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ABSTRACT

Many institutional investors depend on the returns they generate to fund their operations and liabilities. How does these investors' demand for capital affect the management of their portfolios? We address this issue using the insurance industry because insurers are large investors for which detailed portfolio data are available, and can face financial shocks from exogenous weather-related events. We find that insurers with more financial flexibility have larger portfolio weights on riskier and more illiquid assets, and have higher realized returns. Among corporate bonds, for which we can control for regulatory treatment, we find that more financially flexible insurers have larger portfolio weights on riskier and more illiquid corporate bonds. Following losses, P&C insurers decrease allocations to riskier corporate bonds. The effect of losses on allocations is likely to be causal since it holds when instrumenting for P&C losses with weather shocks. The change in allocations following losses is larger for more financially constrained insurers and during the financial crisis, suggesting that the shift toward less risky securities is driven by concerns about financial flexibility. The results highlight the importance of financial flexibility to fund operations in institutional investors' portfolio decisions.

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1. Introduction

Modern portfolio theory began with Markowitz (1952), who proposed the then-novel idea that risk-averse investors will demand a premium to invest in risky assets. The risk of an investor's portfolio, and consequently its expected returns, will depend on how risk-averse the investor is. This idea is naturally applied to portfolios of individual investors, who, according to experimental evidence, do in fact tend to be risk-averse. However, in contrast to the era in which Markowitz wrote his seminal work, the vast majority of financial assets today are owned or managed by institutional investors rather than individuals. The largest investors in the economy today, institutional investors such as pension funds, endowments, and insurance companies, are organizations that depend on their financial investments to fund their operations. Since these organizations do not necessarily have "preferences" like individual investors, it is not obvious how one would characterize the way in which they view the tradeoff between risk and return. To what extent should we think of these institutional investors as risk-averse? And if they are risk-averse in their portfolio decisions, why do they exhibit this behavior?

The answers to these questions are of fundamental importance to our understanding of financial markets. Endowments, foundations, pension funds, and insurance companies had U.S. assets of over $22 trillion at the end of 2017.[1] Their preferences could materially impact the price of risk in the economy, and their appetite for securities is a key factor affecting which firms can raise capital through public debt. These investors are different from professionally managed portfolios such as mutual funds and hedge funds because they rely (at least in part) on the returns generated from their investments to fund their operations. Consequently, they must apply financial management principles to their investment policies in a similar

[1] At the end of 2017, insurers hold assets worth $6.5 trillion and invested assets and pension funds hold $14.5 trillion. At the end of 2015, university endowments hold $0.5 trillion, and foundations hold $0.9 trillion. The sources for these figures are: National Association of Insurance Commissioners for insurers (https://www.naic.org/capital_markets_archive/180816.pdf), Federal Reserve Statistical Release, Financial Accounts of the United States for pension funds (https://www.federalreserve.gov/releases/z1/20180920/z1.pdf, page 94), Department of Education for university endowments (https://nces.ed.gov/fastfacts/display.asp?id=73), and Foundation Center for foundations (http://data.foundationcenter.org/).

manner to public corporations to ensure that they meet their liabilities and preserve financial flexibility in their future. In this paper, we argue that these financial management concerns about ensuring liquidity and solvency affect institutional portfolio management decisions, and can lead otherwise risk neutral investors to be more risk averse.[2]

Why could the portfolio decisions of such investors be different from those of investors such as hedge funds, who manage portfolios for third parties? If an investment manager is reliant on income from its investments to fund operations, she will have to account for the possibility that the organization has a cash shortfall, and will need to sell some of its investments. For example, a pension fund's demand for cash could increase if retirees live longer than was expected. Or a weather event could lead an insurance company to have large unexpected claims that need to be paid immediately. In addition, expected future liabilities can increase, leading the organization closer to insolvency, even if the current cash needs do not increase.[3] The possibility that exogenous factors outside the institution's control can materially change its liabilities can affect the institution's portfolio decisions, likely moving toward less risky and more liquid securities. The cost of unexpected changes in liabilities is likely to be greater for firms that face a higher cost of accessing financial markets.[4]

We consider a sample of 2,084 U.S. Property-Casualty (P&C) insurers and 842 U.S. life insurers between 2001 and 2015. Insurance companies are important institutional investors, holding approximately $6.5 trillion of financial investments, including more than a quarter of U.S. corporate bonds. Insurers report detailed security-level data on their financial investments, so it is straightforward to observe the riskiness and liquidity of these investments. In addition, P&C insurers can suffer from shocks due to natural disasters,

[2] The idea that concerns about future financial constraints can affect liquidity management policies dates at least to Keynes (1936). The modern literature examining this idea began with Opler, Pinkowitz, Stulz, and Williamson (1999). See Almeida, Campello, Cunha, and Weisbach (2014) for a survey.

[3] For example, a pension fund's liabilities (or leverage) and probability of insolvency can increase if the future life expectancy of retirees' is expected to increase.

[4] The argument that the demand for risk management comes from the cost of accessing external financial markets was originally proposed by Froot, Scharfstein, and Stein (1993). In principle, riskier liabilities could lead firms to take more risk in their investments as was famously suggested by Jensen and Meckling (1976). However, as is discussed below, the literature has documented in a number of settings that the "risk management" incentives appear to dominate the "risk shifting" incentives empirically.

like hurricanes, which can tighten insurers' financial constraints by increasing cash demand and pushing insurers closer to insolvency. These exogenous shocks occur independently of insurers' financial investment policies but can meaningfully affect the financial conditions of the P&C insurers, and help us identify causal effects of insurers' financial conditions on their portfolios.

We first examine whether insurers' portfolios vary cross-sectionally with insurers' characteristics. Larger insurers have substantially different portfolios than smaller insurers. In particular, larger insurers have, as a fraction of their total portfolio, less cash and government debt, but more mortgage-backed securities (MBS) and corporate bonds. Because of these differences in portfolios, larger insurers have higher expected returns on their financial portfolios than smaller insurers, and in our sample, earn higher realized returns. In addition, a larger size is associated with a higher financial strength rating, which is a composite albeit coarse measure of insurers' financial flexibility. These cross-sectional correlations are suggestive of the view that larger insurers are more financially flexible. Their higher financial flexibility is one potential reason why larger insurers are able to invest in riskier, less liquid securities that earn higher average returns.

Securities differ from one another in a number of dimensions. Cash and government debt are safer, more liquid, and also receive more lenient regulatory treatment than MBS and corporate bonds.[5] To evaluate whether smaller insurers hold more cash and government debt because of their safety and liquidity or if these differences occur only because of favorable regulatory treatment on them, we consider insurers' holdings of corporate bonds separately. Among corporate bonds, we can accurately control for regulatory treatments and measure risk and liquidity. Our empirical results suggest that larger insurers and better-rated insurers have a larger allocation to riskier and more illiquid corporate bonds than smaller insurers, holding constant the regulatory treatment of different bonds. Such effects of insurers' financial conditions on their choice among corporate bonds are more pronounced during the financial crisis. These results suggest that

[5] Section 2 offers details on regulatory treatment of insurers' financial security holdings.

financial securities' safety and liquidity, in addition to their regulatory treatments, affect insurers' allocations.

The relation between insurers' asset size and their portfolio choices does not necessarily mean that insurers' financial conditions causally affect their portfolio choices. It is possible that the two are related due to other reasons. For example, insurers who are more risk-seeking in their financial portfolios receive, on average, higher realized returns, which could lead firms with riskier portfolios to have larger assets. As a more direct way of linking financial conditions with insurers' portfolios, we assume that insurers' operating losses represent negative shocks to their financial conditions and estimate the way that portfolios change following operating losses. To address the concern that insurers' operating losses and financial portfolios could both be related to insurers' unobservable characteristics (e.g. management quality), we construct an instrumental variable for P&C insurers' losses with two sources of data: unusual weather damages at the state-quarter level and insurers' lagged market share in each state.

Our results suggest that, following operating losses, P&C insurers reduce their holdings of riskier corporate bonds. This result holds using OLS and also instrumenting for losses using weather data. We also find that, following operating losses, insurers are more likely to purchase bonds that are relatively liquid. Finally, we find that when firms are more financially constrained because of either firm-specific conditions or the Financial Crisis, operating losses lead insurers to have larger increases in the allocation to safer corporate bonds. More constrained firms are likely to be affected more by unexpected losses, so this result provides additional support for the view that insurers' financial constraints affect their portfolio choice. These results all suggest that when financial constraints are exacerbated, insurers shift their portfolios toward safer and more liquid securities.

In addition to our conclusions about the way in which financial constraints affect portfolio allocations, this paper has three other important implications. First, we shed light on insurers' attitudes toward risk, their desired portfolio if they were not financially constrained, as well as the shadow cost of financial constraints on insurers' financial investments. We find that larger and more financially flexible insurers have higher portfolio weights on riskier and more illiquid securities, and earn higher realized

returns. Consequently, in the absence of concerns about financial flexibility, insurers appear to seek higher expected returns by taking on more risk and illiquidity in their financial portfolio. The extent to which insurers are risk averse comes from the potential costs they face in the event that they have to raise capital because of unexpected losses. If absent financial management considerations, seeking higher expected returns irrespective of risk is the objective of these investors, one cost of insurers' financial constraints is that insurers need to forego higher expected returns in exchange for lower risk and more liquidity in their financial portfolio.

Second, this paper also offers micro-level evidence that more constrained investors pursue a "flight to quality," meaning that during market downturns, their demand for securities shifts toward safer ones.[6] During aggregate market downturns, it has been documented that issuances of low rated firms decline substantially, but high-rated firms actually issue more bonds in poor times than in good times (see Erel et al. (2012)). Our paper finds that for insurers, who hold more than one quarter of all the corporate bonds in the U.S., exogenous shocks to financial conditions lead them to shift their portfolios towards safer assets. If similar shifts in demand for securities occur when aggregate downturns worsen insurers' financial flexibility, then the aggregate shift towards issuances of safer bonds during worse financial conditions can be partially explained by the shifting demand for safer bonds.

Third, this paper presents a clean test of theories about the way in which firms respond to negative shocks to their financial condition. The "risk-management" theories of Smith and Stulz (1985), Froot, Scharfstein and Stein (1993), and Almeida, Campello, and Weisbach (2011) imply that a weakening of a firm's financial condition should lead to a reduction of the risk of the firm's portfolio because of the increased cost of raising capital in the event of a financial shortfall. In contrast, the "risk-shifting" argument of Jensen and Meckling (1976) suggests that a weakening of a firm's financial conditions should lead it to increase the riskiness of its portfolio. Our results favor the risk-management hypothesis since we find that insurers shift their portfolios towards safer financial investments in response to a negative financial shock.

[6] See Caballero and Krishnamurthy (2008) and Vayanos (2004) for theoretical motivation of the flight to quality arguments.

Closely related to this paper is the literature on "intermediary asset pricing", developed by He and Krishnamurthy (2012, 2013) and summarized in He and Krishnamurthy (2018). When asset values decline, a reduction in the risk tolerance of managers and the intermediary shifts its portfolio accordingly (see section 2.5 of He and Krishnamurthy (2018) for discussion). Our evidence suggests that the phenomenon He and Krishnamurthy describe is widespread -- when asset values decline and financial constraints tighten, asset managers shift their portfolios toward less risky securities. During financial downturns, demand for anything but the safest securities dries up, making it difficult for many firms to receive financing during these times.

