The Removal of Credit Ratings From Capital Regulation: Implications For Systemic Risk

Kathleen Weiss Hanley*
University of Maryland

Stanislava Nikolova
University of Nebraska-Lincoln

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Abstract

We examine whether removing references to credit ratings from regulations, as mandated by the Dodd-Frank Act, affects the transmission of systemic risk through the asset liquidation channel. We analyze an initiative to reduce reliance on ratings for capital adequacy assessment in the insurance industry and its effect on insurers' investment and financing decisions. After the change, insurers are less likely to repair regulatory capital by selling distressed MBS, gains trading corporate bonds, or raising external capital. However, the new regime allows insurers to purchase more low-rated MBS. Thus, the initiative may limit systemic risk transmission through the asset liquidation channel, but at the expense of more risk-taking than prudential regulators may prefer.

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The Council has considered the potential effects on other large financial firms of Prudential's asset fire sales based on the size, leverage, asset composition, and liquidity of Prudential's assets. A forced liquidation of a significant portion of Prudential's assets, possibly including separate account assets, could cause significant disruptions to key markets including *corporate debt and asset-backed securities markets*, particularly during a period of overall stress in the financial services industry and in a weak macroeconomic environment when liquidity dries up and price swings can be magnified. (emphasis added)[1]

I. Introduction

In 2008 and 2009, credit rating agencies downgraded a substantial number of Residential Mortgage Backed Securities (RMBS) and Commercial Mortgage-Backed Securities (CMBS) from investment grade to non-investment grade, arguably the largest deterioration of credit quality of any asset class in history (see the Report to Congress on Risk Retention, Board of Governors of the Federal Reserve System). Financial institutions, whose capital requirements are largely determined by the credit rating of the assets they hold, were particularly affected by these downgrades. Their attempts to manage the depletion of regulatory capital spread the negative effects of the downgrades through the financial system. In response, through Section 939 of the Dodd-Frank Act, Congress mandated that regulatory agencies remove references to credit ratings from financial regulations "because of the systemic importance of credit ratings and the reliance placed on credit ratings by individual and institutional investors and financial regulators."[2] However, the Act provided little guidance on what methodology and tradeoffs should be considered when determining an appropriate substitute for credit ratings.

In this paper, we examine an initiative by the National Association of Insurance Commissioners (NAIC) to no longer rely on credit ratings in the determination of required

[1] Basis for the Financial Stability Oversight Council's Final Determination Regarding Prudential Financial, Inc. http://www.treasury.gov/initiatives/fsoc/Documents/SIFI%20NPR%20--%20FR.pdf

[2] See Subtitle C, Dodd-Frank Wall Street Reform and Consumer Protection Act stating the motivation behind Section 939 to be "the systemic importance of credit ratings and the reliance placed on credit ratings by individual and institutional investors and financial regulators."

capital and accounting treatment of only those securities most affected by the credit-rating downgrades: RMBS and CMBS. During 2008-2009, insurers faced large increases in required capital as approximately 34% of the par value of RMBS and 7% of the par value of CMBS they held fell to non-investment grade. To make matters worse, insurers who did not expect to recover all of the amortized cost of the downgraded securities were required to recognize these expected losses through write-downs, thus decreasing their actual capital by almost $27 billion by the end of 2009.[3] Collectively, these actions resulted in a double hit to insurers' primary measure of capital adequacy, the risk-based capital (RBC) ratio, which is the ratio of actual to required capital. This double penalty placed enormous strain on insurer balance sheets at a time of severe market stress.

The academic literature has shown that capital constrained insurers attempt to improve their RBC ratios primarily by rebalancing their investment portfolios. Specifically, they tend to sell downgraded securities in order to reduce required capital and increase actual capital by replacing high capital charge securities with either investment grade securities or cash. For example, Ellul, Jotikasthira and Lundblad (2011), hereafter abbreviated as EJL (2011), present evidence that insurance companies that are more capital constrained are more likely to sell downgraded bonds. Ambrose, Cai and Helwege (2008) find that insurance companies engage in greater selling

[3] In 2009, the NAIC amended SSAP 43 (43R) to update the treatment of Other-Than-Temporary-Impairment (OTTI) for loan-backed and structured securities. The recently adopted SSAP No. 43R may require insurers to recognize a loss on loan-backed securities even if such insurers have the intent and ability to hold such securities to maturity. "If the insurer, *irrespective of the initial SVO determination on amortized cost*, does not expect to recover the entire amortized cost from the present value of the security's future cash flows, it cannot assert it has the ability to recover the security's amortized cost even though it has no intent to sell and has the intent and ability to retain. The security is therefore other-than-temporarily impaired. A realized loss is recognized for the non-interest-related decline, which is the difference between the security's amortized cost and the present value of cash flows expected to be collected. In addition, subsequent to an OTTI write-down, if there is a significant increase in the cash flows expected or actually collected, an insurer should make a prospective adjustment to the amortization curve for the security." This guidance mitigates, to some extent, the preferential accounting treatment afforded life insurers. For additional information on differences in accounting treatment between life and P&C insurers see Ellul, Jotikasthira, Lundblad and Wang (2013a) and Ellul, Jotikasthira, Lundblad and Wang (2013b).

activity in junk bonds around the time of the downgrade than in comparable bonds that are not downgraded. In the asset-backed securities market, Maconi, Massa and Yasuda (2012) show that among insurance companies, only firms close to or below a certain risk-based capital threshold engage in selling securitized bonds.

However, the need to sell distressed securities creates downward price pressure which may spillover to other entities and increases the transmission of systemic risk. Such price pressure is documented for downgraded corporate bonds by EJL (2011), who show that bonds subject to a high probability of regulatory-induced selling exhibit significant price declines and subsequent reversals. By controlling for characteristics of each RMBS sold, Merrill, Nadauld, Stulz and Sherland (2012) find that insurers facing regulatory capital constraints sell credit-impaired assets at much lower prices than other insurers. Price pressure effects, however, may not be limited to distressed securities, since capital may also be replenished by selling securities with unrealized gains. Ellul, Jotikasthira, Lundblad and Wang (2013a), hereafter abbreviated as EJLW (2013a), show that during the crisis, life insurers with greater exposure to asset-backed securities were more likely to gains trade corporate bonds, which depressed these bonds' prices.

The incentive to sell securities may depend in part on the accounting treatment afforded certain types of insurers. P&C insurers are typically required to hold investment grade securities at amortized cost and non-investment grade securities at fair value, while life insurers are allowed to hold most securities at amortized cost. This differential accounting treatment may steer P&C insurers' towards more prudent investment choices ex ante, but may also affect their response to downgrades ex post. Indeed, Ellul, Jotikasthira, Lundblad, and Wang (2013b) find that leading up to the crisis P&C insurers did not increase their holdings of ABS and non-investment grade bonds as much as life insurers did. In addition, both Merrill et al. (2012) and

EJLW (2013a) find evidence that trading behavior differs by insurer type. P&C insurers are more likely to sell downgraded securities to shore up capital, while life insurers are more likely to gains trade.

In order to respond to the impact on insurers' balance sheets of RMBS and CMBS downgrades and to alleviate the need to sell securities in a distressed market, the National Association of Insurance Commissioners (NAIC) changed its capital assessment methodology in two ways. First, it removed credit ratings as the measure of expected loss and substituted potentially more precise numerical expected loss estimates from PIMCO for RMBS in 2009 and BlackRock for CMBS in 2010. Because there is now only one provider of valuations, because the valuation provider is not paid by issuers, and because these valuations are less coarse than ratings, the change may mitigate some of the adverse consequences of using credit ratings such as ratings shopping (Benmelech and Dlugosz (2009), Skreta and Veldcamp (2009), Becker and Milbourn (2011), Bolton, Freixas and Shapiro (2012), and Griffin and Tang (2013) to name a few) and regulatory arbitrage (Acharya and Richardson (2009), Calomiris and Mason (2010), White (2010), Cornaggia, Cornaggia and Hund (2012), Opp, Opp and Harris (2012) and Stanton Wallace (2012)).

Second, the NAIC removed the double penalty of a security downgrade on an insurer's RBC ratio by recognizing that the security's expected loss depends on its carrying value.[4] The use of credit ratings to calculate capital implicitly assumes that the expected loss of a security is relative to its (amortized) par value. If insurers hold a security at values lower than amortized par, either because of fair value accounting or impairments to the carrying value, for example, the use of

[4] Carrying value refers to the book adjusted carrying value of a security in an insurer's asset portfolio. The book adjusted carrying value equals either the security's amortized cost or its fair value as determined by actual accounting rules. Actual capital refers to insurers' economic capital reported using actual accounting rules rather than Generally Accepted Accounting Principles (GAAP).

credit ratings may overstate an individual insurer's capital need to protect against an expected loss on the security. We estimate that this change in the methodology of determining required and actual capital saved insurers $4.8 billion in regulatory capital.[5] However, these capital savings came at a cost to insurers. In 2008 and 2009 alone, insurance companies impaired the book value of these securities, either through Other-Than-Temporary Impairments or unrealized losses, by $30 billion dollars.

Using Schedule D insurance filings for over 4,000 individual insurance companies we examine whether the NAIC's decision to remove references to credit ratings and to change the methodology for calculating capital on insurers' holdings of RMBS and CMBS reduces the systemic risk effects of forced asset liquidation: one of three transmission channels of systemic risk identified by the Financial Stability Oversight Council in designating non-bank systemically important institutions.[6] We find that the probability of selling downgraded RMBS and CMBS securities is reduced after the regulatory change and insurance companies with the largest amount of risk-based capital (RBC) saved have the largest reduction. We document a similar effect on the probability of gains trading corporate bonds after the regulatory change.

[5] In justifying the change in the method of calculating capital for RMBS in 2009, the NAIC stated "Regulators' goal in adopting the new RMBS process was to increase the accuracy in assessing expected losses, and to use the improved assessment to determine a more appropriate capital requirement for RMBS. The new approach reduces regulatory reliance on rating agencies, and allows for greater regulatory input into the modeling process and the assumptions used. In addition, it links the capital requirement to the carrying values for each specific insurer, instead of treating every investment the same. This new process thus allows for a more precise assessment of expected loss and capital need for individual insurers, benefiting consumers and the insurance market." (http://www.naic.org/rmbs/impact.pdf)

[6] The interpretive guidance also describes three channels the Council believes are most likely to impact firms and markets, thereby posing a threat to U.S. financial stability: (i) exposure of creditors, counterparties, investors, or other market participants to a nonbank financial company; (ii) *disruptions caused by the liquidation of a nonbank financial company's assets*; and (iii) the inability or unwillingness of a nonbank financial company to provide a critical function or service relied upon by market participants and for which there are no ready substitutes. (emphasis added) Financial Stability Oversight Council 12 CFR Part 1310 "Authority to Require Supervision and Regulation of Certain Nonbank Financial Companies," http://www.treasury.gov/initiatives/fsoc/documents/nonbank%20designations%20-%20final%20rule%20and%20guidance.pdf

Replicating the analysis of EJLW (2013a), we show that life insurers, in particular, are significantly less likely to gains trade after the NAIC adopts the new regulations. Thus, the shift to a two dimensional valuation-based methodology for determining capital charges and accounting treatment lowered the potential for price pressure in the market for both mortgage-backed securities and corporate bonds potentially alleviating systemic risk due to asset liquidation.

In addition to the selling of distressed securities and gains trading, insurers may also repair regulatory capital by raising external capital. Koijen and Yogo (2013) and Berry-Stölzle, Nini and Wende (2013) show that life insurers that are affected by losses in variable annuity contracts are more likely to fire-sell policies and raise external financing to shore up regulatory capital. We examine whether the regulatory change affected insurers' financing behavior. The results differ depending on the type of insurer. Life insurers are less likely to raise additional capital the larger their RBC savings.

One consequence of the regulatory change is that insurance companies are no longer penalized by increased capital requirements if they purchase lower rated securities in the secondary market. Depending on the price paid, insurers can now buy mortgage-backed securities at below par and hold lower capital than previously. We find evidence that insurers take advantage of this as the credit quality of RMBS and CMBS secondary-market purchases is worse after the adoption of the new methodology. In addition, insurers with the largest regulatory-capital savings have the highest proportion of secondary market purchases composed of non-investment grade RMBS. One benefit to allowing insurance companies to purchase downgraded RMBS and CMBS is that their purchases can alleviate price pressure from sellers in times of market stress.

However, this benefit must be weighed against the possible incentive to reach for yield by purchasing lower credit quality debt. For example, under the prior rating-based regime, Becker and Ivashina (2013) document yield chasing in corporate bonds because credit ratings are coarse (Goel and Thakor (2013)). Coarseness allows heterogeneity in risk among different securities within a rating category which, in turn, enables insurers to purchase securities at the risky end of the spectrum. The new methodology expands insurance companies' opportunities for yield-chasing beyond the investment-grade range by reducing their penalty to holding sufficiently impaired below-investment-grade securities.

