Insurance Guaranty Funds *

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Abstract

Growing climate risk is placing increasing strain on property insurers' balance sheets, raising concerns about insurer solvency. Insurance guaranty funds protect policyholders by covering the unpaid claims of insolvent insurers, paid for by other surviving firms in the same state. We use a range of identification approaches and datasets to show that guaranty fund assessments incentivize well-capitalized solvent insurers to ration supply in states experiencing insurer insolvencies, due to three motives: diversification, minimizing assessment size, and delaying the timing of contributions. Alternative explanations, such as changing climate risk perceptions or demand shocks, do not account for these exit and rationing patterns, although they may amplify the effects of guaranty fund exposure. Overall, our findings indicate that the current design of guaranty funds undermines the quality and quantity of insurance supply.

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Accelerating climate-related property damage poses significant threats to property insurer balance sheets. Waves of insurer insolvencies tend to follow large natural disasters,[1] raising concerns about the financial stability of insurance markets in the face of climate change and the resiliency of the households, businesses, and lenders relying on insurance to hedge risks (Sastry et al., 2025). To protect consumers from the negative repercussions of insolvency, states have set up insurance guaranty funds which partially cover the unpaid liabilities of insolvent insurers. Payouts are typically financed by assessing other solvent insurers which operate in the state after an insolvency has occurred. Guaranty funds are a crucial pillar of modern insurance regulation, and yet relatively little is known about these government backstops.

This paper takes a first step toward understanding how the design of guaranty funds shapes insurance supply in the United States. We show empirically that the design of insurance guaranty funds unintentionally undermines insurance market functioning by incentivizing rationing. We identify three motives for rationing caused by the guaranty fund. First, guaranty fund assessments in effect transfer the unpaid liabilities of distressed insurers to solvent insurers. This means that solvent insurers' risk exposure extends beyond their own portfolios to include the areas in which the distressed insurer had significant underwriting activity. Solvent insurers, therefore, have incentives to reduce their underwriting in those areas to preserve geographic diversification. Second, because the assessment formula is based on insurers' pre-insolvency market shares, solvent insurers have the incentive to reduce their market shares to reduce their required guaranty fund contributions. Third, annual guaranty fund contributions are capped as a percentage of in-state underwriting in the assessment year, meaning that solvent insurers can delay required guaranty fund contributions further into the future by reducing their underwriting. Using a range of identification strategies and datasets, we find strong evidence that well-capitalized insurers proactively ration supply and exit the market in states where they face guaranty fund exposures, with evidence for all

[1] In Florida, between 2009 and 2023 at least fifteen insurers became insolvent (Sastry et al., 2025). Recently, following the LA Fires, one of the largest insurers in the country, State Farm, warned about the imminent failure of its California-based subsidiary, writing: "We remain deeply concerned about the financial position of State Farm General, as it is difficult to match price to risk in California. To ensure the long-term sustainability of State Farm General, we are being diligent in our efforts to turn around the financial stability of the company."

three motives.

State-run guaranty funds somewhat resemble the well-studied federal deposit insurance program (FDIC) in that both protect consumers against financial institution failure, but they differ in several crucial ways. Guaranty funds are primarily a consumer protection mechanism, rationalized by the idea that insurers can become insolvent if they experience a catastrophic loss event, since they face financial constraints and costly limits to diversification (Froot et al. (1999)). In contrast, deposit insurance aims to prevent bank failures driven by self-fulfilling bank runs (Diamond and Dybvig (1983); Dávila and Goldstein (2023)). A crucial feature is that guaranty funds operate at the state level, while deposit insurance is federally provided. As a result, guaranty fund exposures influence insurers' geographic underwriting decisions, generating significant cross-state spillovers. Finally, guaranty funds are typically post-funded through risk-insensitive assessments imposed after insolvency, in contrast to the pre-funded, risk-based contributions used in deposit insurance. We argue that these differences lead guaranty funds to generate significant rationing motives and cross-state externalities which are absent in the bank deposit insurance context.

In the first part of the paper, we estimate the causal effect of guaranty fund assessments on insurer exit using a stacked difference-in-differences design centered on insurer distress events. We collect administrative data from the NAIC on annual homeowners insurance underwriting at the insurer-state-businesss line level, as well as information on insurer insolvencies, including announcement dates, rehabilitation dates, and liquidation dates. For each insolvency, we identify treated states are those states where the insolvent insurer operated, and identify the solvent insurers operating there at the time of insolvency, as these firms are exposed to guaranty fund assessments. Control states are the other states where the same solvent insurers operate but where the insolvent insurer did not operate. This provides a within-insurer comparison, allowing us to see how solvent insurers change their underwriting behavior across treated and control states. We define the pre-period as all the years prior to the distress event. The post-distress period refers to the period after the date of distress but before the official insolvency date, when news about insurer financial distress is likely to be available and other solvent insurers can anticipate having to pay guaranty fund assessments. In this period, insurers have incentives to ration in order to maintain geographic diversification and to minimize the size of their guaranty fund contributions. The post-insolvency period begins after the distressed insurer enters formal liquidation proceedings. At this time, the solvent insurers cannot change the total assessments they owe and have limited diversification motives, but they can spread their dues over a longer time period by limiting the overall premiums they write in a state. This specification assumes that absent guaranty fund exposures, underwriting trends in treated and control states would have evolved in parallel.

In a simple event study, we find that solvent insurers reduce underwriting in treated states during both the post-distress and post-insolvency periods. The stacked difference-in-differences estimates indicate that these effects are both statistically significant and economically large. Relative to the pre-period, solvent insurers reduce premiums and are more likely to exit treated states in both the post-distress and post-insolvency periods, compared to control states. Our specification includes rich fixed effects to address potential time-varying confounding shocks at the insurer-year level.

A natural concern is whether the observed decline in underwriting following distress events reflect changes in insurers' perceptions of climate risk rather than the effect of the guaranty fund assessments. This concern arises because insurer distress is often triggered by natural disasters, which could have independent effects on underwriting. We address this confounding channel with two tests. First, underwriting also declines for idiosyncratic insolvencies unrelated to climate events, such as those driven by accounting errors or poor management. Second, we find similar underwriting declines in states exposed to the insolvent insurer but not directly affected by the climate event. Together, these results indicate that guaranty fund exposures generate rationing effects that cannot be explained by changing climate risk perceptions.

Another related concern is that natural disasters or insurance insolvency can change household demand for insurance. To address demand-related confounders, we consider a heterogeneity test that exploits variation in guaranty fund exposures while holding fixed demand-related channels. Specifically, we exploit the fact that some states allow insurers to partially offset guaranty fund assessments against state tax liabilities ("premium tax offset," or PTO, states). Because such offsets reduce the effective cost of assessments, incentives to exit are stronger in non-PTO states and weaker in PTO states. We argue that changes in household demand should not systematically vary by the PTO status of the state, whereas insurer supply incentives do. Using our stacked difference-in-differences design, we find that premium reductions following insolvencies are more than twice as large in non-PTO states relative to PTO states. This heterogeneity helps bolster our insurance supply interpretation, and that equilibrium outcomes are driven by guaranty fund exposures rather than other demand-related channels.

We complement our state-level analysis with ZIP-level data on cancellation rates, recently made available by the Federal Insurance Office. With this data, we can utilize a border-discontinuity design that compares neighboring ZIP codes that fall on opposite sides of a state border. While guaranty fund assessments will vary across state borders, our key identifying assumption is that other factors that might also drive cancellations (e.g., changing climate risk, demand shocks, etc.) are similar across state borders. In addition, policy cancellations are at the discretion of the insurer, making this a purer measure of insurance supply. We find that insurers significantly increase cancellations in the post-distress period in states exposed to guaranty funds relative to the neighboring states. We argue this provides independent verification of our main results using different data and different identifying assumptions.

Our findings that insurers ration supply in the post-distress period can be explained by either the motive to maintain geographic diversification or the motive to minimize the size of assessments. To provide independent evidence of the diversification motive, we examine county-level evidence from Florida. The diversification motive operates at both the state and sub-state levels: insurers inherit exposure not only to entire states but also to the specific counties where the failed insurer was active. By contrast, the incentive to minimize or postpone guaranty-fund assessments depends only on an insurer's aggregate market share and premiums within a state, and thus varies solely across states. This asymmetry implies that differences in assessment incentives cannot account for within-state reductions in coverage from affected counties. To identify the diversification motive, we therefore examine evidence at the county level. We focus on the idiosyncratic failure of Sunshine State Insurance Company, which became insolvent in 2014 due to an accounting error that materially overstated its capital position. In particular, we examine whether solvent insurers are disproportionately more likely to exit counties with greater exposure to distressed insurers. A one-standard-deviation increase in a county's exposure to Sunshine is associated with a 40 basis point increase in cancellation rates by solvent insurers, reflecting a 3% increase relative to the baseline cancellation rate. This incentive is strongest in the post-distress period, when insolvency proceedings remain incomplete and new claims can continue to be filed with the distressed insurer. The fact that insurer exit is concentrated in counties with high guaranty fund exposure is strongly consistent with active re-balancing to limit geographic concentration.

