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Is Historical Cost Accounting a Panacea? Market Stress, Incentive Distortions, and Gains Trading

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ABSTRACT

Accounting rules, through their interactions with capital regulations, affect financial institutions' trading behavior. The insurance industry provides a laboratory to explore these interactions: life insurers have greater flexibility than property and casualty insurers to hold speculative-grade assets at historical cost, and the degree to which life insurers recognize market values differs across U.S. states. During the financial crisis, insurers facing a lesser degree of market value recognition are less likely to sell downgraded asset-backed securities. To improve their capital positions, these insurers disproportionately resort to gains trading, selectively selling otherwise unrelated bonds with high unrealized gains, transmitting shocks across markets.

THIS PAPER EXPLORES THE TRADING INCENTIVES of financial institutions induced by the interaction between regulatory accounting rules and capital requirements (Heaton, Lucas, and McDonald (2010)). The theoretical literature (e.g., Allen

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and Carletti (2008), Plantin, Sapra, and Shin (2008), and Sapra (2008)) argues that mark-to-market (MTM), or fair value, accounting leads to the forced selling of assets by financial institutions during times of market stress, resulting in a downward liquidity and price spiral and potential contagion effects for other markets,[1] whereas historical cost accounting (HCA) may avoid fire sales and contagion effects. In contrast to this view on HCA, we provide empirical evidence showing that, when interacting with regulatory capital requirements, HCA induces incentives to "gains trade" where, in order to shore up capital, an institution selectively sells otherwise unrelated assets with high unrealized gains.[2]

The role of MTM during the recent financial crisis has generated intense debate. The accounting rules followed by financial institutions may appear to simply be a measurement issue, which, in frictionless markets, is free of any impact on economic fundamentals. However, when markets are illiquid and trading frictions high, financial assets may temporarily trade at market prices that are well below fundamental values (Duffie (2010)). In such an environment, write-downs and impairments associated with the deterioration of asset prices will lead to an erosion of financial institutions' capital base, potentially forcing the liquidation of some assets. Allen and Carletti (2008) argue that, in such an environment, HCA can help avoid fire sales. In a similar vein, Plantin, Sapra, and Shin (2008) argue that MTM generates excessive volatility in prices, degrading their information content and leading to suboptimal decisions by financial institutions.

However, HCA may also lead to inefficiencies. Financial institutions using HCA have incentives to engage in selective asset sales aimed at the early realization of earnings (Laux and Leuz (2009)). Indeed, Plantin, Sapra, and Shin (2008) note that HCA is not immune to these inefficiencies in normal times when asset prices are high. In this paper, we focus on the implications of this incentive for gains trading and its impact on financial institutions' portfolios during times of market stress. We argue that it is precisely during these episodes that financial institutions have the greatest need to realize gains in order to improve capital positions.

To focus ideas, consider a setting in which financial institutions are regulated by a risk-weighted capital adequacy metric. For example, insurance regulators employ the Risk-Based Capital ratio (RBC ratio)—the ratio of statutory equity capital to required capital.[3] A low RBC ratio indicates financial weakness. Now

[1] This view has received support from the banking industry as well. In a letter to the SEC in September 2008, the American Bankers Association was of the opinion that, among several factors that led to the financial crisis, "one factor that is recognized as having exacerbated these problems is fair value accounting."

[2] Bleck and Liu (2007) theoretically examine the economic consequences of MTM and HCA. They show that HCA may distort management's incentives, and, in some cases, may induce behavior similar to "gains trading" when management tries to signal good project quality to the market. See also Berger, Herring, and Szego (1995).

[3] This ratio is similar in spirit to various capital ratios used by bank regulators. For more details on the RBC ratio as well as the analysis that follows, please refer to Section I.

consider an institution that has invested heavily in asset-backed securities (ABS). During the crisis of 2007 to 2009, many ABS were severely downgraded by rating agencies, putting downward pressure on the institution's RBC ratio. Broadly speaking, such downgrades are likely to increase the institution's RBC (the denominator of the RBC ratio), as it is a function of each asset's credit rating. ABS downgrades may also decrease the institution's statutory equity capital (the numerator of the RBC ratio) if the downgraded assets are marked to market or impaired.[4] Given this pressure, the institution then faces a stark decision: either sell the downgraded ABS to reduce the required RBC or retain them and raise additional capital elsewhere.

Because the downgraded assets experience significant price declines, a crucial determinant of the institution's decision is whether the price declines are (or will soon be) reflected in its statutory equity capital. This is where the accounting treatment of these assets is likely to have a first-order effect on trading and portfolio choices. If the downgraded asset is held under MTM, the price decline would be automatically reflected in the balance sheet, and the loss would directly reduce the institution's statutory equity capital. From a purely accounting perspective, the institution would be indifferent between keeping the asset and selling it. However, from a regulatory capital perspective, selling the downgraded asset has an important advantage, as swapping a speculative-grade asset for either cash or an investment-grade asset immediately reduces the required RBC and improves the RBC ratio. Taken together, selling the downgraded asset is unambiguously beneficial if the asset is held at market value.

The situation is very different if the downgraded asset is held under HCA, as the decline in value would not be recognized in the balance sheet unless the institution sold the asset. Selling the asset thus has two opposing effects on the RBC ratio: (i) a positive effect from reducing the required RBC, and (ii) a negative effect from recognizing the price decline in its statutory equity capital. If the price decline were very large, as was the case for many downgraded ABS in the recent crisis, the negative effect would likely dominate and selling the asset would not be beneficial. To maintain a healthy RBC ratio, the institution may need to resort to other measures. It is precisely in this situation that the incentive for gains trading is increased: in order to shore up its capital positions, the institution may selectively sell those assets held under HCA with the largest unrealized gains, as doing so these gains are realized and flow to its statutory equity capital.

In this paper, we use the insurance industry as a natural laboratory to investigate the above arguments, in particular, whether financial institutions using HCA for troubled assets, compared to those using MTM, are less likely to directly sell the troubled assets and more likely to gains trade. Under the

[4] In Section I.A, we demonstrate that, under the NAIC model regulation, downgrades of ABS from investment to speculative grade reduce the RBC ratios of virtually all insurers holding these assets. However, the precise impact depends on the severity of the downgrades and the associated price declines, as well as the accounting treatment used to book the downgraded assets.

National Association of Insurance Commissioners' (NAIC) model regulation, property and casualty (P&C) and life insurers use the same accounting rules for investment-grade assets but significantly different rules for speculative-grade assets. When an asset is downgraded to speculative grade, P&C insurers have to recognize its value as the lower of book or market value. In contrast, life insurers can largely continue to hold the downgraded asset under HCA. We focus on the 2007 to 2009 crisis, during which thousands of ABS were sharply downgraded and, for some insurers, capital constraints became practically binding. In this environment, the different accounting rules, interacting with the capital adequacy rules, are likely to induce significantly different trading behaviors between life and P&C insurers, particularly those that are most exposed to ABS downgrades.

Our first empirical strategy is to contrast the behaviors of life and P&C insurers, exploiting the stark difference in their regulatory accounting rules for downgraded ABS. We refer to this strategy as the *between-insurance-type* analysis. We recognize, however, that life and P&C insurers differ along many other dimensions and that regulatory accounting rules, while not a choice variable at the individual insurer level, are not the only relevant factors. Differences in the business models between the two types, for example, may lead to commensurate differences in their investment strategies. To address this problem, we also use a second identification strategy—*within-life* analysis—that exploits variation within the life insurance sector in the implementation of NAIC model regulation across U.S. states (insurance regulation in the U.S. takes place at the state level). State-level insurance codes allow for differences in the amount of discretion the local regulatory authority has to require the recognition of market information for downgraded assets; certain states allow their insurance commissioners to be more aggressive in requiring value recognition whereas other states do not. We compare trading behaviors across life insurers domiciled in these two groups of states. This within-life analysis helps rule out alternative mechanisms that may drive the results obtained from the between-insurance-type analysis.

We examine a panel of 1,882 life and P&C firms over the 2004 to 2010 period for which portfolio-security level positions and transactions data are readily available through NAIC. We first find that P&C firms (booking downgraded assets under MTM) are significantly more likely than life firms (generally booking downgraded assets under HCA) to sell their ABS holdings affected by downgrades. Similarly, life insurers domiciled in states that impose a greater degree of market value recognition than strictly required by the NAIC model regulation are more likely to sell the affected ABS, compared to life insurers domiciled in other states.

Second, we find that insurers most impacted by ABS downgrades disproportionately sell otherwise unrelated government and corporate bonds with the highest unrealized gains. Further, among the most impacted firms, those with RBC ratios in the lowest quartile are significantly more likely than others to engage in gains trading, suggesting that insurers use gains trading in part to counteract the negative impact of ABS downgrades on their capital positions.

Most importantly, gains trading is significantly more prevalent among life insurers than P&C insurers. Our within-life analysis provides additional supportive evidence: life insurers domiciled in U.S. states that strictly implement the NAIC model regulation, and thus are more likely to keep the downgraded ABS under HCA, engage in significantly more gains trading than life insurers domiciled in other states.

Although we believe that our within-life analysis provides a clean identification, we contend that the life versus P&C comparison provides useful complementary evidence given the striking contrast in accounting rules. To ensure robustness, we directly examine plausible alternative explanations, and find that they do not explain the differences in trading between life and P&C firms, which remain in the subsamples of life and P&C insurers that (1) are equally and consistently profitable, (2) belong to a universal group that includes both insurance types, and (3) have similar liability structures as measured by fixed-income portfolio duration.

The final question we examine is whether HCA, through its interaction with capital adequacy rules, ultimately engenders price pressure in the assets targeted for gains trading. To address this question, we investigate returns of corporate bonds and find that bonds carrying large unrealized gains in the balance sheet of life insurers significantly underperform otherwise similar bonds during the crisis, when gains trading is most widespread. These price pressures are even more pronounced if life insurers holding high-unrealized-gain bonds are domiciled in U.S. states that strictly follow the NAIC model regulation and allow these insurers full discretion not to recognize the depressed market value of downgraded ABS. Overall, these results show that HCA can also create unintended consequences where contagion effects are not entirely avoided.

Our paper is related to several strands of the literature. We contribute to the growing body of research that explores the trading decisions of institutional investors when facing a financial shock (e.g., Anand et al. (2013), Boyson, Helwege, and Jindra (2011), Manconi, Massa, and Yasuda (2012), and Hau and Lai (2013), among others). To the best of our knowledge, we are the first to empirically demonstrate the importance of the interaction between accounting and capital regulations on institutional investors' trading decisions and the spillover effects that may result. In contrast to earlier efforts,[5] we show that gains trading, an unintended consequence of HCA, takes place during periods of market stress and can generate significant spillover effects. Furthermore, we are the first to investigate gains trading at the security level, as opposed to the aggregate portfolio level, which allows us to better identify gains trading from other strategic trading motives and demonstrate its potential price impact.

[5] Carey (1994) finds evidence of gains trading by banks during 1979 to 1992. He finds that, at the bank level, most banks appear to gains trade to realize earnings as they appear (snacking) or to smooth earnings over time; very few manage tax liabilities or regulatory capital. See also Scholes, Wilson, and Wolfson (1990), Beatty, Chamberlain, and Magliolo (1995), Hirst and Hopkins (1998), Kashyap and Stein (2000), and Lee, Petroni, and Shen (2006) (some refer to gains trading as "cherry picking."

Most importantly, our results contribute to the debate on the choice of accounting system used in regulating financial institutions.[6] The literature (mostly theoretical) suggests that, during a financial crisis, MTM may cause distressed selling and financial instability (Allen and Carletti (2008), Plantin, Sapra, and Shin (2008), and Wallison (2008)).[7] Merrill et al. (2013) provide evidence consistent with this prediction, focusing on insurers' trading in residential mortgage-backed securities (RMBS) following modifications in their accounting rules. We provide new empirical evidence that suggests the debate surrounding financial institutions' accounting choices may be oversimplified, as it ignores important interactions between these choices and the regulatory framework. Specifically, our evidence supports Laux and Leuz's (2009, 2010) conjecture that HCA is not an unambiguous panacea.

The remainder of the paper is organized as follows. In Section I, we discuss the regulatory accounting and capital adequacy rules, and we formally develop our hypotheses. Section II discusses the sample construction and provides relevant summary statistics. Section III presents our main empirical analysis, contrasting the trading behavior of insurers facing different accounting rules during the wave of significant ABS downgrades. In Section IV, we investigate the effects of gains trading on security prices. Section V concludes. We present additional results in an Internet Appendix.[8]

I. Institutional Framework and Hypothesis Development

A. RBC Ratio and Impact of ABS Downgrades under Different Accounting Rules

The RBC ratio is an essential capital adequacy metric in U.S. insurance regulation. The RBC ratio is defined as[9]

$$\text{RBC ratio} = \frac{\text{Total adjusted capital } (TAC)}{\text{Risk-based capital } (RBC)},$$

where *TAC* consists primarily of capital and surplus, and *RBC* is the required capital that reflects both business and asset risks. The NAIC model regulation requires that the RBC ratio exceed a value of two, but earlier regulatory action may be taken following significant declines.[10]

[6] Goh et al. (2015) analyze the determinants of accounting choice and the effects of fair value disclosure on firms' information environment. See also Eccher, Ramesh, and Thiagarajan (1996), Petroni and Wahlen (1995), and Wyatt (1991).

[7] See Veron (2008) and Bleck and Liu (2007) for an opposing view.

[8] The Internet Appendix is available in the online version of the article on *The Journal of Finance* website.

[9] In banking, a key capital adequacy metric is the capital ratio, defined as the ratio of equity capital to risk-weighted assets. This ratio must be higher than a required minimum, say 6%. In insurance, this required minimum and the risk weight apply directly to each asset in calculating RBC. Thus, the RBC ratio is essentially the capital ratio divided by 6%.

[10] Specifically, in certain U.S. states that use "trend tests," a negative three-year trend in such metrics, coupled with an RBC ratio of three or below, may prompt a regulatory investigation.

To understand how ABS downgrades affect an insurer's RBC ratio, we isolate ABS from other components of *TAC* and *RBC* to rewrite the RBC ratio as

$$\frac{TAC^{*} + ABS}{RBC^{*} + (\lambda_{ABS} \times ABS)},$$

where TAC^{*} is *TAC* minus the book value of ABS, *ABS* is the book value of ABS, RBC* is *RBC* minus the required capital for ABS, and λ_{ABS} is the percentage required capital for ABS.[11] From this expression, it is easy to see that ABS downgrades affect the RBC ratio through two channels. First, ABS downgrades increase the percentage required capital, λ_{ABS}, which increases *RBC* and decreases the RBC ratio. Second, depending on the applicable accounting rule, the book value of ABS may also decline, leading to a decrease in both *TAC* and *RBC* and thus having a potentially ambiguous effect on the RBC ratio.

Below, we demonstrate that, for a realistic range of parameters, as determined by the RBC ratios of insurers in our sample and the NAIC capital requirements, downgrades of ABS from investment to speculative grade decrease the RBC ratio under every accounting rule, that is,

$$\frac{TAC^{*}+ABS^{\,post}}{RBC^{*}+\left(\lambda_{ABS}^{post}\times ABS^{\,post}\right)} < \frac{TAC^{*}+ABS^{\,pre}}{RBC^{*}+\left(\lambda_{ABS}^{pre}\times ABS^{\,pre}\right)}, \tag{1}$$

where the superscripts "*pre*" and "*post*" denote the values of a variable before and after the downgrades, respectively.

