-level trends driven by insurers' risk assessments of that location (Keys and Mulder 2024) and state regulators' approvals (Oh et al. 2022). Premium increases only affect homeowners at renewal, so a property's premium change should correlate strongly with recent premium changes that insurers implemented in the local area. Second, within a location, premium increases are typically larger for riskier properties, which we proxy using lagged premiums. The intuition is related to the findings in our Figure 1 and Keys and Mulder (2024).

The exclusion restriction of our first instrument relies on two assumptions. First, insurance policy expiration dates are plausibly exogenous because they are largely determined by when homeowners initially purchased their insurance. Second, changes in average premiums prior to policy renewals are unrelated to individual borrowers' likelihood of delinquency or prepayment. This second assumption is reasonable because premium changes typically reflect factors such as insurers' assessment of local risk and regulatory rate approvals, rather than individual borrower characteristics. It is possible that the local average premium increase is directly related to mortgage outcomes. However, as Jiang (2017) argues, a fully exogenous instrument is hard to come by; an acceptable argument for a good instrument is that the direct effect of the instrument on the outcome is of a secondary order compared to the causal effect of premiums that we are trying to estimate. Given the two assumptions, our first instrument satisfies the exclusion restriction. Consequently, our second instrument—which interacts policy timing with borrowers' lagged premium rates—should also be exogenous since both components are predetermined.

5.3 Instrumental Variable Results

Table 3 uses our instrument in a two-stage least square (2SLS) setting.[13] Columns (1) and (3) present the first-stage results. The dependent variable is premium changes, as described above. The two instruments are the average premium change at the three-digit zip level among policies that reset in the same month, as well as its interaction with the lagged house-level premiums. The first-stage result indicates that both instruments predict premium increases with positive and statistically significant coefficients. The result suggests that a borrower is likely to experience large premium increases if the three-digit zip code experiences larger premium increases in the same month. The borrower will experience an even larger premium increase if her previous premiums were high, which likely corresponds to higher disaster risks. The large Kleibergen-Paap Wald F statistic suggests that the first stage is sufficiently strong.

Columns (2) and (4) present the second-stage results. The dependent variable is an indicator of mortgage delinquency in Column (2) and an indicator of prepayment in (4). The coefficients on the instrumented premium increases are positive and significant in all of the columns. The second-stage effects are highly similar to the OLS results. Given our arguments in Section 5.2 on the exogeneity of the instruments, these results strongly suggest that premium changes lead to an increase in mortgage delinquency and prepayment.

Two different mechanisms can explain the observed increase in mortgage delinquency. First, rising insurance costs may cause households' liquidity constraints to be more bind-

[13] In calculating local average premium changes in the instrument construction, we restrict our analysis to policies that did not change the amount of deductibles or the type of coverage from the previous year. The deductible and coverage information is missing in some zip codes, resulting in the loss of observations.

ing, 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 household default, although this channel is arguably less important.

The increase in mortgage prepayment can also be attributed to two different mechanisms. First, when insurance becomes more costly, the overall costs of homeownership 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.

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.[14] In (6), the outcome variable captures all other refinancing activities not classified as cash-out under the above criteria.

The coefficients on *Premium 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.

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

[14]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.

We also investigate additional relocation outcomes in Table A2, 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 Increase* coefficients are statistically insignificant, suggesting minimal impact on these outcomes.

Finally, we examine changes in mortgage rates among those who refinanced without cash-out (Column 5) and the full sample (Column 6). While the *Premium Increase* coefficient remains insignificant for those refinancing without cash-out, it becomes positive and statistically significant in the full sample, indicating that larger premium increases correlate with greater mortgage rate increases among average borrowers.

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 50% 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 A3, 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 Larger for 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 stronger for 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 the Column (1) described above using different subsamples based on the investor. We use mortgages guaranteed by Ginnie Mae in Column (1), by Fannie Mae in (2), by Freddie Mac in (3), private mortgages that are secularized in (4), and those remain in banks' portfolio 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 secularized and smallest for those guaranteed by Freddie Mac. The fact that the delinquency effect exists for loans guaranteed by the GSEs suggests implies a risk for the GSEs and the federal government from rising insurance premiums. Banks and investors in private-label MBS are similarly exposed.

Table 10 repeats Table 9, using mortgage prepayment as the outcome variable. The coefficients on *Premium Increase* are positive and statistically significant in all columns except (4). In Column (4), the magnitude of estimate is within the range of 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

If insurance premium increases lead to higher delinquency through straining household liquidity, this effect would be more pronounced for borrowers whose liquidity is more severely impacted by such increases. When insurance premiums rise, some homeowners may increase coverage, potentially due to an increase in either actual or perceived disaster risk. However, those facing greater liquidity constraints due to premium increases are less likely to increase their coverage.