In our last specification, we consider a placebo test that exploits cross-state variation in the design of guaranty funds. In New York, guaranty fund payments are pre-determined and not linked to insolvency events. This means that insurers do not inherit the claims of insolvent insurers ex-post, and that insurers cannot reduce or delay guaranty fund contributions by adjusting underwriting. Therefore insolvencies in New York do not generate rationing incentives. We therefore compare the effects of insolvencies in New York to those in post-funded states, where rationing incentives are strong using the same stacked difference-in-differences design. Consistent with this prediction, we find that insurer rationing following insolvencies in New York is economically and statistically insignificant. In contrast, insurer supply reductions in post-funded states are large and statistically significant.

Taken together, our results suggest that the current guaranty fund system leads to insurance market unraveling by incentivizing rationing by solvent insurers. Their exit also serves to lower the quality of insurance supply by decreasing the share of well-diversified solvent insurers. Furthermore, solvent insurers exit states exactly at the time when the funds and consumers need them the most: when there is insurer distress or insolvency, such as after a natural disaster. Our results question the ability of a state-level, post-funded guaranty fund system to adequately protect consumers in the face of climate change.

Literature Review. Our paper connects to the larger literature on the rationale and the design of the backstops for financial institutions, which has mostly focused on deposit insurance for the banking sector. This literature has shown that deposit insurance can prevent insolvencies caused by liquidity-driven bank runs (Diamond and Dybvig, 1983, Calomiris, 1990, Calomiris and Mason, 2003, Dávila and Goldstein, 2023, Correia et al., 2025), but comes at the cost of creating moral hazard (Merton, 1977, Chan et al., 1992, Iyer and Puri, 2012, Anginer et al., 2014, Iyer et al., 2016, Egan et al., 2017, Martin et al., 2024). A related literature examines the optimal design of deposit insurance, emphasizing the trade-offs between its costs and benefits (Kane, 1990, Dávila and Goldstein, 2023). Our contribution is to study these questions in the insurance context, where the rationale and trade-offs differ from deposit insurance. Insurance backstops are designed to protect consumers and sustain trust in insurance markets (Gennaioli et al., 2021, Glaeser and Shleifer, 2003, Hartley, 2024, Cole et al., 2013). While prior work shows that guaranty funds can induce insurer moral hazard (Cummins, 1988, Bohn and Hall, 1997), we highlight a distinct and previously under-explored channel that guaranty funds generate cross-insurer externalities that lead healthy insurers to ration supply and exit in order to limit assessment exposure and concentrated risk. In addition, we argue that this market unraveling can be addressed by alternate funding designs.

Our paper also contributes to a growing literature studying the homeowners insurance market. Existing work on the supply side studies the determinants of pricing and quantity rationing, emphasizing the roles of capital market frictions (Froot and O'Connell, 1999, Jaffee and Russell, 1997, Kalda et al., 2025), state-level price regulations (Oh et al., 2025), informational asymmetry (Boomhower et al., 2023, Jung and Jung, 2025), claims validity (Gennaioli et al., 2021), reinsurance market frictions (Mulder and Keys, 2024, Solomon, 2025), and household characteristics (Blonz et al., 2024).[2] The literature on the demand-side studies the role of mortgage markets (Sastry et al., 2025, 2024) and behavioral frictions (Cookson et al., 2025).[3] There is also a recent literature which aims to identify the broader effects of homeowners insurance market disruptions on mortgage and housing markets (Sastry et al. (2025), Ge et al. (2024), Eastman et al. (2024)). Our main contribution is to identify the drivers of insurers' quantity rationing. We show that the funding structure of guaranty

[2] See Sastry and Sen (2025) for a review of the recent literature on the homeowners insurance market.

[3] More broadly, research on other types of insurance contracts has extensively analyzed both demand-side forces (e.g., adverse selection) and supply-side constraints (e.g., financing frictions). See, e.g., Yaari (1965), Rothschild and Stiglitz (1976) for demand-side, and Koijen and Yogo (2015, 2016, 2022), Ellul et al. (2015, 2022), Ge (2022), Sen and Humphry (2018), Sen (2021), Sen and Sharma (2020), Barbu (2021), Tang (2023), Tenekedjieva (2021), Oh (2020), Egan et al. (2021) for supply-side.

funds generates negative externalities that distort insurance supply. To our knowledge, this is the first paper to link guaranty fund design to both the quantity and quality of homeowners insurance provision.

1. Institutional Background

1.1. *Insolvency Proceedings*

Insurance insolvency proceedings are specialized state receivership processes and unfold in a sequence of legally distinct stages.[4] *Pre-receivership.* When an insurer begins to show signs of distress, the state insurance regulator first intervenes through pre-receivership tools such as administrative supervision or conservation orders. These measures temporarily transfer control over key operations and assets to the regulator; policies remain in force and claims continue to be paid under increased regulatory oversight. *Rehabilitation.* If these measures fail to restore the insurer's financial solvency, the regulator petitions a court in the insurer's domiciliary state for a formal receivership order, typically known as rehabilitation.[5] Rehabilitation appoints the regulator as the rehabilitator; the insurer continues to operate under court supervision while a rehabilitation plan is developed. The plan may include restructuring liabilities, commuting policies, or selling blocks of business. *Liquidation.* Liquidation is the final stage, in which the court formally declares the company insolvent and places it into receivership. At this point, two institutional actors divide responsibilities: the regulator, acting as liquidator, manages the estate, asset recovery, and the formal creditor process, while the guaranty association (fund) assumes eligible claims and begins adjusting and paying them subject to statutory caps and exclusions until obligations are run off and the estate is closed.[6] The receivership court supervises the proceeding throughout. We describe the functioning of guaranty funds in more detail below.

[4] See, e.g., NAIC, Receivers' Handbook for Insurance Company Insolvencies (2024).

[5] See the Insurer Receivership Model Act.

[6] NAIC, Receivers' Handbook for Insurance Company Insolvencies (2024); National Conference of Insurance Guaranty Funds (NCIGF), Insolvencies: An Overview"; National Organization of Life and Health Insurance Guaranty Associations (NOLHGA), What Happens When an Insurance Company Fails?"

1.2. Guaranty Funds

Insurance guaranty funds are state-level institutions that provide financial protection to policyholders in their respective states in the event that their insurer becomes insolvent. Guaranty funds thus serve as a safety net—effectively a form of insurance for insurers—for the vast majority of policyholders within a state. Not all insurers, however, are covered by this protection; policyholders of "non-admitted" insurers and reinsurance "captives" fall outside the guaranty system.[7] Guaranty funds were first established via a federal statute in 1969 and operate in all 50 states, District of Columbia, Puerto Rico, and the U.S. Virgin Islands. However, guaranty fund protections are partial: they cover only covered claims up to a statutory cap, typically around $300,000 per claimant, although specific limits vary across states. Figure 2 provides an illustrative example of how the guaranty fund works.

Funding. Guaranty fund payments are financed through two main sources: (i) recoveries from the insolvent insurers' estate and (ii) ex-post assessments on solvent insurers. First, the liquidator of the insolvent insurer unwinds the assets and collects reinsurance, and transfers the proceeds to the guaranty fund for distribution to claimants. However, recoveries from the estate are typically slow as well as incomplete: liquidation proceedings commonly extend over a decade or more, and receivers ultimately recover only a fraction of the pre-insolvency asset values. For example, Hall (2000) show that liquidators turn over only 33 cents per dollar of pre-insolvency asset to the guaranty funds. Second, the guaranty associations can levy post-insolvency assessments on the remaining solvent insurers in the state to address the shortfall between guaranty fund obligations and the assets of the failed insurer, thereby spreading the losses across the market. Because asset recoveries in practice are limited, ex-post assessments are crucial to support the guaranty system's ability to honor covered claims.[8]

Ex-post Assessments. We next discuss key features of the assessment process that

[7]Non-admitted insurers (also referred to as surplus lines carriers) are not licensed by the state's insurance department to write policies, and typically insure risks that licensed insurers do not underwrite. Reinsurance captives are specialized entities that reinsure the parent's insurance affiliates and similarly fall outside the guaranty fund safety net.

[8]In Florida, for example, the estate distributions accounted for approximately 31% of the guaranty fund's total cash inflows between 2018 and 2022, with the remaining two-thirds coming from insurer assessments and the balance from investment income (Florida Insurance Guaranty Association, 2022).

determine how guaranty fund exposures are distributed across insurers and over time.

Distribution across insurers. Once a court orders an insurer into liquidation, the relevant guaranty association determines the total shortfall between the insolvent insurer's unpaid claims and the expected recovery from the insurer's estate, and then levies an assessment on solvent insurers to close this gap. The aggregate assessment is allocated across member insurers in proportion to their market share based on net direct written premiums in the 1-2 years prior to the final insolvency order.[9] For example, if Allstate accounted for 2% of homeowners' insurance market in Florida in the years immediately prior to when Magnolia went insolvent, Allstate's share of the total assessment would be 2%. In other words, the assessments are essentially size-based rather than risk-based, and riskier insurers do not bear a larger share of the guaranty burden than safer insurers with comparable premium volume. This feature can distort incentives by encouraging solvent insurers to reduce their written premiums, and thus their assessment base, when they anticipate a peer insurer distress and eventual insolvency.

While the decision to place an insurer into liquidation is made by the court in the insurer's state of domicile, guaranty protection is provided in every state where the insolvent insurer wrote premiums. Thus, if an insurer domiciled in State A operated in both California and Oregon, the guaranty associations in California and Oregon would each levy assessments on their own solvent insurers. In each state, the assessment reflects that state's projected shortfall, which in turn depends on the volume and severity of claims arising from policies written by the insolvent insurer in that state.