Indeed, Becker and Opp (2014) argue that the new rating system leaves insurers undercapitalized, particularly for purchases of non-investment grade RMBS and CMBS securities, because the amount of required capital does not provide a sufficient buffer against future losses. Thus, our findings can help inform regulatory agencies of the potential consequences of replacing ratings with other methodologies that characterize credit risk. While the new methodology provides benefits in the form of reduced selling pressure and thus lower systemic risk, we caution financial regulators to try to mitigate the incentive to chase yield when proposing any regulations that shift from using credit ratings to using valuation models for regulatory purposes.

The remainder of the paper is organized as follows: A discussion of NAIC capital requirements and our hypotheses is presented in Section II. Data sources and sample construction are described in Section III. We analyze the implications of the NAIC regulatory change for required and actual capital savings in Section IV. We examine the effect of these savings on asset sales in Sections V, on equity issuance in Section VI, and on secondary-market purchases in Section VII. The paper concludes in Section VIII.

II. The Change in NAIC Regulatory Capital Requirements and Hypotheses

Although risk-based capital requirements for insurance companies depend on a number of factors, the credit risk of their investment portfolio is the main determinant of capital adequacy. This credit risk is assessed by the NAIC's Securities Valuation Office (SVO), which assigns each security in an insurer's portfolio an SVO designation with higher designations implying greater expected losses. The SVO designation of a security is, in turn, used to determine (1) the accounting treatment an insurer must afford the security (i.e. report it at historical amortized cost or fair value), and (2) the amount of capital an insurer must hold to cover expected (credit) losses on the security.[7] As Table 1 shows, the higher the SVO designation of a security, the higher the required capital charge it carries and the more likely it is to be reported at fair value. Thus, a security's SVO designation directly impacts an insurer's required and actual capital, and therefore, the insurer's primary measure of capital adequacy, the ratio of actual to required capital referred to as the RBC ratio.

Prior to 2009 SVO designations for all fixed-income securities held in an insurer's portfolio were based on NRSRO credit ratings as shown below.[8]

SVO	NRSRO Credit Rating (Using S&P Letter Ratings)
1	A- and above
2	BBB+, BBB, BBB-
3	BB+, BB, BB-
4	B+, B, B-
5	CCC+, CCC, CCC-
6	CC, C, D

[7] The level of required capital is based on the expected loss of a security as measured by either credit ratings or the new valuation methodology and should not be interpreted as minimum required capital. It is important to note that insurers with RBC ratios below 2 are subject to supervisory interventions (EJL (2011)), and therefore, insurers must hold at least twice the amount of required capital as a potential cushion against expected and unexpected losses.

[8] Banks' risk-based capital on asset-backed securities is also determined by credit ratings and the level of capital is higher than that required by the NAIC. http://www.fdic.gov/regulations/resources/call/crinst/302rc-r.pdf

Using credit ratings to assess expected losses implicitly assumes that for capital adequacy purposes the relevant benchmark for these losses is a security's amortized par value. Thus, an insurer who purchases a distressed security at a steep discount faces the same capital charge and accounting treatment as one who purchases it at par and happens to hold it when it becomes distressed.

This approach to calculating capital charges and assigning accounting treatment was discontinued in 2009 for RMBS and 2010 for CMBS. First, the NAIC replaced credit ratings as an indicator of expected losses relative to par with potentially more precise numerical estimates in the form of intrinsic values. Intrinsic values are provided by PIMCO for RMBS and BlackRock for CMBS, and intuitively represent the value of each security after accounting for expected principal losses.[9] Second, the NAIC began using the difference between the intrinsic value and the book value of the security in determining the amount of capital to be held. The larger the difference between a security's intrinsic value and its current value on an insurer's books, the higher the insurer's expected losses and therefore the higher the security's SVO designation. For example, if the intrinsic value of a security is $70 on $100 par value and an insurer carries it at $75, the amount of required capital for the security will likely be low because expected losses given default are low. On the other hand, if an insurer carries the same security at $95, more capital will be required because expected losses are high. Therefore, under the new regime, insurers who hold downgraded assets at amortized cost or fair value that is in excess of the intrinsic value, face a cost-benefit tradeoff between writing down the book value of the

[9] The NAIC makes it clear that intrinsic values are meant to be different from market prices. Furthermore, since intrinsic values do not account for other risks that an investor in RMBS/CMBS may face (e.g. liquidity), they are typically higher than market prices.

security and saving required capital, or holding the security at amortized cost/fair value and having higher required capital.

Under the new regime the accounting treatment of a security is also based on its intrinsic value. The determination of whether an insurer must carry it at amortized cost of fair value is now more complicated (see Appendix A for a detailed example), with the important outcome that a security's accounting treatment can now be different from its treatment under the credit-rating regime.[10] This aspect of the regulatory change is particularly relevant to P&C insurers who are required to hold securities with SVO designations in the 3-6 range at fair value. In fact, in the first year of the new regulations 68% of P&C insurers' regulatory capital savings were the result of beneficial accounting treatment (the movement from fair value to amortized cost) and not to lower capital charges.

In sum, we predict that the change from a credit rating-based to a valuation-based method of determining regulatory capital and accounting treatment for mortgage-backed securities will lessen the need for insurers' to engage in strategies to repair their RBC ratio by either increasing actual capital (gains trading/capital issuance) or decreasing required capital (selling distressed securities) in a way that is consistent with lowering systemic risk. However, the new methodology removes one regulatory friction associated with the purchase of downgraded securities and allows insurers the ability to purchase distressed securities below par without incurring high capital charges. We expect that this will create an incentive for insurers to increase their purchases of downgraded securities in the secondary market. We examine the validity of these predictions by testing the following hypotheses:

[10]As the detailed example in Appendix A shows, the new approach to determine required and actual capital of insurers is much more complicated than the old one. Thus, the findings of our paper also contribute to the growing literature on whether regulatory complexity and sophistication is preferable to simpler oversight regimes (see Glaeser and Shleifer (2001), Hakenes and Schnabel (2013), and Behn, Haselmann and Vig (2014) among others).

H1: The probability of selling downgraded securities and gains trading corporate bonds should decline after the change and this decline should be larger for insurers with larger regulatory capital savings.

H2: The probability that an insurer will need to raise external funds should decline after the regulatory change and this decline should be larger for insurers with larger regulatory capital savings.

H3: Removing credit ratings from capital requirements eliminates a costly friction that prevents insurers from purchasing low-rated securities in the secondary market. Thus, purchases of low-rated securities should increase after the regulatory change and this increase should be larger for insurers with larger regulatory capital savings.

III. Data

We test the above hypotheses using data from four main databases: Schedule D insurance filings with the NAIC, S&P's RatingXpress, Mergent's Fixed Income Securities Database (FISD), and Thomson Reuter's SDC Platinum. Annual financial-statement information on insurance companies comes from their statutory filings with the NAIC.[11] Information on end-of-year holdings is collected from Schedule D, Part 1. Information on sales and purchases comes from transactions reported in Schedule D, Parts 3, 4 and 5.[12] For each insurer, holding and transaction information is available at the individual security (9-digit CUSIP) level. In some of our analysis, we use end-of-quarter holdings, which we infer from reported annual holdings and from information on securities acquired or disposed of during a quarter. Appendix B provides additional information on the variables used in our analyses.

[11] Our findings are robust to excluding from the sample companies that predominantly provide financial, mortgage and other credit guarantees. We define these as P&C companies whose premiums underwritten from these lines of business constitute at least 90% of total premiums underwritten. There are 98 such companies during our sample period.

[12] We identify purchases and sales using transactions rather than holdings data, as in Becker and Opp (2014), for three reasons. First, transaction data allows us to disregard changes in holdings that come from maturity, repayment, calls and other non-trading activity. These non-trading reductions in holdings constitute close to half of all reported reductions. Second, using transactions allows us to capture trades in securities purchased and then sold within the same year, since such transactions will leave holdings unaffected. Finally, changes in the book value of reported holdings may also come from impairments in the value of securities.

For each security held or traded we identify, the most recent S&P credit rating from RatingXpress.[13] We gather other security characteristics (e.g. age, remaining maturity, and issuance size) from Mergent's FISD for corporate bonds, and S&P RatingXpress and NAIC Schedule D for RMBS/CMBS. Our sample period is from year end 2004 to year end 2012.

To categorize insurance company holdings into different asset classes, we pull information from four different sources. First, we identify RMBS and CMBS using the NAIC-provided list of PIMCO- and BlackRock-modeled securities. We classify all remaining securities using (1) the sector and subsector codes in S&P RatingXpress, then (2) the issue description and issuer name in NAIC Schedule D, and finally (3) the issuer name and collateral asset type in SDC Platinum's New Issues Module.

Table 2 presents summary statistics on the 4,322 insurers in our sample. Though our sample consists of fewer life insurers (1,142) than P&C insurers (4,322), the former are much larger than the latter with average total assets of $2.6 billion compared to $602 million. Both types of insurers have similar median RBC ratio of almost 10. Given the differences in size, it is not surprising that life insurers have larger net incomes and capital surplus than P&C insurers. Life insurers are also more heavily leveraged than P&C insurers.

Figure 1 presents the composition of life and P&C insurers' corporate debt portfolio (par value) through time. The amount of agency ABS/MBS, GSE/Government Debt and other private label ABS remains relatively constant after 2004.[14] Beginning in 2005, life and P&C insurers increase their holdings of RMBS and CMBS coinciding with the large increases in the

[13] NAIC capital regulations depend on a security's credit ratings issued by all three major NRSROs: Moody's Investors Service, Standard & Poor's, and Fitch Investors Service. Although we have access to only Standard & Poor's ratings, we believe that these provide relatively broad coverage. Indeed, He, Qian and Strahan (2013) show that of the three largest NRSROs, S&P rates the most mortgage-backed securities.

[14] Sovereign debt holdings are reported together with corporate debt holdings, which is why we include them in our summary statistics on insurance companies' corporate debt portfolios.

amount of private-label RMBS and CMBS issued.[15] As documented in He, Qian and Strahan (2013) and Griffin and Tang (2013), many of these securities were issued with an investment-grade rating. Insurers who purchased them would have had the benefit of low capital requirements and relatively higher promised yield than might have been available in the corporate bond market. Finally, Figure 1 shows that as the crisis begins and the numbers of RMBS and CMBS downgrades increases, insurers decrease their exposure to structured products and substitute them with corporate bonds.

We measure the impact of removing references to credit ratings and replacing them with a two-dimensional determination of risk-based capital and accounting treatment in two ways. First, we construct an indicator variable that equals 1 in each of the years after the regulatory change took effect for RMBS (year-end 2009) and CMBS (year-end 2010), and 0 otherwise. Second, for each insurer in our sample, we construct a measure of capital saved as the year-end difference between the actual RBC ratio under the new regime and the hypothetical RBC ratio under the old regime.

The actual RBC ratio for insurance company *j* at year-end *t* is the ratio of Actual $\text{Capital}_{j,t}$ to Required $\text{Capital}_{j,t}$ that we obtain from insurance company filings. To calculate hypothetical Actual $\text{Capital}_{j,t}$, for each insurance company we subtract from its reported actual capital any savings resulting from the change in RMBS/CMBS accounting treatment due to the change in capital regulation. Under the new regime, some assets that were previously required to be carried at FV are now carried at (likely higher) AC, while other assets previously carried at AC are now carried at FV. We infer the previously required accounting treatment of a security using its S&P credit rating, mapping its credit rating to an SVO designation and adjusting for the type

[15] See Board of Governors of the Federal Reserve System, October 2010, Report to the Congress on Risk Retention.

of insurer (life or P&C) holding the security. If we infer that the security would have been held at FV under the old credit-rating-based regime, we calculate Actual Capital $Saved_{j,t}$ as the difference between the carrying value of the security and its reported FV. (See Appendix A for an example.) Unfortunately, if we infer that a security would have been held at AC while it is now carried at FV, we are unable to estimate actual capital savings (the difference between the security's AC and FV), since AC is not reported on Schedule D. Thus, our estimate of Actual Capital $Saved_{j,t}$ may underestimate insurance companies' savings to the extent that some RMBS/CMBS have AC lower than their FV.

Second, we add to the amount of reported required regulatory capital any savings resulting from an insurer carrying a security at an SVO designation, and therefore at a capital charge different from the one an S&P credit rating would imply. To do so, we match each RMBS and CMBS to a credit rating in S&P RatingXpress to obtain an SVO based on credit rating (SVO_{CR}). We determine the dollar amount of capital required by multiplying the corresponding SVO_{CR} capital charge by the hypothetical carrying value of the security. The hypothetical carrying value is either AC or FV depending on SVO_{CR} and insurance company type (life or P&C). We obtain the current SVO based on a valuation model (SVO_V) from the insurer's disclosure on Schedule D and multiply the capital charge by the reported carrying value. The difference between the capital required under SVO_{CR} and SVO_V is the amount of Required Capital $Saved_{j,t}$ for each insurer j at each year-end t. (See Appendix A for an example.)