Table 11 Column (1) uses the subsample of borrowers who transitioned their coverage from Actual Cash Value (ACV) or unknown to Replacement Cost Value (RCV). Under ACV, insurers compensate for the depreciated cost to repair or replace damaged properties, while RCV coverage provides reimbursement for the full repair or replacement cost without deducting for depreciation. Thus, this subsample of borrowers increased their coverage. In Column (2), we analyze the full sample, adding an interaction term between premium increase and an indicator for coverage being increased.

The estimated coefficient on premium increases in this subsample that increased coverage is 0.063, which is 25% smaller than that in the other sample (0.083). The interaction term exhibits a negative and statistically significant coefficient, indicating that the difference between the two subsamples is significant. These findings suggest that the effect of premiums on delinquency is smaller for borrowers who increased coverage, likely due to the greater liquidity these borrowers have.[15]

This result also counters an alternative explanation for our main OLS results on delinquency, which posits that increased disaster risks simultaneously drive insurance premium increases and higher delinquencies (e.g., through higher risks lowering home value). Homeowners who increase coverage are more likely to perceive heightened disaster risks. However, they experience a smaller delinquency effect of premiums, suggesting that this alternative explanation is unlikely to be true. This finding complements our instrumental

[15] The strong delinquency effects persist even among borrowers who increased coverage. It may seem puzzling that borrowers would increase coverage when premium increases push them towards mortgage delinquency. Two factors likely explain this pattern. First, some mortgage servicers strictly enforce replacement cost value (RCV) coverage requirements set by GSEs and certain banks, forcing borrowers to increase their coverage. (Conversations with industry participants indicate significant variation in how strictly servicers enforce RCV requirements.) Second, households may upgrade to RCV coverage before experiencing liquidity shocks that, combined with higher premiums, ultimately trigger delinquency.

variable results in demonstrating a causal effect of premiums on delinquencies.

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. Columns (3) and (4) support this hypothesis, though the premium's effect on delinquency remains substantial for such borrowers—93% 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 0.24 percentage point rise in credit card delinquency probability (0.058×0.042), representing 7.8% 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 0.16 percentage point (0.058×2.718) rise in credit card utilization (0.058×0.042), 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 Increase* is negative and statistically significant, suggesting that borrowers' creditworthiness declines following premium increases. A standard deviation increase in premiums corresponds to a 0.47 drop in risk score change (0.058×8.165), representing 3.2% of the average drop 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.

We intend to investigate several follow-up questions. 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 insurance-induced effect on delinquency adversely impact borrowers' credit scores and subsequently limit their access to credit? Third, does the Mortgage-Backed Securities (MBS) market adequately price risks related to insurance costs? 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 asset prices.

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.

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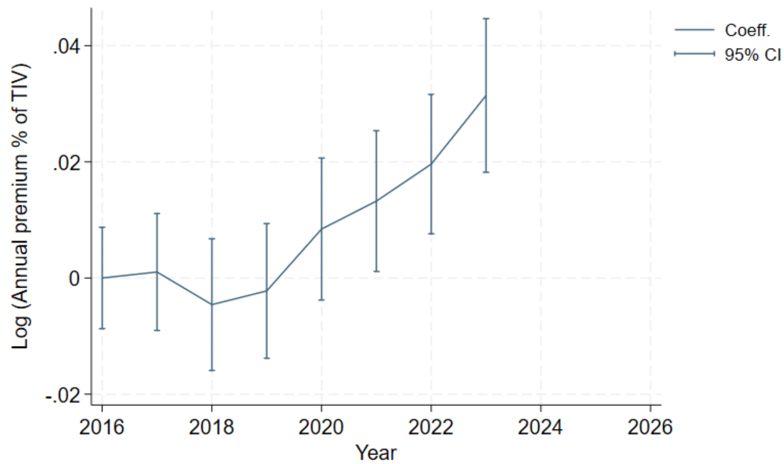
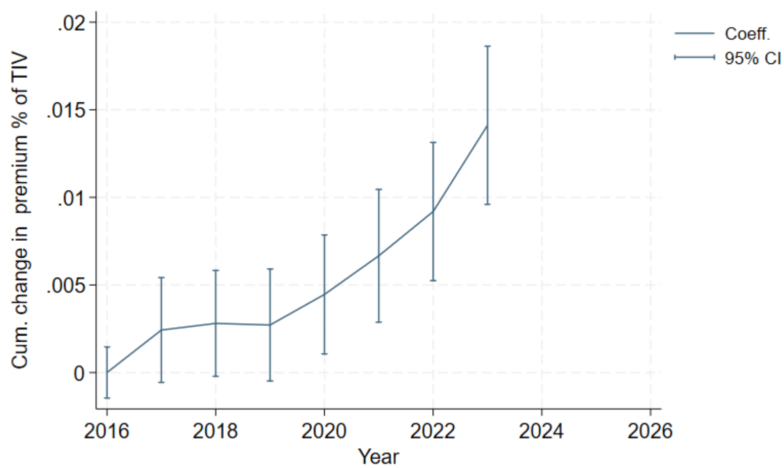
FIGURE 1