Timing of guaranty fund exposures. A second crucial feature is that guaranty assessments are post-insolvency funded. This means that solvent insurers do not begin making assessment payments until the insolvency has been finalized and the guaranty association has identified the expected shortfall. With the exception of New York—which maintains a prefunded mechanism that is triggered when the fund balance falls below a statutory threshold—all

[9] Guaranty fund assessments are premium-based and allocated pro rata. *"Guaranty fund assessments are generally based on premiums written in the state and allocated among member insurers in proportion to their premium writings (...) Class B assessments are levied after an insolvency to provide funds to pay covered claims and administrative expenses."* See NAIC Issue Paper No. 35.

states rely on this ex post funding structure.[10] Insurers are required to make assessment payments each year subject to statutory annual caps that typically limit assessments to about 1–2% of the insurer's premiums in a given year (Table A.1). These caps are intended to smooth the burden of funding large failures and to avoid destabilizing solvent carriers. When the required assessment exceeds what can be collected under the cap in a single year, the unpaid balance is carried forward and called in subsequent years, so that each year's payment stream remains bounded by the statutory percentage of that year's premium base.[11] This structure, however, also implies that insurers can potentially delay future assessment payments by shrinking their current premium base, which may distort underwriting decisions when assessment burdens are high.[12]

Recoupment provisions. To reduce the financial burden of the assessment payments, state regulators allow insurers to partially recoup the assessments payments. However, the scope and mechanics of recoupment vary significantly by state. Some states allow insurers to employ premium tax offsets (PTO), which is a provision whereby insurers can credit a portion of their guaranty fund assessments against future state premium tax liabilities. This helps reduce the assessment burden by reducing future tax payments. Figure 3 show the states that follow the PTO policy. At the same time, other states authorize recovery from policyholders, by allowing insurers to charge higher premiums to recoup the assessment payments. In practice, recoupment through premium increases can be challenging. In many states, increasing insurance rates requires prior regulatory approval, and the rate setting process itself can be highly frictional (Oh et al. (2025)). This makes the process slow, and rate increases may be too constrained to allow full and timely recoupment of costs in practice. While some states allow insurers to directly add a surcharge, insurers may themselves be reluctant to raise prices as higher prices can depress demand leading to some households reducing coverage (Sastry et al. (2024)). For these reasons the PTO provision is typically seen as the

[10] See New York Consolidated Laws, Insurance Law - ISC § 7604.

[11] The Chicago Fed emphasizes that assessments can be smoothed over time: "Guaranty associations may spread assessments over several years rather than calling the full amount immediately"; NOLHGA's assessment-capacity materials similarly state that "assessments in excess of the annual cap may be deferred and called in future years, subject to the same percentage-of-premium limits."

[12] Note that since industry fees are subject to yearly caps, there can still be a mismatch between when the fund's assets and liabilities are due. To increase their liquidity, the guaranty funds can work with states to issue tax-free bonds against the future stream of insurer assessments.

least onerous recoupment mechanism from the insurers' perspective, where the incidence of guaranty funding is shifted in material part to state taxpayers rather than remaining with insurers. We exploit cross-state heterogeneity in guaranty fund exposure—arising from the fact that, in PTO states, insurers effectively face lower net assessment burdens—to identify how these exposures affect insurance supply.

2. Data

Historical insolvency data. We obtain data on insurance insolvencies for homeowners insurance companies from the NAIC's proprietary Global Receivership Information Database (GRID). For our main analysis using insurer-state-year panel data in Section 3, we limit the sample to insolvencies occurring between 2000 and 2016, which gives us a total of 48 insolvencies. In Panel A of Table 1 we break down these insolvencies by type: whether the insolvency is climate driven, or idiosyncratic; whether any of the affected states allow PTO or non-PTO, etc. We consider insolvencies that occur after 2016 in our additional analyses using alternate datasets, in Section 4.2 and 4.3.

Underwriting Operations and Financial Statements. We collect insurers' underwriting data from the Standard & Poor's Market Intelligence (S&P MI) database. Insurers report to regulators underwriting data by each line of business for each state they operate in. This includes total homeowners' premiums sold, which provides us a quantitative measure of insurers' underwriting. The data are available at an annual frequency and for each state an insurer operates in. We construct a measure of insurer exit by examining whether the insurer sold any premiums in the state. We collect data for the subset of P&C insurers that sell HO insurance in the U.S. for the period 1996 to 2019. Panel B of Table 1 provides summary statistics.

Federal Insurance Office (FIO) ZIP-level data on Cancellations. The U.S. Treasury's FIO office issued a call for data requiring most U.S. insurers writing in the homeowners' line to report ZIP code level underwriting details from 2018 to 2022. Treasury publicly released the data aggregated to the ZIP-code-year level. We use these zip-year-level policy cancellations to compare cancellations in a border discontinuity design in Section 4.2. Summary statistics are provided in Panel C of Table 1, which shows that roughly 6% of the ZIP policies get canceled in a given ZIP in the selected border pairs.

Insurers' county-level underwriting data in Florida (QUASR). We also obtain county-level insurance underwriting data for Florida through the state regulator's Quarterly and Supplemental Reporting System (QUASR) database. All property insurers that operate in the state were required to report underwriting information to the Florida Office of Insurance Regulation (FLOIR). The data are publicly available for all insurers selling homeowners' insurance in Florida from 2009 to 2018. Covereage thereafter significantly decreases due to a state court decision (Sastry et al., 2025). Summary statistics are provided in Panel D of Table 1.

3. Empirical Approach

3.1. Guaranty Fund Exposures and Insurance Supply

We wish to analyze to what extent guaranty fund exposures cause solvent insurers to ration supply in states experiencing an insolvency. In this section, we argue that rationing supply helps insurers remain geographically diversified; minimize the size of guaranty fund payments; and delay the timing of assessments.

Diversification motive: As discussed in Section 1, after an insurer fails, unpaid claims of the insolvent insurers are partially covered by the state guaranty fund. These guaranty fund payments are covered by the surviving solvent insurers operating in the state. Therefore, in these scenarios, the exposure of a solvent insurer to a given geography comes not only from its own portfolio, but also from the policies sold by the insolvent insurer because of the state guaranty fund. Guaranty fund exposures therefore change incentives to supply insurance in areas exposed to the insolvent insurer. Solvent insurers have incentives to reduce exposure to the geographies where the failing insurer has large operations: those areas will now account for a larger portion of the solvent insurer's portfolio, creating more concentrated exposures, which the solvent insurer will be on the hook for through the guaranty fund. This creates incentives to cancel policies or limit new underwriting in these specific areas to maintain portfolio diversification.

Minimizing assessments motive: While guaranty funds are paid only after an insolvency has occurred, the assessment formula is based on solvent insurers' *pre-insolvency market shares* in total premiums (in a given state). The structure of the formula means that solvent insurers can reduce the size of their total guaranty fund payments by reducing their market share.

Delaying assessments motive: Furthermore, annual contributions are capped as a small percentage of in-state underwriting in the assessment year. Reducing total premiums sold can reduce the annual cap, allowing the insurer to delay assessment payments further into the future.

3.2. Identification Strategy

We wish to show that guaranty funds lead to changes in insurance supply because insolvencies trigger positive guaranty fund payments. Our main approach will to be examine insurer underwriting before and after an insolvency event, and how this varies by whether an insurer has guaranty fund exposures. However, establishing that changes in insurance underwriting are due to the guaranty fund assessments poses two key econometric challenges. First, guaranty funds become relevant only in a distress or an insolvency event, which are often–but not always–triggered by *natural disaster*s. Because natural disasters may change insurer risk perceptions and therefore supply, we need to separate rationing driven by changing risk perceptions from the effect of guaranty fund exposures. Second, insurer insolvencies and natural disasters can change household *demand* for insurance (positively or negatively). Thus equilibrium outcomes may reflect households demand rather than changes in insurer supply. As a result, we must also seek variation that delivers variation in supply incentives while fixing household demand effects. In this section, we will describe our main empirical strategy, and how we address these confounding channels.

We consider the following stacked difference-in-differences design (Cengiz et al., 2019), where we compare solvent insurers' underwriting in treated states where insolvent insurers operated (i.e., where they have guaranty fund exposures) versus other control states that are unaffected by the insolvency event (i.e., there are no guaranty fund exposures).

We construct our sample as follows. We first identify all the insurers that became insolvent during our sample period, the year in which they became insolvent, and the states in which they operated ("treated states"). To consider which insurers face guaranty fund assessments, we identify all the solvent insurers which also operated in the treated states around the time of the insolvency. We then identify all the other states where these same solvent insurers operated, which will serve as our "control states." For each insolvency event e, we therefore define our $Treated_{ise}$ dummy variable, which equals 1 for solvent insurers i operating in the treated states s, and 0 for the same insurer i in the control states s. Summary statistics are provided in Panel B of Table 1.