To summarize, our second measure for the impact of the new capital regulation regime is the RBC ratio difference:

$$\Delta\text{RBC Ratio}_{j,t} = \frac{\text{Actual Capital}_{j,t}}{\text{Required Capital}_{j,t}} - \frac{(\text{Actual Capital}_{j,t} - \text{Actual Capital Saved}_{j,t})}{(\text{Required Capital}_{j,t} + \text{Required Capital Saved}_{j,t})}$$

where $t \in [2009..2012]$. To eliminate the effect of outliers, we winsorize $\Delta\text{RBC Ratio}_{j,t}$ at the 1st and 99th percentile.

Depending on the analysis conducted, we closely follow the literature on asset sales in insurance companies. These studies control for a number of both security and insurance company characteristics as defined in Appendix B.

IV. The Net Effect of Write-downs and Capital Saved

The period preceding the regime shift from credit ratings to valuation models for determining regulatory capital and accounting treatment of RMBS and CMBS was characterized by substantial downgrades of these securities. These downgrades lead to significant OTTI of RMBS and CMBS for both P&C and life insurers. In this section, we present evidence on the deterioration in credit quality of RMBS and CMBS that lead to the regulatory change and analyze the net effect on capital saved, both required and statutory, of losses recognized through write-downs.[16]

Table 3 presents the time series of downgrades from investment grade to non-investment grade from 2004 to 2012 for the sample of debt securities rated by S&P. Panel A summarizes all downgrades of RMBS, CMBS and corporate bonds in the S&P RatingXpress database, and provides an indication of the large number of mortgage-backed securities downgraded in 2008 and 2009.[17] During this period, over 37,000 RMBS and 2,000 CMBS were downgraded to non-investment grade compared to only 2,100 corporate bonds. These statistics are even more striking when one compares the size of the corporate bond market to the size of the entire asset-

[16] We do not calculate any losses due to fire sales of RMBS and CMBS. Merrill et al. (2012) show that during the crisis capital-constrained insurance companies sold RMBS at lower prices than other insurance companies holding constant the characteristics of the security.

[17] In 2009, an estimated 47% of RMBS par value outstanding is downgraded by Standard & Poor's. This statistic is based on comparing Flow of Funds data on amount outstanding to S&P RatingXpress data on RMBS downgrades.

backed securities market. According to statistics provided by SIFMA, in 2009 the amount of corporate debt outstanding is almost four times the amount of asset-backed securities outstanding, of which mortgage-backed securities are only a fraction (http://www.sifma.org/research/statistics.aspx).

Panel B presents the time series of downgrades of only those securities held in insurers' debt portfolios. Insurance companies hold a smaller proportion of all downgraded RMBS in the S&P RatingXpress database than either CMBS or corporate bonds, though the absolute number of downgraded RMBS held is much larger than the number of CMBS or corporate bonds. However, in 2009 alone, close to 30% of RMBS par value held by insurers is downgraded from investment-grade to non-investment grade by S&P.

To further illustrate the effect of these downgrades on insurers' RMBS and CMBS portfolio, Figure 2 plots the portfolio's credit-rating composition through time. In 2007, almost all par value held is rated investment grade. This proportion, however, falls to 70% by the end of 2009. Thus, the overall credit quality of the RMBS and CMBS portfolio of insurance companies declines dramatically after the onset of the financial crisis and continues to do so until the end of the sample period.

The regulatory response to this decline in mortgage-backed securities' credit quality and the subsequent increase in the amount of capital that insurers were required to hold for RMBS and CMBS, was to move from a single-dimension system where required capital is based upon credit ratings to a two-dimension system based on expected losses from a valuation model and book carrying values. One consequence of this change is that many securities, which would have had a high SVO designation and high capital charge under the credit-ratings regime, now have a lower SVO designation and lower capital charge.

Table 4 illustrates this point. While many securities have the same SVO rating under both regimes, a large number of them, particularly RMBS, have valuation-based SVOs that are different from and lower than their credit-rating-based SVOs. For example, in 2009 4,263 RMBS holdings would have been at an SVO designation of 6 if credit ratings were used, but are at an SVO designation of 1 under the valuation-based method.[18] In 2012, this number is even higher at 5,629 RMBS holdings. The same pattern can be seen in CMBS but is of a smaller magnitude probably reflecting the fact that there are fewer CMBS outstanding and that these are not downgraded to the same extent as RMBS (Table 3, Panel A).

One implication of our findings in Table 4 is that under the new valuation-based methodology insurers typically hold less regulatory capital for securities with worse credit ratings because these securities now have lower SVO designations. Focusing on this aspect of the regulatory change alone, however, ignores the fact that many insurance companies wrote down the value of RMBS and CMBS either to accurately reflect increases in expected losses or to possibly take advantage of the new SVO designations for better capital and accounting treatment. Unlike the old credit rating system whereby all insurance companies are required to hold the same amount of capital for the same security regardless of its carrying value, the new regulations trade off write-downs for required capital savings.

In Table 5, we examine the net effect, in dollars, of this tradeoff for our sample of RMBS and CMBS rated by S&P. As can be seen in Panel A, the required capital saved for RMBS steadily increases from 2009 to 2012 for a total of almost $27 billion.[19] Our estimate of capital saved is a

[18] Note that since different insurance companies can carry the same security at a different SVO_V, the numbers reported here and in Table 4 are at the insurer-security level rather than at the security level.

[19] Our estimates of capital saved are smaller than those reported by Becker and Opp (2014) and the NAIC (http://www.naic.org/rmbs/100408_rbc_impact_estimate.pdf), for two reasons. First, both consider health, fraternity and title insurers in addition to life and P&C insurers, and second, our sample is restricted to only those securities rated by S&P.

lower bound on true savings, since we consider only savings through 2012 even though savings will continue to accrue as long as an insurer continues to hold an affected security (assuming the security's SVO_V remains lower than SVO_{CR}).

We also find significant savings in actual capital due to the change in accounting treatment after the regulatory change.[20] Actual capital saved from carrying RMBS and CMBS at AC instead of FV is over $4 billion. Both required and actual capital saved is much smaller for CMBS than for RMBS. This difference likely reflects the fact that a smaller number of CMBS are held by insurers and are downgraded, which makes this asset class less affected by the change in the calculation of risk-based capital. Altogether, Panel A shows cumulative savings in required and actual capital equal to almost $32 billion over the four years following the regulatory change.

The benefits we document in Table 5, Panel A, however, come at the cost of recognizing significant OTTI and unrealized losses. OTTI and net unrealized gains and losses are largest in the year prior to and the year of the regulatory capital change (2008 and 2009) with over $27 billion in write-downs in those two years alone.[21] By the end of 2012 net OTTI and unrealized gains and losses total approximately $40 billion.

We calculate the total net impact of the new regulations due to both changes in capital and accounting requirements in Panel C. For each year, we cumulate the total amount of capital saved, OTTI, unrealized losses, and any unrealized gains or reverse impairments of OTTI not

[20] In order to look at the effect of the change in methodology, we replicate Table 4 in EJLW (2013a) that documents the frequency of accounting treatment (FV or AC) of downgraded ABS. We use only RMBS and CBMS securities and compare the proportion of downgraded securities held at AC both before and after the regulatory change. Prior to the regulatory change, P&C insurers held 9.1% of 921 downgraded RMBS at AC. After the regulatory change, P&C insurers hold 53% of 3,363 downgraded securities at AC. In the first year of the new regulatory regime alone, P&C insurers save twice the amount of actual capital ($968 million) than required capital ($442 million).

[21] Note that some of the OTTI taken in 2008 is subsequently reversed in 2009. Many of the unrealized gains are due to the change in accounting treatment from FV to AC.

due to the change in actual capital saved. The net effect in 2009, the year the regulatory change is initiated, is a net loss of $23 billion despite the fact that almost $5 billion in regulatory capital is saved. The cumulative effect still remains negative at the end of 2012 at negative $10.7 billion. However, the rate of decline in the net effect on regulatory capital is increasing, because required capital saved continues for the duration of the investment, and will likely be positive in the next few years.

In Table 6, we examine whether the amount of required capital saved is related to how much an insurance company impairs the value of its portfolio assets. We measure impairment as either OTTI, or Write-Downs which is the sum of OTTI and any net unrealized losses. If the level of savings in required capital is accompanied by reductions in security values on insurer balance sheets, we should expect a positive relationship between the amount of impairment and the amount of risk-based capital saved. We control for other characteristics of the firm including the lag of total assets, and whether or not the firm is a P&C insurer.

We estimate the regressions over two time periods: 2009 and 2010-2012. The 2009 regressions estimate the initial effect of the regulatory change and relate the total impairment on mortgage-backed securities to total savings in capital. In the 2010-2012 regressions, we avoid double-counting the initial savings in regulatory capital by regressing incremental capital saved on any new mortgage-backed securities' write-downs. That is, for each mortgage-backed security in each insurer's portfolio we calculate incremental capital saved as the change in capital saved from the prior year. We scale our estimates of capital saved in each year by that year's par value held.

The estimation results in Table 6 indicate a positive and significant relationship in 2009 between the amount of OTTI and write-downs taken in 2008 and 2009. A 1% increase in the

ratio of mortgage-backed-security write-downs to total assets in both 2008 and 2009 is associated with 0.11% increase in the ratio of required capital saved to total assets in 2009. This relationship continues in the following years but is less pronounced. The results in Table 6 suggest a clear link between savings in regulatory capital and portfolio asset impairments.

Overall, the analysis in this section indicates that the change in capital regulation benefits insurers though significant savings in required and actual capital. However, these savings are accompanied by large losses in insurers' investment portfolios. We next examine whether the regulatory capital savings are large enough to affect insurers' asset sales, one aspect of systemic risk transmission identified by the FSOC.

V. Effect on Asset Sales

A number of studies document that asset sales by insurance companies tend to depress prices.[22] This selling price pressure is one of the main criteria for the designation of some insurers as systemically important. In this section, we examine whether the reduced regulatory reliance on credit ratings for assessing capital adequacy alleviates the need for insurers to engage in asset sales of distressed securities as in EJL (2011) and Merrill et al. (2012), and gains trading in corporate bonds as in EJLW (2013a).

Ideally, we would have identified a change in insurers' selling behavior by comparing the probability of them selling downgraded RMBS and CMBS prior to the regulatory change to the probability of doing so afterwards. However, as shown in Figure 3, sales of non-investment-grade RMBS and CMBS are near zero prior to 2009. [23] Instead, we examine the probability of

[22] See EJL (2011), Merrill et al. (2012), and EJLW (2013a). For an opposing view see Ambrose, Cai and Helwege (2012).

[23] After 2008 the sales (and purchases) of mortgage-backed securities rise significantly. One possible interpretation of this time trend is that the regulatory change increased, not decreased, the sales of distressed RMBS and CMBS. However, the results presented in Table 3 indicate that the increase in trading after 2009 is more likely due to an

selling a downgraded security in the cross-section after the regulation went in effect. We hypothesize that insurers with larger capital savings (i.e. larger ΔRBC Ratio) are less likely to be capital-constrained and thus, are less likely to sell a security after it is downgraded. This test is similar to those in EJL (2011) and EJLW (2013a).

We specify the probability of selling a security in the 3 months after it is downgraded from investment-grade (IG) to non-investment-grade (NIG) as a probit model:

$$\Pr(\text{Sell}_{i,j,k} = 1) = \Phi\left(\kappa_0 + \kappa_1 \Delta\text{RBC Ratio}_{j,k} + \kappa_2 X_{i,k} + \kappa_3 Y_{j,k} + \kappa_4 W_q\right)$$

Φ(.) denotes the cumulative normal probability function and $\text{Sell}_{i,j,k}$ is an indicator variable equal to one if an insurance company *j* (holding security *i* at the quarter-end preceding the downgrade) sells security *i* in the 3 months after the downgrade event *k* and zero otherwise. As defined earlier, $\Delta\text{RBC Ratio}_{j,k}$ is the difference between the reported RBC ratio and the hypothetical RBC ratio for insurance company *j* at year-end prior to downgrade event *k*.

$X_{i,k}$ is a vector of security *i*'s characteristics at the quarter-end prior to the downgrade event *k* and includes the log of the security's remaining maturity, the log of its issue size, and credit rating-implied SVO designation fixed effects.

$Y_{j,k}$ is a vector of insurance company *j*'s characteristics at the year-end prior to the downgrade event *k* and includes the log of the current RBC ratio, the log of total assets, the percentage of risky assets in the insurer's corporate debt portfolio, and domicile state fixed effects. Finally, W_q is a vector of time fixed effects. We estimate the above model for all debt securities and then separately for RMBS/CMBS and corporate bonds over the 2009-2012 period. We cluster standard errors by insurance company.

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increase in the number of downgraded mortgage-backed securities which, in turn, was the impetus for the change in regulation.

