Market Discipline and Government Guarantees: Evidence from the Insurance Industry*

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ABSTRACT

We identify the effect of public guarantees on market discipline by exploiting the rich variation in U.S. state guarantees of property-liability insurer obligations. We find that insurer financing is significantly more risk-sensitive in the absence of government guarantees. The effects are especially pronounced among insurers rated A- or lower by A.M. Best. For downgraded insurers, we find that premium growth in business not covered by state guarantees falls in relation to growth in covered business, with the estimate of the difference being as high as 17% for A- rated insurers and 9% for insurers rated below A-. The findings suggest that government guarantees significantly reduce market discipline and enhance stability in this financial sector.

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1. Introduction

Government guarantees of financial institution liabilities are a double-edged sword. On the one edge, guarantees can protect lenders to financial institutions and reduce systemic risk by preventing destabilizing runs. On the other edge, guarantees may affect market discipline by dulling the incentives of consumers to monitor the solvency of their financial institutions. This fundamental tradeoff makes the impact of guarantees on market discipline an issue of critical importance for policymakers.

Identifying the effect of guarantees, however, is problematic. Most empirical research on government guarantees comes from the banking industry, where guarantees are applied on a national basis. Identification in this literature thus typically relies on international comparisons, before-and-after comparisons within a country, or comparisons of the behavior of protected bank financing (e.g., small depositors) with unprotected bank financing (e.g., commercial paper or interbank loans). These approaches suffer from various identification problems. Cultural and regulatory differences are confounding influences in international comparisons; it is difficult to control for regulatory and other secular changes that accompany a change in government guarantee policy when studying a single country; and protected lenders differ from unprotected lenders along other dimensions (financial sophistication, for example).

In this paper, we study the effect of government guarantees in the context of the U.S. property-liability (P/L) insurance industry. With more than $1.5 trillion in assets and more than $500 billion in annual premiums,[1] the sector is worth attention in its own right. In addition, the industry's systemic importance is receiving expanding scrutiny after its role in the financial crisis of 2007-

[1] *Annual Report on the Insurance Industry*, Federal Insurance Office, U.S. Department of the Treasury, 2015.

2008, particularly through its sale of financial guaranty contracts.[2] Most important for our purposes, however, is that the U.S. property-liability industry offers an intriguing opportunity for isolating the effect of government guarantees.

U.S. property-liability insurers are licensed and regulated on a state-by-state basis. Each state has its own guaranty fund, which protects the policyholders of licensed insurers that fail. The types of insurance that receive guaranty fund protection differ across states, lines of business, and time. The generosity of the guaranty also differs across states and time, as states set different maximum claim amounts and net worth provisions. This study exploits the rich cross-sectional and time-series heterogeneity in the breadth and depth of state insurance guaranty fund coverage to identify the influence of public guarantees on market discipline.

We focus mainly on the differential response between protected and unprotected sources of financing for insurers that experience a change in risk. For example, for a firm experiencing a downgrade, we can compare the response of policyholders from protected environments with the response of policyholders from unprotected environments. Thus, our empirical strategy centers on changes in risk at the firm level, not changes in guaranty fund protection at the environmental level, and is free from the identification concerns plaguing studies of the latter. Moreover, since the contracts within the same line of insurance sold in unprotected and protected environments are plausibly similar, our approach is targeted squarely at identifying the effect of the protection itself.

Specifically, we examine whether state insurance guaranty funds dull customer sensitivity to risk by investigating the relationship between premium growth (at the firm-state-line-year level) and changes in A.M. Best's financial strength ratings, which assess an insurer's ability to meet its obligations to policyholders. Variations in state guaranty fund coverage are exogenous to an

[2] Examples of the new attention directed at the industry generally can be found in Harrington (2009); Acharya and Richardson (2014); McDonald and Paulson (2015); Koijen and Yogo (2015, 2016).

individual insurers' financial strength, providing a quasi-natural experiment that allows us to use a difference-in-difference design to identify the effect of government guarantees. Since policyholders covered by guaranty funds have less to lose from the failure of their insurer than do policyholders not covered, we hypothesize that premium growth in lines and states protected by guaranty funds will be less sensitive to rating changes.

We decompose each firm's yearly premiums by state and by line of business and classify whether each state-line-year combination is covered by a state guaranty fund or not. We then use three fixed effects regression models to exploit different sources of variation in state guaranty funds. In the first model, we use firm-line-year fixed effects and state fixed effects to exploit variation in guaranty fund coverage across states. One source of variation in this model is between licensed business (i.e., business in states where the insurer holds a license) which receives guaranty fund coverage, and unlicensed business,[3] which does not. A second source of variation is differences across states in what lines of insurance are covered by guaranty funds. In the second model, we use firm-state-year fixed effects and line fixed effects to exploit variation across the lines of insurance within a state that do and do not receive guaranty fund coverage. In the third model, we use firm-line-state-status fixed effects and year fixed effects to exploit variation across time, as over time states add and drop lines from guaranty fund coverage.

With the first two models, we find that, after a downgrade, an insurer's premium growth for business not covered by a state guaranty fund falls in relation to growth in its covered business, with the estimate of the difference being as high as 17% for insurers rated A- and 9% for insurers rated below A-. With the third model, we find that insurers decrease their premiums written in lines of insurance that lose guaranty fund coverage relative to business that maintains coverage,

[3] Unlicensed insurers can still write business in a state via the surplus lines market.

with the estimate of the differences being 7% for insurers rated A and above, 6% for insurers rated A-, and 7% for insurers rated below A-. In all three models, we find that the effects are concentrated among commercial insurers.

This paper contributes to a large literature on the effects of public guarantees in the banking industry. A number of studies identify market discipline by focusing on the differences between insured and uninsured sources of financing. Billett, Garfinkel, and O'Neal (1998) study downgraded banks, finding a shift toward insured sources of financing (deposits). Park and Peristiani (1998) and Martinez Peria and Schmuckler (2001) study the behavior of insured and uninsured depositors, finding evidence of market discipline by both groups, with the latter study finding little difference between the two. Other papers study how insured and uninsured financing respond to changes in the deposit insurance scheme. Using international data, Gropp and Vesala (2004) document a shift toward insured financing in connection with the enactment of deposit insurance. Karas et al. (2013) find a reduction in market discipline by (newly) insured households, relative to uninsured businesses, following a deposit insurance law change in Russia.

Other studies base identification on changes to public guarantee schemes within a country (e.g., see Imai, 2006; Ioannidou and de Dreu, 2006; and Hadad et al., 2011). Schemes within a country often apply uniformly, but there are exceptions. Thies and Gerlowski (1988) and Wheelock (1992) use data from the U.S. in the early 20th century, when insurance schemes varied by state. Gropp et al. (2014) exploit the differential treatment of savings banks and commercial banks in Germany.

Other studies turn to international comparisons, with mixed results. Demirguc-Kunt and Huizinga (2004) find that explicit deposit insurance schemes reduce market discipline. Gropp and Vesala (2004) and Nier and Baumann (2006) find a seemingly contrary result---that bank riskiness decreases following the enactment of explicit deposit insurance---which they attribute to the

enactment providing a credible *limitation* of the public commitment to save the bank. Demirguc-Kunt and Detragiache (2002), Laeven (2002), Hovakimian et al. (2003), and Forssbaeck (2011) delve deeper, arguing that the effect of deposit insurance depends on political and institutional features of the country as well as of the bank itself.

Our study adds to this literature by exploiting the unique institutional setting of the U.S. property-liability industry to offer a sharp identification strategy for the effect of public guarantees in a fresh setting. Rich variation in guaranty fund coverage across states and time provides us with a unique opportunity to measure the effect of public guarantees without the identification problems present in most banking studies.

Our study also adds to a growing literature on how market discipline works in insurance sectors (e.g. Eling and Kiesenbauer, 2012; Sommer, 1996; Epermanis and Harrington, 2006; Eling and Schmit, 2012). Epermanis and Harrington (2006) examine the impact of discrete risk changes (i.e., ratings downgrades) on the premium growth rate of insurers. They find premium declines for downgrades are larger for commercial insurance than personal insurance. Our findings also provide additional evidence on the adverse incentives created by government guarantees in the insurance industry (e.g. Cummins, 1988; Lee, Mayers, and Smith, 1997; Gropp, Hakenes and Schnabel, 2011; Dam and Koetter, 2012; Grace, et al., 2014).

The remainder of the paper is organized as follows. Section 2 discusses government guarantees in the U.S. P/L insurance industry. Section 3 describes the data and sample construction. Section 4 presents our identification strategy and the empirical results, including robustness checks. Section 5 concludes.

2. Institutional Setting

In this section, we discuss the institutional details relevant for understanding the U.S. P/L insurance industry. We focus on the aspects of the industry that make it ideally suited to identifying the effect of public guarantees on market discipline.