We examine how solvent insurers' underwriting behavior changes when the insolvent insurers first enter financial distress, and also after they are officially declared insolvent. We define the pre-period as all the years prior to when the insurer enters distress. The post-distress period refers to the period after the date of distress but before the official insolvency date. Furthermore, news about insurer distress is typically publicly available from regulatory filings, meaning that solvent insurers can anticipate guaranty fund assessments to be levied when the distressed insurers officially become insolvent. In this period, insurers have incentives to change their underwriting behavior to diversify their portfolios and minimize total guaranty fund contributions (Section 1). The post-insolvency period begins after the distressed insurer enters liquidation. At this time, the solvent insurers cannot change the total assessments they owe, but they still diversify their portfolios and spread their dues over a longer time period by limiting the overall premiums they write in a state in each year, because of the annual cap.

We implement this design in the following empirical specification:

$$(1) \qquad Y_{iste} = \beta_D Treated_{ise} \times PostDistress_{te} + \beta_I Treated_{ise} \times PostInsolvency_{te} + \alpha_{ise} + \alpha_{te} + \alpha_{it} + \epsilon_{iste}$$

Our outcome variable Y refers to measures of insurer i's underwriting in state s in year t. We consider total premiums, cancellation rates, as well as overall exit from a state. Exit will be measured as both an intensive margin reduction in overall premiums, an extensive margin exit from the state altogether, as well as policy cancellations across the U.S. when available. α_{ise} denotes insurer-state-event fixed effects to hold fixed any persistent differences at the insurer-state level. We therefore consider variation over time in premiums for the same insurer in a given state. Year-event fixed effects (α_{te}) address any common time-varying trends (e.g. aggregate demand shocks) that could also drive insurance outcomes. Insurer $\times$ year fixed effects (α_{it}) control for other time varying insurer characteristics that could also drive supply changes, such as changes in an insurer's *financial constraints*. The crucial feature of our identification strategy is that we compare the same insurer's responses across states that are differently affected by an insolvency.

The coefficients of interest β_D and β_I estimate the change in solvent insurers' underwriting among treated states relative to control states using within insurer-year and insurer-state variation. Under our hypotheses, we expect both β_D and β_I to be negative and significant, reflecting solvent insurer motives to ration due to the guaranty funds.

3.2.1. Confounding Channels and Mechanisms

To refine our interpretation of the estimates obtained by Equation 1 and address the confounding channels of natural disasters and household demand changes, we consider different sub-samples that isolate variation in guaranty fund exposures while keeping climate risk perceptions and household demand unchanged.

Climate perceptions: We address confounding effects from natural disasters as follows. First, we examine differences between neighboring zips across state-borders where climate risk is similar but guaranty fund exposures vary. Second, we examine underwriting declines around idiosyncratic insolvencies that are unrelated to natural disasters, such as those driven by accounting errors or poor management. Third, we consider the subset of treated states exposed to the insolvent insurer but not directly affected by the triggering climate event.

Demand: We address demand-related channels in two ways. First, we note that policy cancellations are at the discretion of the insurer and thus are a purer measure of supply, meaning this analysis is less vulnerable to concerns about demand-based confounders. Second, we leverage variation across states in their premium tax offset (PTO) policy, which determines whether guaranty fund exposures can be used to reduce state premium tax payments (see Section 1). The idea of this test is that here is that any effect of climate change or the insolvency itself on household insurance demand should be unrelated to the tax treatment of insurer's guaranty fund assessments. However, on net, guaranty fund exposures are smaller in states where insurers can obtain tax offsets for such payments, meaning that the tax treatment changes the insurer's incentives to adjust supply. Because PTO creates variation in insurer supply incentives while keeping fixed household demand, we argue that this specification reflects supply rationing induced by the guaranty fund. We note that this variation also helps to address climate-related confounding explanations.

Mechanisms: With these robustness checks we can separate the effect of the guaranty fund from other confounding channels, but it does not pin down exactly what about the guaranty fund motivates insurer rationing –whether it is driven by diversification concerns, minimizing the size of assessments, or delaying assessments. Because we are interested in understanding which of these motives are operating, as well as their relative importance, we consider a number of additional tests.

First, to distinguish between the motive to minimize versus delay the assessments, we look at behavior in different time periods. In the post-distress period, insurers can influence only the overall size of their assessment; however, in the post-insolvency period, insurers can only influence the timeline of payments. The coefficients on β_D and β_I can therefore indicate and quantify these relative importance of the different motives.

Second, we note that the diversification motive operates across states but also within a state. That is, insurers not only inherit exposures to particular states, but also to particular sub-regions within a state based on where the insolvent insurer operated. In contrast, the motive to minimize/delay assessments only changes insurer incentives at the state level, because those are determined based on the insurer's total state-level market share and overall premiums. Therefore to identify a diversification motive we bring to bear additional sub-state evidence to identify the diversification motives.

Lastly, we consider a placebo test by estimating our coefficients separately for the state of New York, the only pre-funded state where guaranty fund payments are fixed ex-ante and not tied to insolvency events. Solvent insurers do not inherit exposures through the guaranty fund after an insolvency, limiting their diversification motive. In addition, solvent insurers cannot influence the size or timing of their assessments by changing their operations following distress or insolvency events. We therefore expect to find negligible effects of insurer distress or insolvency in New York.

4. Guaranty Fund Exposures and Insurance Supply

4.1. Main Results

Table 2 shows the effect of insolvency on solvent insurers' underwriting and overall exit specifically for treated states to ascertain whether insurers shrink their portfolios in the post-distress and post-insolvency periods, relative to the pre-period. We find that overall underwriting declines in the treated states by almost 5%, in both the post-distress and post-insolvency periods. Furthermore, exit increases by 90 basis points in the post-distress period, and by 60 basis points in the post-insolvency period. This supports our conjecture that insurance supply responds to guaranty fund exposures in the treated states.

In Table 3, we verify that these patterns hold in a difference-in-differences setting comparing treated states to control states. We find that on the intensive margin, relative to the control states, premiums decrease by 6.5% annually in the treated states in the post-distress period, and by 10.5% annually in the post-insolvency period, indicating that solvent insurers reduce their underwriting in the state where they expect guaranty fund exposures. Similarly, we see that insurers are more likely to exit treated states altogether, with exit increasing by 80 basis points in the post-distress period, and 1.3 percentage points points in the post-insolvency period. Because we exploit within insurer-year variation, we argue that the reallocation patterns are not driven by insurer-level confounding channels such as financial constraints or changing perceptions of an specific insurer's quality.

The coefficients on β_D and β_I can help shed light on the three motives outlined in Section 3.1. In the post-distress period, insurers can influence the overall size of their assessment and have incentives to re-allocate away from exposed states due to diversification motives. Therefore the coefficient on β_D reflects the combine effect of both of these motives. β_D is large and statistically significant, implying that insurers have a strong motive to either diversify their portfolios, minimize the size of their assessments, or both. In Section 4.3, we will disentangle the diversification motive separately from the minimization motive.

In the post-insolvency period, insurers can only influence the timeline of payments; therefore β_I captures the timing motive. The fact that β_I is large and statistically significant shows that insurers adjust underwriting behavior to delay assessments further into the future.

4.1.1. Climate Risk Perceptions

A natural question is whether the observed reduction in underwriting and exit from treated states in Table 3 are due to the guaranty fund exposures, or other confounding effents that coincide with guaranty fund asessments. In particular, there are two potential confounding channels that we will seek to rule out: climate risk (Section 4.1.1) and demand (Section 4.1.2).

It is possible that many insurance insolvencies are triggered by large natural disasters that involve larger-than-expected pay outs. The experience of a natural disaster can lead to changes in insurers' expectations of future losses and thus their willingness to supply in the states exposed to the climate shock. It is then difficult to disentangle whether the observed patterns of rationing are due to the guaranty fund or the changes in insurers loss expectations. We consider two complementary approaches that hold climate risk fixed while isolating variation in guaranty fund exposures.

First, we consider a heterogeneity test where we split all the insolvency events in our sample into two categories: (1) those triggered by a climate event, and (2) idiosyncratic insolvencies that are not driven by a climate event, such as those driven by accounting errors or poor management. For example, we classify the insolvency of Sunshine State Insurance Company in Florida as an "idiosyncratic insolvency", because its insolvency in 2014 was triggered by an accounting error, and occurred during a nine-year period when Florida suffered no major hurricanes.[13] We argue that idiosyncratic insolvencies do not reveal new information about climate risk, and should not therefore not lead to changes in insurers' loss expectations. We then examine the patterns of underwriting and exit separately for

[13] "...the company's capital had been eroded after it discovered an accounting error that meant that a sum of around \$5mn of expenses had been erroneously capitalized... instead of being classified as expenses." Source: (2014, June 5). Sunshine State placed into liquidation. See "Insurance Insider".

climate-driven insolvencies and idiosyncratic insolvencies using the same stacked difference-in-differences design in Equation 1 for each subsample.

Table 4 shows the results. In Columns 2 and 4, when we restrict to idiosyncratic insolvencies, we find that underwriting reduces by 8% in the post-distress period, and continues to decline by 13% in the post-insolvency period. Similarly, exits increase by 70 basis points and by 1 percentage points in the post-distress and post-insolvency periods, respectively. We note that for climate-driven insolvencies (reported in Columns 1 and 3), the magnitudes are higher than they are for idiosyncratic insolvencies. This pattern is to be expected to the extent that climate insolvencies bundle together the treatment effect of changing loss perceptions and guaranty fund assessments which both push in the same direction.

