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

Andrew Ellul
Indiana University, CSEF and ECGI

Chotibhak Jotikasthira
University of North Carolina

Christian T. Lundblad
University of North Carolina

Yihui Wang
Fordham University and Chinese University of Hong Kong

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**ABSTRACT**

We provide new empirical evidence concerning the contentious debate over the use of historical cost versus mark-to-market accounting (HCA vs. MTM) in regulating financial institutions. These accounting rules, through their interactions with capital regulations, alter financial institutions' portfolio decisions and trading behavior. The insurance industry provides a natural laboratory in which to explore these interactions since significant differences exist in regulatory accounting rules: (1) life insurers have greater flexibility to hold speculative-grade instruments under HCA than property and casualty (P&C) insurers, which are required to use MTM, and (2) the degree to which life insurers have to recognize market value through impairment significantly differs across U.S. states. In the context of the sizeable downgrades of asset-backed securities (ABS) during the financial crisis of 2007-2009, we show that insurers facing greater degrees of market value recognition (i.e., MTM) are more likely to sell the downgraded ABS than insurers holding these securities under HCA. Instead, insurers facing HCA disproportionately resort to gains trading, *selectively selling* their corporate and government bond holdings with the highest unrealized gains, to improve their capital positions. Finally, we demonstrate that the trading incentives induced by the interplay between HCA and capital regulations alter financial institutions' portfolio allocations, potentially engender distortions in key regulatory metrics, and transmit shocks across otherwise unrelated markets.

*JEL classifications*: G11; G12; G14; G18; G22
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# 1. Introduction

This paper explores the trading incentives of financial institutions induced by the *interaction* between regulatory accounting rules and capital requirements. The theoretical literature (for example, Allen 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 spiral of liquidity and prices and potential contagion effects for other markets.[1] These authors also contend that historical cost accounting (HCA), in contrast, may avoid fire sales and contagion effects. This paper challenges this view on HCA by providing new empirical evidence that HCA, interacting with regulatory capital requirements, induces an altered incentive 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 an intense debate. The accounting rules followed by financial institutions may appear to simply be an issue of measurement and, in frictionless markets, free of any impact on economic fundamentals. However, when markets are illiquid and trading frictions elevated, financial assets may temporarily trade at market prices that are well below fundamental values (Duffie (2010), AFA Presidential Address). In such an environment, write-downs or impairments (and the associated deterioration of financial institutions' asset values) will lead to an erosion of their capital base, potentially forcing the liquidation of some assets. Allen and Carletti (2008) argue that in such a market environment, HCA will avoid fire sales, and Plantin, Sapra and Shin (2008) argue that MTM generates excessive volatility in prices, degrading their information content and leading to sub-optimal decisions by financial institutions.

However, HCA may also engender inefficiencies as financial institutions using this type of accounting have an incentive to engage in selective asset sales aimed at the early realization of earnings (Laux and Leuz (2009)). Indeed, Plantin, Sapra and Shin (2008) recognize 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 trading incentive and its impact on financial institutions'

[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 a behavior similar to "gains trading" when management tries to signal good project quality to the market. See also Berger, Herring, and Szego (1995).

portfolios during times of *market stress*. We argue that it is precisely during these episodes that financial institutions have the highest need to realize gains in order to improve capital positions.

Indeed, a crucial issue in the debate surrounding the accounting treatment of financial assets and its impact on the behavior of financial institutions relates to the interaction between the regulatory accounting regime and the institutional framework (Heaton, Lucas, and McDonald (2010) and Laux and Leuz (2009, 2010)). To focus ideas, consider a financial institution that invested heavily in Asset-Backed Securities (ABS) in the years leading up to the financial crisis. During the crisis of 2007-2009, many ABS were significantly downgraded by rating agencies. Because *risk-based regulatory capital requirements* are generally set as a function of each asset's credit rating, the severe downgrades of ABS significantly increased the regulatory (or, required) capital of any institution holding these instruments. In the context of the insurance industry, this regulatory capital is referred to as "Risk-Based Capital" (RBC). The increase in RBC leads to a decline in the RBC ratio (the ratio of statutory equity capital to RBC), which measures financial health.[3] Given this negative shock, the institution then faced a stark decision: either sell the downgraded instruments to reduce the RBC or retain them and find additional capital elsewhere.

Since the downgraded instruments experienced severe price declines, a crucial determinant of the institution's decision is whether the price declines have already been (or would soon be) reflected in its statutory equity capital. This is where the accounting treatment of these instruments is likely to have a first-order effect on trading and portfolio choices. If the downgraded asset is held at MTM, the price decline would be automatically reflected in the balance sheet, and the loss would directly reduce the institution's statutory equity capital (the numerator of the RBC ratio). From a purely accounting perspective, the institution would be indifferent between keeping the asset on the balance sheet and selling it. However, from a regulatory capital adequacy perspective, selling the downgraded asset has an important advantage as swapping a speculative-grade asset for cash or an investment-grade asset immediately reduces the required RBC (the denominator of the RBC ratio) and improves the RBC ratio. Taken together, selling the downgraded asset is unambiguously beneficial if the asset is held at market value.[4]

[3] Insurance regulators measure an insurer's financial health using the RBC ratio, calculated as the ratio of Total Adjusted Capital (TAC) to RBC. More details on both TAC and RBC will be provided in Section 2. This ratio is similar in spirit to various capital ratios used by bank regulators. Low values of the RBC ratio indicate weakness. Regulatory intervention is required for insurers with RBC ratios below 2, but attention is often prompted by a downtrend in the RBC ratio above that threshold.

[4] To focus our arguments and analyses on the interaction between accounting and regulatory capital rules, we ignore the fact that asset sales would likely take place in a market already characterized by severe price declines and

The situation is very different if the downgraded asset is held under HCA, because the decline in value would not be recognized in the balance sheet unless the institution sells the asset. In this case, the institution may yet need to respond because the elevated risk charge depresses its RBC ratio. However, under HCA, selling the asset has two opposing effects on the RBC ratio: (i) a positive effect from reducing the required RBC (the denominator of the RBC ratio), and (ii) a negative effect from recognizing the price decline in its statutory equity capital (the numerator of the RBC ratio). If the price decline were very large as was observed for many downgraded securities 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 respond by choosing to realize gains on other assets, to raise additional equity capital, or both. It is precisely in this situation that the incentive for gains trading is elevated: in order to shore up its capital positions, the institution may *selectively sell* other assets held under HCA with the *largest unrealized gains*. By doing so, these gains can be realized and flow to its statutory equity capital.

Based on these arguments, we develop and test two general hypotheses. General Hypothesis 1: financial institutions are more likely to divest positions held at MTM than otherwise similar positions held under HCA. Since downgraded assets, regardless of their accounting treatment, engender capital adequacy implications, they induce incentives to gains trade other securities to capture unrealized gains. This incentive is likely larger for institutions who hold downgraded assets under HCA than those who use MTM because the latter may have already partially recovered from the downgrades by directly selling the affected positions. Hence, General Hypothesis 2: financial institutions have larger incentives to gains trade when they are more affected by downgrades and when they hold these downgraded assets under HCA (vs. MTM).

The insurance industry presents a natural laboratory in which to explore the above hypotheses pertaining to the interaction between accounting rules and capital regulations for financial institutions. While the National Association of Insurance Commissioners (NAIC)'s regulatory accounting rules for investment-grade holdings of life and property and casualty (P&C) insurers are similar, they differ significantly for speculative-grade assets. We focus on the crisis period from 2007-2009 when thousands of ABS were sharply downgraded, capital constraints became practically binding, and so the effects of accounting rules were likely most pronounced. When an ABS is downgraded to speculative grade, P&C insurers have to immediately recognize

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illiquidity. This potentially reduces the incentives to sell downgraded assets, but the effects should apply equally across both HCA and MTM.

its value as the lower of the book value or market price (or model price if no market price is available). On the other hand, depending on the exact implementation of NAIC rules by each U.S. state, life insurers can largely continue to hold the downgraded ABS under HCA except in the extreme case when it is classified as 'in or near default'. Given the sizeable downgrades among insurers' ABS holdings, these accounting variations, interacting with the capital adequacy rules, are likely to induce significantly different trading behaviors and portfolio choices between life and P&C firms, particularly those that are most exposed to ABS downgrades.

Our first empirical strategy is to contrast the behaviors of life and P&C firms, exploiting the stark difference in their regulatory accounting treatments for downgraded ABS. We refer to this as *between-insurance-type* analysis. That said, we recognize that life and P&C insurers differ along many other dimensions and that the regulatory accounting rules, while not a choice variable at the individual insurer level, are not the only relevant differences. Differences in the business models between the two types, for example, may induce commensurate differences in their investment strategies. As a result, our primary identification strategy may not be without concerns. To address this problem, we also implement a second identification strategy by exploiting variation *within* the life insurance sector in the implementation of NAIC rules across U.S. states (technically, 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 the use of MTM or the recognition of 'other-than-temporary impairment' (OTTI)[5] in case of significant price declines, whereas other states do not. We test our general hypotheses across life insurers domiciled in these two groups of states.[6] This *within-life* analysis helps rule out alternative mechanisms that may drive the results obtained from the *between-insurance-type* analysis.[7]

We examine a panel of 1,882 life and P&C firms from 2004 to 2010 for which *portfolio-security level* positions and transactions data are readily available through the NAIC. To identify ABS downgrades, insurers' security holdings are merged with rating history data from S&P's

[5] OTTI refers to an impairment charge taken on a security whose fair value has fallen below the carrying value on the balance sheet and its value is not expected to recover through the holding period of the security. In addition to continuous marking-to-market, OTTI is an alternative mechanism for value-recognition under HCA.

[6] As a robustness check, we also rank states by the realized OTTI frequency, which we calculate for each state by averaging across all downgraded positions of state-domiciled insurers during the *pre-crisis period*.

[7] The variation across states in the discretion given to insurance commissioners in pursuing the recognition of OTTI does not apply to P&C insurers, since the NAIC rules already require that P&C insurers switch to MTM upon the downgrade.

Ratings IQuery, which reports 34,957 investment-to-non-investment downgrades of non-agency ABS over the period 2005-2010. Supplementing with other data sources, we find supporting evidence for both of our general hypotheses. First, we show clear evidence that P&C firms (booking downgraded securities under MTM) are significantly more likely than life firms (generally booking downgraded securities under HCA) to sell their ABS holdings affected by downgrades, consistent with General Hypothesis 1. Our analysis *within* the life insurance sector across U.S. states provides additional supporting evidence. Life insurers domiciled in the states that impose greater degrees of market value recognition than strictly required by NAIC rules are more likely to sell the affected ABS, compared to life insurers domiciled in other states.

Second, we find that insurers most affected by ABS downgrades disproportionately sell the otherwise unrelated government and corporate bonds with the highest unrealized gains. Further, among the most affected firms, those with RBC ratios in the lowest quartile are significantly more likely than others to engage in gains trading, suggesting that insurers gains-trade, in part, to counteract the negative impact of ABS downgrades on their capitalization. Because most fixed-income assets are held under HCA, it is only through trading that these unrealized gains can be recognized and flow to insurers' statutory equity capital (the numerator of the RBC ratio). Most importantly, gains trading is significantly more prevalent among life insurers (again, booking downgraded ABS under HCA) than P&C insurers (again, booking downgraded ABS under MTM), consistent with General Hypothesis 2.[8] Our *within-life* analysis provides additional corroborating evidence. We find that life insurers domiciled in U.S. states that strictly implement NAIC rules, and thus are more likely to keep the downgraded ABS under HCA without recognizing OTTI, engage in significantly more gains trading than life insurers domiciled in other states.

While we believe that our within-life analysis provides a clean identification, we contend that the life versus P&C comparison nevertheless provides important complementary evidence given the striking contrast in accounting rules. To make this between-group identification more convincing then, we directly examine plausible alternative explanations that may drive the differences between life and P&C firms in their propensity to sell downgraded assets and engage in gains trading. We find that such differences remain even in the subsamples of life and P&C insurers that (1) are equally and consistently profitable throughout the sample period, hence addressing tax management concerns, (2) belong to a universal group that includes both types,

[8] In fact, only a tiny group of P&C insurers (less than 10%), those that are most affected by ABS downgrades and have the lowest RBC ratios, gains trade.

hence alleviating the concern that differences in asset management expertise may drive the results, and (3) have the same fixed-income portfolio duration, hence ruling out the possibility that duration differences, as proxies for differences in liability structure, may explain our findings. Finally, life and P&C insurers' portfolio choices in common stocks and government bonds do not appear consistent with an alternative explanation that life insurers utilize their greater capacities to handle/absorb illiquidity and systematic risk during the crisis.

The final question is then whether HCA, through its interaction with capital adequacy rules, ultimately leads to distortions in financial institutions' portfolio decisions and/or engenders price pressures in the assets targeted for gains trading. On portfolio distortions, we find striking differences in the way that life and P&C insurers' portfolios evolve during the crisis. Similar differences, albeit smaller in magnitude, also exist among life insurers domiciled in different U.S. states. In each of these comparisons, insurers facing greater degrees of market value recognition tend to reduce their ABS holdings more aggressively. This difference is most pronounced among insurers that face capital constraints. If we take the least capital-constrained firms that employ MTM as a benchmark, then our results suggest that constrained firms that employ HCA exhibit some distortions in their portfolio choices. On price pressures, we find that the otherwise unrelated bonds associated with large unrealized gains in the balance sheet of life insurers, statistically and economically underperform otherwise similar bonds, on average. These price pressures are even larger if life insurers holding the high-unrealized bonds are domiciled in U.S. states that strictly follow the NAIC rules and allow these insurers full discretion not to recognize OTTI of downgraded ABS. Overall, these results show that HCA can also create unintended consequences where market distortions and spillover effects are not entirely avoided.

Our paper is related to several strands of the literature. We contribute to the growing body of research exploring the trading decisions made by institutional investors when faced with a financial shock (for example, Anand *et al.* (2010), Boyson *et al.* (2011), Manconi *et al.* (2011), Hau and Lai (2011), among others). To the best of our knowledge, we are the first to empirically demonstrate the importance of the interaction between accounting rules and capital regulations on institutional investors' trading decisions and the spillover effects that may result. One unintended consequence of such an interaction that we focus on in this paper is the incentive for gains trading. In contrast to earlier efforts,[9] we show that gains trading takes place during periods of market

[9] Carey (1994) finds some evidence of gains trading by banks during 1979-1992. 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

stress and the extent to which it is conducted is determined, in part, by the interaction between accounting and capital regulations. 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 trading motives and demonstrate its potential price impact.

Most importantly, our results contribute to the debate on the choice of the accounting system used in regulating financial institutions.[10] The literature (mostly theoretical) suggests that during a financial crisis, marking-to-market may cause distressed selling and financial instability (Allen and Carletti (2008), Plantin *et al.* (2008), and Wallison (2008)).[11] Merrill *et al*. (2012) provide evidence in support of this prediction, focusing on insurers' trading in residential mortgage-backed securities (RMBS) following modifications in their accounting rules that require the recognition of changes in their market values. We provide new empirical evidence that suggests that the contentious debate surrounding accounting choices for financial institutions in general cannot ignore the important interactions with the regulatory framework in which they are being employed. Specifically, our evidence supports Laux and Leuz (2009, 2010)'s conjecture that historical cost accounting is not an unambiguous panacea.

The remainder of the paper is organized as follows. In Section 2, we explain in detail the regulatory accounting and capital adequacy rules, and formally develop our hypotheses. Section 3 discusses the sample construction and provides relevant summary statistics. Section 4 presents our main empirical analysis, contrasting the trading behavior of insurers facing different accounting rules during the wave of significant ABS downgrades. In Section 5, we investigate the effects of gains trading on portfolio allocation and security prices. Section 6 concludes. We present additional results in an Internet Appendix.

## 2. Institutional Framework and Hypotheses Development

In this section, we explain how different accounting rules can influence financial institutions' capital positions and, through interactions with capital adequacy regulation, alter the institutions' portfolio decisions and trading behaviors. Our two general hypotheses to be tested in the data

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few try to manage tax liabilities or regulatory capital. See also Scholes *et al.* (1990), Beatty *et al.* (1995), Hirst and Hopkins (1998), Kashyap and Stein (2000), Hirst *et al.* (2004), Lee *et al.* (2006), among others (some refer to gains trading as the 'cherry picking'). Hanley and Nikolova (2013) use our methodology to examine the extent of gains trading among insurers, following the change in NAIC's capital assessment methodology for ABS.

[10] See Goh *et al.* (2009) for an analysis of the determinants of accounting choice and the effects of fair value disclosure on firms' information environment. See also Eccher *at al.* (1996), Penman (2007), Petroni and Wahlen (1995), and Wyatt (1991).

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

can be expressed as follows. General Hypothesis 1: financial institutions have a larger incentive to divest downgraded positions held at MTM, where the associated price declines are already reflected in the balance sheet, than otherwise similar positions held under HCA, where divesting the positions would force the recognition of price declines and hence capital losses. General Hypothesis 2: downgraded assets, regardless of their accounting treatment, engender capital adequacy implications; financial institutions holding these assets under HCA will have a larger incentive than other institutions holding these assets at MTM to trade other unrelated assets to capture unrealized gains.

While we provide new evidence on the debate between HCA and MTM for financial institutions by testing whether these differences are present in the data, it is important to note that regulation is in reality quite nuanced relative to the stark differences often assumed in the theoretical literature. Because of both the detailed nature of the available data and the important variation in the application of accounting rules across institutions, we use the U.S. insurance industry as a laboratory to investigate our research question. At the end of this section, we will carefully justify and place our two general hypotheses in the insurance context and explicitly state what it is we exactly test. Before doing so, we explain the regulatory framework for the insurance industry so that the empirical design is clear and the links to the broader debate about the regulation of financial institutions can be better understood.

### 2.1 Regulatory Capital Ratio

The risk-based capital (RBC) ratio is an essential capital adequacy metric in U.S. insurance regulation. We start by introducing the RBC ratio, and then proceed to explain the mechanisms through which it is affected by ABS downgrades and alternative trading responses by insurers. The RBC ratio is defined as follows:[12]

$$\text{RBC Ratio} = \frac{\text{Total Adjusted Capital}}{\text{Risk-Based Capital}} = \frac{\text{TAC}}{\text{RBC}}$$

[12] In banking regulation, a key capital adequacy metric is the ratio of statutory equity capital over risk-weighted assets. In the insurance business, the statutory equity capital is measured in relation to risk-weighted capital. Despite the difference in scale, the core idea is very similar.

In the insurance industry, regulators require that the RBC ratio has to exceed a value of 2, but earlier regulatory actions may be taken following significant declines.[13]

For a fixed-income asset, its contribution to RBC is determined by its credit rating; the worse the credit rating, the larger the required capital. Therefore, the severe downgrades of ABS during the crisis significantly increased RBC for insurers holding these assets, leading to a significant decline in their RBC ratios (and a commensurate reduction in their perceived financial health). Each affected institution had a few options to bring its RBC ratio back to a healthy level: (i) sell the downgraded ABS and swap into lower-risk assets, thereby lowering the denominator, and/or (ii) trade other risky assets to reduce the denominator or, perhaps, increase the numerator through gains trading.[14] The right choice depends critically on the accounting rules in place.

### 2.2 Accounting Treatment of Downgraded Securities

Broadly speaking, both life and P&C insurers hold three main asset classes: (a) government and investment-grade corporate bonds, (b) structured securities, including ABS, and (c) common and preferred equities. For *both* types of insurers, the regulatory accounting treatment of government bonds, investment-grade corporate bonds, and investment-grade ABS is the same (HCA), and the same rules also apply to equities (MTM). What significantly differs between the two insurance types is the accounting treatment for corporate bonds and ABS the moment they fall from investment to speculative grades. To be clear, this security-level accounting treatment is far more nuanced than typically appears in the theoretical literature, where an institution is assumed to face one type of accounting rule or the other. However, in this case, the variation permits our first identification strategy since we can observe what happens across different sets of regulated financial institutions and their asset holdings, depending upon how the downgraded securities are treated.

NAIC regulations define 6 different asset classes by credit ratings, and all fixed income securities held by insurers fall into one of these classes. An important threshold is between Class 2

[13] Specifically, in certain U.S. states that utilize 'trend tests', a negative three-year trend in such metrics, coupled with an RBC ratio of 3 or below, may prompt a regulatory investigation.

[14] A third option is to increase the numerator by raising either new equity capital (Berry-Stolzle, Nini, and Wende (2012)) or statutory surplus (Koijen and Yogo (2013)). For life insurers, the latter can be done by selling long-term life policies at prices below break-even but above the required statutory reserve. In addition, Koijen and Yogo (2014) show that some insurers also have flexibility to reduce the denominator by carving out part of the liabilities into a captive unit.

and Class 3; the former refers to a BBB-rated security while the latter refers to a BB-rated security. When a fixed-income security is downgraded from investment to non-investment grades, it crosses that threshold and NAIC rules state that P&C insurers have to immediately recognize its value as the lower of the book value (or amortized historical cost at the time of downgrade) or the market price (or model price if no reliable market price is available). On the other hand, life insurers face no such requirement; they can continue holding the downgraded bond under HCA, except in the extreme case when the bond is classified as 'in or near default' (Class 6). A Class 5 security is one that corresponds to a CCC/Caa credit rating; even in such case, NAIC rules permit life insurers to continue holding the security at amortized value.[15] Hence, our first identification strategy takes advantage of this stark difference in accounting rules *between life and P&C insurers.*

The implementation and enforcement of these regulatory accounting rules take place at the U.S. state of domicile and, specifically, is vested in the hands of the state's Commissioner of Insurance. Each state's insurance code lays out the rules to be followed by insurers domiciled in that state as well as the discretion allowed to the commissioner in applying the rules. Our objective, in particular, is to capture variation across states in the discretion afforded to each 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 the same type of insurers*, the effects of market value recognition on insurers' trading and portfolio decisions following the downgrades of their assets. This is our second identification strategy.

We carefully examine state-level insurance codes to glean information on the rules pertaining to how debt and debt-like instruments, like ABS, are booked for accounting purposes. We specifically search within the insurance 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 Commissioner of Insurance has in enforcing the NAIC rules pertaining to the valuation of fixed income instruments held by insurers domiciled in the state. We then followed up with extensive discussions with

[15] It is important to draw a distinction between the accounting rules followed by insurance companies when producing their financial statements for investors (GAAP) and those in the Statutory Accounting Principles (SAP) used by insurance regulators. Securities that are most likely to be 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 booked at MTM, SAP adopts a very different approach. In general, unrealized gains or losses are not recognized in the SAP equity capital calculation. The treatment afforded to unrealized gains and losses of AFS securities by SAP is similar to that afforded by the Regulatory Accounting Principles in the case of banks.

various state regulators. Our analysis reveals that state mandates given to regulators can be quite different. In some states, the NAIC guidelines are strictly enforced, while in others regulators have the autonomy to institute rules both within and above the NAIC 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*, including the Purposes and Procedures of the Securities Valuation Office, the Valuation of Securities manual, the Accounting Practices and Procedures manual, the Annual Statement Instructions or any successor valuation procedures officially adopted by the NAIC. (Our *emphasis*.)

In this case, we code Illinois as a state that strictly implements the NAIC rules. On the other hand, the insurance code of New York (section 1414) states that:[16]

> (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 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 the application of MTM] hereof. (Again, our *emphasis*.)

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

When a bond is downgraded from investment to speculative grades, the NAIC rules (SSAPs 26 and 43) allow life insurers to continue holding the bond at historical cost, as discussed; but, if the decline in market value following the downgrade is *deemed other than temporary*[17], then life insurers should recognize the decline as a one-time loss, through the so-called other-than-temporary impairment (OTTI). This rule clearly gives life insurers full discretion in determining whether or not to recognize OTTI. Starting from this condition, the commissioner may either (a) strictly follow the NAIC rules, i.e., leaving full discretion to life insurers, or (b) impose some

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

[17] The exact language is as follows. SSAP 26 (clause 9): "… 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. …"

instructions on the situations in which MTM should/must be used or OTTI should/must be recognized. Compared to the case of (a), life insurers are forced to use MTM or recognize OTTI more often in the case of (b). Thus, averaging the two possibilities, the level of market value recognition upon rating downgrades should be greater among the states that leave discretion to the commissioner. Moreover, since the difference across states only occurs in the cases where the recognition of market value is discretionary, it does not apply to P&C insurers, who are required by the NAIC to book downgraded securities at the lower of book or market values.[18]

As with any interpretation of rules, it is not always unambiguously clear to which group a state belongs. Specifically, since we use a strict definition of when discretion is *mentioned*, we could inadvertently place states that in reality provide some unmentioned discretion to the commissioner with the group of states that strictly follow the NAIC rules. To address this issue, we conduct two robustness checks in which (i) we reclassify a few relatively ambiguous states into the second group (Alternative 1), and (ii) we rank states by the realized OTTI frequency of state-domiciled insurers during the pre-crisis period and classify as "high MTM states" those with realized OTTI frequencies above the median (Alternative 2). In Appendix C, we show that the classification in (ii), though mechanical in nature, is highly correlated with the insurance-code-based classifications, consistent with the fact that for each state, the realized OTTI frequency should depend, to a certain degree, on the power given to the insurance commissioner. Moreover, as supporting evidence of our insurance-code-based classifications, we also document that OTTI recognition for the *exact same securities* varies significantly across insurers from different states in a manner consistent with our presumed classification (with additional details in Section 3.5).

### 2.3 Impact of Accounting Rules on RBC ratios

In Section 2.1, we explained that, independent of accounting rules, an asset downgrade will result in a reduction of the RBC ratio as the institution's required capital increases commensurate with its now riskier portfolio. In response, an institution will have to consider selling the downgraded asset for lower-risk assets, thereby lowering the RBC ratio's denominator, and/or selling other risky assets to reduce the denominator or, perhaps, increase the numerator through gains trading.

Accounting rules used for these instruments have a first-order effect on trading incentives. If the downgraded asset is held at MTM (or if OTTI is recognized), the price decline would be

[18] Since our state-level classification largely focuses on OTTI as a mechanism for market value recognition, this classification should not be understood in an absolute sense but rather in a relative one: the high MTM states are more likely to have OTTIs than the low MTM states.

automatically reflected in the balance sheet. 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 cash or an investment-grade asset immediately reduces the required capital (the denominator of RBC ratio). Taken together, selling the downgraded asset is unambiguously beneficial if it is held under MTM.[19]

The situation is very different if the downgraded asset is held under HCA, where the decline in value would not be recognized in the balance sheet unless the institution sells the asset. In this case, selling the asset has two opposing effects on the RBC ratio: (i) a positive effect from reducing the required capital (reducing the denominator of the RBC ratio), and (ii) a negative effect from realizing the capital loss (reducing the numerator of the RBC ratio). The net effect depends on the relative magnitudes of (i) and (ii). If the price decline were sufficiently large, as was the case for many downgraded securities in the recent crisis, the negative effect would likely prevail and selling the downgraded asset would not be beneficial.

It is important to note that the precise trading decision taken by a financial institution depends not only on the accounting treatment of the downgraded asset but also on the magnitude of the RBC ratio decline. An insurer that suffers a large decline may have to look beyond the downgraded ABS in order to return to a position of health; and, one alternative that has been proposed in the theoretical literature (e.g., Laux and Leuz (2009, 2010)) and is the main focus of our paper is to *selectively sell* other unrelated assets that are held under HCA and have the *largest unrealized gains*., i.e. to gains trade. For the same decline in the RBC ratio, institutions that have already sold the downgraded asset have partially erased the original RBC ratio decline and therefore will have a smaller incentive to gains trade than those that have not sold the downgraded asset. Since institutions that use HCA for the downgraded asset are likely to keep it to avoid realizing the capital loss, they will have a greater incentive to gains trade than other institutions that use MTM. We explain these different mechanisms in more detail in Appendix A.