We are not the first to distinguish empirically between the risk-management and risk-shifting hypotheses in the setting of financial investment. Rauh (2009) suggests that defined benefit pension plans hold a larger portion of safer assets such as government debt and cash when the plans are poorly funded or the firms have poor credit ratings. Duchin et al (2017) find that nonfinancial firms have larger portfolio weights in safer assets if they are more financially constrained. Our paper's results confirm the results of these two studies, using a different set of firms, insurers, who have a large, understudied portfolio and are important actors in the economy. We improve upon these two papers in two ways. First, we identify firms' losses using weather-related shocks to insurers' financial constraints. Second, since we have CUSIP-level data on insurers' financial assets, we can control for the securities' liquidity while studying how securities' riskiness affects insurers' allocation to them, which Rauh (2009) and Duchin et al (2017) are not able to do. Different from the implications here, as well as in Rauh (2009) and Duchin et al (2017), Mohan and Zhang (2014) and Andonov, Bauer and Cremers (2017) find that public pension funds have higher portfolio weights on riskier assets if the funds have a severe underfunding problem.[7]

[7] While these studies examine investments in financial assets, some other papers examine firms' real investments. Andrade and Kaplan (1998) do not find evidence for risk-shifting behavior among 31 firms that became financially distressed following highly leveraged transactions. Using numerical techniques, Parrino and Weisbach (1999) estimate the magnitude of the investment distortions due to stockholder-bondholder conflicts, which they conclude to be small for most firms. Gilje (2016) studies oil and gas companies' real investments, and suggests that as firms approach financial distress, they shift away from riskier investment projects.

A strand of the literature studies how the safety net for banks (e.g. expected government bailout, analogous to relaxing banks' financial constraints) can affect banks' risk-taking incentives. In addition, Calomiris and Wilson (2004) find that recessions in the 1920s and 1930s are associated with banks' substituting loans with riskless assets (cash and government securities). Duchin and Sosyura (2014) find that banks bailed out by the Troubled Asset Relief Program (TARP) increase the weight of riskier securities and riskier loans. These two studies imply that more constrained banks engage in less risky activities. By studying a different set of firms' financial investments, this paper adds to the body of evidence that risk-management incentives are more important than risk-shifting incentives for financially constrained firms.

Several papers also have implications on the relationship between insurers' financial strength and their risk-shifting or risk-management behavior. For example, Becker and Ivashina (2015) document that insurers with lower regulatory capital surplus acquire bonds with higher yields, compared to insurers with higher capital surplus. This result could potentially not reflect a causal effect of insurers' financial constraints on their portfolios, since insurers' regulatory capital surplus and their appetite for riskier securities could be both related to another variable, e.g. insurers' appetite for a riskier portfolio. Insurers with more tolerance for risk hold riskier assets which lower insurers' regulatory capital surplus through higher required capital. These insurers hold riskier corporate bonds probably because they have the financial flexibility to take on more risk in their portfolios. We use unusual weather damages as exogenous shocks to insurers' financial strength to isolate the causal influence of negative financial shocks on their portfolios. Our results suggest that more constrained insurers prefer safer corporate bonds more than the less constrained insurers.[8]

[8] Some other papers also study insurers' investment in financial assets. Ellul, Jotikasthira, and Lundblad (2011) and Merrill et al (2014) study insurers' fire sales of downgraded assets. Becker and Opp (2014) study how changes in regulation distort insurers' holdings of MBS. Ellul et al (2015) examine how different accounting rules affect insurers' asset holdings differently during the crisis. Getmansky et al (2017) study the commonality in insurers' portfolio and their asset sales behavior. Sen (2018) studies how regulation affects life insurers' hedging incentives. Chodorow-Reich, Ghent, and Haddad (2018) argue that life insurers can insulate the value of financial assets from exposure to market movement by holding the assets for the long run. Ellul et al (2018) find that the investment of insurers selling variable annuities can create systemic risk. Murray and Nikolova (2018) argue that insurers' portfolio choices, driven by regulation, affect prices of corporate bonds. Huang et al (2018) show that insurers' holdings of illiquid bonds affect the bond pricing.

2. Relevant Regulation

Regulators monitor insurers' financial health using several different measures. An important one is the Risk-Based Capital Ratio (hereafter RBC Ratio). This ratio can be seen as the book value of equity (in the language of the regulation, total adjusted capital) divided by required capital. Regulators have complex formulas for calculating the denominator, required capital. Financial securities in insurers' portfolios can add to required capital. The addition to required capital can be simplified as a percentage of the book value of the security, which we denote as *Risk Charge*BV of the security*, where *BV* stands for the book value of the security. The way in which a particular security can affect insurers' RBC ratio can be simplified with the following formula:

$$RBC\ Ratio = \frac{Equity\ excluding\ the\ security + BV\ of\ the\ security}{Required\ capital\ excluding\ the\ security + Risk\ charge * BV\ of\ the\ security}$$

The *Risk charge* assigned to a particular security can be different across securities. Table 1 summarizes these risk charges. Generally, the riskier a security is, the larger is the risk charge. For example, the risk charge for treasury securities is 0, for BBB-rated corporate bonds is 0.96%, and for B-rated corporate bonds is 7.38%.

3. Data

3.1 Insurers' Financial Data and Holdings in Categories

Insurers' financial data between 1999 and 2015 are obtained from the National Association of Insurance Commissioners (NAIC) and SNL Financial. Insurers' financial strength ratings are from Best's Insurance Reports by A.M. Best between 2004 and 2013. A.M. Best is the leading rating agency for insurance companies, and issues such reports three times a year. Insurers with negative assets or net premium written lower than $10,000 are excluded. All financial variables are winsorized at the 1st and 99th percentiles. Panel A of Table 2 offers summary statistics on insurers' financials.

To study the effect of insurers' financial flexibility on their investment portfolio, we use P&C insurers' operating losses as negative shocks to their financial flexibility. We construct an instrumental variable for the reported P&C insurers' operating losses, following Ge (2019). Data on damages due to weather events are from SHELDUS (Spatial Hazard Events and Losses Database for the United States). SHELDUS' main data source is the National Centers for Environmental Information. We include all the event types covered in the dataset, including hurricanes, wildfires, tornadoes, etc.

To construct the instrument, we first sum the dollar value of weather damages to properties (from SHELDUS) at the state-quarter level, then compute rolling historical averages using data on state *s*, prior to quarter *q*, adjusting for inflation. Since weather damages vary systematically by season, we construct historical averages for each quarter *q* using historical data from the same quarter. We then subtract the state-quarter historical average from the state-quarter level weather damages, to obtain what we call *Unusual Weather Damages*.

Second, we construct each P&C insurer *i*'s lagged market share in state *s*, quarter *q*, as insurer *i*'s direct premiums written in state *s* over the four preceding quarters, divided by the sum of the direct premiums written by all the P&C insurers operating in state *s* over the same period. We multiply this lagged market share at the insurer-state-quarter level with *Unusual Weather Damages* at the state-quarter level from the first step. We then sum the resulting products over all the states for each insurer, and scale by assets at the end of the previous year, to obtain the instrumental variable.

Our data on insurers' holdings in financial securities are from SNL Financial. SNL provides annual data on insurers' financial assets in broad categories based on Summary Investment Schedule in insurers' regulatory filings since 2001. We collect data at the category level between 2001 and 2015. Panel A of Table 2 offers summary statistics on holdings in some major categories, whose average holding exceeds 5% in either the P&C or life insurer subsample. Besides cash, municipal and corporate bonds make up the largest portions of P&C insurers' portfolios, while corporate bonds, MBS and treasuries make up the largest portion of life insurers' portfolios. The value of the corporate bonds held by P&C insurers at the end of

2015 was $269.24 billion, and that by life insurers $1.85 trillion, totaling $2.12 trillion, or 26% of all corporate bonds outstanding in the U.S.

In Panel B, we sort insurers into three subsamples based on their asset size and insurers' financial strength rating, respectively. We tabulate the averages of insurers' financial variables and portfolio weights of different security categories for each subsample. If the most two extreme subsamples' averages are statistically different at the 5% level, the numbers are displayed in bold.

Smaller asset size is associated with lower leverage, higher RBC ratios and worse insurer ratings. This observation suggests that smaller firms tend to manage their leverage and RBC ratio in a way that keeps them further away from economic and regulatory default. However, the insurance rating agency still assigns worse ratings to these insurers, potentially because it weighs insurers' size heavily in the rating decision. Presumably, it is harder for an insurer to grow larger in size than to lower its leverage or to increase its RBC ratio. To lower its leverage, an insurer can limit sales of products that increase reserves (under liabilities) more than assets. To increase its RBC ratio, an insurer can limit such policy sales and invest heavily in treasury securities. For these reasons, insurers' size is likely to be a better proxy for insurers' financial flexibility than insurers' leverage or RBC ratios.

To evaluate the extent to which insurers' asset size reflects their financial strength, we measure the way in which assets are associated with ratings of insurers' financial strength. For consumers shopping for insurance, an insurer's financial strength rating is often the only easily observable insurers' characteristic and hence an important factor in their decisions. In Table 3, we present estimates of the following specification:

$$Insurers'Rating_{i,y} = \beta * Insurers'\ Financials_{i,y-1} + FE_y(+FE_i) + e_{i,j,y}, \quad (1)$$

where *i* indexes insurers and *y* years, and β is a vector of coefficients on insurers' lagged financial variables. The regressions are at the annual level, since some financial variables (e.g. RBC Ratio) are reported annually but not quarterly, and we want a fair comparison among these financial variables. We include year fixed effects (FE_y) in all specifications, and add firm fixed effects (FE_i) in some.

Columns (1) - (3) present estimates for P&C insurers, with the differences between the columns being that Column (2) adds insurers' assets and Column (3) adds firm fixed effects. The importance of size in determining ratings can be seen by comparing Columns (1) and (2), where the adjusted R-Squared increases from 0.05 to 0.17. The coefficients on insurers' assets are negative and statistically significant in every column, indicating that across firms and within firms over time, larger assets are associated with better ratings. Based on the estimates in Column (2), a one standard deviation increase in P&C insurers' *Log(Assets)* (1.96) is associated with 1.02-notch improvement in insurers' rating, which is substantial relative to the standard deviation of ratings, 2.48 notches.

We present estimates for life insurers in Columns (4) - (6). The pattern for life insurers is similar to that for P&C insurers. The estimates in Column (5) imply that a one standard deviation increase in life insurers' *Log(Assets)* (2.56) is associated with 1.74-notch improvement in insurers' rating. Perhaps counterintuitively, a higher RBC ratio is associated with worse ratings for life insurers in Column (6), which is substantial relative to the standard deviation of ratings, 2.75 notches.

Overall, the estimates in Table 3 are consistent with the notion that an insurer's size is a better indicator of the insurer's financial strength than its leverage or RBC ratio. It is possible that a large size is correlated with other characteristics related to insurers' financial flexibility. For example, larger insurers tend to have more diversified liabilities. Large asset size most likely does not "cause" insurers to be more financially flexible, but is correlated with other factors affecting their financial flexibility.

Returning to Panel B of Table 2, smaller or worse-rated insurers have larger portfolio weights on cash and U.S. government securities, and smaller weights on MBS and corporate bonds, relative to larger or better-rated insurers. The differences are substantial. For example, the average cash holding is 34% among the smallest one-third of P&C insurers and 9% among the largest. The average corporate bond holding is 13% among the smallest P&C insurers and 22% among the largest. These patterns suggest that more constrained insurers have less risky, more liquid portfolios than less constrained issuers. In addition, since cash and government-issued securities also have lower risk charges than MBS and corporate bonds, constrained insurers could be trying to achieve higher RBC ratio with higher portfolio weights on cash and

U.S. government securities. The difference in portfolio weights between better-rated and worse-rated insurers is similar to but smaller in magnitude than the difference between larger and smaller insurers.