Case 1: MTM. The new, lower market value of downgraded ABS is immediately reflected on an insurer's balance sheet, that is, $ABS^{\,post} < ABS^{\,pre}$. The numerator effect is always negative: the decline in market value decreases *TAC* and in turn the RBC ratio. The denominator effect, however, is ambiguous ($\lambda_{ABS}^{post} \times ABS^{post} \geq \lambda_{ABS}^{pre} \times ABS^{\,pre}$). If the decline in market value is very large relative to the increase in percentage required capital, then RBC for the downgraded ABS may decrease, countering the numerator effect and pushing the RBC ratio higher. Thus, whether ABS downgrades reduce the RBC ratio depends on the values of the different variables in (1). To map these variables to what we observe in our empirical setting, we rewrite (1) as

$$y\left[\lambda_{ABS}^{post} - (RBC\ ratio^{\,pre})^{-1}\right] > \lambda_{ABS}^{pre} - (RBC\ ratio^{\,pre})^{-1}, \tag{2}$$

where $y = ABS^{\,post}/ABS^{\,pre}$, which is the ratio of post-downgrade to pre-downgrade book values of the ABS. We now demonstrate that inequality (2) holds for all insurers in our sample under the NAIC model regulation, that is, under MTM, ABS downgrades decrease the RBC ratio in all possible market scenarios. First, note that the right-hand side of (2) is always negative, and in fact, is less than or equal to $0.014 - 0.050 = -0.036$, since the largest percentage required capital for investment-grade assets is 1.40%

[11] In a broad sense, *ABS* here can be thought of as representing all downgraded assets.

($\lambda_{ABS}^{pre} \leq 0.014$)[12] and the RBC ratios of our sample insurers are between two and 20 ($0.5 \geq (RBC\ ratio^{pre})^{-1} \geq 0.050$). Second, note that the left-hand side of (2) may be positive or negative because the percentage required capital for speculative-grade assets, λ_{ABS}^{post}, can be higher or lower than 0.050 (e.g., λ_{ABS}^{post} for assets rated B and CCC is 0.046 and 0.100, respectively). If the left-hand side is positive, inequality (2) must hold since the right-hand side is always negative. If the left-hand side is negative, then (2) becomes

$$y < \frac{\lambda_{ABS}^{pre} - \left(RBC\ ratio^{pre}\right)^{-1}}{\lambda_{ABS}^{post} - \left(RBC\ ratio^{pre}\right)^{-1}}, \tag{3}$$

which always holds as well, since $y < 1$, but $\lambda_{ABS}^{post} > \lambda_{ABS}^{pre}$ and $\lambda_{ABS}^{post} - (RBC\ ratio^{pre})^{-1} < 0$ together imply that the ratio on the right-hand side of (3) is greater than one.

Case 2: HCA. If the downgraded ABS remain under HCA, then $ABS^{post} = ABS^{pre}$, and because $\lambda_{ABS}^{post} > \lambda_{ABS}^{pre}$, inequality (1) always holds: ABS downgrades unambiguously decrease the RBC ratio.

Case 3: HCA with Other-Than-Temporary-Impairment. The downgraded ABS remain under HCA but are impaired, reflecting a new, lower market value. According to the NAIC model regulation, if the decline in the market value of an asset is *deemed other than temporary*,[13] then insurers using HCA for the asset should recognize such a decline as a one-time loss through the so-called other-than-temporary impairment (OTTI). In this case, $ABS^{post} = ABS^{pre} - \text{OTTI} < ABS^{pre}$, making HCA with OTTI essentially the same as MTM for the purpose of evaluating the immediate impact of ABS downgrades. Therefore, as with MTM, ABS downgrades decrease the RBC ratio.

B. Responses to ABS Downgrades under Different Accounting Rules

As shown above, downgrades of ABS from investment to speculative grades decrease the RBC ratios of insurers holding these assets. Each affected insurer has a few options to bring its RBC ratio back to a healthy level: (i) lower the denominator by selling the downgraded ABS and swapping into lower-risk assets, (ii) increase the numerator by selling unrelated assets with high unrealized gains (Laux and Leuz (2009, 2010)), and (iii) increase the numerator by raising new equity capital (Berry-Stolzle, Nini, and Wende (2014)).[14] In this paper, we focus on options (i) and (ii). We begin by examining whether option

[12] Please refer to the Internet Appendix for the actual percentage required capitals under the NAIC model regulation.

[13] The exact language, provided in SSAP 26 (clause 9), is as follows: "... an impairment shall be considered to have occurred if it is probable that the reporting entity will be unable to collect all amounts due according to the contractual terms of a debt security in effect at the date of acquisition. ..."

[14] Koijen and Yogo (2014a) show that some life insurers with low RBC ratios raised statutory surplus (numerator) by selling long-term policies at prices below break-even but above the required

(i) is beneficial under each accounting rule. We then discuss the extent to which option (ii) is employed as a supplementary measure. At the end of this subsection, we summarize all arguments and develop our general hypotheses.

Selling the downgraded ABS and swapping into lower-risk, or investment-grade, assets is beneficial if doing so improves the RBC ratio, that is,

$$\frac{TAC^{*}+INV}{RBC^{*}+(\lambda_{INV}\times INV)} > \frac{TAC^{*}+ABS^{\,post}}{RBC^{*}+\left(\lambda_{ABS}^{post}\times ABS^{\,post}\right)}, \tag{4}$$

where *INV* is the book value of the investment-grade assets bought with the proceeds from selling the downgraded ABS at their market value, and λ_{INV} is the percentage required capital for the investment-grade assets.

Case 1: MTM. Under MTM, the decline in market value of the downgraded ABS is reflected on the balance sheet, that is, $INV = ABS^{\,post}$. Thus, from an accounting perspective, the insurer holding the downgraded ABS would be indifferent between keeping and selling them. However, from a regulatory capital perspective, selling the downgraded ABS has an advantage, as doing so immediately reduces the required capital, that is, $\lambda_{INV} < \lambda_{ABS}^{post}$. Taken together, inequality (4) always holds: selling the downgraded ABS is unambiguously beneficial.[15,16]

Case 2: HCA. Under HCA, the decline in market value of the downgraded ABS has not yet been recognized and therefore $INV < ABS^{\,post}$. From an accounting perspective, selling the downgraded ABS would force recognition of their new lower market value, negatively impacting *TAC* and hence decreasing the RBC ratio. However, from a regulatory capital perspective, switching from speculative-grade ABS to investment-grade assets reduces *RBC* ($\lambda_{INV}\times INV < \lambda_{ABS}^{post}\times ABS^{\,post}$) and hence increases the RBC ratio. Thus, whether selling the downgraded ABS is beneficial depends on the trade-off between the negative numerator effect and the positive denominator effect. From inequality (4), the insurer should sell if

$$z > \frac{(RBC\ Ratio^{\,post})^{-1} - \lambda_{ABS}^{post}}{(RBC\ Ratio^{\,post})^{-1} - \lambda_{INV}}, \tag{5}$$

where $z = INV/ABS^{\,post}$, or equivalently, the ratio of the market to book values of the downgraded ABS. For our sample of insurers under the NAIC model regulation, $(RBC\ ratio^{post})^{-1} \geq 0.05$ and $\lambda_{INV} \leq 0.014$; thus, the denominator

reserve. In addition, Koijen and Yogo (2014b) show that some insurers have flexibility to reduce the denominator using shadow insurance.

[15] We assume that the selling insurer is a price taker, while in reality selling the downgraded assets may induce further losses (a fire-sale feedback effect). This complication may explain why P&C firms, using MTM for speculative-grade ABS, or life firms that have recognized OTTI, do not immediately sell all downgraded ABS.

[16] In the case of MTM, selling the downgraded ABS also helps avoid a future slip in the RBC ratio should the asset price decline further at a later date ($INV = ABS^{\,post} > ABS^{\,post} +$ Expected Future Losses from Price Decline). This is because the precise rule for MTM is "the lower of book or market value," and therefore the insurer facing MTM can only lose from price movements (unlike HCA).

on the right-hand side of (5) is always positive. It is clear that the larger the required capital that can be saved (i.e., larger λ_{ABS}^{post}), the lower the right-hand-side threshold and the more likely that inequality (5) will hold.[17] However, the lower the market value (i.e., the larger the losses that will be realized from selling or lower z), the less likely that inequality (5) will hold. Thus, if the decline in market value of the downgraded ABS is very large, as was the case for many ABS in the recent crisis, selling the downgraded ABS will not be beneficial. In Figure IA1 of the Internet Appendix, we plot the empirical histograms of z in 2008 and 2009 to show that, for many (but not all) ABS positions, selling is not beneficial.

Case 3: HCA with OTTI. Similar to Case 1 (MTM), $INV = ABS^{post}$ and $\lambda_{INV} < \lambda_{ABS}^{post}$, and hence inequality (4) always holds: selling the downgraded ABS is unambiguously beneficial.

Having described whether selling downgraded ABS is beneficial under each accounting rule, we now turn to gains trading, defined as selectively selling unrelated assets held under HCA that have the largest unrealized gains. By selling these assets, insurers realize the gains, which flow directly to *TAC* on a one-for-one basis and thus help improve the RBC ratio. In this sense, for insurers impacted by ABS downgrades, gains trading and directly selling the downgraded ABS are partial substitutes in returning to a healthy capital position. Therefore, all else equal, insurers that have already sold downgraded ABS will have a smaller incentive to engage in gains trading than insurers that have not. Since insurers that use HCA are less likely to benefit from selling the downgraded ABS, they should have a greater incentive to gains trade than others that use MTM.

In Appendix A, we summarize the above discussion. In Appendix B (brief version) and the Internet Appendix (detailed version), we provide numerical examples to demonstrate the interactions among the many moving parts that affect an insurer's capital position in the event of downgrades. In this example, we use real (though simplified) balance sheet data from two representative insurers, one life insurer and one P&C insurer, that are expected to suffer a large and similar decline in RBC ratio given their holdings of ABS at the end of 2007.[18] The example illustrates our basic algebra: selling the downgraded ABS reflects the trade-off between the benefit of reducing the required capital (the denominator effect) and the cost of recognizing the large decline in market value (the numerator effect). For the P&C firm using MTM (and the life firm using HCA with OTTI), the numerator effect is zero and therefore selling the downgraded ABS is beneficial. For the life firm using HCA, the numerator effect can be large and trump the denominator effect; selling the downgraded ABS

[17] This means that, all else being equal, the ABS that are more severely downgraded (e.g., to CCC) are more likely to be sold. In the extreme, the numerator on the right-hand side may be negative and the downgraded ABS should be sold regardless of their market value.

[18] For simplicity, we assume that life insurers recognize OTTIs on either all downgraded positions or none. In reality, life insurers recognize OTTIs on some positions and do not on others (with the latter being more likely), and therefore their behavior should vary across positions.

would further reduce the RBC ratio, and therefore gains trading is especially needed.

We summarize the general predictions of the above arguments as follows:

GENERAL HYPOTHESIS 1: *Financial institutions have a larger incentive to sell downgraded positions held at MTM than otherwise similar positions held under HCA.*[19]

GENERAL HYPOTHESIS 2: *Financial institutions holding downgraded positions under HCA have a larger incentive than institutions holding these assets at MTM to sell unrelated assets to capture unrealized gains.*

C. Empirical Identification

Broadly speaking, both life and P&C insurers hold three main asset classes: (i) government and corporate bonds, (ii) structured securities, including ABS, and (iii) common and preferred equities. For *both* types of insurers, the regulatory accounting rules for government bonds, investment-grade corporate bonds, and investment-grade ABS are the same (HCA),[20] and so are the general rules of equities (MTM). What differs between the two insurance types is the accounting treatment for corporate bonds and ABS the moment they fall from investment to speculative grade.

The NAIC model regulation defines six risk classes by credit ratings, and all fixed-income securities held by insurers fall into one of these risk classes. An important threshold is between Class 2 (BBB) and Class 3 (BB). When a bond is downgraded from investment to speculative grade, it crosses that threshold and the NAIC guidelines require that P&C insurers switch from HCA to MTM, that is, immediately recognize the bond's value as the lower of book value or market price (or model price if no market price is available). In contrast, life insurers face no such requirement; they can continue holding the downgraded bond under HCA, except in the extreme case in which the bond is considered "in or near default" (Class 6).[21] Hence, our first identification strategy takes advantage of this stark difference in accounting rules between life and P&C insurers for the ABS that are downgraded to Classes 3 to 5.

The implementation of NAIC model regulation takes place at the U.S. state level. Each state's insurance code lays out the rules to be followed by insurers domiciled or licensed to conduct business in that state, as well as the discretion allowed to the insurance commissioner in applying the rules. Our objective is to

[19] General Hypothesis 1 is consistent with the predictions of Allen and Carletti (2008) and Plantin, Sapra, and Shin (2008).

[20] It is important to draw a distinction between the accounting rules followed by insurance companies in producing their financial statements for investors (GAAP) and the statutory accounting principles (SAP) used by insurance regulators. Securities that are most likely targeted for sale in a severe downgrade event are largely classified as available for sale (AFS) under GAAP. While GAAP states that AFS securities should be marked to market, SAP adopts a very different approach, with unrealized gains/losses not recognized in the equity capital calculation.

[21] See the Internet Appendix for further details on the NAIC risk classes.

capture variation across states in the discretion afforded to the commissioner in requiring market value recognition in the case of rating downgrades. Since this variation has long been established and insurers rarely change their states of domicile, we can treat it as exogenous and use it to identify, within an insurance type, the effects of market value recognition on insurers' trading and portfolio decisions following downgrades of their assets. This is our second identification strategy.

We do not use insurers' states of license for identification, as they are likely endogenous. The costs of regulatory compliance are a major consideration in insurers' decision to expand business across states (Pottier (2011)). Although in practice most insurers conduct business in many states and are subject to oversight by multiple regulatory authorities, we are likely to be on safe ground by characterizing each insurer solely by its state of domicile. The bias should be in the direction of not finding differences in behavior among insurers domiciled in different states, as some of them share a few states of license and, by extension, regulatory oversight.

We examine state-level insurance codes to obtain information on the rules pertaining to how debt and debt-like instruments, including ABS, are booked for regulatory accounting purposes. We specifically search within the codes, first under "Valuation of Investments" (or a similar section, such as "Valuation of Securities"), and second under all other relevant sections, such as "Accounting Provisions," to understand the potential discretion the insurance commissioner has in applying the NAIC guidelines. We then followed up with extensive discussions with state regulators. Our analysis reveals that state mandates can be quite different. In some states the NAIC guidelines are strictly enforced, while in others regulators have discretion to institute rules both within and above the guidelines.

A few examples suffice to highlight the differences across states. For example, the insurance code of Illinois (section 126.7) specifically states that:

For the purposes of this Article, the value or amount of an investment acquired or held, or an investment practice engaged in, under this Article, unless otherwise specified in this Code, shall be the value at which assets of an insurer are required to be reported for statutory accounting purposes as determined *in accordance with procedures prescribed in published accounting and valuation standards of the NAIC*, ... (Emphasis added.)

In this case, we classify Illinois as a state that strictly implements the NAIC model regulation. In contrast, the insurance code of New York (section 1414) states that:[22]

(a) (1) All obligations having a fixed term and rate of interest and held by any life insurance company or fraternal benefit society authorized to do business in this state, if amply secured and not in default as to principal or interest, shall be valued as follows: ... [description of HCA] ... (3) *The superintendent shall have the power to determine the eligibility of any such investments for valuation on the basis of amortization, and may by regulation prescribe or limit*

[22] The code refers to HCA as "valuation on the basis of amortization" or in short "amortization."

the types of securities so eligible for amortization. All obligations which in the judgment of the superintendent are not amply secured shall not be eligible for amortization and shall be valued in accordance with subsection (b) [which describes MTM] hereof. (Again, emphasis added).

