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REPLACING RATINGS

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ABSTRACT

Since the financial crisis, replacing ratings has been a key item on the regulatory agenda. We examine a unique change in how capital requirements are assigned to insurance holdings of mortgage-backed securities. The change replaced credit ratings with regulator-paid risk assessments by Pimco and BlackRock. We find no evidence for exploitation of the new system for trading purposes by the providers of the credit risk measure. However, replacing ratings has led to significant reductions in aggregate capital requirements: By 2012, equity capital requirements for structured securities were at $3.73bn compared to of $19.36bn if the old system had been maintained. These savings reflect the new measures of risk, and new rules allowing companies to economize on capital charges if assets are held below par. These book-value adjustments dilute the predictive power of the underlying risk measures, Our results are consistent with a regulatory change being largely driven by industry interests rather than maintaining financial stability.

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Reducing the reliance on ratings in financial regulation has been a key element of the world-wide regulatory agenda following the poor performance in the financial crisis of ratings on structured products by major credit rating agencies (CRA). Most notably, the Dodd-Frank-Act in the U.S. explicitly mandates federal agencies to remove references to ratings from rules to the extent possible. So far, the mandate of "replacing ratings" has not received much traction, mainly because of the lack of tested, viable alternatives (OCC, 2012).

This paper aims to contribute to the search for viable alternatives to ratings by analyzing a fundamental change in how capital requirements work for U.S. insurers. In 2009, the National Association of Insurance Commissioners (NAIC)[1] overhauled the system for capital requirements for structured securities: One of the key features of the reform was to replace ratings through risk assessments by PIMCO (for residential mortgage-backed securities, RMBS, since 2009) and BlackRock (for commercial mortgage-backed securities, CMBS, since 2010).[2] In this new system a second important feature was instituted: capital requirements do not only depend on *security-specific* "expected loss" measures provided by PIMCO and BlackRock, but also are also a decreasing function of the *insurer-specific* book value. Roughly speaking, the new regulation achieves that an insurer's capital requirement for a security equals the difference between the book value of a security and the "intrinsic value" based on the risk assessments. As our analysis reveals, both of these components are important to understand our results.

This regulatory change in capital regulation should offer insights that are relevant above and beyond the insurance industry, in particular for the banking industry. The new model, based on credit risk measures for which the "regulator pays" (instead of using credit ratings for which the "issuer pays"), may offer a method for replacing ratings in financial regulation more generally. The insurance industry's experience provides a laboratory for assessing the costs and benefits of one particular alternative to rating-contingent regulation. How good are the alternative measures of credit risk? Can the apparent conflicts of interest involved when regulation relies on risk assessment performed by large investors be handled effectively by the regulator? Additionally, the change occurred at a time of severe stress for the industry, and thus provides an opportunity to study the political economy of financial regulation under imperfect conditions and with conflicting agendas.

Why did the regulator target the regulation towards the RMBS and CMBS markets? First, structured securities represent a key component of insurers' asset portfolios: in 2012, structured securities were 18.5% of assets (RMBS and CMBS constituted about half of this), second only to corporate bonds, and ahead of government bonds, stocks, real estate, etc. Because many assets in insurance companies' portfolios are safe (e.g., treasuries, agency MBS) and carry the lowest possible capital requirements, non-agency MBS represent most of the capital requirements for insurers, in particular after unprecedented downgrades of RMBS securities whose capital requirements were mechanically related to ratings (under the old system). The officially stated

[1] The NAIC is a coordinating body for state level regulators. Despite lacking formal authority, for practical purposes, the NAIC, does much technical regulatory work, such as developing and implementing the risk based capital system.

[2] For non-structured securities, ratings are still used.

aims for the new system were (i) to avoid using ratings in the wake of poor performance for mortgage-backed securities issued before the financial crisis, and (ii) to reduce capital requirements for positions carried on insurance companies' books at below par. The second change aimed, among other things, to facilitate participation in the secondary market for securities with depressed values.

Our main findings can be summarized as follows. The first building block is concerned with the aggregate effects of the regulatory change. We document that it generated a dramatic decrease in aggregate capital requirements. In 2009, aggregate risk-based charges (RBC) for RMBS was reduced by 67% compared to a maintained ratings-based system, translating into equity capital savings of $7.6bn.[3] This gap between the two systems has been steadily increasing over time, as capital requirements under the new system remained flat but ratings of MBS continued to fall in line with continued losses and defaults. By 2012, total capital requirements for RMBS and CMBS were at $3.73bn compared to hypothetical ratings-based charges of $19.36bn, implying large savings of $15.63bn! These savings were driven almost entirely by a 90% reduction in capital requirements for non-agency RMBS. Two companies alone, Met Life and Teachers Insurance and Annuity Association, jointly saved $3bn in capital requirements. The new system thus achieved massive capital relief for the industry at a time when it faced very large losses and was struggling to meet regulatory requirements.[4] To the extent that the regulator is responsive to such industry concerns (e.g., "captured" as in Stigler, 1971), these capital savings may be well explained by political economy considerations. One industry commentator raised this issue in 2010: *"They take one class of securities and change the rules [to give] insurers capital relief. Let's just hope they aren't picking something out that results in inadequate capital"* (Wall Street Journal 2010).

The second building block of our paper analyzes the properties of the new measure of risk. For each CUSIP, PIMCO and BlackRock provide an estimate of its discounted expected loss (ELOSS). To our knowledge, we are the first study that examines this alternative to ratings: Is ELOSS superior to ratings, as the NAIC had envisaged? On the one hand, we find that ELOSS is a useful measure to predict cross-sectional defaults of RMBS and CMBS securities and even contains some informational content that is not already in ratings and market prices. Moreover, we cannot find any evidence for exploitation of their quasi-regulatory powers by PIMCO and BlackRock for their own trading purposes. On the other hand, we also do not find that ELOSS "outperforms" ratings in a horserace. Thus, our analysis cannot find evidence for more accurate *inputs* to regulation. With regards to the *output* from regulation, our results are more clear-cut: The transformation of the inputs by the regulator via "book-value adjustments" significantly dilutes the usefulness of ELOSS: Our empirical analysis reveals that the old system was better

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[3] This number is an approximation, disregarding various details of regulation, in particular covariance adjustments and the fact that insurers need to hold *twice* as much capital as risk based charges to avoid possible regulatory intervention (see Section 1.1 and Appendix A2). We choose this set of numbers to make them comparable to the official numbers on capital savings provided by the NAIC (which we match).

[4] See Koijen and Moto (2012) as well as Ellul et al. (2013) for evidence on binding (regulatory) capital constraints of the insurance industry during the financial crisis.

able to discriminate between risks. As a result, the old system based on ratings not only provided higher levels of capital, but also ensured that capital was more appropriately related to risks.

We will now summarize the results. First, to assess whether the new system deals appropriately with the heterogeneity of risks, we examine the risk measure's ability to predict defaults. The period from 2010 to 2012 offers an excellent setting for comparing measures of credit risk: due to the large number of defaults and impairments our tests have considerable statistical power. We compare the underlying measure, ELOSS, to credit ratings as well as the transformation of each into the new system and old system (i.e., counterfactual) capital requirements. We rely on three measures of performance: (a) defaults up to three years ahead using the Griffin et al. (2013) methodology; (b) realized losses (see He et al., 2013) up to three years ahead; and (c) prices at which the securities trade contemporaneously. Against all three benchmarks, the new risk metrics perform well. Generally, ratings and expected losses simultaneously predict performance (i.e., both are statistically significant when included simultaneously in predictive regressions). The new measures show higher correlation with current market prices but less with future defaults. Thus the information contained in expected losses is only partially contained in ratings, and vice versa. When we use the transformation of ELOSS into RBC measures for individual securities, including book value adjustments under the new system, the new system appears worse, and sometimes much worse, at sorting securities. Capital requirements do not show much evidence of being higher for those securities which later default or show losses. This dilution of predictive power is in particular true for CMBS securities. We thus conclude that the book value adjustments incorporated in the new system appear to be problematic.

The dual role of BlackRock and PIMCO as investors and raters suggests a new conflict of interest resulting from the ability of the rater to directly influence the regulatory constraints of their counterparties in the market.[7] However, we do not find evidence for these conflicts in the cross-sectional distribution of risk assessments. For both Pimco and BlackRock, securities with low expected losses tend to be those where the firm has current long exposure as well as future net purchases. In other words, there are no signs of strategic use of expected losses to influence prices of securities that the firms plan to sell. To the contrary, we find evidence consistent with ELOSS incorporating information that predicts *future* purchasing plans.[8] One may interpret this (non-existence) result as a consequence of the different payment model: the "regulator-pays" model should align the objectives of the regulator and the raters better than in the issuer-pays model.[9] To the extent that the regulator "cares" about the insurers, this may also explain a somewhat puzzling finding: we find evidence that BlackRock and Pimco tend to provide more favorable risk assessments for securities with larger holdings by the insurance industry (controlling for other observable characteristics such as ratings, market prices, holdings of the

[7] Rating agencies are not involved in any trading activities.

[8] A more subtle agency problem, where favorable (low) expected losses are assigned to assets that a firm holds, but does not intend to sell, is difficult to identify. The positive correlation between holdings and risk assessments is consistent with this, but also with many other mechanisms.

[9] Opp, Opp, Harris (2013) show that the issuer-pays model can lead to rating-inflation once investors are sufficiently constrained by regulation.

PIMCO/BlackRock and security-specific controls). It seems highly unlikely that insurance holdings convey information above and beyond these control variables. However, the result is consistent with an objective of targeted relief of capital requirements for insurance companies.

Finally, we analyze the effect of capital requirements on the portfolio choice of insurance companies following influential papers by Ellul et al. (2011, 2013). We find evidence that the changes in capital requirements appear to have affected capital allocations by insurance companies. Because selling may reflect earnings management and gains trading (Ellul et al., 2013), we focus on buying, and find that securities that receive reduced capital requirements were disproportionately acquired by insurers, but not by mutual funds or pension funds, after the new system was implemented. This is in line with findings that insurance companies' holdings of corporate bonds respond to regulatory capital (see Ellul et al., 2011, and Becker and Ivashina, 2012). Because the trading is in response to security-level changes in ratings caused by a system-wide overhaul, this offers particularly clean evidence on the impact of regulations on financial sector investment behavior and risk taking.

Our study complements the literature on the interconnection between regulation and insurance company decisions during the financial crisis. The existing literature primarily shows how an *existing* set of regulatory rules affects the behavior of constrained insurance companies, such as product market decisions (see Koijen and Moto, 2012 for evidence on underpricing of life annuities) or portfolio decisions (see Ellul, et al. (2011, 2013)). One interpretation of the whole set of results is that the unprecedented scale of the crisis was such that the "arbitrage behavior" within existing rules was insufficient to address the shortage of capital in the system. In consequence, *new* capital rules were necessary to restore formal solvency of the insurance industry (of course, reducing capital requirements does not help actual solvency).

Our analysis proceeds as follows. Section 1 provides a brief summary of capital requirements for US insurers. Since this is the first academic paper to study the new RBC system for mortgage backed securities, we also include a detailed description of the changes in this section. Section 2 describes our different data sources used in our empirical analysis. All empirical results are shown in Section 3. We provide conclusive thoughts in Section 4.

1 Capital requirements for U.S. insurers

Similar to banks, insurance companies across the world are subject to capital requirements to protect policy holders (and implicitly the tax payer) from excessive risk-taking driven by insufficient equity cushions. To put our analysis into context, we first provide a concise description of overall capital requirements of insurance companies in the US (see Section 1.1) before highlighting the change in the regulatory treatment of non-agency RMBS securities in Section 1.2. A normative discussion of the regulatory change and its empirical implications are delegated to Section 1.3 and 1.4, respectively. To make the paper accessible to a wide finance audience, we refrain from using insurer-specific language to the extent possible.