In a second complementary approach, we consider a different source of variation that exploits the fact that guaranty protection is provided in every state where the insolvent insurer wrote premiums. We consider the set of climate-driven insolvencies, but limit our sample of treated states to the ones where the insolvent insurer operated that were not directly hit by the triggering climate disaster ("assessment-only" treated states). For example, suppose an insurer operates in Florida and Wisconsin, and Florida is hit by a natural disaster that prompts the insurer's insolvency. In this case, Wisconsin would also levy assessments on their solvent insurers to cover unpaid claims of the insolvent insurer. Any exit in Florida could reflect both guaranty fund exposures or changes in risk perceptions. However, any rationing in Wisconsin can be attributed to guaranty fund assessments, since disaster events in Florida do not convey information about risk in Wisconsin. We consider this test using this new set of treated states by employing the same stacked difference-in-differences design in Equation 1.

Table 5 shows the results. We find that premiums decline in assessment-only treated states by 8.5% in the post-distress period, and by 10% in the post-insolvency period, relative to control states where insurers face no guaranty fund assessments. We find no change in insurers' propensity to exit in the post-distress period, but a 90 basis point increase in the likelihood of exit in the post-insolvency period.

Taken together, Table 4 and Table 5 suggest that our main results cannot be entirely attributed to changing risk perceptions, and that the guaranty fund asserts an independent effect on insurance supply.

4.1.2. Household Demand

Another confounding channel is that household demand for insurance may also change with the experience of a natural disaster, or an insurer insolvency. For example, natural disasters could increase household demand for insurance if it changes beliefs or saliency of climate risk. Similarly, households may value high quality insurance more after natural disasters or insurance insolvency events. Such channels are less of concern since they would suggest that underwriting by solvent insurers should increase after an insolvency–a result which goes in the opposite direction to Table 3. On the other hand, households trust in insurance may decline upon observing an insurer insolvency, which could lead to declines in household demand. This negative demand effect is somewhat limited by the fact that most households' insurance choices are constrained by what lenders allow, meaning that most households with a mortgage cannot drop insurance policies or even reduce coverage amounts (Sastry et al. (2024)). That said, in this section we consider a test that exploits variation in guaranty fund exposures while holding demand-related channels fixed.

Specifically, we consider heterogeneity by the extent to which guaranty fund assessments can be somewhat recouped using premium tax offset (PTO) provisions. As discussed in Section 1, a number of states allow such tax offsets, while others do not, meaning that guaranty fund exposures on net will be larger in non-PTO states.[14] We therefore expect insurers' incentives to ration supply to be higher in non-PTO states than PTO states, although there may still be incentives to ration even in PTO states. We argue that changes in household demand should not systematically vary by the PTO status of the state, whereas insurer supply incentives do. Therefore this variation helps to isolate underwriting changes driven by supply rather than demand. We also note that this variation also helps to address concerns about climate-related confounders, since changes in insurers loss expectations should also not vary with the PTO status of a state.

[14]In non-PTO states, insurers may be allowed by regulators to increase insurance prices to offset guaranty fund exposures. However, such price increases remain uncertain and subject to regulatory approval, meaning insurers may be constrained in fully recouping guaranty fund payments. See Section 1 for more detail.

Table 6 shows heterogeneity in the treatment effect when insolvencies are split by whether they affect a PTO state ("PTO states") or not ("non-PTO states") using the same stacked difference-in-differences design in Equation 1. In non-PTO states (Columns 2, 4), insurance underwriting declines and exits are more than twice as large as those in PTO states (Columns 1, 3). In particular, Column 3 shows that there are no effects of insolvency on exits in PTO states, showing that our extensive margin results are driven by non-PTO states.

4.2. Bordering ZIP Cancellations Analysis

In this section, we consider an alternative identification strategy and dataset to identify the effect of guaranty fund exposures on insurance supply, which also addresses both the climate and demand-related confounding channels. We exploit more granular ZIP-level cancellation data in a border discontinuity design to test whether insurers differentially ration supply when exposed to guaranty fund assessments.

We employ data on insurer cancellation rates that is available at the zip-year level from the Federal Insurance Office (FIO) for the sample period between 2018-2022 (see Section 2 for more details). This dataset has two distinct advantages over the state-level panel. First, one advantage of this data is that cancellation rates are at the discretion of the insurer and therefore are a purer measure of insurer rationing than overall premiums. Furthermore, they are also more sensitive to insurer behavior than exiting a state altogether. A second advantage is that this data is available at the ZIP level, allowing us to conduct sharper identification of guaranty effects by zooming into bordering zip codes across states. A disadvantage of this data, however, is that we cannot identify the insurer, and the time period is restricted. We are able to analyze five treated states affected by an insolvency within this time period with sufficient pre- and post-periods.

We employ a geographic border discontinuity design where we compare insurance cancellation rates in ZIP codes that are immediately adjacent to one another but fall on opposite sides of a state border. ZIP codes on the treated side lie within the state affected by the insolvency, while adjacent ZIP codes just across the border belong to the unaffected (control) state. While guaranty fund assessments will vary across state borders, our key identifying assumption is that other factors that might also drive cancellations (e.g., changing climate risk, demand shocks, etc.) are similar across state borders. To the extent that insurers cancel policies in response to guaranty fund assessments, we should see an increase in cancellation rates in the treated state. On the other hand, cancellations due to changing climate expectations or demand shocks should be similar across the border.

For each treated state affected by an insolvency in either 2020 or 2021, we identify all the neighboring control states that were not affected by the insolvency. We then exclude any state border pairs that are confounded by other insolvencies in our sample period.

We implement this test using the following difference-in-differences design:

$$\text{(2)} \quad \text{CancellationRate}_{zt} = \phi_D PostDistress_t \times \text{Treated}_z + \phi_I PostInsolvency_t \times \text{Treated}_z + \phi_z + \phi_t + \epsilon_{zt}$$

Our dependent variable, $CancellationRate_{zt}$ is the cancellation rate, defined as the number of policies canceled in a given ZIP code z in year t divided by the total policies-in-force in the prior year. Treated_z is an indicator variable that equals 1 if ZIP code z is part of the state that experiences insolvency, and 0 otherwise. $PostDistress$ indicates the period after the insurer becomes distressed, and $PostInsolvency$ indicates the period after the insurer officially becomes insolvent. We include ZIP, year, and event fixed effects to hold fixed any local conditions or aggregate changes in overall economic conditions that affect supply.

Table 7 shows that cancellation rates increase by 1.1 percentage point more in treated states relative to control states in the post-distress period, which is statistically significant at the 5% level. We also find that cancellation rates increase by 50 basis points in the post-insolvency period, though this result is not statistically significant. The estimates are robust to including fixed effects. We note that this effects are big in economic terms, since on average cancellation rates are 5.7%, meaning our effect represents a 20% increase in cancellation rates relative to the baseline rate.

4.3. Distinguishing Between Diversification and Assessment Minimization Motives

In the previous two sections, we documented that guaranty fund exposures affect insurance supply, and that other confounding channels related to climate risk perceptions or demand shocks do not completely explain the patterns of rationing. As we argue in Section 3.1, guaranty funds can generate incentives to ration in the post-distress period because of both diversification motives as well minimizing the size of assessments. In this section, we seek to disentangle the two motives.

We start by examining the diversification motive using county-level evidence from Florida. To do so, we note that the diversification motive operates both across and within states: insurers inherit not only state-level exposures but also localized exposures to the specific sub-regions in which an insolvent insurer wrote business. In contrast, the motive to minimize or delay guaranty-fund assessments is determined solely by an insurer's total state-level market share and premiums, and thus only varies at the state level. This asymmetry implies that variation in incentives to reduce the size and timing of assessments cannot explain within-state rationing from exposed counties. We therefore bring to bear sub-state (county-level) evidence to isolate and identify the diversification motive.

Diversification. We use a natural experiment from Florida involving the idiosyncratic insolvency of Sunshine State Insurance Company in 2014. We start with Florida because it is one of two states that systematically discloses information about (sub-state) county-level underwriting information for insurance companies.[15] An important feature of the Florida data is that it includes information on insurer cancellation rates, which provides a clean measure of insurer rationing since it is at the discretion of the insurer. This data spans the period between 2009 to 2018. We focus in particular on Sunshine's insolvency because it was entirely triggered by an accounting error, which limits the concern about other confounding effects coming from natural disasters.[16]

[15] California is the other state which produces this information. However, a challenge with the California data is that it is aggregated at the insurer group level, however the insolvent insurer may be one member of a group. As a result, computing the market share of the insolvent insurer would be challenging.

[16] The official insolvency report states that the insolvency was triggered primarily due to an accounting error that overstated Sunshine's capital and surplus for a number of years. Source: Sunshine Insolvency Report. In discussing the insolvency, *Insurance Insider* writes: "...the company's capital had been eroded after it discovered an accounting error that meant that a sum of around $5mn of expenses had been erroneously

We exploit Sunshine's insolvency in a continuous treatment difference-in-differences design that mirrors the spirit of Equation 1. We examine whether solvent insurer's cancellation rates increase in counties more exposed to Sunshine following the insolvency. We estimate the following specification:

$$\text{CancellationRate}_{ict} = \delta_D \text{PostDistress}_t \times \text{SunshineExp}_c + \\ + \delta_I \text{PostInsolvency}_t \times \text{SunshineExp}_c + \delta_c + \delta_{it} + \epsilon_{ict} \tag{3}$$

The dependent variable is an insurer i's policy cancellation rate in county c in year t. The variable $SunshineExp_c$ is defined as the market share of Sunshine Insurance in county c prior to its insolvency. The post-distress period is defined as the period after which information about Sunshine's distress was first publicly available.[17] The post-insolvency period is the period after Sunshine was officially placed into liquidation. In the strictest specification, we include county and insurer-year fixed effects to control for time-invariant county-level conditions and other insurer-year trends in overall cancellations in Florida. For example, any reduction in overall underwriting in Florida to minimize or delay guaranty fund assessments will be captured by the insurer-year fixed effects.