We therefore classify New York as a state that provides the commissioner discretion in applying the NAIC guidelines. In the Internet Appendix, we present in full the applicable parts from the codes of Illinois and New York. Based on similar information, which we systematically capture using two criteria as discussed in Appendix C, we classify U.S. states into those that strictly implement the NAIC guidelines and those that permit their commissioner some discretion. Below, we argue that the latter (former) are likely to yield greater (lower) levels of market value recognition among life insurers, and hence we refer to them as "high MTM states" ("low MTM states").

When a bond is downgraded from investment to speculative grade, the NAIC guidelines (SSAPs 26 and 43) allow life insurers to continue holding the bond at historical cost unless the decline in market value following the downgrade is deemed other than temporary, in which case life insurers should recognize OTTI. This rule clearly gives life insurers full discretion in determining whether to recognize OTTI. From this extreme, the commissioner may either (a) strictly follow the NAIC guidelines, providing full discretion to life insurers, or (b) impose some instructions on the situations in which MTM should/must be used or OTTI should/must be recognized. Compared to case (a), life insurers are forced to use MTM or recognize OTTI more often in case (b). Thus, averaging the two possibilities, the level of market value recognition upon rating downgrades should be (weakly) greater among states that provide discretion to the commissioner. Moreover, since the difference across states only occurs in cases in which the recognition of market value is discretionary, it does not apply to P&C insurers.

As with any interpretation of rules, it is not always unambiguously clear to which group a state belongs. To address this issue, we conduct two robustness checks. In Alternative 1 we reclassify a few relatively ambiguous states into the other group, and in Alternative 2 we rank states by the realized OTTI frequency of state-domiciled insurers during the pre-crisis period. In Appendix C, we show that Alternative 2, though mechanical in nature, is highly correlated with the insurance-code-based classifications.

D. Testable Hypotheses

In the context of the insurance industry, as discussed in Section I.C, General Hypothesis 1 can be restated as follows:

H1a (between-insurance-type): *P&C insurers are more likely to sell downgraded assets than are life insurers.*

H1b (within-life): *Life insurers domiciled in high MTM states are more likely to sell downgraded assets than are those domiciled in low MTM states.*

We also test the conjecture that financial institutions use gains trading to improve capital positions that have been adversely affected by asset downgrades:

H2a: *Insurers that face a larger decline in RBC ratio as a result of asset downgrades engage in a greater degree of gains trading.*

H2b: *Holding the impact of downgrades constant, insurers that have a low RBC ratio will engage in a greater degree of gains trading.*

Finally, we test General Hypothesis 2, which can be restated as follows:

H2c (between-insurance-type): *Holding the impact of downgrades constant, life insurers engage in a greater degree of gains trading than P&C insurers.*

H2d (within-life): *Holding the impact of downgrades constant, life insurers domiciled in low MTM states engage in a greater degree of gains trading than life insurers domiciled in high MTM states.*

II. The Data

A. Sample Construction

We combine three sets of data in our study: information on insurance firms, ABS and their rating changes, and government/corporate bonds and their trade prices. Our sample period is from 2004 to 2010. This period covers the financial crisis of 2007 to 2009 and also a noncrisis period that we use for comparison. When using quarterly data, we classify the first two quarters of 2007 as the noncrisis period because few ABS were downgraded in these quarters.

Our primary data on insurers' transactions and positions are from the NAIC (Schedule D).[23] The data provide detailed daily transactions and year-end holdings of invested securities, including identities of the insurers and the relevant securities (e.g., nine-digit CUSIP). We merge the year-end position data with transaction data to infer quarter-end positions. Finally, the NAIC data provide the book-adjusted carrying value and fair value of each position. We employ this information to infer whether an insurer holds each security at historical cost or fair value.

The financial information on each insurer is from Weiss Ratings, which provides financial strength ratings and other annual firm characteristics, such as invested assets, capital and surplus, and the RBC ratio.[24] We eliminate small insurers with invested assets less than $13 million (the bottom 1%) and/or with an RBC ratio either below 2 or above 20 to avoid any bias from small or unusual firms.[25] We also delete all of AIG's affiliated insurers and 32 others that provide financial insurance and guarantees for bonds, such as credit default

[23] Further details on the NAIC data can be found in Ellul, Jotikasthira, and Lundblad (2011).

[24] In 2010, Weiss Ratings was split from the Street.com to focus on the business of rating insurance companies.

[25] Small insurers do not have many trading choices. Insurers with an RBC ratio below two are subject to supervisory intervention, whereas those with an RBC ratio above 20 are unusual and may behave differently from the average.

swaps and municipal finance, as these firms were affected by the downgrades of ABS through a different channel.[26] Finally, we require that an insurer holds at least one corporate bond and one government bond because we investigate gains trading primarily in these assets. Our final sample consists of 11,232 firm-years, representing 503 life insurers and 1,379 P&C insurers.

Our data on ABS ratings are from S&P's Ratings IQuery (downloaded in February 2011). We extract all data in the structured credit subsector, which comprehensively covers initial ratings and history for all securitized issues rated by S&P from 1991 to 2010. The database records issue and tranche identity, issue amount, class, maturity, collateral type, rating, and rating date. We find 127,719 ABS in 13,430 issues, among which 65% are mortgage-backed securities, 20% are collateralized debt obligations, and 15% are asset-backed securities backed by consumer loans. Using nine-digit CUSIPs to merge with insurers' holdings, we identify 24,452 relevant ABS. Although S&P rated the largest number of ABS among all rating agencies,[27] it does not cover all ABS held by insurers. Relying on the line numbers self-reported by insurers to identify all nonagency ABS holdings, we find that S&P covers about 50% of these holdings. We take this imperfect coverage by S&P into account in calculating the impact of downgrades on insurers' RBC ratios. In most of our analyses, we nevertheless rely on the S&P sample because we need detailed information on rating downgrades and dates to identify a relevant trigger.

Data on corporate bond characteristics and prices come from Mergent Fixed Income Securities Database (FISD) and TRACE. We merge the FISD data with the insurers' position and transaction data to obtain characteristics, such as issue size, of the corporate bonds being held and transacted. We identify corporate bond downgrades using S&P's ratings whenever available, to be consistent with our source of ABS ratings. When S&P's ratings are missing, we use the ratings from Moody's (or Fitch if Moody's ratings are not available). We use transaction prices from TRACE, which covers most transactions for both investment- and speculative-grade corporate bonds since early 2005. Finally, data on government bond characteristics, such as offering date and maturity date, are from CRSP and the CUSIP Master File.

B. Insurance Companies and Their ABS Holdings

Table I presents summary statistics on key financial variables for our sample firms over the 2007 to 2009 crisis period. A detailed description of the variables is in Appendix D.

From 2007 to 2009, we have complete financial information for 1,224 life firm-years and 3,637 P&C firm-years. Life insurers are generally larger than P&C

[26] We identify bond insurers from Ratings IQuery, which reports financial insurance providers in securitized issues. In addition to AIG, we also exclude Ambac Assurance, MBIA Insurance, Financial Guaranty Insurance, etc.

[27] According to SEC (2011), as of 2010 year-end, S&P and Moody's ratings were outstanding for a total of 117,900 and 101,546 ABS securities, respectively.

Table I

Summary Statistics on Insurance Companies' Financial Variables

This table presents (pooled) descriptive statistics on important financial variables for the panel of life insurers (Panel A) and P&C insurers (Panel B) from the end of 2007 to the end of 2009. Included in the sample are insurers that hold at least one corporate bond issue and one government bond issue, have invested assets of at least $13 million, and have an RBC ratio between 2 and 20. We exclude 33 bond insurers such as AMBAC, MBIA, etc. and insurers in the AIG group. Variable descriptions are in Appendix D.

	Mean	10th Pct	Median	90th Pct	*SD*
Panel A. Life firms					
Number of firm-years	1,224				
Invested assets ($ million)	7,240	41	758	15,923	21,704
Capital and surplus ($ million)	765	10	104	1,707	2,196
Leverage	0.84	0.61	0.90	0.96	0.17
Return on equity (ROE)	0.02	−0.22	0.05	0.24	0.28
NAIC risk-based capital ratio (RBC ratio)	9.40	4.33	8.22	15.86	5.48
Holding of investment-grade bonds (%)	72.41	51.78	75.69	90.45	17.53
Holding of risky assets (%)	13.98	1.99	10.71	28.17	14.12
Panel B. Property and casualty firms					
Number of firm-years	3,637				
Invested assets ($ million)	958	26	152	1,481	4,589
Capital and surplus ($ million)	435	13	66	620	2,347
Leverage	0.59	0.41	0.61	0.74	0.14
Return on equity (ROE)	0.07	−0.04	0.08	0.19	0.13
NAIC RBC ratio	9.02	4.00	7.90	15.22	5.00
Holding of investment-grade bonds (%)	73.61	44.82	78.39	94.53	19.94
Holding of risky assets (%)	15.93	0.00	10.77	39.21	17.19

insurers. Mean invested assets are $7.24 billion (median of $758 million) for life firms and $958 million (median of $152 million) for P&C firms. Capital and surplus are also larger for life firms, although, similar to banks, they operate at a much higher leverage. Return on equity, as a measure of profitability, is similar across the two types.

The capital positions of life and P&C firms are similar. The average life and P&C firms have RBC ratios of 9.40 and 9.02, respectively.[28] This similarity suggests that life and P&C firms should have similar needs, from a capital adequacy standpoint, to respond to the shock to their capitalization following ABS downgrades. Both types heavily invest in investment-grade bonds, including government and corporate bonds, which together represent 72% to 74% of invested assets, on average. Hence, their trading behavior in these assets should be representative of their portfolio choice and important to analyze.

Table II reports insurers' holdings of ABS over the period 2004 to 2010. The first two columns show that the fraction of life firms holding ABS (about 85%) is

[28] The required capital for business risks accounts for a relatively larger fraction of RBC for P&C firms. Therefore, although P&C firms have significantly lower leverage than life firms, their RBC ratios are about the same.

Table II

Summary Statistics on Insurance Companies' Holdings of ABS Securities

This table summarizes insurers' year-end holdings of ABS. ABS positions are identified by matching insurers' bond holdings at year-end to a list of ABS identified from S&P's Ratings IQuery using nine-digit CUSIP. Conditional on holding at least one ABS, statistics for the number of ABS securities and the amount of ABS holdings as a percentage of the insurer's total fixed-income portfolio are reported. The ABS and total fixed-income portfolio figures are measured by par value. The mean, median, 10th percentile, and 90th percentile are calculated across insurers at each year-end.

	Number of Firms		Number of ABS Securities Held by Each Firm				% ABS Holding			
Year	All	Holding ABS	Mean	10th Pct	Median	90th Pct	Mean	10th Pct	Median	90th Pct
Panel A. Life firms										
2004	481	391	34.99	1	10	82	4.72	0.57	3.45	9.24
2005	447	380	46.12	2	12	105	5.07	0.63	3.89	10.96
2006	429	368	60.02	2	14	146	6.45	0.65	4.79	14.23
2007	413	351	72.88	2	16	175	7.44	0.75	5.95	15.88
2008	408	342	76.69	2	17	209	7.33	0.68	6.08	15.75
2009	403	337	72.70	2	16	220	6.48	0.52	4.95	13.58
2010	384	319	68.20	1	15	198	5.41	0.40	4.26	11.61
Panel B. Property and casualty firms										
2004	1,151	741	7.81	1	5	17	4.07	0.56	3.36	8.31
2005	1,132	764	9.52	1	6	20	4.45	0.63	3.28	8.78
2006	1,132	785	11.20	1	6	24	5.15	0.56	3.80	11.49
2007	1,173	820	12.30	1	7	26	5.48	0.63	3.83	11.57
2008	1,240	825	12.17	1	6	26	4.92	0.55	3.18	10.78
2009	1,224	777	10.87	1	4	23	3.47	0.30	2.09	7.81
2010	1,215	645	8.59	1	3	18	2.89	0.22	1.56	6.81

greater than that of P&C firms (about 70%) before the crisis. Moreover, over the course of the crisis, the fraction for P&C insurers declines substantially to less than 53% at the end of 2010. In the remaining columns, we report the number and percentage holdings of ABS for insurers that hold at least one ABS at each year-end. Three features of the data are notable. First, insurers' holdings of ABS are quite large during the crisis, about 6% to 7% of the par value of their fixed-income holdings for life firms and about 5% for P&C firms. Still, these numbers underestimate insurers' exposure to the ABS markets since S&P does not cover all ABS in the NAIC data. Second, insurers build up their holdings of ABS in the years leading up to the crisis and reduce their exposures after. Finally, substantial heterogeneity in ABS holdings exists even within each insurance type. For example, in 2007, the median life firm holds only 16 ABS (6% of its bond portfolio) while those in the top 10% hold over 175 such securities (over 15% of its bond portfolio). We employ this heterogeneity within each insurance type, albeit measured in a different but more economically

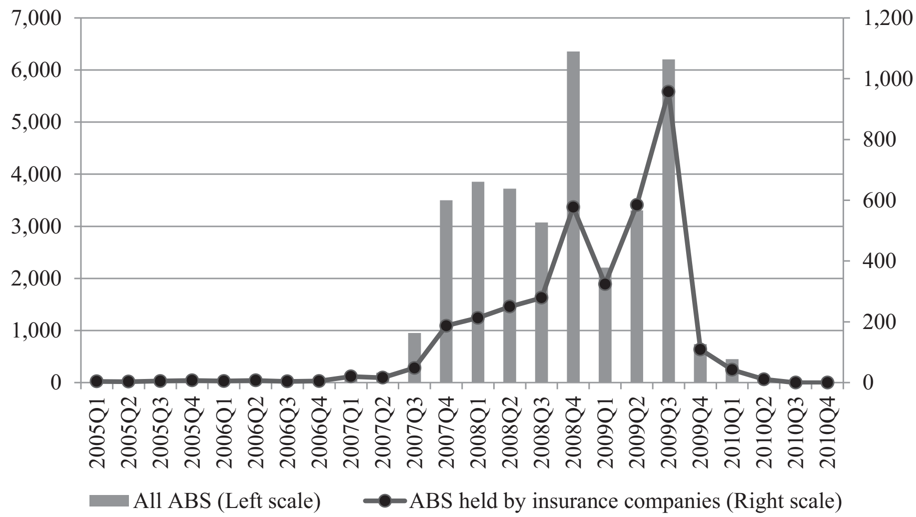

Figure 1. Number of ABS downgraded from investment to speculative grade. This figure presents the number of ABS (each defined by a distinct CUSIP) downgraded from investment grade to speculative grade by S&P on a quarterly basis. The bars show the number of all downgraded ABS included in S&P's Ratings IQuery. The connected dots show the number of downgraded ABS that are held by at least one insurance company.

meaningful way below, to test whether insurers' incentives to gains trade are generated by their exposure to ABS downgrades.