1.1 Capital requirements for U.S. insurance companies

Since 1994 the NAIC uses a risk-based capital system to regulate insurance companies, similar to the Basel guidelines for bank capital requirements. For all insurer types (Life, Property & Casualty (P&C) and Health Insurers) appropriate capitalization is measured by the RBC ratio, which relates book equity, precisely total adjusted surplus, to a measure of total risk σ:

$$\text{RBC ratio} = \frac{\text{Equity}}{\sigma}$$

Our study is primarily concerned about the denominator of the RBC ratio, i.e., σ, the measurement of risk, technically labeled *risk-based capital requirement.* Despite the difference of relevant risk sources across types of insurers, the determination of this requirement for all types of insurers can be expressed as:

$$\sigma = R_0 + \sqrt{\sum_{i=1}^{n} R_i^2}$$

Here R_i represents risk charges for all different risk sources that an insurer faces, i.e., asset risks, underwriting risk as well as well as business risk. For example, for a P&C insurer R_0 to R_2 represent asset risks (from affiliate companies, fixed income, and equities, respectively) whereas categories R_3 to R_5 account for credit risk, reserving risk and premium risk (See Appendix A.1). The (square-root) formula for RBC suggests that total risk (σ) can be roughly interpreted as volatility, assuming that the risk components 1 to 5 have zero correlation.[11]

The RBC ratio is computed for all insurance companies at an annual level. When equity falls short of two times risk-based capital, i.e., $\text{RBC ratio} \leq 2$, the regulator has the right to intervene in the business of the insurer. The harshest form of intervention, i.e., placing the insurer directly under regulatory control, is mandated if the RBC ratio drops below 0.7 (see Appendix A.2. for the entire list of possible regulatory interventions).

1.2 Measurement of fixed income risk

The regulatory "experiment" that we are analyzing governs the change in the determination of RBC charges for structured securities, a subcategory of fixed income. The $ risk-based charge (RBC) for non-treasury fixed income security is a product of its book value (BV), technically the book-adjusted carrying value, and a percentage risk-based capital (RBC%) as an increasing function of the NAIC risk classification (1-6), as illustrated by Table 1. Here, NAIC category 1 refers to the lowest risk class and NAIC 6 represents the highest risk category.[12] For "historical reasons" the risk-based charges for life insurance companies differ from the risk-based charges of P&C insurers, as columns 2 and 3 in Table 1 illustrate.

[11] The term R0 is outside of the square root to prohibit regulatory arbitrage via the legal structure of companies.

[12] Holdings of US treasuries are not subject to a risk-based charge.

For example, a NAIC 4 bond with a book value of $100 would command a $10 RBC charge if held by a life-insurance company and only $4.5 if held by a P&C insurer. This compares with $15 for every $100 invested in equities. The total fixed income charge of an insurer with N bonds would thus be given by

$$R_1 = \sum_{j=1}^{N} \text{RBC}_j = \sum_{j=1}^{N} \text{BV}_j \text{RBC\%}_j$$

What determines the NAIC risk classification of a bond? Prior to year-end 2009, these risk classifications were exclusively determined by ratings of acceptable ratings organizations (AROs) as illustrated in the fourth column of Table 1.[13] That is, a AA-rated bond received a NAIC1 designation whereas a B-rated bond was considered NAIC4.[14] While corporate bond risk classifications still follow this classification scheme, the NAIC started using a new system for RMBS and CMBS.

Following unprecedented downgrades of structured securities by rating agencies in 2008/2009, the NAIC decided to make fundamental changes in how to classify the risk of RMBS securities: In the fall of 2009, the NAIC solicited bids for the business of assessing the risk of roughly 18,000 RMBS requiring that the bidders have five years of experience, have safeguards against conflicts of interest, and be financially sound.[15] PIMCO was eventually selected for 2009 capital requirements or RMBS and has performed this function since. In a similar process BlackRock was selected to assess risks for CMBS in 2010.

Before we describe the details of the new regulation, we want to highlight that the regulation can essentially be understood in two basic steps. First, the risk assessment by PIMCO (BlackRock) determines the intrinsic value of each security for regulatory purposes, i.e., a proxy for the market price. Second, "risk" of a security is defined as the difference between the book value and the intrinsic value. Thus, as long as the book value is sufficiently close to the intrinsic value, a security is essentially deemed "riskless."

Both BlackRock and PIMCO provide risk assessments called "expected losses." For each security, they first estimate losses of principal in 5 macro-states of the economy.[16] These state contingent losses are then mapped into a single expected loss variable by discounting the losses with the coupon rate of the bond and weighing them with the probability of the respective

[13] In March 2013, AROs were Moody's, Standard and Poor's, Fitch, DBRS, A.M. Best, RealPoint, and Kroll Bond Rating Agency, largely the same set of CRAs as those designated nationally recognized statistical ratings organizations (NRSROs) by the SEC.

[14] When two ratings are available, the lower one is used. When three or more ratings are available, the second lowest is used.

[15] There were bids from twenty vendors, of which eleven were short-listed and subject to analysis by NAIC and a financial consultant. This set was narrowed to four, which were assessed based on their valuation of individual securities.

[16] The base case scenario occurs with 50%. There are also 2 more aggressive as well as 2 more conservative scenarios (with respectively, 2.5% and 22.5% probability). The NAIC has control over how to define the scenarios, which might also change from year to year.

scenario.[17] We define this main input variable as ELOSS. The regulator only uses state contingent losses through this summary statistic.

Within the new regulation, ELOSS essentially determines the "intrinsic value" (IV) of a security (relative to the par value):

$$\text{IV} = 1 - \text{ELOSS}$$

Thus, the intrinsic value of a bond with 30% expected loss is given by 70% of par. The regulatory risk classification of bond j for insurer i now depends on the scaled difference Δ between the (insurer-specific) book value of a security, $\text{BV}_{i,j}$ (per value of par), and the intrinsic value of the security j.

$$\Delta(\text{BV}_{i,j}) = \frac{\text{BV}_{i,j} - \text{IV}_j}{\text{BV}_{i,j}}.$$

The formula suggests that Δ can be interpreted as book-value adjusted expected loss. If an insurer holds a bond at par, i.e., BV=1, then Δ just coincides with ELOSS. The lower the book value, the lower the book-value adjusted expected loss. The cutoff values for $\Delta(\text{BV})$ corresponding to the NAIC risk categories are listed in the fourth and fifth column of Table 1.[18] Since the book value of an insurer depends on accounting practices (which differ across Life and P&C insurers, see Ellul et al., 2013), the same security j can have different risk classifications for different insurers![19]

To understand the magnitudes of the risk based charge, observe that the cutoffs (in Table 1) are simply the average of the respective adjacent NAIC RBC% charges, so that $\text{RBC\%} \approx \Delta(\text{BV})$. As a result, the regulation roughly accomplishes that the RBC charge (in USD) is equal to the difference between the intrinsic value and the book value, i.e.,

$$\text{RBC}_j \approx \text{BV}_j - \text{IV}_j.$$ [20]

In Table 2, we consider an example that illustrates the effect of variation in the book value on the RBC% charge for Life and P&C insurers. It reveals that the just described approximation captures the main effect of the book-value adjustment. This book-value adjustment of RBC charges is explicitly advertised by the NAIC as a key ingredient of the reform to avoid double-

[17] We will discuss the potential bias resulting from this choice of discount rate in Section 1.3.
[18] There is one exception to the just described mechanics of book-value adjustments: If a security has zero expected loss, then it belongs in the NAIC 1 category regardless of the book value.
[19] Interestingly, there exists a convoluted feedback loop since accounting practices depend on the risk designation: If a security's risk classification using the amortized cost value is below NAIC 5 (2) for Life and P&C insurers, respectively, then the security has to be marked to market. Since the book value is now at the market price, the risk category using the market value is typically more favorable than the initial risk category using amortized cost.
[20] Of course, this only applies for securities that are carried above the intrinsic value.

punishing insurers, which are "already" dealing with lower capital as a result of marking their asset values down to market.

In brief, two major changes occurred for capital requirements of RMBS / CMBS securities. First, risk assessments are now provided by PIMCO and BlackRock as opposed to rating agencies. Secondly, the risk designation of a bond now directly depends on the book values (and as such on accounting practices).

1.3 RBC design and true asset risk

As the description of the new system revealed, risk charges essentially only apply to losses that are expected to occur, but are not yet recognized in the books. As a result, fixed-income risk charges for structured securities do not provide a buffer against *unexpected* future losses (higher moments of the loss distributions). It is easiest to show the imperfections of the "old" and "new" system using a stylized example with two types of zero-coupon bonds:

- Bond 1: Default probability = 50%, Recovery Rate = 0, BV = 0.5
- Bond 2: Default probability = 100%, Recovery Rate = 50%, BV = 0.5

Although both bonds have high default probabilities (and hence low ratings), basic finance theory tells us that only bond 1 is risky whereas bond 2 is essentially a risk-free bond with payoff 50.[22] Under the old system, bond 2 would be wrongly classified as "risky." Thus, regulation would be too "stringent." Under the new system, both bonds have an expected loss of 50% and hence an intrinsic value of 0.5. If the book value is also at 0.5, then both bonds would be classified as low risk (NAIC1) under the new system, despite their dramatically different risk profile. Since RMBS securities can be thought of as economic catastrophe bonds (see Coval et al., 2009), i.e., type 1 bonds, the new system appears particularly unsuitable for assigning capital to such securities. Moreover, it is puzzling from a theoretical perspective, that regulation does not make use of state contingent expected losses, but rather relies on the unconditional expected loss measure ELOSS. The state-contingent information provided by Pimco and Blackrock (using 4-5 macro-states) would allow the regulator to define riskiness according to expected payoffs in "bad states" of the economy.

1.4 Empirical predictions around the transition to the new system

To organize our empirical examination of the new capital requirements for MBS, we now collect and summarize the most obvious empirical predictions, based on the features described above. We first consider predictions regarding the effect of the new system on the level of capital requirements, then the effect on the cross-section of capital requirements. In many cases, the new book value adjustments and the new measure of credit risk independently predict worse capital requirements (that are either lower or less related to asset risk).

As described in the example above, book value adjustments reduce the capital requirement for positions held below par. Given the low book values of many MBS securities as a result of

[22] This statement implicitly assumes that default is related to the aggregate state of the world.

marking to market, particularly late in our sample, this likely has a large negative effect on capital requirements.

<u>Prediction 1a:</u> The book value adjustments imply savings in aggregate capital requirements.

The present value calculation of ELOSS assumes a state-independent discount rate equal to the coupon rate of the bond. Since losses tend to occur in bad aggregate states of the economy, basic finance theory tells us that losses should indeed be discounted with a lower rate than the risk-free rate, which would imply a higher present value of losses. This methodology is likely to overvalue securities.

<u>Prediction 1b:</u> The intrinsic value of the bond is upward biased compared to a market price, i.e., $\text{IV} \geq MP$.

This prediction is largely born out for RMBS: in 2009, 89.4% of RMBS securities had an intrinsic price higher than the average market price reported by insurers. For CMBS, however, intrinsic price is above the reported intrinsic price only for 53.4% of securities (in 2010). We show in a regression context later (see Table 7) that the fitted regression line of IV on MV lies above the 45 degree line for both RMBS and CMBS (in the relevant region when the market price is between 0 than 1). Thus, taking into account the magnitude of deviations, the intrinsic value used for regulation is consistently "upward biased" relative to the market value. As a result, the new measure in itself constitutes a source of capital relief.

<u>Prediction 1c:</u> The upward bias of ELOSS implies savings in aggregate capital requirements compared to the previous, ratings-based system.

In addition to reducing the level of capital requirements, the book value adjustments of ELOSS are also likely to affect the cross-sectional properties of capital requirements. In particular, based on the example described in Section 1.3, the new system will likely weaken the relation between risk and capital requirements for securities such as MBS that may have low expected recovery in the event of default (or, equivalently, high "loss given default", LGD).

<u>Prediction 2a:</u> Book value adjustments will reduce the correlation between RBC charges and default risk.

Although the input variable ELOSS, and hence $\Delta(\text{BV})$ are essentially continuous variables, the resulting risk-based charges exhibit discontinuities around the cutoffs (see Table 1). The discontinuities in the transformation RBC categories should also reduce the association of risk and capital requirements compared to the underlying ELOSS number.