In order to help elucidate the interplay among all these moving parts, we use a numerical example that is based on real (though simplified) balance sheet data from two representative

[19] We implicitly assume that the selling institution is a price taker, while in reality selling the downgraded asset may induce further losses (a fire-sale feedback effect). This complication may explain why P&C firms, using MTM for speculative-grade ABS, do not immediately sell all downgraded ABS. On the other hand, selling the downgraded asset does help avoid a future decline in the RBC ratio should the asset price declines further at a later date. This is because the precise rule for MTM is "the lower of book or market values", and therefore the institution faces downside risk where it can only lose from price movements.

insurers, one life and one P&C. To make the comparison meaningful, we use representative life and P&C firms that are expected to suffer similar declines in their RBC ratios given their ABS holdings at the end of 2007. For the sake of brevity, here we simply outline the main results from the numerical example and refer interested readers to Appendix B for more details.

In the example, we explain the implications for the RBC ratio of a hypothetical asset downgrade and associated price decline for the life insurer (facing HCA, both with and without OTTI recognition) and the P&C insurer (facing MTM). We then show the implications of each trading response through the lens of the resulting change in the RBC ratio. The example illustrates that selling the downgraded asset reflects a trade-off between the benefits of reducing the required capital (the denominator effect) and the cost of recognizing the large reductions in market value (the numerator effect). For the life insurer, especially in the absence of a one-time OTTI, the latter effect prevails under our assumed parameters, and gains trading is potentially needed to counteract the RBC ratio decline induced by the downgrade. For the life insurer facing OTTI, selling the downgraded asset is clearly effective at improving the RBC ratio. In reality, life insurers recognize OTTIs on some downgraded positions and do not on others (with the latter being significantly more likely), their behavior should vary across positions and the more OTTIs they recognize the more likely they are to sell their downgraded positions. Thus, life insurers in high MTM states are more (less) likely than life insurers in low MTM states to sell downgraded assets (to resort to gains trading).

For the P&C insurer, selling the downgraded asset has clear benefits for the RBC ratio. First, it reduces the required capital, and, second, it removes any downside price risk, ensuring no further numerator effects will materialize from future price declines. Note that divesting the downgraded asset does not rule out the supplementary use of gains trading if the P&C insurer suffers a particularly large RBC ratio decline, as in this example.

### 2.4 Hypotheses

Our discussion suggests two major hypotheses. First, based on the theoretical results of Allen and Carletti (2008) and Plantin *et al*. (2008), as confirmed by our numerical exercise, we formally develop General Hypothesis 1: financial institutions have a larger incentive to divest downgraded positions held at MTM than otherwise similar positions held under HCA.

As discussed, P&C firms are more likely than life firms to hold the downgraded positions at market values, and life firms domiciled in high MTM states are more likely than those

domiciled in low MTM states to recognize market values. General Hypothesis 1 hence leads to the following two testable hypotheses in the context of insurance industry:

*H1a (between-insurance-type): P&C insurance companies are more likely to sell downgraded assets than are life insurance companies.*
*H1b (within-life): Life insurance companies domiciled in high MTM states are more likely to sell downgraded assets than are those domiciled in low MTM states.*

Second, since downgraded securities, regardless of whether they are held under HCA or MTM, engender capital adequacy implications, we expect that financial institutions significantly affected by the downgrades will have an elevated incentive to trade unrelated assets to capture unrealized gains (Laux and Leuz (2009, 2010)). Further, to the extent that gains trading and directly selling downgraded assets are partial substitutes in improving capital positions, insurers that have already sold downgraded assets are less likely to gains trade, leading to our General Hypothesis 2: financial institutions holding downgraded positions under HCA will have a larger incentive than institutions holding these assets at MTM to trade other unrelated assets to capture unrealized gains.

Our General Hypothesis 2 relies on an important assumption that financial institutions conduct gains trading to improve capital positions that have been adversely affected by rating downgrades. This assumption thus implies two testable hypotheses:

*H2a: Insurers that are more affected by asset downgrades will engage in greater degrees of gains trading.*
*H2b: Insurers that face larger regulatory capital constraints, e.g. those with low RBC ratios, will engage in greater degrees of gains trading.*

Finally, given the difference in accounting rules between life and P&C insurers and between life insurers in high MTM states and those in low MTM states, we translate the prediction of General Hypothesis 2 into the following testable hypotheses:

*H2c (between-insurance-type): Holding the impact of downgrades constant, life insurers will, on average, engage in greater degrees of gains trading than will P&C insurers.*
*H2d (within-life): Holding the impact of downgrades constant, life insurers domiciled in low MTM states will, on average, engage in greater degrees of gains trading than will life insurers domiciled in high MTM states.*

To test hypotheses H2a-H2d, we investigate selling of government and corporate bonds with varying degrees of unrealized gains, and compare each institution's selling patterns during the 2007-2009 crisis with those in normal times. We hold the impact of ABS downgrades constant by focusing on a subsample of insurers that suffer significant and largely similar impacts.

# 3. The Data

### 3.1 Sample Construction

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

Our primary data on insurers' transactions and positions are from the NAIC (Schedule D).[20] The data provide year-end holdings of invested securities for each insurer and detailed transaction information on every trade. Both the position and transaction data include the identities of the insurers and the relevant securities (e.g., 9-digit CUSIP). We merge the year-end position data with transaction data to infer quarter-end positions. Finally, the NAIC data provides detailed information about the *book-adjusted carrying value* and *fair value* of each position held by each firm at year-end. We employ this information to infer whether an insurance firm holds its ABS and corporate bonds at historical cost or at fair value.

The financial information on each insurer is from Weiss Ratings, which provides financial strength ratings and other related information.[21] From this source, we obtain annual firm characteristics, such as invested assets, 'capital and surplus', and the RBC ratio. 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 abnormal firms.[22] We also delete all of AIG's affiliated insurers and 32 others that provide financial insurance and guarantees for bonds, such as credit default swaps and municipal finance, as these firms were affected by the downgrade

[20] Further details of the NAIC data can be found in Ellul, Jotikasthira, and Lundblad (2011).
[21] In 2010, Weiss Ratings was split from the Street.com to focus on the business of rating insurance companies.
[22] Small insurers do not have many trading choices. Insurers with RBC ratios below two are subject to supervisory intervention, while those with RBC ratios above 20 are unusual and may behave differently from the average.

of ABS through a different channel.[23] Finally, we also 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 of insurance companies consists of 11,330 firm-years representing 2,050 firms, among which 570 are life insurers and 1,488 P&C insurers.

Our data on ABS ratings are from S&P's Ratings IQuery and were downloaded in February 2011. We extract all the data in the structured credit subsector, which comprehensively covers initial ratings and histories for all securitized issues rated by S&P from 1991 to 2010. The database records issue and tranche identity (9-digit CUSIP), issue amount, class, maturity, collateral type, rating, and rating date. With this dataset, we identify 127,719 ABS securities 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 9-digit CUSIPs to merge with insurers' holdings, we identify 24,452 relevant ABS (with unique 9-digit CUSIPs). Although S&P rated the largest number of ABS among all rating agencies[24], it does not cover all ABS held by insurers. Relying on the line numbers self-reported by insurers to identify all non-agency ABS holdings, we find that S&P covers about 50% of all ABS holdings. We take into account the fact that the S&P sample is not 100% comprehensive when we calculate the impact of the downgrades on insurers. In most of our analysis, we nevertheless rely on the S&P sample because we need detailed information on rating downgrades and dates to identify relevant trigger.

The data on corporate bond characteristics and trading are obtained from Mergent Fixed Income Securities Database (FISD) and TRACE. We merge the FISD data with the position and transaction data of insurance firms to identify the corporate bonds being held and transacted as well as the bond characteristics, such as issue size, age, maturity, rating downgrades, and bankruptcy. When we identify downgrades of corporate bonds, we use S&P's ratings whenever they are available, to be consistent with our data 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). Data on bond market transaction prices and size are from TRACE, which covers over-the-counter corporate bond market transactions for both investment- and speculative-grade bonds since 2004. We use the 9-digit CUSIP to merge bonds in FISD and in TRACE. Finally, the data on government bond characteristics, such as offering date and maturity date, are from CRSP and the CUSIP Master File.

[23] 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.
[24] According to SEC (2011), S&P ratings are outstanding for a total of 117,900 ABS securities as of year-end 2010, greater than Moody's 101,546 outstanding ratings.

### 3.2 Insurance Companies and Their ABS Holdings

Table 1 shows summary statistics on key financial variables for our sample firms at the end of 2007. A detailed description of the variables can be found in Appendix D.

[Insert Table 1 here]

At the end of 2007, we have complete financial information for 1,173 P&C and 413 life insurers. Life firms are generally larger than P&C firms. Invested assets are $6.9 billion, on average, (median of $692 million) for life firms and $934 million, on average, (median of $156 million) for P&C firms. The average 'capital and surplus' is also larger for life firms at $776 million (median of $107 million), compared to $470 million (median of $70 million) for P&C firms. In addition, life firms, similar to banks, operate at much higher leverage than P&C firms. Return on equity, as a measure of profitability, is at similar levels for both types.

The capital positions of life and P&C firms are similar. The average life and P&C firms in our sample have RBC ratios of 9.5 and 8.7, respectively. 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 capitalizations following the significant ABS downgrades. In terms of general portfolio allocations, both types of insurers heavily invest in investment-grade bonds, including government and investment-grade corporate bonds which together represent 71-73% of insurers' portfolios, on average. Therefore, their trading behavior in this asset class should be representative of their portfolio choices and thus important to analyze.

Table 2 reports insurers' holdings of ABS over the period 2004-2010. We identify ABS by matching the CUSIPs in the position data with those in S&P's Ratings IQuerry:

[Insert Table 2 here]

The first two columns show that the fractions of life firms holding ABS (about 85%) are greater than those of P&C firms (about 70%) before the crisis. Moreover, over the course of the crisis, these fractions for P&C firms decline substantially to less than 53% at the end of 2010. In the remaining columns, we report the number and percentage holding 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, as a percentage of their portfolios, are quite large during the crisis. For example, life firms hold, on average, 73-77 ABS during 2007-2009, and these securities account for about 6-7% of the par value of their total fixed-income holdings, including government, corporate, municipal and all

other types of bonds, in addition to securitized instruments. P&C firms hold fewer ABS, compared to life firms, but the average exposure is still about 5% in 2007 and 2008. It is also important to note that the holdings of ABS in both types of insurers are underestimated since Ratings IQuerry does not cover all ABS reported by insurers to NAIC.

Second, insurers build up their holdings of ABS in the years leading up to the crisis and reduce the exposures after. For life firms, the ABS holdings account for 4.7% (median 3.5%) of par value of all bond positions in 2004, increase to 7.4% (median 6%) in 2007, and drop to 5.4% (median 4.3%) by the end of 2010. P&C firms reduce their exposure earlier and more substantially than life firms. Their relative holdings, measured with par value, are reduced from the maximum of 5.5% (median 3.8%) in 2007 to only 2.9% (median 1.6%) in 2010. We also compute ABS holdings using reported fair value instead of par value. The last four columns show that the insurers' holdings, measure by fair value, is substantially lower than those based on par value after 2008, suggesting that the fair values of ABS are more negatively affected by the crisis than those of the other types of bonds.

Third, substantial heterogeneity in ABS holdings exists even within each insurance type. For example, in 2007, the median life firm holds only 16 ABS and those in the top ten percent hold more than 175 such securities. Similarly, the median life firm invests 6% of the bond portfolio in ABS while the top ten percent invest over 15.9%. The same heterogeneity is also present among P&C firms. We will employ this heterogeneity within each insurance type, albeit measured in a different but more economically meaningful way below, to attribute insurers' documented gains trading to the incentives generated by their exposure to ABS downgrades.

### 3.3 Downgrades of ABS and Their Impact on Insurance Companies

The securitization market expanded substantially before the 2007-2009 crisis. Total ABS issuance grew from $1.5 trillion in 2004 to $2.3 trillion in 2007, according to Asset-Backed Alert. Securitization, by pooling and tranching, often creates securities that have better credit ratings than the collateral assets backing the issues. Before the crisis, the better ratings of the ABS attracted investors that faced regulatory constraints mechanically tied to credit ratings, such as insurance firms. Following the onset of the crisis, ABS were sharply downgraded by major rating agencies. In Ratings IQuery, we find 39,464 ABS downgrade actions by S&P in 2008.

We are particularly interested in the downgrades from investment to speculative grades because these downgrades would (i) significantly increase capital requirements, and (ii) force some

but not all insurers to recognize the market values of downgraded assets either by switching from HCA to MTM or by recognizing OTTI. The two conditions together create an ideal experiment for us to explore the interaction between accounting and capital adequacy rules. Figure 1 presents the total number of investment-to-speculative downgrades of ABS on a quarterly basis.

[Insert Figure 1 here]

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, S&P downgraded 33,917 ABS from investment to speculative grades.

To roughly gauge the degree to which insurers were affected by these downgrades, we count the number of investment-to-speculative downgrades of ABS that were held by insurance companies. Figure 1 shows these numbers on the right scale. Only a small portion of the downgrades in the early stage of the crisis (5-9% before the end of 2008) affected insurers. Insurance companies were, however, more significantly affected by the ABS downgrades in 2009 (15-18% of all downgrades in each quarter). This evidence may explain why insurers 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 (2013)).[25]

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 capital requirement or RBC (denominator), and second, it may force the recognition of price decline, lowering the insurer's statutory capital or TAC (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 impacted the capital positions of life firms more than those of P&C firms. In the Internet Appendix, we report summary statistics of these effects, measured for each firm as the change in the RBC ratio that is a result of actual ABS downgrades during the crisis (2007Q3-2009Q4), holding constant the insurer's ABS positions entering the crisis. We hereafter refer to this measure as "ABS exposure."

[25] In the Internet Appendix, we present the rating transitions of downgrades, many of which were by several notches, of the ABS held by insurers. For example, 1,238 ABS were downgraded to a BB rating class (for the sake of brevity, we aggregate BB+, BB or BB- in one class); 451 of them were rated as AAA before the downgrade. The same applies to the 1,639 ABS downgraded to the B rating class; 714 of them were previously rated as AAA. These dramatic shifts, which likely came as a surprise to insurers, significantly impacted the insurers' capital positions.

In our *between-insurance-type* analyses of insurers' trading and portfolio choices, we attempt to isolate the differential effects of accounting rules from the impact of ABS downgrades by focusing on the samples of 189 life and 105 P&C insurers with large and similar ABS exposures, measured in this way. These samples represent, among insurers holding at least one ABS that was downgraded across NAIC classes, 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, suggesting these selected firms are all significantly impacted by ABS downgrades.

### 3.4 Accounting Treatments of Downgraded ABS

Our first identification strategy relies on the different accounting rules used by life (HCA) and P&C insurers (MTM) 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 value (as a measure of market value) in booking investment-grade, speculative-grade, and recently downgraded ABS. We use year-end positions data, which report both the book value and the fair value for each position. We classify as "revalued" the positions for which the book and fair values are equal. Others are classified as held at HCA. This classification rule may underestimate the frequency of MTM as no revaluation is required if the position's book value remains below its fair value (though this is unlikely the case for recently downgraded ABS). However, this underestimation is unlikely to drive the difference in revaluation frequency between the two insurance types because it affects P&C insurers (MTM) more than life insurers (HCA) and therefore tends to diminish such differences.

Figure 2 reports the percentages of ABS holdings (Panel A for investment-grade ABS and Panel B for speculative-grade ABS) revalued at year-end for both life and P&C firms over the period 2004-2010.

[Insert Figure 2 here]

The most striking feature is the significantly higher percentage of speculative-grade positions that are revalued by P&C firms, far greater than those by life firms. In 2008, when a large number of ABS were downgraded and suffered severe price declines, P&C firms revalued 70% of their speculative-grade ABS, while life firms revalued less than 20%.[26] For investment-grade ABS, the

[26] The difference is less striking but still significant in other years, as revaluation is not required if the book value is lower than the market value. The rule changes in 2009 and 2010 may have diminished the differences as both life and P&C firms were allowed for the first time to choose book values for their ABS holdings; both types are incentivized to

difference in revaluation frequency is notably smaller, and was virtually non-existent prior to the crisis. Investment- and speculative-grades combined, P&C firms go from revaluing around 5% of their ABS holdings in 2006 (similar to life firms) to revaluing almost 20% of their positions by 2009. We attribute these differences in revaluation frequency, starting from the end of 2007, to the different accounting rules imposed on life vs. P&C firms that become increasingly relevant when many of the ABS are downgraded to speculative grades.

To focus on the change in accounting treatment around the downgrades, we investigate the differences between life and P&C firms in their accounting treatment of the recently downgraded ABS. Table 3 reports the results for two types of downgrades (a) from investment to speculative grades, and (b) from AAA to speculative grade (this being most severe and unexpected).

[Insert Table 3 here]

There are striking differences between life and P&C insurers, confirming the economic basis for our between-insurance-type analysis. As an example, consider row (2), which includes all downgrades from AAA to speculative grade over the period 2005-2010. Of 1,860 ABS positions that life insurers hold under HCA before the downgrades, 79% remain under HCA and only 9% are revalued after the downgrades. On the other hand, P&C firms 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 the year-end. It is plausible that revaluations occur at different times within 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 these are temporally closer to the year-end measurement and the drift problem may be less important. 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%.

The difference in revaluation frequency we demonstrate here is not due to the difference in characteristics, such as credit quality, of the ABS held by the two types of insurers. In the Internet Appendix, we estimate several linear models for the probability that an ABS position is revalued controlling for credit quality, other distinct characteristics of the ABS (e.g. issue size)

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move each ABS position's book value closer to NAIC's determined fair value to reduce the position's required capital. See Becker and Opp (2014) and Hanley and Nokolova (2013) for further details.

and time-varying characteristics (e.g. remaining maturity) at the end of 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 the regulatory accounting rules in dictating insurers' actual accounting treatments. Together, the evidence supports the relevance of our first identification strategy and provides the economic basis for using life and P&C insurers, respectively, as representatives for institutions using HCA and those using MTM.

### 3.5 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 2.2, we classify states as either those that strictly implement the NAIC rules or those that permit 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 4 reports the average frequencies that life (Panel A) and P&C (Panel B) recognize OTTI for downgraded corporate bonds and ABS in the *pre-crisis 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 bond or ABS 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 asset holdings. For each insurer, we calculate the OTTI frequency as the percentage of all downgraded bond and ABS positions for which OTTI is recognized. We then average the insurer-level OTTI frequencies for all life or P&C firms domiciled in the state and finally average across all states in the high vs. low marked-to-market (MTM) groups under each classification scheme in Appendix C.

[Insert Table 4 here]

The results confirms that the pre-crisis level of OTTIs for life firms domiciled in states that we define as 'high MTM' is larger (around 17%) than those of life firms domiciled in states defined as 'low MTM' (around 4-9%). As expected, there is no difference in the OTTI frequency for P&C firms across high MTM and low MTM states since, as explained before, a departure from the NAIC rules only occurs in the cases where the recognition of market value is discretionary; P&C

insurers are required by the NAIC to book downgraded assets at the lower of book or market values. Overall, the evidence in Table 4 confirms that the 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.

# 4. Empirical Methodologies and Results

### 4.1 Selling of Downgraded ABS

In this section, we first test H1a by assessing whether the P&C firms' revaluation of downgraded ABS to market values indeed makes them more likely to directly sell the downgraded ABS, relative to their life counterparts. We then test H1b in a similar manner but using the cross-state variation in OTTI frequency within the life insurance sector.

Since ABS downgrades are often predictable and insurance companies often sell the soon-to-be downgraded securities preemptively (see Plantin *et al.* (2008) for a theoretical argument and Ellul *et al.* (2011) for empirical evidence), we consider all ABS tranches following a downgrade from investment to non-investment grades 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:

$$S_{i,j,k} = \kappa_0 + \kappa_P P_j + \kappa_V V_{i,j,k} + \kappa_X X_{i,k} + \kappa_Y Y_{j,k} + \kappa_W W_k + \varepsilon_{i,j,k} \qquad (1)$$

where $S_{i,j,k}$ is an indicator variable that equals one if the insurer *j* sells any part of of its holding in downgraded bond *i* by the end of event quarter *k*, and zero otherwise; $P_j$ is an indicator variable that equals one if the insurer *j* is a P&C insurer, and zero otherwise; $V_{i,j,k}$ is an indicator variable that equals one if the insurer *j* holds downgraded bond *i* at market value at the year-end before event *k*, and zero otherwise; $X_{i,k}$ is vector of bond *i*'s static and time-varying characteristics, including initial ratings group dummies, just before event *k*; $Y_{j,k}$ is a vector of the insurer *j*'s static and time-varying characteristics at the year-end just before event *k*; $W_k$ is a vector of time-specific variables for downgrade event *k*; and, $\kappa$'s are the corresponding vectors of coefficients to be estimated. Depending on specification, we include pool fixed effects in $X_{i,k}$, domicile state fixed effects in $Y_{j,k}$, and calendar year fixed effects in $W_k$. Table 5 reports the results.

[Insert Table 5 here]

From Panel A columns (1) and (2), we find that P&C insurers have a higher propensity to sell an ABS position affected by a downgrade than do life insurers. This result is robust to a host of control variables for ABS and insurer characteristics as well as the position's existing accounting treatment. First, the revaluation dummy controls for the likelihood that insurers, regardless of their type, are more likely to sell downgraded positions that have already been re-booked at market price because doing so will not incur further losses but will help reduce the required capital. The significant and positive coefficient of the revaluation dummy confirms this intuition. Second, the significant difference in selling propensity between life and P&C insurers cannot be explained by ABS-level characteristics, such as liquidity, since we include the tranche offering amount and its initial rating (before the first investment-to-non-investment downgrade of the pool) as a control variable in all columns.[27] Third, the results are also not driven by any differences in regulations or other geographical/legal characteristics across U.S. states since we include state fixed effects in column (1). These results remain largely the same when we replace the state and year fixed effects in column (1) with asset pool fixed effects in column (2).

We want to highlight that the unconditional probability of selling downgraded ABS is twice as much for P&C firms (12.7%) as for life firms (6.4%). After including a host of controls in columns (1) and (2), the difference in selling probability is still 2.8-3.3%, approximately 50 percent of the unconditional selling probability of life firms. Together, the results from columns (1) and (2) of Panel A suggest that P&C firms, using MTM for downgraded ABS, are more likely to sell their affected holdings than life firms, using HCA, consistent with our hypothesis H1a.

A valid concern is that our above results may be driven by the fact that, as discussed earlier, P&C firms, due to their lower leverage, are generally less impacted than life firms by the ABS downgrades and hence can afford to realize capital losses from divesting the downgraded ABS. We address this concern by examining the selling of downgraded ABS in the subsample of life and P&C insurers with significant and similar ABS exposures. We describe the construction of this subsample in Section 3.3. Panel B of Table 5 (columns (1) and (2)) confirms that our results in Panel A hold in this controlled sample, suggesting that they are likely explained by the use of HCA vs. MTM, rather than the large or small impact of collective ABS downgrades.

[27] In fact, the marginal effects of issue size show that large-issue ABS are more likely to be sold, possibly due to their superior liquidity.

To address another concern that unobserved differences between life and P&C insurers may drive our results, we next implement the same analysis within the life insurance sector. Our variable of interest, $P_j$ in equation (1), is now the high MTM dummy, which indicates life insurers that are domiciled in the high MTM states according to each alternative definition in Appendix C. Under our hypothesis H1b, we expect a positive coefficient for the high MTM dummy, which the results in columns (3) to (5) in both panels of Table 5 confirm. In column (3), we use our baseline definition of high MTM states, while in columns (4) to (5) we use two alternative definitions to evaluate the robustness of our baseline results. We include rating and pool fixed effects and cluster standard errors at the state level.

The results in columns (3) to (5) provide a confirmation of the impact of regulatory accounting rules on insurers' propensity to sell downgraded assets: life insurers domiciled in high MTM states sell more of their downgraded ABS than do other life insurers. This effect is statistically and economically significant. Considering that the unconditional selling probability for life insurers is 6.4%, the estimate in column (3) shows that life insurers in high MTM states have about 34 percent (relative to the unconditional) higher propensity to sell their holdings of downgraded ABS than do life insurers domiciled in low MTM states.

We next explore whether capital-constrained insurers are more likely to divest downgraded ABS, which should be the case if the economic premise of our study is correct. That is, we assume that insurers sell downgraded ABS to improve capital positions, i.e. increase their RBC ratios, which have been adversely affected by the downgrades. Insurers with low RBC ratios to start with are pushed closer to regulatory or other rating-related thresholds, and thus will have greater need to respond. In all regressions, we include a low RBC ratio dummy (indicating insurers with RBC ratios in the lowest quartile within each type), and find that its coefficients are positive and significant in almost all columns in Panel A (all insurers) and all columns in Panel B (insurers with large ABS exposures) of Table 5. The economic effects, ranging from 2.0% to 7.5%, are highly significant given the relatively small unconditional selling probability. Moreover, as expected, these effects are stronger in the sample of insurers with large ABS exposures, consistent with our premise that the selling of downgraded ABS is an attempt to improve capital positions in response to the massive downgrades during the crisis.

Overall the results in Table 5, obtained from both the between-insurance-type and within-life analyses, consistently demonstrate that insurers that have to use MTM (or, recognize OTTI) for downgraded ABS are more likely to sell their downgraded ABS holdings than those that can

continue to use HCA. This is consistent with General Hypothesis 1, and the general prediction of the theoretical literature, that financial institutions have a larger incentive to divest downgraded positions held at MTM, where the associated price declines are already reflected in the balance sheet, than otherwise similar positions held under HCA, where divesting the positions would force the recognition of price declines and hence capital losses.

### 4.2 Gains Trading

In this section, we assess insurance companies' propensity to gains trade, defined as selectively selling the positions that have high unrealized gains, when they hold these positions at amortized historical costs. We focus on gains trading (Laux and Leuz (2009, 2010)) as one of a few options, including among others, raising new capital (Berry-Stolzle, Nini, and Wende (2011)) and selling insurance policies at prices below market but above the required reserves to generate surplus (Koijen and Yogo (2013)), that insurers have to improve capital positions. We will first justify why we look at corporate and government bonds, and then move on to test each of our gains trading hypotheses, H2a-H2d, in order.

#### 4.2.1 Unrealized Gains and Losses

For each bond position, we calculate the *unrealized gain* as the difference between the position's book-adjusted carrying value and fair value as a percentage of book-adjusted carrying value. As discussed, insurers report both the carrying values and the fair values of all bond positions at year-end to the NAIC. Table 6 reports the distribution of the percentage unrealized gains (and losses) separately for life and P&C firms. Panel A is for ABS, Panel B is for corporate bonds, and Panel C is for government bonds.