PREMIUMS HAVE GONE UP MORE IN HIGH-CLIMATE-RISK AREAS

Panel A. Premium Trend of Riskier vs Safer Zips
(All policies with 0.5% deductible)



Panel B. Premium Trend of Riskier vs Safer Zips
(Repeat measure using existing owners)

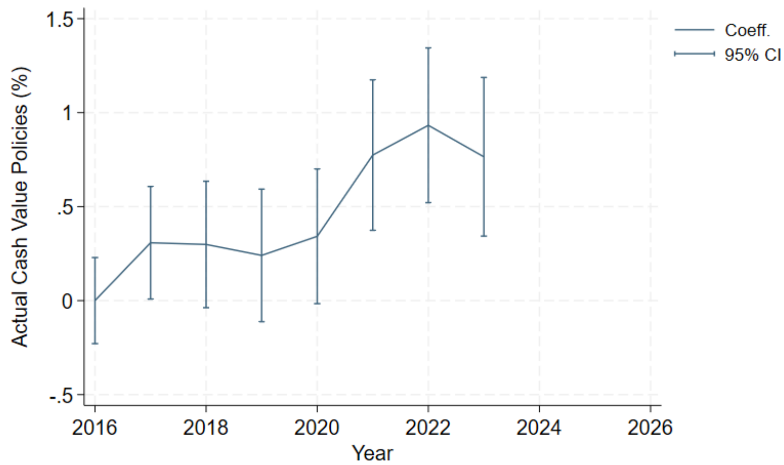


NOTES: Source: ICE McDash, decennial census (controls).
In Figure 1, we examine how premiums have evolved in recent years. We estimate the following regression at the zip-by-year level. $\log(Premium/TIV)_{z,t} = \gamma_z + \delta_{c,t} + \sum_{t=2016}^{2023} \beta_t \log(ClimateRisk_z) + \alpha_t Controls_z + \epsilon_{z,t}$, where z denotes zip code, c denotes the county, and t the year. The dependent variable is premiums relative to the total insured value, 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. Panel A plots the estimates of β_t. Panel B repeats A, replacing the dependent variable with the cumulative change, relative to 2014, in the premium as a percentage of TIV for policies where 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.