<u>Prediction 2b:</u> Due to the smaller number of values used for RBC than for ELOSS, ELOSS is a better cross-sectional predictor than capital requirements of default risk.

Finally, due to their function as large institutional investors, potential conflicts of interests between the goal of objective risk assessments and trading profits may arise.

Prediction 3: PIMCO and BlackRock have an incentive to rate assets they hold favorably. This is especially true those they intend to sell.[25]

These incentives may be tempered or even eliminated by reputational concerns.[26]

Overall, these predictions concern likely flaws in the new system. In principle, such flaws may represent mistakes or deliberate choices. The design of the new system is largely done by the central organization of NAIC, presumably with input from state commissioners, as well as the regulated industry. Flaws and weaknesses in the new system may reflect conscious attempts to achieve a regulatory goal (such as reduced capital requirements). Under this interpretation, design features such as low discount rates and book value adjustments are *proximate* causes of low capital requirements, whereas the *ultimate* causes are the pressures exerted on regulatory policy by industry interests, or concerns of the regulator that conflict with the goal of assigning sufficient risk capital requirements. Such goals may include the desire for stability both in the asset markets and for insurance companies (and even, in extreme cases, "gambling for resurrection"). The empirical investigation that follows has more power to examine the predictions outlined above rather than the ultimate drivers of any weaknesses in the new system. We discuss this again below.

2 Data

We use data from a variety of sources. We obtain two distinct data sets from the NAIC: The first data set provides us with the ELOSS measure at the CUSIP level for the universe of non-agency RMBS in 2009 and 2010, and for the universe of CMBS in 2010 and 2011. There are 23,765 cusips of RMBS in 2009 and 21,575 in 2010. There are 5,293 cusips of CMBS in 2010 and 5,974 in 2011. This includes all securities for which there are positive holdings in the U.S. insurance industry (in any year) as well as a few additional securities (where an insurer may have requested an RBC number).

A second data set from the NAIC provides us with CUSIP-level holdings information for each insurance company in the US (Schedule D Part 1) from 2007-2012. This data set covers end-of-year holdings for all fixed income securities (including treasury bonds, corporate bonds, agency backed RMBS) providing us with insurer-specific book adjusted carrying values, par values, fair values and NAIC risk classification in addition to insurer characteristics (such as the state, business type: Life, P&C, Health, Fraternity and Title). We use book values of each insurer to calculate holding-level RBC requirements (according to Table 1) and then aggregate these at the insurer, business type and industry level (see Table 3). When calculating capital requirements for the total fixed income portfolio, we take into account that treasuries are exempt from a

[25] For PIMCO, the asset holdings of its parent, Allianz may be relevant as well. Because the U.S. operations of Allianz hold almost not RMBS securities, this concern is moot.
[26] See, e.g., Mathis McAndrew and Rochet (2009), Opp, Opp and Harris (2012) as well as Becker and Milbourn (2011) regarding the operations of reputational concerns for rating agencies.

capital charge.[27] This data also allows us to construct a yearly time series of market prices for each security, based on insurance firms' reporting, typically of year-end, broker quotes.[28]

Table 3 provides relevant summary statistics of the holdings data. In the time period between 2009-2012, aggregate holdings of all insurer types in fixed income grew from $3.3 trillion to $3.6 trillion with the predominant share of these assets held by life insurers (70%) and P&C insurers (27%). During the same time period, capital requirements for the entire portfolio fell from $50bn to $37 bn, translating into an average RBC% charge of 1.5% (1%) of the book values. We will revisit the two sub-categories RMBS and CMBS in the next section.

We additionally collect quarterly holdings data from eMAXX. This data covers not only US insurers but also other US institutional investors, in particular mutual funds and pension funds. For non-insurance investors, only the par amount is reported.[29] The data ends in 2012. The eMAXX data indicates both the owner and the manager for most holdings, i.e., when an insurance company delegates management, the identity of the external manager is usually observed. The main use of eMAXX data is to determine the holdings for PIMCO and BlackRock and estimate transaction prices for securities. We follow the methodology of Merrill et al. (2013): for each investor-quarter-security combination, we check whether there is a change in holdings from the preceding quarter. If so, we calculate the estimated price as the ratio of the change in book value to the change in par value of holdings. We exclude negative and very high values (above three), and then collect price estimates for each security-year combination. We use the median across all price estimates within a security-year. We discard observations based on less than three distinct prices. About half of all price observations are in the 0.99-1.01 range, and for both RMBS and CMBS, the median price in any year is very close to 1. This likely reflects selectivity in the securities that trade, consistent with Ellul's, Jotikasthira's and Lundbladh's (2011) findings for corporate bonds. Despite this and despite dwindling transaction volumes, average realized prices for RMBS show a downward trend over the sample period, as illustrated in Figure 1.

We collect data on credit ratings directly from the two largest CRAs, S&P and Moody's, as well as for Fitch from eMAXX. Of our RMBS 2009 universe, 6.8% of securities are unrated, 22.7% have one rating, 65.2% have two ratings, and 5.4% have three ratings. S&P, Moody's and Fitch covered 79%, 64% and 27% of securities by number and 82%, 89% and 27% by value, respectively.

Overall, our sample period saw a steep decline in the ratings of MBS securities. For RMBS securities, the median S&P (Moody's) rating was AAA (AAA) in 2008, A (BBB-) in 2009, BB+ (B+) in 2010, B- (CCC+) in 2011 and CCC (CCC) in 2012 (this includes defaulted securities).

[27] Treasuries in our sample are recorded as all CUSIPs whose first 5 digits are between 91274 and 91283.

[28] We use the average market price of given security (across insurer reports), if a security is held by multiple insurance companies. The discrepancies are negligible.

[29] When coverage of eMAXX and NAIC holdings overlap (year end insurance holdings), there are some discrepancies where eMAXX report lower values. To some extent, we believe this corresponds to CUSIPS classified as RMBS in the NAIC data but not in the eMAXX data.

CMBS experienced a smaller decline: the median Moody's rating was AA in 2008, AA in 2009, A+ in 2010, A in 2011, and BBB in 2012. The ratings data sets contain information about individual assets such as maturity, issue date, seniority etc. We use ratings to calculate counterfactual capital requirements under the old system (according to Table 1), which we can compare to the new requirements.

We additionally use credit ratings to estimate defaults of securities subsequent to the RBC calculation. We define a security as defaulted if it were downgraded to CCC or below, or, if the rating disappears after reaching BB- or lower (see Griffin, Nickerson, and Tang 2013 regarding some of the issues in identifying defaults and an alternative method). This method relies on credit ratings. As an alternative measure of performance of MBS securities, independent of credit ratings, we also use losses up to year end 2012, from Qian, He and Strahan (2013). This data is available for approximately 70% of MBS securities held by insurers (these securities represent 80% of total par value). Table 4 summarizes insurance holdings and various credit metrics for each CUSIP in the first year of the new system for capital requirements (2009 for RMBS and 2010 for CMBS).[30]

3 Empirical Results

3.1 Aggregate risk based capital

How did aggregate capital requirements develop as the new system was introduced? To assess this, we compare actual capital requirements to those that would have obtained had the rating-based system been maintained (by using actual year-end ratings). The new system was immediately tested since the first few years after its introduction saw such poor MBS performance. Thus, we can very quickly form a picture of how the new, proprietary system compares to the old, ratings-based system.

To make our aggregate numbers in this section directly comparable to the official numbers provided by the NAIC, we report the raw effect on the total fixed income charge, R_i, rather than the effect on σ, which also depends on other risks through the covariance adjustment (see Section 1.1.). Moreover, to be conservative, we did not multiply our numbers with 2, which is the required RBC ratio to avoid any regulatory intervention (see Appendix A2). Figure 2 illustrates aggregate RBC as a fraction of book values for US insurers in the years of the RMBS and CMBS transitions. For RMBS, the system produced a sharp decrease in capital requirements compared to what they would have been under the old system, as the left panel of Figure 2 illustrates. With the transition to the new system in 2009, the industry-wide RBC requirement for RMBS (as a fraction of book values) rose by 40.7% compared to 2008 levels[31], instead of rising by 425.8% if the old system had been maintained. In other words, the introduction of the new system allowed the insurance industry to avoid the effects a massive

[30] All columns in Table 4 are based on all available securities. Aggregate insurance holdings of RMBS in 2009 add up to $147 billion, which is lower than the total in Table 3 ($150 billion) because some assets lack ratings.

[31] We obtain the 2008 capital requirements for RMBS from the NAIC rather than using our own calculations.

increase in capital requirements that would otherwise have taken place, reducing the RBC requirement for non-agency RMBS by 67.0% (equivalent to a $7.6 billion reduction of RBC, see Table 3). The increase in capital requirements which would have taken place under the old system reflected the CRAs' downgrades of vast numbers of MBS securities, both in response to house price developments and to changes in methodologies. The effect of the new system was even more striking in 2010, the second year of the new system. 2010 capital requirements were 78.2% below the ratings-based counterfactual, reflecting both a reduction in capital requirements under the new model *and* considerable further deterioration in CRA ratings. The discount remained at over 80% in both 2011 and 2012. Despite the small and falling portfolio share invested in RMBS (4.5% in 2009, 3.0% in 2012), aggregate capital requirements of the fixed income portfolio are significantly affected by the change in RMBS capital requirements. In 2009 aggregate RBC savings for the entire fixed income portfolio were 13.2% growing to 28.6% in 2012. This large effect is driven by the high risk of the RMBS portfolio compared to the remaining fixed-income assets. Under the old regulation, the RMBS portfolio RBC charge would have been $17.23 billion in 2012, or 16% of book value, which is comparable to the RBC% on equities (15%).

In contrast to the RMBS experience, the new system initially produced similar aggregate capital requirements for CMBS, as the right panel of Figure 2 illustrates. The increase in the RBC requirement (as a faction of book values), in 2010, was 26.2% over the preceding year. Despite the rise, capital requirements were slightly lower than they would have been under the old RBC system, by -0.4%. After the first year, the new system became progressively more lenient than the old ratings-based system would have been, in line with the RMBS capital requirements. The relief in the RBC requirement (as a faction of book values) relative to what the old system would have produced was 36.2% in 2011 and 44.3% in 2012.

To provide additional detail, Figure 3 shows the breakdown of 2009 RMBS requirements, actual and counterfactual, by NAIC category. Key differences are that the new system assigns more value to the first category with miniscule capital requirements, and fewer assets to category 5, i.e. undefaulted but very risky assets.

Assessing the welfare consequences of a given level of capital requirements is complicated. However, the fact that capital requirements saw a sharp decline at a time of historically high default rates for this asset class suggests that the new regulation failed to provide adequate protection for long term losses. We next turn to the analysis of the cross-section of capital requirements for individual securities.

3.2 Capital requirements and credit quality

Capital requirements are supposed to assign reasonable aggregate quantities of capital to financial firms, but also to discriminate between assets of different risk. We want to note that these two properties of a system are important, but not necessarily related. A high level of capital generates safety, whereas the ability to discriminate between risks allows the system to work most efficiently for a given level of capital requirements. A system could perfectly measure risk, but underprovide capital or vice versa. A stated motivation for introducing the new system was to improve the relevance of capital requirements to actual risks in insurers' asset portfolios. Therefore, we now turn to the cross-section of securities.

The risk for fixed income securities is that they do not repay in full. For RMBS securities based on a pool of mortgage loans, the final payoff may not be known until 30 years after issuance. Since there exists no universally accepted measure of performance, we rely on three distinct measures used in the literature. Following Griffin et al. (2013), we use a ratings-based default measure, which identifies securities that have transitioned into poor ratings (many of them subsequently transition to not covered status). Second, we use a measure of accumulated losses from He, Qian and Strahan (2013). This variable measures losses up to year end 2012. It has the advantage of not depending on ratings, providing a ratings-independent way of assessing different RBC measures. Third, we use the market price (quotes) of each security.