C. Downgrades of ABS and Their Impact on Insurance Companies

We are particularly interested in downgrades from investment to speculative grade because these downgrades (i) significantly increase capital requirements, and (ii) force some but not all insurers to recognize the market value of downgraded assets either by switching from HCA to MTM or by recognizing OTTI. Figure 1 presents the total number of investment-to-speculative downgrades of ABS on a quarterly basis. The downgrade wave starts in 2007Q3, with 952 downgrades from investment to speculative grades. In each of the following four quarters, we observe over 3,500 such downgrades. From 2007Q3 to 2009Q4, over 33,000 ABS were downgraded from investment to speculative grade.

The right axis of Figure 1 shows that only a small portion of the downgrades in the early stage of the crisis (5% to 9% before the end of 2008) affect insurers. However, the insurers are increasingly hit by the ABS downgrades in 2009 (15% to 18% of all downgrades in each quarter). This evidence may explain why insurers have pushed hard to have the NAIC change its capital assessment methodology for residential and commercial mortgage-backed securities (Becker and Opp (2014) and Hanley and Nikolova (2014)).[29]

[29] In Table IAI in the Internet Appendix, we present the rating transitions of the downgraded ABS held by insurers. Many of the downgrades were by several notches. For example, 1,238 ABS

What is central to our analysis is the impact of these ABS downgrades on an insurer's capital position, not its holdings of ABS or downgraded ABS per se. Recall that a downgrade degrades the capital position, as proxied by the RBC ratio, of an insurer holding the downgraded asset in two ways: first, it increases the percentage capital requirement (denominator), and, second, it may force the recognition of the price decline, reducing the insurer's statutory equity capital (numerator). Leverage amplifies these effects as they both operate through capital, which is only a fraction of total assets. Thus, even though life and P&C firms had similar portfolio allocations to ABS entering the crisis, the significant ABS downgrades during the crisis impact the capital positions of life firms more than those of P&C firms. In Table IAIII in the Internet Appendix, we report summary statistics on these effects, measured for each firm as the expected change in the RBC ratio as a result of actual ABS downgrades during the crisis (2007Q3 to 2009Q4), holding constant the insurer's ABS positions entering the crisis. Hereafter we refer to this measure as "ABS exposure." In many of our analyses, we isolate the differential effects of accounting rules from the impact of ABS downgrades by focusing on a subsample of 189 life and 105 P&C insurers with large and similar ABS exposures. These samples represent, among insurers holding at least one downgraded ABS, the top 75% of life firms and the top 25% of P&C firms. The cutoff exposure is approximately −0.4 on the RBC ratio scale.

D. Accounting Treatments of Downgraded ABS by Life and P&C Insurance Companies

Our first identification strategy relies on the different accounting rules used by life (HCA) and P&C (MTM) insurers for speculative-grade bonds. Exclusion restrictions aside, we assess the relevance of this strategy by exploring the cross-sectional differences between P&C and life insurers in the use of fair, or market, value in booking recently downgraded ABS. Using year-end position data, we classify as revalued those positions for which the book and fair values are equal; all other positions are classified as held at HCA. Table III reports the revaluation frequencies for two types of downgrades: (i) from investment to speculative grade, and (ii) from AAA to speculative grade (this case being most severe and unexpected).

The results in Table III show striking differences between life and P&C insurers, confirming the economic basis for our between-insurance-type analysis. For example, consider row (2), which includes all downgrades from AAA to speculative grade over the 2005 to 2010 period. Of 1,860 ABS positions that life insurers hold under HCA before the downgrades, 79% remain under HCA, 9% are revalued, and 12% are sold after the downgrades. In contrast, P&C firms

were downgraded to the BB class (for brevity, we group BB+, BB, and BB− into one class), 451 of which were rated AAA before the downgrade. These dramatic shifts, which likely came as a surprise to insurers, significantly impacted the insurers' capital positions.

Table III

Accounting Treatment of Downgraded ABS

This table reports frequency statistics on insurers' accounting treatment of downgraded ABS previously held at modified historical costs. Two types of downgrade are considered: (a) from investment to speculative grade, and (b) from AAA to speculative grade. Rows (1) and (2) include all downgrades from 2005 to 2010, and rows (3) and (4) include only those downgrades in the fourth quarter of each year. Over the year in which the downgrade occurs, each position held at modified historical cost at the beginning of the year is reclassified into one of the following three groups: (i) kept at historical cost (HCA), (ii) kept but revalued to the year-end fair value (revalued), and (iii) sold. The percentages of these groups are reported separately for each type of downgrade and for life and P&C insurers.

	Life Firms				Property & Casualty Firms			
		Treatment after Downgrade				Treatment after Downgrade		
	Number of Positions	HCA	Revalued	Sold	Number of Positions	HCA	Revalued	Sold
Panel A. All downgrades in 2005–2010								
(1) Investment to speculative	5,161	71%	15%	14%	1,588	40%	39%	21%
(2) AAA to speculative	1,860	79%	9%	12%	851	45%	36%	20%
Panel B. Downgrades in the fourth quarter of each year								
(3) Investment to speculative	1,207	74%	14%	13%	327	20%	60%	20%
(4) AAA to speculative	514	79%	10%	11%	220	16%	63%	21%

hold 851 soon-to-be-downgraded ABS positions, of which 45% remain under HCA, 36% are revalued, and 20% are sold.

One drawback of the NAIC balance sheet data for this particular type of analysis is that the positions are available only at year-end. It is plausible that revaluations occur at different times in the year and market prices subsequently drift, creating a bias against finding revaluations. This may have happened, for example, during 2009, when many of the extreme downgrades took place relatively early in the year. To address this issue, we consider a subset of downgrades that occurred in the fourth quarter, as the drift problem may be less important for these downgrades, which are temporally closer to the year-end measurement. As expected, the results are more striking: P&C firms keep only 16% of downgraded ABS under HCA, revalue 63% (six times as much as life), and sell 21%.[30]

The difference in revaluation frequency between life and P&C insurers is not due to differences in the characteristics, such as credit quality, of their ABS. In Table IAII in the Internet Appendix, we estimate several linear models for the

[30] Similarly, Figure IA2 in the Internet Appendix shows that P&C firms revalue a significantly higher percentage of speculative-grade positions than do life firms in each year during our sample period.

probability that an ABS position is revalued controlling for its credit quality, other distinct characteristics (e.g., issue size), and time-varying characteristics (e.g., maturity remaining at the end of the downgrade year). We find that, even with all these controls, P&C firms remain significantly more likely than life firms to revalue a downgraded position, confirming the importance of regulatory accounting rules in dictating insurers' actual accounting treatments. Taken together, this evidence supports the relevance of our first identification strategy and provides the economic basis for using life and P&C insurers as representatives for institutions using HCA and MTM, respectively.

E. OTTI Recognition across U.S. States

Our second identification strategy relies on the fine variation in accounting practices among the same type of insurers across domicile states. As explained in Section I.C, we classify states as either those that strictly implement the NAIC model regulation or those that provide some level of discretion to their commissioners. Here, we assess the economic relevance of our classification by exploring whether the recognition of market value for accounting purposes varies significantly across states of domicile, in line with our expectation.

Table IV reports the average frequencies with which life (Panel A) and P&C (Panel B) insurers recognize OTTI for downgraded corporate bonds and ABS in the precrisis period. For each insurer-downgrade observation, OTTI is considered recognized if (a) OTTI is reported for the bond or ABS position at year-end, or (b) the book-adjusted carrying value of the position is reset to the reported fair value at year-end. Thus, our definition captures both MTM and OTTI under HCA, reflecting the maximum degree to which each insurer recognizes the change in market value of their downgraded holdings. For each insurer, we calculate the OTTI frequency as the percentage of all downgraded positions for which OTTI is recognized. We then average the insurer-level OTTI frequencies for all life or P&C firms domiciled in each state and finally average across all states in the high versus low MTM groups.

The results confirm that the precrisis level of OTTIs for life firms domiciled in high MTM states is larger (around 17%) than those of life firms domiciled in low MTM states (around 4% to 9%). These differences may result from the actual exercise of regulatory discretion by the commissioners in high MTM states and/or the concerns of life firms in these states that, if they do not properly recognize OTTIs, they may be penalized. In contrast, there is no difference in OTTI frequency between P&C firms in the high and low MTM states, consistent with the notion that a departure from the NAIC guidelines only occurs in cases in which the recognition of market value is discretionary. P&C insurers are required by the NAIC guidelines to use MTM. Overall, the evidence in Table IV confirms that exogenous variation in the degree of market value recognition does exist among life insurers domiciled in different U.S. states, thereby providing the economic basis for our within-life analysis.

Table IV

OTTI Recognition for Downgraded Corporate Bonds and ABS in High and Low Mark-to-Market States

This table presents average frequencies with which life (Panel A) and P&C (Panel B) insurers recognize OTTI for downgraded corporate bonds and ABS across U.S. states classified as high MTM states and low MTM states. Only those downgrades from investment to speculative grade during the precrisis period (2005 to 2007) are included. For each insurer-downgrade observation, OTTI is recognized if (a) OTTI is reported for the bond or ABS position at year-end, or (b) the book-adjusted carrying value of the bond or ABS position is reset to the reported fair value at year-end. For each insurer, %OTTI is calculated as the number of downgraded positions for which OTTI is recognized divided by the total number of downgraded positions. The insurer-level %OTTI's are then averaged across all life or P&C insurers domiciled in each state and finally averaged across all states in the high versus low MTM groups under three alternative classifications (Baseline, Alternative 1, and Alternative 2), as defined in Appendix C. Number of states is the number of states that have at least one life or P&C insurer and are classified into either the high or low MTM groups. For life (P&C) insurers, seven (six) of the classified states, namely HI, ID, ME, NH, NM, RI, and SD (AL, AR, ME, MS, NM, and UT), do not enter the average %OTTI calculation and the *t*-test of differences between the two groups because life (P&C) insurers in these states do not hold downgraded positions during the precrisis period.

	Baseline		Alternative 1		Alternative 2	
	No. States	% OTTI	No. States	% OTTI	No. States	% OTTI
Panel A. Life firms						
Low MTM	35	8.69%	32	7.82%	25	4.12%
High MTM	10	16.97%	13	17.53%	20	17.17%
High – Low		8.28%		9.70%		13.05%
p-value		(0.001)		(0.000)		(0.000)
Panel B. Property and casualty firms						
Low MTM	36	66.39%	33	66.60%	26	69.22%
High MTM	10	66.42%	13	66.01%	20	62.91%
High – Low		0.03%		−0.58%		−6.30%
p-value		(0.498)		(0.547)		(0.883)

III. Empirical Methodology and Results

A. Selling of Downgraded ABS

In this section, we first test Hypothesis H1a by assessing whether P&C firms' revaluation of downgraded ABS to market value does indeed make them more likely than their life counterparts to directly sell the downgraded ABS. We then test H1b in a similar manner but use the cross-state variation in market value recognition within the life insurance sector.

Since ABS downgrades are often predictable and insurers often sell soon-to-be-downgraded securities preemptively (see Plantin, Sapra, and Shin (2008) for a theoretical argument and Ellul, Jotikasthira, and Lundblad (2011) for empirical evidence), we consider all ABS tranches following a downgrade from investment to speculative grade of any tranche backed by the same asset pool.

We model the probability of selling each affected ABS by the end of the quarter in which the downgrade occurs as a linear model:

$$S_{i.j.k} = \kappa_0 + \kappa_P P_j + \kappa_V V_{i,j,k} + \kappa_X X_{i,k} + \kappa_Y Y_{j,k} + \kappa_W W_k + \varepsilon_{i,j,k}, \qquad (6)$$

where $S_{i.j.k}$ is a dummy variable that equals one if insurer j sells some of its holding in downgraded bond i by the end of event quarter k; P_j is a dummy variable that equals one if insurer j is a P&C insurer; $V_{i,j,k}$ is an dummy variable that equals one if insurer j revalues downgraded bond i at the year-end before event k; $X_{i,k}$ is a vector of bond i's static and time-varying characteristics, including the rating group dummies, immediately preceding event k; $Y_{j,k}$ is a vector of insurer j's static and time-varying characteristics at the year-end prior to event k; W_k is a vector of time-specific variables for downgrade event k; and κ's are the corresponding vectors of coefficients to be estimated.

Table V reports the results. In columns (1) and (2) of Panel A, the coefficients on the P&C dummy are positive and significant. Consistent with Hypothesis H1a, P&C insurers, using MTM for speculative-grade ABS, have a higher propensity to sell an ABS position affected by a downgrade than do life insurers, using HCA. In column (1), we include rating, state, and year dummies, thus identifying the result by comparing the selling propensities of life and P&C insurers after absorbing any variation across states, rating groups, and year of the downgrade. In column (2), the common denominators are an ABS's rating group and asset pool. The difference in selling propensity between life and P&C firms is similar in both columns, at 2.8% to 3.3%, which is about half of the unconditional selling probability of life firms.[31]

We include a number of control variables to capture ABS and insurer characteristics as well as the position's existing accounting treatment. First, we include a revaluation dummy that controls for the likelihood that, regardless of their type, insurers are more likely to sell downgraded positions that have already been re-booked at market price, as doing so will not generate further losses but will help reduce the required RBC. The significant and positive coefficient on the revaluation dummy confirms this intuition. Second, we include ABS-level characteristics, such as liquidity. These characteristics cannot explain the difference in selling propensity that we demonstrate between life and P&C firms. We also include the tranche offering amount and its initial rating (before the first downgrade of the pool), which tend to be correlated with liquidity, as control variables in all columns.[32]

A valid concern is that our results may be driven by the fact that, due to their lower leverage, P&C firms are generally less impacted by ABS downgrades than are life firms. We address this concern by examining the subsample of life and P&C insurers with similar, and significant, ABS exposures. We describe the construction of this subsample in Section II.C. Panel B of Table V (columns (1)

[31] The unconditional probability of selling downgraded ABS is 12.7% for P&C firms and 6.4% for life firms.

[32] Our estimates suggest that large ABS issues are more likely to be sold, possibly due to their superior liquidity.