[Insert Table 6 here]

Panel A shows that up to the end of 2007, the median unrealized gain for ABS is close to zero, but in 2008 the median unrealized gain for life firms turns into unrealized losses to the tune of -30% with over nine tenths of all ABS positions having unrealized losses and over one tenth having losses exceeding 75%. These unrealized losses slightly improve in 2009 and 2010, but the overall distribution remains negatively skewed.[28] P&C firms' ABS portfolios exhibit a much

[28] Part of this improvement is due to the strategic impairments of ABS which, based on the new NAIC capital assessment methodology implemented for RMBS in 2009 and CMBS in 2010, would help reduce capital requirements. See Becker and Opp (2014) and Hanley and Nikolova (2013) for further analyses.

lesser degree of unrealized losses, with the median unrealized gain coming back to around zero in 2009 and 2010. This sharp difference between the two groups may be due to the fact that P&C firms are forced to revalue their ABS holdings that are downgraded to speculative-grade, essentially truncating the left tail of the unrealized gain distribution. In addition, as we demonstrated, life firms are likely to avoid selling their ABS in 2008-2009, as doing so would have a significant negative effect on their income and capital.

Panel B of Table 6 shows that the distribution of unrealized gains for corporate bonds also suffers a negative shift in 2008, but quickly returns to normal in 2009. Interestingly, over a quarter of corporate bond positions have unrealized gains in 2008, suggesting that there is more flexibility to potentially realize these gains by selling. In Panel C, we find that for both life and P&C insurers, the distributions of unrealized gains for government bonds shifts slightly upward and becomes more dispersed beginning in 2008. For life insurers, for example, the 10$^{th}$ percentile is 0.1% in 2008, compared to -31.6% for corporate bonds and -75.3% for ABS. Given the availability of unrealized gains and the dispersion of these gains necessary to identify specific issues most likely targeted for gains trading, we will use government and corporate bonds as the asset classes for studying gains trading among insurers. These two asset classes, on average, account for slightly over 60% of invested assets for life and P&C insurers.

### 4.2.2 Propensity to Gains Trade and ABS Exposure

We model the probability of selling each government or corporate bond position as a linear model:

$$S_{i,j,q} = \gamma_0 + (\gamma_z + \gamma_{zy} y_{j,q} + \gamma_{zc} c_q + \gamma_{zyc} y_{j,q} c_q) z_{i,j,q} + \gamma_X X_{i,q} + \gamma_Y Y_{j,q} + \gamma_W W_q + \varepsilon_{i,j,q} \qquad (2)$$

where $S_{i,j,q}$ is an indicator variable that equals one if the insurer *j* sells bond *i* in calendar quarter *q*, and zero otherwise; $z_{i,j,q}$ is the percentile (ranging from 0 to 1) of unrealized gain 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/diminish the effect of $z_{i,j,q}$, measured at the year-end prior to quarter *q*; $c_q$ is an indicator variable that equals one if quarter *q* lies in the crisis period, and zero otherwise; $X_{i,q}$ is a vector of bond *i*'s static and time-varying characteristics, including ratings 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; and, $\gamma$'s are the corresponding coefficients to be estimated. Depending on the specification, we include either domicile state fixed effects or firm fixed effects in $Y_{j,q}$.

Our coefficients of interest are the $\gamma_z's$, 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. In the same manner, positive (negative) coefficients of the interaction terms indicate a large (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 in order to prove our fundamental assumption that insurers engage in gains trading, in part, to reverse the capitalization impact of ABS downgrades. We estimate our probability model for a sample of life and P&C insurers that are affected by ABS downgrades in Table 5 Panel A, and include in the model an interaction term between unrealized gain percentile and an indicator variable for insurers we identify as having large ABS exposures. Recall briefly that we measure ABS exposures as the expected decline in the RBC ratio due to ABS downgrades during the crisis, and identify 75% of life and 25% of P&C insurers with the expected decline of about 0.4 or greater as having large exposures. If hypothesis H2a is true, then we expect the coefficient of the interaction term to be positive for the crisis period. Table 7 reports the results.

[Insert Table 7 here]

We start by investigating the crisis period, in isolation. Columns (1) and (4) show that both life and P&C insurers with high ABS exposures engage in greater degrees of gains trading than do other insurers of the same type. The results are significant at the 1% for life insurers and the 10% for P&C insurers. In economic terms (and relative to an otherwise similar position held by insurers with low ABS exposures), 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% (0.022 x 0.5, or 30 percent increase from the mean of 3.7%) for life firms and 0.8% (0.015 x 0.5, or 13 percent increase from the mean of 6.1%) for P&C firms.

It is important to note that we obtain our results after controlling for a host of position-level, insurer-level, and bond-level characteristics. The coefficients of these variables are generally intuitive. For example, we include an indicator variable for positions that were revalued at the previous year-end, and in all specifications, its coefficients 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 negative price impact.[29] Other significant control variables include an indicator that measures whether the bond is downgraded to a speculative class during the quarter, an indicator that captures whether the bond issuer files for bankruptcy during the quarter, and depending on specifications, the proportion of risky assets in an insurer's portfolio (capturing the insurer's risk appetite or its capacity to bear risk) as well as the insurer's ROE.

A criticism against looking at the crisis period in isolation is that certain firms may gains trade even in normal times (Carey (1994), for example) and therefore what we show in columns (1) and (4) of Table 7 may have nothing to do with the sizeable ABS downgrades during the crisis. To address this criticism, we investigate gains trading in the entire sample period (2004-2010) and introduce the crisis dummy to compare insurers' behavior during the crisis with that in normal times. This type of specification has an important advantage in isolating the *incremental* behavior during the crisis from other common behaviors of each insurer that may be present throughout the sample period. Column (2) 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 (2009, 2010)'s conjecture that financial institutions may gains trade to relieve financial stress.[30] More importantly, life insurers with high ABS exposures do not behave any differently from others in non-crisis periods but gains trade to a significantly greater degree during the crisis. 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, all results in Table 7 are consistent with hypothesis H2a, pointing to the importance of ABS downgrades in driving gains trading among insurance companies.

### 4.2.3 Propensity to Gains Trade and Capital Positions

We now test hypothesis H2b, which pertains to another important assumption: insurers trade gains to manage their RBC ratios that have been adversely affected by ABS downgrades. In this

[29] 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.

[30] Our results also imply that reported income that includes realized gains and losses may not be reflective of insurers' financial health and valuation, consistent with the findings of Nissim (2011).

test, we use a subsample of insurers that we identify as having largeABS exposures (those with the expected decline in RBC ratio of about 0.4 or greater), as opposed to the entire sample of affected insurers as in Table 7. Doing so allows us to focus on the most relevant group of insurers and to hold constant the impact of ABS downgrades without overly complicating the model with triple or quadruple interaction terms.

[Insert Table 8]

Before proceeding, we first confirm whether we have enough power to identify gains trading among these insurers with high ABS exposures. Focusing on the first and fourth rows, columns (1)-(3) of Table 8 show that we do for life firms; columns (5)-(7) show that we also do, albeit less so, for P&C firms. In all specifications, we include the same set of control variables as in Table 7. We then take the model in columns (3) and (7), which include firm fixed effects, as our starting point, and add in columns (4) and (8) an interaction term between unrealized gain percentile and an indicator variable for insurers that have RBC ratios in the bottom quartile of each type. If hypothesis H2b is true, then we should expect the coefficient on the interaction term to be positive during the crisis. This is indeed what we see for both life and P&C insurers. In normal times, insurers with low RBC ratios do not behave differently from others. During the crisis, however, they engage in higher degrees of gains trading. Take life insurers, for example. Among those with healthy RBC ratios (and taking the behavior in normal times as a benchmark), an interquartile increase in unrealized gain percentile increases the probability that a corporate or government bond position will be sold in a quarter by 1.8% (0.035 x 0.5) during the crisis. The same effect would be 2.8% (0.056 x 0.5), significantly higher if the position were instead held by life firms with low RBC ratios. This cross-sectional difference is also present between the healthy and the low RBC ratio groups of P&C insurers.

### 4.2.4 Life vs. 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 higher degrees of gains trading than others that use HCA? In this section, we use the distinction between P&C and life insurers as a proxy for institutions that use MTM vs. those that use HCA, respectively. In the next section, we will instead use the variation in degrees of market value recognition across life insurers domiciled in high vs. low MTM states.

Hypothesis H2c states that life insurers will, on average, engage in greater degrees of gains trading than will P&C insurers. This is because the latter have already sold a larger number

of downgraded ABS positions (decreasing the denominator of the RBC ratio), as we showed in Table 5, and doing so alleviates the need to employ gains trading (increasing the numerator of the RBC ratio). The results in Table 7 and the first eight columns of Table 8 provide preliminary evidence for this hypothesis. First, in Table 7, the effects of an interquartile increase in unrealized gain percentile on the probability that a bond position will be sold during the crisis are stronger for life firms (1.1%, or 30 percent increase from the mean of 3.7%) than for P&C firms (0.8%, or 13 percent increase from the mean of 6.1%). The latter is also statistically weaker. Second, while gains trading is widespread among life firms with large ABS exposures (columns (1)-(4) of Table 8), only P&C firms with large ABS exposures plus low RBC ratios exhibit significant degrees of gains trading (columns (5)-(8) of Table 8). This highly selective group consists of only 28 out of 105 P&C firms that have large ABS exposures (and over 1,000 P&C firms in our entire sample).

In column (9) of Table 8, 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, we have documented so far. We include both insurance types in the estimation but introduce a P&C dummy to distinguish the degrees of gains trading between the two types. Our coefficient of interest is in the sixth row, for the triple interaction among crisis indicator, P&C indicator, and the unrealized gain percentile. The estimate is negative and significant, consistent with hypothesis H2c. In economic terms, the marginal effect of an interquartile increase in unrealized gain percentile on the probability of being sold (in a quarter during the crisis) is about 1.2% smaller (-0.023 x 0.5) for a bond position held by P&C insurers than an otherwise similar position held by life insurers. This is highly significant given the unconditional probabilities (that a bond position will be sold in a quarter during the crisis) of 4.2% and 8.0%, respectively, for life and P&C insurers with large ABS exposures. Taken together, the results in Table 7 and especially in Table 8 provide clear evidence for hypothesis H2c: P&C insurers, using MTM for downgraded ABS, engage in lesser degrees of gains trading than life insurers, using HCA.

### 4.2.5 Life Insurance Companies in High vs. Low MTM States

We now move to investigate the gains trading behavior *within* the life insurance sector to exploit the variation in the implementation of NAIC rules across U.S. states. Our hypothesis H2d predicts that life insurers domiciled in high MTM states will have a lower propensity to engage in gains trading relative to life insurers domiciled in low MTM states. Again, to maximize power

and to hold the expected impacts of ABS downgrade about the same, we test hypothesis H2d using the sample of life insurers with high ABS exposures. Table 9 reports the results.

[Insert Table 9]

In columns (1) to (3), we look at the crisis period in isolation and, in columns (4) to (6), we explore the entire sample period, taking normal times as a benchmark. The coefficients of interest are in the second and fourth rows, respectively. All columns point to the same conclusion: while life insurers with high ABS exposures, in general, tend to gains trade during the crisis, those domiciled in high MTM states have a lower propensity to do so as compared to others domiciled in low MTM states. These results are robust across all alternative classifications of U.S. states 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. However, the negative and significant coefficient of -0.018 in the fourth row indicates that life insurers in the high MTM states (i.e., those whose values of the high MTM dummy is one) gains trade to lesser degrees than the others. In economic terms, the marginal effect of an interquartile increase in unrealized gain percentile on probability of being sold (in a quarter during the crisis) is about 0.9% smaller (-0.018 x 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 highly significant given that the unconditional probability (that a bond position will be sold in a quarter during the crisis) is about 4.2% for life insurers with high ABS exposures. Overall, these results provide confirmation to hypothesis H2d.

Together, the tests we have conducted for hypotheses H2a-H2d provide support for General Hypothesis 2. Downgraded assets, or downgraded ABS in our context, regardless of their accounting treatment, engender capital adequacy implications. Financial institutions holding these assets under HCA have a larger incentive than other institutions holding these assets under MTM to trade other unrelated assets to capture unrealized gains.

### 4.3 Robustness Checks

While our results as a whole consistently show the significant impact of different regulatory accounting rules on insurers' trading behaviors, there may be alternative explanations for the different individual results, particularly those obtained from the comparison of life and P&C insurers. For example, the gains trading effect may be driven by different tax management policies that life and P&C insurers follow or due to their different abilities in managing risk and

illiquidity. Although these alternative explanations, unlike our hypotheses, cannot explain the collective set of results, particularly those obtained from comparing life insurers across U.S. states, we still want to address each alternative here to make sure it does not fully explain each individual result that we use support our hypotheses.

First, we address three other alternatives that may explain 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 Panel A of Table 10, we try to hold each of these aspects constant in exploring the propensity to sell ABS in the sample of life and P&C insurers with similar ABS exposures (as in Panel B of Table 5). We use the exact same specification but, for brevity, only report the main coefficient estimates in Table 10. The full table is in the Internet Appendix.

[Insert Table 10]

We hold asset management expertise constant by investigating a subsample of life and P&C insurers that belong to a universal group with both types under the same umbrella. In this case, both insurance types likely share the same asset management infrastructure. The results in column (1) show that P&C insurers belonging to a universal group remain more likely to engage in ABS selling than do life insurers also in a universal group. Next, we use duration of fixed income portfolio as a proxy for duration of liabilities, and hold constant the liability structures by restricting our analysis to a set of life and P&C insurers with portfolio duration more than 4 but less than 7 years[31]. Column (2) shows that P&C firms continue to have a higher propensity to sell downgraded ABS than life firms with similar portfolio durations. Finally, the results in column (3) show that tax management considerations do not drive our results because profitable P&C insurers engage in more ABS selling than similarly profitable life insurers.

We next address the implications of these alternatives for the gains trading result in Panel B of Table 10, using the same specification as in column (9) of Table 8. Using the same samples as in Panel A, we hold constant the asset management expertise in column (1) and the liability structures in column (2). In both cases, we find that the asset management and the liability

[31] We report the summary statistics of duration and maturity of life and P&C insurers' fixed income portfolio in the Internet Appendix. As expected, life insurers generally have longer portfolio duration than P&C insurers. By restricting duration to the range of 4 to 7 years, we pick about 40-50% of each type.

structure hypotheses do not fully explain our core result: life insurers have a higher propensity to engage in gains trading during the crisis period than P&C insurers in both samples. Finally, in column (3), we test whether gains trading is simply the result of tax management: profitable insurers may engage in gains trading to manage tax payments over the business cycle. We find that the tax management hypothesis does not fully account for the differences in gains trading propensity between life and P&C insurers.[32]

Finally, we also investigate a specific alternative hypothesis related to the fact that life insurers' longer-term liabilities may permit higher illiquidity and risk bearing capacities. This alternative hypothesis predicts that life insurers are more likely to hold illiquid and risky assets such as ABS, when the rest of the market is selling them. Our within-life analysis is sufficient to show that this hypothesis does not fully explain our findings. Still, to have confidence in our between-insurance-type analysis, we further investigate this question by exploring the risk and liquidity characteristics of life and P&C insurers' investments in (unaffiliated) common stocks and government bonds. The accounting treatments for these asset classes are the same for life and P&C firms; therefore, any differences in illiquidity and risk bearing capacities should be most easily spotted here. For brevity, we only report the main results in Table 11, and place the full tables in the Internet Appendix.

[Insert Table 11 here]

In Panel A, we examine systematic risk and illiquidity of common stocks and find no statistical differences between life and P&C insurers when it comes to their exposures to systematic risk. For liquidity, life firms tend to hold less liquid stocks but this tendency remains unchanged during the crisis period, compared to normal times. In Panel B, we explore the liquidity of government bond portfolios. Among government bonds (including government-guaranteed bonds such as GNMA), Treasury notes and bonds are significantly more liquid but have lower yields than others. Thus, if life firms are better suited to hold illiquid assets, they should hold less Treasury notes and bonds and more of other government bonds that carry higher

[32] We perform an additional robustness check to examine our results separately for public and private insurance firms. While the majority of the insurers in our sample are private, some are publicly listed. Public firms have to disclose unrealized gains/losses (under accumulated other comprehensive income) in their annual reports, as the majority of bond positions are classified as "available for sale" and hence marked to market under GAAP (as opposed to the statutory accounting principles highlighted here). This disclosure may alter the incentives generated by HCA vs. MTM as they interact with regulation. However, we find qualitatively similar results for both groups.

yields (with default risk, capital charge, and accounting rules held constant).[33] This is indeed what we observe in columns (3) and (6) using different measures of percentage holdings. However, we do not observe any change in behavior during the crisis, compared to normal times.

Together, both the stock and government bond analyses show results that stand in sharp contrast with those of our main analyses on ABS selling and gains trading. Recall that the latter analyses show that the behaviors of life and P&C firms diverge during the crisis in a manner that is consistent with our hypotheses. Together, the robustness results thus confirm that differences in accounting rules (MTM vs. HCA), rather than these plausible alternative explanations, explain why, during the crisis, life firms are less likely to sell downgraded ABS and more likely to gains trade than P&C firms.

Finally, since our sample firms are relatively small, one criticism may be that our results are driven by small firms but invalid for large ones. We investigate this possibility by repeating our ABS selling and gains trading analyses on the sample of large insurers. We focus on the within-life identification strategy since it is relatively clean from endogeneity concerns and life insurers are generally larger than P&C insurers. In the Internet Appendix, we show that all our results hold for this sample, thus giving us comfort on their external validity.

# 5. Portfolio and Price Distortions

The literature has convincingly demonstrated that fire sales of downgraded assets can generate significant price distortions (Ellul *et al*. (2011) and Merrill *et al*. (2013), for example). In this section, we investigate plausible portfolio and price implications of avoiding the sales of downgraded ABS and instead engaging in gains trading. Since institutions using HCA for downgraded assets have larger incentives to take this route, our evidence will shed light on an important question: is HCA indeed an unambiguous panacea?

## 5.1 Distortions in Portfolio Allocation

Our goal is to explore whether trading incentives induced by the interplay between HCA and capital regulations alter financial institutions' portfolio allocation, potentially engendering distortions in key regulatory metrics. Since it is impossible to determine each insurer's "optimal" portfolio allocation, we cannot directly identify whether and by how much insurers using HCA

[33] This is consistent with the reaching-for-yield hypothesis of Becker and Ivashina (2013).

vs. MTM depart from optimality. Here, we use the pre-crisis risk-return profile as the benchmark for analyzing the evolution of insurers' portfolio allocations over the course of the crisis. By contrasting the evolution for insurers using HCA vs. MTM in a difference-in-differences framework, we can assess the incremental impact of avoiding the sales of ABS and instead engaging in gains trading.

We focus on insurers' ABS allocations, as a percentage of invested assets, since ABS as an asset class experienced arguably the greatest decrease in price and the greatest increase in perceived risk, opaqueness, and illiquidity. Given these dynamics, if insurers' goal is to maintain similar portfolio risk as in the pre-crisis period, they should reduce their ABS allocation. However, doing so will force the realization of capital losses if the ABS are held under HCA. Therefore, insurers using HCA for most ABS have incentives to engage in gains trading as a way to raise statutory capital, allowing them to maintain their risky ABS holdings. This is less likely the case for insurers using MTM.

We investigate this conjecture by regressing ABS allocation on year dummies during the period 2007-2010 and their interactions with a high MTM institutions dummy, which identifies insurers facing greater degrees of market value recognition in their ABS holdings. This allows us to capture any differences in allocation change (a) between P&C and life insurers in a between-insurance-type analysis, and (b) between life insurers domiciled in high MTM states and low MTM states in a within-life analysis. The benchmark period is the average ABS holdings of each firm over the years 2004-2006, as we include insurer fixed effects in all specifications.

[Insert Table 12]

Columns (1)-(3) of Table 12 report the results for the between-insurance-type analysis where the high MTM institutions dummy indicates P&C insurers. Starting from the entire sample of insurers that are affected by ABS downgrades, column (1) shows that life firms' ABS allocation increases by 3.2% of the portfolio in 2007 and as the crisis unfolds, largely returns to the pre-crisis level. Beginning in 2008, the ABS holdings of P&C insurers follow a significantly different trajectory, and by the end of 2010, P&C insurers have reduced ABS allocations by 2.4% more than life insurers (relative to their own pre-crisis benchmarks). Columns (2) and (3) reveal that this divergence between life and P&C insurers is concentrated among those with low RBC ratios (Column (2)), i.e. those that are financially weak and hence most sensitive to risk and further reductions in the value of their positions.

The within-life analysis in columns (4)-(6) of Table 12 paints the same picture. Here, the high MTM institutions dummy indicates life insurers domiciled in the high MTM states. Beginning in 2007, the ABS holdings of these insurers are about 0.7-1.1% lower than those of life insurers in low MTM states, both measured relative to their own pre-crisis levels. Importantly, columns (5) and (6) further reveal that these marked differences are concentrated among life insurers with low RBC ratios where, by 2010, those domiciled in high MTM states have cut their ABS allocation by 4.6% more than the others. These conditional results suggest that accounting rules and regulatory capital considerations together explain part of the ABS selling or the lack thereof. If we take the least constrained firms using MTM as those for whom incentives are least distorted, then our results suggest that constrained firms that employ HCA exhibit the most severe distortions in their portfolio choices.

Finally, we note that the failure to cut ABS positions (held under HCA) may induce a wedge between insurers' *reported* RBC ratios and the hypothetical values that better reflect market conditions. Since most ABS experience extremely large price declines, without selling them, insurers using HCA are left with large unrealized losses (Table 6), which are not properly reflected in their RBC ratios. We investigate this issue in Figure 3. For each insurer-year, we calculate a *market-adjusted* RBC ratio by adding the unrealized gains and losses on all securities held under HCA to the firm's reported statutory capital, the numerator of the RBC ratio. We then calculate the RBC ratio distortion as the market-adjusted RBC ratio minus the reported RBC ratio. Negative numbers thus mean that the reported RBC ratios are artificially inflated, which appear to be the case during the crisis for life insurers, particularly those domiciled in high MTM states.

[Insert Figure 3]

Panel A of Figure 3 shows that in 2008-2009, the RBC ratio distortions are extremely negative among life insurers and are largely induced by ABS holdings (the differences in distortion between the high and low ABS exposure groups are approximately -3 and -1 in 2008 and 2009, respectively). Panel B shows that these distortions are significantly smaller among P&C insurers, consistent with the fact that they use MTM for speculative-grade ABS and divest these ABS more aggressively. Comparing the distortions for life insurers domiciled in high vs. low MTM states (Panels C and D), we arrive at the same conclusion: the greater the use of MTM, the smaller (less negative) are the distortions during the crisis. To the extent that market values contain any relevant information, the sizeable nature of these distortions constructed from our

novel position-level data suggests that RBC ratios, as reported under HCA, can be misleading as a regulatory metric: firms that are undercapitalized may appear healthy in the eyes of the regulators.[34]

### 5.2 Price Impact of Gains Trading

The final question we address is whether gains trading generates enough pressure in the targeted bonds to distort prices. We focus on corporate bonds since government bonds are highly liquid and thus unlikely to suffer any price pressure from the selective selling. We compare the quarterly return across corporate bonds that are subject to different degrees of gains trading. If a large number of insurers gains trade using the same bonds in an illiquid market, these bonds are likely to suffer significant price pressure.[35]

Using the 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.[36] If a bond trades more than once in a day, we use the size-weighted average of trade prices on the last day of a quarter.[37] Our model of quarterly bond return is as follows:

$$R_{i,q} = \beta_0 + (\beta_z + \beta_{zc} c_q)\bar{z}_{i,q} + \beta_X X_{i,q} + \beta_W W_q + \xi_{i,q} \qquad (3)$$

where $R_{i,q}$ is the return of bond *i* in quarter *q*; $\bar{z}_{i,q}$ is the selling pressure, measured as average unrealized gain percentile across all insurers in the high or low MTM institutions group that hold bond *i* at the beginning of quarter *q*; $c_q$ is an indicator variable that equals one if quarter *q* lies in the crisis period, and zero otherwise; $X_{i,q}$ is a vector of bond static and time-varying characteristics in quarter *q*, $W_q$ is a vector of time-specific variables for quarter *q*, and $\beta$'s are the corresponding vectors of coefficients to be estimated.

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[34] Huizinga and Laeven (2012) find similar results for banks.

[35] Schultz (2001) and Ellul *et al.* (2011) estimate that insurers collectively hold between one-third and forty percent of investment-grade corporate bonds.

[36] 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. We however find that for the bonds in our data that pass our screen, 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.

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

Our variable of interest is $\bar{z}_{i,q}$, the (equally-weighted) average unrealized gain percentile. We distinguish the effect of gains trading from other effects of unrealized gains by interacting $\bar{z}_{i,q}$ with $c_q$, the crisis indicator since the selling pressure from gains trading should only operate during the crisis when insurers are hit by the significant ABS downgrades. If gains trading creates price pressure, then $\beta_{\bar{z}c}$ should be negative. We include standard control variables for the fundamental movement in the bond price, using maturity-matched Treasury and rating- and maturity-matched credit spread returns, and other bond characteristics, such as bond age and issue size. We use the interpolated constant maturity Treasury bond/note from the Fed to calculate the Treasury return. The spread return is 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 the above model by OLS, and cluster the standard errors by bond issuer and calendar quarter. Table 13 reports the results. In the Internet Appendix, we report robustness checks using value-weighted average unrealized gain percentile as $\bar{z}_{i,q}$.

[Insert Table 13 here]

In columns (1)-(3), we conduct a between-insurance-type analysis. For each bond, we calculate the average unrealized gain percentile separately across life insurers' positions and across P&C insurers' positions. Here, we consider life (P&C) insurers as low (high) MTM institutions since in the scale of MTM frequency, life insurers are at the low end and P&C insurers are at the high end (Table 3). 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 our findings that for the most part, gains trading is employed to raise statutory capital during times of stress. An interquartile increase in low MTM institutions' or life insurers' average unrealized gain percentile decreases quarterly return by about 2.2% (-0.043 x 0.5), highly significant given that the interquartile range of abnormal return is about 4.8% during the 2007-2009 crisis. The effect is 1.2% (-0.023 x 0.5) for high MTM institutions' or P&C insurers' unrealized gain percentile. In column (3), we find that the pressure from life insurers is significantly stronger than that from P&C insurers; in fact, the latter largely disappears when the

former is also included. This is consistent with our earlier finding that gains trading is widespread among life insurers but quite limited among P&C insurers.[38]

In columns (4)-(6), we conduct a within-life analysis and find similar results. Here, we calculate the average unrealized gain percentile separately across positions of life firms domiciled in high MTM states (high MTM institutions) and those of life firms in low MTM states (low MTM institutions). Columns (4) and (5) show that for both groups of life insurers, their gains trading generates significant price impact during the crisis. When we include the selling pressures from both groups in column (6), we find that the pressure from life firms domiciled in high MTM states dominates, again suggesting that the lower the degrees of market value recognition for downgraded ABS, the more widespread is gains trading and the larger price impact it generates. To put these results in perspective: the price pressure is generated by gains trading, which in turn originates, in part, from insurers' exposures to downgraded ABS held under HCA. Our evidence therefore demonstrates spillover effects from downgraded ABS to otherwise unrelated corporate bonds through the interaction between the accounting rules and regulatory capital requirements.