The period after the new system was introduced RMBS securities was characterized by unprecedented poor performance. The equal weighted, three year default rate for the 2009 RMBS universe is around 39% (the value weighted default rate is slightly lower). Figure 4 shows defaults for each NAIC category of RMBS outstanding in 2009 under the actual system (Panel A) and under the counterfactual of maintaining the ratings-based system using 2009 ratings (Panel B). The new system appears worse: Default rates for the safest category (NAIC 1) exceed 10% for the new system, but were below 1% for securities rated AAA through A- (the range of ratings previously used to define NAIC 1). The period after the new system was introduced was characterized by poor performance for CMBS as well, although less extreme than for RMBS, and with a delay of approximately two years.

We next turn to regression tests that can identify the (conditional) information content of the different risk measures.

3.2.1 Comparison of ELOSS and ratings

We first compare the underlying credit measure used in the new system, ELOSS, and a measure of expected loss based on ratings. For the latter measure, we use the hypothetical RBC requirement based on ratings (see construction in Table 1), RBC (old), for three reasons. First, we want to summarize the ratings-based measure in a single variable (rather than a fixed effect for each notch) to make it comparable to the single variable ELOSS. Secondly, we want to account for the nonlinearity of risk in the ratings scale (see e.g., Hilcher and Wilson 2013) which is achieved by the RBC categorization (see Table 1). Third, we want to use a transformation that is not subject to our own discretion. If anything, this ad-hoc transformation of ratings should make ratings perform "worse" relative to the continuous measure ELOSS.

Results are reported in Table 5, where Panel A contains tests for the first year of the new system for RMBS, and Panel B for CMBS. In column (1) we regress one-year default rates on ELOSS and ratings (the ratings are mapped into capital requirements under the old system for comparability, RBC (old)). We use a linear probability model (i.e., OLS). Both risk measures predict default and thus capture independent sources of information. However, the ELOSS contributes less to R-squared and has smaller economic importance: A one-standard deviation increase in ELOSS (controlling for ratings) leads to a 12.15% increase in the default probability, whereas a one standard deviation increase in the ratings measure leads to an increase of default by 26%.[33] In column (2) we examine long-run, i.e., three year default rates, and find almost identical coefficients to specification (1). These results suggest that both measures are useful predictors (explaining together almost 60% of the cross-sectional variation), but also highlight that ELOSS is not superior to traditional credit ratings. If anything, ratings are associated with an economically larger effect (with both measures being statistically significant).

In column (3), we add a range of controls for security features and ownership, as well as the security's market price. These controls are designed to control for observable features of the assets, and thus convey the conditional information content of ELOSS and ratings. It is worthwhile noting that the coefficient on market prices is negative and significant, i.e., market prices have predictive ability beyond what's in the risk measures or captured by the security features we measure. In column (4) we also add fixed effects for vintage and maturity year (since certain mortgage vintages are known to be of particularly poor quality). As before, ELOSS does predict default in these regressions, but contributing less than credit ratings to overall predictability. The coefficients on ELOSS and ratings are almost identical to the specifications without controls.

In columns (5) and (6) we use realized losses by 2012 as the dependent variable, with controls and with or without fixed effects. Realized losses are a more conservative measure of credit risk, in that known losses in underlying pools, which inevitably will affect securities at some point, are not yet manifested as losses on the securities issued against the pool. Here, ELOSS does better in terms of predictive power than ratings, which are not statistically significant. Finally, in column (7) and (8), we turn to market prices. Here, both ELOSS and ratings are statistically (and economically) significant in explaining market prices, which can be thought of as the market's assessment of quality (of course, prices may also reflect liquidity and risk premia).

In Panel B, we repeat the analysis for CMBS. Because the regulatory change took place one year later, we are limited to two year default predictions at most. The results are broadly consistent with the RMBS results. When using the default measure by Griffin et al., both measures are statistically significant and capture together roughly 60% of the cross-sectional variation. A one standard deviation increase in ELOSS leads to a 6.2% increase in default, whereas a one standard deviation increase in the ratings measure leads to a 20% increase in the default probability.[34] Interestingly, the two measures do not only contain information above and beyond the market price (see specification (3) and (4)), but the market price is only marginally significant in both significant (with the wrong sign).

[33] For the sample used in the first specification of RMBS 2009, the standard deviation of ELOSS is 0.33 and 0.12 for RBC old. These values slightly differ across specifications since the sample decomposition changes from specification to specification.
[34] For the sample used in the first specification of CMBS 2010, the standard deviation of ELOSS is 0.2644 and 0.09 for RBC old.

For losses sustained to date (specifications (5) and (6)), neither risk measure, nor any other variable, has much predictive ability; resulting in a very low R^2. This might reflect the low realized losses so far for CMBS securities (the underlying pools have sustained some losses, but payment defaults have been rare). In the final regressions using the market price, both ELOSS and ratings are significant and capture most of the variation in the market price as the R^2 of 70% reveals.

Overall, Table 5 shows that both ELOSS and ratings are useful measures of credit risk, both adding predictive power to predictive regressions. Based on our sample, we find no evidence that ELOSS is more accurate than ratings, but we also cannot conclude that it is a worse measure.

3.2.2 Comparison of new and old system

Table 5 compares the underlying credit measures, not the charges assessed on insurance companies, which are ultimately relevant for the efficacy of the system. We next turn to these actual capital requirements, by each security. A graphical analysis is exhibited in Figure 5, which shows default rates for MBS securities, sorted by old or new capital requirements, over our sample period. Default prediction can be expected to be harder at longer horizons. In Figure 5, we break down RMBS defaults occurring between 2010 and 2012 by year in which they occurred, and report the defaults by NAIC category under the new and the counterfactual systems. Figure 5 Panel B shows that ratings have a better ability to predict short-term defaults (i.e. there is a more pronounced difference between the short-term than the long-term default rates). The new system, on the other hand, is surprisingly poor even at the shortest horizon: the one year default rate for the top category is almost 10%.

Predictive default regressions comparing the explanatory power of capital requirements produced by the old and new systems are reported in Table 6. We use the same set of tests as in Table 5 (again, RMBS in panel A and CMBS in panel B). The only difference between Table 5 and 6 is that we replace ELOSS with its transformation into actual capital requirements, RBC new. We want to note, that the specifications without controls are most relevant from a regulator's perspective as the regulator is not concerned about the incremental information content of a measure, but the total information content. This is because capital requirements are set without controlling for other security features.

For both RMBS (Panel A) and CMBS (Panel B), one can immediately deduce that the transformation of ELOSS into capital requirements constitutes a loss in information content: The R^2 is reduced for all 8 specifications, respectively! This is perfectly consistent with our prediction 2a) and 2b) outlined in Section 1.4.

For RMBS (Panel A), the transformation of ELOSS into capital requirements leads to similar results as in Table 5, i.e., significance of capital requirements under the old and new system (except for a decrease in explanatory power). Note that the coefficient on RBC (old) is now positive and significant even for the He et al. (2013) measure of losses and increases in all other specifications. This suggests that RBC (old) is picking up some of the information that was previously contained in ELOSS (see Table 5), but not in RBC (new). We can conclude that the new system based on ELOSS does not discriminate risks better than the old system based on ratings.

For CMBS (Panel B), the transformation of ELOSS into capital requirements has larger (negative) effects. The new capital requirements lose their explanatory power in half of the regressions, implying that the loss in information content of ELOSS due to the transformation into risk-based capital is costly. Thus, for CMBS the conclusion is one-sided: There is clear evidence that the new system made capital requirements *less* related to credit risk.

Overall, the new system appears to be worse at sorting securities based on their risk. While we do not find conclusive evidence on the relative performance of the underlying measures of credit risk (see Table 5), the findings based on the resulting capital requirements are stronger: capital requirements under the new system have a weaker association with credit risk relative to the old (counterfactual) system.

3.3 Testing for conflicts of interest of the "new raters"

Clearly, the new system has generated some flaws in capital requirements. A possible further weakness of the new system is that credit risk measures are provided by institutions which are themselves large investors in MBS securities. On the one hand, this may make it easier to provide the ELOSS measure for the thousands of securities that are outstanding, and therefore cheaper for the regulator (and, hence, for the industry). On the other hand, these institutions face an incentive to bias ELOSS in order to profit. Setting ELOSS to a low value reduces the insurance industry's capital requirements. For example, providing low capital requirements could support the price of securities BlackRock and PIMCO hold, or even securities they currently hold but intent to sell (see Prediction 3).

We therefore turn to regressions predicting ELOSS using BlackRock and PIMCO's holdings of securities as well as measures of credit quality and risk. In Table 7 (columns 1-3) we test if PIMCO's holdings and trading are related to the intrinsic value (i.e., 1 – ELOSS) that the firms assigns to RMBS securities.[38] In column 1, we compare the intrinsic value to the market price. The slope is a little below one (the difference from one is statistically significant). Moreover, the constant estimate (0.290, not reported in the table), implies that the fitted regression line lies above the 45 degree line (in the relevant region between a market price of 0 and 1). This is consistent with Prediction 1c) which highlighted that the level of the intrinsic value might be upward biased. In column 2, we include two variables reflecting PIMCO's holdings: the value of holdings at year end, and the relative change in its position over the next year (log difference). Higher PIMCO holdings are associated with higher intrinsic value. The same is true when we include controls for securities' features and ratings (see column 3), which should rule out that the result simply reflects some attitude to, e.g., seniority or maturity. The positive association between holdings and intrinsic values is predicted by almost any theory of PIMCO's information production, and does not necessarily suggest any agency conflict. For example, it may be that PIMCO mutual funds tend to invest in assets that the firm's internal models are optimistic

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[38] Note that holdings may refer to assets managed on behalf of others, from mutual funds, and held on a firm's own account.

about, and that the same information is incorporated into ELOSS. To address exploitation, we include the variable “future trading’’ in our specification. If Pimco was trying to “pump and dump” a security, we would expect to see a negative coefficient on future trading, i.e., assets that Pimco intends to sell in the future are rated more highly. Our evidence shows the contrary: Future trading is positively associated with higher intrinsic value. This suggests PIMCO’s risk assessment partially reflects positive private information about their future trading behavior. Interestingly, PIMCO’s risk assessment is also positively related to contemporaneous holdings of the insurance industry. This is consistent with at least two potential explanations. First, PIMCO deliberately caters his assessment to insurance companies (inducing targeted relief of capital requirements). Secondly, holdings of insurance companies might be related to an unobservable characteristic of default risk. Note, however, that this characteristic should not already be captured by our control variables, such as market price, ratings or PIMCO’s own holding / future trading.

In Table 7, columns 4-6, we perform the equivalent analysis for CMBS securities evaluated by BlackRock. Column 4 only uses market prices to explain intrinsic values. The slope is positive, and less than one, as for RMBS. The constant is at 0.33 (unreported in Table 7). Therefore, the fitted values for risk assessments by BlackRock also lie above the 45 degree line (in the relevant region between a market price of 0 and 1), confirming prediction 1c). In column 5, BlackRock’s holdings and future trading show a negative association with the intrinsic value it assigns to a security. This result may not indicate bias but potentially some omitted variable. The next regression includes security level controls. Now the results are qualitatively identical to RMBS: BlackRock issues higher values for securities which BlackRock holds and which it will buy in the next year. Moreover, BlackRock assigns higher value to securities to securities that are held by insurance companies.

Taken together, the results in Table 7 suggest that BlackRock and PIMCO do not use ELOSS to inflate prices on assets they want to sell. Therefore, the primary concern of using large investors as a source for risk measures does not seem to be empirically prevalent. The fact that the conflict is not detectable in the current context and data sample does not rule out that it exists, or that it can be important in other settings or later. If anything, there is a bias that both Pimco as well as BlackRock cater to insurance companies: securities with larger holdings by insurance companies are rated better (controlling for the holdings of Pimco, ratings and the market price). It would seem prudent for research to revisit this question with more data.