Table V

Probability of Selling ABS following Downgrade

This table reports coefficient estimates for linear models of the probability that an ABS position is sold following a downgrade. For each ABS (as defined by a distinct CUSIP), a downgrade is considered as having occurred if any tranche backed by the same asset pool of the ABS is downgraded from investment to speculative grade. Panel A includes ABS positions held by any insurer at the beginning of the year in which such a downgrade occurs. Panel B is restricted to the ABS positions held by life and P&C insurers with high ABS exposure, that is, those insurers whose RBC ratios are expected to drop by approximately 0.4 or more due to actual ABS downgrades during the crisis. The dependent variable equals one if the company holding the downgraded ABS sells any amount of it by the end of the quarter in which the downgrade occurs, and zero otherwise. Both life and P&C insurers are included in columns (1) and (2), where *P&C* is a dummy variable indicating that the position is held by a P&C insurer, and where the insurer control variables, including *ln(capital & surplus)*, *% risky assets*, *Leverage*, and *ROE*, are demeaned within each type. Columns (3) to (5) include life insurers only. *High MTM* is a dummy variable equal to one if the life insurer is domiciled in a U.S. state classified as in the high MTM group under each of the three alternative classifications (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. The same set of control variables is included in Panel B but not reported for brevity. The full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors (SE), clustered at the firm or state level, are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

			Life Only		
			(3)	(4)	(5)
	Life and P&C		Definition for "High MTM"		
	(1)	(2)	Baseline	Alternative 1	Alternative 2
			Panel A. Full sample		
P&C	0.033***	0.028***			
	(0.012)	(0.010)			
High MTM			0.022**	0.014*	0.020**
			(0.008)	(0.008)	(0.008)
Low RBC ratio	0.032*	0.020	0.069***	0.069***	0.073***
	(0.017)	(0.013)	(0.019)	(0.020)	(0.020)
Revalue	0.061***	0.077***	0.070***	0.071***	0.069**
	(0.019)	(0.017)	(0.026)	(0.026)	(0.026)
ln(tranche size)	0.004	0.006*	0.005	0.005	0.005
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
ln(capital & surplus)	−0.006*	−0.004	0.003	0.004	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
% risky assets	0.000	0.000	−0.001	−0.001	−0.001*
	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Leverage	0.004	−0.016	−0.082	−0.084	−0.090
	(0.059)	(0.050)	(0.081)	(0.082)	(0.081)
ROE	0.007	0.009	0.008	0.009	0.012
	(0.029)	(0.019)	(0.019)	(0.019)	(0.018)
Rating FE	YES	YES	YES	YES	YES
Pool FE	NO	YES	YES	YES	YES
Year FE	YES	NO	NO	NO	NO
State FE	YES	NO	NO	NO	NO
SE cluster	FIRM	STATE	STATE	STATE	STATE

(*Continued*)

Table V—*Continued*

	Life and P&C		Life Only		
			(3)	(4)	(5)
			Definition for "High MTM"		
	(1)	(2)	Baseline	Alternative 1	Alternative 2
Panel A. Full sample					
Observations	11,339	11,339	8,446	8,446	8,446
R^2	0.071	0.014	0.019	0.018	0.018
Number of pools		2,120	2,011	2,011	2,011
Panel B. Subsample of life and P&C firms with high ABS exposure					
P&C	0.040**	0.034***			
	(0.019)	(0.010)			
High MTM			0.022**	0.015*	0.025***
			(0.009)	(0.009)	(0.009)
Low RBC ratio	0.060**	0.049**	0.075***	0.075***	0.082***
	(0.028)	(0.019)	(0.022)	(0.023)	(0.023)
Bond controls	YES	YES	YES	YES	YES
Insurer controls	YES	YES	YES	YES	YES
Rating FE	YES	YES	YES	YES	YES
Pool FE	NO	YES	YES	YES	YES
Year FE	YES	NO	NO	NO	NO
State FE	YES	NO	NO	NO	NO
SE cluster	FIRM	STATE	STATE	STATE	STATE
Observations	8,894	8,894	7,957	7,957	7,957
R^2	0.064	0.016	0.021	0.020	0.020
Number of pools		2,054	1,985	1,985	1,985

and (2)) shows that our results in Panel A continue to hold in this controlled sample, which suggests that the results are likely explained by the use of HCA versus MTM, rather than the large or small impact of collective ABS downgrades.

To implement the above analysis within the life insurance sector, our variable of interest, P_j in equation (6), is now the high MTM dummy, which indicates life insurers that are domiciled in high MTM states according to the definitions in Appendix C. Under H1b, we expect a positive coefficient on the high MTM dummy, which the results in columns (3) to (5) in Table V, Panels A and B, confirm. Since we include asset pool and rating fixed effects, the coefficient of interest is identified by comparing life insurers across high and low MTM states after controlling for factors specific to each asset pool and rating group. The coefficient estimates show that life insurers domiciled in high MTM states sell more of their downgraded ABS than do other life insurers. This difference is both statistically and economically significant. If we take the unconditional selling probability as the benchmark, the estimate in column (3) shows that the probability of selling downgraded ABS positions is about 34% higher than average (0.022/0.064) for life insurers domiciled in high MTM states.

We next explore whether capital-constrained firms are more likely to divest downgraded ABS, which is expected to be the case if insurers sell downgraded ABS to improve their capital positions. Intuitively, insurers that start with low RBC ratios should be pushed closer to regulatory (or other rating-related) thresholds, and thus have greater need to respond. To capture this effect, in all regressions we include a low RBC ratio dummy, which indicates insurers with RBC ratios in the lowest quartile within each type. We find that the coefficients on this dummy are positive and significant in almost all columns of Table V, Panel A (all insurers) and in all columns of Table V, Panel B (insurers with large ABS exposures). The economic effects, ranging from 2.0% to 8.2%, are significant given the relatively small unconditional selling probability. Moreover, as expected, these effects are stronger in the sample of insurers with large ABS exposures.

Overall, the results in Table V, obtained from both between-insurance-type and within-life analyses, consistently demonstrate that insurers that are required to use MTM (or recognize OTTI) for downgraded ABS are more likely to sell their downgraded holdings than insurers that can continue to use HCA. This result is consistent with General Hypothesis 1, and the general prediction of the theoretical literature.

B. Gains Trading

In this section, we assess insurers' propensity to gains trade by examining the extent to which an insurer's decision to sell a bond position is motivated by its unrealized gain. For each position, we calculate the unrealized gain as the difference between the position's book-adjusted carrying value and fair value, which is measured as a percentage of its book-adjusted carrying value. If the insurer engages in gains trades, it should be more likely to sell a bond position with an unrealized gain than an otherwise similar position with an unrealized loss. Thus, to identify gains trading, we need assets that are both (i) held under HCA and (ii) have sufficient cross-sectional variation, whereby some positions carry unrealized gains while others carry unrealized losses. The former condition essentially rules out equities. The latter condition rules out ABS and structured products, as most of them carry extremely large unrealized losses.[33] This leaves us with government and corporate bonds, which together account for over 70% of invested assets for both life and P&C insurers. Insurers can choose any combination of these two asset classes to gains trade, depending on the availability of unrealized gains in each.

[33] In Table IAV in the Internet Appendix, we report the distribution of the percentage of unrealized gains (and losses) separately for life and P&C firms. Panel A corresponds to ABS, Panel B to corporate bonds, and Panel C to government bonds. Panel A shows that over 90% of ABS positions carry unrealized losses in 2008 (with the median as large as −30%), and over 75% still do in 2009. Panels B and C show that unrealized gains (of various magnitudes) are much more available for corporate and government bonds.

B.1. Propensity to Gains Trade and ABS Exposure

We model the probability of selling a bond position as a linear model:

$$S_{i,j,q} = \gamma_0 + \left(\gamma_z + \gamma_{zy} y_{j,q} + \gamma_{zc} c_q + \gamma_{zyc} y_{j,q} c_q\right) z_{i,j,q} + \gamma_X X_{i,q} + \gamma_Y Y_{j,q} + \gamma_W W_q + \varepsilon_{i,j,q}, \tag{7}$$

where $S_{i,j,q}$ is a dummy variable that equals one if insurer j sells bond i in calendar quarter q; $z_{i,j,q}$ is the unrealized gain percentile (ranging from zero to one) of bond i in the portfolio of insurer j at the year-end prior to quarter q; $y_{j,q}$ is a characteristic of insurer j that is expected to amplify or diminish the effect of $z_{i,j,q}$, measured at the year-end prior to quarter q; c_q is a dummy variable that equals one if quarter q lies in the crisis period; $X_{i,q}$ is a vector of static and time-varying characteristics of bond i, including rating group dummies, at the beginning of quarter q; $Y_{j,q}$ is a vector of financial and risk characteristics of insurer j at the year-end prior to quarter q; W_q is a vector of calendar-quarter dummies interacted with a bond-type dummy (government vs. corporate)[34]; and the γ's are the corresponding coefficients to be estimated. Depending on the specification, we also include either domicile state fixed effects or firm fixed effects in $Y_{j,q}$.

Our coefficients of interest are the γ_z's, both the main term and the interaction terms. We interpret a positive coefficient as evidence for gains trading, since it indicates that positions that carry higher unrealized gains are more likely to be sold. Similarly, positive (negative) coefficients on the interaction terms indicate a larger (smaller) degree of gains trading during the crisis ($c_q = 1$) and/or for insurers with a certain characteristic as captured by $y_{j,q}$.

We first test Hypothesis H2a. We estimate our probability model for a sample of life and P&C insurers that are affected by ABS downgrades (i.e., the sample of insurers in Panel A of Table V), and include in the model the interaction between the unrealized gain percentile and a high ABS exposure dummy. If H2a is true, then we expect the coefficient on the interaction term to be positive for the crisis period.

Table VI reports the results. We start by investigating the crisis period in isolation. In columns (1) and (4), the coefficients on the interaction between the unrealized gain percentile and the high ABS exposure dummy are positive and significant (at the 1% level for life and 10% level for P&C insurers), indicating that both life and P&C insurers with high ABS exposure engage in a greater degree of gains trading than do other insurers of the same type. These results are identified by comparing the degree of gains trading between firms with high and low ABS exposure, holding constant bond characteristics including

[34] We interact calendar-quarter with bond-type dummies to identify gains trading from other alternative forces that may drive insurers to sell mostly government or corporate bonds. This is a concern since, during the crisis, government bonds as a group carry significantly larger unrealized gains than corporate bonds. In robustness checks in the Internet Appendix (Tables IAVI, IAVIII, and IAXI), we separately consider corporate bonds and government bonds and show that our main findings hold in both samples.

Table VI

Do Exposures to Downgraded ABS Induce Gains Trading?

This table reports coefficient estimates for linear models of the probability that an insurance company holding at least one downgraded ABS will sell a corporate or government bond position. The dependent variable is a dummy that equals one if the insurer holding the bond at the beginning of the quarter sells the bond during the quarter, and zero otherwise. The regressions are run separately for life insurers (columns (1) to (3)) and P&C insurers (columns (4) to (6)). The variables of interest are *Unrealized gain pct.* and its interactions with the crisis and high ABS exposure dummies. *Corp* (*Gov*) is a dummy variable equal to one for corporate bond (government bond) positions, and zero otherwise. Bond characteristics are interacted with these bond-type dummies. All variables, including fixed effects, are defined in Appendix D. Standard errors (SE), either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Life			Property & Casualty		
	(1)	(2)	(3)	(4)	(5)	(6)
	Crisis	All	All	Crisis	All	All
Main variables						
(1) Unrealized gain pct.	−0.004	−0.023***	−0.023***	−0.003	−0.002	−0.000
	(0.008)	(0.007)	(0.005)	(0.004)	(0.005)	(0.004)
(1) × (2)	0.021***	0.001	0.000	0.015*	−0.003	−0.009*
	(0.006)	(0.006)	(0.003)	(0.009)	(0.007)	(0.005)
Crisis × (1)		0.022**	0.021**		0.001	−0.000
		(0.010)	(0.009)		(0.006)	(0.005)
Crisis × (1) × (2)		0.020***	0.019***		0.017*	0.022*
		(0.008)	(0.005)		(0.010)	(0.011)
Related insurer controls						
(2) High ABS exposure	0.000	−0.001		0.015**	0.015*	
	(0.005)	(0.008)		(0.007)	(0.008)	
(3) Low RBC ratio	0.024***	0.011**	0.008	0.002	0.004	0.012**
	(0.007)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
(4) Revalue	0.062***	0.047***	0.048***	0.013*	0.014*	0.017**
	(0.012)	(0.010)	(0.012)	(0.007)	(0.008)	(0.007)
Crisis × (2)		0.001	0.001		−0.001	−0.004
		(0.007)	(0.003)		(0.007)	(0.007)
Crisis × (3)		0.009	0.007		−0.002	−0.004
		(0.007)	(0.005)		(0.005)	(0.004)
Crisis × (4)		0.019	0.017		−0.009	−0.009
		(0.012)	(0.015)		(0.014)	(0.011)
Bond controls						
Corp × ln(bond age)	−0.006***	−0.007***	−0.006***	−0.006**	−0.007***	−0.005***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
Corp × ln(maturity)	−0.011***	−0.008***	−0.009***	−0.002	0.001	−0.004*
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Corp × ln(issue size)	0.012***	0.011***	0.009***	0.009***	0.009***	0.007***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Corp × Bankruptcy	0.262***	0.274***	0.275***	0.179***	0.200***	0.200***
	(0.020)	(0.028)	(0.028)	(0.066)	(0.063)	(0.046)
Corp × Downgrade	0.040***	0.078***	0.079***	0.133***	0.154***	0.153***
	(0.015)	(0.022)	(0.022)	(0.030)	(0.028)	(0.026)

(*Continued*)

Table VI—*Continued*

	Life			Property & Casualty		
	(1)	(2)	(3)	(4)	(5)	(6)
	Crisis	All	All	Crisis	All	All
Gov × ln(bond age)	−0.034***	−0.033***	−0.032***	−0.032***	−0.036***	−0.035***
	(0.007)	(0.006)	(0.004)	(0.007)	(0.005)	(0.004)
Gov × ln(maturity)	−0.017***	−0.017***	−0.015***	−0.000	−0.004	−0.004**
	(0.004)	(0.004)	(0.002)	(0.004)	(0.003)	(0.002)
Other insurer controls						
ln(capital & surplus)	0.001	0.001	0.009**	−0.000	−0.000	0.014
	(0.001)	(0.001)	(0.004)	(0.002)	(0.002)	(0.012)
% risky assets	0.000	0.000**	0.000	0.000*	0.000**	−0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	0.026	0.017	0.063	0.016	0.003	−0.003
	(0.024)	(0.023)	(0.042)	(0.024)	(0.020)	(0.056)
ROE	0.004	−0.002	0.005	−0.030*	−0.038***	−0.023
	(0.006)	(0.004)	(0.003)	(0.017)	(0.012)	(0.014)
Rating FE	YES	YES	YES	YES	YES	YES
Quarter × Type FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	NO	YES	YES	NO
Firm FE	NO	NO	YES	NO	NO	YES
SE cluster 1	FIRM	FIRM	QTR	FIRM	FIRM	QTR
SE cluster 2	QTR	QTR	–	QTR	QTR	–
Observations	790,559	1,854,938	1,854,938	305,876	742,777	742,777
R^2 (within)	0.027	0.022	0.014	0.026	0.023	0.013

credit rating, firm characteristics including domicile state, and the calendar quarter in which the trading takes place. In economic terms (and relative to an otherwise similar position held by insurers with low ABS exposure), an interquartile increase in unrealized gain percentile increases the probability that a corporate or government bond position will be sold in a quarter by 1.1% (0.021 × 0.5, or 30% from the mean of 3.7%) for life firms and 0.8% (0.015 × 0.5, or 13% from the mean of 6.1%) for P&C firms.

The coefficients on the control variables are generally intuitive. For example, in all models, the coefficients on the revalue dummy are significantly positive, suggesting that these positions may be held for trading rather than as a long-term investment. We also control for bond liquidity using bond age and issue size, and find that the probability of being sold is higher for more liquid bonds, consistent with the notion that insurers actively try to minimize any price impact.[35] Other significant control variables include a dummy that measures whether the bond is downgraded to speculative grade, a dummy that captures whether the bond issuer files for bankruptcy, and, depending on the model, the proportion of risky assets in an insurer's portfolio (capturing the insurer's risk appetite or capacity to bear risk) as well as the insurer's ROE.

[35] See Edwards, Harris, and Piwowar (2007), Hong and Warga (2000), and Schultz (2001). Driessen (2005) uses bond age to identify the liquidity component of credit spreads.

A criticism against looking at the crisis period in isolation is that certain firms may gains trade even in normal times (Carey (1994)), in which case the results in columns (1) and (4) of Table VI may have nothing to do with the sizeable ABS downgrades during the crisis. To address this criticism, we investigate gains trading over the full sample period (2004 to 2010) and introduce the crisis dummy to compare insurers' behavior during the crisis with their behavior in normal times. This specification thus has the important advantage of isolating incremental behavior during the crisis from common behavior that may be present in all periods. The two variables of interest are (i) the interaction between the crisis dummy and the unrealized gain percentile, which captures the incremental propensity to gains trade, and (ii) the triple interaction between (i) and the high ABS exposure dummy, which captures the extent to which gains trading differs between insurers with high and low ABS exposure.