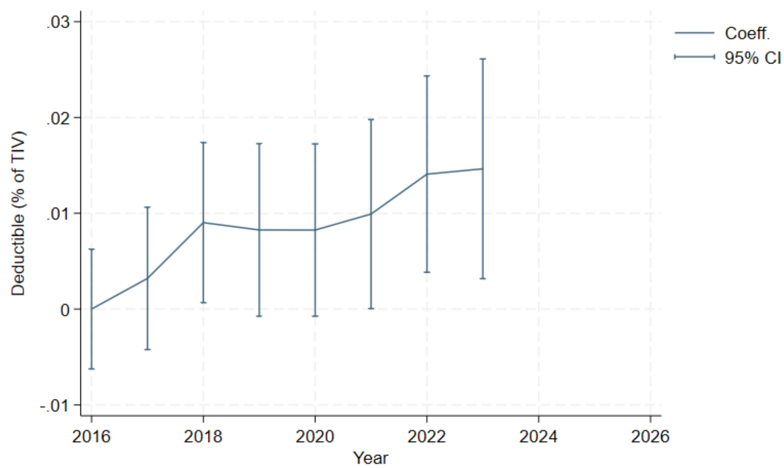
FIGURE 2

ACV & HIGH DEDUCTIBLE POLICIES INCREASINGLY PREVALENT IN HIGH-CLIMATE-RISK AREAS

Panel A. % of Homes with "Actual Cash Value" Coverage, Riskier vs Safer Zips



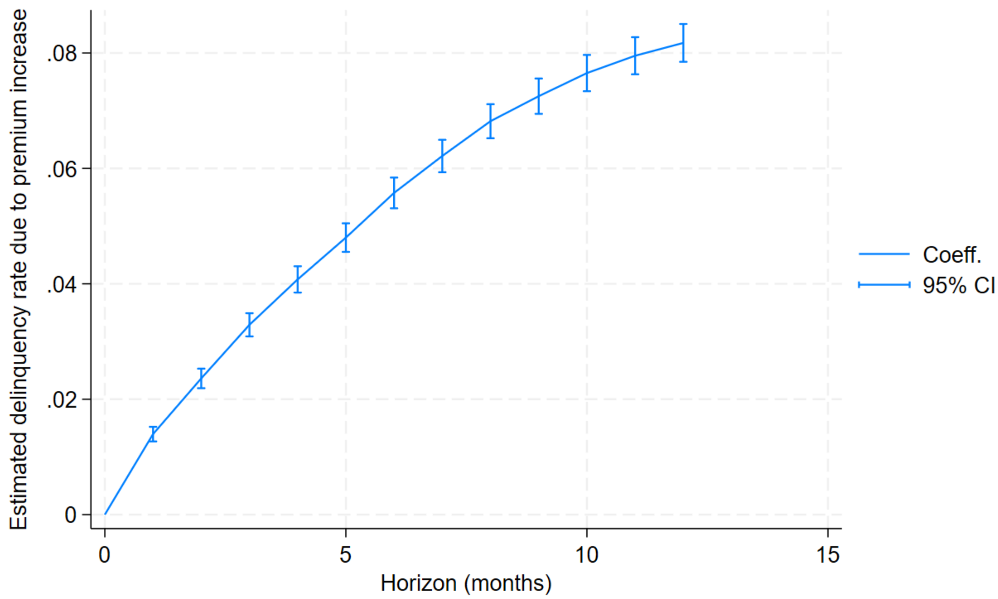
Panel B. Deductible, Riskier vs Safer Zips



NOTES: Source: ICE McDash, decennial census (controls).
Figure 2 repeats Figure 1, replacing the dependent variable with the percentage of homes with "Actual Cash Value" as coverage in Panel A and average deductible as a percentage of total insured value in Panel B. "Actual Cash Value" policies subtract depreciation in claim payouts and are thus considered to offer less coverage. Both dependent variables are at the zip-year level. We again plot the estimates of the coefficients, β_t.

FIGURE 3

MORTGAGE DELINQUENCY DYNAMIC RESPONSE TO PREMIUM INCREASES

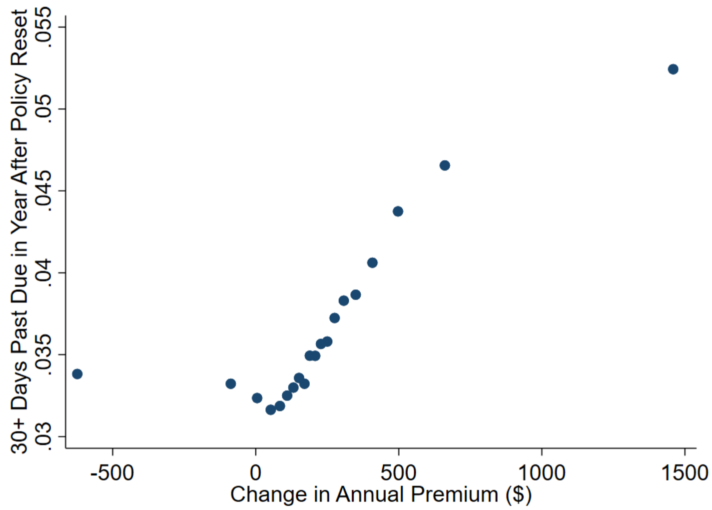


NOTES: Source: ICE McDash.
This figure plots the dynamic response of mortgage delinquency to insurance premium increases by the number of months after the insurance policy renewal. We plot the coefficients and the confidence interval.