3.4 Capital requirements and portfolio allocations

Finally, we turn to assessments of the impact of the new capital requirements on insurers’ asset holdings. Of course, capital requirements’ main function is to force risky firms to hold sufficient capital, not necessarily to impact their portfolios. However, it is interesting to determine the extent to which insurers respond by adjusting their portfolios when the new system radically reduced capital requirements for a range of assets (and raised requirements for a handful).[39]

In Table 8, we examine changes in aggregate life insurers' holdings of securities over time.[40] On average, there is a small negative change, reflecting a gradual disinvestment by the industry.[41] We compare net changes to securities' RBC requirements following the introduction of the new system (which occurred at year-end 2009 and 2010 for RMBS and CMBS, respectively). If insurers find regulatory capital costly (as Koijen and Yogo, 2012 suggest), we expect the slope on new capital requirements to be negative (i.e., if an asset saw a reduction in capital requirements, it became more attractive to hold). In column 1, the dependent variable is the net change in holdings of RMBS over 2010. We only control for the previous year's capital requirement (which was based on credit ratings). The coefficient on RBC is negative and significant, suggesting that there is a trading response to capital requirements. The elasticity is around 0.1, implying that a doubling of capital requirements is associated with a drop in life insurers' holdings equivalent to 10% of par, i.e. a large effect relative not just to life insurer's portfolios but also to total holdings. In column (2), we also control for the market price, the ratings change in 2009, and a host of security features. Again, the slope on contemporaneous requirements is negative and significant. The slope is larger, suggesting that insurers exhibit systematic preferences over other security features. The coefficient estimate for market price is negative, suggesting that life insurers prefer to sell assets with high market values, which is consistent with findings by Ellul et al (2011) around downgrades of corporate bonds.[42] We next weigh assets by their asset value (column 3), to rule out that the result is driven by only small securities. The value weighted coefficient is of slightly smaller magnitude than equal weighted, but remains negative and significant.

In columns 4-6 we repeat the same set of tests for CMBS in 2011. Again, we find that raised capital requirements are associated with a drop in holdings over the next year. For this group of assets, market price is not significantly related to trading. This may reflect that slightly fewer CMBS had very low prices at this time, so that insurers felt free to sell relatively poor performers.

Based on both CMBS and RMBS, it appears that new capital requirements may discourage insurers from holding assets (or encourage them to sell them). In other words, this confirms that capital requirements were costly to insurers in 2010-2011 (the shadow cost on regulatory capital is positive), in line with the conclusions of Koijen and Yogo (2012) for the crisis period.

[39] For very illiquid securities, capital requirements might affect acquisition at issuance but not future trading. Thus, these tests can be seen as a joint test of costly regulatory capital and sufficient liquidity to allow trading in the secondary market for mortgage backed securities.
[40] We use only Life, because the book values of Property and Casualty insurers are marked to market for most securities, making it harder to identify trading using changes in book values. Life represents the majority of holdings.
[41] Much of the drop in book values that can be seen in Table 3 reflects reduced valuations. Holdings have also shrunken as some securities have defaulted.
[42] Alternatively, insurers may prefer to buy risky securities as reflected in a low market value (controlling for the RBC charge), which can be interpreted as "reaching for yield" (see Becker and Ivashina, 2012).

Additionally, the trading responses induced by changes in capital requirements appear large relative to the market size.

4 Conclusions

The insurance industry provides a unique setting to analyze the implications of "replacing ratings" in financial regulation. Our findings indicate that the switch from risk assessments by traditional rating agencies to risk assessments by institutional investors led to a significant decrease in aggregate capital requirements, vastly driven by the RMBS market assessed by PIMCO. Secondly, we find that the risk ranking of securities, i.e., the ability to discriminate between risks, has not improved relative to the old ratings-based system. While the underlying measures of PIMCO and BlackRock are informative, the loss of predictive power is primarily due to book value adjustments of the risk-based capital charge which allow insurers to face lower capital charges if assets are held below par. This feature implies that the new system only recognizes current (expected) losses, but does not provide any buffer against possible future losses. Our results are consistent with regulatory changes being largely driven by industry interests.

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A. Appendix

A.1. RBC Risk Sources

	Life	**P&C**	**Health**
R_0	- Affiliate investment - Off-balance sheet risk - Business risk (guaranty fund assessment and separate account risks)	- Affiliate investment - Off-balance sheet risk	- Affiliate investment - Off-balance sheet risk
R_1	- Invested asset risk (except stocks) - Interest rate risk - reinsurance credit risk	- Fixed income asset risk	- Invested asset risk
R_2	- Equity asset risk	- Equity asset risk	n/a
R_3	- Insurance Risk	- Credit risk - 50% reinsurance risk	- Insurance risk
R_4	- Health provider credit risk	- Loss reserve risk - 50% reinsurance risk	- Credit risk (health provider, reinsurance, misc. receivables)
R_5	- Business risk (health administrative expense risk)	- Premium risk - growth risk	- Business risk (health administrative expense risk, guaranty fund assessment risk, excessive growth)

A.2. RBC Intervention Cascade

Regulatory intervention is based on the RBC ratio (see Section 1.1.). The more severe the capital shortage is, the stronger the regulatory powers become. The five action levels are:

1) No Action, which means that a company's RBC ratio is at least 2

2) Company Action Level, which means that the RBC ratio is at least 1.5 but less than 2

3) Regulatory Action Level, which means that the RBC ratio is at least 1 but less than 1.5

4) Authorized Control Level, which means that the RBC ratio is at least 0.7 but less than 1)

5) Mandatory Control Level, which means that the RBC ratio is less than 0.7

Figure 1 – Transaction prices and trading volumes for MBS
This graph shows the number of identified transactions (quarters where the book value and par value held of a particular security changed compared to the preceding quarter for a particular insurance company). The graph also shows average prices, after removing asset fixed effects. Transaction volumes are in bars, measured against the right-hand axis, and prices, as a fraction of par, are indicated by lines, measured against the left axis. RMBS and CMBS are treated separately.

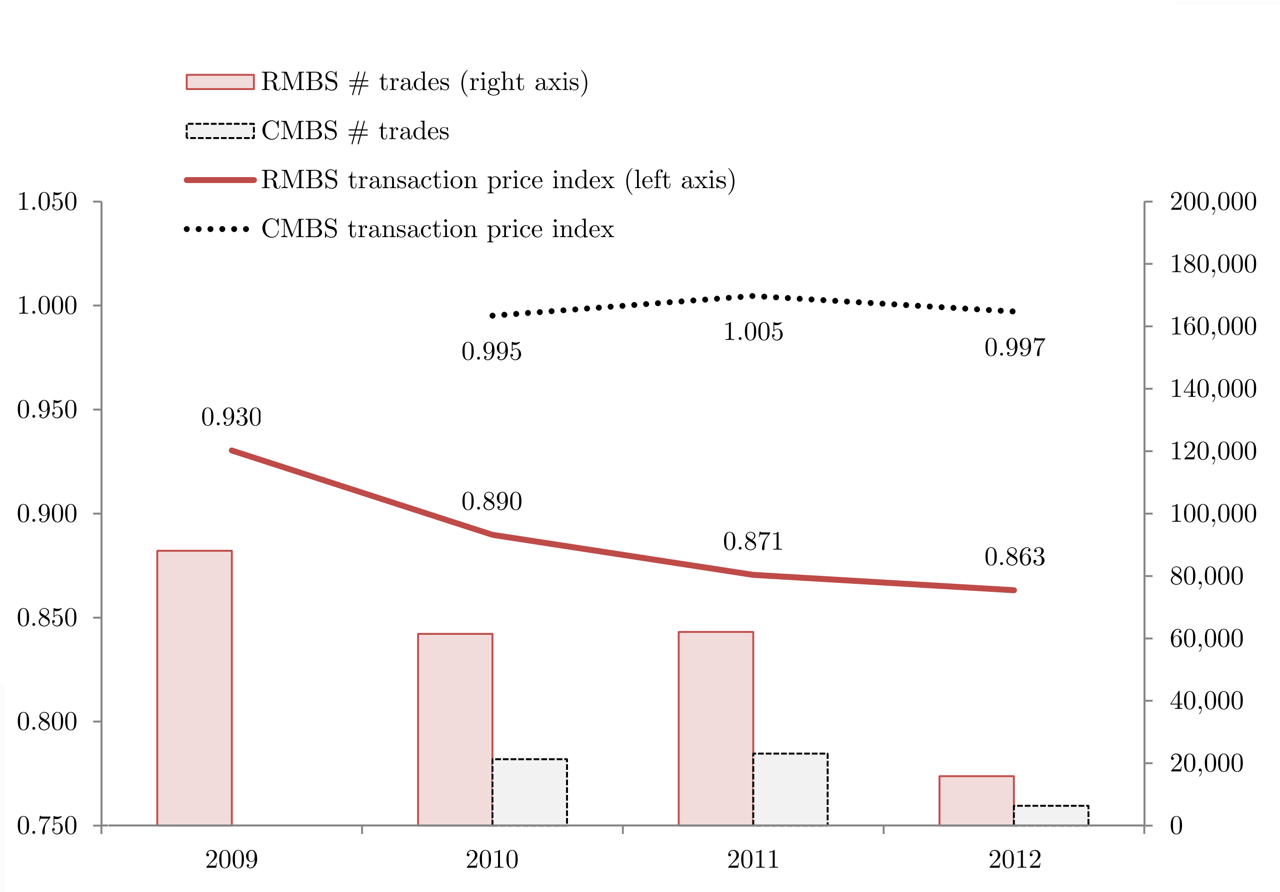


Figure 2 – Aggregate risk-based capital requirements under new and old system
These graphs show capital requirements (risk based capital, RBC, scaled by book value) under new and old systems. For each year, aggregate scaled capital requirements for RMBS (left panel) and CMBS (right panel) held by the insurance industry are shown. The dotted orange line refers to the old system (and the counterfactual path if the old system had been kept). The solid black line refers to the new system. Based on NAIC reports and author calculations.

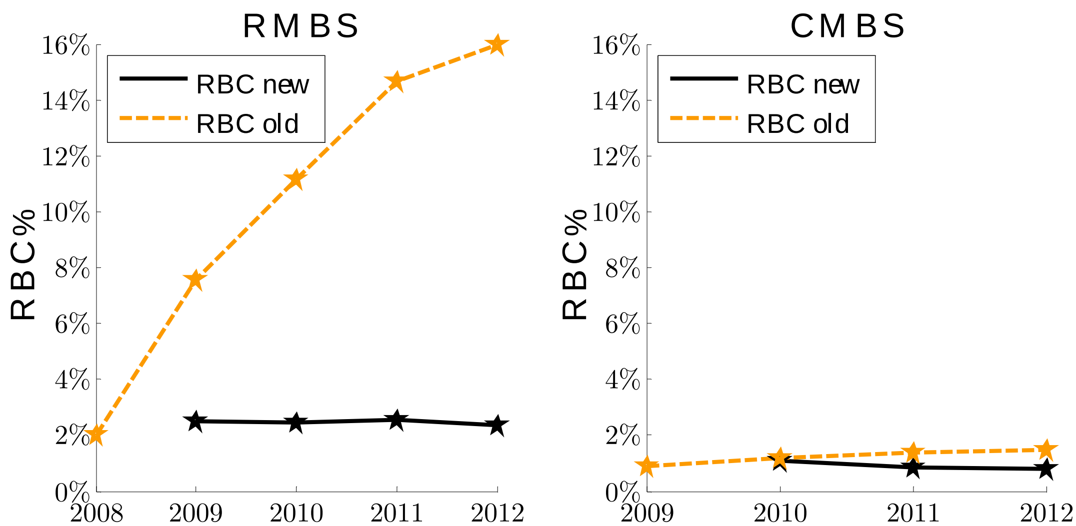
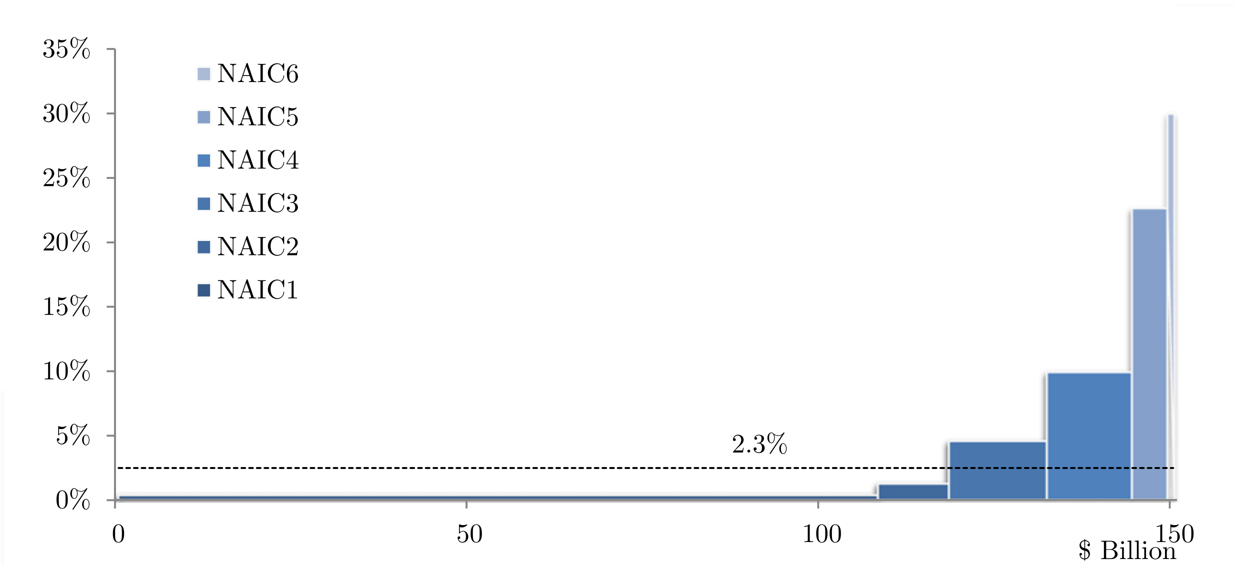