Column (2) of Table VI shows that life insurers are less likely to sell bonds with high unrealized gains in normal times (possibly to avoid paying taxes) but more likely to do so during the crisis, consistent with Laux and Leuz's (2009, 2010) conjecture that financial institutions may gains trade to relieve financial stress.[36] More importantly, the coefficient on the triple interaction shows that this gains trading behavior is significantly more pronounced among life insurers with high ABS exposure. Column (3), which includes firm fixed effects, confirms that this result is not driven by firm-level time-invariant unobserved heterogeneity, and columns (5) and (6) show that a similar effect is also present among P&C firms. Together, the results in Table VI are consistent with Hypothesis H2a, and highlight the importance of ABS downgrades in driving gains trading among insurance firms.

B.2. Propensity to Gains Trade and Capital Positions

We now test Hypothesis H2b, which posits that insurers gains trade to manage their RBC ratio (as opposed to net income, for example). In this test, we use the subsample of insurers that we identify as having high ABS exposure, rather than the entire sample of affected insurers as in Table VI. Doing so allows us to focus on the most relevant insurers and to hold relatively constant the impact of ABS downgrades without overly complicating the model with triple or quadruple interaction terms.

Table VII reports the results. We first examine whether we have sufficient power to identify gains trading among this subset of insurers with high ABS exposure. Focusing on the first and fourth rows, columns (1) and (2) of Table VII show that we have sufficient power for life firms; columns (4) to (6) show that we also have sufficient power for P&C firms, albeit to a lesser extent. In all specifications, we include the same set of controls as in Table VI. Taking the model in columns (2) and (5), which includes firm fixed effects, as our

[36] Our results also imply that reported income that includes realized gains and losses may not be informative about insurers' financial performance, consistent with the findings of Nissim (2012).

Table VII

Is an Objective of Gains Trading to Manage RBC Ratio? Does the Extent of Gains Trading Differ between Life and P&C Firms?

This table reports coefficient estimates for linear models of the probability that an insurer, whose RBC ratio is expected to drop by approximately 0.4 or more due to actual ABS downgrades during the crisis, will sell a corporate or government bond position. The dependent variable is a dummy that equals one if the insurer holding the bond at the beginning of the quarter sells the bond during the quarter, and zero otherwise. The regressions are run separately for life insurers (columns (1) to (3)) and P&C insurers (columns (4) to (6)). Both types of insurers are pooled together in column (7), where *P&C* is a dummy variable indicating that the position is held by a P&C insurer, and where the insurer control variables are demeaned within each type. Columns (1) and (4) include only the crisis period, from the third quarter of 2007 to the end of 2009, while the other columns cover the full period from 2004 to 2010. The variables of interest are *Unrealized gain pct.* and its interactions with the crisis, low RBC ratio, and P&C dummy variables. Bond and other insurer control variables, as in Table VI, are included but not reported for brevity. The full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors (SE), either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Life			Property and Casualty			All
	(1) Crisis	(2) All	(3) All	(4) Crisis	(5) All	(6) All	(7) All
Main variables							
(1) Unrealized gain pct.	0.020*	−0.023***	−0.027***	0.010	−0.006	−0.005	−0.027***
	(0.010)	(0.004)	(0.005)	(0.012)	(0.005)	(0.004)	(0.005)
(1) × (2)			0.003			−0.002	0.003
			(0.004)			(0.011)	(0.005)
(1) × P&C							0.023***
							(0.008)
Crisis × (1)		0.043***	0.035***		0.018	0.012	0.035***
		(0.011)	(0.010)		(0.012)	(0.014)	(0.010)
Crisis × (1) × (2)			0.021*			0.028*	0.023**
			(0.012)			(0.016)	(0.011)
Crisis × (1) × P&C							−0.023**
							(0.011)
Related insurer controls							
(2) Low RBC ratio	0.032***	0.010	−0.004	−0.012	0.018*	0.019	0.001
	(0.010)	(0.006)	(0.006)	(0.009)	(0.009)	(0.011)	(0.006)
(3) Revalue	0.091***	0.058***	0.052***	0.012	0.024**	0.024**	0.042***
	(0.018)	(0.015)	(0.013)	(0.015)	(0.010)	(0.010)	(0.009)
Crisis × (2)		0.011*	0.007		−0.011	−0.025*	−0.002
		(0.006)	(0.006)		(0.009)	(0.013)	(0.006)
Crisis × (3)		0.037	0.021		−0.009	−0.009	−0.003
		(0.026)	(0.029)		(0.015)	(0.015)	(0.016)
Crisis × P&C							0.010
							(0.007)
Bond controls	YES	YES	YES	YES	YES	YES	YES
Insurer controls	YES	YES	YES	YES	YES	YES	YES
Rating FE	YES	YES	YES	YES	YES	YES	YES
Quarter × Type FE	YES	YES	YES	YES	YES	YES	YES
State FE	YES	NO	NO	YES	NO	NO	NO

(*Continued*)

Table VII—*Continued*

	Life			Property and Casualty			All
	(1) Crisis	(2) All	(3) All	(4) Crisis	(5) All	(6) All	(7) All
Main variables							
Firm FE	NO	YES	YES	NO	YES	YES	YES
SE cluster 1	FIRM	QTR	QTR	FIRM	QTR	QTR	QTR
SE cluster 2	QTR	–	–	QTR	–	–	–
Observations	647,893	1,512,622	1,512,622	62,655	151,038	151,038	1,663,660
R^2 (within)	0.028	0.015	0.015	0.046	0.015	0.015	0.013

starting point, in columns (3) and (6) we add the interaction between the unrealized gain percentile and low RBC ratio. We also add the triple interaction with the crisis dummy to identify the extent to which the differential propensity to gains trade between insurers with healthy and low RBC ratios increases during the crisis. If Hypothesis H2b holds, then we expect the coefficient on this triple interaction to be positive, which turns out to be the case for both life and P&C firms. In normal times, insurers with a low RBC ratio do not behave differently from others. During the crisis, however, they engage in a higher degree of gains trading. Take life insurers, for example. Among those with a healthy RBC ratio (taking their behavior in normal times as a benchmark), an interquartile increase in the unrealized gain percentile increases the probability that a corporate or government bond position will be sold in a quarter by 1.8% (0.035×0.5) during the crisis. The same effect would be 2.8% (0.056×0.5), significantly higher, if the position were instead held by life firms with a low RBC ratio.

B.3. Life versus P&C Insurance Companies

We now turn to the most important tests of our paper: do financial institutions that use MTM for downgraded assets engage in less gains trading than others that use HCA? In this subsection, we use the distinction between P&C and life insurers as a proxy for institutions that use MTM versus those that use HCA, respectively. In the next subsection, we instead use the variation in degrees of market value recognition across life insurers domiciled in high versus low MTM states.

Hypothesis H2c states that on average life firms gains trade more than P&C firms. This is because the latter have already sold a larger number of downgraded ABS positions, and doing so alleviates the need to employ gains trading. The results in Table VI and the first six columns of Table VII provide suggestive evidence. First, in Table VI, the effect of an interquartile increase in the unrealized gain percentile on the probability that a bond position will be sold during the crisis is stronger for life firms (1.1%, or 30% increase from the mean of 3.7%) than for P&C firms (0.8%, or 13% increase from the mean of

6.1%). Second, while gains trading is widespread among life firms with large ABS exposures (columns (1) to (3) of Table VII), only P&C firms with large ABS exposures plus a low RBC ratio exhibit a significant degree of gains trading (columns (4) to (6) of Table VII). This select group consists of only 28 out of the 105 P&C firms with large ABS exposures (and over 1,000 P&C firms in our full sample).

In column (7) of Table VII, we formally test the difference in gains trading between life and P&C insurers controlling for all other effects, including the direct effects of ABS exposures and RBC ratios, which we have considered so far. We include both insurance types in the estimation but introduce a P&C dummy to distinguish the degree of gains trading between the two types. Our coefficient of interest, in the sixth row, is that on the triple interaction among the crisis dummy, P&C dummy, and unrealized gain percentile. The estimate is negative and significant, consistent with Hypothesis H2c. In economic terms, the effect of an interquartile increase in the unrealized gain percentile on the probability of being sold during the crisis is about 1.2% smaller (-0.023×0.5) for a bond position held by P&C firms than an otherwise similar position held by life firms. This is highly significant given the unconditional selling probabilities of 4.2% and 8.0% for life and P&C firms, respectively, with large ABS exposures. Taken together, the results in Table VI and especially in Table VII provide clear evidence that P&C firms, using MTM for downgraded ABS, engage in less gains trading than life firms, using HCA.

B.4. Life Insurance Companies in High Versus Low MTM States

We now investigate gains trading behavior *within* the life insurance sector, exploiting the variation in the implementation of NAIC model regulation across U.S. states. Hypothesis H2d predicts that life insurers domiciled in high MTM states have a lower propensity to engage in gains trading relative to life insurers domiciled in low MTM states. We test this hypothesis using the sample of life insurers with large ABS exposures.

Table VIII reports the results. In columns (1) to (3), we look at the crisis period in isolation. The variable of interest is the interaction between the high MTM dummy and the unrealized gain percentile (the second row), which captures the difference in gains trading propensity, if any, between life insurers in high and low MTM states. In columns (4) to (6), we employ the full sample period, taking normal times as a benchmark. In these specifications, the variable of interest is the triple interaction between the crisis dummy, high MTM dummy, and unrealized gain percentile (the fourth row).

All columns of Table VIII point to the same conclusion: while life insurers generally tend to gains trade during the crisis, those domiciled in high MTM states have a lower propensity to do so as compared to life insurers domiciled in low MTM states. These results are robust across all alternative classifications of U.S. states as described in Appendix C. Take the estimates in column (4), for example. The positive and significant coefficient of 0.051 in the third row shows that gains trading is prevalent in this sample of life insurers (which we

Table VIII

Does the Extent of Gains Trading Differ for Life Firms in Different U.S. States?

This table reports coefficient estimates for linear models of the probability that a life insurer, domiciled in different U.S. states, sell a corporate or government bond position. The sample includes life insurers whose RBC ratios are expected to drop by approximately 0.4 or more due to actual ABS downgrades during the crisis. The dependent variable is a dummy that equals one if the life insurer holding the bond at the beginning of the quarter sells the bond during the quarter, and zero otherwise. The variables of interest are *Unrealized gain pct.* and its interactions with the crisis and high MTM dummies. *High MTM* is a dummy indicating that life insurers are domiciled in high MTM states under each alternative definition, as defined in Appendix C. Bond and other insurer control variables, as in Table VI, are included in all models but not reported for brevity. The full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors (SE), either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Crisis			All		
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	Alt. 1	Alt. 2	Baseline	Alt. 1	Alt. 2
Main variables						
(1) Unrealized gain pct.	0.026**	0.028**	0.022*	−0.023***	−0.023***	−0.025***
	(0.012)	(0.013)	(0.012)	(0.005)	(0.005)	(0.005)
(1) × High MTM	−0.017**	−0.017**	−0.012**	−0.001	−0.000	0.004
	(0.007)	(0.008)	(0.006)	(0.004)	(0.004)	(0.003)
Crisis × (1)				0.051***	0.052***	0.048***
				(0.013)	(0.013)	(0.012)
Crisis × (1) × High MTM				−0.018**	−0.018**	−0.017***
				(0.007)	(0.007)	(0.005)
Related insurer controls						
(2) Low RBC ratio	0.032***	0.032***	0.029***	0.010	0.010	0.010
	(0.010)	(0.010)	(0.011)	(0.006)	(0.006)	(0.006)
(3) Revalue	0.091***	0.091***	0.091***	0.059***	0.059***	0.059***
	(0.018)	(0.018)	(0.020)	(0.015)	(0.015)	(0.014)
Crisis × (2)				0.012**	0.013**	0.008
				(0.006)	(0.006)	(0.005)
Crisis × (3)				0.036	0.036	0.037
				(0.026)	(0.026)	(0.026)
Crisis × High MTM				0.016***	0.016***	0.010**
				(0.005)	(0.005)	(0.005)
Bond controls	YES	YES	YES	YES	YES	YES
Insurer controls	YES	YES	YES	YES	YES	YES
Rating FE	YES	YES	YES	YES	YES	YES
Quarter × Type FE	YES	YES	YES	YES	YES	YES
State FE	YES	YES	YES	NO	NO	NO
Firm FE	NO	NO	NO	YES	YES	YES
SE cluster 1	FIRM	FIRM	FIRM	QTR	QTR	QTR
SE cluster 2	QTR	QTR	QTR	–	–	–
Observations	647,893	647,893	647,893	1,512,622	1,512,524	1,512,524
R^2 (within)	0.028	0.028	0.028	0.015	0.015	0.014

show earlier in Table VII). However, the negative and significant coefficient on the triple interaction term in the fourth row indicates that life insurers in high MTM states gains trade to a lesser degree than others. In economic terms, the effect of an interquartile increase in the unrealized gain percentile on the probability of being sold during the crisis is about 0.9% smaller (-0.018×0.5) for a bond position held by life insurers in high MTM states than an otherwise similar position held by other life insurers. This is significant given that the corresponding unconditional probability is only about 4.2%. Overall, these results are consistent with Hypothesis H2d.

Taken together, the tests of Hypotheses H2c and H2d provide support for General Hypothesis 2. Financial institutions holding downgraded assets under HCA have a larger incentive to gains trade than other institutions holding downgraded assets under MTM.

C. Robustness Checks

While our results as a whole consistently show a significant impact of regulatory accounting rules on insurers' trading behaviors, alternative explanations may drive the different individual results, particularly those obtained from the comparison between life and P&C insurers. To address this concern, we first examine three alternative explanations for why life firms are less likely to sell downgraded ABS but more likely to gains trade than P&C firms: (i) differences in asset management expertise (e.g., life firms can better manage complex and illiquid assets), (ii) differences in liability or payout structures (e.g., life firms have longer and less uncertain liabilities), and (iii) differences in tax circumstances (e.g., life firms suffer losses during the crisis but P&C firms do not). In Table IAXIII in the Internet Appendix, we hold each of these factors roughly constant in a subsample of life and P&C firms and investigate the propensities to sell ABS (Panel A, similar to Table V) and to gains trade (Panel B, similar to column (9) of Table VII) in this subsample.[37] We find that the differences in trading behavior between life and P&C insurers remain largely the same as in our baseline analyses, suggesting that these alternative explanations do not drive our results.[38]

Next, we examine whether the long-term nature of life insurers' liabilities permits them to hold illiquid and risky assets such as ABS when the rest of the market is selling them. In Table IAXIV in the Internet Appendix, we test this prediction by exploring characteristics of life and P&C firms' investments in (unaffiliated) common stocks (Panel A) and government bonds

[37] We thank an anonymous referee for suggesting these robustness checks. For example, we hold asset management expertise constant by investigating the subsample of life and P&C insurers that belong to a universal group with both types under the same umbrella. See the description of Table IAXIII in the Internet Appendix for more details.

[38] We concede that using life and P&C firms with similar ABS exposures does not fully address the concern that life firms have higher leverage than P&C firms and hence may respond differently to the downgrades (even if they are equally affected). Our within-life analyses, however, are free from this concern.