State P/L insurance guaranty funds, enacted between 1969 and 1981, cover policyholder losses associated with insurer insolvencies. The funds are administered by nonprofit associations that consist of all the licensed insurers in the state that write insurance in lines covered by the guaranty funds. All states, with the exception of New York,[4] finance these funds by levying post-insolvency assessments on solvent insurers. Assessments, based on the premiums written in the state during the past year, are subject to a statutory ceiling (typically 2%). The assessment is independent of an insurer's risk. Assessed insurers can recoup these fees through rate increases and/or tax offsets at a rate of up to 20% per year. Thus, future policyholders and current taxpayers fund guaranty funds.

The lines of insurance that receive guaranty fund protection differ across states and over time. The National Association of Insurance Commissioners (NAIC), the association of state regulators that coordinates regulatory oversight among the states, classifies 30 lines of insurance.[5] Table 1A shows the lines of insurance that are not covered by guaranty funds in each state. The average state excludes about seven lines from guaranty fund coverage during our sample period. There is considerable variation across the states in the lines that do not receive guaranty fund protection, but the lines most commonly excluded are accident and health, credit, fidelity, mortgage guaranty, financial guaranty, ocean marine, surety, title, and warranty. At the extremes, the guaranty fund in

[4] New York uses a pre-funding model instead of an ex-post funding model.
[5] We exclude reinsurance or international business from our analysis, so we examine 28 lines of insurance.

Michigan covers all lines of insurance over our sample period, while 14 states exclude all nine of the commonly excluded lines listed above from guaranty fund protection.

Another layer of cross-sectional variation is unlicensed versus licensed insurance. For all states but New Jersey,[6] guaranty funds do not cover insurance business not licensed in the state (surplus lines insurance).[7] Many insurers operate in some states on a licensed basis and in other states on an unlicensed basis (in the same line) and, because state guaranty funds treat licensed and unlicensed business differently, provide insurance to both protected and unprotected customers in the same line of business and year.

Table 1A also shows that there is time-series variation in the lines of insurance receiving from guaranty fund coverage. Twenty states made modifications to the lines receiving protection from guaranty funds during our sample years. In sum, the cross-sectional and time-series variation in guaranty fund protection provides clean identification of the impact of public guarantees on market discipline.

Guaranty fund protection for covered lines is not complete. Table 1B shows the maximum amount that guaranty funds pay per claim by state. The maximum claim amount for states during our sample period ranges from $100,000-$5,000,000. A majority of states have a maximum amount in the $300,000-$500,000 range. Guaranty fund coverage for workers compensation insurance is unlimited in 49 states. Table 1B also shows that many states apply policyholder net worth provisions, in which claims are not paid for policyholders that have a net worth above

[6] Unlicensed insurers doing business in New Jersey are the exception. New Jersey provided guaranty fund coverage to unlicensed insurers until 2002. Starting in 2003, only unlicensed insurers that write medical malpractice and certain homeowners insurance in New Jersey receive guaranty fund coverage.

[7] Unlicensed insurers provide coverage on risks that were not accepted by the licensed insurers in the state or require specialized coverage, pricing or underwriting. An insurer can be licensed in one state, yet provide insurance on an unlicensed (surplus lines) basis in another state. Surplus lines insurers have flexibility both in contract language and pricing that allow them to underwrite risks---including ones that are unusual and/or substandard—that do not conform to typical insurer appetites.

specified levels. The typical net worth provision is $25,000,000, and ranges from $5,000,000 to $50,000,000.

3. Data and Sample

3.1 Data

We use data from the National Association of Insurance Commissioners (NAIC) annual statement database for the period 1989-2012. The database contains underwriting and financial information for all U.S P/L insurers. Our analysis is based on affiliated and unaffiliated single insurers. The Exhibit of Premiums Written (Schedule T) in the annual statement documents the states in which the insurer is licensed. The Exhibit of Premiums and Losses (the "State Page") documents the amount of business an insurer writes in each state and line of business. We also collect other firm level information including total assets, leverage, reinsurance ceded, business diversification, and firm demographics, such as organizational form, distribution channel, and whether the insurer is affiliated with a group of insurers.

We match the insurer data with guaranty fund data in the P/L insurance industry. The guaranty fund data has been hand collected from the following sources: the National Conference of Insurance Guaranty Funds, state insurance divisions, and the session laws and compiled statutes of the various states.

We use A.M. Best financial strength rating changes to proxy for changes in insurer default risk. The insurance market is evaluated by several rating agencies such as A.M. Best, Fitch, Moody's and Standard and Poor's (S&P). A.M Best has, by far, the most comprehensive coverage over the sample period. AM Best's financial strength ratings are assessments of insurers' claims paying

ability.[8] From A.M. Best's *Insurance Reports, Property-Casualty Edition and Best's Key Rating Guide*, we obtain insurer financial strength ratings from 1989 to 2011. The financial strength ratings are on a scale from A++ (the highest) to F (the lowest). We exclude the small number of insurers with financial strength ratings below C- (less than 0.1% of total observations), as those are firms under some form of regulatory control (those rated E or F) or close to those levels (those rated D).[9] Observations on firms for which A.M. Best did not assign a rating – for reasons such as insufficient size, company request, or failure to submit an NAIC annual statement – are excluded from our analysis, as are observations rated on the parallel Financial Performance Rating (FPR) scale that was used during the 1990's. A.M Best updates ratings throughout the year with most changes occurring before July. Following other studies (e.g., Epermanis and Harrington, 2006), we treat any rating change from August of last year through July of this year as a rating change in this year, and any rating change after August of this year as a rating change in the next year. Table 2 shows A.M. Best ratings and how we categorize the ratings into high (above A-), A-, and low (below A-) ratings.

Table 3 shows the number and distribution of insurers by rating category and by upgrades and downgrades. The table also categorizes firm-line-state-year observations into "covered" and "uncovered" groups. Panel A provides the distribution of ratings for the sample uncovered by guaranty funds, while Panel B shows it for the covered sample. The panels show that the percent of upgrades, downgrades, and no rating changes is comparable between the uncovered and covered samples. Figure 1 Panels A-C show the patterns of rating changes by year for the covered and

[8] A.M. Best also issues credit ratings on the financial instruments issued by insurance companies. We focus on financial strength ratings because the intent of these ratings is to help policyholders make decisions on which insurers to buy coverage from.

[9] All of the results are robust to the inclusion of these very low-rated firms (rated as D, E and F).

uncovered samples. The trends of the rating changes for the covered and uncovered samples are parallel.

We use three state level control variables. First, we use employment in the insurance sector (*Insurance Employment*) divided by total state population scaled by 10,000 as a proxy for the power of insurance labor in a state. Second, we use insurance gross state product per capita (*Insurance GSP*) scaled by 1,000 as a proxy for the economic magnitude of the insurance sector in a state. Income per capita (*state income*) scaled by 10,000 is used to proxy the relative household wealth for each state each year. All the above state variables are obtained from the Bureau of Economic Analysis. Last, the number of insolvent insurers (*insolvent insurers*) in a state by year is used to proxy for policyholder knowledge about insurer insolvency. The variable is calculated as the count of the number of insurers that went insolvent in a year that are domiciled in a state. The list of insolvent firms is collected from the NAIC's Global Receivership Information Database (GRID). We classify an insurer as insolvent if it is subject to proceedings for conservation of assets, rehabilitation, receivership, or liquidation in each year.

We use two line of business control variables. Loss ratio is calculated as aggregate direct losses incurred divided by direct premiums earned, for each line and each year. Loss volatility is calculated as the cross-sectional standard deviation of losses incurred for each line and year. Loss volatility is scaled by the cross-sectional standard deviation of premiums earned for each line and year.

3.2 Sample

The original sample has 4,615,898 firm-line-state-year level observations. To be included in the final sample, we require observations to have positive direct and net direct premiums written and write business in a line in the three years around a rating change (i.e. year t-1, t, t+1). This

requirement reduces the sample to 3,049,116 firm-line-state-year observations, of which 229,410 observations are downgraded, 232,039 observations are upgraded, and 2,587,667 observations have no change. All variables are winsorized at the 1% and 99% levels to mitigate the effect of outliers.

Table 4 presents the summary statistics for the variables used in the analysis. Panel A shows the summary statistics of premium growth at the firm-line-state-year level for the downgrade sample. We measure premium growth as the first difference of the log of direct premium written in one year and the log of direct premium written in the previous year. Premium growth is censored at -1 and 1.[10] Average premium growth is -0.3% and average premium written is 96,278. The average firm-line-state-year observation has a loss ratio 0.636 and loss volatility of 0.776. On average, insurance GSP is $915 per capita, insurance employment is 66,310 and the number of insolvent insurers is 0.540. Panel B and C show the summary statistics at the firm-line-state-year level for the upgrade and no rating change samples, respectively. Average premium growth is 3.6% for the upgrade sample and 5.2% for the no rating change sample.

4. Guaranty Funds and Market Discipline

In this section we exploit the cross-sectional and time-series variation in the guaranty fund protection of P/L insurance business to identify the effect of public guarantees on market discipline. We present our identification strategy in Section 4.1, the results in Section 4.2, and robustness tests in Section 4.3.