3.2. Insurers' Corporate Bond Holdings at the CUSIP Level

We obtain CUSIP-firm-year-level bond holding data for P&C insurers from SNL for each year between 2008 and 2015, which are based on insurers' annual Schedule D—Part 1 regulatory filings, Long-Term Bonds Owned December 31 of Current Year.[9] These data offer CUSIP-level or CUSIP-year-level information, for example, the maturity date, interest rate, and NAIC designation for risk charge of the security at the time of reporting. Insurers' statutory filing data also offer CUSIP-firm-year-level information on the book value of the holding, unrealized valuation change, and effective rate of interest, among other variables. From Mergent FISD, we obtain bond ratings and maturity dates. If the maturity date for the same bond is different between the insurers' data and Mergent, we use Mergent's. If the maturity date for a certain bond is missing in both a specific insurer's filing and Mergent, we use the most frequent maturity date for that bond that appeared in any P&C insurer's Schedule D filings. We use bond ratings as a measure of bonds' riskiness.

Panel C of Table 2 offers summary statistics of CUSIP-level corporate bond holdings by P&C insurers. A P&C insurer holds an average of 74 bonds each year, with a median of 32. There are on average 24,395 unique CUSIPs per year among all the corporate bonds P&C insurers hold (median = 23,274). There are 83,966 unique CUSIPs in total, among all the corporate bonds. Panel C of Table 2 presents summary statistics of corporate bonds in P&C insurers' portfolios at the CUSIP-firm-year level that have all the necessary information available to be included in our statistical analyses.

[9] Although annual holding data of corporate bonds at the CUSIP-level are available since 2004, quarterly trading data are not available until 2008. We use quarterly trading data to back out quarter-end holding information.

4. Empirical Results

4.1. Insurers' Financial Conditions and Investments in Broad Categories

To examine how insurers' financial conditions affect their financial investment decisions, we first estimate the relationship between insurers' lagged financial conditions and their allocations across broad categories. We use the following specification:

$$Holding\ of\ Category_{i,j,y} = \beta_1 * Log(Assets)_{i,y-1} + \beta_2 * Leverage_{i,y-1} + \beta_3 * RBC\ Ratio_{i,y-1} + \beta_4 * Insurer\ Rating_{i,y-1} + FE_i + FE_y + e_{i,j,y}, \quad (2)$$

where *i* indexes the insurer, *j* the category of securities (cash, treasury etc.), and *y* the year. The dependent variable is the holding of security type *j*, as a percentage of insurer's cash and invested assets. The regressions are at the annual level, since insurers report holdings in broad categories annually but not quarterly. We control for firm and year fixed effects.

Table 4 contains estimates of this equation. Among asset size, leverage, RBC Ratio and insurers' ratings, asset size is the only variable consistently associated with insurers' allocations across different kinds of assets. For both P&C and life insurers, larger insurers allocate a smaller share of the assets to cash and treasury, and a larger share to MBS and corporate bonds. For P&C insurers, a one standard deviation increase in *Log(Assets)* (1.96) is associated with a decrease in cash holdings of 8.06 percentage points (31.89% of the standard deviation), a decrease in treasury holdings of 7.37 percentage points (45.59% of the standard deviation), an increase in MBS holdings of 2.28 percentage points (21.80% of the standard deviation), and an increase in corporate bond holdings of 6.64 percentage points (37.70% of the standard deviation).

For life insurers, a one standard deviation increase in *Log(Assets)* (2.91) is associated with a decrease in cash holdings of 12.80 percentage points (53.92% of the standard deviation), a decrease in treasury holdings of 7.65 percentage points (43.87% of the standard deviation), an increase in MBS holdings of 5.38 percentage points (37.86% of the standard deviation), and an increase in corporate bond holdings of 14.35 percentage points (55.58% of the standard deviation).

Some of the coefficients on other lagged financial variables are statistically significantly different from zero. However, the effects on portfolio allocation are much smaller than those of assets. For example, for P&C insurers, higher leverage is associated with a larger allocation to cash and a smaller allocation to corporate bonds. The estimates imply that a one standard deviation increase in leverage is associated with an increase in the share of cash of 0.41 percentage points (1.62% of the standard deviation), as well as a 0.50 percentage point decrease in the share of corporate bonds (2.82% of the standard deviation). The consistent message from Table 3 is that if insurers' asset size indeed reflects insurers' financial flexibility, more flexible insurers have larger portfolio weights on riskier and more illiquid securities compared to less flexible insurers.

4.2. Insurers' Financial Conditions and Realized Portfolio Returns

Presumably, the reason why larger insurers allocate more of their portfolios to riskier and more illiquid securities is to receive higher expected returns. Therefore, given that larger insurers have riskier and more illiquid portfolios than smaller insurers, insurers' expected returns should be positively correlated with their size. On average, therefore, we expect larger insurers to achieve higher realized returns. We test this prediction by estimating the following equation:

$$Realized\ Return\ on\ Cash\ \&\ Invested\ Assets_{i,q} = \beta_1 * Log(Assets)_{i,q-1} + \beta_2 * Leverage_{i,q-1} + \beta_3 * RBC\ Ratio_{i,y-1} + \beta_4 * Insurer\ Rating_{i,q-1} + FE_i + FE_q + e_{i,q}, \quad (3)$$

where i indexes insurers, q quarters, and y years. We estimate this equation at the quarterly level since insurers report their investment returns quarterly. However, *RBC Ratio* is only available at the annual frequency, so we use *RBC Ratio* on the right-hand side from the end of the previous year. We control for firm and year-quarter fixed effects.

We present estimates of Equation (3) in Table 5. In Column (1), we include all the variables in the specification and the coefficient on *Log(Assets)* is positive, but not statistically significant. In Column (2), we omit the variable *Insurers' Rating*, the number of observations increases by 85%, and the coefficient on *Log(Assets)* becomes statistically significant with a t-statistic of 5.18. In Column (3), we omit the firm fixed

effects and include the variation in asset size across insurers. The coefficient on assets is again positive and statistically significant. The estimates imply that a one standard deviation increase in *Log(Assets)* leads to an 8 basis point increase in realized quarterly returns, which is 10% of the median quarterly return (0.8%) and 18% of the standard deviation (0.4%).

Columns (4) - (6) of Table 5 repeat the analysis for life insurers, with similar results. The estimates suggest that larger insurers have higher portfolio returns. The estimated coefficients reported in Column (6) imply that a one standard deviation increase in *Log(Assets)* leads to a 9 basis point increase in realized quarterly returns, which is 8% of the median quarterly return (1.2%) and 16% of the standard deviation (0.5%). Overall, the results in Table 5 suggest that larger insurers achieve higher realized portfolio returns, consistent with the idea that they seek higher expected returns by taking on more risk and illiquidity in their financial portfolios.

4.3. Insurers' Financial Conditions and Investments in Corporate Bonds at CUSIP-level

Section 4.1 suggests that more financially constrained insurers invest larger fractions of their portfolios in cash and government securities than less constrained insurers. Cash and government securities are relatively safe and liquid, and, relative to other securities, are subject to more lenient regulatory treatment through lower risk charges. What makes cash and government securities more attractive to smaller than to larger insurers? It is possible that these portfolio choices occur because of risk and liquidity management incentives to ensure solvency. However, it is also possible that these choices occur because of regulatory reasons since each asset class is treated differently in terms of capital ratios (see Table 1). Regardless of the specific reason, low levels of financial flexibility restrict insurers' ability to bear the risk, illiquidity or regulation in exchange for higher expected returns. The key issue is whether smaller insurers hold more cash and government debt simply due to regulation, or the higher cash and government debt holdings of smaller insurers is at least partially due to the safety and liquidity of cash and government debt.

Distinguishing between these explanations is complicated by the fact that asset classes differ systematically in their risk, their liquidity and their regulatory treatment. However, since securities in a

given asset class (or in a given subgroup within an asset class) are treated the same by regulators, it is possible to evaluate the importance of financial flexibility by examining choices *within* a given asset class. We focus on corporate bonds since they constitute one of the largest categories in insurers' portfolios and have substantial variation in their riskiness and liquidity. In addition, there are commonly accepted measures of corporate bonds' risk and liquidity.

We estimate the way in which P&C insurers' holdings of individual corporate bonds vary with insurers' financial conditions and the bonds' characteristics. We use P&C insurers' CUSIP-level corporate bond holding data to estimate the following specification:

$$Holding\ of\ Bond_{i,j,q} = Financial_{i,q-1} * \big(\beta_1 * Bond\ Worse - Rated_{j,q-1} + \beta_2 * Bond\ Illiquidity_{j,q-1} + \beta_3 * Bond\ Maturity_{j,q} + \beta_4 * Bond\ Coupon\ Rate_j + \beta_5 * Bond\ Downgrade\ Dummy_{j,q-1} + \lambda * Bond\ NAIC\ 1\ Dummy_{j,q-1}\big) + FE_{i,q} + FE_{j,q} + e_{i,j,q}, \quad (4)$$

where *i* indexes insurers, *j* indexes bonds and *q* indexes year-quarters. *Financial* includes a vector of insurers' financial variables, *Log(Assets*), *Insurer Rating, Leverage* and *RBC Ratio*. *RBC Ratio* is only available annually, we use the value from the previous year-end. We also control for insurer-year-quarter and bond CUSIP-year-quarter fixed effects. For a specified insurer, we only consider bonds the insurer actually holds. We use lagged *Bond Worse-Rated* as our measure of the bond's risk. We transform different rating agencies' latest bond ratings to numeric values (see Table A.2 in Appendix), and take the average across different rating agencies. For bonds in the NAIC 1 category, *Bond Worse-Rated* is bonds' average rating. For bonds in the NAIC 2 category, we subtract seven from the average rating, so that the bonds in NAIC 1 and 2 categories have some common support for the variable *Bond Worse-Rated.*

We first estimate the equation using the corporate bonds in the NAIC 1 category in terms of risk charge. Such bonds make up 57% of the corporate bonds held by P&C insurers (equally weighting the bonds). In addition, we also estimate the equation using corporate bonds in both NAIC 1 and 2 categories, which together consist on average 89% of all the corporate bonds held by P&C insurers (equally weighting the bonds).

Panel A of Table 6 contains estimates of this specification. In Columns (1) and (2), the dependent variable is the market value of bond *j* in P&C insurer *i'*s portfolio at the end of quarter *q*, expressed as a fraction of the total market value of all the corporate bonds insurer *i* holds. In Columns (3) and (4), the dependent variable is the market value of bond *j* in P&C insurer *i'*s portfolio at the end of quarter *q*, expressed as a fraction of the insurer *i*'s cash and invested assets. Columns (1) and (3) only include corporate bonds in NAIC category 1, which are the highest quality bonds. Columns (2) and (4) include all corporate bonds in the insurers' portfolios.

The positive and statistically significant coefficients on the interaction term between *Log(Assets)* and *Bond Worse-Rated* suggest that P&C insurers with larger assets have a larger portfolio weight on riskier bonds. To illustrate the magnitude of this difference, suppose there are two corporate bonds: Bond 1 is rated A- and Bond 2 AAA, the difference being six notches. Column (1) suggests that a decrease in insurers' assets by one standard deviation is associated with 0.04 percentage point decrease in the holding of Bond 1 relative to Bond 2, which is 35% of the median (0.12%) and 13% of the standard deviation (0.33%).

The negative, statistically significant coefficients on the interaction term between *Insurer Rating* and *Bond Worse-Rated* suggest that worse-rated insurers have a smaller portfolio weight on riskier bonds. Again, if Bond 1 is rated A- and Bond 2 rated AAA, Column (1) implies that a deterioration in an insurers' rating of 2.5 notches (one standard deviation), is associated with a 0.03 percentage point decrease in the holding of bond 1 relative to bond 2, which is 22% of the median and 8% of the standard deviation. These results are consistent with the idea that more constrained insurers have more risk-management incentives and prefer safer securities than less constrained insurers.