(Panel B).[39] Life and P&C firms use the same accounting rules for each of these assets, so, if differences in illiquidity and risk-bearing capacities rather than differences in accounting rules drive our results, we should observe differences in liquidity and risk of the stock and government bond investments that show up during the crisis. We do not find evidence consistent with this prediction.

Finally, although our within-life identification is relatively free from endogeneity concerns, one may still argue that the discretion provided to state insurance commissioners is correlated with the sophistication in asset management of state-domiciled insurers and that it is the asset management sophistication that drives our results. We address this concern in two ways. First, we simply note that states that are "financial centers" show up in both the high MTM group (e.g., CA, DE, and NY) and the low MTM group (e.g., CT, IL, and MA), in which case asset management sophistication is not likely to explain differences in trading behavior between the two groups. Second, in Table IAXVII in the Internet Appendix, we repeat our ABS selling and gains trading analyses on the subsamples of large insurers and public insurers, which arguably are more sophisticated groups. Our results continue to hold.

IV. Price Distortions

The literature convincingly demonstrates that fire sales of downgraded assets can generate significant price distortions (Ellul, Jotikasthira, and Lundblad (2011) and Merrill et al. (2013), for example). In this section, we examine this relation for bonds that are targeted for gains trading. Our goal is to shed light on the debate on whether HCA helps to completely avoid market distortions and spillover effects during a financial crisis.[40]

We focus on corporate bonds since government bonds are highly liquid and thus unlikely to suffer price pressure from selective selling. Our identification relies on the cross-section of similar corporate bonds subject to different degrees of gains trading. If a large number of insurers conduct gains trading using the same bonds in an illiquid market, these bonds are likely to suffer significant

[39] We use beta and the Amihud ratio to measure the systematic risk and illiquidity of common stocks. We use the fraction of Treasury notes/bonds in the total government bond portfolio to measure the illiquidity of government bonds. We acknowledge that the choice between Treasury and other government bonds may be driven by other considerations, such as the reaching-for-yield hypothesis of Becker and Ivashina (2013).

[40] In Figure IA3 in the Internet Appendix, we show that HCA is also associated with an overstatement of the reported RBC ratio during the crisis, as market values are substantially lower than book values for many assets. Huizinga and Laeven (2012) find similar results for banks. In Table IAXV, we show that the portfolio allocations to ABS evolve very differently between life and P&C insurers, as well as between life insurers domiciled in high and low MTM states. Thus, the trading behaviors induced by different regulatory accounting rules also have portfolio and risk implications. See Ellul et al. (2014) for a similar analysis for the precrisis period.

price pressure.[41] To test this prediction, we estimate the following model of quarterly bond returns:

$$R_{i,q} = \beta_0 + \left(\beta_{\bar{z}} + \beta_{\overline{zc}} c_q\right) \bar{z}_{i,q} + \beta_X X_{i,q} + \beta_W W_q + \varepsilon_{i,q}, \tag{8}$$

where $R_{i,q}$ is the return of bond i in quarter q; $\bar{z}_{i,q}$ is the gains-trading selling pressure from a particular group of insurers that hold bond i at the beginning of quarter q; c_q is a dummy variable that equals one if quarter q lies in the crisis period; $X_{i,q}$ is a vector of static and time-varying characteristics of bond i in quarter q; W_q is a vector of time-specific variables for quarter q; and the β's are the corresponding vectors of coefficients to be estimated.

Using transaction prices from TRACE, we calculate the quarterly return of a bond as the logged change in price from the last day of the previous quarter to the last day of the current quarter.[42] If a bond trades more than once in a day, we use the size-weighted average trade price on the last day of a quarter.[43] Our variable of interest is $\bar{z}_{i,q}$, which we calculate as the standardized value-weighted average unrealized gain percentile across all relevant insurers holding bond i. Let $Holding_{\mathrm{i,j,q}}$ denote the par value of bond i held by insurer j at the beginning of quarter q. Then the value-weighted average unrealized gain percentile is calculated as

$$\left[\frac{\sum_j \left(Holding_{i,j,q} \times \textit{Unrealized Gain Pct.}_{i,j,q}\right)}{\sum_j Holding_{i,j,q}}\right] \times \left[\frac{\sum_j Holding_{i,j,q}}{\textit{Issue Size}_{i,q}}\right],$$

where the sum is over all insurers j in the high or low MTM groups. We next standardize the average unrealized gain percentile by subtracting its sample mean and dividing the result by its sample standard deviation. Our objective for the standardization is to ensure that the sample variation is roughly the same across the high and low MTM groups, so that the coefficients on selling pressure from the two groups can be directly compared.

We distinguish the effect of gains trading from other effects of unrealized gains by interacting $\bar{z}_{i,q}$ with the crisis indicator c_q, since gains-trading selling pressure should only operate during the crisis, when insurers are hit by the ABS downgrades. If gains trading creates price pressure, then $\beta_{\overline{zc}}$ should be

[41] Schultz (2001) estimates that insurers collectively hold about 33% to 40% of investment-grade corporate bonds.

[42] This return measure is far from perfect. First, corporate bonds do not trade every day, so the last day on which we observe trades for each bond is often a few days before quarter-end. For the bonds in our data that do pass our screen, however, approximately 90% of the last trading days fall in the last month of the quarter. Second, the holding period over which we measure the bond return may be greater than one quarter. This problem affects less than 5% of the observations. We address these two problems, which result in irregular holding periods, by measuring the values of (some) control variables over the same period in which the bond return is measured.

[43] Trade prices tend to be more accurate for larger trades. See Bao, Pan, and Wang (2011), Feldhutter (2012), and Jotikasthira (2008) for evidence that prices vary significantly across transactions, even on the same day.

negative.[44] We include standard controls for fundamental movements in the bond price, in particular, maturity-matched Treasury and rating- and maturity-matched credit spread returns, and other bond characteristics, such as issue size. We use the interpolated constant-maturity Treasury bond from the Fed to calculate the Treasury return. The spread return is given as the corporate bond index return minus the Treasury return, where we use the rating- and maturity-matched Bank of America–Merrill Lynch bond index as our primary source. We estimate model (8) by OLS, and cluster standard errors by bond issuer-calendar quarter.

Table IX reports the results. In columns (1) to (3), we conduct between-insurance-type analysis. For each bond, we calculate the standardized average unrealized gain percentile separately for life insurers' positions and P&C insurers' positions. We consider life (P&C) insurers as low (high) MTM insurers. The first two columns present clear evidence that the corporate bonds disproportionately targeted for gains trading statistically and economically underperform otherwise similar bonds during the crisis. These effects are absent in normal times, consistent with the notion that gains trading is used to raise statutory equity capital during times of stress. A one-standard-deviation increase in low MTM insurers' or life firms' average unrealized gain percentile decreases quarterly return of bonds by 0.63%, which is highly significant given that the interquartile range of the abnormal return is about 4.56% during the 2007 to 2009 crisis. The corresponding effect is 0.19% for high MTM insurers' or P&C firms' average unrealized gain percentile. In column (3), we find that the pressure from life firms is significantly stronger than that from P&C firms—indeed, the latter largely disappears when both are included. This result is consistent with our finding that gains trading is widespread among life but limited among P&C insurers.[45]

In columns (4) to (6), we conduct within-life analysis and obtain similar results. Here, we calculate the standardized average unrealized gain percentile separately across positions of life firms domiciled in high MTM states and those domiciled in low MTM states. Columns (4) and (5) show that, for both groups, their gains trading generates a significant price impact during the crisis. In column (6), we find that the pressure from life firms domiciled in high MTM states trumps, again suggesting that the lower the degree of market value recognition for downgraded ABS, the more widespread is gains trading and the larger its price impact. To put these results in perspective: the price pressure is generated by gains trading, which originates, in part, from insurers' exposures

[44] This is because the bond return and selling pressure are contemporaneous. We find some evidence that the underperformance persists for five to six quarters, since the ABS downgrades spread through the crisis and the pressure often remains for the same bonds. The underperforming bonds eventually outperform once the pressure subsides, creating a V-shape price pattern similar to that of downgraded corporate bonds demonstrated by Ellul, Jotikasthira, and Lundblad (2011).

[45] On average, life (P&C) insurers buy about 4% (3%) of the same bonds back within three months after selling. This number increases to about 30% (20%) if we consider substitute bonds with the same credit rating (e.g., A) and with a maturity within ±1 year of the bond sold. This appears rather like a wash sale, but for the sole purpose of realizing an accounting gain.

Table IX

Impact of Gains Trading on Corporate Bond Returns

This table reports OLS coefficient estimates for regressions of quarterly corporate bond returns on gains-trading selling pressure from insurers in either the low MTM group or the high MTM group. For each bond i in quarter q, unstandardized low (high) MTM unrealized gain percentile is calculated as $[\frac{\sum_j(\text{Holding}_{i,j,q}\times \text{Unrealized gain pct.}_{i,j,q})}{\sum_j \text{Holding}_{i,j,q}}]\times[\frac{\sum_j \text{Holding}_{i,j,q}}{\text{Issue size}_{i,q}}]$, where the sum is over all insurer *j*'s with high ABS exposure and in the low (high) MTM group. Low (high) MTM unrealized gain pct. is then obtained by subtracting the unstandardized low (high) MTM unrealized gain percentile by its sample mean and dividing the result by its sample standard deviation. In columns (1) to (3), life (P&C) insurers are low (high) MTM insurers. In columns (4) to (6), life insurers domiciled in high (low) MTM states according to the baseline definition in Appendix C are high (low) MTM insurers. To be included, a bond must be held by at least one low MTM and one high MTM insurer at the beginning of the quarter. Corporate bond returns are winsorized at the 2.5% and 97.5% levels. *Treasury return* is the logged return of the maturity-matched Treasury bond, proxied by the interpolated constant maturity Treasury bond from the Fed. *Spread return* is the logged return of the maturity- and rating-matched corporate bond index minus the Treasury return. The corporate bond index return is calculated using the Bank of America–Merrill Lynch bond index, adjusted for the duration difference between the index and each individual bond. Bond controls, including ln(bond age), ln(issue size), ln(maturity), and downgrade and bankruptcy dummies, are included in all models but not reported for brevity. The full table is in the Internet Appendix. All other variables are defined in Appendix D. Standard errors, two-way clustered by bond issuer and calendar quarter, are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	All: Life (Low MTM) vs. P&C (High MTM)			Life Only: Low MTM States vs. High MTM States		
	(1)	(2)	(3)	(4)	(5)	(6)
(1) Low MTM	0.131		0.131	0.090		0.099
unrealized gain pct.	(0.130)		(0.126)	(0.108)		(0.084)
Crisis × (1)	−0.634**		−0.620***	−0.544***		−0.414***
	(0.247)		(0.239)	(0.202)		(0.160)
(2) High MTM		0.033	−0.007		0.080	−0.012
unrealized gain pct.		(0.053)	(0.037)		(0.106)	(0.067)
Crisis × (2)		−0.193*	−0.065		−0.506***	−0.142
		(0.104)	(0.066)		(0.191)	(0.089)
Treasury return	0.717***	0.725***	0.717***	0.648***	0.648***	0.648***
	(0.048)	(0.047)	(0.048)	(0.057)	(0.057)	(0.057)
Spread return	0.691***	0.699***	0.692***	0.611***	0.612***	0.611***
	(0.061)	(0.059)	(0.061)	(0.059)	(0.059)	(0.059)
Bond controls	YES	YES	YES	YES	YES	YES
Rating FE	YES	YES	YES	YES	YES	YES
Quarter FE	YES	YES	YES	YES	YES	YES
Wald test: (1) = (2)			1.73			1.19
Wald test: Crisis × (1) = Crisis × (2)			7.23***			3.08*
Observations	51,345	51,345	51,345	86,153	86,153	86,153
R^2	0.410	0.408	0.410	0.380	0.380	0.380

to downgraded ABS held under HCA. Our evidence therefore demonstrates spillover effects from downgraded ABS to otherwise unrelated corporate bonds through the interaction between HCA and regulatory capital requirements.

V. Conclusions

The theoretical literature argues that HCA insulates financial institutions from the price distortions associated with market stress. We challenge this view by providing new empirical evidence that HCA, interacting with regulatory capital requirements, increases financial institutions' incentive to gains trade. We use the insurance industry as a laboratory to explore this interaction due to the availability of detailed security-level data and the significant differences that exist in regulatory accounting rules: (i) life insurers have greater flexibility than P&C insurers to hold speculative-grade instruments under HCA, and (ii) implementation of these rules for life insurers varies significantly across U.S. states.

Faced with severe downgrades among their ABS holdings during the financial crisis, insurers respond by selling the downgraded securities to reduce the required capital and/or by gains trading to raise the statutory equity capital, among a few other alternatives. Life firms, using HCA for downgraded ABS, are less likely than P&C firms, using MTM, to sell these securities and more likely to resort to gains trading. These differences in trading behavior are robust to plausible alternative explanations based on structural business differences between the two insurance types. Moreover, our analysis within the life insurance sector confirms the results: life firms domiciled in high MTM states engage in less gains trading and more impaired-asset selling than those in low MTM states. Finally, we demonstrate price distortions associated with the HCA-induced incentives to gains trade, suggesting that, contrary to common theoretical predictions, HCA does not necessarily avoid illiquidity spillovers and financial contagion.

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Appendix A

Impacts of Accounting Rules on Financial Institutions' RBC Ratios and Optimal Responses Following the Downgrades of Financial Assets

	Mark-to-Market Accounting	Historical Cost Accounting
Immediate price decline of downgraded asset reflected in the balance sheet?	Yes	No[b]
Future price declines of downgraded asset (to be) reflected in the balance sheet?	Yes	No

(*Continued*)

Appendix A—*Continued*

	Mark-to-Market Accounting	Historical Cost Accounting
Numerator Effect: Impact on total adjusted capital (TAC)[a]	Immediate decrease	No impact[b]
Denominator Effect: Impact on risk-based capital (RBC)[a]	Increase	Increase
Net: Impact on RBC ratio[a]	Decrease	Decrease (potentially with a smaller magnitude than under MTM, due to a lower numerator effect)
Accounting Perspective: Selling the downgraded asset?	(0) Indifferent between selling the downgraded asset and keeping it on the balance sheet.	(−) Selling the downgraded asset leads to the recognition of any price decline as capital losses, negatively impacting statutory equity capital (numerator).
Regulatory Capital Perspective: Selling the downgraded asset?	(+) Selling the downgraded asset for lower-risk assets reduces RBC (denominator).	(+) Selling the downgraded asset for lower-risk assets reduces RBC (denominator).
Net: Selling of the downgraded asset?	(+) Likely because of unambiguously positive net benefits from the two perspectives.	(−/+) Unclear because of ambiguous net benefits from the two opposing perspectives. Unlikely if the price decline is large and the negative effect from the accounting perspective prevails.
Need for supplemental measures to improve the RBC ratio, including gains trading of unrelated assets held under historical cost accounting?	Less, because selling of the downgraded asset partially raises the RBC ratio.	More. In the absence of selling the downgraded asset, the institution needs to sell other assets to reduce the RBC (denominator), or raise TAC (numerator), or both, to raise the RBC ratio closer to its pre-downgrade value.

[a]The NAIC risk-based capital ratio, or RBC ratio, is calculated as follows: RBC ratio = $\frac{\text{total adjusted capital (TAC)}}{\text{Risk-based capital (RBC)}}$, where TAC is made up primarily of capital and surplus and asset valuation reserve (AVR), if the institution maintains one, and therefore is essentially the same as statutory equity capital. RBC reflects business risk and asset risk, where the latter is based largely on the credit ratings of the assets.