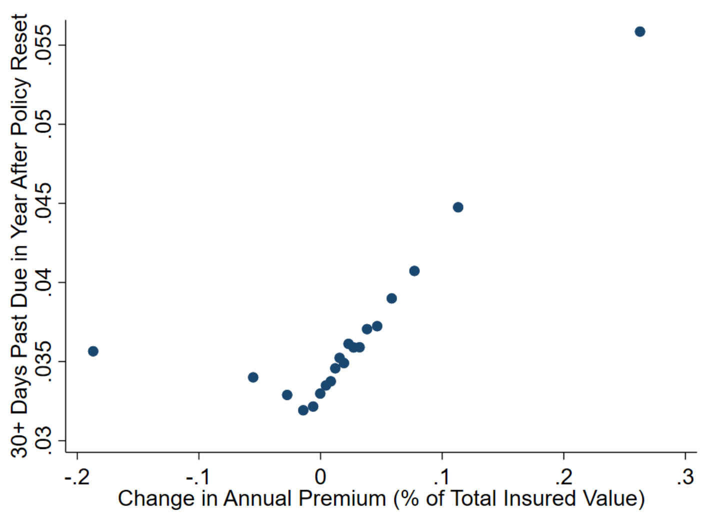
FIGURE 4

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)

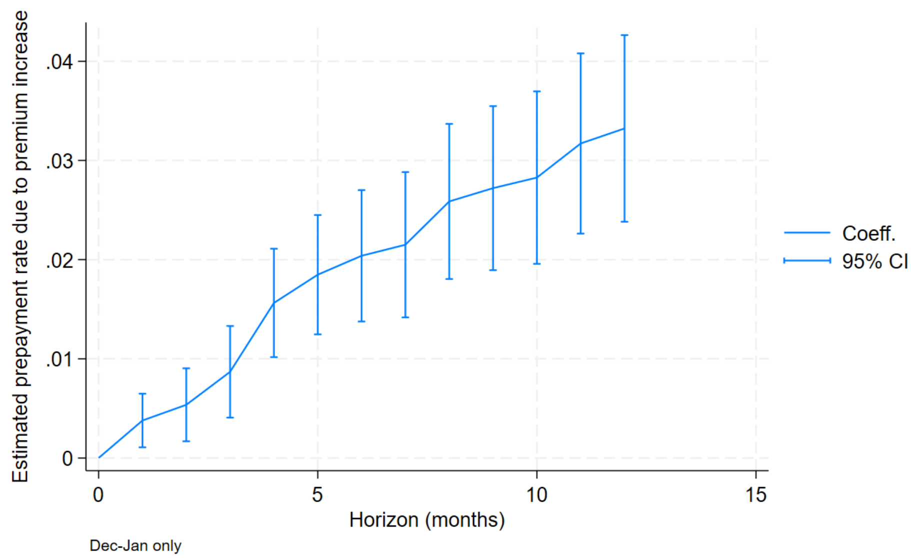


NOTES: Source: ICE McDash.

These figures are bin-scatter plots of 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 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

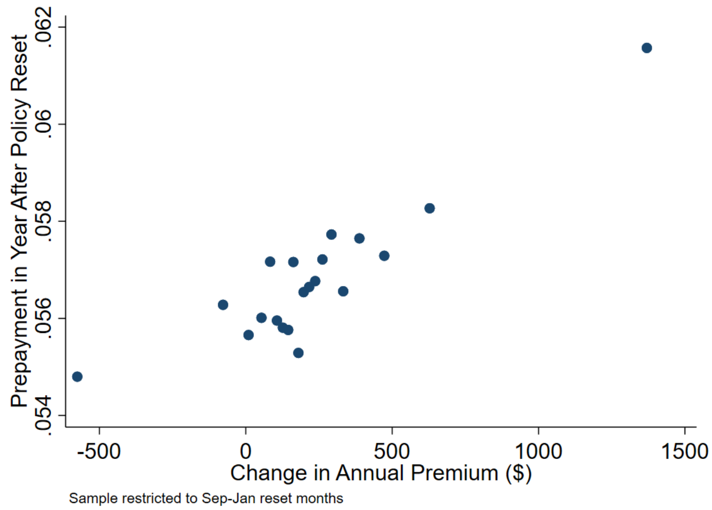


NOTES: Source: ICE McDash.
This figure plots the dynamic response of mortgage prepayment to insurance premium increases by the number of months after the insurance policy renewal. We plot the coefficients and the confidence interval.