Table 7 presents the results of these estimations. The difference between reported and hypothetical RBC ratio is associated with a significant reduction in the probability of selling RMBS/CMBS (column (1)) but has no effect on the probability of selling corporate bonds (column (2)). Thus, the more capital saved after the regulatory change, the lower is the probability of promptly selling downgraded RMBS and CMBS. This finding is consistent with the stated motivation for the regulatory change in reducing systemic risk by decreasing the need to sell downgraded securities in distressed markets and mitigating the potential for spillover effects to other institutions holding similar assets.

Unlike EJL (2011) who document that the probability of selling downgraded securities is decreasing in the level of the RBC ratio, we find that under the new regime this effect is absent. Also, P&C firms are less likely to sell distressed RMBS and CMBS after controlling for the capital saved. This suggests that the new accounting treatment reduces P&C insurers' incentives to sell downgraded ABS and is in contrast to the findings of EJLW (2013a) for the period prior to the regulatory change. Larger firms, as measured by total assets, are also less likely to sell downgraded securities possibly because any one security's capital charge has a relatively small impact on their capital requirements. Securities with larger issue size are more likely to be sold, all else constant, likely because they tend to be more liquid.

In addition to sales of distressed securities, EJLW (2013a) document that during the crisis life insurers attempted to repair their regulatory capital by selling corporate bonds carried on their books at unrealized gains.[24] We expect that savings in regulatory capital will make life insurers less likely to gains trade after capital regulations change. To test this hypothesis, we estimate a model similar to that in EJLW (2013a) but augment their specifications to include two

[24] "Cherry picking" of assets to sell is not limited to insurance companies. Boyson, Helwege and Jindra (2013) document a similar behavior by commercial banks.

additional independent variables to capture the effect of the regulatory change: (1) an indicator for the period after the regulation changed, or (2) the change in the RBC ratio due to the regulatory shift.

We specify the probability of selling a corporate bond in any given quarter as the following two probit models:

$$\Pr(\text{Sell}_{i,j,q} = 1) = \Phi\big(\gamma_0 + \gamma_1 \text{UG Rank}_{i,j,q} + \gamma_2 \text{UG Rank}_{i,j,q}\text{Crisis}_q + \gamma_3 \text{UG Rank}_{i,j,q}\text{Reg Change}_q + \gamma_4 X_{i,q} + \gamma_5 Y_{j,q} + \gamma_6 W_q\big)$$

$$\Pr(\text{Sell}_{i,j,q} = 1) = \Phi\big(\beta_0 + \beta_1 \text{UG Rank}_{i,j,q} + \beta_2 \text{UG Rank}_{i,j,q}\Delta\text{RBC Ratio}_{j,q} + \beta_3 \Delta\text{RBC Ratio}_{j,q} + \beta_4 X_{i,q} + \beta_5 Y_{j,q} + \beta_6 W_q\big)$$

$\Phi(.)$ denotes the cumulative normal probability function and $\text{Sell}_{i,j,q}$ is an indicator variable that equals 1 if the insurance company *j* (holding bond *i*) sells the bond in quarter *q* and 0 otherwise.

We are using the following independent variables of interest. Reg Change_q is an indicator variable that equals 1 in the quarters from 2010Q1 to 2012Q4, and 0 otherwise. $\text{UG Rank}_{i,j,q}$ is the percentile (ranging from 0 to 1) of unrealized gain on corporate bond *i* in the corporate debt portfolio of insurance company *j* at the year-end prior to quarter q. As defined previously, $\Delta\text{RBC Ratio}_{j,q}$ is the difference between reported RBC ratio under the new regime and the hypothetical RBC under the old regime. This variable is set to zero for any period prior to the regulatory change. Crisis_q is an indicator variable that equals 1 in the quarters from 2007Q3 to 2009Q4, and 0 otherwise (as in EJLW (2013a)).

$X_{i,q}$ is a vector of bond *i*'s characteristics at the beginning of quarter *q* and includes, in addition to those used in Table 7, the following variables. Bankrupt is an indicator variable equal to1 if the issuer of the bond files for bankruptcy, 0 otherwise. Downgrade is an indicator variable equal to 1 if the bond is downgraded by S&P from investment to non-investment grade,

0 otherwise. LnAge is the natural log of the number of years from the bond's issuance to the beginning of quarter *q*.[25]

$Y_{j,q}$ is a vector of life insurance company *j*'s characteristics at the year-end closest to quarter *q* and includes two measures of ABS Exposure. The first measure is identical to the measure used in EJLW (2013a) and is included in the first two specifications in Table 8. We replace their measure in the second two regressions by considering the percentage of the insurer *j*'s bond portfolio invested in all asset-backed securities (ABS) not held at fair value but only *when carrying value is higher than fair value*. EJLW (2013a) argue that when insurers carry an ABS at AC (determined by checking if carrying value is different from FV), they are more likely to gains trade corporate bonds rather than sell impaired ABS. The implied assumption is that the ABS is distressed and thus its FV is less than its AC. However, accounting rules require an insurer using FV to carry a security at the lower of FV or AC. Although most securities have FV less than AC, under the new regulations some RMBS and CMBS may have FV greater than AC. One reason why this may occur is that if the breakpoint carrying value for a certain level of capital is lower than the FV of the security an insurer may have the incentive to impair the carrying value or AC below FV in order to obtain preferential capital treatment. Only when the AC is higher than the FV is the incentive to gains trade higher and we therefore restrict our measure of ABS Exposure to those instances.

In addition, we control for the following insurer characteristics as in EJLW (2013a): regulatory capital constraints using an indicator variable, Low RBC, which equals to 1 if an insurer's RBC ratio is in the bottom quartile for the sample, 0 otherwise; insurer size using

[25] We do not include LnAge in specifications estimated for RMBS/CMBS, because we do not have issuance dates for a large portion of the RMBS/CMBS securities in our sample. For corporate bonds, issuance dates are collected from Mergent's FISD.

Ln(Capital Surplus), which equals to the natural log of total capital and surplus; insurer leverage using Leverage, which is the ratio of total liabilities to total assets; and, profitability using ROE which is the ratio of net income to book value of common stock. All specifications include SVO_{CR}, time and state fixed effects. We cluster standard errors by insurance company.

In Table 8, the first two columns directly replicate the estimation specification in EJLW (2013a) with the second regression including an indicator variable and interaction terms related to the regulatory change. As in EJLW (2013a), life insurers are less likely to sell a bond that has an unrealized gain. Once the percentile of unrealized gains is interacted with the crisis indicator, we confirm the result that life insurers are more likely to gains trade during the crisis than before. In the second specification (column (2) of Table 8) we extend the sample period to the end of 2012 and examine whether these same relationships hold after the regulatory change occurs. The negative coefficient on the interaction between the amount of unrealized gains and the regulatory change indicator suggests that life insurers are *less* likely to gains trade after the regulatory shift. Note that this effect is in addition to the effect estimated for the pre-crisis period and indicates that the regulatory change does not simply reverse the crisis period effect.

One possible interpretation of these findings is that the end of the financial crisis coincides with the regulatory change we study and therefore, the reduction in gains trading is due to a time trend rather than a regime shift. We examine this possibility further in the next two specifications. First, we use the entire sample period but now include ΔRBC ratio, our measure of capital savings, as an independent variable. This variable is set to zero prior to 2009 before the regulatory change took effect. We hypothesize that life insurers, which saved larger amounts of capital after the regulatory change, have a lower probability of gains trading. The results from estimating this specification are reported in column (3) of Table 8 and support our hypothesis.

The coefficient on the interaction term between ΔRBC ratio and unrealized-gains ranking is significantly negative. This indicates that the more capital life insurers' save because of the regulatory change, the less likely they are to gains trade. We find similar results when we examine only the post-regulatory change period (column (4) of Table 8).

Collectively, the results of this section suggest that the regulatory change, by having a positive impact on insurers' RBC ratios, reduces the need to sell downgraded RMBS/CMBS or corporate bonds with unrealized gains in order to repair regulatory capital. Since trades motivated by recent downgrades or by unrealized gains have been documented to depress prices (Merrill et al. (2012) and EJLW (2013a)), a reduction in these practices may reduce the price pressure in the market for RMBS, CMBS and corporate bonds and in turn, decrease the spillover effect of depressed prices on other financial institutions' debt portfolios. The change in the way regulatory capital is calculated for insurance companies potentially alleviates one of the key attributes identified by the FSOC as central to the designation of non-bank financial institutions as systemically important: "A nonbank financial company holds assets that, if liquidated quickly, would cause a fall in asset prices and thereby significantly disrupt trading or funding in key markets or cause significant losses or funding problems for other firms with similar holdings."[26]

VI. Effect on External Financing

In the wake of the financial crisis, many financial institutions became undercapitalized due to operating losses (Koijen and Yogo (2013)) and substantial declines in the credit quality of their mortgage-backed securities portfolios. Many of these institutions attempted to restore their regulatory capital through external financing (see Acharya, Gujral, Kulkarni and Shin (2011) and

[26] http://www.treasury.gov/initiatives/fsoc/designations/Documents/Prudential%20Financial%20Inc.pdf

Boyson, Helwege and Jindra (2013) for banks, and Berry-Stölzle, Nini and Wende (2012) for insurance companies).

Since the new NAIC regulatory regime provides capital relief to insurers that hold downgraded mortgage-backed securities, it may offset these insurers' need to raise external financing in order to conserve capital. This could be particularly valuable in times of market stress when the inability of institutions to raise capital at all or at reasonable prices can exacerbate systemic risk in the financial system. We hypothesize that after the change in the methodology for calculating risk-based capital, the need for insurers to raise external financing will be reduced and the probability of doing so will be lower for those insurers who saved more capital.

We test this hypothesis by specifying the following probit model similar to the one in Berry-Stölzle et al. (2012):

$$\Pr\left(\text{Financing}_{j,t} = 1\right) = \Phi\left(\delta_0 + \delta_1 \text{Crisis}_t + \delta_2 \text{Reg Change}_t + \delta_3 Y_{j,t-1}\right)$$

$$\Pr\left(\text{Financing}_{j,t} = 1\right) = \Phi\left(\eta_0 + \eta_1 \text{Crisis}_t + \eta_2 \text{Reg Change}_t + \eta_3 \Delta\text{RBC Ratio}_{j,t-1} + \eta_4 Y_{j,t-1}\right)$$

$\Phi(.)$ denotes the cumulative normal probability function and the dependent variable is an indicator variable, $\text{Financing}_{j,t}$, that equals 1 if (a) insurance company *j* raises capital either through surplus notes or paid-in capital in year *t*. As in Berry-Stölzle et al. (2012) we include surplus notes along with paid-in capital as a measure of external financing because these subordinated-debt instruments are treated like capital for regulatory purposes.[27]

[27] Berry-Stölzle, Nini and Wende (2012) also examine dividend cuts. Although we replicate their analysis with the inclusion of our two measures of regulatory change impact, RegChange and ΔRBC Ratio, we find mixed results. We have chosen not to report these results here because we are unable to identify dividends per share, only total dividends. Therefore, we cannot separate out the effect of a change in the number of shares outstanding (external financing) from dividend decisions.

Our independent variables of interest are Reg Change$_{t.}$ and ΔRBC Ratio$_{j,t}$ as in Table 8. We control for a number of issuer characteristics at the year-end prior to issuance as in Berry-Stölzle et al. (2012) including: Ln(RBC), the log of actual to required capital ratio; ROA, the ratio of net income to total assets; Ind Neg NI, an indicator variable equal to 1 if net income is negative, 0 otherwise; Chg Net Premiums, the annual percentage change in net premiums collected; Ln(TA), the log of total assets; Ind Perc Annty, an indicator variable equal to 1 if the proportion of premiums collected from selling annuities is in the 90th percentile of the sample, 0 otherwise; Ind Mutual, an indicator variable equal to 1 if an insurance company is organized as a mutual company, 0 otherwise; and Ind Grp Member, an indicator variable equal to 1 if an insurance company is affiliated with a group of insurance companies, 0 otherwise. As in Berry-Stölzle et al. (2012), we control for year fixed effects and cluster standard errors by insurance company.

Although both Berry-Stölzle et al. (2012) and Koijen and Yogo (2013) consider only life insurance companies, Table 9 presents separate regressions for both life or P&C insurers for two time periods, the entire sample period 2005- 2012 and the post-regulatory period 2010-2012. When we examine the effect of the regulatory change on issuances, however, we find that the effect is restricted to life insurance companies only. Life insurers are less likely to raise external capital after the regulatory change occurs. Further, the larger the capital savings of life insurers as a result of the regime shift (the larger ΔRBC Ratio), the lower the probability they will raise external funds. This suggests that an additional benefit of the new valuation-based RBC requirement is to reduce the need to access capital markets – an effect that can be particularly valuable in times of financial stress when the asymmetric information cost of external financing is likely high.

VII. Purchases of Downgraded Securities

In this section, we examine whether the shift to a valuation-based method of calculating RBC affects the investing behavior of insurance companies. When regulatory capital is determined only by the credit rating of a security, financial institutions subject to capital requirements may be reluctant to purchase a non-investment-grade security even at potentially profitable low prices because the amount of required capital is likely to be very high. Credit-rating-based capital requirements are most useful for risk assessment of primary market purchases since the expected loss given default is based on the security's par value. They are not as useful in determining the relative risk-return tradeoff for securities purchased at prices below par in the secondary market.