# 6. Conclusions

While the theoretical literature has argued that historical cost accounting (HCA) may insulate financial institutions from the price distortions associated with market stress, we provide new empirical evidence supporting the view that HCA, interacting with regulatory capital requirements, increases financial institutions' incentive to "gains trade" – that is, to selectively sell otherwise unrelated assets with high *unrealized* gains. We use the insurance industry as a laboratory to explore this interaction due to detailed security-level data availability and 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) the implementation of these rules for life insurers significantly differs 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 gains trading to raise the statutory equity capital, among a few other alternatives. Life insurers, using

[38] On average, life (P&C) insurers buy about 4% (3%) of the same bonds back within 3 months after selling. Further, this number increases to about 30% (20%) if we consider substitute bonds with the same credit rating (for example, A) and with maturity within ±1 year of the bond sold. As these are rather illiquid, purchases of substitute bonds may generate price effects in the original bond as traders extract what information they can from related trading activity. This appears rather like a wash sale, but for the sole purpose of realizing an accounting gain.

HCA for downgraded securities, are less likely than P&C insurers, 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 pertaining to structural business differences between life and P&C firms. Moreover, our analysis within the life insurance sector confirms the results: life insurers domiciled in 'high MTM' states engage in less gains trading and more impaired-asset selling than insurers domiciled in 'low MTM' states. Finally, we demonstrate some potential portfolio and price distortions associated with the HCA-induced trading incentives, 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 instrument reflected in the balance sheet? | Yes | No* |
| Future price declines of downgraded instrument reflected in the balance sheet? | Yes | No |
| Numerator Effect: Impact on total adjusted capital (TAC)** | Immediate decrease | No impact* |
| Denominator Effect: Impact on required risk-based capital (RBC)** | Increase | Increase |
| Net: Impact on RBC ratio** | Decrease | Decrease (potentially with a smaller magnitude when compared to 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 required risk-based capital (denominator) | (+) Selling the downgraded asset for lower-risk assets reduces required risk-based capital (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 price decline is sufficiently large and the negative effect from the accounting perspective prevails. |
| Need for supplemental measures to improve RBC ratio, including gains trading of unrelated assets held under historical cost accounting | Less because selling of the downgraded asset has partially raised the RBC ratio. | More. In the absence of selling the downgraded asset, the institution needs to sell other assets to reduce the required risk-based capital (denominator), or raise additional equity capital (numerator), or both, to raise the RBC ratio closer to its pre-downgrade value. |

* If the institution recognizes Other-Than-Temporary Impairment (OTTI), then its statutory (equity) capital and assets will immediately decrease by the amount of OTTI, generating a negative numerator effect on its RBC ratio.

** The NAIC risk-based capital ratio, or RBC ratio, is calculated as follows:

$$\text{RBC Ratio} = \frac{\text{Total Adjusted Capital}}{\text{Risk-Based Capital}} = \frac{\text{TAC}}{\text{RBC}},$$

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 credit ratings of the assets.

## Appendix B: Numerical Examples

Case 1: Life Insurer, HCA - No OTTI

In this example, we use the positions of Metropolitan Tower Life Insurance (company code = 97136) at the end of 2007. We have the following information:

A1. Risk-Based Capital (RBC), Total Adjusted Capital (TAC), and RBC ratio = TAC/RBC.
A2. Total invested assets and portfolio weights for cash, investment-grade bonds, speculative-grade bonds, ABS and structured products, stocks, real estate, mortgages in good standing, mortgages in default, and others.

We then make the following simplifying assumptions to obtain different components of RBC prior to the ABS downgrades:

B1. All ABS and structured products are in Class 1.
B2. All speculative-grade bonds are in Class 3.
B3. All real estates are in the least risky class and hence equivalent from the RBC standpoint to bonds in Class 4.*
B4. All stocks are unaffiliated common stocks.
B5. The remaining assets (100% - items 1 to 4 above) are bonds in Class 1.
B6. All bonds and ABS are issued by 500 unique issuers and the exposure to each is about equal ($ 10 million approximately). This assumption translates to the size factor = {(2.5 x first 50) + (1.3 x next 50) + (1 x next 300) + (0.9 x next 100)}/500 = 1.16, which gets multiplied by the total RBC of all bonds. Size factor penalizes concentration of credit risk exposures.*
B7. RBC from bonds (C1o) and from stocks (C1cs) are then taken out from the company action-level RBC to obtain the other components. Formula: RBC = C0 + $[(C1o + C3a)^2 + (C1cs)^2 + (C2)^2 + (C3b)^2 + (C4b)^2]^{1/2}$ + C4a where C0 = insurance affiliate investment and (non-derivative) off-balance sheet risk, C2 = insurance risk, C3a = interest rate risk, C3b = health provider credit risk, C4a = guaranty fund assessment and separate account risks, and C4b = health administrative expense risk. C0 and C4a are assumed to be zero.*
B8. All calculations are pre-tax.

Finally, we make the following simplifying assumptions about the ABS downgrades:

C1. 50% of the statement value of ABS and structured products is downgraded from Class 1 to Class 4.
C2. The average price decline of 35% applies to all downgraded ABS and structured products, but will only be realized in the case where these securities are sold. Upon selling, the realized losses flow through Asset Valuation Reserve (AVR) to decrease TAC on a one-for-one basis.
C3. All other components of RBC and TAC are unaffected by the downgrades. The cross product C3a x C1o is also unrealistically fixed, independent of the increase in C1o.
C4. If the insurer sells downgraded ABS and structured products, the proceeds are used to purchase bonds in Class 1.

Key results: The pre-crisis RBC ratio was 4.21 (= 1197.03/284.22). [1.1] shows that with no OTTI recognition, the effect of the downgrades is transmitted exclusively via the capital charges (the denominator effect), increasing it from 284.22 to 338.69 and reducing the RBC ratio from 4.21 to 3.53 (= 1197.03/338.69), a reduction of about 16%. [1.2] If this life insurer were to sell the downgraded ABS and swap for Class 1 bonds, it would (a) recognize the losses of 268.40 *decreasing the numerator* (TAC), but (b) reduce the capital charge by 55.15 *decreasing the denominator* (RBC). The net effect is that RBC ratio would decline further to 3.28 (=928.63/283.54), a further reduction of 8%. This clearly illustrates the interactions we focus on: selling the downgraded ABS

is a trade-off between the benefits of reducing the capital charges and the cost of recognizing the large losses due to the price declines. In this case, the latter negative effect prevails, with an overall negative impact on the RBC ratio.

* For further details, please see the report on "Comparison of the NAIC Life, P&C and Health RBC Formulas" dated December 12, 2002 by American Academy of Actuaries' Joint RBC Taskforce.

| | Before ABS Downgrade | | | | After ABS Downgrade | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | [1.1] No OTTI, Not Sell | | [1.2] No OTTI, Sell | |
| | Portfolio Weight | Statement Value | Risk-Based Capital Factor | Risk -Based Capital | Statement Value | Risk -Based Capital | Statement Value | Risk -Based Capital |
| Class 1 Cash | 0.00% | 0.00 | 0.4% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 1 Bonds | 50.50% | 3,013.82 | 0.4% | 12.06 | 3,013.82 | 12.06 | 3,512.29 | 14.05 |
| Class 1 ABS | 25.70% | 1,533.77 | 0.4% | 6.14 | 766.88 | 3.07 | 766.88 | 3.07 |
| Class 2 Bonds | 0.00% | 0.00 | 1.3% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 2 ABS | 0.00% | 0.00 | 1.3% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 3 Bonds | 1.70% | 101.46 | 4.6% | 4.67 | 101.46 | 4.67 | 101.46 | 4.67 |
| Class 3 ABS | 0.00% | 0.00 | 4.6% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 4 Bonds | 18.70% | 1,116.01 | 10.0% | 111.60 | 1,116.01 | 111.60 | 1,116.01 | 111.60 |
| Class 4 ABS | 0.00% | 0.00 | 10.0% | 0.00 | 766.88 | 76.69 | 0.00 | 0.00 |
| Class 5 Bonds | 0.00% | 0.00 | 23.0% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 5 ABS | 0.00% | 0.00 | 23.0% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bonds subject to size factor | | | | 134.46 | | 208.08 | | 133.38 |
| Size factor | | | | 1.2 | | 1.2 | | 1.2 |
| **RBC for Bonds (C1o)** | | | | **155.97** | | **241.37** | | **154.73** |
| **RBC for Common Stocks (C1cs)** | 3.40% | 202.91 | 30.0% | **60.87** | 202.91 | **60.87** | 202.91 | **60.87** |
| **sqrt(C3a^2+C2^2+C3b^2+C4b^2)** | | | | **229.67** | | **229.67** | | **229.67** |
| **Company Action-Level RBC** | | | | **284.22** | | **338.69** | | **283.54** |
| Covariance Discount | | | | 162.29 | | 193.22 | | 161.73 |
| **Total Adjusted Capital (TAC)** | | | | **1197.03** | | **1197.03** | | **928.63** |
| **RBC Ratio** | | | | **4.21** | | **3.53** | | **3.28** |

Case 2: Life Insurer, HCA - OTTI

We use the same information and assumptions as in Case 1 (Life Insurer, HCA - No OTTI), except Assumption C2 where we instead assume that the insurer recognizes other-than-temporary-impairment (OTTI) from the downgrades. The OTTI equal to the actual price decline of 35% works to decrease the book-adjusted carrying values (under HCA) and flows through AVR to decrease TAC by the same amount. The insurer can now sell the downgraded ABS and structured products at the current market value, which equals the updated book-adjusted carrying values, with no additional price impacts.

Key results: The pre-crisis RBC ratio was 4.21, the same as Case 1. [2.1] shows that if the insurer has to recognize OTTI (again, assuming the impairment mirrors the actual price decline), potentially as instructed by state insurance commissioners, the effect of the downgrades is transmitted via both the increase in capital charges from 284.22 to 317.26 (the denominator effect) and the one-time losses of 268.40 reducing TAC from 1197.03 to 928.63 (the numerator effect). The two effects compound to reduce the RBC ratio to 2.93, a reduction of more than 30% (thus almost double that of a similar life insurer that do not recognize OTTI in Case 1). [2.2] shows that if the insurer were to sell the downgraded ABS, it would (a) recognize no further losses hence *no effect on the numerator* (TAC), but (b) reduce the capital charges by 33.72 *decreasing the denominator* (RBC). Thus, the net effect would be to increase RBC ratio to 3.28 (=928.63/283.54), an improvement of 12%. This result suggests that with OTTI, selling the downgraded ABS is likely preferred to not selling.

| | Before ABS Downgrade | | | | After ABS Downgrade | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | [2.1] OTTI, Not Sell | | [2.2] OTTI, Sell | |
| | Portfolio Weight | Statement Value | Risk-Based Capital Factor | Risk -Based Capital | Statement Value | Risk -Based Capital | Statement Value | Risk -Based Capital |
| Class 1 Cash | 0.00% | 0.00 | 0.4% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 1 Bonds | 50.50% | 3,013.82 | 0.4% | 12.06 | 3,013.82 | 12.06 | 3,512.29 | 14.05 |
| Class 1 ABS | 25.70% | 1,533.77 | 0.4% | 6.14 | 766.88 | 3.07 | 766.88 | 3.07 |
| Class 2 Bonds | 0.00% | 0.00 | 1.3% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 2 ABS | 0.00% | 0.00 | 1.3% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 3 Bonds | 1.70% | 101.46 | 4.6% | 4.67 | 101.46 | 4.67 | 101.46 | 4.67 |
| Class 3 ABS | 0.00% | 0.00 | 4.6% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 4 Bonds | 18.70% | 1,116.01 | 10.0% | 111.60 | 1,116.01 | 111.60 | 1,116.01 | 111.60 |
| Class 4 ABS | 0.00% | 0.00 | 10.0% | 0.00 | 498.47 | 49.85 | 0.00 | 0.00 |
| Class 5 Bonds | 0.00% | 0.00 | 23.0% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 5 ABS | 0.00% | 0.00 | 23.0% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bonds subject to size factor | | | | 134.46 | | 181.24 | | 133.38 |
| Size factor | | | | 1.2 | | 1.2 | | 1.2 |
| **RBC for Bonds (C1o)** | | | | **155.97** | | **210.24** | | **154.73** |
| **RBC for Common Stocks (C1cs)** | 3.40% | 202.91 | 30.0% | **60.87** | 202.91 | **60.87** | 202.91 | **60.87** |
| **sqrt(C3a^2+C2^2+C3b^2+C4b^2)** | | | | **229.67** | | **229.67** | | **229.67** |
| **Company Action-Level RBC** | | | | **284.22** | | **317.26** | | **283.54** |
| Covariance Discount | | | | 162.29 | | 183.52 | | 161.73 |
| **Total Adjusted Capital (TAC)** | | | | **1197.03** | | **928.63** | | **928.63** |
| **RBC Ratio** | | | | **4.21** | | **2.93** | | **3.28** |

Case 3: P&C Insurer, MTM

In this example, we use the positions of Mid Century Insurance (company code = 21687) at the end of 2007. We have the same information as in Case 1 (A1 and A2).

We then make the following simplifying assumptions to obtain different components of RBC prior to the ABS downgrades:

B1. All ABS and structured products are in Class 1.
B2. All speculative-grade bonds are in Class 3.
B3. All other assets with capital requirement greater than or equal to that of bonds in Class 3, except common stocks, are lumped together with bonds in Class 3. These assets account for a very small percentage of the portfolio.
B4. All stocks are unaffiliated common stocks.
B5. The remaining assets (100% - items 1 to 4 above) are bonds in Class 1.
B6. All bonds and ABS are issued by 500 unique issuers and the exposure to each is about equal ($4 million approximately). This assumption translates to the size factor = {(2.5 x first 50) + (1.3 x next 50) + (1 x next 300) + (0.9 x next 100)}/500 = 1.16, which gets multiplied by the total RBC of all bonds. Size factor penalizes concentration of credit risk exposures.*
B7. RBC from bonds (R1) and from stocks (R2) are then taken out from the company action-level RBC to obtain the other components. Formula: RBC = $R0 + [R1^2 + R2^2 + R3^2 + R4^2 + R5^2]^{1/2}$ where R0 = insurance affiliate investment and (non-derivative) off-balance sheet risk, R3 = credit risk (non-reinsurance plus one half reinsurance credit risk), R4 = loss reserve risk, one half reinsurance credit risk, growth risk, R5 = premium risk, growth risk. R0 is assumed to be zero so that all the other components inside the square root can be inferred.*
B1. All calculations are pre-tax.

Finally, we make the same assumptions about ABS downgrades as in Case 1 (Life Insurer, HCA - No OTTI), except Assumption C2 where we instead assume that the insurer switches to MTM. MTM, or more precisely lower of book and market values, generates two additional effects for the ABS that are downgraded from Class 1 to Class 4: (i) the immediate losses equal to the actual price decline of 35% works to decrease the book-adjusted carrying values (under MTM) and TAC, and (ii) future price declines will lead to further realized losses. The expected impact of (ii) is calculated as the value of (short positions in) 1-year at-the-money put options on Class 4 ABS; the implied volatility is assumed to equal the physical volatility of ABX BBB- Index in 2007, estimated by Longstaff (2010) to be approximately 6.824% at the weekly frequency. If the insurer sells the downgraded ABS and structured products, the sale price will equal the current market value (i.e., no additional price impacts) and the expected impact of (ii) will also be eliminated.

Key results: The pre-crisis RBC ratio was 3.69 (= 724.36/196.47). [3.1] shows that the ABS downgrades impact RBC ratio by (i) increasing the capital charges and hence RBC from 196.47 to 198.01, net of the reduction in statement values from (ii) which help alleviate this effect (the denominator effect), (ii) generating the immediate realized losses of 156.25 from price decline under MTM (the immediate numerator effect) and hence decreasing TAC by the same amount, and (iii) generating the expected impacts from the downside exposure to future price declines of 50.09 (the expected additional numerator effect) and hence further decreasing TAC by the same amount. The value of (iii) is calculated using a simple Black-Scholes formula under the above assumptions. The combined effects, all negative, are to reduce RBC ratio to 2.62 (= 518.01/198.01), a reduction of almost 30%. [3.2] shows that selling the downgraded ABS in exchange for Class 1 bonds will have two advantages for the insurer: (a) reducing the capital charges and hence RBC from 198.01 to 196.42, and (b) removing the downside exposure and hence increasing TAC from 518.01 to 568.10 (i.e., ensuring no further numerator effects from price declines). In this case, the selling of ABS will increase the RBC ratio to 2.89 (= 568.10/196.42), an increase of almost 11%.

* For further details, please see the report on "Comparison of the NAIC Life, P&C and Health RBC Formulas" dated December 12, 2002 by American Academy of Actuaries' Joint RBC Taskforce.

| | Before ABS Downgrade | | | | After ABS Downgrade | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | [3.1] MTM, Not Sell | | [3.2] MTM, Sell | |
| | Portfolio Weight | Statement Value | Risk-Based Capital Factor | Risk -Based Capital | Statement Value | Risk -Based Capital | Statement Value | Risk -Based Capital |
| Class 1 Cash | 0.00% | 0.00 | 0.4% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 1 Bonds | 44.00% | 1,155.49 | 0.4% | 4.70 | 1,155.49 | 4.70 | 1,445.68 | 5.88 |
| Class 1 ABS | 34.00% | 892.88 | 0.4% | 3.63 | 446.44 | 1.82 | 446.44 | 1.82 |
| Class 2 Bonds | 0.00% | 0.00 | 1.3% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 2 ABS | 0.00% | 0.00 | 1.4% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 3 Bonds | 4.00% | 105.04 | 2.7% | 2.85 | 105.04 | 2.85 | 105.04 | 2.85 |
| Class 3 ABS | 0.00% | 0.00 | 2.7% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 4 Bonds | 0.00% | 0.00 | 6.1% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 4 ABS | 0.00% | 0.00 | 6.1% | 0.00 | 290.19 | 17.71 | 0.00 | 0.00 |
| Class 5 Bonds | 0.00% | 0.00 | 13.6% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Class 5 ABS | 0.00% | 0.00 | 13.6% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Bonds subject to size factor | | | | 11.18 | | 27.07 | | 10.55 |
| **Expected impact from further price decline for Class 4 ABS** | | | | 0.00 | -50.09 | -3.06 | 0.00 | 0.00 |
| Size factor | | | | 1.16 | | 1.2 | | 1.2 |
| **RBC for Bonds (R1)** | | | | **12.97** | | **27.86** | | **12.23** |
| **RBC for Common Stocks (R2)** | 18.00% | 472.70 | 23.1% | **109.09** | 472.70 | **109.09** | 472.70 | **109.09** |
| **sqrt(R3^2 + R4^2 + R5^2)** | | | | **162.88** | | **162.88** | | **162.88** |
| **Company Action-Level RBC** | | | | **196.47** | | **198.01** | | **196.42** |
| Covariance Discount | | | | 88.47 | | 101.82 | | 87.78 |
| **Total Adjusted Capital (TAC)** | | | | **724.36** | | **518.01** | | **568.10** |
| **RBC Ratio** | | | | **3.69** | | **2.62** | | **2.89** |

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

The following table lists the value of "High MTM Dummy" for different U.S. states, and relevant criteria and statistics, under three alternative classification schemes.

- Baseline and alternative 1 classifications are based on the Insurance Codes for each state. First, we search the insurance code to see whether the state meets Criterion A and assign the value of 1 if it does and zero otherwise. Criterion A: the state's insurance code explicitly states, or uses clear language to that effect, that the Insurance Commissioner (or Insurance Division) has full discretion in determining the method of calculating (fixed income) assets' values. Second, if the state meets Criterion A, then we proceed to search the code to see whether the state also meets Criterion B and assign the value of 1 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 insurance 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 National Association of Insurance Commissioners (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. Alternative 1 classification expands the baseline classification to include three additional states whose insurance codes, based on our reading, are ambiguous on Criterion B.

- Alternative 2 classification is based on realized average frequencies that life insurers in the state recognize Other-than-Temporary Impairment (OTTI) for downgraded corporate bonds and ABS. Only the downgrades from investment to non-investment grades during the pre-crisis period (2005-2007) 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 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, including HI, ID, ME, NH, NM, RI, and SD (AL, AR, ME, MS, NM, and UT), do not have valid average % OTTI because life insurers in these states do not hold downgraded positions during the pre-crisis period. We do not treat these seven states as "High MTM" states for 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% |
| 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% |

| | 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 |
| 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/?* | 0 | - |
| WA | 0 | 1 | 1 | 0/?** | 1 | 16.25% |
| OH | 0 | 1 | 1 | 0/?*** | 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% |

* 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.

** 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.

*** 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: Descriptions of Variables

| Variable | Specific to | Definition |
|---|---|---|
| % risky assets | Insurer-year | Percentage of investment assets invested in any of the following asset classes: non-investment grade bonds, common and preferred stocks, non-performing mortgages, real estate, and other investments. According to Weiss Ratings and NAIC, the required capital percentages for these assets are greater than or equal to those of the least risky class of non-investment grade bonds (BB). |
| ABS exposure or High ABS exposure dummy | Insurer | Expected impact of ABS downgrades during the crisis (2007Q3-2009Q4) on 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 new 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; therefore, the changes in TAC and RBC are calculated first from ABS available in Ratings IQuerry and then scaled by the ratio of value of all insurer-reported ABS to value of ABS in Ratings IQuerry. Insurer-reported ABS are private-labeled ABS, identified using line numbers in the NAIC position data. Statutory accounting rules are strictly applied to each ABS position; HCA is used for all positions of life (P&C) insurers except those in NAIC Class 6 (Class 3-6) where MTM is used. Market price of a position is the average price of the last trades or reported market values of all insurance companies at the end of 2009. High ABS exposure dummy equals 1 for life (P&C) insurers with the expected decline on RBC ratio in the top 75% (25%) of all those that are affected by ABS downgrades, and 0 otherwise. The threshold is about the same for life and P&C insurers at approximately 0.4 in RBC ratio terms. |
| Amihud ratio | Stock-quarter | Measure of stock illiquidity, calculated as the average daily Amihud ratio over the quarter where the daily Amihud ratio is calculated as \|return\|/(volume x closing price/1,000,000). A minimum of 22 days in the estimation window are required. |
| Beta | Stock-quarter | CAPM beta, estimated by regressing the stock's daily return on CRSP value-weighted market return over a 2-year window up to the current-quarter end. A minimum of 60 trading days in the estimation window are required. |
| Bankruptcy dummy | Bond-quarter | Dummy variable equal to 1 if the issuer of the bond files for bankruptcy during the quarter, and 0 otherwise. |
| Bond age | Bond-quarter | Time from issuance to the beginning of quarter of interest or the beginning of quarter in which the interested transactions fall (depending on specifications), measured in years. |
| Bond return | Bond-quarter | Log of change in prices 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 a factor of 100. If a bond trades more than once in a day, we use the size-weighted average of trade prices on the last day of a quarter. |
| Calendar quarter fixed effects or year fixed effects | Quarter or Year | Set of dummy variables for calendar quarters in which the observations fall and set of dummy variables for years in which the observations fall, respectively. |
| Capital and surplus | Insurer-year | The insurance company'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 RBC ratio. |
| Crisis dummy | Quarter | Dummy variable equal to 1 if the calendar quarters are in the 2007-2009 crisis period, and 0 otherwise. The crisis period is defined based on the volume of ABS downgrades, and covers 2007Q3 to 2009Q4. |
| Downgrade dummy | Bond-quarter | Dummy variable equal to 1 if the bond is downgraded from investment to non-investment grades during the quarter, and 0 otherwise. S&P ratings are used wherever available. Moody's ratings are used when S&P ratings are unavailable. |
| Firm fixed effects | Insurer | Set of dummy variables for insurance companies to which the observations belong. |

| Variable | Specific to | Definition |
|---|---|---|
| High mark-to-market (MTM) dummy | Insurer | Dummy variable equal to 1 if the life insurer is domiciled in a U.S. state classified as being in the high MTM group under each of the three alternative classifications in Appendix C, and 0 otherwise. States not in the high MTM group are considered "low MTM states." |
| High MTM institutions dummy | Insurer | Dummy variable equal to 1 if the insurer is considered a high MTM institution in that particular test, and 0 otherwise. In a between-insurance type analysis, high (low) MTM institutions refer to P&C (life) insurers. In a within-life analysis, high (low) MTM institutions refer to life insurers domiciled in high (low) MTM states. |
| High MTM institutions' unrealized gain pct. and low MTM institutions' unrealized gain pct. | Bond-quarter | Equally-weighted (Table 13) or value-weighted (the Internet Appendix) average unrealized gain percentile across all qualified insurers' positions in the bond. For high MTM institutions' unrealized gain pct. (low MTM institutions' unrealized gain pct.), qualified insurers must have positions in the bond at the beginning of the quarter, have high ABS exposure, i.e., their RBC ratios are expected to drop by 0.4 or more due to actual ABS downgrades during the crisis, and belong to the high MTM group (low MTM group). In a between-insurance-type analysis, high (low) MTM institutions refer to P&C (life) insurers. In a within-life analysis, high (low) MTM institutions 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 dummy | Insurer-year | Dummy variable equal to 1 if the insurer's year-end RBC ratio is in the bottom quartile among all insurers of the same type (life or P&C), and 0 otherwise. |
| Maturity | Bond-quarter | Maturity of the bond at the beginning of quarter of interest or the beginning of quarter in which the interested transactions fall (depending on specifications), 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 RBC ratio of 1.0 has capital equal to its RBC. Insurance companies with higher RBC ratios are considered better capitalized. Insurance companies with RBC ratio below 2.0 are subject to supervisory interventions. The levels of supervisory actions depend on the level of RBC ratio. Low RBC ratio dummy equals 1 for RBC ratios below the annual median, and 0 otherwise. |
| Pool fixed effect | Bond | Set of dummy variables for all ABS tranches issued on the same asset pool. |
| Rating group fixed effects | Bond-quarter | Set of dummy variables for credit rating groups, defined by the NAIC's capital requirement in the RBC ratio formula. The groups are, in order of credit quality, A and above, BBB, BB, and B and below. S&P ratings are used wherever available. Moody's ratings are used when S&P ratings are unavailable. |
| Revalue dummy | Position-year | Dummy variable equal to 1 if the position has the book value that is equal to its reported fair or market value, and 0 otherwise. |
| ROE | Insurer-year | Return on equity, measured as net income divided by book value of equity at the beginning of the year. |
| Sell dummy | Position-quarter | Dummy variable equal to 1 if part or all of the position is sold during a defined time period, and 0 otherwise. It is the dependent variable in linear probability models for selling ABS following rating downgrade and for selling government and corporate bonds conditional on their relative unrealized gains. |
| State fixed effects | 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 and loss | Position-year | Difference between insurer's reported fair value and book-adjusted carrying value of the position at previous year end, measured as percentage of book value. |
| Unrealized gain pct. | Position-year | Percentile rank, ranging from 0 to 1, of the position's dollar unrealized gain within the insurer's portfolio at previous year end. |

**Table 1: Summary Statistics of Insurance Companies' Financial Variables**

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

*Panel A: Life firms*

| | Mean | 10thPct | Median | 90thPct | Std.Dev. |
|---|---|---|---|---|---|
| Number of firms | 413 | | | | |
| Invested assets ($ million) | 6,905 | 40 | 692 | 15,672 | 20,951 |
| Capital and surplus ($ million) | 776 | 10 | 107 | 1,710 | 2,279 |
| Leverage | 0.84 | 0.65 | 0.90 | 0.96 | 0.15 |
| Return on equity (ROE) | 0.06 | -0.07 | 0.08 | 0.25 | 0.26 |
| NAIC risk-based capital ratio (RBC ratio) | 9.49 | 4.45 | 8.47 | 15.83 | 4.90 |
| Holding of investment-grade bonds (%) | 71.27 | 51.44 | 74.20 | 89.75 | 17.30 |
| Holding of risky assets (%) | 16.45 | 3.36 | 12.55 | 31.16 | 14.77 |