Figure 3 – Capital requirement decomposition, new and old systems
Figures plot default rates by NAIC category for 2009 RMBS, by NAIC category. The widths of columns indicate book value held in each category by the US insurance industry at the end of the fiscal year 2009. The heights of columns indicate average capital requirement for securities in that category. The capital requirement is the actual one (somewhere between that which applies to life and for property and casualty, respectively). The area measures total capital requirements.

Panel A – 2009 RBC for RMBS under new system (actual)



Panel B – 2009 RBC for RMBS under old system (counterfactual)

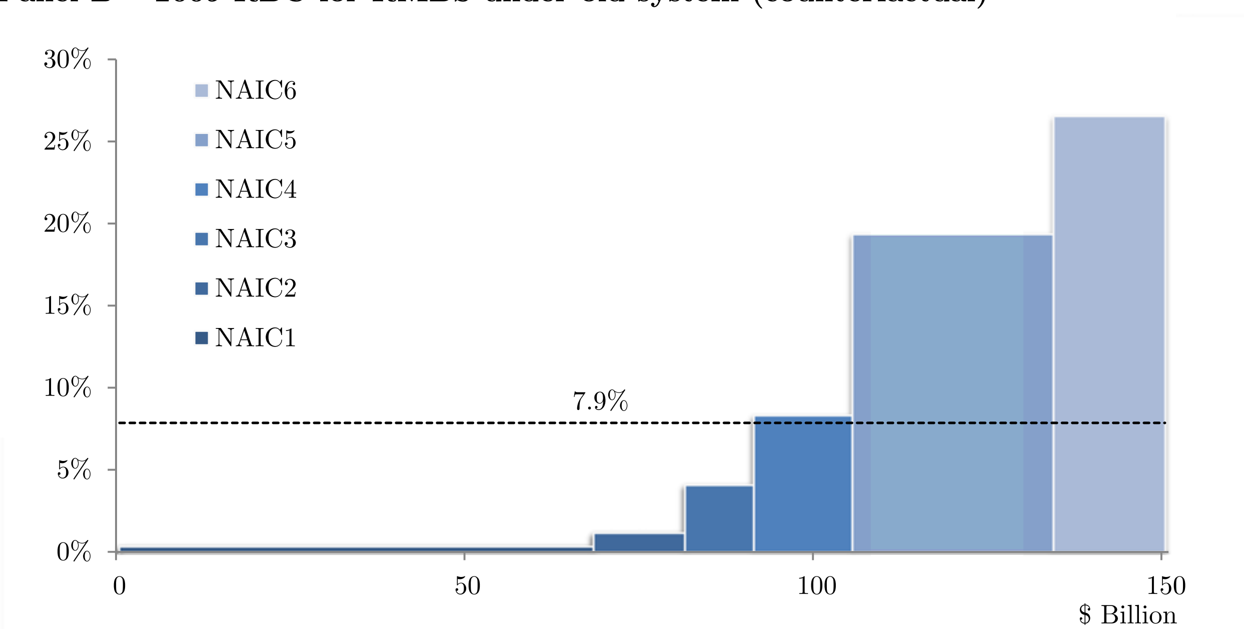
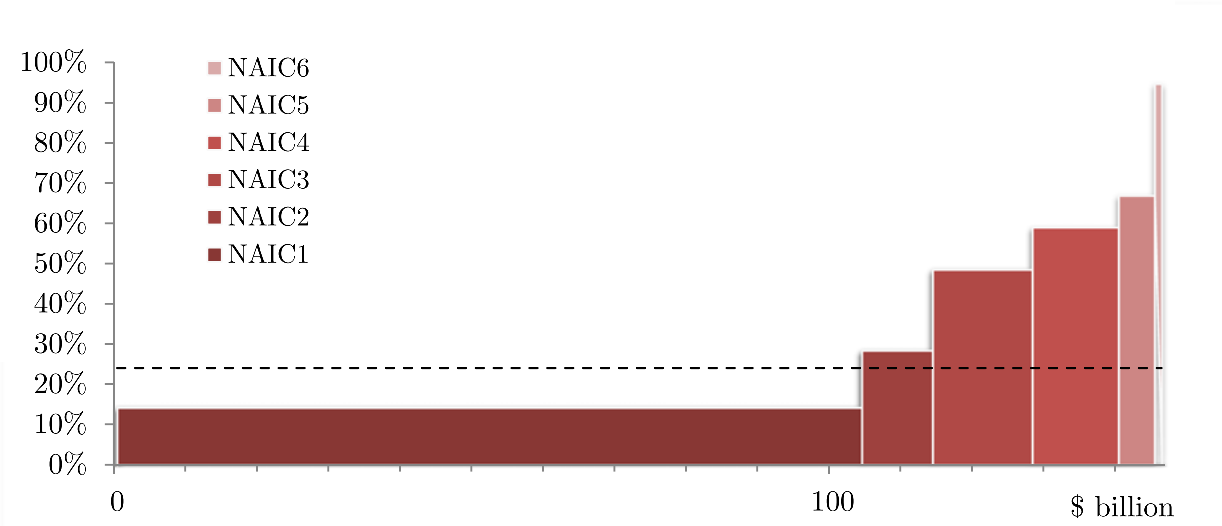


Figure 4 – NAIC risk categories and default risk for RMBS, new and old systems
Figures of default rates by NAIC category for 2009 RMBS. Default is defined as downgrade to CCC or below. Figures exclude cusips where default status is ambiguous. The widths of columns indicate the book value of securities held in each category by the US insurance industry at the end of the fiscal year 2009. The heights of columns indicate three year value weighted default rates for securities in that category. The overall average default rate is 24.0%. The areas of columns indicate book value of defaults.

Panel A – Three year default rates for RMBS under new system (actual)



Panel B – Three year default rates for RMBS under old system (counterfactual)

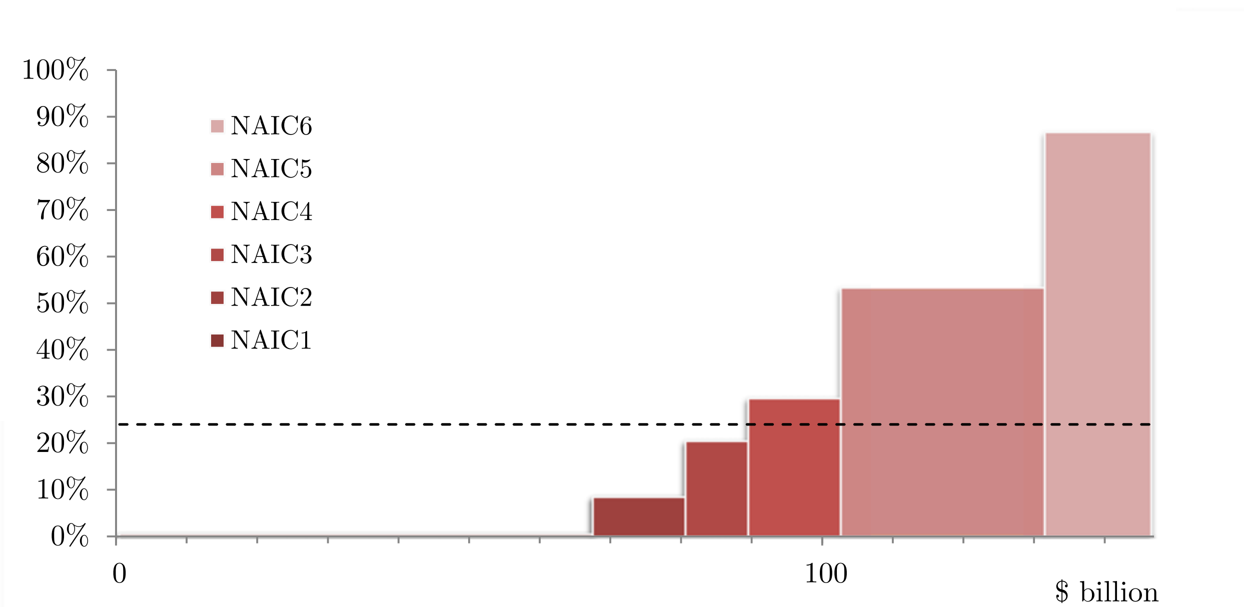
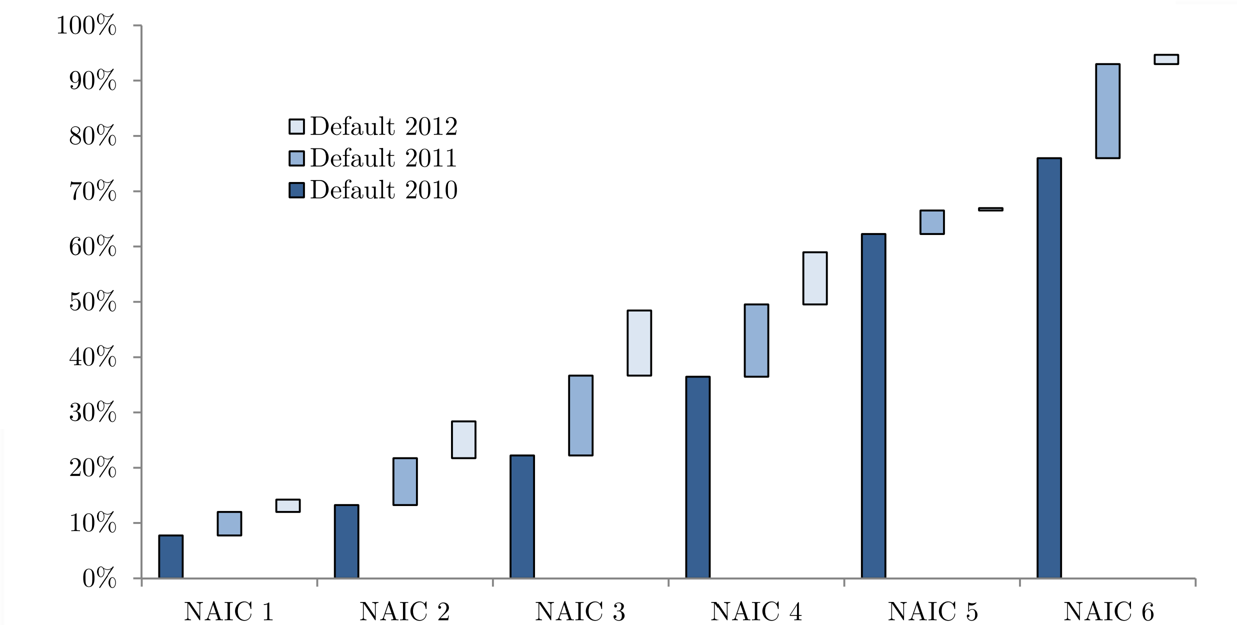


Figure 5 – Timing of default: Credit risk for RMBS, new and old systems
Figures plot default rates by NAIC category for 2009 RMBS, by NAIC category. Default is defined as downgrade to CCC or below. The graph separates defaults by whether they occurred in 2010, 2011 or 2012.