[10] All of our results hold if we do not censor premium growth at -1 and 1, and the effects of guaranty funds are larger.

Epermanis and Harrington (2006) show that downgraded insurers experience sharp declines in premium growth, while upgraded insurers experience increases, a pattern consistent with market discipline. In unreported analysis, we verify these responses in our data.

Guaranty funds should, in theory, mitigate both of these responses by making policyholders less sensitive to risk: a downgraded firm would experience less of a decline in business from consumers in protected environments, while an upgraded firm would experience less of an increase from consumers in protected environments. This logic mirrors the argument by Billet, Garfinkel, and O'Neal (1998), who argue that downgraded banks can shift their financing toward protected sources in theory (and verified the pattern empirically).

4.1 Identification Strategy

Many insurers operate in multiple states and, because of differences in guaranty fund protection across states, provide insurance to both protected and unprotected customers in the same line of business and year. Many insurers also operate multiple lines and, because of line of business differences in state guaranty fund protection, provide insurance to both protected and unprotected customers in the same state and year. In addition, insurers operate in multiple years and, because of differences over time in state's guaranty fund protection for a line of business, provide insurance to both protected and unprotected customers in the same state and line of business. Our identification strategy is to use data at the firm-line-state-year level to exploit the features of guaranty funds that vary across states, lines, and time.

The first set of tests examine firm-line-state-year observations that experience a rating change. The objective is to examine whether state insurance guaranty funds dull customer sensitivity to risk by investigating the relationship between firm premium growth and changes in A.M. Best's financial strength ratings, which assess an insurer's ability to meet its obligations to policyholders.

Variations in state guaranty fund coverage are exogenous to an individual insurers' financial strength, providing a quasi-natural experiment that allows us to identify the effect of government guarantees.

The first regression model exploits variation in guaranty fund protection across states. The regression model includes a firm-line-year fixed effect and a state fixed effect. The firm-line-year fixed effect sweeps out the variation between firm-lines, making the estimates based on only the variation within each firm-line and across states. The state fixed effect controls for constant state unobserved heterogeneity over time. Within firm-line variation occurs when a given firm-line has premiums in two or more states whose guaranty fund protection differs at least once during the sample period. The primary source of identification is driven by surplus lines insurers, i.e., insurance firms that are not licensed in some states and therefore not covered by guaranty funds. A secondary source of identification is the lines of insurance that receive guaranty fund coverage in some states but not others (see Table 1A).

To investigate state variations in guaranty fund protection we estimate the following:

$$\Delta P_{ijst} = \alpha_{ijt} + \gamma_s + \beta_1 P_{ijst-1} + \beta_u^{'} \times Uncover_{ijst} \times PRC_{it} + \beta_s^{'} \times State_{st} + \varepsilon_{ijst} \quad (1)$$

where ΔP_{ijst} is premium growth for firm *i*, insurance line *j*, state *s*, and year *t*; P_{ijst-1} is the natural logarithm of lagged premiums, PRC_{it} is the pre-change rating category (i.e. A- or Low), and $Uncover_{ijst}$ is an indicator variable that equals 1 if for firm *i* insurance line *j* is not covered by the guaranty fund in state *s* in year *t*, and 0 otherwise; $State_{st}$ is a vector of state time-variant variables including insurance gross state production per capita, employment in the insurance sector, income per capita and the number of insurers that became insolvent; α_{ijt} is the firm-line-year fixed effect; and γ_s is the state fixed effect. The standard errors are clustered at the firm-line-year level.

The second regression model exploits variation in guaranty fund protection across lines of business within each firm and state. The regression model includes a firm-state-year fixed effect and a line fixed effect. The firm-state-year fixed effect sweeps out the between firm-state variation, and the effect of guaranty funds is identified on the basis of protection differences within a firm operating multiple lines of business in a state.

To investigate line of business variations in guaranty fund coverage we estimate the following:

$$\Delta P_{ijst} = \alpha_{ist} + \gamma_j + \beta_1 P_{ijst-1} + \beta_u^{'} \times Uncover_{ijst} \times PRC_{it} + \beta_j^{'} \times Line_{jt} + \varepsilon_{ijst} \quad (2)$$

where $Line_{jt}$ is a vector of line of business variables including loss ratio and loss volatility; α_{ist} is the firm-state-year fixed effect; and γ_j is the line fixed effect. All other variables are defined as in Equation (1). The standard errors are clustered at the firm-state-year level.

For Equations (1) and (2), β'_u captures the differential premium growth response to a rating change between observations that do not receive guaranty fund coverage and those that do. A significant coefficient on β'_u suggests that premium growth for uncovered lines is more sensitive to discrete changes in insurer risk than covered lines.

A second set of tests exploits changes over time to the lines of admitted business receiving guaranty fund coverage in a state. There are two types of changes over time: (1) states making changes to the lines of business receiving guaranty fund coverage; and (2) insurers making changes to their licensing status in a state. Since we are interested in the effect of exogenous changes in guaranty fund coverage, we sweep out the effect of firm changes in licensing status (i.e., surplus lines status) in a state over time. Accordingly, the regression model includes a firm-line-state-status fixed effect and a year fixed effect. Since we do not want changes in insurer risk to influence this analysis, we focus on firms that do not experience a rating change.

To investigate time variations in guaranty fund coverage we estimate the following:

$$\Delta P_{ijst} = \alpha_{ijsd} + \gamma_t + \beta_1 P_{ijst-1} + \beta_u^{'} \times Uncover_{ijst} \times PRC_{it} + \beta_j^{'} \times Line_{jt} + \beta_s^{'} \times State_{st} + \varepsilon_{ijst} \quad (3)$$

where α_{ijsd} is the firm-line-state-status fixed effect and γ_t is the year fixed effect. All other variables are defined as in Equations (1) and (2). The standard errors are clustered at the firm-line-state-status.

4.2 Results

Table 5A presents the state variation in guaranty fund protection results, Equation (1), for firm-line-state-year observations that experience a ratings downgrade. Column (1) shows the results for all lines of insurance. The coefficients on the interaction terms of the ratings level and the indicator for lack of guaranty fund protection are negative and statistically significant for High, A-, and low rated insurers. A downgrade yields a 2.0% drop in premium growth for High rated firms, a 17.3% drop for A- rated firms, and an 8.8% drop for low rated firms in lines of insurance not protected by guaranty funds. The results suggest that the presence of guaranty fund protection reduces market discipline, i.e., guaranty funds dull the risk sensitivity of demand.

To see whether this state-variation effect is driven by non-traditional lines of insurance, we re-do the analysis using only traditional lines of insurance or only non-traditional lines. We classify non-traditional lines of insurance as those lines that are commonly excluded by guaranty funds: accident and health, credit, surety, fidelity, financial guaranty, mortgage guaranty, ocean marine, warranty, and title insurance. Column (2) shows the results using the traditional lines of insurance. Column (3) shows the results for non-traditional lines. For traditional lines, the coefficients on the interaction terms of ratings level and the indicator for lack of guaranty fund protection are negative and statistically significant for downgrades of A- and low rated firms. A downgrade yields a 24.0% drop in premium growth for A- rated firms and a 12.8% drop for low rated firms. For non-traditional lines, the coefficients on the interaction terms of ratings level and the indicator for lack

of guaranty fund protection are negative and statistically significant for downgrades. A downgrade yields a 4.6% drop in premium growth for high rated firms, and a 10.3% drop for A- rated firms. The results indicate that the findings are not driven by non-traditional lines of insurance. In fact, the magnitudes of the declines are greater in traditional lines than in non-traditional lines for A- and Low rated firms. Customer sensitivity to risk is greater for lower rated insurers in traditional lines, but higher for higher rated insurers in non-traditional lines, suggesting financial quality is perhaps more important in non-traditional lines.

The features of state guaranty funds might affect market discipline. Guaranty funds have a maximum claim payment. If there is a significant proportion of private loss in excess of the caps in the case of an insurer's insolvency, policyholders might have additional incentive to monitor insurers. Guaranty fund protection is likely to be complete for a majority of personal lines policyholders, but not for commercial lines policyholders. Columns (4) and (5) investigate whether there is a difference between personal and commercial lines.[11] The results indicate that guaranty fund effects are mainly confined to commercial lines. A downgrade results in an 18.0% drop in premium growth for A- rated firms, and a 10.4% drop for below A- rated firms. The results are in line with the findings in Epermanis and Harrington (2006) that market discipline is stronger in commercial lines than personal lines.

Table 5B presents the state variation in guaranty fund protection results, Equation (1), for firm-line-state-year observations that experience a ratings upgrade. The results indicate that guaranty fund protection reduces the sensitivity of premium growth to upgrades in insurer's financial strength ratings. In the Column (1), which includes all lines of insurance, the coefficients for all

[11] Personal lines include farm owners multiple peril, homeowners multiple peril, private passenger auto liability, and private auto physical damage; commercial lines include everything else.

three interaction variables are significantly positive, suggesting that guaranty funds reduce market discipline, but relative to downgrades the effect for upgrades is much weaker.