Because capital requirements and accounting treatment based on credit ratings are an impediment to purchasing distressed securities at discounted prices, we predict that the shift to a two dimensional valuation-based method of RBC calculation will increase the purchases of low-rated RMBS and CMBS in the secondary market. We test this hypothesis in two ways: by examining whether the average credit rating of securities purchased decreases and whether the proportion of purchases that are non-investment-grade increases after the regulatory change.

Because SDC Platinum provides offering dates for only a small number of the RMBS and CMBS held by insurers, we are unable to determine the date of issuance for many of the securities in our sample. We, therefore, identify secondary market purchases using the following methodology. We construct a measure of potential primary market purchases by identifying the first instance a security appears in the transaction files. If the first transaction is a purchase, we assume that this is a primary market purchase and eliminate from the sample all purchases that take place on that date. If the first transaction is a sale, we retain all trades for that security.

Note that this method likely eliminates some purchases that are, in fact, secondary market purchases.

We construct two measures of changes in the credit-risk quality of secondary-market purchases for use as dependent variables. First, we calculate the weighted average credit-rating implied SVO for corporate bonds, RMBS and CMBS using the par value purchased as the weight (Avg SVO_{CR}). Second, we calculate the proportion of secondary market purchases that are non-investment grade corporate bonds, RMBS or CMBS (% Non-IG). Our first measure captures the variation among low-rated securities by distinguishing between an SVO_{CR} of 3 and 6, while our second measure emphasizes the economic magnitude of the potential shift toward non-investment grade purchases by incorporating the purchase size.

We specify the following linear regressions for each of the three asset classes we analyze:

$$\text{Credit Quality}_{j,t} = \alpha_0 + \alpha_1 \text{Reg Change}_t + \alpha_2 Y_{j,t-1} + \varepsilon_{j,t}$$

$$\text{Credit Quality}_{j,t} = \mu_0 + \mu_1 \Delta\text{RBC Ratio}_{j,t-1} + \mu_2 Y_{j,t-1} + \epsilon_{j,t}$$

$\text{Credit Quality}_{j,t}$ is one of our two measures of the credit quality of purchases, Avg SVO_{CR} or %Non-IG, for insurance company *j* at year-end *t*. As in prior tables, our two independent variables of interest are Reg Change measured separately for RMBS (2009-2012) and CMBS (2010-2012), and ΔRBC Ratio. We also control for similar firm characteristics as previously, include U.S. state of domicile and year fixed effects, and cluster standard errors at the insurance-company level.

Table 10 presents separate estimation results for Avg SVO_{CR} of RMBS, CMBS and corporate bonds over two different time periods – the entire sample period and the period after the regulatory change. After the regulatory change Avg SVO_{CR} increases for all three asset classes and larger insurers are more likely to purchase low-rated securities. However, the coefficient on

ΔRBC Ratio is significant only for RMBS indicating that the more capital saved due to the regulatory change, the worse is the average credit rating of secondary-market RMBS purchases.

Table 11 uses the percentage of purchases of non-investment grade securities (% Non-IG) as the dependent variable to examine whether there is a shift in the amount purchased toward low-rated securities. We document that this is the case for all three asset classes: RMBS, CMBS and corporate bonds. Furthermore, for RMBS and CMBS this proportional shift is larger for insurers with larger ΔRBC Ratio. The more regulatory capital insurers save due to the new capital regulations, the more they shift their secondary-market purchases to non-investment grade RMBS and CMBS.

The ability of insurers to purchase distressed securities in the secondary market can alleviate price pressure during times of market stress which is another aspect of the new regulatory regime that may reduce systemic risk. However, the findings in Tables 10 and 11 also suggest that the new regulatory regime may increase yield chasing by insurance companies, and underscores the importance of correctly capturing risk through required capital charges and asset value impairment recognition.

Becker and Opp (2014) provide empirical evidence on this point from the NAIC experiment. On one hand, they show that PIMCO and BlackRock's estimates of expected losses perform as well and sometimes better than ratings in predicting realized losses. On the other, their findings suggest that the reduction in required capital under the new regime may be insufficient to ensure the financial stability of insurance companies, which may impact systemic risk transmission through channels other than asset liquidation (e.g. interconnectedness or substitutability). Thus, if insurer and other financial-firm regulators were to further reduce their reliance on credit

ratings and implement a valuation-based RBC for other types of debt securities, they will need to be mindful of the risk-shifting incentives this may create.

VIII. Conclusion

In this paper we examine the 2009-2010 change from a credit rating-based capital regulation in the insurance industry to a valuation-based one. We document that this change results in more than $31 billion of required and actual capital savings on RMBS and CMBS over 2009-2012. These savings coincide with large write-downs of RMBS and CMBS, which by the end of 2012 still remain $11 billion higher than our estimate of cumulative capital saved. Our results are consistent with a 2013 GAO report on the insurance industry during the financial crisis that concludes that "changes to certain risk-based capital provisions and an accounting requirement helped reduce pressure on insurers' capital."

Our analysis contributes to the understanding of the effect of credit-rating based capital requirements on the transmission of systemic risk through asset liquidation. We document that insurance companies change their investment and financing behavior when capital adequacy assessment is no longer based on credit ratings alone. We find evidence that asset sales in RMBS/CMBS and gains trading in corporate bonds are less likely after the regulatory change, and that insurers with larger regulatory capital savings are less likely to engage in these types of asset sale practices. In addition, we find that after the regulatory change, life insurers are less likely to raise external capital, particularly when their regulatory capital savings are larger.

These findings suggest that a movement toward a two dimensional capital charge regime, which captures both the credit quality and the book carrying value of a security for determining regulatory capital, makes insurers less likely to quickly sell distressed securities and more likely to purchase them. This, in turn makes insurers less likely to contribute to downward price spirals

in security markets. Therefore, a two-dimensional assessment of expected losses given default as implemented by the NAIC for insurance companies may inhibit the transmission of systemic risk through the asset liquidation channel.

Finally, we show that one unintended consequence of substituting credit-ratings in capital regulations with valuation-based methodologies is that it makes it economically feasible for insurers to increase their secondary-market purchases of low-rated securities. After the regulatory change the average rating of secondary market RMBS/CMBS purchases worsens and the proportion of low-rated RMBS/CMBS purchased increases, and this effect is more pronounced for insurers that have larger savings of required and actual capital. Although this outcome may be beneficial for alleviating systemic risk because it may support secondary-market trading of distressed securities, it could be undesirable from prudential regulatory perspective if the valuation-based capital charges capture a security's risk-return tradeoff imperfectly. If as a result of the regulatory change, insurers no longer hold sufficient capital to ensure their financial health, systemic risk transmission may be negatively impacted through channels other than asset liquidation (e.g. interconnectedness and substitutability). Mitigating this effect should be an important consideration for regulators of financial firms when removing references to credit ratings from their rules as required by Section 939 of the Dodd-Frank Act.

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Appendix A

Example of accounting treatment and capital charges for RMBS
held by a P&C insurer using PIMCO valuations
From NAIC Valuation Securities Task Force, December 1, 2010

Cusip	Amortized Cost	Fair Value	SVO_{CR}
55265KWV7	95.47	27.32	5
12669GL33	90.64	85.04	3

Breakpoint carrying value (BCV) using PIMCO:

	SVO_V					
Cusip	1	2	3	4	5	6
55265KWV7	92.99	93.83	95.56	99.52	112.14	Above 112.14
12669GL33	90.3	91.14	92.88	96.84	109.46	Above 109.46

1. Compare current amortized cost to range above to determine initial designation.
   a. 55265KWV7 has an **SVO_V of 3.**
      i. Its AC of 95.47 is less than the BCV of SVO_V 3 of 95.56 but greater than the BCV of SVO_V 2 of 93.83.
   b. 12669GL33 has an **SVO_V of 2.**
      i. Its AC of 90.64 is less than the BCV of SVO_V 2 of 91.14 but greater than the BCV of SVO_V 1 of 90.3.
2. Determine the carrying value using SVO_V and insurer type.
   a. 55265KWV7 is held at the **FV of 27.32**.
      i. The security at has an initial designation of SVO_V 3 which requires the insurer to hold it at FV.
      ii. Under the credit-rating regime, the security would have had an SVO_{CR} of 5, which would have required the insurer to hold it at FV. Thus, there is no accounting treatment change from the credit ratings regime so the insurer does not have any change in actual capital.
   b. 12669GL33 is held at the **AC of 90.64**.
      i. The security has an initial designation of SVO_V 2 which allows the insurer to hold it at AC.
      ii. Under the credit-rating regime, the insurer would have had to hold the security at FV (SVO_{CR} 3) but now holds it at AC and so saves 5.40 in actual capital.
3. Determine the SVO for capital charges from the BCV chart above.
   a. 55265KWV7 has a final **SVO_V of 1** with a capital charge of 0.3%.
      i. Its FV of 27.32 is less than the BCV of SVO_V 1 of 92.99.
      ii. Its required capital saving is 2.65 or [(27.32*0.10)-(27.32*0.003)]
   b. 12669GL33 has a final **SVO_V of 2**.
      i. It is held at AC so its SVO_V for capital charges is the same as its initial designation.
      ii. Its capital saving is 0.79 or [(85.04*0.02)-(90.64*0.01)]

The table below summarizes the change in actual and required capital:

Cusip	Old Carrying Value	New Carrying Value	Actual Capital Saved	Old SVO	New SVO	Required Capital Saved	Total Capital Saved
55265KWV7	FV	FV	0.00	5	3	2.65	2.65
12669GL33	FV	AC	5.40	3	2	0.79	6.19

Appendix B
Variable List

Variable	Definition	Source
	Insurance Company	
PC	Dummy variable =1 if insurer is a P&C insurer	Annual statements (NAIC)
ABS Exposure	Either as in EJLW (2013a) or calculated as the percentage of the bond portfolio invested in asset-backed securities (ABS) not held at fair value when carrying value is higher than fair value, measured in market value terms	Schedule D (NAIC)
Low RBC Ratio	Indicator variable if the insurer's actual to required capital ratio at the year-end closest to the beginning of quarter q is in the bottom quartile for the sample	Annual statements (NAIC)
% Risky Assets	Percentage of investment assets with reported SVO in the 3-6 range (including equities, municipal bonds, and Treasuries)	Annual statements (NAIC)
Capital Surplus	The insurers' total capital and surplus at the year-end.	Annual statements (NAIC)
Leverage	The insurer's total liabilities to total assets	Annual statements (NAIC)
ROE	The ratio of net income to book value of common stock	Annual statements (NAIC)
ROA	Net income to total assets at year-end prior to issuance.	Schedule D (NAIC)
Ind Neg NI	Indicator variable equal to 1 if net income is negative at year-end prior to issuance	Annual statements (NAIC)
Chg Net Premiums	The percentage change (year to year) in net premiums collected at year-end prior to issuance	Annual statements (NAIC)
TA	Total assets at year-end prior to issuance.	Annual statements (NAIC)
Ind % Annty	Indicator variable if the proportion of premiums collected from selling annuities are in the 90th percentile	Annual statements (NAIC)
Ind Mutual	Indicator variable if an insurance company is a mutual insurance company	Annual statements (NAIC)
Ind Grp Member	Indicator variable if an insurance company is affiliated with a group of other insurance companies	Annual statements (NAIC)
Crisis	indicator variable that equals 1 in the quarters from 2007Q3 to 2009Q4 (as in EJLW (2013a))	
Reg Change	indicator variable that equals 1 in the quarters from 2010Q1 to 2012Q4	
Security		
Issue Size	Amount of security originally issued ($ mils)	Mergent FISD (corporate bonds only) S&P RatingXpress (when Mergent FISD data is missing)
Bankrupt	Indicator variable if the issuer of the bond files for bankruptcy in the prior quarter	Mergent FISD (corporate bonds only)
Downgrade	Indicator variable if the bond is downgraded by S&P from investment to non-investment grade in the prior quarter	S&P RatingXpress
Age	The number of years from issuance	Mergent FISD (corporate bonds only)
Maturity	Remaining maturity of a security measured as of the end of the observation quarter	Mergent FISD (corporate bonds only) S&P RatingXpress (when Mergent FISD data is missing)
SVO1 to SVO6	Indicator variable for each of the SVO designations	Schedule D (NAIC)
OTTI	Other-Than-Temporary-Impairment	Schedule D (NAIC)
Write-down	OTTI plus unrealized losses	Schedule D (NAIC)
UG Rank	Percentile of unrealized gain of security i (all securities in the corporate bond portfolio) in insurance company j at the year-end prior to quarter q	Schedule D (NAIC)

Figure 1
Time Series of Insurer Corporate Debt Holdings

The graphs plot total par value held in life (1,142) and P&C insurers' (3,180) corporate debt portfolios by asset class. Agency ABS/MBS include asset-backed securities with GSE (mainly FNMA, FHLM and GNMA) guarantees. GSE/Govt Debt include debt securities issued by governments and GSEs. RMBS include private-label residential mortgage-backed securities. CMBS include private-label commercial mortgage-back securities. Other Private-Label ABS includes private-label ABS other than RMBS and CMBS. Corp Debt includes corporate bonds.