Panel A – One to three year default rates for RMBS under new system (actual)



Panel B – One to three year default rates for RMBS under old system (counterfactual)

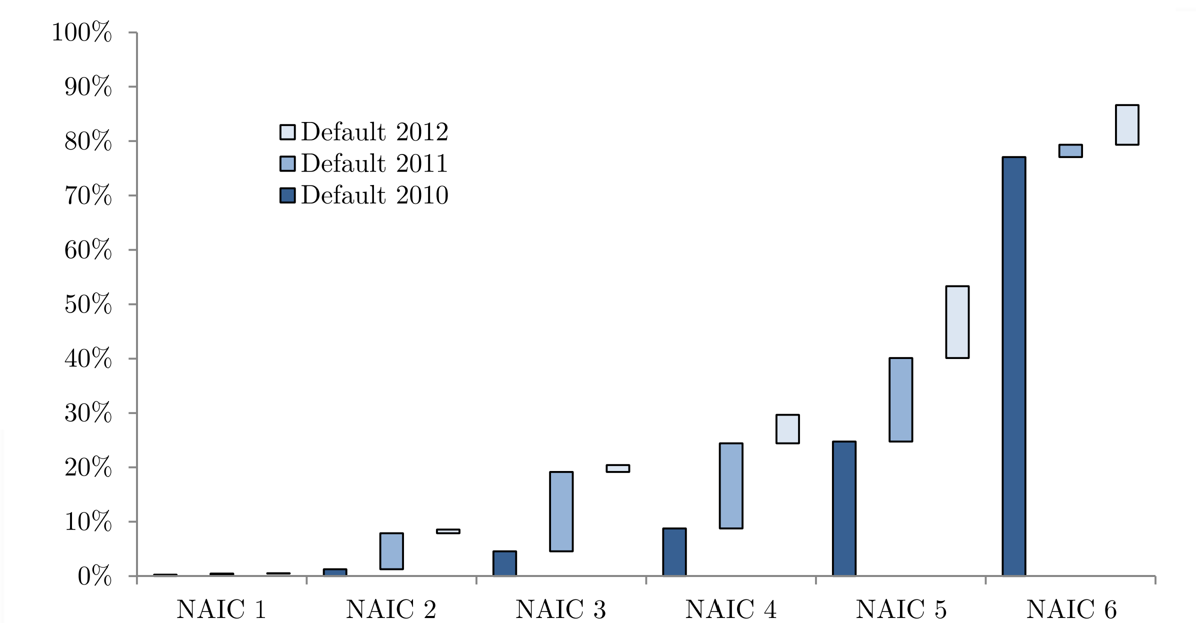


Table 1 – NAIC risk categories and risk based charges

This table shows Risk Based Capital charges (RBC%) for mortgage-backed securities, depending on the insurer type (Life vs. P&C) as well as the cutoffs for the risk designation under the old ratings-based regulation (column 1 to 3) and the new regulation (columns 4 and 5). Fraternity insurers are subject to the same requirements as Life insurers. Health and Title insurers are subject to the same regulation as P&C insurers.

NAIC Category	**RBC%**		**Rating Cutoff**	**Δ(BV) Cutoff**	
	Life	**P&C**		**Life**	**P&C**
1	0.4%	0.3%	A	0.85%	0.65%
2	1.3%	1%	BBB	2.95%	1.5%
3	4.6%	2%	BB	7.30%	3.25%
4	10%	4.5%	B	16.50%	7.25%
5	23%	10%	CCC	26.50%	20%
6	30%	30%	D		

Table 2 – Book-value adjustments in the new regulation - Example

This table illustrates capital requirements for an asset assigned ELOSS = 4.75% (IV = 95.25%). The table presents the resulting capital requirement for the asset depending on the book value at which it is carried.

BV, % par	**Δ(BV)**	**RBC % Life**	**RBC % P&C**	**NAIC**
100%	4.75%	4.6%	7.25%	3
96.5%	1.3%	1.3%	1%	2
95.5%	0.26%	0.4%	0.3%	1

Table 3 – Holdings information and aggregate RBC charges by business type and year

This table lists aggregate holdings information for all fixed income securities, RMBS and CMBS held by insurance companies for the years between 2009 and 2012. We distinguish by business type: Life, P&C, and Other (Health, Fraternity, Title insurers). The variable BV refers to the book-adjusted carrying value (in \$bn). The variable MV refers to the market value (in \$bn). RBC FI is the RBC charge for all fixed income securities (in \$bn). RBC new (old) refers to the capital charge under the new (old) system. RBC save measures the % savings in RBC requirements relative to the old capital requirements (RBC old) of the sub-category. RBC save FI relates the savings (RBC new – RBC old) to the hypothetical RBC of the *entire* fixed income (FI) portfolio under the old system (RBC FI+RBC old – RBC new). The variable Share indicates the portfolio share of RMBS and CMBS, respectively.

		ALL FIXED INCOME			RMBS							CMBS						
		BV	MV	RBC FI	Share	BV	MV	RBC new	RBC old	RBC save	RBC save FI	Share	BV	MV	RBC new	RBC old	RBC disc.	RBC disc. FI
2009	Life	2,307	2,299	31	5.5%	126.8	100.7	3.56	9.93	-64.2%	-17.3%							
	P&C	883	908	4	2.2%	19.6	17.9	0.10	1.08	-91.1%	-18.6%							
	Other	126	128	15	3.1%	3.9	3.3	0.10	0.34	-71.7%	-1.6%							
	Total	3,315	3,335	50	4.5%	150.4	122.0	3.75	11.35	-67.0%	-13.2%							
2010	Life	2,445	2,542	30	4.5%	109.8	99.7	2.91	12.56	-76.9%	-24.1%	5.9%	143.2	145.5	1.79	1.92	-7.1%	-0.4%
	P&C	893	923	4	1.6%	13.9	13.8	0.10	1.18	-91.7%	-19.4%	2.7%	24.4	25.3	0.09	0.10	-15.4%	-0.3%
	Other	137	142	1	2.7%	3.7	3.4	0.09	0.47	-80.0%	-25.2%	3.2%	4.4	4.6	0.03	0.02	20.0%	0.4%
	Total	3,475	3,607	36	3.7%	127.3	116.8	3.10	14.21	-78.2%	-23.6%	5.0%	172.0	175.3	1.90	2.05	-7.2%	-0.4%
2011	Life	2,556	2,761	30	4.1%	104.4	94.8	2.97	15.55	-80.9%	-29.2%	5.2%	133.2	136.5	1.32	2.08	-36.6%	-2.4%
	P&C	918	972	5	1.7%	15.7	15.3	0.10	2.05	-94.9%	-28.9%	2.7%	24.7	25.7	0.08	0.12	-36.9%	-0.9%
	Other	145	154	1	2.0%	2.9	2.7	0.09	0.47	-80.4%	-25.2%	3.3%	4.8	5.0	0.03	0.03	-5.3%	-0.1%
	Total	3,618	3,888	36	3.4%	123.0	112.8	3.17	18.06	-82.5%	-29.1%	4.5%	162.7	167.2	1.42	2.23	-36.2%	-2.2%
2012	Life	2,566	2,851	30	3.6%	91.2	93.3	2.39	14.88	-84.0%	-29.3%	4.6%	118.9	128.3	1.09	1.99	-45.3%	-2.9%
	P&C	902	967	5	1.6%	14.3	15.6	0.11	1.93	-94.6%	-25.2%	2.6%	23.2	24.9	0.08	0.12	-37.4%	-0.8%
	Other	144	156	1	1.6%	2.3	2.4	0.05	0.42	-87.9%	-24.4%	3.0%	4.3	4.7	0.03	0.03	-0.8%	0.0%
	Total	3,613	3,973	37	3.0%	107.9	111.2	2.54	17.23	-85.2%	-28.6%	4.1%	146.5	157.9	1.19	2.14	-44.3%	-2.5%

Table 4 – Sample summary

The table shows summary statistics for the sample of RMBS and CMBS securities used in the paper. Summary statistics are reported for the first year of the new regulatory regime – 2009 for RMBS and 2010 for CMBS. Insurance holdings are valued at book value. ELOSS is the credit risk measure provided by PIMCO and BlackRock to the regulator for each cusip. Default is based on ratings and is defined as a current rating of D, CCC or CC, or for securities with no having no rating, having first had a rating of BB- or above, and subsequently a rating of CC or below. Losses by 2012, % are from He, Qian and Strahan (2013) and is based on reported impairments by year-end 2012 (refers to 16,568 RMBS and 2,625 CMBS assets). Market prices are from insurers' accounting reports. Coverage refers to the data availability of a certain variable as represented by the total $bn amount held by insurers in the CUSIPS with data availability.

Panel A – RMBS (2009)

	Insurance holdings, $ billion	# cusips	Average book value, % par	ELOSS, % par	Default % by 2012	HQS Losses by 2012, % par	Market price, 2009, % par
A- to AAA	67.0	8,367	97.8	0.9	2.8	0.1	83.4
BBB- to BBB+	13.0	1,720	89.1	6.8	24.5	0.2	66.4
BB- to BB+	9.3	1,218	85.1	10.7	39.2	0.2	62.2
B- to B+	13.4	1,639	50.5	15.4	53.1	0.3	57.1
CCC or CC	29.1	3,179	73.4	24.4	79.0	3.8	52.7
C or D	15.2	4,302	39.9	61.3	97.3	36.0	29.4
Total	147.0	20,425	80.2	19.5	39.3	8.5	63.2
Coverage ($bn)			147	147	146	124	147

Panel B – CMBS (2010)

	Insurance holdings, $ billion	# cusips	Average book value, % par	ELOSS, % par	Default % by 2012	HQS Losses by 2012, % par	Market price, 2010
A- to AAA	144.0	2,776	102.1	0.7	0.0	0.0	100.2
BBB- to BBB+	13.3	648	98.2	2.5	1.1	0.3	83.7
BB- to BB+	6.5	458	94.2	10.5	6.8	0.0	69.8
B- to B+	4.4	444	73.2	25.6	26.0	0.0	54.1
CCC or CC	2.2	414	51.1	44.8	44.8	1.0	40.4
C or D	0.7	399	24.2	68.2	98.4	10.8	21.9
Total	172.0	5,139	88.6	12.4	15.1	0.9	80.8
Coverage ($b)			172	169	169	110	172

Table 5 – Default risk: ELOSS vs. Ratings

Regression of RMBS (Panel A) and CMBS (Panel B) defaults on various security features. Default is defined as downgrade to CCC or below. ELOSS is the expected loss assigned to a security under the new system for capital requirements. RBC (old) is the counterfactual capital requirement that would have prevailed if the ratings-based system had been maintained. The market price is based on the contemporaneous fair value reported in the insurers' accounting reports. Insurance holdings are measured at book value, year-end 2009. Par at issue is the amount of face value of the security when first issued. Mezzanine and subordinated tranches are identified based on Moody's classifications. Other variables as defined in Table 4. Robust standard errors are reported in brackets below coefficients. * indicates a coefficient different from zero at the 10% significance level, ** at the 5% level, and *** at the 1% level.