Table 6A presents the results for the line of business variation model, Equation (2), for firm-line-state-year observations that experience a ratings downgrade. The results indicate that a downgrade yields a 7.2% drop in premium growth for high rated firms, a 5.9% decline for A- rated firms, and 6.8% for below A- rated firms in lines of insurance not protected by guaranty funds. The results in Table 6B, for firm-line-state-year observations that experience a ratings upgrade, confirm that guaranty funds significantly decrease market discipline, but the effect is asymmetric, i.e., the response is greater for downgrades than it is for upgrades. In both tables, the effect is manifest in nontraditional and commercial lines.

Table 7 presents the results for the time variation model, Equation (3). A temporal change from guaranty fund protected to unprotected yields a 2.7% drop in premium growth for high rated firms and an 11.3% drop for firms rated below A-, even though insurers do not experience a change in their financial strength rating. We also conduct the analysis separately for commercial lines. The effect is again evident in commercial lines.

4.3 Robustness Checks

An alternative explanation of our results is that covered and uncovered business can differ in their business characteristics and in particular their profitability and riskiness. Firms may transition their business to lines that are in general more profitable or less risky after a downgrade. Thus, our results that premium growth decreases (increases) following a downgrade (upgrade) may be explained by changes in the composition of the insurer's underwriting portfolio, driven by company risk management concerns, instead of guaranty fund protection.

We investigate the alternative explanation in two ways. First, we examine whether there are differences in the profitability of uncovered and covered business. We test whether the mean value of the ratio of losses to premiums (the loss ratio) differs by guaranty fund status. A higher loss ratio implies less profitable business. We first split an insurers' business into covered and uncovered business at the firm-line-state-year level. We then aggregate direct losses incurred and direct premium earned for covered and uncovered business, at the line and year level. We then divide aggregate losses by aggregate premiums. Table 8A reports differences in the means by guaranty fund covered status. In general, the results show that the loss ratio of uncovered business is largely the same as the loss ratio of covered business. We do not find significant differences in the mean values of the loss ratio between covered business and uncovered business, except for workers compensation, special liability and warranty. The mean loss ratio for uncovered business is higher in workers compensation and lower in special liability and warranty. As a result, we exclude workers compensation from our sample and repeat all our previous analyses. All of our results are robust. Overall, we find that uncovered business is not more or less profitable than covered business.

Second, we examine whether premium growth differs by the risk characteristics of business surrounding rating changes. If our results are driven by downgraded insurers' trimming risky business, then we should observe that behavior across all lines of business (i.e., firms would also cut back on riskier covered business). To examine riskiness, we calculate the variance of the loss ratio by line of business (shown in Table 8B). A more volatile loss ratio suggests a higher risk line of business (Lamm-Tennant and Starks, 1993). We sort the lines of business into high and low risk groups – if the variance of the loss ratio is in the top 7 among the 14 lines, it is classified as high

risk and if it is in the bottom then it is classified as low risk.[12] The 7 high risk lines are homeowners/farmowners, medical malpractice, special liability, special property, fidelity/surety, product liability and financial guaranty/mortgage guaranty.

To investigate whether our results are driven by differences in risk, using the firm-line-state-year observations that experience a rating change we estimate the following regression:

$$\Delta P_{ijst} = \alpha_{it} + \gamma_j + \delta_s + \beta'_r \times Risky_Business \times PRC + \beta'_j \times Line_{jt} + \beta'_s \times State_{st} + \varepsilon_{ijst} \quad (4)$$

where *Risky_Business* equals one indicate if the line of business is high risk, and 0 otherwise; α_{it} is the firm-year fixed effect; γ_j is the line fixed effect; and δ_s is the state fixed effect. The firm-year fixed effect sweeps out the variation between firms, making the estimates based on only the variation within each firm across line of business and states. All other variables are defined as in Equations (1) and (2). The standard errors are clustered at the firm level.

Table 9 presents the results from estimating Equation (4). Column (1) shows the results for the observations that experience a downgrade and column (2) an upgrade. None of the coefficients on the interactions of the pre-change rating categories and *Risky Business* are statistically different than zero, suggesting that the greater premium declines in lines of insurance not covered by guaranty funds relative to lines receiving coverage are not driven by insurers changing the risk composition of their underwriting portfolios.

[12] We also examine whether the variances of the loss ratio differ significantly by guaranty fund status. To avoid the issue that the volatility of the loss ratio is caused primarily by significantly less premium volume in uncovered lines than their covered counterparts, we conduct the analysis for insurers having both uncovered business and covered business. Table 8B reports the means and variances of the loss ratio by guaranty fund covered status. In general, the results show that the business characteristics of uncovered business and covered business are largely the same. We do not find significant differences in the variances of the loss ratio between covered business and uncovered business, except for homeowners/farmowners, product liability and special liability. We find the variances of the loss ratio are higher for the uncovered business in homeonwers/farmowners, but the measure is lower for uncovered business in special liability and product liability. Since uncovered business in homeonwers/farmowners is observed to be riskier than covered business, we exclude homeowners/farmowners insurance and repeat all our previous analyses. All of our results are robust.

5. Conclusion

This paper explores how government safety-net schemes affect market discipline in the financial sector. We study the state regulated P/L insurance industry because the diversity of guaranty fund protection offered by the states offers a compelling environment in which to identify the effects of public guarantees. The evidence suggests that public guarantees dull customer sensitivity to financial institution risk, and overall the effects are quite large. The effects are especially large for A- and low-rated insurer downgrades. The effects are most pronounced within commercial insurance lines.

In summary, our study finds that government guarantees significantly affect market discipline and risk sensitivity among consumers. As noted in the introduction, government guarantees are a double-edged sword---so policy implication are similarly nuanced.

On the one hand, policymakers are increasingly aware of the role of market discipline in the regulation of financial firms, and modern regulatory policy tries to encourage market discipline (e.g. Solvency Modernization Initiative, Basel II and Solvency II). In fact, both Basel and Solvency II include market discipline as a fundamental pillar and attempt to enhance it through public disclosure of risk-related information by banks and insurance companies. The benefit of stronger market discipline is believed to reduce the need for government intervention and burdens shared by consumers and taxpayers.[13]

On the other hand, the flip side of reduced market discipline is a reduction of risk sensitivity that may contribute to greater financial system stability. Of particular interest are the forms of

[13] Leverty and Grace (2012) find that the average cost of insolvency for P/L insurers is roughly $1.02 for every dollar of pre-insolvency assets. In comparison, for U.S. banks the average cost of failure is $0.33 per dollar of assets (Bennett and Unal, 2015). The burden of insurance guaranty fund assessments is ultimately shared with consumers (through higher insurance rates) and taxpayers (through state premium tax offsets and deductions for federal income taxes).

credit protection sold by monoline property-liability firms to banks, such as Mortgage Guaranty and Financial Guaranty contracts: these lines are, with few exceptions, excluded from guaranty fund coverage by the states. Our study provides evidence that the financing sources of property-liability insurers are indeed risk-sensitive, especially so at firms such as the monolines that are not covered by government guarantees. Policymakers will thus have to trade off the benefits of market discipline with those of financial stability when reforming the guaranty fund system.

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Figure 1 Panel A: Percentages of Upgrades across Years