Figure 1A:Life Insurers

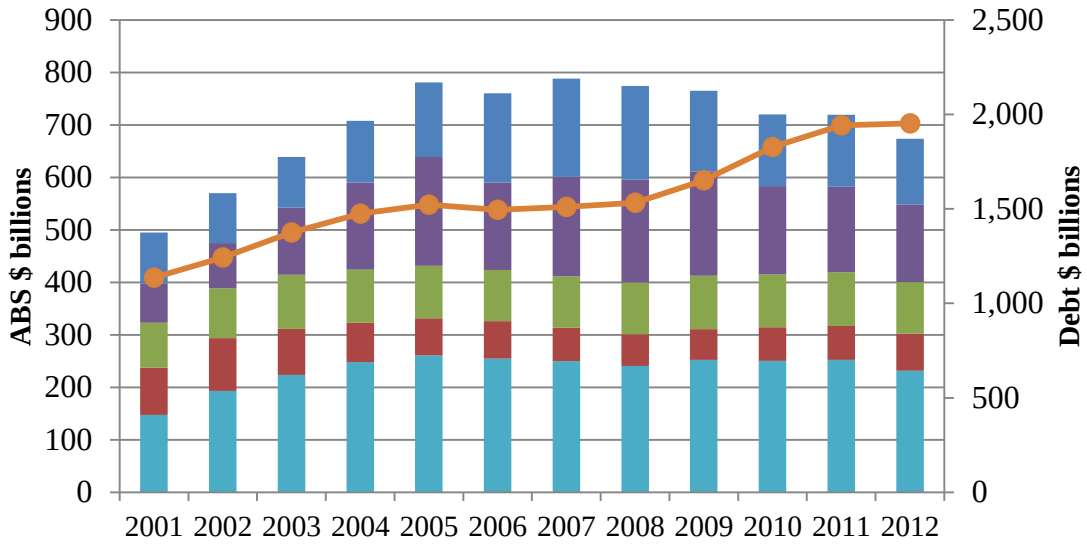

Figure 1B: P&C Insurers

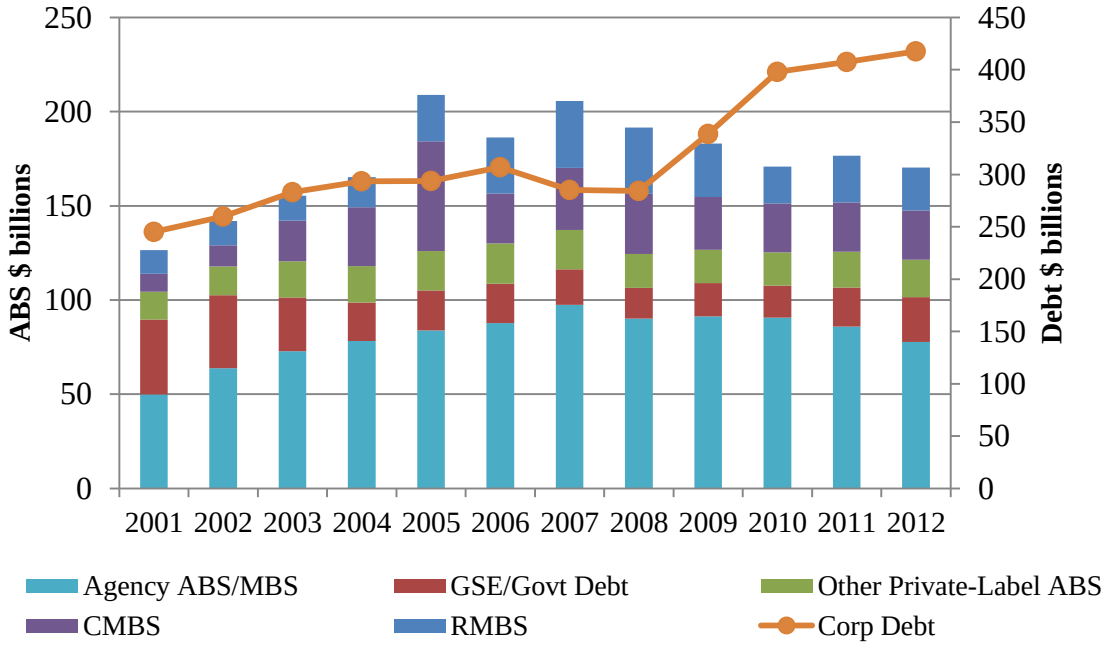

Figure 2
Credit Rating Composition of Insurers' RMBS and CMBS Portfolio

The composition of insurers' private-label RMBS and CMBS portfolio broken down by credit-rating implied SVO (SVO_{CR}) designation. For each security, the S&P credit rating is measured at year-end. Percentages are calculated using par values.

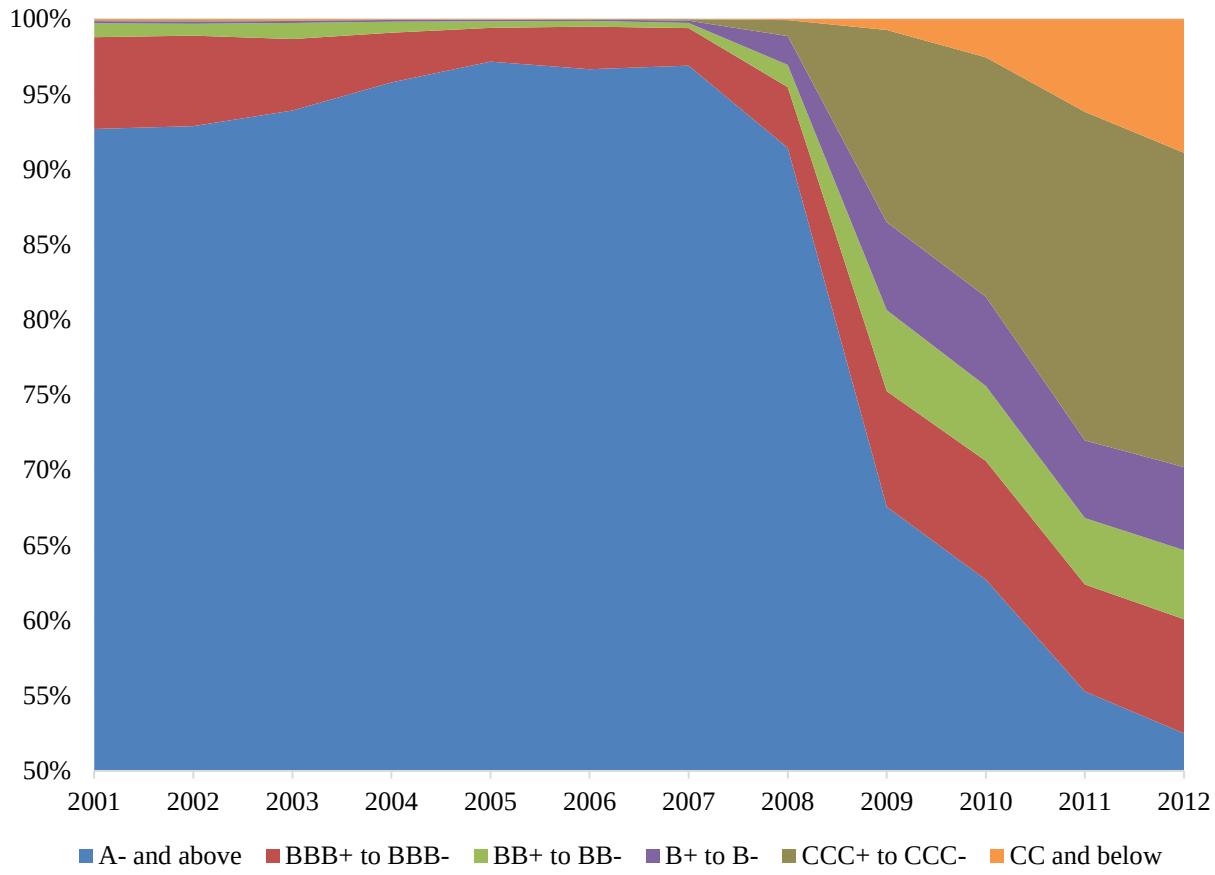

Figure 3
Sales and Purchases of Non-Investment Grade RMBS and CMBS

The graph plots the monthly dollar amount of insurance company sales and purchases of RMBS and CMBS with SVO_{CR} in the 3 to 6 range.

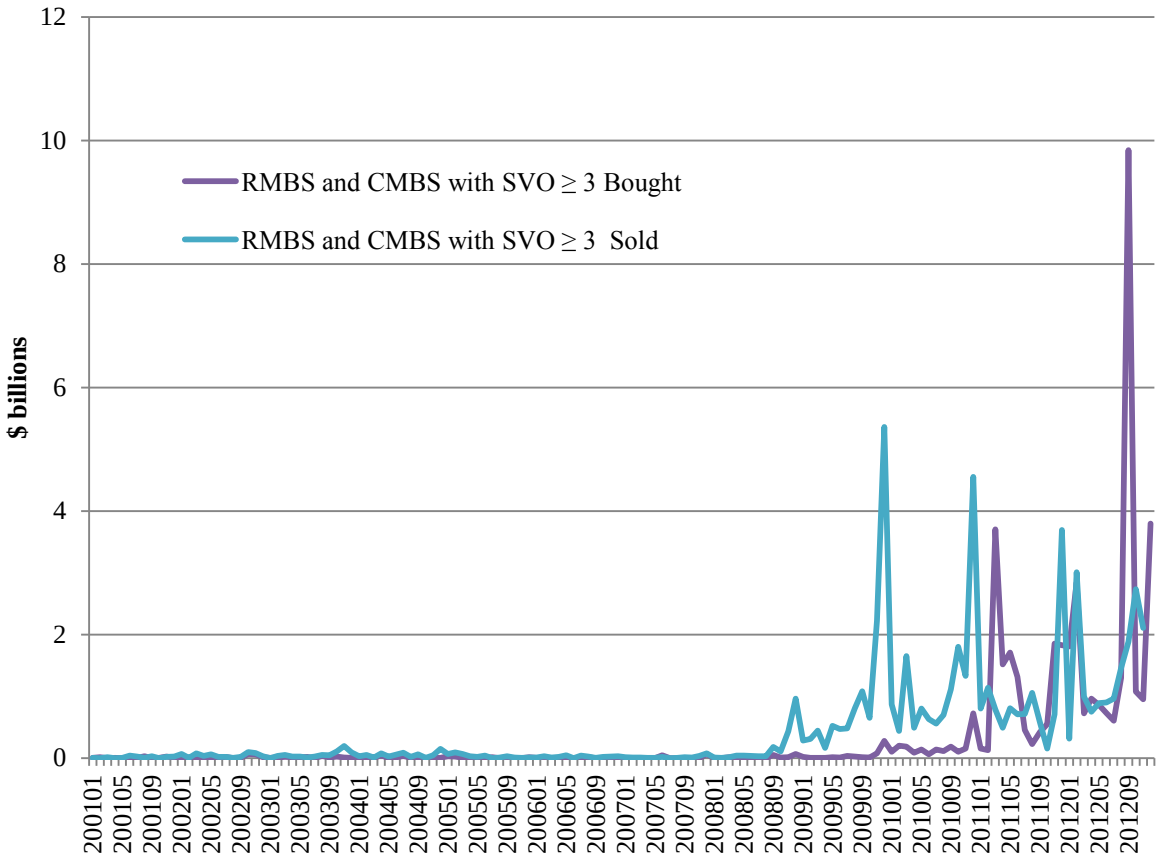

Table 1

Mapping of SVO Designation to Required Capital Charges and Accounting Treatment

These are SVO designations mapped to required capital charges and accounting treatment of fixed-income securities held by insurers. AC indicates that a security must be carried at amortized cost. FV indicates that a security must be carried at the lower of amortized cost or fair value.

	Required Capital Charge		**Accounting Treatment**	
SVO	*Life*	*P&C*	*Life*	*P&C*
1	0.4%	0.3%	AC	AC
2	1.3%	1.0%	AC	AC
3	4.6%	2.0%	AC	FV
4	10.0%	4.5%	AC	FV
5	23.0%	10.0%	AC	FV
6	30.0%	30.0%	FV	FV

Table 2
Summary Statistics on Insurers

Summary statistics are for the 2004 to 2012 for the sample of life and P&C insurers compiled from the annual statements provided to the NAIC. Total Assets ($ million) exclude assets held in separate accounts, segregated accounts and protected cell accounts. RBC Ratio is the ratio of actual capital (total adjusted capital) to required capital (authorized control level risk-based capital). Net Income ($ million) is total income from underwriting, investment and other sources. Capital & Surplus ($ million) is total capital stock and surplus. Leverage is the ratio of total liabilities to total assets excluding liabilities/assets in separate accounts, segregated accounts and protected cell accounts. All variables are winsorized at the 1st and 99th percentiles for the year.