In Columns (2) and (4), the interaction term between *Log Assets* and *Bond NAIC 1 Dummy* has a negative and statistically significant coefficient, suggesting that smaller insurers hold more of bonds in the safer NAIC 1 category relative to the riskier NAIC 2 category. Column (4) suggests that a decrease in insurers' assets by one standard deviation is associated with 0.05 percentage point increase in the holding of bonds in NAIC 1 relative to NAIC 2 category, which is 44% of the median and 16% of the standard deviation. The interaction term between *Insurer Rating* and *Bond NAIC 1 Dummy* has a positive and

statistically significant coefficient, suggesting that worse-rated insurers hold more of bonds in the safer NAIC 1 category relative to the riskier NAIC 2 category. Column (4) implies that a deterioration in an insurers' rating of 2.5 notches (one standard deviation), is associated with a 0.1 percentage point increase in the holding of bonds in NAIC 1 relative to NAIC 2 category, which is 89% of the median and 32% of the standard deviation. These results could be explained by smaller and worse-rated insurers' incentives to achieve higher RBC ratio, since bonds in the NAIC 1 category have a lower risk charge compared to those in the NAIC 2 category. However, these results are also consistent with our conclusion from the within-NAIC category observation: smaller and worse-rated insurers have a stronger preference for safer corporate bonds, compared to other insurers.

Do insurers with different financial conditions have different preferences for bond liquidity? To measure bond illiquidity, we use the number of days without trading scaled by the total number of trading days. The positive, statistically significant coefficients on the interaction term between *Log(Assets)* and *Bond Illiquidity* suggest that P&C insurers with larger assets have larger portfolio weights on riskier bonds. To illustrate the magnitude, consider two corporate bonds, where Bond 1 is more illiquid than Bond 2 by 0.3 (one standard deviation within NAIC 1 category). Column (1) suggests a deterioration in insurers' rating by one standard deviation, is associated with a 0.004 percentage point decrease in the holding of Bond 1 relative to Bond 2, which is 3% of the median and 1% of the standard deviation. The effect of a decrease in insurer assets is similar and also small.

The magnitude of the effect of insurers' financial variables on their holdings across bonds with different risk and liquidity levels is relatively small. These results nonetheless provide evidence that the large difference in holdings across categories between small and large (or worse-rated and better-rated) insurers is at least partially due to the safety and liquidity of cash and government securities relative to MBS and corporate bonds. It does not appear to be entirely driven by the more lenient regulatory treatment of cash and government securities.

4.4. The Financial Crisis, Insurers' Financial Conditions and Investments in Corporate Bonds at CUSIP-level

The previous section finds that, all other things equal, smaller and worse-rated insurers tend to prefer safer corporate bonds. If this result occurs because the smaller and worse-rated insurers are usually more financially constrained, one would expect that during the 2008 Financial Crisis, when the external financing frictions are more severe, smaller and worse-rated insurers' preference for safer bonds would be larger than in other time periods. Panel B of Table 6 tests this idea by adding Financial Crisis interaction terms to the specification from Columns (1) and (2) of Panel A. Columns (1) and (2) of Panel B add interaction terms between the *Crisis Dummy*, *Log Assets*, and all the bond characteristics, where *Crisis Dummy* equals one for 2008 and 2009 (the sample at the bond level starts in 2008) and zero otherwise. The interaction term *Crisis Dummy*Log Assets*Bond Worse-Rated*, as well as the term *Log Assets*Bond Worse-Rated* has a positive and statistically significant coefficient in each column. The estimates suggest that during the periods outside of the crisis, smaller insurers have a higher allocation to safer bonds relative to larger insurers, and such effect is 33% larger during the Financial Crisis. Additionally, results also suggest that smaller insurers' preference for bonds in the safer NAIC 1 category (relative to larger insurers) is stronger during the Financial Crisis.

Columns (3) and (4) of Panel B add the interaction terms between the *Crisis Dummy*, *Insurer Rating*, and all the bond characteristics. The interaction term *Crisis Dummy* Insurer Rating *Bond Worse-Rated*, as well as the term *Insurer Rating *Bond Worse-Rated* has a negative and statistically significant coefficient in each column. The estimates suggest that during the period outside of the crisis, worse-rated insurers have a higher allocation to safer bonds relative to better-rated insurers, and this effect is 133% larger during the Financial Crisis. In addition, results also suggest that worse-rated insurers' preference for bonds in the safer NAIC 1 category is stronger during the Financial Crisis.

4.5. Insurers' Operating Losses and Investments in Corporate Bonds at the CUSIP-level

We have documented that larger insurers tend to take more risky investments than smaller insurers and subsequently earn higher average returns. One possible explanation is that larger insurers have more financial flexibility and therefore are less concerned about meeting potential cash flow requirements. However, it is possible that this relation could occur for other reasons. For example, the higher average returns that come from the riskier investments would mechanically lead to a larger asset size, which would lead insurers who take riskier investments to become larger over time than insurers who are more risk-averse in their investment choices.

A concern with the causal interpretation of the results presented to this point is that insurers' financial conditions can be jointly determined with their investment preferences. Insurers seeking more risk in their portfolios can earn higher returns on average and thus can grow more quickly and appear less constrained. To address this concern, we use insurers' operating losses as shocks to their financial strength. In P&C insurance industry, there is uncertainty about the size and timing of claims, and an unusually large number of claims in a short period of time can represent a shock to an insurer's financial position. Such shocks are especially important in the P&C business, where a disaster, often caused by unusual weather, can lead to a larger number of claims in a region where a particular insurer has a significant market share. Such unusual weather are exogenous shocks that can substantially affect an insurer's financial condition.

We estimate the extent to which operating losses can cause insurers to change their corporate bond holdings. We do so using data on the individual bonds held by each insurer. We use the following specification:

$$Holding\ of\ Bond_{i,j,q} = \alpha * Loss_{i,q-1} * Bond\ Characteristics_{j,q-2} + \beta * Financial_{i,q-2} * Bond\ Characteristics_{j,q-2} + FE_{i,q} + FE_{j,q} + e_{i,j,q}, \quad (5)$$

where *Holding of Bond* is the amount of any particular bond that the insurer holds scaled by the total value of all corporate bonds that the insurer holds. *Loss* is the operating losses due to insurers' underwriting activities (net of reinsurance payments) from *q-1* scaled by insurers' assets from *q*-2.

$Bond\ Characteristics$ is a vector of bond characteristics, including bond rating, illiquidity, and all variables included in Equation (4). To address the concern that operating losses and insurers' financial portfolios can be both related to insurers' unobservable characteristics (e.g. management quality), we instrument for operating losses using the weather-based instrument from Ge (2019) described in Section 3.

Table 7 contains estimates of this equation. Columns (1) - (4) only include bonds in NAIC 1 category. The dependent variable is the insurer *i*'s holding of bond *j* as a fraction of the book value of the insurer's entire portfolio in Columns (1) and (2). Column (1) presents estimates using OLS and Column (2) includes the results when instrumenting for operating losses. In each column, the coefficient on the interaction term between *Loss* and *Bond Rating* is negative and statistically significantly different from zero, suggesting that following operating losses, P&C insurers reduce their holdings of riskier corporate bonds. The estimates in Column (2) imply that following one standard deviation of losses (4.6% of lagged assets), insurers' holdings of bond 1 will decrease by 0.05 percentage points relative to bond 2, which is 39% of the median holding (0.12%) and 14% of the standard deviation (0.33% of cash and invested assets).

Columns (3) and (4) use an alternative dependent variable, in which bond holdings are scaled by the market value of all the corporate bonds held by the insurer. The results are similar to those in Columns (1) and (2), although the coefficients are larger since the dependent variable is scaled by a smaller number (and hence has a larger value). To illustrate the magnitude of the estimated effect, consider two hypothetical corporate bonds, where Bond 1 is rated A- and Bond 2 is rated AAA.

Columns (5) - (8) repeat the specifications presented in Columns (1) - (4) but include all the bonds in NAIC 1 and 2 categories. The results using the larger sample of bonds are similar to those on the sample of NAIC 1 category. The coefficients on the interaction term between *Loss* and *Bond Worse-Rated* are negative and statistically significant in all columns. These results suggest that when P&C insurers have exogenously occurring losses from weather damages, they respond by shifting their portfolios toward safer securities, consistent with Columns (1)-(4).

The interaction terms between *Loss* and *Bond NAIC 1 Dummy* in the specifications presented in Columns (5) through (8) have positive and statistically significant coefficients. These coefficients suggest

that after insurers suffer losses, their preference for bonds in the safer NAIC 1 category over bonds in the riskier NAIC 2 category increases. The estimates in Column (6) imply that following one standard deviation of losses (4.6% of lagged assets), insurers' holdings of bonds in the NAIC 1 category will increase by 0.03 percentage points relative to bonds in the NAIC 2 category, which is 29% of the median holding (0.12%) and 10% of the standard deviation (0.33% of cash and invested assets).

Table 8 examines the way in which insurers adjust their portfolio following losses in more detail, by considering the sales and purchases of bonds separately. In Columns (1) and (2), we estimate the specification described in Equation (5), replacing the dependent variable with the par value of bond *j* that insurer *i* sold in quarter *q*, as a fraction of the par value of bond *j* insurer *i* held at the end of quarter *q-2*. The estimated coefficients on the interaction term between *Loss* and *Bond Rating* are positive, suggesting that insurers sell more of riskier bonds relative to safer bonds following losses. However, these estimated coefficients are not statistically significantly different from zero.

In Columns (3) and (4), we report estimates of Equation (5) in which the dependent variable is the amount spent by insurer *i* for buying bond *j* in quarter *q*, scaled by insurer *i's* cash and invested assets at the end of quarter *q-2*. We include all the corporate bonds that an insurer could conceivably buy — any corporate bond that any insurer bought in that quarter. The coefficients on the interaction term between *Loss* and *Bond Worse-Rated* are negative and statistically significantly different from zero, suggesting that following operating losses, insurers' preference for safer bonds relative to riskier bonds become stronger. In addition, the coefficients on the interaction term between *Loss* and *Bond Illiquidity* are negative and statistically significant, suggesting that, following operating losses, insurers' preference for more liquid bonds relative to less liquid bonds become stronger. Columns (3)-(4) also suggest that smaller insurers buy more safer, more liquid bonds, and bonds in the NAIC 1 category, compared to larger insurers. In addition, worse-rated insurers tend to buy more liquid bonds compared to those purchased by better-rated insurers.

The results in Table 8 are consistent with the idea that when more constrained, insurers shift their portfolio towards safer and more liquid assets. However, the effect is much larger for purchases than for

sales. Rather than paying the transactions costs selling bonds in their portfolios, insurers appear to change their portfolios following losses by replacing bonds that mature with less risky ones.