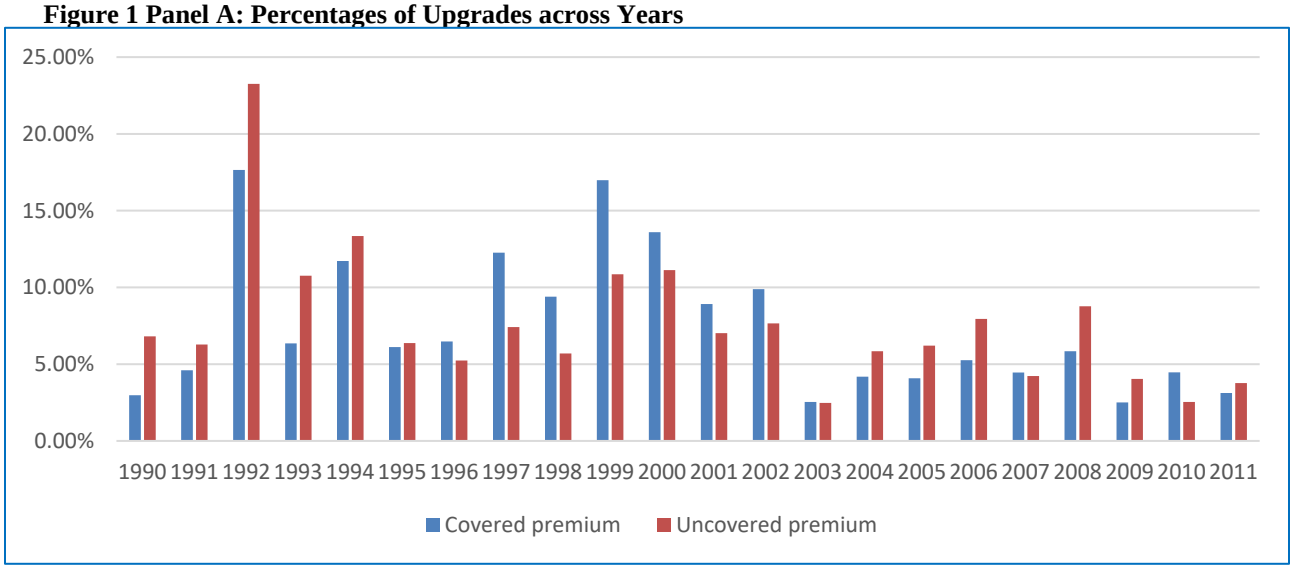


Figure 1 Panel B: Percentages of Downgrades across Years

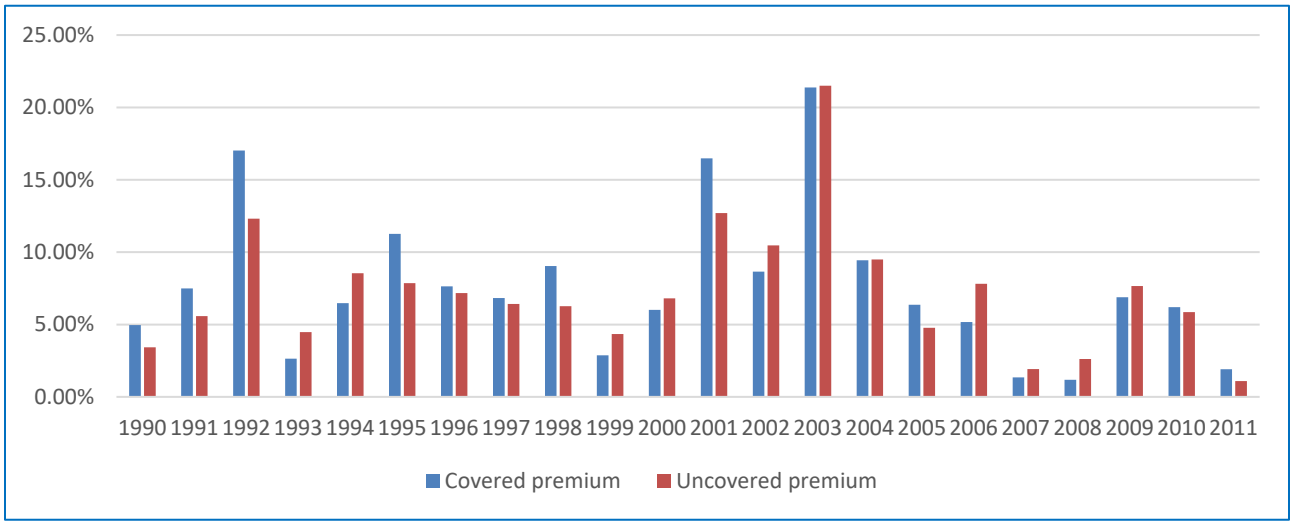


Figure 1 Panel C: Percentages of No Rating Change across Years

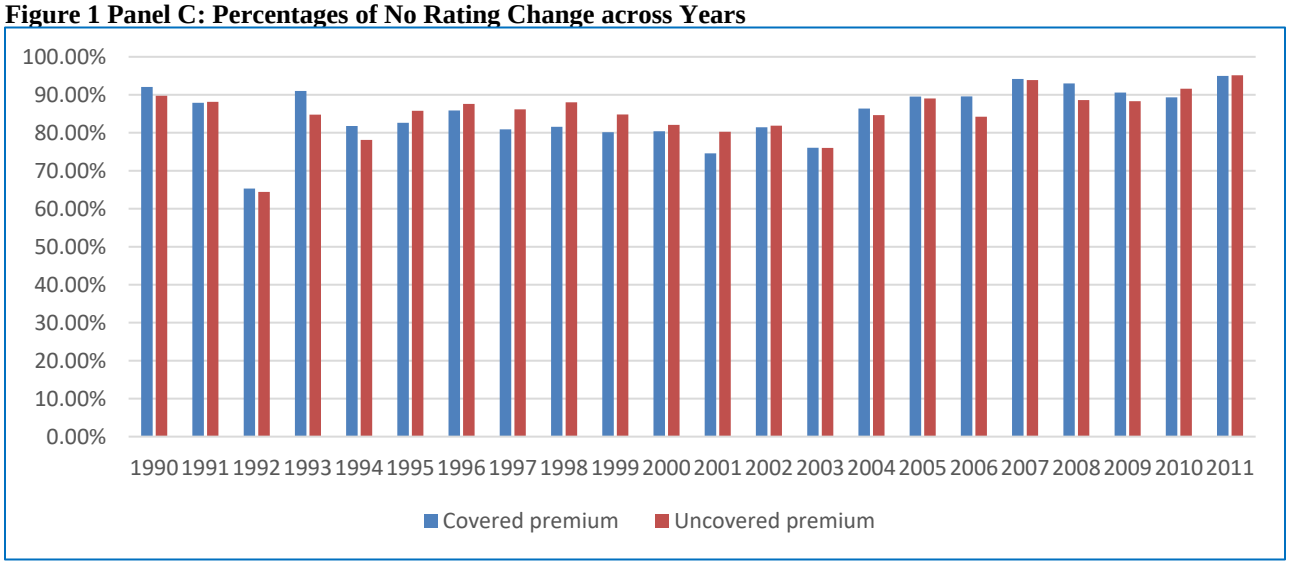


Table 1A
Summary of Lines of Insurance Not Covered by Guaranty Funds, By State[14]

State	Unlicensed Lines	A&H	Credit	Fidelity	Financial Guaranty	Ocean Marine	Mortgage Guaranty	Surety	Title	Warranty	Guaranty funds policy changes
AL	X	X	X			X	X	X	X		------
AK	X		X				X	X	X		stopped covering fidelity, financial guaranty in 2007, and warranty in 2008
AZ	X		X			X	X	X	X		stopped covering warranty in 2008
AR	X	X	X	X	X	X	X		X	X	
CA	X	X	X	X	X	X	X	X	X		------
CO	X	X	X		X	X	X	X			------
CT	X	X	X		X	X	X	X	X		stopped covering fidelity in 2007 and warranty in 2008
DE	X	X	X	X	X	X	X	X	X	X	------
FL	X	X	X	X	X	X	X	X	X	X	------
GA	X	X	X	X	X	X	X	X	X	X	------
HI	X	X	X	X	X	X	X	X	X	X	------
ID	X	X	X		X	X	X	X	X	X	stopped covering fidelity in 2007
IL	X	X		X	X	X	X	X		X	------
IN	X	X	X	X	X	X	X	X	X	X	------
IA	X	X	X	X	X	X	X	X	X	X	------
KS	X	X					X		X		stopped covering financial guaranty in 2007 and warranty in 2008
KY	X	X	X			X	X		X	X	stopped covering financial guaranty in 2007
LA	X	X	X	X	X	X	X	X	X		------
ME	X	X	X		X	X	X		X		stopped covering warranty in 2008 and surety in 2009
MD	X	X					X				stopped covering surety in 2009
MA	X	X	X		X	X	X	X	X	X	------
MI	X										------
MN	X	X	X		X	X	X		X		stopped covering warranty in 2008

[14] The X denotes whether a line of insurance is not covered by the state guaranty fund in 1990.

MS	X	X	X	X	X	X	X	X	X		stopped covering warranty in 2008
MO	X	X	X			X	X	X	X		stopped covering warranty in 2008
MT	X		X			X	X	X	X		------
NE	X	X	X	X	X	X	X	X	X		------
NV	X	X				X	X	X	X		stopped covering financial guaranty, credit in 1993, fidelity in 2007, and warranty in 2008
NH	X	X	X			X	X	X	X		------
NJ		X	X	X		X	X	X	X		stopped covering unlicensed lines except insurers that write medical malpractice and certain homeowners insurance
NM	X	X	X		X	X	X	X	X		started to cover financial guaranty in 2007
NY	X	X	X		X		X		X		------
NC	X	X	X	X	X	X	X	X	X	X	------
ND	X	X	X		X	X	X	X	X		stopped covering financial guaranty in 2001, fidelity in 2007 and warranty in 2008
OH	X	X				X	X	X	X	X	stopped covering financial guaranty, fidelity, credit in 1994
OK	X	X	X		X	X	X	X	X	X	------
OR	X	X	X			X	X	X	X		------
PA	X	X	X	X		X	X	X	X		stopped covering financial guaranty in 1995
RI	X	X	X	X	X		X	X	X	X	stopped covering ocean marine in 2005
SC	X	X	X	X	X	X	X	X	X	X	------
SD	X	X	X	X	X	X	X	X	X	X	------
TN	X	X	X			X	X	X	X		stopped covering fidelity in 2007 and warranty in 2008
TX	X	X	X	X	X	X	X	X	X	X	------
UT	X		X		X	X	X	X	X	X	------
VT	X	X	X			X	X	X	X		------
VA	X	X	X	X	X	X	X	X	X	X	------
WA	X		X			X	X	X	X		------
WV	X		X			X	X	X	X		------
WI	X		X	X	X	X	X	X	X	X	------
WY	X		X			X	X	X	X		------