	Life Insurers (1,142)				*P&C Insurers (3,180)*			
Variable	**Mean**	**10th Pct**	**50th Pct**	**90th Pct**	**Mean**	**10th Pct**	**50th Pct**	**90th Pct**
Total Assets	2,642.13	6.45	182.99	7,726.31	601.49	6.24	60.27	1,002.27
RBC Ratio	58.94	4.49	9.68	71.33	81.99	3.68	9.95	206.84
Net Income	28.38	-3.82	1.11	91.60	15.17	-1.10	1.00	26.73
Capital & Surplus	355.31	2.82	35.67	860.70	191.45	3.45	26.71	353.71
Leverage	0.65	0.12	0.79	0.94	0.48	0.05	0.54	0.75

Table 3
S&P Downgrades of RMBS, CMBS, and Corporate Bonds

Number and par value amount of RMBS, CMBS and corporate bonds downgraded from IG (investment grade) to Non-IG (non-investment grade). Note that downgrades in 2012 are only for a partial year, since credit ratings are current as of 9/5/2012. N is the number of securities downgraded. Amount issued is the issuance amount ($M) of downgraded securities (when available in RatingXpress). %Par Value Held Downgraded is the proportion of par value ($M) held at the beginning of the year and downgraded by S&P from IG to Non-IG during a year.

Panel A: All Securities in S&P Ratings Express Downgraded from IG to Non-IG

	RMBS		CMBS		Corporate Bonds	
Downgrade Year	**N**	**Amount Issued**	**N**	**Amount Issued**	**N**	**Amount Issued**
2004	17	148	16	318	195	45,435
2005	20	190	31	360	2,059	181,671
2006	121	1,796	21	229	227	42,264
2007	4,502	59,116	37	725	361	69,265
2008	15,440	437,435	272	13,398	814	237,370
2009	21,761	1,165,972	1,823	111,969	1,350	297,813
2010	4,501	224,960	797	41,788	518	38,736
2011	3,763	218,470	511	25,224	188	63,643
2012	433	18,042	138	10,009	107	54,262

Panel B: Insurer Holdings Downgraded by S&P from IG to Non-IG

Downgrade Year	**RMBS**		**CMBS**		**Corporate Bonds**	
	N	**% Par Value Held Downgraded**	**N**	**% Par Value Held Downgraded**	**N**	**% Par Value Held Downgraded**
2004	4	0.02%	10	0.08%	150	0.74%
2005	7	0.01%	13	0.06%	648	1.55%
2006	42	0.02%	5	0.00%	187	0.97%
2007	474	0.57%	11	0.04%	249	1.18%
2008	2,267	5.57%	82	0.34%	476	1.42%
2009	6,047	28.90%	998	7.11%	705	1.52%
2010	1,469	6.98%	434	2.12%	126	0.34%
2011	1,737	7.84%	290	1.98%	141	0.51%
2012	194	0.53%	87	0.56%	78	0.37%

Table 4

Number of Securities in Each SVO Designation By Regulatory Regime

Number of insurer-security pairs by rating-implied SVO (SVO_{CR}) and valuation-implied SVO (SVO_V) for RMBS in 2009 and 2012, and CMBS in 2010 and 2012. The sample consists of RMBS and CMBS rated by S&P and the rating-implied SVO is calculated using the S&P credit rating at the end of 2009 (RMBS), 2010 (CMBS) or 2012 (both). The valuation implied SVO is dependent on the relationship between the carrying value and the valuation produced by either PIMCO or BlackRock.

Panel A: 2009 for RMBS
15,470 unique securities

SVO_{CR} \ SVO_V	1	2	3	4	5	6
1	1,719	1,46	585	350	125	151
2	1,403	217	135	147	42	66
3	1,188	126	148	164	103	38
4	1,485	118	162	226	130	71
5	4,263	300	554	876	499	525
6	587	17	17	28	20	162

Panel B: 2010 for CMBS
4,087 unique securities

SVO_{CR} \ SVO_V	1	2	3	4	5	6
1	18,23	31	323	156	21	337
2	1,093	84	266	131	76	18
3	572	42	135	160	147	81
4	488	22	35	92	110	136
5	320	4	22	13	51	162
6	107	1	4	3	2	128

Panel B: 2012 for RMBS
13,524 unique securities

SVO_{CR} \ SVO_V	1	2	3	4	5	6
1	1,178	799	460	296	126	211
2	964	159	127	87	42	35
3	924	98	90	65	28	22
4	1,361	147	169	161	132	70
5	5,629	544	732	817	354	428
6	2,166	126	166	284	216	309

Panel D: 2012 for CMBS
3,048 unique securities

SVO_{CR} \ SVO_V	1	2	3	4	5	6
1	15,56	14	123	121	56	164
2	1,612	72	101	64	53	40
3	627	45	79	65	52	25
4	349	13	37	88	71	86
5	331	15	18	29	38	135
6	270	4	3	15	16	176

Table 5
Economic Effect of the Regulatory Change

Panel A shows the amount of Required and Actual Capital saved after the removal of credit ratings for determining capital charges and accounting treatment of RMBS and CMBS. Required capital saved is calculated as the difference between the capital charge under the prior regime using credit ratings and under the new regime using PIMCO/BlackRock valuations. Actual capital saved is defined as the change in adjusted book carrying value of a security moving from fair value to (higher) amortized cost. Panel B shows OTTI, which is other-than-temporary-impairments to the adjusted book carrying value, and unrealized gains and losses. Panel C calculates the net effect of the regulatory change as the savings from both required and actual capital to depletions in asset value due negative OTTI and unrealized losses not due to the savings in actual capital. All numbers are in $ millions.

Panel A: Required and Actual Capital Saved

	RMBS			CMBS			
Year	Required Capital Saved	Actual Capital Saved	Total Capital Saved	Required Capital Saved	Actual Capital Saved	Total Capital Saved	Total Capital Saved
2009	3,751	1,113	4,864				4,864
2010	5,395	778	6,173	(249)	71	(178)	5,995
2011	8,648	1,484	10,132	372	156	528	10,659
2012	9,152	455	9,606	428	55	483	10,090
Total	26,945	3,830	30,775	551	282	833	31,608

Panel B: OTTI and Unrealized Gains and Losses (both RMBS and CMBS)

Year	Net OTTI	Net Unrealized Gains and Losses	OTTI (Impairment)	OTTI (Reversed Impairment)	Unrealized Losses	Unrealized Gains
2008	(10,777)	(1,613)	(10,793)	16	(1,669)	55
2009	(10,597)	(4,063)	(12,523)	1,926	(4,918)	856
2010	(7,400)	(328)	(7,406)	6	(2,800)	2,473
2011	(4,369)	371	(4,371)	1	(1,547)	1,918
2012	(2,819)	1,231	(2,823)	4	(736)	1,967
Total	(35,962)	(4,401)	(37,915)	1,953	(11,670)	7,269

Panel C: Net Effect for both RMBS and CMBS

Year	Cumulative Total Capital Saved (+)	Cumulative OTTI (Impairment) (-)	Cumulative Unrealized Losses (-)	Cumulative Unrealized Gains and Reversed Impairment OTTI not due to Actual Capital Saved (+)	Net Effect	RMBS Par Value Held	CMBS Par Value Held
200	4,864	(23,300)	(6,587)	1,933	(23,106)	189,865	240,86
201	10,859	(30,706)	(9,387)	2,772	(26,479)	162,568	207,12
201	21,518	(35,076)	(10,934)	4,181	(20,327)	167,035	200,14
201	31,608	(37,899)	(11,670)	7,320	(10,657)	151,038	183,91

Table 6
Effect of Asset Write-Downs on Required Capital Saved

OLS regressions where the dependent variable is either the amount of the initial required capital saved in 2009 scaled by total assets (columns (1) and (2) or incremental required capital saved scaled by par value from 2010-2012 (columns (3) and (4)). Required capital saved is calculated as the dollar difference between the capital charge for each RMBS or CMBS under the prior regime using credit ratings (SVO_{CR}) and under the new regime using PIMCO/BlackRock valuations (SVO_V). OTTI is other-than-temporary impairments and write-downs are the sum of OTTI and any unrealized losses as reported on Schedule D. TA is total assets. PC is an indicator variable equal to 1 if the insurer is a P&C insurer, 0 otherwise. Year_2010 and Year_2011 are indicator variables that equal 1 in 2010 and 20911 respectively, and 0 otherwise. Two time periods are examined: 2009, to capture the initial effect of the regime shift, and 2010-2012, to capture the follow-on impact. Standard errors are clustered by insurance company. *,**, and *** indicate statistical significant at the 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)
Variables	2009	2009	2010-2012	2010-2012
$OTTI/TA_t$	0.078***		46.502*	
	(3.33)		(1.73)	
$OTTI/TA_{t-1}$	0.039***			
	(7.78)			
Write-downs/TA_t		0.064***		38.205**
		(4.19)		(2.01)
Write-downs/TA_{t-1}		0.037***		
		(5.82)		
$Ln(TA_{t-1})$	-0.001	-0.0001	0.120***	0.120***
	(-0.85)	(-0.96)	(6.87)	(6.88)
PC	-0.001***	-0.001***	-0.207***	-0.209***
	(-3.59)	(-3.89)	(-7.31)	(-7.54)
Year_2010			0.061***	0.055***
			(2.88)	(2.53)
Year_2011			0.144***	0.144***
			(6.80)	(6.78)
Intercept	0.002	0.002	-2.129***	-2.124***
	(1.43)	(1.50)	(-6.56)	(-6.56)
N	1,232	1,232	4,341	4,341
R^2	0.101	0.120	0.157	0.156

Table 7
Probability of Selling Downgraded Securities

Probit model specification where the dependent variable is equal to 1 if the insurance company holding a downgraded security sells it within three months of the downgrade. ΔRBC Ratio is the difference between actual RBC ratio under the new regime and hypothetical RBC ratio under the old regime. RBC Ratio is the actual to required capital ratio. TA is total assets. PC is an indicator variable equal to 1 if the insurer is a P&C insurer, 0 otherwise. % Risky Assets is the percentage of all investment assets with reported SVO in the 3-6 range. Maturity is the number of years to the security's maturity date. Issue Size is amount of security originally issued. All firm characteristics are measured at the year-end prior to downgrade. All security characteristics are measured at the quarter-end prior to downgrade. Standard errors are clustered by insurance company. *,**, and *** indicate statistical significant at the 10%, 5%, and 1% level.

Variables	(1) Corporate Bonds	(2) RMBS and CMBS
ΔRBC Ratio$_t$	-0.029 (-0.76)	-0.065*** (-2.85)
Ln(RBC Ratio)	0.165* (1.78)	0.025 (0.42)
Ln(TA)	-0.072*** (-3.12)	-0.060*** (-3.50)
PC	-0.430*** (-3.45)	-0.090 (-1.10)
% Risky Assets	-3.079** (-2.15)	-1.456 (-1.04)
Ln(Maturity)	0.067 (1.23)	-0.265*** (-3.48)
Ln(Issue Size)	0.762*** (6.11)	0.395*** (16.94)
Constant	-17.974*** (-14.51)	-1.031* (-1.78)
State FE	Y	Y
SVO_{CR} FE	Y	Y
Year-quarter FE	Y	Y
Observations	2,085	6,252
Pseudo R-squared	0.469	0.226

Table 8
Probability of Gains Trading by Life Insurers

Probit model specification where the dependent variable is equal to 1 if a life insurance company sells a corporate bond, 0 otherwise. UG Rank is the percentile of unrealized gain of bond i in life insurance company j's (non-government) debt portfolio. Crisis is an indicator variable equal to 1 for the quarters 2007Q3 to 2009Q4 and 0 otherwise. Reg Change is an indicator variable equal to 1 for the period after the regulatory change (2010Q1 to 2012Q4), 0 otherwise. ΔRBC Ratio is the difference between actual RBC ratio under the new regime and hypothetical RBC ratio under the old regime and winsorized at the 99% level from 2009 onward, 0 otherwise. ABS Exposure is calculated in the same way as in Ellul et al. (2013a) in the replication specifications but in the last two specifications ABS exposure is calculated as the percentage of the bond portfolio invested in asset-backed securities (ABS) not held at fair value *when carrying value is higher than fair value*, measured in market value terms. Low RBC Ratio is an indicator variable equal to1 if the insurer's actual to required capital ratio is in the bottom quartile for the sample, 0 otherwise. Bankrupt is an indicator variable equal to 1 if the issuer of the bond files for bankruptcy, 0 otherwise. Downgrade is an indicator variable equal to 1 if the bond is downgraded by S&P from IG to non-IG, 0 otherwise. Age is the number of years from bond issuance. Maturity is the number of years to the bond's maturity date. Issue Size is the bond amount originally issued. Capital Surplus is the insurer' total capital and surplus. % Risky Assets is the percentage of all investment assets with reported SVO in the 3-6 range. Leverage is the insurer's total liabilities to total assets. ROE the ratio of net income to book value of common stock. All time-varying firm characteristics are measured at the year-end prior to sale. All time-varying security characteristics are measured at the quarter-end prior to sale. Standard errors are clustered by insurance company. *,**, and *** indicate statistical significant at the 10%, 5%, and 1% level.