Panel A – RMBS (2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable	Default by 2010	Default by 2012	Default by 2012	Default by 2012	HQS Losses by 2012	HQS Losses by 2012	Market price	Market price
Dep. Var. Mean	0.254	0.377	0.392	0.415	0.086	0.056	0.634	0.609
ELOSS	0.368***	0.354***	0.302***	0.301***	0.500***	0.341***	-0.625***	-0.433***
	(0.014)	(0.013)	(0.022)	(0.024)	(0.012)	(0.016)	(0.005)	(0.011)
RBC (old)	2.201***	2.591***	2.302***	1.993***	0.002	-0.021	-0.490***	-0.474***
	(0.038)	(0.030)	(0.043)	(0.052)	(0.013)	(0.022)	(0.016)	(0.023)
Market price			-0.235***	-0.210***		0.052***		
			(0.021)	(0.025)		(0.009)		
Insurance holdings, log			0.009***	0.006***		-0.018***		0.005***
			(0.002)	(0.002)		(0.001)		(0.001)
Par at issue, log			-0.023***	-0.031***		-0.011***		-0.001
			(0.002)	(0.003)		(0.001)		(0.001)
Mezzanine tranche			-0.081***	-0.051***		0.017***		-0.167***
			(0.010)	(0.010)		(0.006)		(0.005)
Subordinated tranche			-0.036**	-0.011		0.020		-0.204***
			(0.015)	(0.017)		(0.012)		(0.009)
Issue year FE	-	-	-	Yes	-	Yes	-	Yes
Maturity year FE	-	-	-	Yes	-	Yes	-	Yes
R-squared	0.555	0.565	0.558	0.559	0.479	0.452	0.652	0.704
N	16,776	16,776	10,896	9,057	14,235	8,075	17,596	9,298
F-test: $\beta_{ELOSS} = \beta_{RBC}$	1,434.9***	2,904.1***	1231.7***	662.9***	528.3***	136.6***	14.75***	1.86

Panel B – CMBS (2010)

Dep. Variable	(1) Default by 2011	(2) Default by 2012	(3) Default by 2012	(4) Default by 2012	(5) HQS Losses by 2012	(6) HQS Losses by 2012	(7) Market price	(8) Market price
Dep. Var. Mean	0.117	0.133	0.133	0.133	0.003	0.003	0.806	0.832
ELOSS	0.236***	0.272***	0.293***	0.281***	0.037**	0.031**	-0.467***	-0.400***
	(0.039)	(0.039)	(0.052)	(0.068)	(0.017)	(0.015)	(0.021)	(0.032)
RBC (old)	2.240***	2.358***	2.439***	2.385***	0.056*	0.007	-1.603***	-1.228***
	(0.106)	(0.105)	(0.154)	(0.189)	(0.034)	(0.015)	(0.059)	(0.032)
Market price			0.064*	0.012		0.003		
			(0.040)	(0.055)		(0.005)		
Insurance holdings, log			-0.013***	-0.009**		-0.003		0.013***
			(0.003)	(0.004)		(0.002)		(0.003)
Par at issue, log			0.017***	0.016***		0.003*		0.041***
			(0.004)	(0.006)		(0.002)		(0.003)
Mezzanine tranche			0.024***	0.001		0.002		0.041***
			(0.008)	(0.013)		(0.001)		(0.013)
Subordinated tranche			0.033***	0.013		0.001		0.026**
			(0.011)	(0.015)		(0.001)		(0.011)
Issue year FE	-	-	-	Yes	-	Yes	-	Yes
Maturity year FE	-	-	-	Yes	-	Yes	-	Yes
R-squared	0.585	0.603	0.641	0.643	0.050	0.084	0.693	0.793
N	4,658	4,658	3,139	2,149	2,463	1,244	4,784	2,155
F-test: $\beta_{ELOSS} = \beta_{RBC}$	203.0***	230.0***	124.6***	80.5***	0.2	1.1	89.4***	41.2***

Table 6 – Default risk: Comparison of new and old system

Regression of RMBS (Panel A) and CMBS (Panel B) default or impairment on various security features, measured at year end 2009 (RMBS) or 2010 (CMBS). Default is defined as downgrade to CCC or below. Losses is accumulated losses by year-end 2012, from Qian He and Strahan (2013). The market price is based on the fair value reported in the insurers' accounting reports. RBC (new) is the value weighted capital requirement under the actual (new) system used by NAIC, based on ELOSS. RBC (old) is the counterfactual capital requirement that would have prevailed if the ratings-based system had been maintained. Other variables are as in Tables 4 and 5. Robust standard errors are reported in brackets below coefficients. * indicates a coefficient different from zero at the 10% significance level, ** at the 5% level, and *** at the 1% level.

Panel A – RMBS (2009)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable	Default by 2010	Default by 2012	Default by 2012	Default by 2012	HQS Losses by 2012	HQS Losses by 2012	Market price	Market price
Dep. Var. mean	0.353	0.377	0.392	0.415	0.086	0.057	0.632	0.609
RBC (new)	0.663***	0.664***	0.432***	0.381***	0.522***	0.234***	-0.599***	-0.186***
	(0.045)	(0.045)	(0.053)	(0.055)	(0.044)	(0.049)	(0.028)	(0.028)
RBC (old)	2.891***	2.963***	2.443***	2.141***	0.740***	0.181***	-1.421***	-0.945***
	(0.023)	(0.021)	(0.040)	(0.049)	(0.022)	(0.021)	(0.018)	(0.023)
Market price			-0.359***	-0.331***		-0.010***		
			(0.019)	(0.022)		(0.001)		
Insurance holdings, log			0.000***	-0.004**		-0.029***		0.023***
			(0.001)	(0.002)		(0.001)		(0.001)
Par at issue, log			-0.024***	-0.033***		-0.015***		0.006***
			(0.002)	(0.003)		(0.002)		(0.001)
Mezzanine tranche			-0.072***	-0.039***		0.037***		-0.238***
			(0.010)	(0.010)		(0.006)		(0.005)
Subordinated tranche			0.029*	0.024		0.039***		-0.285***
			(0.015)	(0.017)		(0.013)		(0.0109)
Issue year FE	-	-	-	Yes	-	Yes	-	Yes
Maturity year FE	-	-	-	Yes	-	Yes	-	Yes
R-squared	0.537	0.548	0.551	0.553	0.240	0.378	0.430	0.634
N	16,776	16,776	10,896	9,057	14,235	8,075	17,596	9,298

Panel B – CMBS (2010)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Variable	Default by 2011	Default by 2012	Default by 2012	Default by 2012	HQS Losses by 2012	HQS Losses by 2012	Market price	Market prices
Dep. Var. mean	0.133	0.151	0.133	0.133	0.010	0.003	0.806	0.831
RBC (new)	-0.205**	-0.152*	-0.004	-0.122	-0.069*	0.036	-0.444***	-0.343***
	(0.089)	(0.092)	(0.117)	(0.146)	(0.037)	(0.058)	(0.057)	(0.069)
RBC (old)	2.790***	2.968***	2.782***	2.711***	0.170***	0.040**	-2.445***	-1.830***
	(0.061)	(0.058)	(0.129)	(0.162)	(0.045)	(0.020)	(0.041)	(0.064)
Market price			-0.030	-0.089*		-0.006		
			(0.041)	(0.052)		(0.006)		
Insurance holdings, log			-0.020***	-0.016***		-0.004*		0.030***
			(0.003)	(0.004)		(0.002)		(0.003)
Par at issue, log			0.028***	0.024***		0.004**		0.030***
			(0.005)	(0.006)		(0.002)		(0.004)
Mezzanine tranche			0.034***	0.009		0.003*		0.026**
			(0.009)	(0.014)		(0.002)		(0.013)
Subordinated tranche			0.029**	0.007		0.003		0.029**
			(0.011)	(0.016)		(0.002)		(0.012)
Issue year FE	-	-	-	Yes	-	Yes	-	Yes
Maturity year FE	-	-	-	Yes	-	Yes	-	Yes
R-squared	0.573	0.588	0.628	0.634	0.048	0.082	0.634	0.765
N	4,658	4,658	3,139	2,149	2,463	1,244	4,920	2,155

Table 7 – Explaining intrinsic value

Regression of RMBS (column 1-3) and CMBS (column 4-6) intrinsic values (one minus the ELOSS assigned by BlackRock and Pimco). Independent variables include various security features and PIMCO's (col. 1-3) and BlackRock's (col. 4-6) positions in each asset (log of the $ par value held in own accounts or accounts managed for others). Net trade refers to the change in position over the next year, as a fraction of par. Other variables as defined in Tables 4 and 5. Robust standard errors are reported in brackets below coefficients. * indicates a coefficient different from zero at the 10% significance level, ** at the 5% level, and *** at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Asset category	RMBS (2009)			CMBS (2010)		
Firm	PIMCO			BlackRock		
Dep. Variable	Intrinsic value (= 1 - ELOSS)			Intrinsic value (= 1 - ELOSS)		
Dep. Var. Mean	0.819	0.874	0.873	0.878	0.897	0.886
Market price	0.838***	0.736***	0.411***	0.678***	0.676***	0.393***
	(0.006)	(0.013)	(0.023)	(0.012)	(0.017)	(0.004)
PIMCO or BlackRock holdings (log)		0.005***	0.002*		-0.004***	0.004***
		(0.001)	(0.001)		(0.000)	(0.001)
PIMCO or BlackRock net trade, next 4 quarters		0.538***	0.356*		-0.280**	0.787**
		(0.137)	(0.182)		(0.111)	(0.201)
Market price, previous year			-0.004			-0.047
			(0.019)			(0.032)
Insurance holdings, log			0.016***			0.024***
			(0.001)			(0.003)
Par at issue, log			0.008***			-0.025***
			(0.002)			(0.003)
Mezzanine tranche			-0.033**			-0.012
			(0.013)			(0.009)
Subordinated tranche			-0.079***			0.026***
			(0.017)			(0.009)
Issue year FE	-	-	Yes	-	-	Yes
Maturity year FE	-	-	Yes	-	-	Yes
Rating notch FE	-	-	Yes	-	-	Yes
R-squared	0.628	0568	0.732	0.623	0.611	0.788
N	18,385	5,974	4,408	4,920	2,874	2,026

Table 8 – Trading responses

Table of regressions explaining change in life insurance holdings from year end 2009 to year end 2010, for RMBS (column 1-3) and from year end 2010 to year end 2011 CMBS (column 4-6). The dependent variable is defined as the change in life insurance holdings divided by the security's par value. Other variables as in Table 4 and 5. Robust standard errors, clustered by asset pool, are reported in brackets below coefficients. * indicates a coefficient different from zero at the 10% significance level, ** at the 5% level, and *** at the 1% level. One year % change in book value, non-defaulted securities (Life only).

	(1)	(2)	(3)	(4)	(5)	(6)
Category	RMBS			CMBS		
Dep. Variable	One year % change in book value, non-defaulted securities (Life only)			One year % change in book value, non-defaulted securities (Life only)		
Dep. Var. mean	-0.030	-0.030	-0.010	-0.027	-0.027	-0.016
RBC (new)	-0.082***	-0.161***	-0.116***	-0.140**	-0.115*	-0.104*
(contemporaneous)	(0.024)	(0.025)	(0.039)	(0.065)	(0.067)	(0.059)
RBC (old)	0.012	-0.147*	-0.148***	0.048	-0.048	-0.017
(previous year)	(0.074)	(0.076)	(0.049)	(0.045)	(0.062)	(0.068)
Market price		-0.066***	-0.030***		0.027	-0.023
		(0.006)	(0.003)		(0.017)	(0.018)
Ratings change, one year, notches (x100)		0.000	0.000		0.003**	0.002**
		(0.000)	(0.000)		(0.001)	(0.001)
Par at issue, log		0.014***	0.010***		0.002	0.013***
		(0.001)	(0.001)		(0.003)	(0.002)
Mezzanine tranche		0.010***	0.011***		-0.033*	-0.005
		(0.001)	(0.002)		(0.019)	(0.016)
Subordinated tranche		-0.001***	0.008**		0.021***	0.028***
		(0.000)	(0.003)		(0.007)	(0.008)
Weights	-	-	Size	-	-	Size
Issue year FE	-	-	-	-	-	-
Maturity year FE	-	-	-	-	-	-
R-squared	0.002	0.056	0.067	0.006	0.020	0.054
N	7,760	7,760	7,760	2,417	2,417	2,417