Table 1B
Summary of Property-Liability Insurance Guaranty Funds Limits, By State

State	Effective Date	Max Per Claim	Net Worth Provision	State	Effective Date	Max Per Claim[15]	Net Worth Provision
AL	1981	$150,000	$25,000,000	MT	1971	$300,000	$50,000,000
AK	1970	$300,000 before 1990; $500,000	NO	NE	1971	$300,000	NO
AZ	1977	$100,000 before 2007; $300,000	NO	NV	1971	$300,000	$25,000,000
AR	1977	$300,000	$50,000,000	NH	2004	$300,000	$25,000,000
CA	1969	$500,000	NO	NJ	1974	$300,000	$25,000,000
CO	1971	$300,000	$25,000,000	NM	1973	$100,000	NO
CT	1971	$300,000 before 2007; $400,000	NO	NY	1969	$1,000,000	NO
DE	1970	$300,000	$10,000,000	NC	1971	$300,000	$50,000,000
FL	1970	$300,000	NO	ND	1971	$300,000	$10,000,000
GA	1970	$100,000 before 2005; $300,000	$10,000,000	OH	1970	$300,000	$50,000,000
HI	1971	$300,000	$25,000,000	OK	1980	$150,000	$50,000,000
ID	1970	$300,000	NO	OR	1971	$300,000	$25,000,000
IL	1971	$300,000	$25,000,000	PA	1994	$300,000	$50,000,000
IN	1972	$50,000 before 1988; $100,000	$5,000,000	RI	1970	$500,000	$50,000,000
IA	1970	$300,000 before 2010; $500,000	NO	SC	1971	$300,000	$10,000,000
KS	1970	$300,000	NO	SD	2000	$300,000	$50,000,000
KY	1972	$100,000 before 1998; $300,000	$25,000,000	TN	1971	$100,000	$10,000,000
LA	1970	$150,000 before 2008; $500,000	$25,000,000	TX	2007	$300,000	$50,000,000
ME	1970	$300,000	$25,000,000	UT	1971	$300,000	$25,000,000
MD	1971	$300,000	$50,000,000	VT	1970	$500,000	NO
MA	1971	$300,000	$25,000,000	VA	1970	$300,000	$50,000,000
MI	1969	$5,000,000	$25,000,000	WA	1971	$300,000	NO
MN	1971	$300,000	$25,000,000	WV	1970	$300,000	NO
MS	1971	$300,000	NO	WI	1969	$300,000	$25,000,000
MO	1971	$300,000	$25,000,000	WY	1971	$150,000	No

[15] Maximum claims exclude workers compensation, since coverage for workers compensation is unlimited in 49 states.

Table 2
Categories of A.M Best Ratings

High categories ↓
A++
A+
A
A-
Low categories ↓
B++
B+
B
B-
C++
C+
C
C-
D
E
F
No categories ↓
NR (NR 1, NR 2, NR 3, NR 4, NR5)

Table 3
Number and Percentage of Sample Firm-Line-State-Years, by Rating Categories

Panel A: Uncovered	Rating	No. of observation	% Total	No change	% No change	Upgrade	% Upgrade	Downgrade	% Downgrade
High	**A++**	65,155	12.25%	58,889	90.38%	0	0.00%	6,266	9.62%
	A+	160,579	30.20%	140,367	87.41%	6,077	3.78%	14,135	8.80%
	A	183,304	34.48%	161,328	88.01%	10,668	5.82%	11,308	6.17%
	Total	409,038	76.93%	360,584	88.15%	16,745	4.09%	31,709	7.75%
	A-	97,864	18.41%	79,885	81.63%	13,724	14.02%	4,255	4.35%
Low	**B++**	10,901	2.05%	5,989	54.94%	3,736	34.27%	1,176	10.79%
	B+	10,090	1.90%	4,925	48.81%	4,444	44.04%	721	7.15%
	B	2,366	0.44%	1,473	62.26%	796	33.64%	97	4.10%
	B-	923	0.17%	373	40.41%	497	53.85%	53	5.74%
	C++	106	0.02%	25	23.58%	16	15.09%	65	61.32%
	C+	266	0.05%	78	29.32%	184	69.17%	4	1.50%
	C	125	0.02%	50	40.00%	72	57.60%	3	2.40%
	C-	7	0.00%	5	71.43%	1	14.29%	1	14.29%
	Total	24,784	4.66%	12,918	52.12%	9,746	39.32%	2,120	8.55%
Total		531,686	100.00%	453,387	85.27%	40,215	7.56%	38,084	7.16%

Panel B: Covered	Rating	No. of observation	% Total	No change	% No change	Upgrade	% Upgrade	Downgrade	% Downgrade
High	**A++**	243,866	9.68%	219,253	89.91%	0	0.00%	24,613	10.09%
	A+	762,085	30.26%	663,160	87.02%	27,054	3.55%	71,871	9.43%
	A	853,913	33.90%	735,133	86.09%	55,938	6.55%	62,842	7.36%
	Total	1,859,864	73.85%	1,617,546	86.97%	82992	4.46%	159,326	8.57%
	A-	492,227	19.54%	409,184	83.13%	62,518	12.70%	20,525	4.17%
Low	**B++**	69,214	2.75%	45,418	65.62%	18,199	26.29%	5,597	8.09%
	B+	61,675	2.45%	39,083	63.37%	17,514	28.40%	5,078	8.23%
	B	23,312	0.93%	16,397	70.34%	5,647	24.22%	1,268	5.44%
	B-	7,743	0.31%	4,298	55.51%	3,073	39.69%	372	4.80%
	C++	966	0.04%	404	41.82%	485	50.21%	77	7.97%
	C+	2,439	0.10%	1,310	53.71%	959	39.32%	170	6.97%
	C	930	0.04%	488	52.47%	387	41.61%	55	5.91%
	C-	205	0.01%	152	74.15%	50	24.39%	3	1.46%
	Total	166,484	6.61%	107,550	64.60%	46,314	27.82%	12,620	7.58%
Total		2,518,575	100.00%	2,134,280	84.74%	191,824	7.62%	192,471	7.64%

Table 4
Summary Statistics at Firm-Line-State-Year Level

Panel A includes the firm-line-state-years downgrade sample during 1990-2011. Panel B includes the firm-line-state-years upgrade sample during 1990-2011. Panel C includes the firm-line-state-years no rating change sample during 1990-2011. *Log Direct Premium* the is logarithm of direct premium. *Δ Log Direct Premium* is measured as the first difference of the log of direct premium written by insurer at time *t* and the log of direct premium written by the same insurer at time t-1. *Insurance GSP* is calculated as economic size of the insurance sector in a state divided by total state population scaled by 1,000 for each state each year. *Insurance Employment* is calculated as employment in the insurance sector divided by 10,000 for each state each year. *State income* is income per capita scaled by 10,000 for each state each year. *Insolvent Insurers* is the number of insolvent insurers in a state by year. *Loss Ratio* is calculated as aggregated direct loss incurred divided by directed premium earned for each line and each year. *Loss Volatility* is calculated as the cross-sectional standard deviation of losses incurred for each line and each year. Loss volatility is scaled by the cross-sectional standard deviation of premiums earned for each line and each year.

Variables	Mean	SD	Min	25%	50%	75%	Max
Panel A: Downgrade sample (N=229,410)							
Log Direct Premium	11.475	2.700	5.521	9.567	11.604	13.442	21.002
Δ Log Direct Premium	-0.003	0.567	-1.000	-0.308	-0.001	0.302	1.000
Insurance GSP	0.915	0.814	0.226	0.496	0.700	1.019	5.020
State Income	2.826	0.742	1.585	2.243	2.755	3.323	4.929
Insurance Employment	6.631	6.386	0.250	1.874	4.913	7.913	31.102
Insolvent Insurers	0.540	1.239	0.000	0.000	0.000	1.000	12.000
Loss Ratio	0.636	0.347	0.099	0.503	0.627	0.716	1.516
Loss Volatility	0.776	0.550	0.143	0.582	0.685	0.825	3.211
Panel B: Upgrade sample (N=232,039)							
Log Direct Premium	11.263	2.726	6.094	9.304	11.409	13.262	21.140
Δ Log Direct Premium	0.036	0.571	-1.000	-0.259	0.034	0.356	1.000
Insurance GSP	0.888	0.802	0.181	0.471	0.670	0.999	8.036
State Income	2.762	0.752	1.329	2.175	2.642	3.233	5.755
Insurance Employment	6.578	6.374	0.246	1.860	4.861	7.856	31.102
Insolvent Insurers	0.512	1.250	0.000	0.000	0.000	1.000	12.000
Loss Ratio	0.640	0.432	0.089	0.527	0.633	0.716	1.516
Loss Volatility	0.783	0.648	0.150	0.586	0.702	0.832	3.211
Panel C: No rating change sample (N=2,587,667)							
Log Direct Premium	11.741	2.671	6.378	9.818	11.802	13.568	21.245
Δ Log Direct Premium	0.052	0.519	-1.000	-0.197	0.034	0.311	1.000
Insurance GSP	0.970	0.895	0.181	0.504	0.741	1.096	8.036
State Income	2.970	0.853	1.329	2.273	2.897	3.547	5.755
Insurance Employment	6.636	6.356	0.250	1.887	4.956	7.915	31.102
Insolvent Insurers	0.450	1.070	0.000	0.000	0.000	0.000	12.000
Loss Ratio	0.607	0.369	0.047	0.495	0.594	0.695	1.491
Loss Volatility	0.732	0.565	0.130	0.567	0.666	0.787	3.211