4.6. Financial Constraints, Insurers' Operating Losses and Investments in Corporate Bonds at the CUSIP-level

The results in Section 4.5 indicate that after operating losses, P&C insurers shift their corporate bond portfolio towards safer corporate bonds. We have argued that this shift likely occurs because the operating losses tighten the financial constraints facing these insurers. This explanation predicts that more financially constrained insurers should shift their portfolios to safe bonds in larger magnitude following losses compared to less constrained insurers, since the marginal cost of additional constraints is likely to be more severe for firms that are already constrained. We also predict that during the 2008 Financial Crisis, when financing frictions are more severe, the effect of operating losses on insurers' allocation across bonds is more pronounced than during periods outside of the crisis. To test these hypotheses, we estimate the following specification:

$$Holding\ of\ Bond_{i,j,q} = \gamma * Fin\ Constraint_{q-2} * Loss_{i,q-1} * Bond\ Characteristics_{j,q-2} + \alpha * Loss_{i,q-1} * Bond\ Characteristics_{j,q-2} + \beta * Financial_{i,q-2} * Bond\ Characteristics_{j,q-2} + FE_{i,q} + FE_{j,q} + e_{i,j,q}. \quad (5)$$

The dependent variable is the market value of bond j in P&C insurer i's portfolio at the end of quarter q, as a fraction of the total market value of all the corporate bonds insurer i holds. $Fin\ Constraint$ is defined in three different ways. In Columns (1) and (2), $Fin\ Constraint$ is *Insurer Small Dummy*, which equals one if the insurer is smaller than the median in quarter *q-2*. In Columns (3) and (4), $Fin\ Constraint$ is *Insurer Worse Rated Dummy*, which equals one if the insurer's rating is worse than the median in quarter *q-2*. In Columns (5) and (6), $Fin\ Constraint$ is the *Crisis Dummy*. $Bond\ Characteristics$ is a vector of bond characteristics, including bond rating, illiquidity, and all other variables controlled for in Table 6. Columns (1), (3) and (5) only use bonds in the NAIC 1 category, while Columns (2), (4) and (6) use bonds in both NAIC 1 and 2 categories, and include the *NAIC 1 Dummy* among the $Bond\ Characteristics$.

Table 9 reports estimates of this equation. The estimated coefficients on the interaction terms of *Fin Constraint*, *Loss* and *Bond Rating* are all negative and statistically significantly different from zero. This result suggests that more constrained insurers decrease their holdings of riskier bonds more than less constrained insurers following operating losses. To illustrate the magnitude of these estimates, compare two hypothetical corporate bonds: Bond 1 is rated A- and Bond 2 is rated AAA. The estimated coefficients in Column (1) imply that, following one standard deviation of losses (4.6% of lagged assets), smaller insurers' holdings of Bond 1 will decrease by 0.03 percentage points (21% of the median holding) relative to Bond 2, compared to the holdings of larger insurers.

These results suggest that when more financially constrained, insurers make larger shifts in their portfolios following losses than less constrained insurers. This result provides additional support for the view that a consideration in structuring insurers' portfolios is to provide funds in the event of a cash flow shortfall. As such, they highlight the role of financial flexibility in the portfolio strategy of insurance companies.

5. Summary and Discussion

Endowments, foundations, pension funds, and insurance companies are among the most important investors in the economy, with U.S. assets totaling over $22 trillion in 2017. These investors are different from professionally managed portfolios such as mutual funds and hedge funds because they rely (at least in part) on the returns generated from their investments to fund their operations. While there has been substantial research on some of these investors' activities such as their activism programs, there has been surprisingly little work on the more basic question of how these investors determine which securities to include in their portfolios. This paper studies the investment decisions of a large sample of insurance companies and evaluates the extent to which financial management practices because of risks coming from the operational side of the firms affect the management of their portfolios.

We consider a sample of 2,084 P&C and 842 life insurance companies between 2001 and 2015, all of which are from the U.S. Insurance companies are important institutional investors that do not control the

timing and the size of claims they must pay. P&C insurers in particular can face large costs when weather-related or other disasters unexpectedly strike. We study how insurers' financial flexibility, measured by their lagged financial variables, affects their portfolio allocation. We also evaluate how insurers change their allocations among corporate bonds following operating losses, and how the extent to which they are financially constrained affects the magnitude of the changes.

We find that more financially flexible insurers have smaller portfolio weights on cash and government securities, and larger weights on MBS and corporate bonds, compared with less flexible insurers. These riskier portfolios should lead more financially flexible insurers to have higher expected returns than less flexible insurers. In our sample, more flexible insurers do have higher realized returns on their investments, probably for this reason.

One issue that is important to address in any study of insurers' portfolios is that of regulation. Insurers' portfolios are regulated in that each asset has a certain "risk capital charge," and the resulting RBC ratio affects whether regulators deem insurers as insolvent. It is possible to control econometrically for the regulatory effects of security choices within an asset class. We choose corporate bonds because they account for the largest share of insurers' portfolios and we can measure their risks and liquidity, which has significant variation among corporate bonds. For this reason, we repeat our analysis on the corporate bond portfolios that our insurers hold. We find that in their choices of corporate bond investments, more flexible insurers tend to invest in riskier and more illiquid bonds than less flexible insurers. This pattern is stronger during the 2008 Financial Crisis, when financial constraints were exacerbated for most firms. These findings support the view that insurers' financial flexibility affects the portfolio choices of insurers independently of any regulation.

It is possible that the results reviewed so far do not reflect the causal effect of insurers' financial condition on their portfolio choices. Insurers' financial conditions could potentially be jointly determined with their investment preferences. Insurers seeking more risk in their portfolios can earn higher returns on average and thus can grow more quickly and appear less constrained. For this reason, we use insurers' operating losses as shocks to their financial flexibility. We estimate the way in which operating losses affect

insurers' portfolios. Our results suggest that following operating losses, P&C insurers reduce their holdings in riskier corporate bonds. This finding also holds when we instrument for insurers' losses with weather damages, which can substantially affect insurers' claims. This result shows that exogenous shocks to insurers' financial strength lead insurers to lower the risk of their portfolios. Insurers with more financial flexibility can afford to take more portfolio risk, and hence receive higher expected returns.

Finally, we consider the role of financial constraints in how insurers change their portfolios following losses. Presumably, the change in financial flexibility when there is a negative financial shock will be larger for firms that are more financially constrained than for firms that are less constrained. Therefore, we expect financially constrained firms to adjust their portfolios more than unconstrained firms in response to a negative financial shock. Empirically, following losses, more financially constrained insurers decrease holdings of riskier corporate bonds by more than less constrained insurers. In addition, we also find that during the 2008 Financial Crisis, insurers make a larger shift to a safer corporate bond portfolio following losses, compared to periods outside of the crisis. These results suggest that insurers have stronger risk-management incentives when they become more financially constrained. As argued by Froot, Scharfstein, and Stein (1993), risk management incentives appear to occur because of the costs of accessing financial markets.

Institutional investors who are not delegated money managers are some of the most important investors in the economy. However, we know surprisingly little about the way in which they make their investment choices. Theory is not clear on the extent to which institutional investors are risk-averse, and the reasons for any risk aversion they do exhibit. By studying insurance companies' portfolio strategies, we hope to understand the decisions of these important investors, and also on the considerations affecting portfolio decisions of institutional investors more broadly.

Our results suggest that more constrained insurance companies make portfolio choices as if they were more risk-averse, plausibly because the increased cost of financial distress exacerbates the downside risk of any investment. The amount of risk they are willing to take is a function of their financial flexibility.

The desire to maintain financial flexibility appears to lead insurers to forego higher expected returns to obtain less risk and greater liquidity in their portfolios.

This study raises a number of questions. Given that there are capital raising costs that limit the ability of insurers to take more risky investments, can we identify the factors leading to these costs and can we quantify their magnitudes directly? Do other institutional investors take advantage of insurers' demand for safe securities and adjust their portfolios based on the changing supply of available securities? How do macroeconomic conditions interact with the change in insurers' investment demands? In particular, does the quality of bonds demanded by insurers vary inversely with the business cycle, leading to the observed increase in the quality of bonds issued during down cycles? Finally, and perhaps most importantly, to what extent are insurers typical of other institutional investors, and how general is the finding that access to capital markets is an important factor in institutional portfolio decisions? These and other related questions would be excellent topics for future research.

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Table 1: BRC Risk Charge for Different Securities

This table presents the regulatory risk capital charge used in calculation of BRC ratio, associated with different categories of securities, for P&C and life insurers, respectively. See Becker and Opp (2014) for MBS.

Security Type	Credit Ratings	NAIC Corporate Bonds Category	Risk Charge	
			P&C	Life
U.S. Treasury Debt and Government Debt (guaranteed and backed by the full faith and credit of the U.S. government)		NA	0	0
Cash		NA	0.3%[12]	0.4%[13]
Bonds Issued by U.S. Government Agencies (not backed by the U.S. government)[14]		NAIC 1	0.3%	0.4%
Corporate Bonds[15] & Municipal Bonds	AAA, AA, A	NAIC 1	0.3%	0.4%
	BBB	NAIC 2	0.96%	1.3%
	BB	NAIC 3	3.39%	4.6%
	B	NAIC 4	7.38%	10%
	CCC	NAIC 5	16.96%	23%
	CC or below	NAIC 6	19.50%	30%
Unaffiliated Common Stock		NA	15%	22.5% ~ 45%[16]
Other Long-Term Assets		NA		
Real Estate		NA	10%	5% ~ 23%[17]
Mortgage Loans		NA	5%	3% ~ 20%
Schedule BA (Private Equity, Hedge Funds ect.)		NA	20%	30%[18]

[12] NAIC (2015a), P10.
[13] NAIC (2015b), P41.
[14] Examples are FNMA and FHLMC collateralized mortgage obligations, see NAIC (2015a) P8.
[15] See Becker and Ivashina (2015), and Becker and Opp (2014).
[16] NAIC (2015b), P16: "30% adjusted in the case of publicly traded stock by the weighted average beta for the portfolio of common stock, subject to a minimum factor of 22.5% and a maximum factor of 45%."
[17] NAIC (2015b), P19.
[18] NAIC (2015b), P23.

Table 2: Summary Statistics

This table presents summary statistics of the data. Panel A offers statistics on insurers' financial variables and their holdings in major categories. In Panel B we sort insurers into tertiles based on lagged assets or insurer rating, and report the average of lagged financial variables and holdings in categories in each subsample. If the averages between the most two extreme subsamples are statistically different at the 5% level, the numbers are marked as bold. Panel C offers statistics on corporate bonds in P&C insurers' holdings at the CUSIP-insurer-year level.

Panel A: Insurers' Financials and Holdings in Major Categories

Variable	N	Mean	Std	25 Pctl	Median	75 Pctl	Total $Billion 2015
P&C Insurers							
Financial Variables							
Asset ($Billion)	28780	0.47	1.48	0.02	0.06	0.24	
Leverage (%)	28780	72.33	71.76	45.16	61.61	72.85	
RBC Ratio	26989	14.88	25.56	4.80	7.78	13.47	
Rating (Larger=Worse)	15972	3.99	2.48	3 (A)	3 (A)	4 (A-)	
Public	28780	0.39	0.49	0.00	0.00	1.00	
Standalone	28780	0.36	0.48	0.00	0.00	1.00	
Underwriting Loss (% of Lagged Assets), >=0	23022	2.35	4.64	0.00	0.00	2.69	
Underwriting Loss (% of Lagged Assets)	23022	-0.16	7.22	-3.27	-0.27	2.69	
Holdings in % of Cash and Invested Assets							
Cash	28780	19.93	25.26	3.82	9.64	24.64	71.77
Treasury	28780	10.60	16.17	0.35	4.05	13.38	54.12
U.S. Gov Agency	28780	6.07	11.94	0.00	0.44	6.45	12.16
Muni Bond	28780	20.74	23.83	0.00	11.59	34.94	252.81
MBS	28780	10.14	13.22	0.00	4.02	16.92	105.91
Corp Bond	28780	18.03	17.63	0.00	14.75	29.51	269.24
Public Stocks	28780	5.43	10.65	0.00	0.00	6.44	147.14
Other	28780	8.41	13.29	0.00	2.47	11.15	317.32
Life Insurers							
Financial Variables							
Asset ($Billion)	13110	4.68	16.19	0.02	0.12	1.29	
Leverage (%)	13110	65.69	30.59	45.10	78.63	91.10	
RBC Ratio	12711	66.77	246.81	6.37	9.82	20.58	
Rating (Larger=Worse)	6663	4.24	2.75	2 (A+)	4 (A-)	5 (B++)	
Public	13110	0.40	0.49	0.00	0.00	1.00	
Standalone	13110	0.21	0.41	0.00	0.00	0.00	
Holdings in % of Cash and Invested Assets							
Cash	13110	15.52	23.75	1.96	5.44	16.98	103.36
Treasury	13110	9.21	17.45	0.15	1.82	8.92	137.55
U.S. Gov Agency	13110	5.77	12.50	0.00	0.56	4.62	48.94
Muni Bond	13110	5.70	11.38	0.00	0.62	5.46	151.00
MBS	13110	13.12	14.22	0.01	9.63	21.00	435.07
Corp Bond	13110	33.88	25.81	6.07	35.94	55.08	1853.40
Public Stocks	13110	1.88	5.38	0.00	0.00	0.44	29.56
Other	13110	14.26	18.22	0.81	8.03	20.70	1016.30