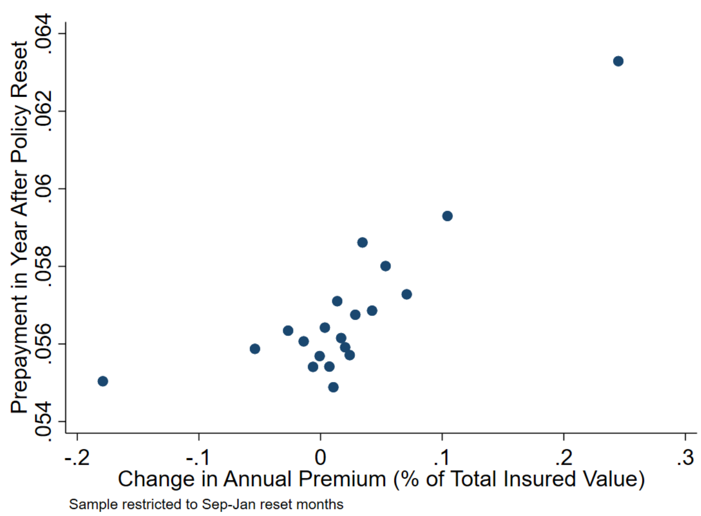
FIGURE 6

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
Delinquent	0.04	0.20	0.00	0.00	0.00
Prepayment (all months)	0.038	0.191	0	0	0
Prepayment (Sep–Jan)	0.057	0.231	0	0	0
Zip Avg Prem Chg in 12 months before Renewal	0.02	0.12	-0.01	0.01	0.04
Premium Increase	0.04	0.07	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

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
	(1)	(2)	(3)
Premium Increase	0.081***	0.082***	0.034***
	(48.70)	(47.88)	(13.56)
Loan Age	-0.001***	-0.001***	0.016***
	(-4.52)	(-4.06)	(33.69)
Method	OLS	OLS	OLS
Sample	All	All	Sep-Jan
Zip FE	Y	N	Y
Zip×Start Month FE	N	Y	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	0.037	0.037	0.057
X Mean	0.036	0.036	0.033
N	6719309	6670212	2517168

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 Increase	Delinquency	Prem Increase	Prepayment
	(1)	(2)	(3)	(4)
Zip Avg Prem Chg	0.501***		0.311***	
	(12.81)		(5.88)	
Zip Avg Premium Chg ×	0.450***		0.507***	
Lagged Premium (% of TIV)	(10.12)		(9.34)	
Premium Increase		0.103***		0.035**
		(9.29)		(2.26)
Lagged Premium (% of TIV)	-0.004***	0.001	-0.005***	-0.000
	(-3.52)	(1.28)	(-6.83)	(-1.37)
Loan Age	-0.001***	-0.001***	-0.002***	0.008***
	(-10.09)	(-5.25)	(-13.53)	(14.46)
2SLS Stage	1st Stage	2nd Stage	1st Stage	2nd Stage
Sample	All	All	Sep-Jan	Sep-Jan
State 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	0.037	0.032	0.057
Y SD	0.074	0.188	0.069	0.231
X Mean	0.025	0.036	0.021	0.032
X SD	0.029	0.074	0.024	0.069
N	6656878	6656878	2505567	2505567
Kleibergen-Paap Wald F stat		3,890.408		1,099.242

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

	Delinquent		
	(1)	(2)	(3)
Premium Increase	0.099***	0.069***	0.068***
	(34.99)	(39.17)	(39.55)
Premium Increase × High DTI			0.034***
			(12.49)
High DTI			0.000
			(.)
Method	OLS	OLS	OLS
Sample	DTI >= 40	DTI < 40	All
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	0.051	0.030	0.037
Y SD	0.221	0.169	0.188
X Mean	0.040	0.035	0.036
X SD	0.081	0.073	0.076
Sort Var Mean	45.149	27.828	33.452
Sort Var SD	4.462	7.892	10.692
N	2179522	4536303	6719309

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

	Delinquent		
	(1)	(2)	(3)
Premium Increase	0.029***	0.082***	0.082***
	(5.05)	(48.51)	(48.45)
Premium Increase × Jumbo			-0.041***
			(-7.36)
Jumbo			0.001**
			(2.00)
Loan Age	0.001	-0.001***	-0.001***
	(0.82)	(-4.61)	(-4.53)
Method	OLS	OLS	OLS
Sample	Jumbo	Non-Jumbo	All
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	0.012	0.037	0.037
Y SD	0.111	0.190	0.188
X Mean	0.029	0.036	0.036
X SD	0.065	0.076	0.076
N	186798	6530498	6719309

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	-0.012	0.032***	0.032***
	(-0.88)	(12.63)	(12.78)
Premium Increase × Jumbo			-0.034***
			(-2.63)
Jumbo			0.001
			(0.81)
Loan Age	0.013***	0.008***	0.008***
	(4.77)	(14.77)	(15.14)
Method	OLS	OLS	OLS
Sample	Jumbo	Non-Jumbo	All
	(Sep-Jan)	(Sep-Jan)	(Sep-Jan)
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	0.033	0.057	0.057
Y SD	0.178	0.233	0.231
X Mean	0.027	0.033	0.033
X SD	0.060	0.072	0.071
N	69355	2446112	2517168