*Panel B: Property & Casualty firms*

| | Mean | 10thPct | Median | 90thPct | Std.Dev. |
|---|---|---|---|---|---|
| Number of firms | 1173 | | | | |
| Invested assets ($ million) | 934 | 28 | 156 | 1,473 | 4,106 |
| Capital and surplus ($ million) | 470 | 14 | 70 | 658 | 2,565 |
| Leverage | 0.59 | 0.41 | 0.61 | 0.73 | 0.13 |
| Return on equity (ROE) | 0.11 | 0.02 | 0.11 | 0.22 | 0.11 |
| NAIC risk-based capital ratio (RBC ratio) | 8.71 | 4.10 | 7.70 | 14.40 | 4.36 |
| Holding of investment-grade bonds (%) | 73.22 | 43.64 | 78.18 | 94.06 | 19.82 |
| Holding of risky assets (%) | 18.00 | 0.00 | 12.99 | 43.07 | 18.03 |

**Table 2: Summary Statistics of Insurance Companies' Holding of ABS Securities**

This table summarizes the year-end holding of asset-backed securities (ABS) of insurance companies. ABS positions are identified by matching insurers' bond holding positions at year-end to a list of ABS identified from S&P's Ratings IQuery using 9-digit CUSIP. S&P's Ratings IQuery comprehensively covers initial ratings and histories for all securitized issues rated by S&P from 1991 to 2010. The statistics on the number and size of ABS holdings are reported only for firms investing in at least one ABS. The size of the ABS holdings is the par (or fair) value of the identified ABS held by a firm relative to the par (or fair) value of all of the firm's fixed income positions. The mean, median, 10th percentile, and 90th percentile are calculated across firms at each year-end.

| | | Number of Firms | | Number of ABS Securities Held by Each Firm | | | | % ABS Holding (Par Value) | | | | % ABS Holding (Fair Value) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | All | Holding ABS | Mean | 10th Pct | Median | 90th Pct | Mean | 10th Pct | Median | 90th Pct | Mean | 10th Pct | Median | 90th Pct |
| Life | 2004 | 481 | 391 | 34.99 | 1 | 10 | 82 | 4.72% | 0.57% | 3.45% | 9.24% | 4.62% | 0.57% | 3.58% | 9.29% |
| | 2005 | 447 | 380 | 46.12 | 2 | 12 | 105 | 5.07% | 0.63% | 3.89% | 10.96% | 5.05% | 0.65% | 3.97% | 10.95% |
| | 2006 | 429 | 368 | 60.02 | 2 | 14 | 146 | 6.45% | 0.65% | 4.79% | 14.23% | 6.43% | 0.68% | 4.79% | 14.14% |
| | 2007 | 413 | 351 | 72.88 | 2 | 16 | 175 | 7.44% | 0.75% | 5.95% | 15.88% | 7.06% | 0.72% | 5.78% | 14.84% |
| | 2008 | 408 | 342 | 76.69 | 2 | 17 | 209 | 7.33% | 0.68% | 6.08% | 15.75% | 5.40% | 0.58% | 4.38% | 11.80% |
| | 2009 | 403 | 337 | 72.70 | 2 | 16 | 220 | 6.48% | 0.52% | 4.95% | 13.58% | 4.91% | 0.46% | 3.69% | 10.46% |
| | 2010 | 384 | 319 | 68.20 | 1 | 15 | 198 | 5.41% | 0.40% | 4.26% | 11.61% | 4.28% | 0.35% | 3.48% | 9.09% |
| Property & Casualty | 2004 | 1,151 | 741 | 7.81 | 1 | 5 | 17 | 4.07% | 0.56% | 3.36% | 8.31% | 4.05% | 0.56% | 3.31% | 8.38% |
| | 2005 | 1,132 | 764 | 9.52 | 1 | 6 | 20 | 4.45% | 0.63% | 3.28% | 8.78% | 4.42% | 0.62% | 3.26% | 8.69% |
| | 2006 | 1,132 | 785 | 11.20 | 1 | 6 | 24 | 5.15% | 0.56% | 3.80% | 11.49% | 5.10% | 0.55% | 3.74% | 11.22% |
| | 2007 | 1,173 | 820 | 12.30 | 1 | 7 | 26 | 5.48% | 0.63% | 3.83% | 11.57% | 5.25% | 0.63% | 3.71% | 11.16% |
| | 2008 | 1,240 | 825 | 12.17 | 1 | 6 | 26 | 4.92% | 0.55% | 3.18% | 10.78% | 3.73% | 0.44% | 2.43% | 8.13% |
| | 2009 | 1,224 | 777 | 10.87 | 1 | 4 | 23 | 3.47% | 0.30% | 2.09% | 7.81% | 2.62% | 0.27% | 1.71% | 6.01% |
| | 2010 | 1,215 | 645 | 8.59 | 1 | 3 | 18 | 2.89% | 0.22% | 1.56% | 6.81% | 2.31% | 0.18% | 1.29% | 5.21% |

**Table 3: Accounting Treatment of Downgraded ABS**

This table reports frequency statistics on insurance companies' accounting treatment of downgraded ABS that are previously held at modified historical costs. Two types of downgrade are considered: (a) from investment to non-investment grades, and (b) from AAA to non-investment grade. Rows (1) and (2) include all downgrades from 2005 to 2010, and rows (3) and (4) include only the downgrades in the fourth quarter of each year. Over the year in which the downgrade occurs, each position held at historical cost at the beginning of year is re-classified 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 insurance companies.

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

**Table 4: OTTI Recognition for Downgraded Corporate Bonds and ABS in High and Low Mark-to-Market States**

This table presents average frequencies that life (Panel A) and P&C (Panel B) insurers recognize Other-than-Temporary Impairment (OTTI) for downgraded corporate bonds and ABS across U.S. states classified as 'high MTM states' and 'low MTM states'. Only the downgrades from investment to non-investment grades during the pre-crisis period (2005-2007) 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 vs. low MTM groups under three different alternative classifications (Baseline, Alternative 1 and Alternative 2). These classifications of U.S. states into the high and low MTM groups are 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 the low MTM groups. For life (P&C) insurers, seven (six) of these classified states, including 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 difference between the two groups because life (P&C) insurers in these states do not hold downgraded positions during the pre-crisis 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: P&C 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) |

**Table 5: Probability of Selling ABS following Downgrade**

This table reports coefficient estimates for linear models of the probability that an ABS position is sold following an investment-to-non-investment downgrade of any tranche backed by the same asset pool as the ABS in question. Panel A includes ABS positions held by any insurer at the beginning of the year in which such downgrade occurs. Panel B is restricted to the ABS positions held by life and P&C insurers with high ABS exposure, i.e., those whose RBC ratios are expected to drop by about 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 dummy indicates if the position is held by a P&C insurer, and where the insurer-level controls variables, e.g., ln(capital and surplus), % risky assets, Leverage, and ROE, are demeaned within each type. Columns (3) to (5) include life insurers only. High MTM dummy equals one if the life insurer is domiciled in a U.S. state classified as being in the high MTM group under each of the three alternative classifications as indicated in the column heading (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. The same set of control variables is also included in Panel B but not report for brevity. Full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors, clustered at firm or state level, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

*Panel A: Full sample*

| | Life and P&C | | Life Only | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | | | Definition for "High MTM Dummy" | | |
| | | | Baseline | Alternative 1 | Alternative 2 |
| P&C dummy | 0.033*** | 0.028*** | | | |
| | (0.012) | (0.010) | | | |
| High MTM dummy | | | 0.022** | 0.014* | 0.020** |
| | | | (0.008) | (0.008) | (0.008) |
| Low RBC ratio dummy | 0.032* | 0.020 | 0.069*** | 0.069*** | 0.073*** |
| | (0.017) | (0.013) | (0.019) | (0.020) | (0.020) |
| Revalue dummy | 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 and 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) |

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| | Life and P&C | | Life Only | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | | | Definition for "High MTM Dummy" | | |
| | | | Baseline | Alternative 1 | Alternative 2 |
| Rating group fixed effects | YES | YES | YES | YES | YES |
| Pool fixed effects | NO | YES | YES | YES | YES |
| Year fixed effects | YES | NO | NO | NO | NO |
| State fixed effects | YES | NO | NO | NO | NO |
| Standard error cluster | FIRM | STATE | STATE | STATE | STATE |
| Observations | 11,339 | 11,339 | 8,446 | 8,446 | 8,446 |
| R-squared | 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*

| | Life and P&C | | Life Only | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | | | Definition for "High MTM Dummy" | | |
| | | | Baseline | Alternative 1 | Alternative 2 |
| P&C dummy | 0.040** | 0.034*** | | | |
| | (0.019) | (0.010) | | | |
| High MTM dummy | | | 0.022** | 0.015* | 0.025*** |
| | | | (0.009) | (0.009) | (0.009) |
| Low RBC ratio dummy | 0.060** | 0.049** | 0.075*** | 0.075*** | 0.082*** |
| | (0.028) | (0.019) | (0.022) | (0.023) | (0.023) |
| Bond control variables | YES | YES | YES | YES | YES |
| Firm control variables | YES | YES | YES | YES | YES |
| Rating group fixed effects | YES | YES | YES | YES | YES |
| Pool fixed effects | NO | YES | YES | YES | YES |
| Year fixed effects | YES | NO | NO | NO | NO |
| State fixed effects | YES | NO | NO | NO | NO |
| Standard error cluster | FIRM | STATE | STATE | STATE | STATE |
| Observations | 8,894 | 8,894 | 7,957 | 7,957 | 7,957 |
| R-squared | 0.064 | 0.016 | 0.021 | 0.020 | 0.020 |
| Number of pools | | 2,054 | 1,985 | 1,985 | 1,985 |

**Table 6: Summary Statistics of Unrealized Gains/Losses of ABS, Corporate Bond, and Government Bond Positions**

This table presents descriptive statistics on the distribution of year-end unrealized gains/losses on ABS (Panel A), corporate bonds (Panel B), and government bonds (Panel C) held by insurance firms. For each bond position, unrealized gain is the difference between the position's fair value and book-adjusted carrying value, measured as a percentage of book-adjusted carrying value.

| | Life | | | | | | Property & Casualty | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | No. of Positions | 10thPct | 25thPct | 50thPct | 75thPct | 90thPct | No. of Positions | 10thPct | 25thPct | 50thPct | 75thPct | 90thPct |
| *Panel A: ABS* | | | | | | | | | | | | |
| 2004 | 13,494 | -1.4% | -0.2% | 0.9% | 4.4% | 10.1% | 5,642 | -1.7% | -0.8% | 0.0% | 1.8% | 5.9% |
| 2005 | 17,785 | -3.3% | -1.8% | -0.1% | 1.0% | 5.3% | 7,072 | -3.2% | -2.0% | -0.7% | 0.1% | 1.8% |
| 2006 | 22,270 | -2.7% | -1.1% | 0.0% | 1.0% | 3.8% | 8,508 | -2.7% | -1.4% | -0.2% | 0.2% | 1.4% |
| 2007 | 26,754 | -17.1% | -8.0% | -2.1% | 0.2% | 2.9% | 9,886 | -7.4% | -1.7% | -0.3% | 0.6% | 1.9% |
| 2008 | 26,476 | -75.3% | -55.7% | -30.8% | -8.8% | -0.3% | 8,416 | -54.6% | -31.9% | -12.1% | -1.9% | 0.0% |
| 2009 | 24,091 | -60.9% | -38.3% | -16.4% | -0.2% | 7.4% | 6,733 | -35.4% | -15.0% | -1.5% | 1.7% | 9.5% |
| 2010 | 20,418 | -36.5% | -18.8% | -2.8% | 4.7% | 23.3% | 4,281 | -16.0% | -4.0% | 1.4% | 6.9% | 28.5% |
| *Panel B: Corporate bonds* | | | | | | | | | | | | |
| 2004 | 142,626 | -0.8% | 0.9% | 4.1% | 9.5% | 15.5% | 69,897 | -1.3% | -0.1% | 2.0% | 6.4% | 11.6% |
| 2005 | 143,492 | -3.5% | -1.6% | 0.7% | 5.1% | 11.1% | 67,288 | -3.4% | -2.2% | -0.5% | 2.2% | 7.0% |
| 2006 | 136,579 | -3.9% | -1.9% | 0.2% | 3.4% | 8.2% | 66,790 | -3.5% | -2.2% | -0.3% | 1.6% | 5.3% |
| 2007 | 135,159 | -6.8% | -2.6% | 0.1% | 2.8% | 7.0% | 63,947 | -3.6% | -1.1% | 0.3% | 2.1% | 4.8% |
| 2008 | 133,204 | -31.6% | -18.1% | -6.6% | 0.0% | 4.9% | 63,542 | -17.7% | -7.6% | -1.8% | 1.0% | 4.5% |
| 2009 | 128,304 | -6.1% | -0.1% | 4.2% | 7.8% | 13.1% | 69,066 | -0.5% | 1.8% | 4.7% | 7.6% | 11.9% |
| 2010 | 115,007 | -0.8% | 2.7% | 7.1% | 11.8% | 17.4% | 61,337 | 0.3% | 2.4% | 6.3% | 10.4% | 14.9% |
| *Panel C: Government bonds* | | | | | | | | | | | | |
| 2004 | 44,677 | -0.1% | 2.6% | 6.2% | 9.9% | 13.8% | 40,317 | -1.1% | 0.0% | 3.0% | 7.6% | 10.6% |
| 2005 | 42,916 | -1.6% | 0.4% | 4.0% | 7.8% | 12.0% | 38,887 | -2.7% | -1.4% | 0.3% | 5.1% | 8.3% |
| 2006 | 39,556 | -2.3% | -0.2% | 2.3% | 5.8% | 10.3% | 36,986 | -3.0% | -1.6% | 0.0% | 3.4% | 6.7% |
| 2007 | 34,484 | -0.2% | 1.2% | 3.9% | 7.8% | 12.5% | 34,682 | -0.3% | 0.2% | 2.1% | 5.3% | 8.4% |
| 2008 | 28,839 | 0.1% | 2.5% | 5.1% | 9.1% | 15.0% | 30,876 | 0.0% | 1.6% | 4.6% | 7.6% | 11.5% |
| 2009 | 25,935 | -1.4% | 2.8% | 7.9% | 11.9% | 14.9% | 31,641 | -1.2% | 0.2% | 4.2% | 9.0% | 13.2% |
| 2010 | 24,589 | -0.2% | 3.0% | 9.5% | 13.9% | 17.8% | 30,555 | -0.8% | 0.7% | 4.7% | 11.2% | 15.6% |

**Table 7: 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., defined as the percentile rank of each bond position's unrealized gain in each insurer's portfolio, and its interactions with crisis dummy and high ABS exposure dummy. Unrealized gain is calculated as the fair value minus the book-adjusted carrying value at the latest year end before the calendar quarter of interest. Crisis dummy equals one for the periods from the third quarter of 2007 to the end of 2009. High ABS exposure dummy equals one for insurers whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. Corp dummy equals one for corporate bond positions, and gov dummy equals one for government bond positions. The bond characteristics are interacted with the bond type dummies. All variables are defined in the Appendix D. Standard errors, either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Life | | | Property & Casualty | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Crisis | All | All | Crisis | All | All |
| Main variables | | | | | | |
| (1) Unrealized gain pct. | -0.005 | -0.023*** | -0.023*** | -0.004 | -0.002 | -0.000 |
| | (0.008) | (0.007) | (0.005) | (0.004) | (0.005) | (0.004) |
| (1) x (2) | 0.022*** | 0.001 | 0.000 | 0.015* | -0.003 | -0.009* |
| | (0.006) | (0.006) | (0.003) | (0.009) | (0.007) | (0.005) |
| Crisis dummy x (1) | | 0.021** | 0.020** | | 0.001 | -0.001 |
| | | (0.010) | (0.008) | | (0.006) | (0.005) |
| Crisis dummy x (1) x (2) | | 0.020*** | 0.020*** | | 0.017* | 0.021* |
| | | (0.008) | (0.006) | | (0.010) | (0.011) |
| Related insurance characteristics | | | | | | |
| (2) High ABS exposure dummy | -0.000 | -0.000 | | 0.015** | 0.015* | |
| | (0.005) | (0.008) | | (0.007) | (0.008) | |
| (3) Low RBC ratio dummy | 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 dummy | 0.063*** | 0.047*** | 0.048*** | 0.013* | 0.015* | 0.018** |
| | (0.012) | (0.010) | (0.012) | (0.007) | (0.008) | (0.007) |
| Crisis dummy x (2) | | 0.001 | 0.000 | | -0.001 | -0.004 |
| | | (0.007) | (0.003) | | (0.007) | (0.007) |
| Crisis dummy x (3) | | 0.009 | 0.007 | | -0.002 | -0.004 |
| | | (0.007) | (0.005) | | (0.005) | (0.004) |
| Crisis dummy x (4) | | 0.019 | 0.017 | | -0.010 | -0.010 |
| | | (0.012) | (0.015) | | (0.014) | (0.011) |

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| | Life | | | Property & Casualty | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Crisis | All | All | Crisis | All | All |
| Bond control variables | | | | | | |
| Corp dummy x 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 dummy x 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 dummy x ln(issue size) | 0.012*** | 0.011*** | 0.009*** | 0.010*** | 0.009*** | 0.007*** |
| | (0.001) | (0.001) | (0.000) | (0.001) | (0.001) | (0.001) |
| Corp dummy x Bankruptcy dummy | 0.262*** | 0.273*** | 0.274*** | 0.180*** | 0.200*** | 0.200*** |
| | (0.020) | (0.028) | (0.028) | (0.066) | (0.063) | (0.046) |
| Corp dummy x Downgrade dummy | 0.040*** | 0.078*** | 0.079*** | 0.133*** | 0.153*** | 0.152*** |
| | (0.015) | (0.022) | (0.022) | (0.030) | (0.027) | (0.026) |
| Gov dummy x ln(bond age) | -0.033*** | -0.032*** | -0.031*** | -0.032*** | -0.036*** | -0.034*** |
| | (0.007) | (0.006) | (0.004) | (0.007) | (0.005) | (0.004) |
| Gov dummy x ln(maturity) | -0.016*** | -0.017*** | -0.015*** | -0.000 | -0.004 | -0.004* |
| | (0.004) | (0.004) | (0.003) | (0.004) | (0.003) | (0.002) |
| Other insurance control variables | | | | | | |
| ln(capital and 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 | 0.062 | 0.016 | 0.003 | -0.003 |
| | (0.023) | (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 group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | NO | YES | YES | NO |
| Firm fixed effects | NO | NO | YES | NO | NO | YES |
| Standard error cluster 1 | FIRM | FIRM | QTR | FIRM | FIRM | QTR |
| Standard error cluster 2 | QTR | QTR | - | QTR | QTR | - |
| Observations | 790,559 | 1,854,938 | 1,854,938 | 305,876 | 742,777 | 742,777 |
| R-squared (within) | 0.027 | 0.022 | 0.014 | 0.026 | 0.023 | 0.012 |

**Table 8: 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 insurance company, whose RBC ratio is expected to drop by about 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 firms (in columns (1) to (4)) and for P&C firms (in columns (5) to (8)). Both types of insurance companies are pooled together in column (9), with P&C dummy to indicate that the position is held by a P&C insurer. Columns (1) and (5) include only the crisis period, from the third quarter of 2007 to the end of 2009, and the other columns cover the period from 2004 to 2010. The variables of interest are unrealized gain pct., defined as the percentile rank of each bond position's unrealized gain in each insurer's portfolio, and its interactions with crisis dummy, low RBC ratio dummy, and P&C dummy. Low RBC ratio dummy equals one for insurers whose beginning-of-year RBC ratios are in the lowest quartile. Bond and other insurance control variables, as in Table 7, are included but not reported for brevity. Full table is in the Internet Appendix. All variables are defined in the Appendix D. Standard errors, either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Life | | | | Property & Casualty | | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Crisis | All | All | All | Crisis | All | All | All | All |
| Main variables | | | | | | | | | |
| (1) Unrealized gain pct. | 0.019* | -0.023*** | -0.023*** | -0.027*** | 0.008 | -0.006 | -0.006 | -0.005 | -0.027*** |
| | (0.010) | (0.005) | (0.004) | (0.005) | (0.012) | (0.006) | (0.005) | (0.004) | (0.005) |
| (1) x (2) | | | | 0.003 | | | | -0.001 | 0.003 |
| | | | | (0.004) | | | | (0.011) | (0.005) |
| (1) x P&C dummy | | | | | | | | | 0.023*** |
| | | | | | | | | | (0.008) |
| Crisis dummy x (1) | | 0.044*** | 0.043*** | 0.035*** | | 0.020* | 0.017 | 0.012 | 0.035*** |
| | | (0.011) | (0.010) | (0.010) | | (0.012) | (0.013) | (0.015) | (0.010) |
| Crisis dummy x (1) x (2) | | | | 0.021* | | | | 0.028* | 0.022** |
| | | | | (0.012) | | | | (0.016) | (0.011) |
| Crisis dummy x (1) x P&C dummy | | | | | | | | | -0.023** |
| | | | | | | | | | (0.011) |

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| | Life | | | | Property & Casualty | | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Crisis | All | All | All | Crisis | All | All | All | All |
| Related insurance characteristics | | | | | | | | | |
| (2) Low RBC ratio dummy | 0.032*** | 0.011** | 0.010 | -0.004 | -0.012 | 0.002 | 0.017* | 0.018 | 0.001 |
| | (0.010) | (0.006) | (0.006) | (0.006) | (0.009) | (0.010) | (0.009) | (0.011) | (0.006) |
| (3) Revalue dummy | 0.091*** | 0.063*** | 0.058*** | 0.052*** | 0.012 | 0.025* | 0.025** | 0.026** | 0.042*** |
| | (0.018) | (0.011) | (0.015) | (0.013) | (0.015) | (0.014) | (0.010) | (0.010) | (0.009) |
| Crisis dummy x (2) | | 0.014 | 0.011* | 0.007 | | -0.007 | -0.011 | -0.023* | -0.002 |
| | | (0.009) | (0.006) | (0.006) | | (0.011) | (0.010) | (0.013) | (0.006) |
| Crisis dummy x (3) | | 0.032 | 0.037 | 0.021 | | -0.013 | -0.010 | -0.010 | -0.003 |
| | | (0.021) | (0.026) | (0.029) | | (0.021) | (0.015) | (0.015) | (0.016) |
| Crisis dummy x P&C dummy | | | | | | | | | 0.011 |
| | | | | | | | | | (0.008) |
| Bond controls | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Other insurance controls | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | NO | NO | YES | YES | NO | NO | NO |
| Firm fixed effects | NO | NO | YES | YES | NO | NO | YES | YES | YES |
| Standard error cluster 1 | FIRM | FIRM | QTR | QTR | FIRM | FIRM | QTR | QTR | QTR |
| Standard error cluster 2 | QTR | QTR | - | - | QTR | QTR | - | - | - |
| Observations | 647,893 | 1,512,622 | 1,512,622 | 1,512,622 | 62,655 | 151,038 | 151,038 | 151,038 | 1,663,660 |
| R-squared (within) | 0.028 | 0.022 | 0.014 | 0.014 | 0.045 | 0.036 | 0.014 | 0.014 | 0.013 |

**Table 9: Does the Extent of Gains Trading Differ among Life Firms in Different U.S. States?**

This table reports coefficient estimates for linear models of the probability that a life insurance company, domiciled in different U.S. states, will sell a corporate or government bond position. Included in the sample are life insurers whose RBC ratios are expected to drop by about 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., defined as the percentile rank of each bond position's unrealized gain in each insurer's portfolio, and its interactions with crisis dummy and high MTM dummy. High MTM dummy equals one for life insurers domiciled in U.S. states classified as being in the high MTM group under each of the three alternative definitions indicated in the column heading (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. Bond and other insurance control variables, as in Table 7, are included in all models but not reported for brevity. Full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors, either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Crisis | | | All | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| Main variables | | | | | | |
| (1) Unrealized gain pct. | 0.026** | 0.027** | 0.028** | -0.023*** | -0.023*** | -0.021*** |
| | (0.012) | (0.013) | (0.013) | (0.005) | (0.005) | (0.005) |
| (1) x High MTM dummy | -0.017** | -0.017** | -0.017*** | -0.001 | -0.000 | -0.004 |
| | (0.007) | (0.008) | (0.005) | (0.004) | (0.004) | (0.003) |
| Crisis dummy x (1) | | | | 0.051*** | 0.052*** | 0.051*** |
| | | | | (0.012) | (0.013) | (0.013) |
| Crisis dummy x (1) x High MTM dummy | | | | -0.018** | -0.018** | -0.015*** |
| | | | | (0.007) | (0.007) | (0.005) |
| Related insurance characteristics | | | | | | |
| (2) Low RBC ratio dummy | 0.032*** | 0.032*** | 0.029*** | 0.010 | 0.010 | 0.009 |
| | (0.010) | (0.010) | (0.011) | (0.006) | (0.006) | (0.006) |
| (3) Revalue dummy | 0.091*** | 0.091*** | 0.091*** | 0.059*** | 0.059*** | 0.058*** |
| | (0.018) | (0.018) | (0.020) | (0.015) | (0.015) | (0.015) |
| Crisis dummy x (2) | | | | 0.012** | 0.013** | 0.011* |
| | | | | (0.006) | (0.006) | (0.005) |
| Crisis dummy x (3) | | | | 0.036 | 0.036 | 0.037 |
| | | | | (0.026) | (0.026) | (0.026) |
| Crisis dummy x High MTM dummy | | | | 0.016*** | 0.016*** | 0.016*** |
| | | | | (0.005) | (0.005) | (0.003) |
| Bond controls | YES | YES | YES | YES | YES | YES |
| Other insurance controls | YES | YES | YES | YES | YES | YES |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | YES | NO | NO | NO |
| Firm fixed effects | NO | NO | NO | YES | YES | YES |
| Standard error cluster 1 | FIRM | FIRM | FIRM | QTR | QTR | QTR |
| Standard error cluster 2 | QTR | QTR | QTR | - | - | - |
| Observations | 647,893 | 647,893 | 647,893 | 1,512,622 | 1,512,524 | 1,512,524 |
| R-squared (within) | 0.028 | 0.028 | 0.028 | 0.014 | 0.014 | 0.014 |