Panel B: Insurers' Holdings in Different Subsamples

		Financial Variables (y-1)				Holdings in % of Cash and Invested Assets (y)							
	N (Firm-Year)	Assets ($Billion)	Leverage (%)	RBC Ratio	Rating Larger=Worse	Cash	Treasury	U.S. Gov Agency	Muni Bond	MBS	Corp Bond	Public Stocks	Other
P&C Insurers													
Sort by P&C Insurers' Assets (y-1)													
Largest	9776	**1.3**	**73.73**	**9.83**	**3.08**	**9.36**	**8.12**	**4.28**	**26.2**	**12.77**	**21.74**	**6.13**	**11.06**
Middle	9498	**0.07**	**73.68**	**14.95**	**4.15**	**16.57**	**11.41**	**7.24**	**22.2**	**11.87**	**19.43**	**4.51**	**6.14**
Smallest	9506	**0.01**	**69.52**	**20.48**	**5.69**	**34.15**	**12.35**	**6.75**	**13.67**	**5.72**	**12.82**	**5.64**	**7.94**
Sort by P&C Insurers' Rating (y-1)													
Best	8352	**1.04**	73.68	**16.67**	**2.54**	**10.76**	**11.16**	**4.59**	**27.86**	**11.57**	18.56	**5.83**	9.01
Middle	3905	**0.24**	72.42	**15.25**	**4.01**	**14.00**	**9.35**	**6.94**	**23.25**	**12.13**	20.25	**5.97**	7.74
Worst	3715	**0.13**	71.75	**11.7**	**7.22**	**20.15**	**10.31**	**8.05**	**17.74**	**10.75**	19.08	**4.76**	8.58
Life Insurers													
Sort by Life Insurers' Assets (y-1)													
Largest	4450	**13.61**	**87.07**	**10.21**	**2.93**	**4.16**	**3.07**	**2.70**	**3.95**	**16.04**	**49.62**	**0.94**	**19.48**
Middle	4325	**0.18**	**69.36**	**24.96**	**4.63**	**10.39**	**7.64**	**6.46**	**7.41**	**15.72**	**36.14**	**2.15**	**13.27**
Smallest	4335	**0.01**	**40.08**	**175.7**	**7.33**	**32.29**	**17.08**	**8.23**	**5.79**	**7.52**	**15.48**	**2.57**	**9.89**
Sort by Life Insurers' Rating (y-1)													
Best	3069	**15.17**	**81.43**	**17.45**	**2.32**	**5.78**	**4.33**	**2.39**	**4.35**	**15.09**	**49.72**	**1.14**	**17.12**
Middle	1838	**1.58**	**71.64**	**21.56**	**4.33**	**9.30**	**7.18**	**6.61**	**8.07**	**16.31**	**39.8**	**1.13**	**11.44**
Worst	1756	**0.63**	**66**	**30.17**	**7.52**	**15.32**	**9.89**	**7.69**	**7.51**	**13.64**	**32.12**	**1.8**	**11.64**

Panel C: Summary Statistics of P&C Insurers' Corporate Bond Holdings, CUSIP-Insurer-Year Level

Variable	N	Mean	Std	25 Pctl	Median	75 Pctl
Book Value/Asset (%)	565426	0.24	0.33	0.04	0.12	0.30
Effective Rate of Interest	563007	4.70	1.96	3.39	4.80	5.78
Bond Rating (Annual Avg)	564255	7.15	2.87	5.25	6.75	8.89
Holding of the Issurers' Other Bonds (%)	565426	0.05	0.13	0.00	0.00	0.01
Years to Maturity	565426	5.85	5.32	3.00	5.00	8.00
Coupon Rate	565426	5.23	1.82	4.13	5.38	6.38
Downgraded Dummy	565426	0.17	0.38	0.00	0.00	0.00
0-Trading Day (%)	565426	34.25	30.19	4.83	27.78	58.97
Imputed Round-trip Transct Cost	565426	0.01	0.00	0.00	0.00	0.01
Bond Unrealized Gain	565426	0.00	0.00	0.00	0.00	0.00
Dummy for NAIC Category = 1	565426	0.57	0.49	0.00	1.00	1.00
Dummy for NAIC Category = 2	565426	0.32	0.47	0.00	0.00	1.00
Dummy for NAIC Category = 3	565426	0.06	0.23	0.00	0.00	0.00
Dummy for NAIC Category = 4	565426	0.04	0.19	0.00	0.00	0.00
Dummy for NAIC Category = 5	565426	0.01	0.09	0.00	0.00	0.00
Dummy for NAIC Category = 6	565426	0.00	0.00	0.00	0.00	0.00
Offering Spread over Treasury	241157	156.54	108.22	83.30	127.30	190.30
Years since Issue	308355	4.13	3.00	2.00	3.00	6.00

Table 3: Insurers' Financial Conditions and Insurers' Financial Strength Rating

The dependent variable is insurers' rating in year *y*. This table estimates how insurers' ratings are related to their lagged financial variables, see equation below. Columns (1)-(3) use P&C insurers, (4)-(6) life insurers. Columns (1), (2), (4) and (5) include year fixed effects, (3) and (5) also firm fixed effects. Standard errors are corrected for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

$Insurers' Rating_{i,y} = \beta * Insurers'\ Financials_{i,y-1} + FE_y(+FE_i) + e_{i,j,y}$, where i indexes the insurer and *y* the year.

Dependent Variable:	Insurers' Rating (y) (Larger Number = Worse Rating)					
	P&C Insurer			Life Insurer		
	(1)	(2)	(3)	(4)	(5)	(6)
log(Assets) (y-1)		-0.52***	-0.36***		-0.68***	-0.30***
		(-9.37)	(-3.87)		(-15.62)	(-2.88)
Leverage (y-1)	0.56	1.19***	0.33**	-1.04*	0.69*	0.76**
	(1.50)	(3.23)	(2.28)	(-1.89)	(1.84)	(2.26)
RBC Ratio (y-1)	-0.005**	-0.004**	-0.002**	0.002	0.002	0.001**
	(-2.56)	(-2.53)	(-2.12)	(1.59)	(1.42)	(2.47)
Direct Premium Written (y-1)	-0.01	-0.17***	-0.01	0.38***	0.24***	0.09***
	(-0.30)	(-3.92)	(-0.61)	(6.58)	(5.17)	(2.65)
Net Income (y-1)	-5.48***	-4.17***	-0.80*	-3.43***	-2.54***	-0.07
	(-3.96)	(-3.68)	(-1.72)	(-4.47)	(-3.84)	(-0.24)
Current Liquidity (y-1)	0.00***	0.00	0.00	0.00**	-0.00	-0.00
	(3.16)	(0.51)	(0.08)	(2.21)	(-1.57)	(-0.74)
Unrealized Capital Gain (y-1)	-2.69***	-1.30*	-0.42	-0.82**	-0.06	0.55***
	(-2.75)	(-1.77)	(-1.49)	(-2.06)	(-0.10)	(3.18)
Asset Grth (y-1)	0.24*	0.51***	0.14**	-0.43*	0.14	0.15
	(1.73)	(3.29)	(2.36)	(-1.78)	(1.23)	(1.42)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE			Yes			Yes
Cluster SE by Firm	Yes	Yes	Yes	Yes	Yes	Yes
N (Firm-Year)	11665	11665	11531	7864	7864	7756
Adj R2	0.047	0.172	0.879	0.162	0.344	0.915

Table 4: Insurers' Financial Conditions and Holdings in Broad Categories

The dependent variable is insurers' holdings of different broad categories of securities in percentage of assets. The independent variables are insurers' lagged financial variables. This table presents results estimating the relationship between insurers' asset allocation to each category of securities and insurers' lagged financial variables, see the equation below. Standard errors are corrected for clustering at the firm level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

$Holding\ of\ Category_{i,j,y} = \beta_1 * Log(Assets)_{i,y-1} + \beta_2 * Leverage_{i,y-1} + \beta_3 * RBC\ Ratio_{i,y-1} + \beta_4 * Insurer\ Rating_{i,y-1} + FE_i + FE_y + e_{i,j,y}$, where i indexes the insurer, j the category of securities (cash, treasury etc.), and y the year.

	P&C Insurers						Life Insurers					
Dependent Var: Holding (y) o	Cash	Treasury	Gov Agency	Muni Bond	MBS	Corp Bond	Cash	Treasury	Gov Agency	Muni Bond	MBS	Corp Bond
(% of cash & invested assets)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log(Assets) (y-1)	-4.10***	-3.76***	-0.04	1.14*	1.47***	3.39***	-4.40***	-2.63***	-0.99**	0.67	1.85***	4.93***
	(-6.15)	(-6.42)	(-0.16)	(1.76)	(3.82)	(6.15)	(-5.60)	(-3.78)	(-2.43)	(1.09)	(3.14)	(6.46)
Leverage (y-1)	0.57**	-0.09	-0.02	0.12	0.03	-0.69***	3.09	-6.02*	3.80	1.50	0.95	1.97
	(2.57)	(-0.46)	(-0.37)	(0.53)	(0.24)	(-3.73)	(0.92)	(-1.87)	(1.63)	(0.57)	(0.33)	(0.54)
RBC Ratio (y-1)	0.01	0.02**	-0.00	-0.01	-0.00	-0.01	0.00	0.00	-0.00	-0.00	-0.00*	-0.00
	(1.05)	(2.31)	(-0.45)	(-0.40)	(-0.41)	(-0.46)	(0.66)	(0.99)	(-0.85)	(-0.89)	(-1.78)	(-0.19)
Insurer's Rating (y-1)	0.34	0.05	-0.03	-0.94***	0.28**	0.08	0.35	0.07	0.08	-0.07	-0.05	-0.40*
(larger number = worse)	(1.64)	(0.36)	(-0.29)	(-4.83)	(2.21)	(0.50)	(1.45)	(0.34)	(0.97)	(-0.39)	(-0.30)	(-1.67)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE by Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	15625	15625	15625	15625	15625	15625	6615	6615	6615	6615	6615	6615

Table 5: Insurers' Financial Conditions and Realized Returns on Financial Investment

The dependent variable is insurers' investment income (dividends and interests) plus realized and unrealized capital gains in quarter q scaled by insurers' cash and invested assets at the end of quarter *q-1*. The independent variables are insurers' lagged financial variables. This table presents results estimating the relationship between insurers' realized returns and their lagged financial variables, see the equation below. Standard errors are corrected for clustering at the year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

$Realized\ Return\ on\ Cash\ \&\ Invested\ Assets_{i,q} = \beta_1 * Log(Assets)_{i,q-1} + \beta_2 * Leverage_{i,q-1} + \beta_3 * RBC\ Ratio_{i,y-1} + \beta_4 * Insurer\ Rating_{i,q-1} + FE_i + FE_q + e_{i,q}$, where i indexes the insurer, q the year-quarter, and y the year.