Insurers with a diversification motive should increase policy cancellations in the counties exposed to Sunshine once starting in the post-distress period. This is because insurers expect to inherit large exposures to these counties through the guaranty fund in case Sunshine files for insolvency. We therefore expect $\delta_D > 0$. We do not expect cancellations to continue to persist as strongly once guaranty fund assessments are finalized ($\delta_D > \delta_I$). Insurer-year fixed effects will capture any changes in insurers' state-level underwriting, which is used to determine the annual cap and timing of assessments. Therefore, we do not expect systematic increases in cancellations in exposed counties after the inclusion of these fixed effects for the post-insolvency period.

capitalized... instead of being classified as expenses." Source: Insurance Insider, "Sunshine State placed into liquidation", June 2014. Furthermore, Sunshine's insolvency also took place during a nine-year period when Florida suffered no major hurricanes: "The year 2014 marks the longest period on record – nine consecutive years since Hurricane Wilma in 2005 – that no major hurricanes made landfall over the U.S., and also the ninth consecutive year that no hurricane made landfall over the coastline of Florida." Source: 2014 North Atlantic Hurricane Season Review.

[17] See Florida Office of Insurance Regulation Examination Report, December 2011.

Table 8 shows the results. We find that insurers cancel more polices in the counties where exposures to Sunshine are larger in the post-distress period, with δ_1 being positive and significant. To interpret magnitudes, these coefficients suggest that a one standard deviation increase in exposure to Sunshine leads a roughly 40 basis point increase in cancellation rates, which reflects a 3.3% increase relative to the baseline mean cancellation rate. The county-level exit patterns we document here are consistent with solvent insurers exiting counties exposed to the insolvent insurer to maintain diversified portfolios, due to concerns about inheriting concentrated exposures from the guaranty fund.

4.4. Robustness and Placebo Test

As a robustness exercise, we conduct a placebo analysis by estimating our coefficients separately for New York (NY), the only pre-funded state in which guaranty fund payments are predetermined and not linked to insolvency events (See Section 1). Because solvent insurers do not assume additional exposures through the guaranty fund after an insolvency, their incentive to diversify is limited. Moreover, they cannot affect the amount or timing of their assessments by adjusting their operations in response to distress or insolvency in NY. Accordingly, we expect insurer distress or insolvency to have little to no effect in NY, and our results should be driven entirely by non-NY insolvencies. We run the same stacked difference-in-differences specification in Equation 1, but separately for NY and the non-NY post-funded treated states.

The results are in Table 9. We see that in the sample of all insolvencies in post-funded states (Columns 1, 3), β_D and β_I are strong and statistically significant. Premiums decrease by 9.6% in the post-distress period, and by 15.3% in the post-insolvency period. Additionally, exits increase by 1.2 percentage points in the post-distress period, and by 1.9 percentage points in the post-insolvency period. As we expect, these magnitudes are larger than the main effects we report earlier that pool all treated states together regardless of funding mechanism (Table 3). In contrast, the sample that limits to NY insolvencies shows no significant effects for either premiums or exit (Columns 2, 4). The coefficients are both economically small and statistically insignificant.

5. Conclusion

This paper studies how insurance supply responds to guaranty fund exposures in the face of accelerating climate-related losses and rising insurer insolvencies. We find that guaranty funds unintentionally encourage well-capitalized solvent insurers to ration supply, operating through three distinct motives: diversification, minimizing assessment size, and delaying the timing of contributions. All three motives result because solvent insurers inherit the unpaid claims of insolvent insurers through the guaranty fund, creating these externalities and distortions. We combine administrative data on underwriting and insolvencies along with a border-discontinuity design using ZIP-level data, and county-level evidence from Florida. Across all approaches, we find evidence of systematic reductions in supply, measured as reduced premiums, increased state-wide exits, and elevated cancellation rates.

Our findings highlight a key unintended consequence of the state-level, post-funded design of insurance guaranty funds: by shifting the liabilities of failed insurers onto solvent ones, these mechanisms amplify rather than mitigate instability in property insurance markets. Well-capitalized insurers respond to guaranty fund exposures by rationing coverage and retreating from high-exposure areas—precisely when and where insurance protection is most needed. The resulting contraction in supply undermines both risk-sharing and consumer resilience in the face of climate-driven losses. These results call for a re-evaluation of guaranty fund design, suggesting that more risk-sensitive, pre-funded, or federally coordinated mechanisms may be needed to sustain insurance market stability under accelerating climate risk.

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Figures

Figure 1: Fraction of High Risk States Affected by an Insolvency

Using SHELDUS data, we identify the ten states that have the highest number of property damage per capita since 1961. For each year, we estimate the fraction of high risk states affected by an insolvency. Insolvency data comes from GRID (provided by NAIC), state underwriting data comes from NAIC's Statutory Insurance Filings, accessed trough S&P Market Intelligence.

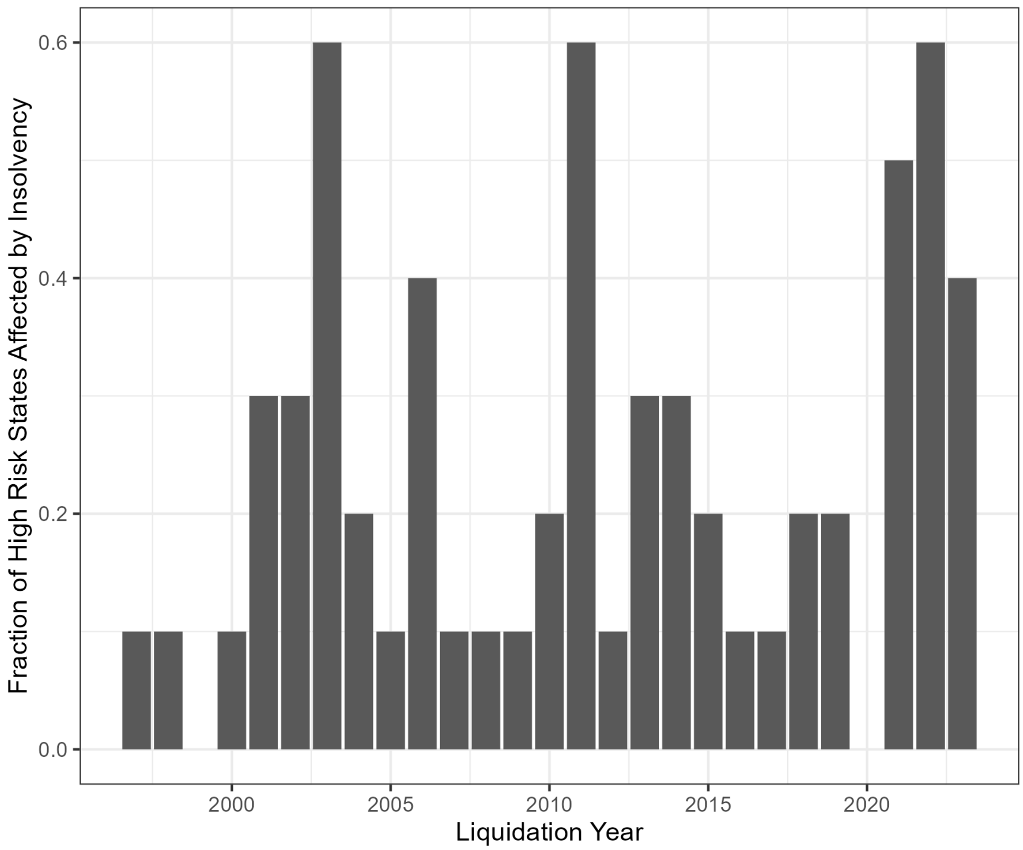


Figure 2: Structure of a Post-Funded State Guaranty Fund

The figure shows a stylistic representation of how households, insurers and guaranty funds operate. If Insurer 1 goes insolvent, the state Guaranty Fund collects assessment fees from Insurers 2 and 3 and pays for all outstanding claims for properties that were supposed to be protected by Insurer 1. These payments are subject to a maximum cap.