**Table 10: Robustness Checks for Differences between Life and P&C Firms**

This table reports main results in Tables 5 and 8 obtained in three subsamples, each of which includes only life and P&C firms with certain characteristics held to be approximately the same. Included in the starting sample are life and P&C insurers whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. From the starting sample, the subsample in column (1) includes only insurers that belong to a universal group with both life and P&C firms under the same umbrella. The subsample in column (2) includes only insurers whose portfolio durations are more than 4 but less than 7 years. Portfolio duration is the value-weighted average duration of all fixed income securities held by the insurer at the beginning of the year. The subsample in column (3) includes only insurers that have ROE greater than 0.07 (rounded sample median) in each year. Panel A reports coefficient estimates of P&C dummy in a linear model, similar to column (2) of Table 5 Panel B, of the probability that an ABS position is sold following an investment-to-non-investment downgrade of any tranche backed by the same asset pool as the ABS in question. Panel B reports coefficient estimates of unrealized gain pct. and its interactions with crisis dummy and P&C dummy in a linear model, similar to column (9) of Table 8, of the probability that a corporate or government bond position is sold in each calendar quarter. Bond and insurer control variables and fixed effects as in column (2) of Table 5 (column (9) of Table 8) are included in Panel A (Panel B) but omitted for brevity. Full table is in the Internet Appendix. Standard errors clustered by state (Panel A) or by calendar quarter (Panel B) are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | (1)<br>Universal Group | (2)<br>Same Duration | (3)<br>Same/High Profit |
|---|---|---|---|
| *Panel A: ABS selling probability as in Column (2) of Table 5 Panel B* | | | |
| P&C dummy | 0.045*** | 0.058*** | 0.113*** |
| | (0.012) | (0.013) | (0.030) |
| Control variables/ Fixed effects | YES | YES | YES |
| Observations | 3,068 | 4,210 | 2,526 |
| R-squared | 0.022 | 0.014 | 0.031 |
| Number of pools | 1,159 | 1,450 | 1,059 |
| *Panel B: Government and corporate bond selling probability as in Column (9) of Table 8* | | | |
| (1) Unrealized gain pct. | -0.034*** | -0.022*** | -0.027*** |
| | (0.010) | (0.006) | (0.005) |
| Crisis dummy x (1) | 0.042*** | 0.030*** | 0.028** |
| | (0.013) | (0.010) | (0.013) |
| Crisis dummy x (1) x P&C dummy | -0.033* | -0.030* | -0.026* |
| | (0.018) | (0.015) | (0.015) |
| Control variables/ Fixed effects | YES | YES | YES |
| Observations | 700,175 | 790,291 | 821,088 |
| R-squared | 0.015 | 0.013 | 0.012 |
| Number of firms | 158 | 217 | 254 |

**Table 11: Risk and Liquidity of Equity Portfolio and Government Bond Portfolio**

This table reports OLS coefficient estimates for regressions of insurance companies' equity portfolio beta and Amihud ratios (Panel A) and the fraction of treasury notes/bonds in the government bond portfolio (Panel B) on crisis dummy, life dummy, and other firm characteristics. In Panel A, an insurer's equity portfolio consists of all non-affiliated common equity held at the end of each quarter from 2004 to 2010. The dependent variable in columns (1) to (3) is the value-weighted portfolio beta multiplied by 100. Individual stock beta is estimated by regressing the stock's daily return on CRSP value-weighted market return over a 2-year window up to the current-quarter end for each stock-quarter. A minimum of 60 trading days in the estimation window are required. The dependent variable in columns (4) to (6) is the log of value-weighted Amihud ratio of the portfolio multiplied by 100. For each stock-quarter, Amihud ratio is the average daily Amihud ratio over the quarter, where the daily Amihud ratio equals |return|/(volume x closing price/1,000,000). A minimum of 22 trading days in the estimation window are required. In Panel B, an insurer's government bond portfolio consists of treasury notes/bonds and other government bonds (e.g., guaranteed bonds issued by government agencies). The dependent variable is the fraction of treasury notes/bonds in the government bond portfolio at the end of each year, calculated using the bonds' book-adjusted carrying value (in columns (1) to (3)) or par value (in columns (4) to (6)). Treasury notes/bonds are distinguished from other government bonds using line number provided by the NAIC. Life dummy indicates a life insurer. Crisis dummy equals one for the periods from the third quarter of 2007 to the end of 2009 in Panel A and from 2007 to 2009 in Panel B. Firm controls, including ln(capital and surplus), % risky asset, leverage, and ROE, are not reported for brevity. In columns (3) and (6), firm controls are demeaned within each insurance type. Full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors, clustered by insurer, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | (1) Life | (2) P&C | (3) All | (4) Life | (5) P&C | (6) All |
|---|---|---|---|---|---|---|
| *Panel A: Common Stocks* | Beta x 100 | | | Log of Amihud Ratio x 100 | | |
| Crisis dummy | 2.730 | 3.930*** | 4.001*** | 1.114*** | 0.572*** | 0.582*** |
| | (2.011) | (0.705) | (0.708) | (0.372) | (0.147) | (0.146) |
| Life dummy | | | 2.309 | | | 1.316*** |
| | | | (2.123) | | | (0.423) |
| Life dummy x Crisis dummy | | | -1.549 | | | 0.524 |
| | | | (2.124) | | | (0.404) |
| Firm controls/ State fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 4,614 | 13,796 | 18,410 | 4,615 | 13,796 | 18,411 |
| R-squared | 0.090 | 0.054 | 0.041 | 0.117 | 0.048 | 0.064 |
| *Panel B: Government Bonds* | Percentage of Treasury by Book-Adjusted Carrying Value | | | Percentage of Treasury by Par Value | | |
| Crisis dummy | -0.009 | -0.015** | -0.016** | -0.010 | -0.015* | -0.016** |
| | (0.013) | (0.008) | (0.008) | (0.013) | (0.008) | (0.008) |
| Life dummy | | | -0.041*** | | | -0.040*** |
| | | | (0.012) | | | (0.012) |
| Life x Crisis dummy | | | 0.006 | | | 0.006 |
| | | | (0.016) | | | (0.016) |
| Firm controls/ State fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 2,654 | 7,674 | 10,328 | 2,654 | 7,674 | 10,328 |
| R-squared | 0.140 | 0.101 | 0.095 | 0.144 | 0.099 | 0.094 |

**Table 12: Implications for Portfolio Allocation**

This table reports OLS coefficient estimates for regressions of insurance companies' ABS portfolio allocation on year dummies and their interactions with high MTM institutions dummy. Included in the sample are insurers whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. Columns (1) to (3) include both life and P&C firms, where high MTM institutions dummy equals one for P&C firms. Columns (4) to (6) include only life firms, where high MTM institutions dummy equals one for those domiciled in U.S. states classified as being in the high MTM group under the baseline definition in Appendix C. In all columns, years 2004-2006 are lumped together as the benchmark for evaluating the evolution of ABS allocations over the subsequent years. All regressions include firm dummies to absorb the fixed effects of firm characteristics on ABS allocation, creating the benchmark that is firm-specific. Columns (2) and (5) (columns (3) and (6)) report estimates for insurers in the bottom quartile (the top three quartiles) of RBC ratio within each insurance type (life or P&C) at the beginning of each year. Robust standard errors, clustered by insurer, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | All: High MTM Institutions Dummy = 1 for P&C Insurers | | | Life Only: High MTM Institutions Dummy = 1 for Insurers in High MTM States | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | All | RBC Ratio ≤ 25th Pct. | RBC Ratio > 25th Pct. | All | RBC Ratio ≤ 25th Pct. | RBC Ratio > 25th Pct. |
| 2007 dummy | 0.032** | 0.028*** | 0.031*** | 0.035** | 0.035*** | 0.033** |
| | (0.009) | (0.005) | (0.003) | (0.010) | (0.004) | (0.010) |
| 2008 dummy | 0.008 | 0.016** | 0.006* | 0.011 | 0.034*** | 0.008 |
| | (0.009) | (0.005) | (0.004) | (0.010) | (0.007) | (0.011) |
| 2009 dummy | -0.004 | -0.001 | -0.004 | -0.001 | 0.009 | -0.002 |
| | (0.009) | (0.006) | (0.004) | (0.010) | (0.008) | (0.011) |
| 2010 dummy | -0.010 | -0.009 | -0.011*** | -0.006 | 0.014 | -0.009 |
| | (0.009) | (0.005) | (0.004) | (0.009) | (0.008) | (0.011) |
| 2007 dummy x High MTM institutions dummy | -0.010 | -0.022 | -0.009 | -0.011** | -0.018*** | -0.006* |
| | (0.011) | (0.019) | (0.007) | (0.004) | (0.004) | (0.003) |
| 2008 dummy x High MTM institutions dummy | -0.019*** | -0.022* | -0.015** | -0.009** | -0.037*** | -0.004 |
| | (0.005) | (0.012) | (0.007) | (0.003) | (0.008) | (0.003) |
| 2009 dummy x High MTM institutions dummy | -0.024*** | -0.037** | -0.017** | -0.007* | -0.024** | -0.004 |
| | (0.005) | (0.014) | (0.008) | (0.003) | (0.010) | (0.003) |
| 2010 dummy x High MTM institutions dummy | -0.024*** | -0.033** | -0.016** | -0.009** | -0.046*** | -0.004 |
| | (0.005) | (0.014) | (0.008) | (0.003) | (0.009) | (0.003) |
| Firm fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 1,474 | 305 | 1,169 | 1,122 | 227 | 895 |
| R-squared | 0.125 | 0.131 | 0.122 | 0.169 | 0.190 | 0.174 |
| Number of firms | 260 | 102 | 239 | 181 | 78 | 171 |

**Table 13: Impact of Gains Trading on Corporate Bond Returns**

This table reports OLS coefficient estimates for regressions of quarterly corporate bond return on gains-trading selling pressure, measured as equally-weighted average unrealized gain percentile. For each bond-quarter, the average is taken across insurers that have positions in the bond at the beginning of the quarter, have high ABS exposure (i.e., their RBC ratios are expected to drop by 0.4 or more due to actual ABS downgrades during the crisis), and belong to either the high MTM group or the low MTM group. In Columns (1) to (3), life (P&C) insurers are considered low (high) MTM institutions. In Columns (4) to (6), life insurers domiciled in high MTM states according to the baseline definition in Appendix C are considered high MTM institutions, and all others are considered low MTM institutions. To be included, a bond must be held by at least one low-MTM institution and at least one high-MTM institution at the beginning of the quarter. Quarterly corporate bond return is the log of change in price from the previous quarter to the current quarter, winsorized at the 2.5% and 97.5%. Treasury return is the logged return on maturity-matched Treasury bond/note, proxied by the interpolated constant maturity Treasury bond/note from the Fed. Spread return is the logged return on maturity- and rating-matched corporate bond index minus Treasury return. Corporate bond index return is calculated using Bank of America-Merrill Lynch bond index, adjusted for duration difference between the index and the bond in question. Bond controls include ln(bond age), ln(issue size), ln(maturity), downgrade dummy, and bankruptcy dummy but are not reported for brevity. Full table and a robustness check using value-weighted average unrealized gain percentile as a measure of gains-trading selling pressure are in the Internet Appendix. All variables are defined in Appendix D. Standard errors, two-way clustered by bond issuer and calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | All: Life (Low MTM Institutions) vs. P&C (High MTM Institutions) | | | Life Only: Low MTM States (Low MTM Institutions) vs. High MTM States (High MTM Institutions) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (1) Low MTM institutions' unrealized gain pct. | 0.010 | | 0.010 | 0.009 | | 0.007 |
| | (0.008) | | (0.008) | (0.007) | | (0.005) |
| Crisis dummy x (1) | -0.043*** | | -0.042*** | -0.040*** | | -0.029*** |
| | (0.015) | | (0.015) | (0.013) | | (0.009) |
| (2) High MTM institutions' unrealized gain pct. | | 0.005 | -0.000 | | 0.007 | 0.003 |
| | | (0.004) | (0.001) | | (0.006) | (0.003) |
| Crisis dummy x (2) | | -0.023*** | -0.002 | | -0.035*** | -0.013** |
| | | (0.008) | (0.002) | | (0.012) | (0.006) |
| Treasury return | 0.721*** | 0.724*** | 0.721*** | 0.652*** | 0.651*** | 0.651*** |
| | (0.048) | (0.047) | (0.048) | (0.057) | (0.057) | (0.057) |
| Spread return | 0.678*** | 0.697*** | 0.678*** | 0.603*** | 0.604*** | 0.602*** |
| | (0.063) | (0.059) | (0.063) | (0.060) | (0.059) | (0.060) |
| Bond controls | YES | YES | YES | YES | YES | YES |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| Wald test: (1) = (2) | | | 1.61 | | | 1.54 |
| Wald test: Crisis dummy x (1) = Crisis dummy x (2) | | | 6.72*** | | | 7.97*** |
| Observations | 51,345 | 51,345 | 51,345 | 86,153 | 86,153 | 86,153 |
| R-squared | 0.416 | 0.411 | 0.416 | 0.386 | 0.384 | 0.386 |

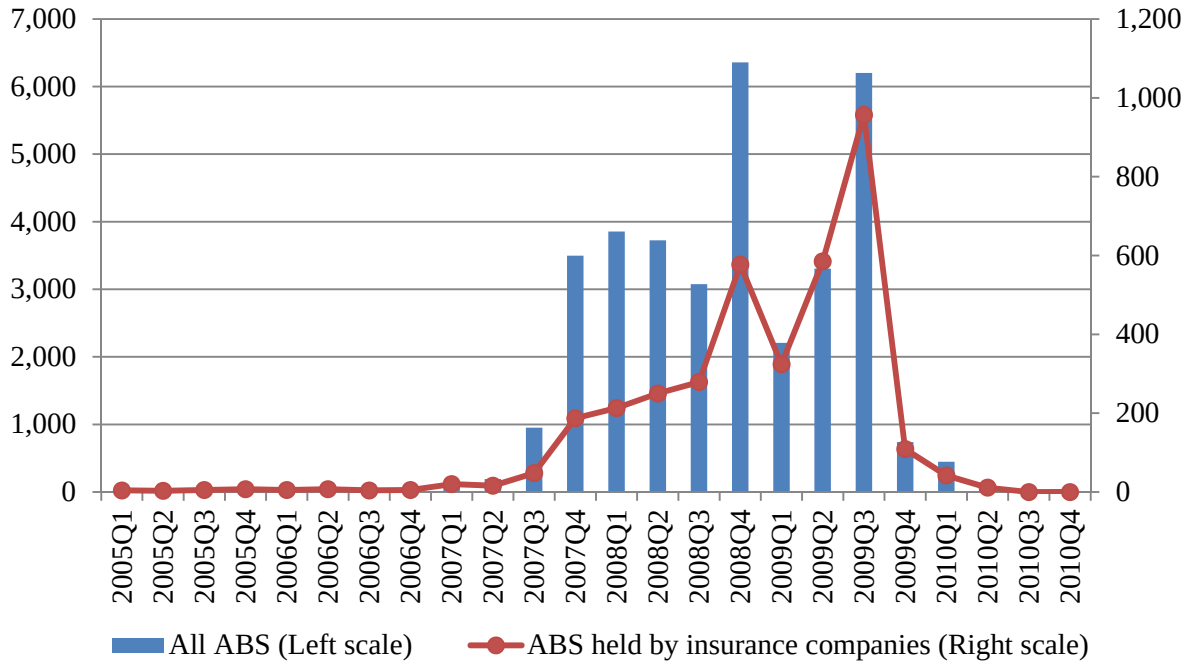


**Figure 1: Number of Downgrades of ABS by S&P from Investment to Non-Investment Grades**

This figure presents the number of downgrades of ABS securities from an investment-grade rating to a speculative-grade rating by S&P on quarterly basis. The bars show the number of all downgraded ABS securities included in S&P's Ratings IQuery. The connected dots show the number of downgraded ABS securities that are held by at least one insurance company.

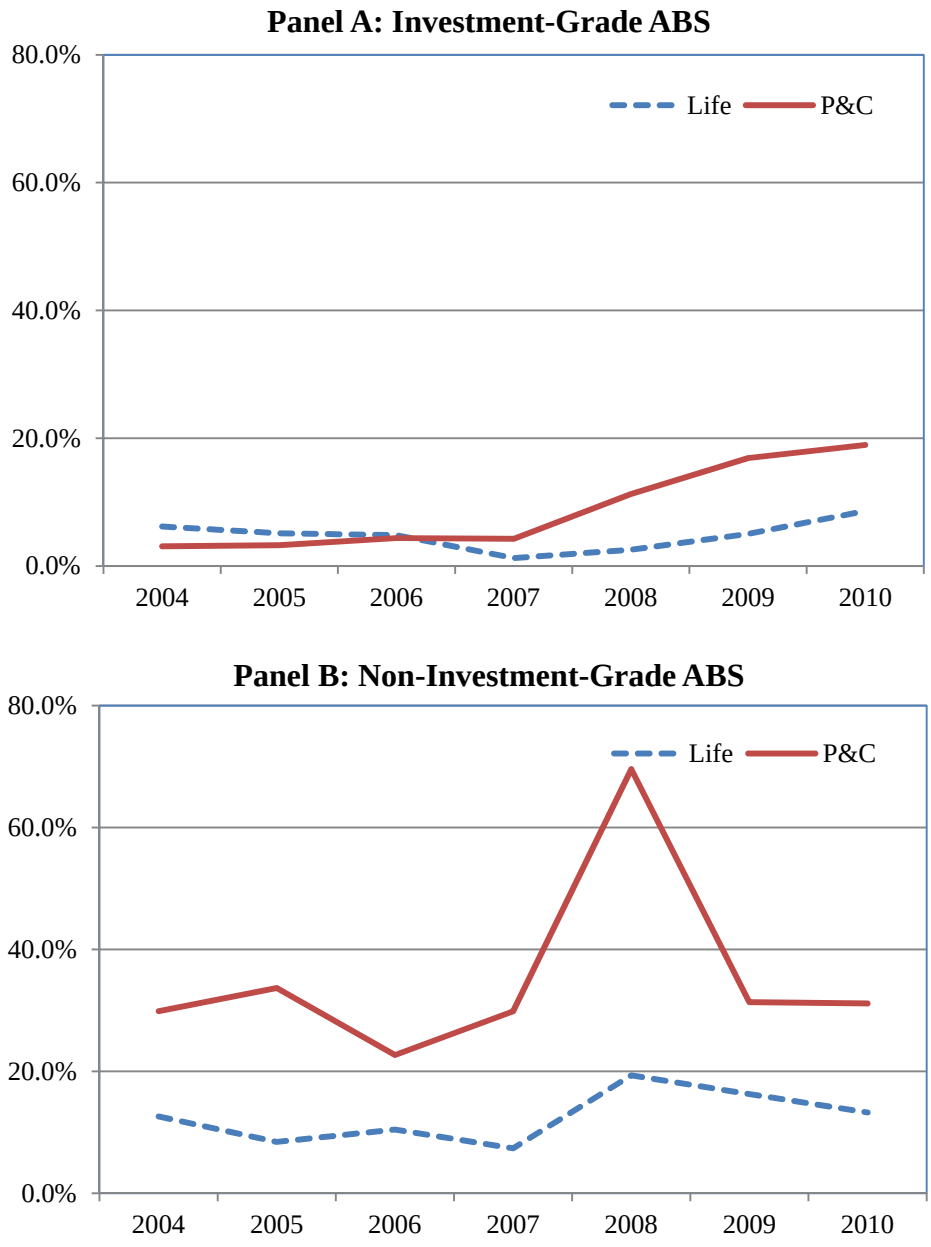


**Figure 2: Fraction of ABS Positions Revalued at Year End**

This figure presents the number of ABS positions revalued to the year-end fair value as a percentage of all ABS positions across all life and P&C firms at the end of 2004-2010. A position is classified as revalued to the year-end fair value if the book-adjusted carrying value equals the reported fair value reported. Panel A is for investment-grade ABS (those rated BBB- and above by S&P) and Panel B is for non-investment-grade ABS (those rated BB+ and below including NR).

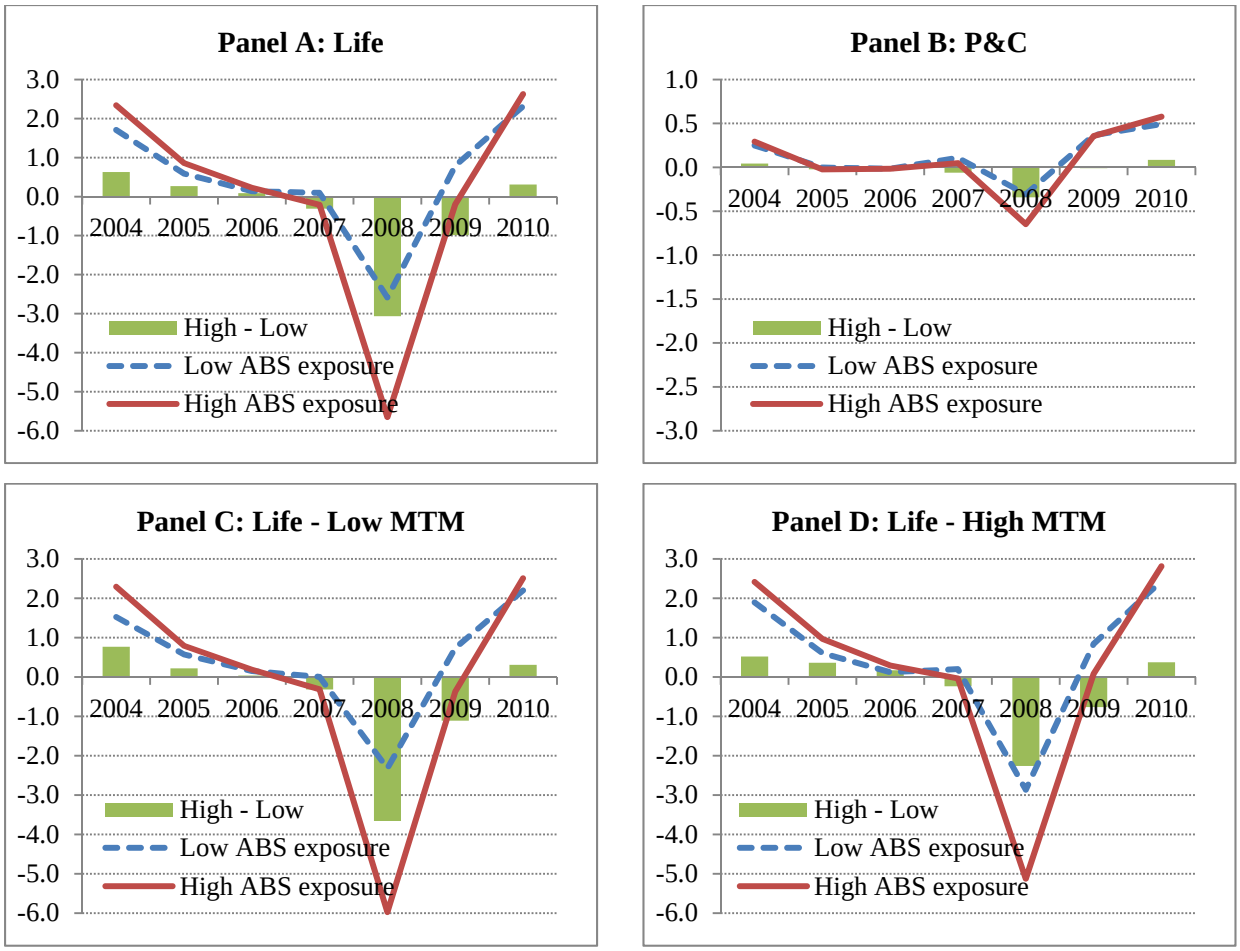


**Figure 3: RBC Ratio Distortion**

This figure presents the average distortions of RBC ratio due to historical cost accounting for life insurers (Panel A), P&C insurers (Panel B), life insurers domiciled in low MTM states (Panel C), and life insurers domiciled in high MTM states (Panel D). Baseline classification of U.S. states, as described in Appendix C, is used. Included in each sample are insurers holding at least one downgraded ABS during the crisis. RBC ratio distortion is calculated as market-adjusted RBC ratio minus reported RBC ratio, where market-adjusted RBC ratio is the ratio of reported total adjusted capital (TAC) plus unrealized gains and losses on all fixed-income securities held at amortized historical costs to NAIC risk-based capital (RBC). For each position, unrealized gains and losses are calculated as firm's reported fair value minus book-adjusted carrying value. In all panels, the solid (dashed) line represents the average distortion of RBC ratio for insurers with high (low) ABS exposures, defined as those whose RBC ratios are expected to drop by about 0.4 or more (by less than about 0.4) due to actual ABS downgrades during the crisis. The bars represent the differences between the solid and dashed lines.

# Internet Appendix for "Is Historical Cost Accounting a Panacea? Market Stress, Incentive Distortions, and Gains Trading"

Sample insurance codes from Illinois (commissioner having little discretion) and New York (commissioner having much discretion)

Table IA1: Rating Downgrades of ABS Held by Insurance Companies

Table IA2: Probability of Revaluing ABS to Year-End Fair Value

Table IA3: Expected Impact of ABS Downgrade on RBC Ratio

Table IA4: Probability of Selling ABS following Downgrade (Complete Version of Table 5 Panel B)

Table IA5: Is an Objective of Gains Trading to Manage RBC Ratio? Does the Extent of Gains Trading Differ between Life and P&C Firms? (Complete Version of Table 8)

Table IA6: Does the Extent of Gains Trading Differ among Life Firms in Different U.S. States? (Complete Version of Table 9)

Table IA7: Summary Statistics of Value-Weighted Average Duration and Maturity of Insurance Companies' Bond Portfolios

Table IA8: Robustness Checks for Differences between Life and P&C Firms (Complete Version of Table 10)

Table IA9: Risk and Liquidity of Equity Portfolio and Government Bond Portfolio (Complete Version of Table 11)

Table IA10: Impact of Gains Trading on Corporate Bond Returns (Complete Version of Table 13 and Robustness Checks Using Value-Weighted Average Unrealized Gain Percentile)

Table IA11: Validity of Within-Life Results for Large Firms and Public Firms

**(215 ILCS 5/) Illinois Insurance Code**

http://www.ilga.gov/legislation/ilcs/ilcs5.asp?ActID=1249&ChapterID=22

Sec. 126.7. Valuation of investments.

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, including the Purposes and Procedures of the Securities Valuation Office, the Valuation of Securities manual, the Accounting Practices and Procedures manual, the Annual Statement Instructions or any successor valuation procedures officially adopted by the NAIC. The Director shall promulgate rules for determining and calculating values to be used in financial statements submitted to the Department for investments not subject to published National Association of Insurance Commissioners valuation standards.

(Source: P.A. 90-418, eff. 8-15-97.)

**New York Insurance Code**

http://public.leginfo.state.ny.us/LAWSSEAF.cgi?QUERYTYPE=LAWS+&QUERYDATA=@LLISC+&LIST=LAW+&BROWSER=BROWSER+&TOKEN=57926798+&TARGET=VIEW

§ 1414. Valuation of investments.

(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:
(A) if purchased at par, at the par value;
(B) if purchased above or below par, on the basis of the purchase price adjusted so as to bring the value to par at maturity and yield in the meantime the effective rate of interest at which the purchase was made, or, in the superintendent's discretion, on the basis of the method of calculation commonly known as the pro rata method.

(2) The purchase price shall in no case be taken at a higher figure than the actual market value at the time of acquisition.

(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 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) hereof.

(4) The superintendent may, if he finds that the interests of policyholders so permit or require, by regulation permit or require any class of insurers, other than life insurance companies or fraternal benefit societies, authorized to do business in this state, to value their obligations in accordance with the foregoing rule.

(b) (1) Except securities subject to amortization and except as otherwise provided in this chapter, the investments (including any investments in an investment company) of all insurers authorized to do business in this state shall be valued, in the discretion of the superintendent, at their market value, or at their appraised value, or at prices determined by him as representing their fair market value.

(2) If the superintendent finds that in view of the character of investments of the insurer it would be prudent for such insurer to establish a special reserve for possible losses or fluctuations in the

values of its investments, he may require that a reserve, reasonable in amount, be established and maintained and that it be reported in any statement or report of the financial condition of such insurer.