Table 5A
Impact of Guaranty Funds on Market Discipline, State Variation---Downgrade

The dependent variable is ΔLog Premium$_t$. The sample is at firm-line-state-year level and the period is 1990-2011. Regressions include only downgraded firms. *Uncover* equals 1 if the premiums in a state are uncovered by guaranty funds, 0 otherwise. Traditional lines exclude ocean marine, fidelity, surety, credit, title, financial guaranty, accident and health, mortgage guaranty and warranty. The control variables include the logarithm of lagged premium, a firm-line-year fixed effect and a state fixed effect. State time-variant variables are included in all regressions, which are insurance employment, insurance gross state product (GSP), state income, and the number of insolvent insurers. All state variables are scaled by state annual population. Standard errors are adjusted for heteroskedasticity and clustered at firm-line-year level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**All Lines**	**Traditional Lines**	**Nontraditional Lines**	**Personal Lines**	**Commercial Lines**
Log Premium $_{t-1}$	-0.087***	-0.087***	-0.091***	-0.033***	-0.102***
	(0.001)	(0.001)	(0.004)	(0.002)	(0.001)
Uncover × High	-0.020**	0.050	-0.046***	-0.070	-0.024**
	(0.009)	(0.034)	(0.010)	(0.105)	(0.010)
Uncover × A-	-0.173***	-0.240***	-0.103***	-0.041	-0.180***
	(0.026)	(0.038)	(0.032)	(0.082)	(0.026)
Uncover × Low	-0.088***	-0.128**	-0.065	0.253	-0.104***
	(0.034)	(0.058)	(0.040)	(0.190)	(0.034)
High	0.144	-0.147	0.346	-0.286***	0.130
	(0.175)	(0.205)	(0.229)	(0.105)	(0.171)
A-	0.209	0.004	0.412*	0.000	0.196
	(0.161)	(0.172)	(0.236)	(.)	(0.157)
Insurance GSP	0.003	0.003	0.005	-0.003	0.005
	(0.004)	(0.004)	(0.012)	(0.008)	(0.004)
State Income	0.017*	0.015	0.030	-0.015	0.026**
	(0.010)	(0.010)	(0.030)	(0.022)	(0.011)
Insurance Employment	0.004*	0.004*	0.002	0.004	0.004
	(0.002)	(0.002)	(0.007)	(0.005)	(0.003)
Insolvent Insurers	-0.001	-0.000	-0.002	0.001	-0.001
	(0.001)	(0.001)	(0.003)	(0.002)	(0.001)
Firm-Line-Year Fixed Effect	YES	YES	YES	YES	YES
State Fixed Effect	YES	YES	YES	YES	YES
R^2	0.410	0.412	0.397	0.445	0.417
Observations	229,410	204,124	25,286	36,750	192,660

Table 5B
Impact of Guaranty Funds on Market Discipline, State Variation---Upgrade

The dependent variable is ΔLog Premium$_t$. The sample is at firm-line-state-year level and the period is 1990-2011. Regressions include only upgraded firms. *Uncover* equals 1 if the premiums in a state are uncovered by guaranty funds, 0 otherwise. Traditional lines exclude ocean marine, fidelity, surety, credit, title, financial guaranty, health and accident, mortgage guaranty and warranty. The control variables include the logarithm of lagged premium, a firm-line-year fixed effect and a state fixed effect. State time-variant variables are included in all regressions, which are insurance employment, insurance gross state product (GSP), state income, and the number of insolvent insurers. All state variables are scaled by state annual population. Standard errors are adjusted for heteroskedasticity and clustered at firm-line-year level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**All Lines**	**Traditional Lines**	**Nontraditional Lines**	**Personal Lines**	**Commercial Lines**
Log Premium $_{t-1}$	-0.075***	-0.072***	-0.102***	-0.023***	-0.086***
	(0.001)	(0.001)	(0.004)	(0.002)	(0.001)
Uncover × High	0.020*	-0.009	0.036***	-0.083	0.018
	(0.012)	(0.041)	(0.014)	(0.243)	(0.012)
Uncover × A-	0.029*	0.030	0.040**	-0.076	0.030*
	(0.016)	(0.040)	(0.017)	(0.201)	(0.016)
Uncover × Low	0.037**	0.018	0.073***	0.111	0.030*
	(0.017)	(0.026)	(0.022)	(0.088)	(0.017)
High	-0.178	-0.198	-0.172	0.000	-0.187
	(0.122)	(0.153)	(0.179)	(.)	(0.119)
A-	-0.024	0.014	-0.169	1.159***	-0.046
	(0.079)	(0.101)	(0.109)	(0.221)	(0.076)
Insurance GSP	-0.006	-0.007*	0.002	-0.009	-0.006
	(0.004)	(0.004)	(0.012)	(0.008)	(0.004)
State Income	0.021**	0.019*	0.037	0.031	0.024**
	(0.010)	(0.011)	(0.030)	(0.027)	(0.011)
Insurance Employment	-0.002	-0.003	0.004	-0.006	-0.001
	(0.002)	(0.002)	(0.007)	(0.006)	(0.003)
Insolvent Insurers	0.001	0.001	0.001	-0.003	0.002
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)
Firm-Line-Year Fixed Effect	YES	YES	YES	YES	YES
State Fixed Effect	YES	YES	YES	YES	YES
R^2	0.371	0.362	0.454	0.443	0.368
Observations	232,039	208,534	23,505	33,461	198,578

Table 6A
Impact of Guaranty Funds on Market Discipline, Line of Business Variation---Downgrade

The dependent variable is ΔLog Premium$_t$. The sample is at firm-line-state-year level and the period is 1990-2011. Regressions include only downgraded firms. *Uncover* equals 1 if the premiums in a state are uncovered by guaranty funds, 0 otherwise. Nontraditional lines include ocean marine, fidelity, surety, credit, title, financial guaranty, health and accident, mortgage guaranty and warranty. The set of control variables include logarithm of lagged premium, a firm-state-year fixed effect and an insurance line of business fixed effect. Aggregate line of business time-variant variables are included in all regressions, which are loss ratio and loss volatility. Standard errors are adjusted for heteroskedasticity and clustered at firm-state-year level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**All lines**	**Nontraditional Lines**	**Commercial Lines**
Log Premium $_{t-1}$	-0.058***	-0.036***	-0.069***
	(0.001)	(0.004)	(0.001)
Uncover × High	-0.072***	-0.044*	-0.077***
	(0.011)	(0.027)	(0.011)
Uncover × A-	-0.059***	-0.270*	-0.050**
	(0.022)	(0.138)	(0.022)
Uncover × Low	-0.068**	-0.174	-0.072**
	(0.032)	(0.162)	(0.033)
High	0.215	0.163	0.211
	(0.197)	(0.325)	(0.202)
A-	-0.026	0.064	-0.008
	(0.198)	(0.421)	(0.204)
Loss Ratio	-0.007	-0.331**	-0.010
	(0.011)	(0.140)	(0.011)
Loss Volatility	0.007	0.194**	0.008
	(0.007)	(0.092)	(0.007)
Firm-State-Year Fixed Effect	YES	YES	YES
Line Fixed Effect	YES	YES	YES
R^2	0.424	0.727	0.438
Observations	229,410	25,286	192,660

Table 6B
Impact of Guaranty Funds on Market Discipline, Line of Business Variation---Upgrade

The dependent variable is ΔLog Premium$_t$. The sample is at firm-line-state-year level and the period is 1990-2011. Regressions include only upgraded firms. *Uncover* equals 1 if the premiums in a state are uncovered by guaranty funds, 0 otherwise. Nontraditional lines include ocean marine, fidelity, surety, credit, title, financial guaranty, health and accident, mortgage guaranty and warranty. The set of control variables include logarithm of lagged premium, a firm-state-year fixed effect and an insurance line of business fixed effect. Aggregate line of business time-variant variables are included in all regressions, which are loss ratio and loss volatility. Standard errors are adjusted for heteroskedasticity and clustered at firm-state-year level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**All lines**	**Nontraditional Lines**	**Commercial Lines**
Log Premium $_{t-1}$	-0.044***	-0.045***	-0.055***
	(0.001)	(0.005)	(0.001)
Uncover × High	0.038***	0.050	0.036***
	(0.012)	(0.034)	(0.013)
Uncover × A-	0.054***	0.045	0.049***
	(0.014)	(0.047)	(0.015)
Uncover × Low	0.048***	0.101	0.056***
	(0.018)	(0.100)	(0.018)
High	0.034	0.002	0.021
	(0.173)	(0.516)	(0.174)
A-	-0.118	-0.509	-0.126
	(0.126)	(0.403)	(0.129)
Loss Ratio	0.033***	-0.140	0.026**
	(0.011)	(0.224)	(0.011)
Loss Volatility	-0.005	0.181	-0.001
	(0.007)	(0.122)	(0.008)
Firm-State-Year Fixed Effect	YES	YES	YES
Line Fixed Effect	YES	YES	YES
R^2	0.398	0.727	0.411
Observations	232,039	23,505	198,578