[b]If the institution recognizes OTTI, then its assets and hence statutory (equity) capital will immediately decrease by the amount of OTTI, generating a negative numerator effect on its RBC ratio.

Appendix B
Numerical Examples

We use the positions of Mid Century Insurance (company code = 21687) at the end of 2007 as the pre-downgrade positions in Case 1, and the positions of Metropolitan Tower Life Insurance (company code = 97136) at the end of 2007 as the pre-downgrade positions in Cases 2 and 3. We assume that the original ABS positions are in NAIC Class 1 and that half of these positions are later downgraded to Class 4. We also assume that if the insurer sells the downgraded ABS, it replaces them with Class 1 bonds. The RBC ratio in each scenario is calculated according to:

$$\text{RBC ratio} = \frac{\text{Total adjusted capital } (TAC)}{\text{Risk-based capital } (RBC)} = \frac{TAC^{*} + ABS}{RBC^{*} + (\lambda \times ABS)},$$

where TAC^{*} is the total adjusted capital, excluding the book value of ABS; ABS is the book value of ABS; RBC^{*} is the risk-based capital, excluding the portion required for holding ABS; and λ is the percentage required capital for holding ABS (or new assets that replace the downgraded ABS). For simplicity, the above formula and the following numerical examples ignore the size factor and covariance discount in the calculation of RBC and thus the results here are only an approximation. Please refer to the Internet Appendix for more precise and detailed calculations, as well as the full list of assumptions.

		Post-Downgrade	
	Pre-Downgrade	Not Sell	Sell
Case 1: P&C Insurer, MTM			
(1) *ABS*	446.44	290.19	290.19
(1.1) Expected impact from further price decline[a]	0.00	−50.09	0.00
(2) TAC^{*}	277.91	277.91	277.91
(3) $TAC = (1) + (1.1) + (2)$	724.36	518.01	568.1
(4) $\lambda \times ABS$	1.82	17.71	1.18
(4.1) Expected impact from further price decline	0.00	−3.06	0.00
(5) RBC^{*}	194.65	194.65	194.65
(6) $RBC = (4) + (4.1) + (5)$	196.47	209.3	195.83
RBC ratio = (3)/(6)	3.69	2.47	2.90
Case 2: Life Insurer, HCA			
(1) *ABS*	766.88	766.88	498.47
(2) TAC^{*}	430.15	430.15	430.15
(3) $TAC = (1) + (2)$	1,197.03	1,197.03	928.63
(4) $\lambda \times ABS$	3.07	76.69	1.99
(5) RBC^{*}	281.15	281.15	281.15
(6) $RBC = (4) + (5)$	284.22	357.84	283.15
RBC ratio = (3)/(6)	4.21	3.35	3.28
Case 3: Life Insurer, HCA with OTTI			
(1) *ABS*	766.88	498.47	498.47
(2) TAC^{*}	430.15	430.15	430.15
(3) $TAC = (1) + (2)$	1,197.03	928.63	928.63
(4) $\lambda \times ABS$	3.07	49.85	1.99
(5) RBC^{*}	281.15	281.15	281.15
(6) $RBC = (4) + (5)$	284.22	331	283.15
RBC ratio = (3)/(6)	4.21	2.81	3.28

[a]The precise rule for MTM is "the lower of book or market value." The insurer can only lose from a price decline but not gain from a price increase. We therefore value the expected impact of a price decline as a short position in a one-year at-the-money put option on B-rated ABS.

Appendix C
Classifications of U.S. States into High and Low Mark-to-Market Groups

The following table lists the value of the high MTM dummy for different U.S. states, and relevant criteria and statistics, under three classification schemes.

- The Baseline and Alternative 1 classifications are based on the insurance codes for each state. We begin by searching the insurance code to see whether the state meets Criterion A and assign the value of one if it does and zero otherwise. Criterion A: the state's code explicitly states or uses clear language to suggest that the Insurance Commissioner (or Insurance Division) has full discretion in determining the method of calculating (fixed income) asset values. If the state meets Criterion A, we then search the code to see whether the state also meets Criterion B and assign the value of one if it does and zero otherwise. (If the state does not meet Criterion A, we assign a value of "N/A" to Criterion B.) Criterion B: the state's code does not explicitly state that the rules used by the Insurance Commissioner (or Insurance Division) shall not be inconsistent with the method approved by the NAIC (as set forth in the latest edition of its publication "Valuation of Securities"). To be classified as a high MTM state (dummy = 1) under the Baseline classification, the state has to meet both criteria. The Alternative 1 classification expands the Baseline classification to include three additional states whose insurance codes, based on our reading, are ambiguous on Criterion B.
- The Alternative 2 classification is based on realized average frequencies with which life insurers in the state recognize OTTI for downgraded corporate bonds and ABS. Only downgrades from investment to speculative grade during the precrisis period (2005 to 2007) are included. For each insurer-downgrade observation, OTTI is recognized if (a) OTTI is reported for the bond or ABS position at year-end, or (b) the book-adjusted carrying value of the position is reset to the reported fair value at year-end. For each insurer, %OTTI is calculated as the number of downgraded positions for which OTTI is recognized divided by the total number of downgraded positions. The insurer-level %OTTIs are then averaged across all life insurers domiciled in the state. States with the average %OTTI above the median are considered high MTM states (dummy = 1). Seven states in the following table, namely, HI, ID, ME, NH, NM, RI, and SD, do not have valid average %OTTI because life insurers in these states do not hold downgraded positions during the precrisis period. We do not treat these seven states as high MTM states in our analyses.

	Classification Based on Reading of State Insurance Code				Classification Based on Pre-Crisis OTTI Frequency	
State	Baseline	Alternative 1	Criterion A	Criterion B	Alternative 2	% OTTI
AL	0	0	1	0	1	12.44%
AR	0	0	0	N/A	1	14.74%
CO	0	0	0	N/A	1	21.51%
CT	0	0	0	N/A	0	4.62%
DC	0	0	0	N/A	1	15.38%
FL	0	0	1	0	0	5.56%
HI	0	0	1	0	0	–
IA	0	0	1	0	0	10.47%
IL	0	0	0	N/A	0	7.43%
KS	0	0	0	N/A	0	5.71%
KY	0	0	1	0	0	0.00%
LA	0	0	0	N/A	1	27.73%
MA	0	0	0	N/A	1	19.29%

(*Continued*)

Appendix C—*Continued*

	Classification Based on Reading of State Insurance Code				Classification Based on Pre-Crisis OTTI Frequency	
State	Baseline	Alternative 1	Criterion A	Criterion B	Alternative 2	% OTTI
MD	0	0	0	N/A	0	0.60%
ME	0	0	0	N/A	0	–
MN	0	0	0	N/A	0	9.63%
MO	0	0	0	N/A	0	3.92%
MS	0	0	0	N/A	0	0.00%
NC	0	0	0	N/A	0	4.17%
ND	0	0	0	N/A	0	0.00%
NE	0	0	1	0	0	9.77%
NH	0	0	0	N/A	0	–
NJ	0	0	0	N/A	1	10.94%
NM	0	0	0	N/A	0	–
OK	0	0	1	0	0	3.33%
OR	0	0	1	0	0	1.47%
PA	0	0	0	N/A	0	5.81%
RI	0	0	1	N/A	0	–
SD	0	0	1	0	0	–
TN	0	0	1	0	0	3.47%
UT	0	0	0	N/A	1	10.99%
VA	0	0	0	N/A	0	2.23%
VT	0	0	1	0	0	0.00%
ID	0	1	1	0/?[a]	0	–
WA	0	1	1	0/?[b]	1	16.25%
OH	0	1	1	0/?[c]	1	24.41%
AZ	1	1	1	1	1	19.37%
CA	1	1	1	1	1	25.00%
DE	1	1	1	1	1	21.68%
GA	1	1	1	1	1	14.29%
IN	1	1	1	1	1	11.23%
MI	1	1	1	1	1	23.05%
NY	1	1	1	1	1	11.41%
SC	1	1	1	1	1	20.00%
TX	1	1	1	1	1	12.22%
WI	1	1	1	1	1	11.42%

[a]"The director may adopt rules establishing standards and limitations for investments by insurers that are not otherwise specifically permitted or prohibited in this chapter. In the absence of a rule prohibiting such, all assets shall be valued according to rules promulgated by the National Association of Insurance Commissioners (NAIC), NAIC's valuation of securities office or by NAIC's financial condition subcommittee."

[b]"All bonds or other evidences of debt having a fixed term and rate held by any insurer may, if amply secured and not in default as to principal or interest, be valued as follows ... [description of HCA] ... or in lieu of such method, according to such accepted method of valuation as is approved by the commissioner. ... [Further conditions] The commissioner shall have full discretion in determining the method of calculating values according to the rules set forth in this section, and not inconsistent with any such methods then currently formulated or approved by the National Association of Insurance Commissioners."

[c]"The Insurance Commissioner shall adopt rules in accordance with the Code to establish standards for the determination and calculation of values, for purposes of use in statutory financial statements submitted to the department of insurance, for those investments for which the National Association of Insurance Commissioners has not published valuation standards."

Appendix D
Variable Descriptions

Variable	Specific To	Definition
% risky assets	Insurer-year	Percentage of investment assets in any of the following asset classes: speculative-grade bonds, common and preferred stocks, nonperforming mortgages, real estate, and other investments. According to NAIC, the required capital percentages for these assets are greater than or equal to those of the least risky class of speculative-grade bonds (BB).
ABS exposure or High ABS exposure	Insurer	Expected impact of ABS downgrades during the crisis (2007Q3 to 2009Q4) on the RBC ratio given an insurer's ABS positions before the crisis. For each insurer, the new total adjusted capital or TAC (numerator) and RBC (denominator) are calculated to reflect the credit ratings at the end of 2009 of all ABS positions held at the end of 2007Q2. ABS whose credit ratings are not available in Ratings IQuerry are assumed to experience the same average downgrades and price declines as those whose credit ratings are available in Ratings IQuerry. NAIC capital requirements and statutory accounting rules are strictly applied to each position; HCA is used for all positions of life (P&C) insurers except those in NAIC Class 6 (Classes 3–6), where MTM is used. The market price of a position is the average price of the last trades or reported fair values of all insurers at the end of 2009. High ABS exposure is a dummy variable equal to one for life (P&C) insurers with the expected decline in RBC ratio in the top 75% (25%) of all those affected by ABS downgrades, and zero otherwise. The threshold is about the same for life and P&C insurers at approximately 0.4 in RBC ratio terms.
Bankruptcy	Bond-quarter	Dummy variable equal to one if the issuer of the bond files for bankruptcy during the quarter, and zero otherwise.
Bond age	Bond-quarter	Years from issuance to the beginning of the quarter of interest.
Bond return	Bond-quarter	Logged change in price from the last day when there are any trades of a bond in the previous quarter to the last day in the current quarter, scaled by 100. If a bond trades more than once in a day, we use the size-weighted average trade price on the last day of a quarter.
Capital & surplus	Insurer-year	Insurer's statutory net worth (including paid-in capital and additional funds in surplus) in millions of dollars through the most recent year-end. Capital and surplus and asset valuation reserve, if any, are the primary components of total adjusted capital (TAC), the numerator of the RBC ratio.
Crisis	Quarter	Dummy variable equal to one if the calendar quarters are in the 2007 to 2009 crisis period, and zero otherwise. The crisis period is defined based on the volume of ABS downgrades, and covers 2007Q3 to 2009Q4.

(*Continued*)

Appendix D—*Continued*

Variable	Specific To	Definition
Downgrade	Bond-quarter	Dummy variable equal to one if the bond is downgraded from investment to speculative grades during the quarter, and zero otherwise. S&P ratings are used wherever available. Moody's ratings are used when S&P ratings are unavailable.
Firm FE	Insurer	Set of dummy variables for insurance companies to which the observations belong.
High mark-to-market (MTM)	Insurer	Dummy variable equal to one if the life insurer is domiciled in a U.S. state in the high MTM group under each of the three alternative classifications in Appendix C, and zero otherwise.
High MTM and low MTM unrealized gain percentile	Bond-quarter	Value-weighted average unrealized gain percentile across all qualified insurers' positions in the bond, scaled by the fraction of bond issue size held by qualified insurers and then standardized by subtracting the sample mean and dividing by the sample standard deviation. For high (low) MTM unrealized gain percentile, qualified insurers must have positions in the bond at the beginning of the quarter, have high ABS exposure, that is, their RBC ratios are expected to drop by approximately 0.4 or more due to actual ABS downgrades during the crisis, and belong to the high (low) MTM group. In the between-insurance-type analysis, high (low) MTM insurers refer to P&C (life) insurers. In the within-life analysis, high (low) MTM insurers refer to life insurers domiciled in high (low) MTM states.
Issue size	Bond	Offering amount of the bond, measured in million dollars.
Leverage	Insurer-year	Debt as a percentage of total assets, all measured at book values.
Low RBC ratio	Insurer-year	Dummy variable equal to one if the insurer's year-end RBC ratio is in the bottom quartile among all insurers of the same type, and zero otherwise.
Maturity	Bond-quarter	Maturity of the bond at the beginning of quarter of interest, measured in years.
NAIC risk-based capital ratio (RBC ratio)	Insurer-year	Ratio of total adjusted capital (TAC), made up primarily of capital and surplus and applicable valuation reserves, to NAIC risk-based capital (RBC). RBC is the *minimum* amount of capital that the insurance company must maintain based on the inherent risks in its operations. RBC is calculated based on the NAIC's formula, which reflects its assessment of risks of different asset classes and businesses. For example, a company with a RBC ratio of 1.0 has capital equal to its RBC. Insurance companies with higher RBC ratios are considered better capitalized. Insurance companies with a RBC ratio below two are subject to supervisory intervention. The level of supervisory action depends on the level of the RBC ratio. Low RBC ratio dummy equals one for RBC ratios below the annual median, and zero otherwise.

(*Continued*)

Appendix D—*Continued*

Variable	Specific To	Definition
P&C	Insurer	Dummy variable equal to one if the insurer is a P&C firm, and zero otherwise.
Pool FE	Bond	Set of dummy variables for ABS tranches issued on the same asset pool.
Quarter, Quarter × Type, and Year FE	Quarter, Quarter-Bond type, or Year	Set of dummy variables for calendar quarters in which the observations fall. Set of dummy variables for calendar quarters in which the observations fall, by bond type (corporate or government bonds). Set of dummy variables for years in which the observations fall.
Rating FE	Bond-quarter	Set of dummy variables for credit rating groups, defined by the NAIC's RBC requirement. The groups are, in order of credit quality, A and above, BBB, BB, and B and below. S&P ratings are used wherever available; otherwise, Moody's ratings are used.
Revalue	Position-year	Dummy variable equal to one if the position's book value is equal to its reported fair or market value, and zero otherwise.
ROE	Insurer-year	Return on equity, measured as net income divided by book value of equity at the beginning of the year.
State FE	Insurer-year	Set of dummy variables for insurers' domicile states.
Tranche size	ABS	Offering amount of the ABS tranche, measured in thousand dollars.
Unrealized gain pct.	Position-year	Percentile rank, ranging from zero to one, of the position's dollar unrealized gain within the insurer's portfolio at the previous year-end. A position's dollar unrealized gain is the difference between the insurer's reported fair value and book-adjusted carrying value of the position at the previous year-end, measured as a percentage of book value.

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Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

Appendix S1: Internet Appendix.