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

	Delinquent				
	(1)	(2)	(3)	(4)	(5)
Premium Increase	0.136***	0.061***	0.054***	0.111***	0.074***
	(30.01)	(29.15)	(25.52)	(6.16)	(16.34)
Method	OLS	OLS	OLS	OLS	OLS
Sample	GNMA	FNMA	FHLMC	Private Securitized	Portfolio
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	0.084	0.026	0.025	0.082	0.035
Y SD	0.278	0.158	0.155	0.274	0.183
X Mean	0.046	0.035	0.035	0.036	0.031
X SD	0.089	0.074	0.073	0.084	0.069
N	9.75e+05	2.64e+06	2.21e+06	66092.000	7.74e+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	0.028***	0.033***	0.037***	0.029	0.018**
	(5.14)	(7.63)	(7.98)	(0.88)	(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	0.050	0.060	0.058	0.063	0.050
Y SD	0.218	0.238	0.233	0.243	0.219
X Mean	0.042	0.032	0.032	0.032	0.029
X SD	0.084	0.070	0.068	0.077	0.065
N	3.61e+05	9.90e+05	8.32e+05	16751.000	2.92e+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 CHANGES

	Delinquent			
	(1)	(3)	(1)	(3)
Premium Increase	0.063***	0.083***	0.075***	0.084***
	(14.96)	(44.01)	(14.69)	(44.41)
Premium Increase × Cov Increased		-0.015***		
		(-3.71)		
Premium Increase × Cov Decreased				-0.009**
				(-1.98)
Cov Increased		0.000		
		(0.13)		
Cov Decreased				0.000
				(0.75)
Loan Age	-0.001	-0.001***	0.001	-0.001***
	(-1.36)	(-4.05)	(0.85)	(-3.59)
Method	OLS	OLS	OLS	OLS
Sample	Cov Increased	All	Cov Decreased	All
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	0.036	0.036	0.036
Y SD	0.185	0.187	0.186	0.187
X Mean	0.041	0.035	0.061	0.035
X SD	0.084	0.073	0.122	0.074
N	640913	6005789	196991	5562366

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 "Actual Cash Value" to "Replacement Cost Value". Column (2) uses borrowers who changed coverage from "Replacement Cost Value" to "Actual Cash Value". Columns (2) and (4) use 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

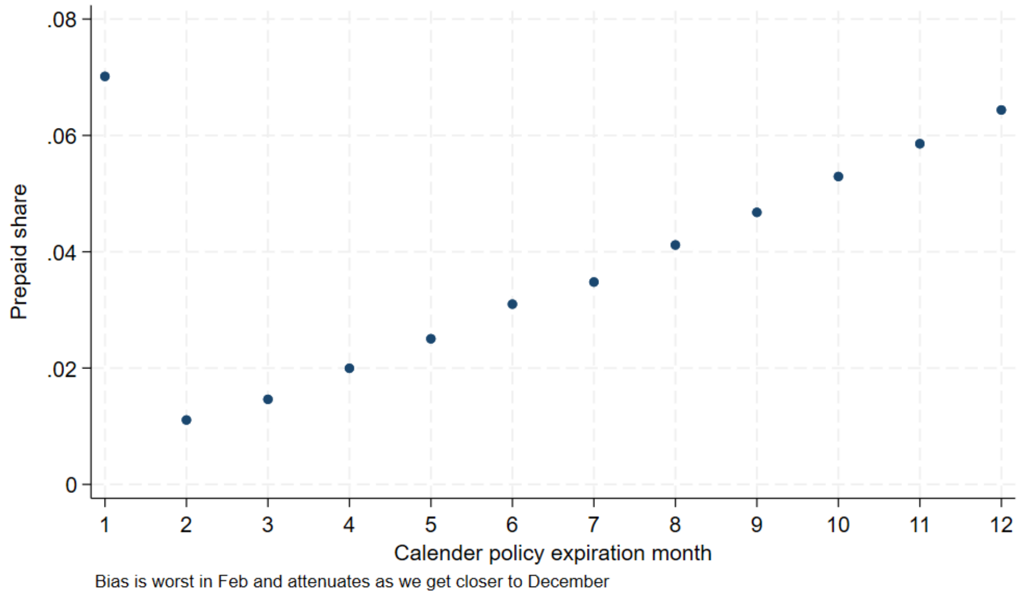
INSURANCE PREMIUM INCREASES AND CREDIT OUTCOMES