Variables	(1) EJLW 2013a Replication	(2) EJLW 2013a Replication (Extended Sample Period)	(3) Whole Sample Period	(4) Subsample Post Regulatory Change
UG Rank	-0.147***	-0.148***	-0.184***	-0.257***
	(-5.38)	(-5.38)	(-8.20)	(-8.13)
Crisis	-0.032	-0.031	-0.121***	
	(-0.85)	(-0.86)	(-2.72)	
UG Rank x Crisis	0.308***	0.305***	0.339***	
	(9.70)	(9.52)	(12.50)	
Reg Change		0.070		
		(1.44)		
UG Rank x Reg Change		-0.132***		
		(-3.40)		
ΔRBC Ratio			0.029**	0.014
			(2.06)	(0.95)
ΔRBC Ratio x UG Rank			-0.058***	-0.037*
			(-2.64)	(-1.80)
ABS Exposure	0.512***	0.667***	0.975***	1.732***
	(3.77)	(4.64)	(4.91)	(4.22)
Low RBC Ratio	0.049*	0.042	0.042	0.058
	(1.79)	(1.61)	(1.59)	(1.11)
Bankrupt	0.263***	0.191***	0.190***	-0.447***
	(4.16)	(3.24)	(3.23)	(-2.62)
Downgrade	0.222***	0.188***	0.185***	0.038
	(10.38)	(8.90)	(8.72)	(0.81)
Ln(Age)	-0.098***	-0.091***	-0.091***	-0.078***
	(-16.82)	(-15.68)	(-15.62)	(-10.24)
Ln(Maturity)	-0.046***	-0.060***	-0.060***	-0.089***
	(-7.21)	(-9.08)	(-9.07)	(-8.98)
Ln(Issue Size)	0.080***	0.077***	0.078***	0.074***
	(12.50)	(12.63)	(12.64)	(8.18)
Ln(Capital Surplus)	0.022**	0.016*	0.018*	0.003
	(2.20)	(1.74)	(1.92)	(0.21)
% Risky Assets	0.108	0.149	0.134	0.088
	(0.97)	(1.17)	(1.07)	(0.41)
Leverage	-0.071	-0.123	-0.115	-0.258**
	(-0.90)	(-1.60)	(-1.51)	(-2.31)
ROE	-0.000	-0.000	-0.000	0.000
	(-0.16)	(-0.47)	(-0.10)	(0.15)
Constant	-2.121***	-1.043***	-1.040***	-0.674**
	(-9.11)	(-5.46)	(-5.71)	(-2.43)
SVO_{CR} FE	Y	Y	Y	Y
Year-quarter FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Observations	3,103,500	4,874,905	4,874,905	1,771,241
Pseudo R-squared	0.0470	0.0504	0.0503	0.0599

Table 9
Probability of Raising External Capital

Probit model specification where the dependent variable equals 1 if an insurance company raised capital either through surplus notes or paid-in capital, 0 otherwise. Crisis is an indicator variable equal to 1 for the quarters 2007Q3 to 2009Q4, 0 otherwise. Reg Change is an indicator variable equal to 1 for the period after the regulatory change (2010Q1 to 2012Q4), 0 otherwise.). ΔRBC Ratio is the difference between actual RBC ratio under the new regime and hypothetical RBC ratio under the old regime from 2009 onward, 0 otherwise. RBC Ratio is actual to required capital ratio. ROA is net income to total assets. Ind Neg NI is an indicator variable equal to 1 if net income is negative, 0 otherwise. Chg Net Premiums is the annual percentage change in net premiums collected. TA is total assets. Ind % Annty is an indicator variable equal to1 if the proportion of premiums collected from selling annuities is in the 90th percentile, 0 otherwise. Ind Mutual is an indicator variable equal to 1 if an insurance company is a mutual, 0 otherwise. Ind Grp Member is an indicator variable equal to1 if an insurance company is affiliated with a group of other insurers, 0 otherwise. All time-varying firm characteristics are measured at the year-end prior to issuance. Standard errors are clustered by insurance company. *,**, and *** *,**,*** indicate statistical significant at the 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Life	P&C	Life	P&C	Life	P&C
Variables	2005-2012	2005-2012	2005-2012	2005-2012	2010-2012	2010-2012
Crisis	-0.013	-0.088*	-0.012	-0.088*		
	(-0.18)	(-1.93)	(-0.17)	(-1.93)		
Reg Change	-0.298***	0.069	-0.229***	0.071		
	(-4.04)	(1.55)	(-3.00)	(1.57)		
ΔRBC Ratio			-0.110***	-0.016	-0.078**	-0.030
			(-2.81)	(-0.41)	(-2.12)	(-0.76)
Ln(RBC Ratio)	-0.123***	-0.143***	-0.116***	-0.142***	-0.107**	-0.093***
	(-3.48)	(-8.52)	(-3.29)	(-8.47)	(-2.00)	(-3.79)
ROA	-0.145	-0.045	-0.149	-0.045	-1.231*	-1.558***
	(-0.97)	(-0.74)	(-1.00)	(-0.75)	(-1.72)	(-3.21)
Ind Neg NI	0.583***	0.376***	0.582***	0.376***	0.487***	0.332***
	(11.37)	(11.27)	(11.35)	(11.27)	(5.33)	(5.35)
Chg Net Premiums	-0.000	0.000	-0.000	0.000	-0.000	0.000
	(-1.07)	(1.38)	(-1.05)	(1.38)	(-1.03)	(1.25)
Ln(TA)	0.080***	0.033***	0.083***	0.034***	0.035*	0.009
	(6.36)	(2.80)	(6.56)	(2.81)	(1.82)	(0.52)
Ind % Annty	0.165**		0.177**		0.025	
	(2.39)		(2.55)		(0.21)	
Ind Mutual	-0.460***	-0.694***	-0.465***	-0.694***	0.006	-0.809***
	(-2.83)	(-10.50)	(-2.87)	(-10.51)	(0.03)	(-8.46)
Ind Grp Member	0.325***	-0.211***	0.329***	-0.212***	0.472***	-0.212***
	(5.40)	(-4.75)	(5.46)	(-4.76)	(4.58)	(-3.37)
Constant	-2.431***	-1.223***	-2.517***	-1.226***	-1.911***	-0.785**
	(-8.67)	(-5.50)	(-8.86)	(-5.51)	(-4.56)	(-2.50)
Year FE	Y	Y	Y	Y	N	N
Observations	7,699	20,791	7,699	20,791	2,173	6,752
Pseudo R-squared	0.103	0.0672	0.105	0.0672	0.0748	0.0706

Table 10
Average Credit Rating SVO of Securities Purchased

OLS regressions where the dependent variable is the weighted average credit-rating-implied SVO for RMBS, CMBS and corporate bond secondary-market purchases for each insurer. Reg Change (RMBS) is an indicator variable equal to 1 for the period after the RMBS regulatory change, 2009-2012. Reg Change (CMBS) is an indicator variable equal to 1 for the period after the CMBS regulatory change, 2010-2012. ΔRBC Ratio is the difference between actual RBC ratio under the new regime and hypothetical RBC ratio under the old regime from 2009 onward, 0 otherwise. TA is total assets. Low RBC Ratio is an indicator variable equal to 1 if the insurer's actual to required capital ratio is in the bottom quartile for the sample, 0 otherwise. ROE the ratio of net income to book value of common stock. Capital Surplus is the insurer's total capital and surplus. PC is an indicator variable equal to 1 if the insurer is a P&C insurer, 0 otherwise. All time-varying firm characteristics are measured at the year-end prior to issuance. Standard errors are clustered by insurance company. *,**, and *** indicate statistical significant at the 10%, 5%, and 1% level.

Variables	(1) RMBS 2005-2012	(2) RMBS 2009-2012	(3) CMBS 2005-2012	(4) CMBS 2010-2012	(5) Corporate Bonds 2005-2012	(6) Corporate Bonds 2010-2012
Reg Change (RMBS)	1.516***				0.185***	
	(13.92)				(12.28)	
Reg Change (CMBS)			0.290***			
			(7.30)			
ΔRBC Ratio		0.232***		-0.010		0.009
		(5.18)		(-0.71)		(1.24)
Ln(TA)	0.090***	0.279***	0.050***	0.110***	0.063***	0.064***
	(3.33)	(3.11)	(5.24)	(3.95)	(6.22)	(4.70)
Low RBC Ratio	-0.004	0.051	-0.001	-0.014	-0.005	-0.003
	(-0.11)	(0.39)	(-0.07)	(-0.29)	(-0.42)	(-0.17)
ROE	-0.000	0.000	0.000***	0.000***	0.000***	0.000***
	(-1.25)	(0.32)	(10.28)	(5.83)	(9.41)	(7.60)
Ln(Capital Surplus)	-0.032	-0.159	-0.029***	-0.073**	-0.005	-0.008
	(-0.97)	(-1.54)	(-2.73)	(-2.44)	(-0.43)	(-0.48)
PC	-0.037	0.082	0.019	0.021	-0.116***	-0.112***
	(-0.81)	(0.55)	(1.26)	(0.55)	(-6.85)	(-4.79)
Constant	-1.309***	2.601***	0.856***	0.596***	0.075	0.288***
	(-6.05)	(4.39)	(4.52)	(2.90)	(1.03)	(3.07)
Year FE	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	2,645	722	3,851	1,196	14,482	5,203
Adjusted R-squared	0.304	0.174	0.084	0.059	0.155	0.135

Table 11
Percentage of Purchases of Non-Investment Grade Securities

OLS regressions where the dependent variable is the percentage of all secondary market purchases that are non-investment grade RMBS, non-investment grade CMBS, or non-investment grade corporate bonds for each insurer. Reg Change (RMBS) is an indicator variable equal to 1 for the period after the RMBS regulatory change, 2009-2012. Reg Change (CMBS) is an indicator variable equal to 1 for the period after the CMBS regulatory change, 2010-2012. ΔRBC Ratio is the difference between actual RBC ratio under the new regime and hypothetical RBC ratio under the old regime from 2009 onward, 0 otherwise. TA is total assets. Low RBC Ratio is an indicator variable equal to 1 if the insurer's actual to required capital ratio is in the bottom quartile for the sample, 0 otherwise. ROE the ratio of net income to book value of common stock. Capital Surplus is the insurer's total capital and surplus. PC is an indicator variable equal to 1 if the insurer is a P&C insurer, 0 otherwise. All time-varying firm characteristics are measured at the year-end prior to issuance. Standard errors are clustered by insurance company. *,**, and *** indicate statistical significant at the 10%, 5%, and 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
	RMBS	RMBS	CMBS	CMBS	Corporate Bonds	Corporate Bonds
Variables	2005-2012	2009-2012	2005-2012	2010-2012	2005-2012	2010-2012
Reg Change (RMBS)	0.152***				0.483***	
	(4.52)				(2.92)	
Reg Change (CMBS)			0.009**			
			(2.07)			
ΔRBC Ratio		0.404***		0.015*		-0.078
		(3.13)		(1.76)		(-1.14)
Ln(TA)	0.111**	0.270**	0.007**	0.016**	0.304	0.342
	(2.16)	(2.10)	(2.52)	(2.58)	(1.51)	(1.56)
Low RBC Ratio	0.060	0.249*	0.001	0.001	0.274*	0.456*
	(1.05)	(1.66)	(0.16)	(0.11)	(1.80)	(1.77)
ROE	-0.000***	-0.000**	-0.000***	-0.000**	0.000***	0.000***
	(-5.73)	(-1.98)	(-2.80)	(-2.26)	(3.09)	(2.81)
Ln(Capital Surplus)	-0.042	-0.116	-0.003	-0.012*	0.202	0.227
	(-0.66)	(-0.73)	(-1.27)	(-1.88)	(0.83)	(0.86)
PC	-0.051	-0.002	-0.000	-0.003	-1.353***	-1.410***
	(-1.29)	(-0.02)	(-0.11)	(-0.72)	(-4.23)	(-3.57)
Constant	-1.509***	-2.306***	-0.066***	-0.062**	-7.838***	-8.482***
	(-4.24)	(-2.89)	(-3.72)	(-2.27)	(-7.93)	(-6.34)
Year FE	Y	Y	Y	Y	Y	Y
State FE	Y	Y	Y	Y	Y	Y
Observations	17,293	6,285	17,293	6,285	17,293	6,285
Adjusted R-squared	0.018	0.036	0.002	0.009	0.052	0.053