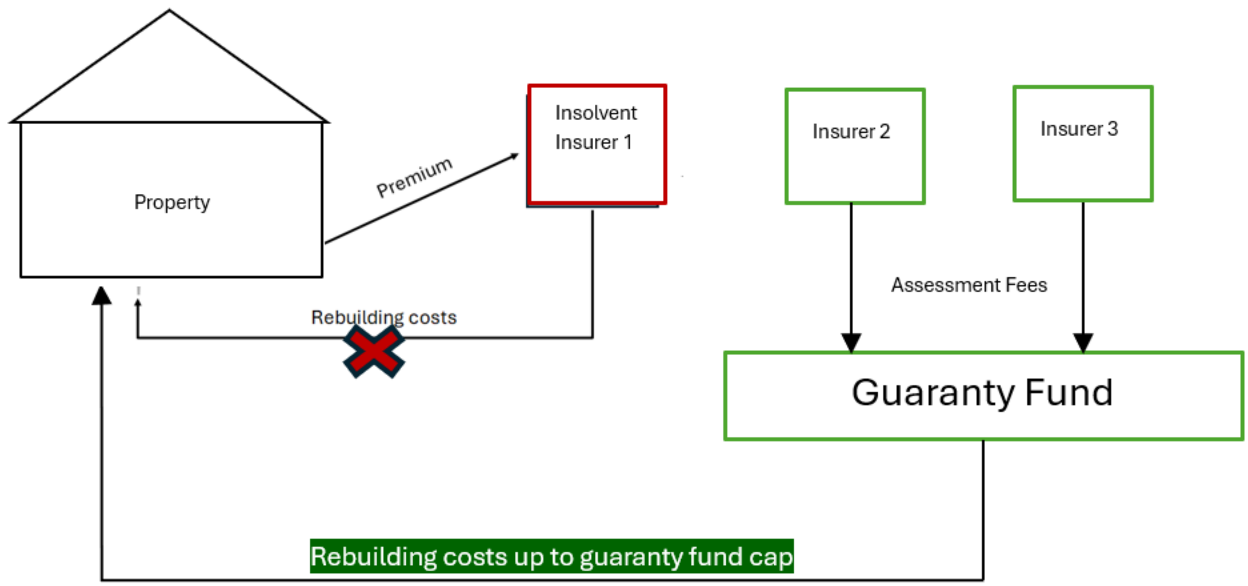
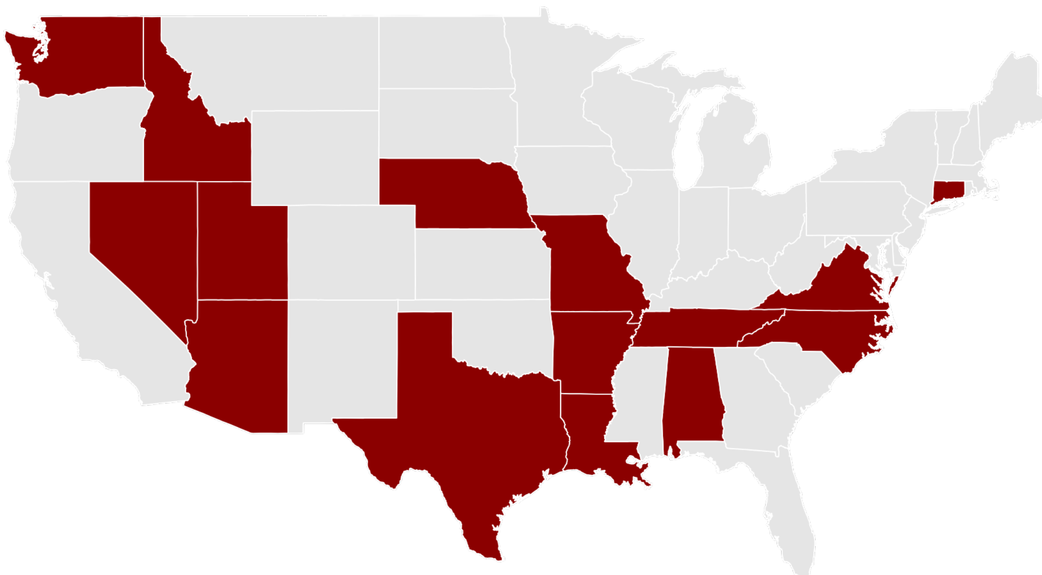


Figure 3: States that Allow Premium Tax Offset (PTO)

The figure shows which states allow insurers to recoup guaranty fund assessments using premium tax offsets (PTO), shown in red.



Tables

Table 1: Summary Statistics

The table describes the samples used in our analyses. The subscripts used are as follows: i is an unique insurer, s is a state, t is an year, e is a unique insolvency, z is a ZIP code and c is a county.

Panel A: Number of Insolvencies (NAIC GRID)								
Total no. of insolvencies 2000–2016	48							
Climate-driven insolvencies	32							
Idiosyncratic insolvencies	16							
PTO insolvencies	17							
Non-PTO insolvencies	31							
Insolvencies affecting NY	3							
Variable	N	Mean	SD	Min	Q_{25}	Median	Q_{75}	Max
Panel B: Statutory filings (1996-2019): Insurer-State-Year premiums and exits								
Log(Premium$_{iste}$)	2863748	6.419	2.655	0.693	4.644	6.653	8.323	14.504
Is Exit$_{iste}$	4845841	0.409	0.492	0.000	0.000	0.000	1.000	1.000
Panel C: FIO data (2018-2022): ZIP-year cancellations								
Cancellation Rate$_{zte}$	935	0.057	0.023	0	0.042	0.053	0.067	0.175
Panel D: QUASR data on Florida (2010-2017): Insurer-county-year cancellations								
Cancellation Rate$_{ict}$	36961	0.139	0.166	0	0.043	0.102	0.169	1.000

Table 2: Event Study: Insurer rationing and guaranty fund exposures

This table presents results from a event study for the sample of treated states affected by an insolvency. We consider two dependent variables: log of total premiums written by insurer i in state s in year t for insolvency event e (Column 1), and an indicator variable for whether the insurer exited the state, defined as whether it sold any premiums in that state and year (Column 2). $PostDistress$ refers to the period after the date of distress but before the official insolvency date. $PostInsolvency$ begins after the distressed insurer officially enters liquidation. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	Log(Premium$_{iste}$)	Is Exit$_{iste}$
	(1)	(2)
PostDistress$_{te}$	-0.047^{***}	0.009^{***}
	(0.013)	(0.003)
PostInsolvency$_{te}$	-0.053^{***}	0.006^{*}
	(0.020)	(0.004)
Insurer × State × Event FE	Yes	Yes
Insurer × Year	Yes	Yes
Observations	191,142	335,237
Adjusted R^2	0.925	0.843

Table 3: Stacked Difference-in-Differences: Insurer reallocation and guaranty fund exposures

This table presents results from the stacked difference-in-differences design in Equation 1 for two dependent variables: log of total premiums written by insurer i in state s in year t for insolvency event e (Column 1), and an indicator variable for whether the insurer exited the state, defined as whether it sold any premiums in that state and year (Column 2). The variable $PostDistress$ refers to the period after the date of distress but before the official insolvency date. The variable $PostInsolvency$ begins after the distressed insurer officially enters liquidation. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	$\text{Log}(\text{Premium}_{iste})$	Is Exit_{iste}
	(1)	(2)
$\text{Treated}_{ise} \times \text{PostDistress}_{te}$	-0.065^{***}	0.008^{***}
	(0.012)	(0.002)
$\text{Treated}_{ise} \times \text{PostInsolvency}_{te}$	-0.105^{***}	0.013^{***}
	(0.022)	(0.003)
Insurer × State × Event FE	Yes	Yes
Year × Event FE	Yes	Yes
Insurer × Year	Yes	Yes
Observations	2,863,748	4,845,841
Adjusted R^2	0.925	0.848

Table 4: Stacked Difference-in-Differences: Heterogeneity by Climate-driven and non-climate driven (idiosyncratic) insolvencies

This table presents results from the stacked difference-in-differences design in Equation 1 for two subsamples. We consider the subset of treated states where the insolvency was climate-driven (columns 1, 3) and the subset of treated states where the insolvency was idiosyncratic and not driven by a climate event (Columns 2, 4). Outcome variables are defined as in Table 3. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	Log(Premium$_{iste}$)		Is Exit$_{iste}$	
	(1)	(2)	(3)	(4)
Treated$_{ise}\times$ PostDistress$_{te}$	-0.121^{***}	-0.079^{***}	0.018^{***}	0.007^{**}
	(0.022)	(0.018)	(0.004)	(0.003)
Treated$_{ise}\times$ PostInsolvency$_{te}$	-0.187^{***}	-0.130^{***}	0.030^{***}	0.010^{**}
	(0.036)	(0.029)	(0.006)	(0.004)
Climate-driven insolvency	Yes	No	Yes	No
Insurer × State × Event FE	Yes	Yes	Yes	Yes
Year × Event FE	Yes	Yes	Yes	Yes
Insurer × Year FE	Yes	Yes	Yes	Yes
Observations	876,048	1,621,618	1,493,682	2,706,603
Adjusted R^2	0.922	0.925	0.843	0.848

Table 5: Stacked Difference-in-Differences: Effect of guaranty fund exposures in assessment-only states

This table presents results from the stacked difference-in-differences design in Equation 1 for the following subsample. We consider the set of insolvencies caused by a climate event, but then limit to the subset of assessment-only treated states which were not hit by the triggering natural disaster but where the insolvent insurer also operated. Outcome variables are defined as in Table 3. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	$\text{Log(Premium}_{iste})$	Is Exit_{iste}
	(1)	(2)
$\text{Treated}_{ise} \times \text{PostDistress}_{te}$	-0.085^{***}	-0.004
	(0.021)	(0.004)
$\text{Treated}_{ise} \times \text{PostInsolvency}_{te}$	-0.107^{***}	0.009^{*}
	(0.029)	(0.005)
Insurer × State × Event FE	Yes	Yes
Year × Event FE	Yes	Yes
Insurer × Year FE	Yes	Yes
Observations	834,491	1,417,005
Adjusted R^2	0.923	0.845