Table 7
Impact of Guaranty Funds on Market Discipline, Time Variation---No Rating Change

The dependent variable is ΔLog Premium$_t$. The sample is at firm-line-state-year level and the period is 1990-2011. Regressions include only firms with no rating change. *Uncover* equals 1 if the premiums in a state are uncovered by guaranty funds in that year, 0 otherwise. The set of control variables include logarithm of lagged premium, a firm-line-state-status fixed effect and a year fixed effect. Status accounts for insurers that change their licensing status to unlicensed in a state and year. State time-variant variables are included in all regressions, which are insurance employment, insurance gross state product (GSP), state income, and the number of insolvent insurers. All state variables are scaled by state annual population. Aggregate line of business time-variant variables are included in all regressions, which are loss ratio and loss volatility. Standard errors are adjusted for heteroskedasticity and clustered at firm-line-state-status level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**All Lines**	**Nontraditional Lines**	**Commercial Lines**
Log Premium $_{t-1}$	-0.158***	-0.165***	-0.168***
	(0.000)	(0.002)	(0.000)
Uncover × High	-0.032***	-0.015	-0.042***
	(0.011)	(0.014)	(0.012)
Uncover × A-	-0.005	0.022	-0.013
	(0.012)	(0.015)	(0.012)
Uncover × Low	-0.087***	-0.049**	-0.103***
	(0.015)	(0.020)	(0.015)
Insurance GSP	0.002***	0.001	0.002***
	(0.000)	(0.001)	(0.000)
State Income	-0.011***	-0.000	-0.010***
	(0.001)	(0.005)	(0.002)
Insurance Employment	0.040***	0.035***	0.045***
	(0.003)	(0.012)	(0.004)
Insolvent Insurers	0.004***	0.008**	0.005***
	(0.001)	(0.003)	(0.001)
Loss Ratio	0.004	0.010	0.002
	(0.003)	(0.014)	(0.003)
Loss Volatility	-0.001	-0.017**	0.001
	(0.002)	(0.009)	(0.002)
Firm-Line-State-Status Fixed Effect	YES	YES	YES
Year Fixed Effect	YES	YES	YES
R^2	0.280	0.279	0.278
Observations	2,587,667	287,595	2,192,414

Table 8A
Univariate Tests of Loss Ratio by Guaranty Fund Covered Status by Lines

The table shows results of univariate tests for loss ratio across guaranty funds covered status from 1990 to 2011 by lines, in which loss ratio is calculated at the line by year level. Special liability includes ocean marine, aircraft, and boiler and machinery; special property includes fire, allied lines, inland marine, earthquake and burglary and theft; other includes credit, accident and health. The covered business is defined as premiums covered by guaranty funds and uncovered business is defined as premiums uncovered by guaranty funds at firm-line-state-years. Loss ratio is defined as directed loss incurred divided by directed premium earned, where direct loss incurred and direct premium earned are aggregated at the line by year level. Significance of tests of differences in means are based on a two-tailed t-test.

Lines of Business	Covered Business (1)	Uncovered Business (2)	Difference (1)-(2)	Variance of Loss Ratio
Homeowners / Farmowners	0.690	0.572	0.118	0.031
Auto Liability	0.676	0.633	0.043	0.012
Workers compensation	0.695	1.127	-0..432*	0.020
Commercial Multiple Peril	0.591	0.568	0.023	0.022
Medical Malpractice	0.627	0.602	-0.025	0.040
Special Liability	0.595	0.632	-0.037	0.031
Other Liability	0.651	0.615	0.036	0.022
Special Property	0.634	0.618	0.016	0.051
Auto Physical Damage	0.604	0.571	0.033	0.010
Fidelity/Surety	0.396	0.333	0.062	0.032
Other Lines	0.678	0.724	-0.046	0.011
Product Liability	0.904	0.573	0.331***	0.073
Fin. /Mortg. Guaranty	0.599	0.737	-0.137	0.176
Warranty	0.617	0.747	-0.130**	0.027

Table 8B
Univariate Tests of Loss Ratio by Guaranty Fund Covered Status for Insurers with Covered Business and Uncovered Business, by Lines

The table shows results of univariate tests for loss ratio across guaranty funds covered status for insurers with both covered business and uncovered business from 1990 to 2011 by lines, in which loss ratio is calculated at the line by year level. Special liability includes ocean marine, aircraft, and boiler and machinery; special property includes fire, allied lines, inland marine, earthquake and burglary and theft; other includes credit, accident and health. The covered business is defined as premiums covered by guaranty funds and uncovered business is defined as premiums uncovered by guaranty funds at firm-line-state-years. Loss ratio is defined as directed loss incurred divided by directed premium earned, where direct loss incurred and direct premium earned are aggregated at the line by year level. The premium earned is scaled by 100,000,000. Significance of tests of differences in means and variance are based on a two-tailed t-test.

Lines of Business	Covered Business (1)			Uncovered Business (2)			Difference of Loss Ratio	
	Loss Ratio Mean	Loss Ratio Variance	Premium Earned	Loss Ratio Mean	Loss Ratio Variance	Premium Earned	Diff. of Mean	Equality of Variances
Homeowners / Farmowners	0.708	0.076	0.359	0.601	0.412	0.443	0.106	3.43**
Auto Liability	0.631	0.022	4.337	0.774	0.031	1.381	-0.025	1.95
Workers compensation	2.243	1.054	0.676	1.921	0.800	0.102	0.677	2.31
Commercial Multiple Peril	0.565	0.067	2.399	0.578	0.064	2.675	0.005	1.13
Medical Malpractice	0.699	0.046	3.315	0.819	0.695	1.894	-0.013	1.04
Special Liability	0.600	0.045	17.327	0.632	0.026	14.837	-0.032	2.92**
Other Liability	0.567	0.039	6.969	0.555	0.035	2.024	0.011	1.24
Special Property	0.506	0.044	3.056	0.602	0.062	5.278	-0.096	2.03
Auto Physical Damage	0.503	0.018	1.919	0.578	0.022	0.631	-0.076**	1.41
Fidelity/Surety	0.394	0.039	9.702	0.332	0.032	32.450	0.062	1.43
Other	0.663	0.011	6.552	0.666	0.013	47.067	-0.003	1.42
Product Liability	0.726	0.221	0.311	0.571	0.056	2.234	0.155	14.93***
Fin. /Mortg. Guaranty	0.654	0.189	2.512	0.685	0.153	44.22	-0.031	1.46
Warranty	0.582	0.014	9.332	0.626	0.011	9.421	-0.044	1.63

Table 9
Insurers' Risk Management Behavior

The dependent variable is ΔLog Premium$_t$. The sample period is 1991-2011. Risky business is defined as the first seven insurance lines with high variances of loss ratio based on Table 8B. Regressions include only business covered by guaranty funds. *Risky Business* equals 1 if the premiums are in a line which is high risk, 0 otherwise. The set of control variables include logarithm of lagged premium, firm-year, state and insurance line of business fixed effects. Standard errors are adjusted for heteroskedasticity and clustered at firm-year level and are reported below the coefficients in parentheses. Coefficients marked with ***, **, and * are significant at the 1%, 5%, and 10% level, respectively.

Variables	**Downgrade**	**Upgrade**
Log Premium $_{t-1}$	-0.063***	-0.048***
	(0.002)	(0.002)
Risky Business × High	-0.070	0.070
	(0.144)	(0.114)
Risky Business × A-	-0.045	0.111
	(0.146)	(0.113)
Risky Business × Low	-0.015	0.090
	(0.146)	(0.114)
High	0.327*	-0.085
	(0.182)	(0.178)
A-	0.102	-0.101
	(0.176)	(0.075)
Insurance GSP	0.006	-0.007
	(0.005)	(0.005)
State Income	0.025*	0.023
	(0.014)	(0.014)
Insurance Employment	0.002	-0.003
	(0.003)	(0.003)
Insolvent Insurers	-0.000	0.002
	(0.002)	(0.002)
Loss Ratio	-0.012	0.025
	(0.029)	(0.025)
Loss Volatility	0.011	0.001
	(0.020)	(0.018)
Firm-Year Fixed Effect	YES	YES
Line of Business Fixed Effect	YES	YES
State Fixed Effect	YES	YES
R^2	0.215	0.175
Observations	229,410	232,039