Dependent Var: Realized Return on Cash & Invested Assets (q)						
	P&C			Life		
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Assets) (q-1)	0.01	0.03***	0.04***	0.00	0.02***	0.03***
	(1.53)	(5.18)	(13.00)	(0.34)	(3.85)	(10.11)
Leverage (q-1)	-0.04*	-0.07***	0.04**	0.08	0.13***	0.51***
	(-1.84)	(-5.15)	(2.07)	(1.55)	(4.29)	(17.13)
RBC Ratio (y-1)	-0.00*	-0.00***	0.00***	-0.00	-0.00	0.00
	(-1.87)	(-2.90)	(2.90)	(-0.59)	(-0.83)	(0.25)
Insurer's Rating (q-1)	-0.00**		-0.01***	0.00		-0.01***
(larger number = worse)	(-2.27)		(-7.74)	(0.10)		(-8.73)
Firm FE	Yes	Yes		Yes	Yes	
Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE by Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes
N	57298	105919	57310	24219	48956	24225

Table 6: Financial Conditions and Corporate Bond Holdings at CUSIP Level, P&C Insurers

The dependent variable is P&C insurer *i*'s holdings of a specific corporate bond *j*, as percentage of *i*'s cash and invested assets in quarter q in both panels. Panel A presents results estimating the following equation. $Holding\ of\ Bond_{i,j,q} = Financial_{i,q-1} * \left(\beta_1 * Bond\ Rating_{j,q-1} + \beta_2 * Bond\ Illiquidity_{j,q-1} + \beta_3 * Bond\ Maturity_{j,q} + \beta_4 * Bond\ Coupon\ Rate_j + \beta_5 * Bond\ Downgrade\ Dummy_{j,q-1} + \lambda * NAIC\ Category\ FE_{j,t}\right) + FE_{i,q} + FE_{j,q} + e_{i,j,q}$, where i indexes the insurer, *j* the bond and *q* the year-quarter. Controls include interaction terms between insurers' leverage and bond characteristics, as well as interactions between insurers' RBC ratio and bond characteristics. In Columns (1) and (2), the dependent variable is the market value of bond *j* in P&C insurer *i*'s portfolio at the end of quarter *q*, as a percentage of the total market value of all the corporate bonds insurer *i* holds. In Columns (3) and (4), the dependent variable is the market value of bond *j* in P&C insurer *i*'s portfolio at the end of quarter *q*, as a percentage of the insurer *i*'s cash and invested assets. Columns (1) and (3) only include corporate bonds in NAIC category 1, those with the best ratings. Columns (2) and (4) include all corporate bonds in insurers' portfolios. Panel B adds extra interaction terms to Columns (1) and (2) in Panel A. Columns (1) and (2) of Panel B add the interaction terms between the *Crisis Dummy*, *Log Assets*, and all the bond characteristics, where *Crisis Dummy* equals one for 2008 and 2009 (the sample at the bond level starts in 2008) and zero otherwise. Columns (3) and (4) of Panel B add the interaction terms between the *Crisis Dummy*, *Insurer Rating*, and all the bond characteristics on top of all the variables in Columns (1) and (2) in Panel A. In both panels, standard errors are corrected for clustering at the CUSIP-year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

Panel A: Financial Conditions and Corporate Bond Holdings at CUSIP Level

Dependent Variable:	Mrkt Value(i,j,q)*100/Cash & Invested Assets(i,q)		Mrkt Value(i,j,q)*100/Mrkt Value of All Corp Bonds Held(i,q)	
	NAIC Category 1	NAIC Category 1 & 2	NAIC Category 1	NAIC Category 1 & 2
	(1)	(2)	(3)	(4)
Log Assets (q-1)*Bond Worse-Rated(q-1)	0.0038***	0.0038***	0.0146***	0.0135***
	(21.56)	(24.70)	(17.55)	(18.84)
Log Assets (q-1)*Bond Coupon Rate	-0.0032***	-0.0027***	-0.0115***	-0.0098***
	(-18.34)	(-20.67)	(-14.42)	(-16.52)
Log Assets (q-1)*Bond Months to Maturity (q)	-0.0018	0.0036***	0.0472	0.0216**
	(-0.45)	(2.63)	(1.20)	(2.35)
Log Assets (q-1)*Bond Illiquidity (q-1)	0.0049***	0.0041***	0.0070*	0.0087***
	(5.84)	(6.62)	(1.78)	(2.97)
Log Assets (q-1)*Bond Downgraded Dummy (q-1)	0.0036***	0.0023***	0.0182***	0.0131***
	(4.12)	(3.46)	(4.18)	(4.04)
Log Assets (q-1)*Bond NAIC 1 Dummy (q-1)		-0.0287***		-0.1033***
		(-38.67)		(-29.70)
Insurer Rating (larger=worse) (q-1)	-0.0018***	-0.0013***	-0.0097***	-0.0075***
*Bond Worse-Rated(q-1)	(-7.68)	(-6.04)	(-8.65)	(-7.71)
Insurer Rating (q-1)*Bond Coupon Rate	-0.0006***	-0.0005***	-0.0016	-0.0025***
	(-2.68)	(-2.63)	(-1.52)	(-3.18)
Insurer Rating (q-1)*Bond Months to Maturity (q)	-0.0202*	0.0048	-0.1192	0.0452
	(-1.68)	(0.83)	(-1.18)	(1.34)
Insurer Rating (q-1)*Bond Illiquidity (q-1)	-0.0052***	-0.0036***	-0.0221***	-0.0264***
	(-4.79)	(-4.29)	(-4.53)	(-6.93)
Insurer Rating (q-1)*Bond Downgraded Dummy (q-1)	-0.0004	-0.0001	0.0051	0.0057
	(-0.35)	(-0.16)	(1.02)	(1.50)
Insurer Rating (q-1)*Bond NAIC 1 Dummy (q-1)		0.0075***		0.0434***
		(7.13)		(9.20)
Controls	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes
N	821940	1364711	823157	1366650

Panel B: Crisis, Financial Conditions and Corporate Bond Holdings at CUSIP Level

Dependent Variable:	Mrkt Value (i,j,q) *100 / Cash & Invested Assets (i,q)			
NAIC Category:	1	1 & 2	1	1 & 2
	(1)	(2)	(3)	(4)
Crisis ('08-'09) Dummy*	0.0012***	0.0014***		
Log Assets (q-1)*Bond Worse-Rated(q-1)	(3.60)	(5.13)		
Log Assets (q-1)*Bond Worse-Rated (q-1)	0.0035***	0.0033***		
	(17.46)	(19.83)		
Crisis ('08-'09) Dummy*			-0.0016***	-0.0020***
Insurer Rating (larger=worse) (q-1) *Bond Worse-Rated (q-1)			(-3.63)	(-5.15)
Insurer Rating (q-1)*Bond Worse-Rated (q-1)			-0.0012***	-0.0004
			(-3.90)	(-1.63)
Controls	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes
N	821940	1364711	821940	1364711

Table 7: Losses and Corporate Bond Holdings at CUSIP Level, P&C Insurers

The dependent variable is P&C insurer *i*'s holdings of a specific corporate bond *j*, as percentage of *i*'s cash and invested assets in quarter *q*. This table presents results estimating the equation below. Controls include all the independent variables used for estimation for Table 6 (including those not shown). Odd columns present OLS results, and even columns the second-stage results of the instrumental variable regressions. The first-stage results corresponding to Column (2) are reported in Table A.3. Standard errors are corrected for clustering at the CUSIP-year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

$$Holding\ of\ Bond_{i,j,q} = \alpha * Loss_{i,q-1} * Bond\ Charateristics_{j,q-2} + \beta * Financial_{i,q-2} * Bond\ Charateristics_{j,q-2} + FE_{i,q} + FE_{j,q} + e_{i,j,q}$$

	NAIC Category = 1				NAIC Category = 1 & 2			
Dependent Variable:	Mrkt Value (i,j,q) *100 / Cash & Invested Assets (i,q)		Mrkt Value (i,j,q) *100 / Mrkt Value of All Corp Bonds Held (i,q)		Mrkt Value (i,j,q) *100 / Cash & Invested Assets (i,q)		Mrkt Value (i,j,q) *100 / Mrkt Value of All Corp Bonds Held (i,q)	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loss (q-1)*Bond Worse-Rated(q-1)	-0.1312***	-0.1681***	-0.4435***	-0.7473**	-0.1088***	-0.1515***	-0.3361***	-0.6131**
	(-7.37)	(-2.61)	(-6.06)	(-1.99)	(-7.32)	(-2.70)	(-5.44)	(-2.21)
Loss (q-1)*Bond Coupon Rate	0.0130	-0.0332	0.1244**	0.7857**	-0.0118	-0.0171	-0.0090	0.3714
	(0.91)	(-0.41)	(2.02)	(2.11)	(-1.13)	(-0.28)	(-0.20)	(1.43)
Loss (q-1)*Bond Months to Maturity (q)	0.0000	0.0019	0.0002	0.0329	-0.1511	0.9292	-0.5343	13.8909
	(0.76)	(0.47)	(0.66)	(0.46)	(-0.83)	(0.83)	(-0.65)	(0.79)
Loss (q-1)*Bond Illiquidity (q-1)	0.0089	0.3566	0.3828	1.2039	-0.0074	0.1854	0.2841	0.7119
	(0.13)	(1.07)	(1.26)	(0.77)	(-0.14)	(0.73)	(1.27)	(0.72)
Loss (q-1)*Bond Downgraded Dummy (q-1)	-0.1254*	-0.3914	-0.5531*	-1.1858	-0.1192**	-0.0841	-0.4472*	0.1961
	(-1.71)	(-0.98)	(-1.70)	(-0.55)	(-2.13)	(-0.27)	(-1.81)	(0.12)
Loss (q-1)*Bond NAIC 1 Dummy (q-1)					0.4935***	0.7454**	1.3595***	3.3970**
					(6.76)	(2.56)	(4.46)	(2.47)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	848671	848218	849175	848722	1418688	1417926	1419495	1418733
Cragg-Donald Wald F statistic		145.787		144.568		1290.103		1323.616

Table 8: Losses and Corporate Bond Disposals & Purchases at CUSIP Level, P&C Insurers

In Columns (1) and (2), the dependent variable is the par value of bond *j* insurer *i* sold in quarter *q*, as a percentage of the par value of bond *j* insurer *i* held at the end of quarter *q-2*. In Columns (3) and (4), the dependent variable with insurer *i's* actual costs for buying bond *j* in quarter *q*, scaled by insurer *i's* cash and invested assets at the end of quarter *q-2*. We include all the corporate bonds that an insurer can theoretically buy—any corporate bond any insurer bought in quarter *q*. Controls include all the independent variables used for estimation for Table 6 (including those not shown). Standard errors are corrected for clustering at the CUSIP-year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