Table 6: Stacked Difference-in-Differences: Heterogeneity by premium tax offset status

This table presents results from the stacked difference-in-differences design in Equation 1 for two sub-samples of treated states: states that allow guaranty funds payments to be recouped with premium tax offsets (Columns 1, 3), and states that do not (Columns 2, 4). Outcome variables are defined as in Table 3. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	$\text{Log}(\text{Premium}_{iste})$		Is Exit_{iste}	
	(1)	(2)	(3)	(4)
$\text{Treated}_{ise} \times \text{PostDistress}_{te}$	-0.062^{***}	-0.169^{***}	-0.002	0.034^{***}
	(0.014)	(0.032)	(0.003)	(0.006)
$\text{Treated}_{ise} \times \text{PostInsolvency}_{te}$	-0.058^{***}	-0.326^{***}	-0.0002	0.050^{***}
	(0.022)	(0.058)	(0.003)	(0.009)
PTO Status	Yes	No	Yes	No
Insurer × State × Event FE	Yes	Yes	Yes	Yes
Year × Event FE	Yes	Yes	Yes	Yes
Insurer × Year	Yes	Yes	Yes	Yes
Observations	1,091,215	1,406,451	1,790,051	2,410,234
Adjusted R^2	0.922	0.926	0.844	0.847

Table 7: Stacked Difference-in-Differences: Effect of Guaranty Fund Exposures on Insurer Cancellations across Bordering ZIP codes

This table presents results from the border-design stacked difference-in-differences shown in Equation 2 which examines the effect of guaranty fund exposures on insurer cancellation rates across bordering ZIP codes. We limit the sample to neighboring ZIPs across state borders, where one side (treated) is affected by insolvency and the other (control) is not. Other variables are defined as in Table 3. Fixed effects are included as indicated. Standard errors are in parentheses clustered at the state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	Cancellation Rate_{zte}	
	(1)	(2)
$\text{TreatedZIP}_z \times \text{PostDistress}_t$	0.011^{***}	0.011^{**}
	(0.004)	(0.004)
$\text{TreatedZIP}_z \times \text{PostInsolvency}_t$	0.005	0.005
	(0.005)	(0.005)
PostDistress_t	−0.004	
	(0.003)	
PostInsolvency_t	0.002	
	(0.004)	
TreatedZIP_z	-0.007^{**}	
	(0.004)	
Constant	0.058^{***}	
	(0.003)	
ZIP Fixed Effect	No	Yes
Year Fixed Effect	No	Yes
Observations	935	935
Adjusted R^2	0.014	0.541

Table 8: Effect of Guaranty Fund Exposures on Within-State Policy Cancellations

This table presents results from the continuous treatment difference-in-differences shown in Equation 3. The dependent variable is insurer i's cancellation rate in county c in year t. The independent variable is $SunshineExp_c$, the market share of Sunshine State Insurance Company in county c and year t prior to its insolvency. Other variables are defined as in Table 3. Fixed effects are included where indicated. Standard errors are in parentheses and clustered at the county level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	Cancellation rate$_{ict}$		
	(1)	(2)	(3)
SunshineExp$_c$× PostDistress$_t$	0.328**	0.309**	0.322**
	(0.127)	(0.128)	(0.135)
SunshineExp$_c$× PostInsolvency$_t$	0.274	0.241	0.148
	(0.180)	(0.178)	(0.147)
County Fixed Effect	Yes	Yes	Yes
Year Fixed Effect	Yes	Yes	Yes
Insurer Fixed Effect	No	Yes	Yes
Insurer × Year Fixed Effect	No	No	Yes
Observations	36,961	36,961	36,961
Adjusted R^2	0.005	0.205	0.290

Table 9: Stacked Difference-in-Differences: Heterogeneity comparing Pre-Funded and Post-funded States

This table presents results from the stacked difference-in-differences design in Equation 1 for two sub-samples of treated states: in Columns 1 and 3, we limit treated states to post-funded, and in Columns 2 and 4, we limit treated states to New York, which is pre-funded. Outcome variables are defined as in Table 3. Fixed effects are included as indicated. Standard errors are in parentheses and clustered at the insurer-state level. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

	Log(Premium_{iste})		Is Exit_{iste}	
	(1)	(2)	(3)	(4)
$\text{Treated}_{ise} \times \text{PostDistress}_{te}$	-0.096^{***}	-0.004	0.012^{***}	0.001
	(0.015)	(0.016)	(0.003)	(0.003)
$\text{Treated}_{ise} \times \text{PostInsolvency}_{te}$	-0.153^{***}	-0.005	0.019^{***}	0.003
	(0.028)	(0.022)	(0.005)	(0.004)
Sample	Post-funded	Pre-funded	Post-funded	Pre-funded
Insurer × State × Event FE	Yes	Yes	Yes	Yes
Year × Event FE	Yes	Yes	Yes	Yes
Insurer × Year	Yes	Yes	Yes	Yes
Observations	2,497,666	319,518	4,200,285	572,710
Adjusted R^2	0.925	0.923	0.847	0.856

A. Additional Figures and Tables

Table A.1: Guaranty Fund Structure Across U.S. States

This table describes the key differences in guaranty fund structures across U.S. states. Data are from National Conference of Insurance Guaranty Funds and states' regulatory statutes.

State	Funding	Annual Assessment Cap	Claim Cap	Homeowner Cap	Recoupment
Alabama (AL)	Post	1–2%	$300,000	Same	PTO
Alaska (AK)	Post	2%	$500,000	Same	Premium Increase
Arizona (AZ)	Post	1%	$300,000	Same	PTO
Arkansas (AR)	Post	2%	$300,000	Same	PTO
California (CA)	Post	2%	$500,000	Same	Premium Increase
Colorado (CO)	Post	2%	$300,000	Same	Premium Increase
Connecticut (CT)	Post	2%	$300,000	Same	PTO
Delaware (DE)	Post	2%	$500,000	Same	PTO / Premium Increase
Florida (FL)	Post	2%	$300,000	$500,000 (HO)	Premium Increase
Georgia (GA)	Post	2%	$300,000	Same	Premium Increase
Hawaii (HI)	Post	2%	$300,000	Same	Premium Increase
Idaho (ID)	Post	1%	$300,000	Same	PTO
Illinois (IL)	Post	2%	$500,000	Same	Premium Increase
Indiana (IN)	Post	1%	$300,000	Same	PTO / Premium Increase
Iowa (IA)	Post	2%	$500,000	Same	Premium Increase
Kansas (KS)	Post	2%	$300,000	Same	PTO / Premium Increase
Kentucky (KY)	Post	2%	$300,000	Same	Premium Increase
Louisiana (LA)	Post	1%	$500,000	Same	PTO
Maine (ME)	Post	2%	$300,000	Same	Premium Increase
Maryland (MD)	Post	2%	$300,000	Same	Premium Increase
Massachusetts (MA)	Post	2%	$500,000	Same	Premium Increase
Michigan (MI)	Post	1%	$5,000,000	Same	Premium Increase
Minnesota (MN)	Post	2%	$300,000	Same	PTO / Premium Increase
Mississippi (MS)	Post	1%	$300,000	Same	Premium Increase
Missouri (MO)	Post	2%	$300,000	Same	PTO
Montana (MT)	Post	2%	$300,000	Same	Premium Increase
Nebraska (NE)	Post	1%	$300,000	Same	PTO
Nevada (NV)	Post	2%	$300,000	Same	PTO
New Hampshire (NH)	Post	2%	$300,000	Same	Premium Increase
New Jersey (NJ)	Post	2%	$300,000	Same	Premium Increase
New Mexico (NM)	Post	2%	$100,000	Same	Premium Increase
New York (NY)	Pre	No Fixed %	$1,000,000	Same	Premium Increase
North Carolina (NC)	Post	2%	$500,000	Same	PTO
North Dakota (ND)	Post	2%	$300,000	Same	Premium Increase
Ohio (OH)	Post	1.5%	$300,000	Same	Premium Increase
Oklahoma (OK)	Post	Formula	$150,000	Same	PTO / Premium Increase
Oregon (OR)	Post	2%	$300,000	Same	Premium Increase
Pennsylvania (PA)	Post	2%	$300,000	Same	PTO / Premium Increase
Rhode Island (RI)	Post	2%	$500,000	Same	Premium Increase
South Carolina (SC)	Post	1–2%	$300,000	Same	Premium Increase
South Dakota (SD)	Post	2%	$300,000	Same	Premium Increase
Tennessee (TN)	Post	2%	$300,000	Same	PTO
Texas (TX)	Post	2%	$300,000	Same	PTO
Utah (UT)	Post	2%	$300,000	Same	PTO
Vermont (VT)	Post	2%	$500,000	Same	Premium Increase
Virginia (VA)	Post	2%	$300,000	Same	PTO
Washington (WA)	Post	2%	$300,000	Same	PTO
West Virginia (WV)	Post	2%	$300,000	Same	Premium Increase
Wisconsin (WI)	Post	2%	$300,000	Same	Premium Increase
Wyoming (WY)	Post	1%	$300,000	Same	Premium Increase