(3) The superintendent may, in connection with any examination or required financial statement of the insurer, require it to furnish him a complete financial statement and audited report of the financial condition of any corporation whose securities are owned wholly or partly by such insurer and may cause an examination to be made of any subsidiary or affiliate of such insurer.

The rest of this article 1414 states the rules for other assets including investments in affiliates, stocks, real estates, etc.

**Table IA1: Ratings Downgrades of ABS Held by Insurance Companies**

This table reports the ratings transitions of ABS that are held by at least one life or P&C insurance company and are downgraded during the financial crisis (from 2007Q3 to 2009Q4). The rating downgrades are identified using in S&P Ratings IQuerry. The downgraded securities are grouped by the ratings before and after the downgrade. For example, 714 different ABS securities are downgraded directly from AAA to B.

| | | Rating After Downgrade | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | AA | A | BBB | BB | B | CCC | CC | C | D | Total | % of Total |
| Rating Before Downgrade | AAA | 935 | 660 | 569 | 451 | 714 | 129 | 7 | 0 | 2 | 3,467 | 40.1% |
| | AA | | 445 | 327 | 129 | 159 | 131 | 21 | 0 | 0 | 1,212 | 14.0% |
| | A | | | 568 | 266 | 223 | 204 | 34 | 0 | 1 | 1,296 | 15.0% |
| | BBB | | | | 392 | 276 | 306 | 79 | 0 | 5 | 1,058 | 12.2% |
| | BB | | | | | 267 | 307 | 58 | 0 | 0 | 632 | 7.3% |
| | B | | | | | | 510 | 95 | 0 | 2 | 607 | 7.0% |
| | CCC | | | | | | | 339 | 3 | 19 | 361 | 4.2% |
| | CC | | | | | | | | 0 | 10 | 10 | 0.1% |
| | C | | | | | | | | | 3 | 3 | 0.0% |
| | Total | 935 | 1,105 | 1,464 | 1,238 | 1,639 | 1,587 | 633 | 3 | 42 | 8,646 | 100.0% |
| | % of Total | 10.8% | 12.8% | 16.9% | 14.3% | 19.0% | 18.4% | 7.3% | 0.0% | 0.5% | 100.0% | |

**Table IA2: Probability of Revaluing ABS to Year-End Fair Value**

This table reports coefficient estimates for linear models of the probability that an insurance company revalues its ABS position to the year-end fair value. The dependent variable is a dummy that equals one if the insurance company revalues the ABS position, and zero otherwise. Each observation is position-year, and the sample includes all ABS positions from 2004 year-end to 2010 year-end. P&C dummy equals one if the position is held by a P&C insurer. Downgrade dummy equals one if the position is downgraded from investment to non-investment grades during the year. All variables are defined in the Appendix D of the paper. Standard errors, clustered at the firm level, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | (1) Non-Crisis | (2) Crisis | (3) Non-Crisis | (4) Crisis | (5) All | (6) All | (7) All | (8) All |
|---|---|---|---|---|---|---|---|---|
| P&C dummy | 0.022 | 0.105*** | 0.033*** | 0.103*** | 0.022 | 0.025 | 0.033** | 0.038** |
| | (0.015) | (0.016) | (0.012) | (0.016) | (0.016) | (0.017) | (0.014) | (0.016) |
| Downgrade dummy | | | -0.017 | 0.012 | | | 0.045** | 0.043** |
| | | | (0.024) | (0.021) | | | (0.018) | (0.017) |
| P&C dummy x Downgrade dummy | | | 0.394*** | 0.266*** | | | 0.274*** | 0.271*** |
| | | | (0.062) | (0.029) | | | (0.028) | (0.028) |
| Crisis dummy | | | | | -0.026 | | -0.027 | |
| | | | | | (0.017) | | (0.017) | |
| P&C dummy x Crisis dummy | | | | | 0.081*** | 0.079*** | 0.066*** | 0.063*** |
| | | | | | (0.020) | (0.022) | (0.020) | (0.021) |
| ln(maturity) | | | 0.012*** | 0.018*** | | | 0.014*** | 0.015*** |
| | | | (0.003) | (0.003) | | | (0.002) | (0.002) |
| ln(issue size) | | | -0.012*** | -0.015*** | | | -0.014*** | -0.014*** |
| | | | (0.003) | (0.002) | | | (0.002) | (0.002) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | YES | YES | YES | YES | YES | YES |
| Year fixed effects | YES | YES | YES | YES | NO | YES | NO | YES |
| Observations | 95,570 | 97,973 | 95,570 | 97,973 | 193,543 | 193,543 | 193,543 | 193,543 |
| R-squared | 0.075 | 0.153 | 0.084 | 0.175 | 0.096 | 0.105 | 0.114 | 0.122 |

**Table IA3: Expected Impact of ABS Downgrade on RBC Ratio**

This table reports summary statistics of the expected impact of ABS downgrades during the crisis (2007Q3-2009Q4) on RBC ratio given an insurer's ABS position before the crisis (at the end of 2007Q2). For each insurer-year affected by ABS downgrades, the new total adjusted capital or TAC (numerator) and RBC (denominator) are calculated to reflect the new ratings and market values of the downgraded securities at the end of the year. Statutory accounting rules are strictly applied to each ABS position; HCA is used for all downgraded positions of life (P&C) insurers except those in NAIC Class 6 (Classes 3-6) where MTM is used. Market value of a position is the average price of the last trades and/or reported fair values of all insurance companies at the end of the year. 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; therefore, the changes in TAC and RBC are calculated first from ABS available in Ratings IQuerry and then scaled by the ratio of value of all insurer-reported ABS to value of ABS found in Ratings IQuerry at the end of each year. Insurer-reported ABS are private-labeled ABS, identified using line numbers in the NAIC position data. The first three rows report summary statistics of the cumulative change in the RBC ratio at the end of each year relative to the RBC ratio at the end of 2006. The last row reports statistics of the decline in RBC ratio during the whole crisis period for any insurers affected by downgrades, where the top 75% of life insurers and the top 25% of P&C insurers, highlighted in grey, are classified as having high ABS exposure.

| | Life | | | | | Property & Casualty | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | N | Mean | 25th Pct | Median | 75th Pct | N | Mean | 25th Pct | Median | 75th Pct |
| 2007 | 70 | -0.242 | -0.252 | -0.076 | -0.012 | 31 | -0.076 | -0.060 | -0.028 | -0.005 |
| 2008 | 192 | -0.981 | -1.186 | -0.483 | -0.114 | 249 | -0.189 | -0.156 | -0.046 | -0.013 |
| 2009 | 239 | -2.161 | -2.881 | -1.449 | -0.491 | 388 | -0.375 | -0.432 | -0.156 | -0.047 |
| 2007-2009 | 252 | -2.063 | -2.784 | -1.259 | -0.427 | 423 | -0.363 | -0.415 | -0.143 | -0.035 |

**Table IA4: Probability of Selling ABS following Downgrade (Complete Version of Table 5 Panel B)**

This table reports coefficient estimates for linear models of the probability that an ABS position is sold following an investment-to-non-investment downgrade of any tranche backed by the same asset pool as the ABS in question. Included in the estimation are ABS positions held by life and P&C insurers with high ABS exposure, i.e., those whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. The dependent variable equals one if the company holding the ABS position 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 a P&C dummy indicates if the position is held by a P&C insurer, and where the insurer-level control variables, e.g., ln(capital and surplus), % risky assets, Leverage, and ROE, are demeaned within each type. Columns (3) to (5) include life insurers only. High MTM dummy equals one if the life insurer is domiciled in a U.S. state classified as being in the high MTM group under each of the three alternative classifications as indicated in the column heading (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. All variables are defined in the Appendix D. Standard errors, clustered at firm or state level, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Life and P&C | | Life Only | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | | | Definition for "High MTM Dummy" | | |
| | | | Baseline | Alternative 1 | Alternative 2 |
| P&C dummy | 0.040** | 0.034*** | | | |
| | (0.019) | (0.010) | | | |
| High MTM dummy | | | 0.022** | 0.015* | 0.025*** |
| | | | (0.009) | (0.009) | (0.009) |
| Low RBC ratio dummy | 0.060** | 0.049** | 0.075*** | 0.075*** | 0.082*** |
| | (0.028) | (0.019) | (0.022) | (0.023) | (0.023) |
| Revalue dummy | 0.058** | 0.073*** | 0.077*** | 0.078*** | 0.075** |
| | (0.025) | (0.025) | (0.027) | (0.028) | (0.028) |
| ln(tranche size) | 0.003 | 0.005 | 0.004 | 0.004 | 0.004 |
| | (0.003) | (0.004) | (0.004) | (0.004) | (0.004) |
| ln(capital and surplus) | -0.003 | 0.000 | 0.001 | 0.002 | 0.001 |
| | (0.004) | (0.002) | (0.003) | (0.003) | (0.003) |
| % risky assets | 0.000 | -0.000 | -0.001 | -0.001 | -0.001 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Leverage | 0.045 | 0.024 | -0.004 | -0.004 | -0.003 |
| | (0.069) | (0.058) | (0.096) | (0.098) | (0.100) |
| ROE | 0.013 | 0.016 | 0.013 | 0.015 | 0.015 |
| | (0.034) | (0.021) | (0.019) | (0.019) | (0.019) |
| Rating group fixed effects | YES | YES | YES | YES | YES |
| Pool fixed effects | NO | YES | YES | YES | YES |
| Year fixed effects | YES | NO | NO | NO | NO |
| State fixed effects | YES | NO | NO | NO | NO |
| Standard error cluster | FIRM | STATE | STATE | STATE | STATE |
| Observations | 8,894 | 8,894 | 7,957 | 7,957 | 7,957 |
| R-squared | 0.064 | 0.016 | 0.021 | 0.020 | 0.020 |
| Number of pools | | 2,054 | 1,985 | 1,985 | 1,985 |

**Table IA5: Is an Objective of Gains Trading to Manage RBC Ratio? Does the Extent of Gains Trading Differ between Life and P&C Firms? (Complete Version of Table 8)**

This table reports coefficient estimates for linear models of the probability that an insurance company, whose RBC ratio is expected to drop by about 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 firms (in columns (1) to (4)) and for P&C firms (in columns (5) to (8)). Both types of insurance companies are pooled together in column (9), with P&C dummy to indicate that the position is held by a P&C insurer. Columns (1) and (5) include only the crisis period, from the third quarter of 2007 to the end of 2009, and the other columns cover the period from 2004 to 2010. The variables of interest are unrealized gain pct., defined as the percentile rank of each bond position's unrealized gain in each insurer's portfolio, and its interactions with crisis dummy, low RBC ratio dummy, and P&C dummy. Low RBC ratio dummy equals one for insurers whose beginning-of-year RBC ratios are in the lowest quartile. Bond and other insurance control variables, as in Table 7, are included but not reported for brevity. Full table is in the Internet Appendix. All variables are defined in the Appendix D. Standard errors, either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Life | | | | Property & Casualty | | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Crisis | All | All | All | Crisis | All | All | All | All |
| Main variables | | | | | | | | | |
| (1) Unrealized gain pct. | 0.019* | -0.023*** | -0.023*** | -0.027*** | 0.008 | -0.006 | -0.006 | -0.005 | -0.027*** |
| | (0.010) | (0.005) | (0.004) | (0.005) | (0.012) | (0.006) | (0.005) | (0.004) | (0.005) |
| (1) x (2) | | | | 0.003 | | | | -0.001 | 0.003 |
| | | | | (0.004) | | | | (0.011) | (0.005) |
| (1) x P&C dummy | | | | | | | | | 0.023*** |
| | | | | | | | | | (0.008) |
| Crisis dummy x (1) | | 0.044*** | 0.043*** | 0.035*** | | 0.020* | 0.017 | 0.012 | 0.035*** |
| | | (0.011) | (0.010) | (0.010) | | (0.012) | (0.013) | (0.015) | (0.010) |
| Crisis dummy x (1) x (2) | | | | 0.021* | | | | 0.028* | 0.022** |
| | | | | (0.012) | | | | (0.016) | (0.011) |
| Crisis dummy x (1) x P&C dummy | | | | | | | | | -0.023** |
| | | | | | | | | | (0.011) |
| Related insurance characteristics | | | | | | | | | |
| (2) Low RBC ratio dummy | 0.032*** | 0.011** | 0.010 | -0.004 | -0.012 | 0.002 | 0.017* | 0.018 | 0.001 |
| | (0.010) | (0.006) | (0.006) | (0.006) | (0.009) | (0.010) | (0.009) | (0.011) | (0.006) |

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| | Life | | | | Property & Casualty | | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Crisis | All | All | All | Crisis | All | All | All | All |
| (3) Revalue dummy | 0.091*** | 0.063*** | 0.058*** | 0.052*** | 0.012 | 0.025* | 0.025** | 0.026** | 0.042*** |
| | (0.018) | (0.011) | (0.015) | (0.013) | (0.015) | (0.014) | (0.010) | (0.010) | (0.009) |
| Crisis dummy x (2) | | 0.014 | 0.011* | 0.007 | | -0.007 | -0.011 | -0.023* | -0.002 |
| | | (0.009) | (0.006) | (0.006) | | (0.011) | (0.010) | (0.013) | (0.006) |
| Crisis dummy x (3) | | 0.032 | 0.037 | 0.021 | | -0.013 | -0.010 | -0.010 | -0.003 |
| | | (0.021) | (0.026) | (0.029) | | (0.021) | (0.015) | (0.015) | (0.016) |
| Crisis dummy x P&C dummy | | | | | | | | | 0.011 |
| | | | | | | | | | (0.008) |
| Bond control variables | | | | | | | | | |
| Corp dummy x ln(bond age) | -0.007*** | -0.006*** | -0.006*** | -0.007*** | -0.014*** | -0.013** | -0.012*** | -0.012*** | -0.007*** |
| | (0.002) | (0.002) | (0.001) | (0.001) | (0.005) | (0.005) | (0.003) | (0.003) | (0.001) |
| Corp dummy x ln(maturity) | -0.012*** | -0.008*** | -0.009*** | -0.009*** | -0.011*** | -0.006* | -0.008*** | -0.008*** | -0.009*** |
| | (0.002) | (0.001) | (0.001) | (0.002) | (0.004) | (0.003) | (0.003) | (0.003) | (0.002) |
| Corp dummy x ln(issue size) | 0.014*** | 0.012*** | 0.010*** | 0.010*** | 0.012*** | 0.011*** | 0.010*** | 0.010*** | 0.010*** |
| | (0.001) | (0.001) | (0.000) | (0.001) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) |
| Corp dummy x Bankruptcy dummy | 0.287*** | 0.294*** | 0.294*** | 0.279*** | 0.273*** | 0.279*** | 0.280*** | 0.281*** | 0.283*** |
| | (0.026) | (0.027) | (0.027) | (0.026) | (0.053) | (0.051) | (0.060) | (0.060) | (0.025) |
| Corp dummy x Downgrade dummy | 0.041** | 0.078*** | 0.078*** | 0.079*** | 0.130*** | 0.135*** | 0.133*** | 0.133*** | 0.086*** |
| | (0.017) | (0.022) | (0.022) | (0.012) | (0.033) | (0.023) | (0.021) | (0.021) | (0.011) |
| Gov dummy x ln(bond age) | -0.038*** | -0.034*** | -0.034*** | -0.039*** | -0.043*** | -0.046*** | -0.039*** | -0.040*** | -0.039*** |
| | (0.009) | (0.007) | (0.005) | (0.006) | (0.014) | (0.008) | (0.005) | (0.005) | (0.005) |
| Gov dummy x ln(maturity) | -0.018*** | -0.020*** | -0.018*** | -0.018*** | 0.009 | -0.002 | -0.003 | -0.003 | -0.013*** |
| | (0.004) | (0.005) | (0.003) | (0.004) | (0.010) | (0.006) | (0.005) | (0.005) | (0.003) |
| Other insurance control variables | | | | | | | | | |
| ln(capital and surplus) | 0.003* | 0.001 | 0.010** | 0.014*** | 0.007* | 0.004 | 0.019 | 0.019 | 0.016*** |
| | (0.001) | (0.001) | (0.004) | (0.004) | (0.004) | (0.002) | (0.017) | (0.017) | (0.004) |
| % risky assets | 0.000 | 0.000 | 0.000 | 0.001 | 0.001** | 0.001*** | 0.000 | 0.000 | 0.001 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) | (0.001) | (0.001) | (0.000) |

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| | Life | | | | Property & Casualty | | | | All |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| | Crisis | All | All | All | Crisis | All | All | All | All |
| Leverage | 0.077** | 0.034 | 0.030 | 0.043 | 0.009 | 0.033 | 0.054 | 0.055 | 0.038 |
| | (0.032) | (0.027) | (0.051) | (0.071) | (0.031) | (0.031) | (0.083) | (0.083) | (0.052) |
| ROE | 0.005 | -0.003 | 0.004 | 0.006 | -0.061** | -0.062*** | -0.026 | -0.026 | 0.002 |
| | (0.005) | (0.004) | (0.003) | (0.005) | (0.030) | (0.022) | (0.028) | (0.028) | (0.005) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | NO | NO | YES | YES | NO | NO | NO |
| Firm fixed effects | NO | NO | YES | YES | NO | NO | YES | YES | YES |
| Standard error cluster 1 | FIRM | FIRM | QTR | QTR | FIRM | FIRM | QTR | QTR | QTR |
| Standard error cluster 2 | QTR | QTR | - | - | QTR | QTR | - | - | - |
| Observations | 647,893 | 1,512,622 | 1,512,622 | 1,512,622 | 62,655 | 151,038 | 151,038 | 151,038 | 1,663,660 |
| R-squared (within) | 0.028 | 0.022 | 0.014 | 0.014 | 0.045 | 0.036 | 0.014 | 0.014 | 0.013 |

**Table IA6: Does the Extent of Gains Trading Differ among Life Firms in Different U.S. States? (Complete Version of Table 9)**

This table reports coefficient estimates for linear models of the probability that a life insurance company, domiciled in different U.S. states, will sell a corporate or government bond position. Included in the sample are life insurers whose RBC ratios are expected to drop by about 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., defined as the percentile rank of each bond position's unrealized gain in each insurer's portfolio, and its interactions with crisis dummy and high MTM dummy. High MTM dummy equals one for life insurers domiciled in U.S. states classified as being in the high MTM group under each of the three alternative definitions indicated in the column heading (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. Bond and other insurance control variables, as in Table 7, are included in all models but not reported for brevity. Full table is in the Internet Appendix. All variables are defined in Appendix D. Standard errors, either two-way clustered by insurer and calendar quarter or one-way clustered by calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

| | Crisis | | | All | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| Main variables | | | | | | |
| (1) Unrealized gain pct. | 0.026** | 0.027** | 0.028** | -0.023*** | -0.023*** | -0.021*** |
| | (0.012) | (0.013) | (0.013) | (0.005) | (0.005) | (0.005) |
| (1) x High MTM dummy | -0.017** | -0.017** | -0.017*** | -0.001 | -0.000 | -0.004 |
| | (0.007) | (0.008) | (0.005) | (0.004) | (0.004) | (0.003) |
| Crisis dummy x (1) | | | | 0.051*** | 0.052*** | 0.051*** |
| | | | | (0.012) | (0.013) | (0.013) |
| Crisis dummy x (1) x High MTM dummy | | | | -0.018** | -0.018** | -0.015*** |
| | | | | (0.007) | (0.007) | (0.005) |
| Related insurance characteristics | | | | | | |
| (2) Low RBC ratio dummy | 0.032*** | 0.032*** | 0.029*** | 0.010 | 0.010 | 0.009 |
| | (0.010) | (0.010) | (0.011) | (0.006) | (0.006) | (0.006) |
| (3) Revalue dummy | 0.091*** | 0.091*** | 0.091*** | 0.059*** | 0.059*** | 0.058*** |
| | (0.018) | (0.018) | (0.020) | (0.015) | (0.015) | (0.015) |
| Crisis dummy x (2) | | | | 0.012** | 0.013** | 0.011* |
| | | | | (0.006) | (0.006) | (0.005) |
| Crisis dummy x (3) | | | | 0.036 | 0.036 | 0.037 |
| | | | | (0.026) | (0.026) | (0.026) |
| Crisis dummy x High MTM dummy | | | | 0.016*** | 0.016*** | 0.016*** |
| | | | | (0.005) | (0.005) | (0.003) |
| Bond control variables | | | | | | |
| Corp dummy x ln(bond age) | -0.006*** | -0.006*** | -0.006** | -0.006*** | -0.006*** | -0.005*** |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) |
| Corp dummy x ln(maturity) | -0.012*** | -0.012*** | -0.014*** | -0.009*** | -0.009*** | -0.010*** |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) |

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| | Crisis | | | All | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| Corp dummy x ln(issue size) | 0.014*** | 0.014*** | 0.014*** | 0.010*** | 0.010*** | 0.010*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.000) | (0.001) |
| Corp dummy x Bankruptcy dummy | 0.287*** | 0.287*** | 0.281*** | 0.294*** | 0.294*** | 0.291*** |
| | (0.026) | (0.026) | (0.025) | (0.027) | (0.027) | (0.026) |
| Corp dummy x Downgrade dummy | 0.041** | 0.041** | 0.044*** | 0.078*** | 0.078*** | 0.077*** |
| | (0.017) | (0.017) | (0.017) | (0.022) | (0.022) | (0.021) |
| Gov dummy x ln(bond age) | -0.037*** | -0.037*** | -0.034*** | -0.034*** | -0.034*** | -0.033*** |
| | (0.009) | (0.009) | (0.007) | (0.005) | (0.005) | (0.005) |
| Gov dummy x ln(maturity) | -0.018*** | -0.018*** | -0.019*** | -0.018*** | -0.018*** | -0.018*** |
| | (0.004) | (0.004) | (0.005) | (0.003) | (0.003) | (0.003) |
| Other insurance control variables | | | | | | |
| ln(capital and surplus) | 0.003* | 0.003* | 0.003 | 0.009** | 0.010** | 0.010** |
| | (0.001) | (0.001) | (0.002) | (0.004) | (0.004) | (0.004) |
| % risky assets | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001* |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Leverage | 0.077** | 0.077** | 0.082** | 0.029 | 0.032 | 0.048 |
| | (0.032) | (0.032) | (0.039) | (0.051) | (0.051) | (0.054) |
| ROE | 0.005 | 0.005 | 0.003 | 0.004 | 0.004 | 0.002 |
| | (0.005) | (0.005) | (0.006) | (0.003) | (0.003) | (0.003) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| State fixed effects | YES | YES | YES | NO | NO | NO |
| Firm fixed effects | NO | NO | NO | YES | YES | YES |
| Standard error cluster 1 | FIRM | FIRM | FIRM | QTR | QTR | QTR |
| Standard error cluster 2 | QTR | QTR | QTR | - | - | - |
| Observations | 647,893 | 647,893 | 647,893 | 1,512,622 | 1,512,524 | 1,512,524 |
| R-squared (within) | 0.028 | 0.028 | 0.028 | 0.014 | 0.014 | 0.014 |

**Table IA7: Summary Statistics of Value-Weighted Average Duration and Maturity of Insurance Companies' Bond Portfolios**

This table presents summary statistics of the modified duration and maturity (both in years) of life and P&C insurance companies' bond portfolios. For each insurance company and each year-end, the duration (maturity) is calculated as the value-weighted average modified duration (maturity) of all identifiable bonds and ABS held by the company. Embedded options and prepayments are ignored for simplicity. Cross-sectional distribution statistics of the company-level bond portfolio duration and maturity are reported separately for life and P&C insurance companies.

| | | No. of | 10th Pct | | 25th Pct | | 50th Pct | | 75th Pct | | 90th Pct | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year | Firms | Duration | Maturity | Duration | Maturity | Duration | Maturity | Duration | Maturity | Duration | Maturity |
| Life | 2004 | 481 | 4.159 | 5.587 | 5.292 | 7.475 | 6.599 | 10.575 | 8.320 | 14.243 | 9.299 | 16.633 |
| | 2005 | 447 | 4.210 | 5.641 | 5.473 | 7.911 | 6.726 | 11.187 | 8.349 | 14.349 | 9.223 | 16.332 |
| | 2006 | 429 | 4.168 | 5.673 | 5.365 | 8.082 | 6.715 | 11.220 | 8.335 | 14.474 | 9.475 | 16.955 |
| | 2007 | 413 | 4.412 | 5.912 | 5.440 | 8.577 | 6.944 | 11.882 | 8.404 | 14.917 | 9.408 | 17.530 |
| | 2008 | 408 | 4.044 | 5.209 | 5.090 | 7.863 | 6.332 | 10.907 | 7.992 | 14.271 | 8.985 | 16.857 |
| | 2009 | 403 | 4.193 | 5.339 | 5.147 | 7.649 | 6.430 | 10.583 | 8.078 | 14.325 | 9.254 | 17.296 |
| | 2010 | 384 | 4.070 | 5.071 | 5.061 | 7.299 | 6.572 | 10.580 | 8.346 | 14.658 | 9.759 | 17.625 |
| Property & Casualty | 2004 | 1,151 | 2.632 | 3.148 | 3.541 | 4.478 | 4.618 | 6.295 | 5.843 | 8.457 | 6.934 | 10.738 |
| | 2005 | 1,132 | 2.593 | 3.173 | 3.532 | 4.470 | 4.465 | 6.161 | 5.587 | 8.393 | 6.725 | 10.728 |
| | 2006 | 1,132 | 2.507 | 2.934 | 3.417 | 4.265 | 4.352 | 6.083 | 5.606 | 8.486 | 6.892 | 11.585 |
| | 2007 | 1,173 | 2.534 | 2.956 | 3.473 | 4.388 | 4.555 | 6.456 | 5.834 | 9.210 | 7.147 | 12.543 |
| | 2008 | 1,240 | 2.610 | 2.901 | 3.394 | 4.110 | 4.327 | 5.883 | 5.482 | 8.457 | 6.689 | 11.150 |
| | 2009 | 1,224 | 2.552 | 2.890 | 3.274 | 3.937 | 4.212 | 5.472 | 5.241 | 7.441 | 6.518 | 10.021 |
| | 2010 | 1,215 | 2.294 | 2.587 | 3.189 | 3.891 | 4.052 | 5.043 | 5.195 | 7.132 | 6.599 | 9.725 |

**Table IA8: Robustness Checks for Differences between Life and P&C Firms (Complete Version of Table 10)**

This table reports main results in Tables 5 and 8 obtained in three subsamples, each of which includes only life and P&C firms with certain characteristics held to be approximately the same. Included in the starting sample are life and P&C insurers whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. From the starting sample, the subsample in column (1) includes only insurers that belong to a universal group with both life and P&C firms under the same umbrella. The subsample in column (2) includes only insurers whose portfolio durations are more than 4 but less than 7 years. Portfolio duration is the value-weighted average duration of all fixed income securities held by the insurer at the beginning of the year. The subsample in column (3) includes only insurers have ROE greater than 0.07 (rounded sample median) in each year. Panel A (complete version of Table 10 Panel A) reports all coefficient estimates of a linear model, similar to column (2) of Table 5 Panel B, of the probability that an ABS position is sold following an investment-to-non-investment downgrade of any tranche backed by the same asset pool as the ABS in question. Panel B (complete version of Table 10 Panel B) reports all coefficient estimates of a linear model, similar to column (9) of Table 8, of the probability that a corporate or government bond position is sold in each calendar quarter. All variables are defined in Appendix D. In both panels, insurance controls variables, e.g., ln(capital and surplus), % risky assets, Leverage, and ROE, are demeaned within each type of insurers. Standard errors clustered by state (Panel A) or by calendar quarter (Panel B) are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