	Sell		Buy	
Dependent Variable:	Par Value Sold (i,j,q) *100 / Par Value of the Bond Held (i,j,q-2)		Actual Costs (i,j,q) *10E8 / Cash & Invested Assets (i,q)	
NAIC Category	1	All	1	All
	(1)	(2)	(3)	(4)
Loss (q-1)*Bond Worse-Rated(q-1)	0.0020	0.0023	-2.6068***	-1.9824***
	(1.14)	(1.40)	(-2.83)	(-2.77)
Loss (q-1)*Bond Coupon Rate	0.0026	0.0011	-0.2234	-0.3177
	(1.28)	(0.69)	(-0.52)	(-1.13)
Loss (q-1)*Bond Months to Maturity (q)	0.0000	-0.0000	0.0002**	-0.0003
	(0.00)	(-1.15)	(2.02)	(-1.22)
Loss (q-1)*Bond Illiquidity (q-1)	0.0001	0.0001	-6.3974**	-7.0677***
	(0.69)	(0.89)	(-2.20)	(-3.72)
Loss (q-1)*Bond Downgraded Dummy (q-1)	0.0107	-0.0053	4.0814	4.4937*
	(1.20)	(-0.72)	(1.14)	(1.70)
Loss (q-1)*Bond NAIC 1 Dummy (q-1)		-0.0082		9.3771***
		(-0.99)		(2.97)
Log Assets (q-2)*Bond Worse-Rated(q-1)	-0.0087	-0.0056	9.0806*	13.7105***
	(-0.72)	(-0.53)	(1.80)	(3.45)
Log Assets (q-2)*Bond Coupon Rate	-0.0655***	-0.0613***	-1.1013	-0.9055
	(-4.98)	(-5.92)	(-0.33)	(-0.41)
Log Assets (q-2)*Bond Months to Maturity (q)	0.0010***	0.0011***	0.0038**	0.0032***
	(2.77)	(3.93)	(2.57)	(2.71)
Log Assets (q-2)*Bond Illiquidity (q-1)	-0.0009*	-0.0009**	307.3318***	244.4617***
	(-1.70)	(-2.00)	(15.22)	(19.05)
Log Assets (q-2)*Bond Downgraded Dummy (q-1)	0.1270*	0.0682	13.2178	5.1661
	(1.79)	(1.22)	(0.54)	(0.31)
Log Assets (q-2)*Bond NAIC 1 Dummy (q-1)		0.0766		-160.9596***
		(1.41)		(-9.08)
Insurer Rating (larger=worse) (q-2)	0.0287*	0.0273**	1.9224	1.8858
*Bond Worse-Rated(q-1)	(1.94)	(1.97)	(0.37)	(0.45)
Insurer Rating (q-2)*Bond Coupon Rate	0.0297*	0.0092	-2.8573	2.8139
	(1.71)	(0.68)	(-0.81)	(1.17)
Insurer Rating (q-2)*Bond Months to Maturity (q)	0.0020***	0.0017***	-0.0020*	0.0035
	(3.98)	(4.05)	(-1.87)	(1.00)
Insurer Rating (q-2)*Bond Illiquidity (q-1)	-0.0015**	-0.0025***	-160.8924***	-140.4793***
	(-2.02)	(-3.76)	(-8.24)	(-10.48)
Insurer Rating (q-2)*Bond Downgraded Dummy (q-1)	0.0913	0.0389	-15.4779	14.3796
	(0.76)	(0.42)	(-0.76)	(0.90)
Insurer Rating (q-2)*Bond NAIC 1 Dummy (q-1)		-0.1599**		-10.7964
		(-2.11)		(-0.59)
Controls	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes
N	819578	1366253	17457838	34467944

Table 9: Financial Constraints, Losses and Corporate Bond Holdings at CUSIP Level, P&C Insurers

The dependent variable is the market value of bond *j* in P&C insurer *i*'s portfolio at the end of quarter *q*, as a percentage of the total market value of all the corporate bonds insurer *i* holds. Controls include all the independent variables used for estimation for Table 6 (including those not shown). Standard errors are corrected for clustering at the CUSIP-year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions. This table presents results estimating the following equation. $Holding\ of\ Bond_{i,j,q} = \gamma * Fin\ Constraint_{q-2} * Loss_{i,q-1} * Bond\ Charateristics_{j,q-2} + \alpha * Loss_{i,q-1} * Bond\ Charateristics_{j,q-2} + \beta * Financial_{i,q-2} * Bond\ Charateristics_{j,q-2} + FE_{i,q} + FE_{j,q} + e_{i,j,q}$. $Fin\ Constraint$ is one of three variables. In Columns (1) and (2), $Fin\ Constraint$ is *Insurer Small Dummy*, which equals one if the insurer is smaller than the median in quarter *q-2*. In Columns (3) and (4), $Fin\ Constraint$ is *Insurer Worse Rated Dummy*, which equals one if the insurer's rating is worse than the median in quarter *q-2*. In Columns (3) and (4), $Fin\ Constraint$ is the *Crisis Dummy*. $Bond\ Characteristics$ is a vector of bond characteristics, including bond rating, illiquidity, and all other variables controlled for in Table 6. Columns (1), (3) and (5) only use bonds in the NAIC 1 category. Columns (2), (4) and (6) use bonds in both NAIC 1 and 2 categories, and include *NAIC 1 Dummy* among the $Bond\ Characteristics$.

Dependent Variable:	Mrkt Value (i,j,q) *100 / Cash & Invested Assets (i,q)					
	Insurer Small Dummy (q-2)		Insurer Worse Rated Dummy (q-2)		Crisis (2008-2009) Dummy	
NAIC Category:	1	1 & 2	1	1 & 2	1	1 & 2
	(1)	(2)	(3)	(4)	(5)	(6)
Financial Constraint Dummy	-0.0932***	-0.0790***	-0.0972***	-0.1216***	-0.0886**	-0.0906**
*Loss (q-1)*Bond Worse-Rated(q-1)	(-2.70)	(-2.84)	(-3.06)	(-4.79)	(-1.98)	(-2.29)
Loss (q-1)*Bond Worse-Rated(q-1)	-0.0717***	-0.0601***	-0.0742***	-0.0264	-0.1088***	-0.0882***
	(-2.65)	(-2.90)	(-3.05)	(-1.44)	(-5.63)	(-5.60)
Financial Constraint Dummy	-0.0100***	-0.0101***	-0.0037***	-0.0032***		
*Bond Worse-Rated(q-1)	(-18.41)	(-21.22)	(-6.51)	(-6.51)		
Financial Constraint Dummy		0.4855***		0.7386***		0.4178**
*Loss (q-1)*Bond NAIC 1 Dummy (q-1)		(3.60)		(5.88)		(2.27)
Loss (q-1)*Bond NAIC 1 Dummy (q-1)		0.2288**		0.0098		0.3987***
		(2.34)		(0.11)		(5.03)
Financial Constraint Dummy		0.0781***		0.0192***		
*Bond NAIC 1 Dummy (q-1)		(33.20)		(8.19)		
Controls	Yes	Yes	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes	Yes	Yes
N	848671	1418688	848671	1418688	848671	1418688

Appendix

Table A.1: Variable Definitions

Firm-Level Financial Variables

Assets	Net admitted assets
Leverage	Total liabilities/net admitted assets
RBC Ratio	See Section 2
Insurers' Rating	Rating from A.M. Best, converted to a numeric value, larger means worse rating. 1 for A.M. Best rating of A++, 2 for A+, 3 for A, 4 for A-, 5 for B++, 6 for B+, 7 for B, 8 for B-, 9 for C++, 10 for C+, 11 for C, 12 for C-, and missing for ratings below or missing.
Net Income	Net income scaled by assets.
Direct Premium Written	Direct premium written scaled by assets.
Current Liquidity	A.M. Best's measure of insurers' liquidity, which "measures the proportion of liabilities (excluding AVR, conditional reserves and separate account liabilities) covered by cash and unaffiliated holdings, excluding mortgages and real estate".
Asset Grth	The admitted assets of the life insurer in year (t - 1) minus that in year (t - 2), scaled by the latter, in percentage.
P&C Operating Loss	Set to zero if net underwriting gain is positive. Equal to the negative of net underwriting gain, scaled by lagged assets, if net underwriting gain is negative. Net underwriting gain is available on Statement of Income in the statutory filings, Line 8 Column 1 in 2014 filing. To break it down, P&C Losses = (losses incurred + loss expenses incurred + other underwriting expenses incurred + aggregate write-ins for underwriting deductions) - (premiums earned + net income of protected cells), and set to 0 if the first bracket is smaller than the second bracket. Life insurers unaffiliated with P&C insurers, when included in regressions, are assigned P&C Losses equal to zero. Losses incurred = losses paid less salvage from direct business and reinsurance assumed - reinsurance recovered + net losses unpaid current year - net losses unpaid prior year.
P&C Weather Exposure	Instrument variable for P&C Loss, see Section 3 for the construction of the variable
CUSIP-Level Bond Variables	
Bond Rating	We first convert bond ratings to numeric values (see Table A.2) and take the average of the ratings across rating agencies
Bond Worse-Rated	For bonds in the NAIC 1 category, Bond Worse-Rated is bonds' average rating. For bonds in the NAIC 2 category, we subtract seven from the average rating.

Months to Maturity	Number of months until the bond matures
Coupon Rate	Reported by the insurers in the regulatory filings
Downgraded Dummy	Dummy variable that equals one if the bond has been downgraded in a time period by any rating agency
Bond Illiquidity	We use 0-Trading Day (%) to proxy for bond illiquidity, which is the percentage of days when no trading for this bond happened relative to the number of trading days
Dummy for NAIC Category = i	Dummy variable that equals one if the bond belongs to NAIC category i

Table A.2: Conversion from Bond Rating to Numeric Value

This table shows how we convert rating agencies rating to a numeric value.

Fitch	**S&P**	**Moody's**	**Numeric Code**
AAA	AAA	Aaa	1
AA+	AA+	Aa1	2
AA	AA	Aa2, Aa	3
AA-	AA-	Aa3	4
A+	A+	A1	5
A	A	A2, A	6
A-	A-	A3	7
BBB+	BBB+	Baa1	8
BBB	BBB	Baa2, Baa	9
BBB-	BBB-	Baa3	10
BB+	BB+	Ba1	11
BB	BB	Ba2, Ba	12
BB-	BB-	Ba3	13
B+	B+	B1	14
B	B	B2, B	15
B-	B-	B3	16
CCC+	CCC+	Caa1	17
CCC	CCC	Caa2, Caa	18
CCC-	CCC-	Caa3	19
CC	CC	Ca	20
C	C	C	21
DDD			23
DD			24
D	D		25
SUSP	SUSP	SUSP	26

Table A.3: Losses and Corporate Bond Holdings at CUSIP Level, P&C Insurers, Instrumental Variable Approach, First Stage

This table presents the first-stage results estimating Equation (4), using the instrumental variable approach, corresponding to Column (2) in Table 7. Standard errors are corrected for clustering at the CUSIP-year-quarter level. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels. See Table A.1 for variable definitions.

Dependent Variable:	Loss (q-1)*Bond Rating (larger=worse) (q-1)	Loss (q-1)*Bond Coupon Rate	Loss (q-1)*Bond Months to Maturity (q)	Loss (q-1)*Bond Illiquidity (q-1)	Loss (q-1)*Bond Downgraded Dummy (q-1)
	(1)	(2)	(3)	(4)	(5)
Weather Exposure (q-1)*Bond Rating (larger=worse) (q-1)	0.5563***	0.0117	-1.1704	0.0019	-0.0021
	(24.91)	(1.23)	(-1.64)	(0.84)	(-1.54)
Weather Exposure (q-1)*Bond Coupon Rate	-0.0018	0.4468***	0.9749	0.0005	0.0003
	(-0.17)	(32.16)	(0.45)	(0.24)	(0.24)
Weather Exposure (q-1)*Bond Months to Maturity (q)	-0.0000	0.0000	0.4695	-0.0000*	-0.0000
	(-0.84)	(0.31)	(0.54)	(-1.75)	(-0.22)
Weather Exposure (q-1)*Bond Illiquidity (q-1)	0.0717	0.0545	1.6083	0.5761***	-0.0097*
	(1.40)	(1.18)	(0.21)	(33.46)	(-1.88)
Weather Exposure (q-1)*Bond Downgraded Dummy (q-1)	-0.1370*	-0.0213	1.5895	-0.0273**	0.5790***
	(-1.88)	(-0.37)	(0.33)	(-2.05)	(11.72)
Controls	Yes	Yes	Yes	Yes	Yes
CUSIP-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
Firm-Year-Quarter FE	Yes	Yes	Yes	Yes	Yes
Cluster SE by CUSIP-Year-Quarter	Yes	Yes	Yes	Yes	Yes
N	848722	848722	848722	848722	848722