	(1) Mortgage Delinquency	(2) Credit Card Delinquency	(3) Share Lines Delinquent	(4) Utilization (max - initial)	(5) Risk Score (min - initial)
Premium Increase	0.075***	0.042***	0.028***	2.718***	-8.165***
	(41.55)	(23.64)	(37.25)	(16.80)	(-26.96)
Method	OLS	OLS	OLS	OLS	OLS
Sample	All	All	All	All	All
Zip FE	Y	Y	Y	Y	Y
Zip×Start Month FE	N	N	N	N	N
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	0.033	0.031	0.017	11.617	-14.674
Y SD	0.178	0.175	0.074	15.859	29.541
X Mean	0.026	0.026	0.026	0.026	0.026
X SD	0.058	0.058	0.058	0.058	0.058
N	3600220	3600220	3600220	3598488	3525547

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

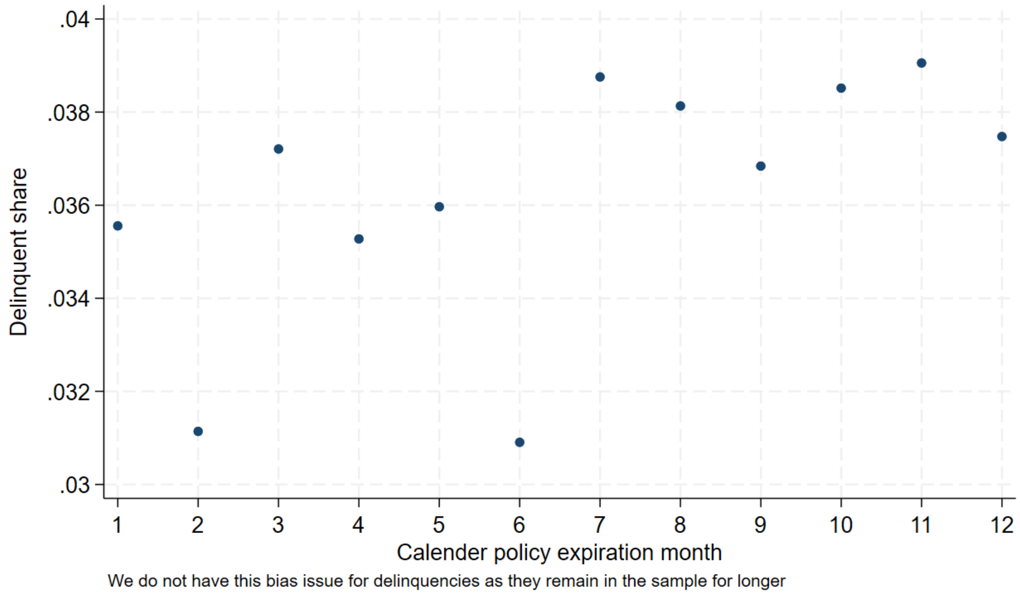
SHARE OF PREPAID MORTGAGES REPORTED BY INSURANCE RENEWAL MONTH



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

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
Premium Increase	0.127	-0.171	-0.009	-0.015	0.123	0.005**
	(1.39)	(-1.50)	(-0.08)	(-0.23)	(1.18)	(2.05)
Method	OLS	OLS	OLS	OLS	OLS	OLS
Sample	Movers	Movers	Movers	Movers	Refi - No Cash	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	0.440	0.422	0.595	0.543	-0.883	-0.015
Y SD	0.543	0.482	0.681	0.487	1.009	0.246
X Mean	0.030	0.029	0.030	0.030	0.027	0.026
X SD	0.062	0.060	0.061	0.062	0.059	0.058
N	14564	8916	13780	18191	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 A3

DELINQUENCY EFFECT IS LARGER FOR HIGH-LTV MORTGAGES

	Delinquent		
	(1)	(2)	(3)
Premium Increase	0.111***	0.055***	0.056***
	(39.48)	(33.84)	(35.87)
Premium Increase × $LTV \geq 80$			0.054***
			(19.46)
$LTV \geq 80$			0.000
			(.)
Loan Age	-0.002***	-0.001***	-0.001***
	(-2.98)	(-2.76)	(-4.75)
Method	OLS	OLS	OLS
Sample	LTV≥80	LTV<80	All
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	0.059	0.024	0.037
Y SD	0.235	0.152	0.188
X Mean	0.042	0.033	0.036
X SD	0.083	0.071	0.076
Sort Var Mean	90.144	60.179	71.336
Sort Var SD	7.122	15.790	19.626
N	2499771	4215988	6719309

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.