*Panel A: ABS selling probability as in Column (2) of Table 5*

| | (1)<br>Universal Group | (2)<br>Same Duration | (3)<br>Same/High Profit |
|---|---|---|---|
| P&C dummy | 0.045*** | 0.058*** | 0.113*** |
| | (0.012) | (0.013) | (0.030) |
| Low RBC ratio dummy | 0.065*** | 0.004 | 0.034 |
| | (0.012) | (0.024) | (0.035) |
| Revalue dummy | 0.020 | 0.027 | 0.075 |
| | (0.040) | (0.031) | (0.051) |
| ln(tranche size) | 0.016** | -0.004 | 0.009 |
| | (0.006) | (0.006) | (0.010) |
| ln(capital and surplus) | 0.003 | -0.003 | 0.001 |
| | (0.004) | (0.004) | (0.006) |
| % risky assets | 0.000 | 0.000 | 0.001 |
| | (0.001) | (0.001) | (0.001) |
| Leverage | 0.010 | -0.029 | -0.078 |
| | (0.090) | (0.064) | (0.073) |
| ROE | 0.024 | -0.025 | 0.266** |
| | (0.032) | (0.019) | (0.117) |
| Rating group fixed effects | YES | YES | YES |
| Pool fixed effects | YES | YES | YES |
| Observations | 3,068 | 4,210 | 2,526 |
| R-squared | 0.022 | 0.014 | 0.031 |
| Number of pools | 1,159 | 1,450 | 1,059 |

*Panel B: Government and corporate bond selling probability as in Column (9) of Table 8*

| | (1) Universal Group | (2) Same Duration | (3) Same/High Profit |
|---|---|---|---|
| Main variables | | | |
| (1) Unrealized gain pct. | -0.034*** | -0.022*** | -0.027*** |
| | (0.010) | (0.006) | (0.005) |
| (1) x (2) | -0.006 | -0.013 | -0.001 |
| | (0.011) | (0.012) | (0.008) |
| (1) x P&C dummy | 0.024* | 0.019** | 0.025*** |
| | (0.013) | (0.009) | (0.008) |
| Crisis dummy x (1) | 0.042*** | 0.030*** | 0.028** |
| | (0.013) | (0.010) | (0.013) |
| Crisis dummy x (1) x (2) | 0.029* | 0.063*** | 0.021 |
| | (0.017) | (0.021) | (0.013) |
| Crisis dummy x (1) x P&C dummy | -0.033* | -0.030* | -0.026* |
| | (0.018) | (0.015) | (0.015) |
| Related insurance characteristics | | | |
| (2) Low RBC ratio dummy | 0.008 | 0.019 | 0.008 |
| | (0.011) | (0.011) | (0.007) |
| (3) Revalue dummy | 0.039*** | 0.039*** | 0.038*** |
| | (0.009) | (0.011) | (0.012) |
| Crisis dummy x (2) | -0.004 | -0.013 | -0.015* |
| | (0.011) | (0.013) | (0.008) |
| Crisis dummy x (3) | 0.013 | -0.029 | 0.006 |
| | (0.019) | (0.018) | (0.020) |
| Crisis dummy x P&C dummy | 0.025** | 0.023* | 0.011 |
| | (0.012) | (0.012) | (0.016) |
| Bond control variables | | | |
| Corp dummy x ln(bond age) | -0.009*** | -0.007*** | -0.005*** |
| | (0.001) | (0.001) | (0.001) |
| Corp dummy x ln(maturity) | -0.010*** | -0.005** | -0.007*** |
| | (0.003) | (0.002) | (0.002) |
| Corp dummy x ln(issue size) | 0.010*** | 0.009*** | 0.010*** |
| | (0.001) | (0.001) | (0.001) |
| Corp dummy x Bankruptcy dummy | 0.260*** | 0.305*** | 0.272*** |
| | (0.037) | (0.041) | (0.060) |
| Corp dummy x Downgrade dummy | 0.090*** | 0.089*** | 0.089*** |
| | (0.015) | (0.012) | (0.014) |
| Gov dummy x ln(bond age) | -0.038*** | -0.053*** | -0.042*** |
| | (0.005) | (0.006) | (0.005) |
| Gov dummy x ln(maturity) | -0.007* | -0.006 | -0.015*** |
| | (0.003) | (0.004) | (0.005) |
| Other insurance control variables | | | |
| ln(capital and surplus) | 0.029*** | 0.009 | 0.022 |
| | (0.006) | (0.007) | (0.014) |
| % risky assets | 0.001* | 0.000 | 0.001** |
| | (0.001) | (0.000) | (0.000) |
| Leverage | 0.006 | -0.004 | -0.098 |
| | (0.049) | (0.084) | (0.093) |
| ROE | -0.015** | 0.002 | 0.021** |
| | (0.006) | (0.004) | (0.009) |

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| | (1) Universal Group | (2) Same Duration | (3) Same/High Profit |
|---|---|---|---|
| Rating group fixed effects | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES |
| Firm fixed effects | YES | YES | YES |
| Observations | 700,175 | 790,291 | 1,204,181 |
| R-squared (within) | 0.015 | 0.013 | 0.012 |
| Number of firms | 158 | 217 | 285 |

**Table IA9: Risk and Liquidity of Equity Portfolio and Government Bond Portfolio (Complete Version of Table 11)**

This table reports OLS coefficient estimates for regressions of insurance companies' equity portfolio beta and Amihud ratios (Panel A) and the fraction of treasury notes/bonds in the government bond portfolio (Panel B) on crisis dummy, life dummy, and other firm characteristics. In Panel A, an insurer's equity portfolio consists of all non-affiliated common equity held at the end of each quarter from 2004 to 2010. The dependent variable in columns (1) to (3) is the value-weighted portfolio beta multiplied by 100. Individual stock beta is estimated by regressing the stock's daily return on CRSP value-weighted market return over a 2-year window up to the current-quarter end for each stock-quarter. A minimum of 60 trading days in the estimation window are required. The dependent variable in columns (4) to (6) is the log of value-weighted Amihud ratio of the portfolio multiplied by 100. For each stock-quarter, Amihud ratio is the average daily Amihud ratio over the quarter, where the daily Amihud ratio equals |return|/(volume x closing price/1,000,000). A minimum of 22 trading days in the estimation window are required. In Panel B, an insurer's government bond portfolio consists of treasury notes/bonds and other government bonds (e.g., guaranteed bonds issued by government agencies). The dependent variable is the fraction of treasury notes/bonds in the government bond portfolio at the end of each year, calculated using the bonds' book-adjusted carrying value (in columns (1) to (3)) or par value (in columns (4) to (6)). Treasury notes/bonds are distinguished from other government bonds using line number provided by the NAIC. Life dummy indicates a life insurer. Crisis dummy equals one for the periods from the third quarter of 2007 to the end of 2009 in Panel A and from 2007 to 2009 in Panel B. All variables are defined in Appendix D. Standard errors, clustered by insurance company, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

*Panel A: Common Stocks*

| | Beta x 100 | | | Log of Amihud Ratio x 100 | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | Life | P&C | All | Life | P&C | All |
| Crisis dummy | 2.730 | 3.930*** | 4.001*** | 1.114*** | 0.572*** | 0.582*** |
| | (2.011) | (0.705) | (0.708) | (0.372) | (0.147) | (0.146) |
| Life dummy | | | 2.309 | | | 1.316*** |
| | | | (2.123) | | | (0.423) |
| Life x Crisis dummy | | | -1.549 | | | 0.524 |
| | | | (2.124) | | | (0.404) |
| ln(capital and surplus) | 0.748 | 0.725* | 0.694* | 0.122 | 0.104 | 0.127 |
| | (0.941) | (0.414) | (0.373) | (0.252) | (0.075) | (0.087) |
| % risky assets | -0.155 | -0.075* | -0.076* | -0.010 | 0.008 | 0.005 |
| | (0.118) | (0.042) | (0.039) | (0.033) | (0.008) | (0.009) |
| Leverage | 9.152 | -5.594 | -0.435 | 3.100 | 2.182** | 2.447** |
| | (12.640) | (4.695) | (4.517) | (2.900) | (1.061) | (1.001) |
| ROE | -2.733 | -6.983* | -5.897* | 0.264 | 0.114 | 0.399 |
| | (4.492) | (3.813) | (3.219) | (1.316) | (0.705) | (0.975) |
| State fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 4,614 | 13,796 | 18,410 | 4,615 | 13,796 | 18,411 |
| R-squared | 0.090 | 0.054 | 0.041 | 0.117 | 0.048 | 0.064 |

*Panel B: Government Bonds*

| | Percentage of Treasury by Book-Adjusted Carrying Value | | | Percentage of Treasury by Par Value | | |
|---|---|---|---|---|---|---|
| | (1) Life | (2) P&C | (3) All | (4) Life | (5) P&C | (6) All |
| Crisis dummy | -0.009 | -0.015** | -0.016** | -0.010 | -0.015* | -0.016** |
| | (0.013) | (0.008) | (0.008) | (0.013) | (0.008) | (0.008) |
| Life dummy | | | -0.041*** | | | -0.040*** |
| | | | (0.012) | | | (0.012) |
| Life x Crisis dummy | | | 0.006 | | | 0.006 |
| | | | (0.016) | | | (0.016) |
| ln(capital and surplus) | 0.006 | 0.020*** | 0.015*** | 0.005 | 0.020*** | 0.014*** |
| | (0.004) | (0.003) | (0.002) | (0.004) | (0.003) | (0.002) |
| % risky assets | 0.001 | -0.001** | -0.000 | 0.001 | -0.001** | -0.000 |
| | (0.001) | (0.000) | (0.000) | (0.001) | (0.000) | (0.000) |
| Leverage | -0.275*** | -0.137*** | -0.200*** | -0.276*** | -0.138*** | -0.200*** |
| | (0.054) | (0.031) | (0.026) | (0.054) | (0.031) | (0.027) |
| ROE | -0.060** | -0.061** | -0.054*** | -0.062** | -0.060** | -0.055*** |
| | (0.027) | (0.029) | (0.019) | (0.027) | (0.029) | (0.020) |
| State fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 2,654 | 7,674 | 10,328 | 2,654 | 7,674 | 10,328 |
| R-squared | 0.140 | 0.101 | 0.095 | 0.144 | 0.099 | 0.094 |

**Table IA10: Impact of Gains Trading on Corporate Bond Returns (Complete Version of Table 13 and Robustness Checks Using Value-Weighted Average Unrealized Gain Percentile)**

This table reports OLS coefficient estimates for regressions of quarterly corporate bond return on gains-trading selling pressure, measured as equally-weighted (Panel A) and value-weighted (Panel B) average unrealized gain percentile. For each bond-quarter, the average is taken across insurers that have positions in the bond at the beginning of the quarter, have high ABS exposure (i.e., their RBC ratios are expected to drop by 0.4 or more due to actual ABS downgrades during the crisis), and belong to either the high MTM group or the low MTM group. In Columns (1) to (3), life (P&C) insurers are considered low (high) MTM institutions. In Columns (4) to (6), life insurers domiciled in high MTM states according to the baseline definition in Appendix C are considered high MTM institutions, and all others are considered low MTM institutions. To be included, a bond must be held by at least one low-MTM institution and at least one high-MTM institution at the beginning of the quarter. Quarterly corporate bond return is the log of change in price from the previous quarter to the current quarter, winsorized at the 2.5% and 97.5%. Treasury return is the logged return on maturity-matched Treasury bond/note, proxied by the interpolated constant maturity Treasury bond/note from the Fed. Spread return is the logged return on maturity- and rating-matched corporate bond index minus Treasury return. Corporate bond index return is calculated using Bank of America-Merrill Lynch bond index, adjusted for duration difference between the index and the bond in question. Bond controls include ln(bond age), ln(issue size), ln(maturity), downgrade dummy, and bankruptcy dummy but are not reported for brevity. Full table and a robustness check using value-weighted average unrealized gain percentile as a measure of gains-trading selling pressure are in the Internet Appendix. All variables are defined in Appendix D. Standard errors, two-way clustered by bond issuer and calendar quarter, are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

*Panel A: Equally-weighted average unrealized gain percentile (complete version of Table 13)*

| | All: Life (Low MTM Institutions) vs. P&C (High MTM Institutions) | | | Life Only: Low MTM States (Low MTM Institutions) vs. High MTM States (High MTM Institutions) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (1) Low MTM institutions' unrealized gain pct. | 0.010 | | 0.010 | 0.009 | | 0.007 |
| | (0.008) | | (0.008) | (0.007) | | (0.005) |
| Crisis dummy x (1) | -0.043*** | | -0.042*** | -0.040*** | | -0.029*** |
| | (0.015) | | (0.015) | (0.013) | | (0.009) |
| (2) High MTM institutions' unrealized gain pct. | | 0.005 | -0.000 | | 0.007 | 0.003 |
| | | (0.004) | (0.001) | | (0.006) | (0.003) |
| Crisis dummy x (2) | | -0.023*** | -0.002 | | -0.035*** | -0.013** |
| | | (0.008) | (0.002) | | (0.012) | (0.006) |
| Treasury return | 0.721*** | 0.724*** | 0.721*** | 0.652*** | 0.651*** | 0.651*** |
| | (0.048) | (0.047) | (0.048) | (0.057) | (0.057) | (0.057) |
| Spread return | 0.678*** | 0.697*** | 0.678*** | 0.603*** | 0.604*** | 0.602*** |
| | (0.063) | (0.059) | (0.063) | (0.060) | (0.059) | (0.060) |
| ln(bond age) | -0.008 | -0.029 | -0.010 | -0.065 | -0.050 | -0.056 |
| | (0.071) | (0.063) | (0.071) | (0.065) | (0.066) | (0.070) |
| ln(issue size) | 0.027 | 0.009 | 0.028 | 0.012 | 0.017 | 0.017 |
| | (0.154) | (0.147) | (0.154) | (0.160) | (0.161) | (0.162) |
| ln(maturity) | 0.041 | 0.072 | 0.044 | 0.011 | 0.013 | 0.011 |
| | (0.069) | (0.074) | (0.070) | (0.105) | (0.106) | (0.105) |

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| | All: Life (Low MTM Institutions) vs. P&C (High MTM Institutions) | | | Life Only: Low MTM States (Low MTM Institutions) vs. High MTM States (High MTM Institutions) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Downgrade dummy | -2.746** | -2.605* | -2.741** | -3.258*** | -3.239*** | -3.268*** |
| | (1.365) | (1.439) | (1.362) | (1.241) | (1.255) | (1.234) |
| Bankruptcy dummy | -8.362 | -8.554 | -8.372 | -11.550* | -11.461* | -11.509* |
| | (5.766) | (5.835) | (5.758) | (5.927) | (5.966) | (5.927) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| Wald test: (1) = (2) | | | 1.61 | | | 1.54 |
| Wald test: Crisis dummy x (1) = Crisis dummy x (2) | | | 6.72*** | | | 7.97*** |
| Observations | 51,345 | 51,345 | 51,345 | 86,153 | 86,153 | 86,153 |
| R-squared | 0.416 | 0.411 | 0.416 | 0.386 | 0.384 | 0.386 |
| Number of issuers | 1,799 | 1,799 | 1,799 | 2,423 | 2,423 | 2,423 |

*Panel B: Value-weighted average unrealized gain percentile*

| | All: Life (Low MTM Institutions) vs. P&C (High MTM Institutions) | | | Life Only: Low MTM States (Low MTM Institutions) vs. High MTM States (High MTM Institutions) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| (1) Low MTM institutions' unrealized gain pct. | 0.008 | | 0.008 | 0.007 | | 0.005 |
| | (0.006) | | (0.006) | (0.006) | | (0.004) |
| Crisis dummy x (1) | -0.033*** | | -0.030*** | -0.032*** | | -0.022*** |
| | (0.012) | | (0.011) | (0.011) | | (0.007) |
| (2) High MTM institutions' unrealized gain pct. | | 0.004 | -0.000 | | 0.006 | 0.002 |
| | | (0.004) | (0.001) | | (0.005) | (0.003) |
| Crisis dummy x (2) | | -0.020*** | -0.004** | | -0.028*** | -0.013*** |
| | | (0.007) | (0.002) | | (0.010) | (0.005) |
| Treasury return | 0.720*** | 0.724*** | 0.721*** | 0.651*** | 0.650*** | 0.650*** |
| | (0.049) | (0.047) | (0.048) | (0.057) | (0.057) | (0.057) |
| Spread return | 0.680*** | 0.697*** | 0.681*** | 0.604*** | 0.605*** | 0.602*** |
| | (0.062) | (0.059) | (0.062) | (0.060) | (0.059) | (0.060) |
| ln(bond age) | 0.005 | -0.024 | -0.001 | -0.063 | -0.038 | -0.046 |
| | (0.072) | (0.062) | (0.072) | (0.065) | (0.069) | (0.071) |
| ln(issue size) | 0.020 | 0.010 | 0.022 | 0.005 | 0.015 | 0.014 |
| | (0.153) | (0.147) | (0.153) | (0.160) | (0.161) | (0.162) |
| ln(maturity) | 0.049 | 0.071 | 0.056 | 0.017 | 0.018 | 0.018 |
| | (0.071) | (0.074) | (0.072) | (0.106) | (0.107) | (0.106) |
| Downgrade dummy | -2.705* | -2.606* | -2.697* | -3.215** | -3.221** | -3.235*** |
| | (1.383) | (1.439) | (1.377) | (1.257) | (1.263) | (1.247) |
| Bankruptcy dummy | -8.417 | -8.584 | -8.444 | -11.515* | -11.479* | -11.484* |
| | (5.808) | (5.828) | (5.793) | (5.955) | (5.986) | (5.954) |

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| | All: Life (Low MTM Institutions) vs. P&C (High MTM Institutions) | | | Life Only: Low MTM States (Low MTM Institutions) vs. High MTM States (High MTM Institutions) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| Wald test: (1) = (2) | | | 2.08 | | | 0.85 |
| Wald test: Crisis dummy x (1) = Crisis dummy x (2) | | | 5.96** | | | 3.71* |
| Observations | 51,345 | 51,345 | 51,345 | 86,153 | 86,153 | 86,153 |
| R-squared | 0.414 | 0.410 | 0.414 | 0.385 | 0.384 | 0.385 |
| Number of issuers | 1,799 | 1,799 | 1,799 | 2,423 | 2,423 | 2,423 |

**Table IA11: Validity of Within-Life Results for Large Firms and Public Firms**

This table reports within-life results in Tables 5 and 9 obtained in three subsamples of large life insurers (column (1)) and public life insurers (column (2)). Included in the starting sample are life insurers whose RBC ratios are expected to drop by about 0.4 or more due to actual ABS downgrades during the crisis. From the starting sample, large life insurers are those with invested assets greater than the median each year and public insurers are those whose stocks are publicly listed or those that belong to a universal group with at least one firm in the group having publicly listed stocks. Panel A reports all coefficient estimates of a linear model, similar to columns (3)-(5) of Table 5 Panel B, of the probability that an ABS position is sold following an investment-to-non-investment downgrade of any tranche backed by the same asset pool as the ABS in question. Panel B reports all coefficient estimates of a linear model, similar to columns (4)-(6) of Table 9, of the probability that a corporate or government bond position is sold in each calendar quarter. High MTM dummy equals one if the life insurer is domiciled in a U.S. state classified as being in the high MTM group under each of the three alternative classifications as indicated in the column heading (Baseline, Alternative 1, and Alternative 2). These classifications are defined in Appendix C. All variables are defined in Appendix D. Standard errors clustered by state (Panel A) or by calendar quarter (Panel B) are in parentheses. *, **, and *** refer to statistical significance at 10%, 5%, and 1% levels.

*Panel A: ABS selling probability as in Columns (3)-(5) of Table 5*

| | Large Firms | | | Public Firms | | |
|---|---|---|---|---|---|---|
| | Definition for "High MTM Dummy" | | | Definition for "High MTM Dummy" | | |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| High MTM dummy | 0.020** | 0.016* | 0.026*** | 0.033* | 0.035** | 0.061*** |
| | (0.009) | (0.009) | (0.008) | (0.017) | (0.015) | (0.010) |
| Low RBC ratio dummy | 0.081*** | 0.082*** | 0.093*** | 0.097*** | 0.099*** | 0.119*** |
| | (0.022) | (0.023) | (0.025) | (0.021) | (0.021) | (0.017) |
| Revalue dummy | 0.075*** | 0.076*** | 0.069** | 0.030 | 0.029 | 0.019 |
| | (0.027) | (0.027) | (0.028) | (0.036) | (0.036) | (0.035) |
| Tranche offering amount | 0.003 | 0.003 | 0.004 | -0.001 | -0.001 | -0.001 |
| | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| ln(capital and surplus) | 0.001 | 0.002 | -0.001 | -0.011 | -0.010 | -0.012 |
| | (0.003) | (0.003) | (0.003) | (0.011) | (0.011) | (0.011) |
| % risky assets | -0.000 | -0.000 | -0.000 | -0.000 | -0.001 | -0.000 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.002) | (0.002) |
| Leverage | 0.129 | 0.131 | 0.163** | 0.483** | 0.472** | 0.578*** |
| | (0.082) | (0.082) | (0.073) | (0.178) | (0.175) | (0.141) |
| ROE | 0.022 | 0.024 | 0.026 | 0.030 | 0.031 | 0.019 |
| | (0.021) | (0.021) | (0.020) | (0.035) | (0.035) | (0.035) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Pool fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 7,451 | 7,451 | 7,375 | 3,342 | 3,342 | 3,342 |
| R-squared | 0.022 | 0.022 | 0.024 | 0.036 | 0.036 | 0.044 |
| Number of pools | 1,927 | 1,927 | 1,923 | 1,229 | 1,229 | 1,229 |

**Table IA11, Cont'd: Validity of Within-Life Results for Large Firms and Public Firms**

*Panel B: Government and corporate bond selling probability as in Columns (4)-(6) of Table 9*

| | Large Firms | | | Public Firms | | |
|---|---|---|---|---|---|---|
| | Definition for "High MTM Dummy" | | | Definition for "High MTM Dummy" | | |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Main variables | | | | | | |
| (1) Unrealized gain pct. | -0.024*** | -0.024*** | -0.023*** | -0.025*** | -0.026*** | -0.022*** |
| | (0.005) | (0.005) | (0.005) | (0.007) | (0.007) | (0.007) |
| (1) x High MTM dummy | -0.001 | -0.001 | -0.003 | 0.003 | 0.004 | -0.006 |
| | (0.004) | (0.004) | (0.003) | (0.008) | (0.008) | (0.007) |
| Crisis dummy x (1) | 0.051*** | 0.053*** | 0.054*** | 0.062*** | 0.064*** | 0.060*** |
| | (0.012) | (0.013) | (0.013) | (0.014) | (0.015) | (0.015) |
| Crisis dummy x (1) x | -0.016** | -0.016** | -0.017*** | -0.030** | -0.032** | -0.021** |
| High MTM dummy | (0.007) | (0.008) | (0.005) | (0.012) | (0.012) | (0.010) |
| Related insurance characteristics | | | | | | |
| (2) Low RBC ratio dummy | 0.013* | 0.013* | 0.012* | 0.022 | 0.022 | 0.019 |
| | (0.007) | (0.007) | (0.007) | (0.013) | (0.013) | (0.013) |
| (3) Revalue dummy | 0.074*** | 0.074*** | 0.074*** | 0.090*** | 0.090*** | 0.090*** |
| | (0.017) | (0.017) | (0.017) | (0.027) | (0.027) | (0.027) |
| Crisis dummy x (2) | 0.011 | 0.012* | 0.009 | 0.017 | 0.017 | 0.012 |
| | (0.007) | (0.007) | (0.006) | (0.010) | (0.010) | (0.009) |
| Crisis dummy x (3) | 0.028 | 0.028 | 0.028 | -0.001 | -0.001 | 0.004 |
| | (0.029) | (0.029) | (0.029) | (0.041) | (0.041) | (0.041) |
| Crisis dummy x | 0.015** | 0.016*** | 0.016*** | 0.029*** | 0.029*** | 0.021*** |
| High MTM dummy | (0.006) | (0.005) | (0.003) | (0.009) | (0.009) | (0.007) |
| Bond control variables | | | | | | |
| Corp dummy x ln(bond age) | -0.005*** | -0.005*** | -0.005*** | -0.009*** | -0.009*** | -0.009*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.002) |
| Corp dummy x ln(maturity) | -0.009*** | -0.009*** | -0.010*** | -0.009*** | -0.009*** | -0.010*** |
| | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) | (0.002) |
| Corp dummy x ln(issue size) | 0.011*** | 0.011*** | 0.011*** | 0.013*** | 0.013*** | 0.013*** |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| Corp dummy x | 0.309*** | 0.309*** | 0.305*** | 0.297*** | 0.297*** | 0.288*** |
| Bankruptcy dummy | (0.028) | (0.028) | (0.028) | (0.045) | (0.045) | (0.045) |
| Corp dummy x | 0.076*** | 0.076*** | 0.074*** | 0.087*** | 0.087*** | 0.082*** |
| Downgrade dummy | (0.022) | (0.022) | (0.021) | (0.024) | (0.024) | (0.022) |
| Gov dummy x ln(bond age) | -0.042*** | -0.042*** | -0.041*** | -0.060*** | -0.060*** | -0.057*** |
| | (0.006) | (0.006) | (0.006) | (0.010) | (0.010) | (0.009) |
| Gov dummy x ln(maturity) | -0.023*** | -0.023*** | -0.024*** | -0.028*** | -0.028*** | -0.028*** |
| | (0.004) | (0.004) | (0.004) | (0.007) | (0.007) | (0.007) |

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| | Large Firms | | | Public Firms | | |
|---|---|---|---|---|---|---|
| | Definition for "High MTM Dummy" | | | Definition for "High MTM Dummy" | | |
| | Baseline | Alternative 1 | Alternative 2 | Baseline | Alternative 1 | Alternative 2 |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Other insurance control variables | | | | | | |
| ln(capital and surplus) | 0.011*** | 0.011*** | 0.011*** | 0.005 | 0.005 | 0.009 |
| | (0.004) | (0.004) | (0.004) | (0.006) | (0.006) | (0.005) |
| % risky assets | 0.000 | 0.000 | 0.000 | 0.001 | 0.000 | 0.001 |
| | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Leverage | 0.030 | 0.034 | 0.060 | 0.041 | 0.043 | 0.058 |
| | (0.071) | (0.070) | (0.074) | (0.164) | (0.165) | (0.159) |
| ROE | 0.002 | 0.003 | 0.002 | 0.009 | 0.009 | 0.009 |
| | (0.003) | (0.003) | (0.003) | (0.008) | (0.008) | (0.008) |
| Rating group fixed effects | YES | YES | YES | YES | YES | YES |
| Calendar quarter fixed effects | YES | YES | YES | YES | YES | YES |
| Firm fixed effects | YES | YES | YES | YES | YES | YES |
| Observations | 1,363,918 | 1,363,918 | 1,363,918 | 676,482 | 676,482 | 676,482 |
| R-squared (within) | 0.015 | 0.015 | 0.015 | 0.017 | 0.017 | 0.016 |
| Number of firms | 128 | 128 | 128 | 64 | 64 | 64 |