Changes in Risk-based Capital and Reaching for Yield

Florian Weinlich *

February 28, 2024

The National Association of Insurance Commissioners ("NAIC") in the U.S. proposed changes in risk-based capital ("RBC") factors for corporate bonds in the last decade. The changes refer to a more granular structure of RBC factors, which were updated several times. I analyze the effects these revisions had on U.S. life insurers' reaching for yield behavior. These proposed changes affect life insurers' acquisition behavior in a period even when the old RBC factors were still applicable. I show that for examining reaching for yield, life insurers need to consider not only the downgrade probabilities but also the probability and the magnitude of an expected change in capital requirements. I find that reaching for yield is decreasing in the magnitude of the expected RBC changes. Life insurers react to the uncertainty of RBC changes and adjust their investment decisions when the proposed RBC factors are near the implementation date. Modifying RBC bond factors to enhance the identification of potentially weakly capitalized companies represents a positive and progressive step forward.

JEL-Classification: G22,G23,G38
Key words: reaching for yield, capital regulation, risk-based capital, investment behavior, asset allocations

* Vienna Graduate School of Finance (VGSF) Welthandelsplatz 1, Building D4, 1020 Vienna, Austria, florian.weinlich@vgsf.ac.at. I want to thank Alexander Mürmann, Stanislava Nikolova, Alexander Pasler, Elizabeth Rinde, Clemens Wagner, Patrick Weiss and the VGSF faculty for their valuable comments and feedback. I also want to thank Hao Ding (discussant) and participants at the World Finance & Banking Symposium in Vilnius for feedback. The views expressed in this paper are mine and may not necessarily reflect those of the individuals or groups mentioned above.

1 Introduction

Insurers are incentivized to acquire assets that offer favorable returns on a risk-adjusted basis to enhance their overall portfolio performance and ensure the ability to meet their obligations to policyholders. Put differently, insurers need to balance between pursuing high returns and considering the associated risks. Ignoring the potential risks in favor of higher returns could expose insurers to substantial losses, especially during market downturns or adverse economic conditions. Such losses could severely impact their financial stability, putting their ability to fulfill policyholder claims at risk. Regulators play a vital role in safeguarding policyholders by imposing standards on capital regulation for insurers. The risk-based capital ("RBC") requirement in the U.S. introduced by the National Association of Insurance Commissioners ("NAIC") sets a minimum level of capital that insurers must hold, considering their risk exposures and thereby ensuring their ability to fulfill obligations and withstand unexpected losses (NAIC, 2021).

A proposed new capital regulation on corporate bonds[1] by the NAIC and the American Academy of Actuaries ("AAA") in the last decade reevaluates how much capital insurers need to hold for bonds to reflect the actual levels of risk better. The purpose of this new RBC regulation is a more granular RBC structure for corporate bonds. This proposed new capital regulation is expected to change how insurers invest in bonds, the largest asset class in life insurers' portfolios, as the changes are not uniform for all bond ratings. As insurers hold over one-third of all outstanding investment-grade ("IG") corporate bonds, any changes in RBC can affect insurers' demand for certain bonds.

The term 'reaching for yield' is used in the literature, e.g., by Becker and Ivashina (2015), to describe investors' preference to buy riskier assets to achieve higher yields in the corporate bond market as long as these assets comply with regulatory requirements. Reaching for yield is essential to meet return expectations in low-interest rate environments (Koijen and Yogo, 2017). It is important to distinguish reaching for yield from investors' preferences, such as bond duration, offering amount, and liquidity (Becker and Ivashina, 2015). The aim of this capital regulation was to reduce the reaching for yield behavior

[1] The changes in RBC for bonds were initially only announced for corporate bonds and not for private placements, 144a, municipals, sovereigns, hybrids, or mezzanine debt. The intention was to develop separate RBC requirements for various types of fixed income assets in the future (AAA, 2015), which were finally not implemented. U.S. sovereign debt is not affected by the RBC changes as it is an exempt asset with no capital requirements in place.

of insurers. This paper analyzes the impact of this proposed change in RBC regulation on insurers' reaching for yield behavior.

While insurers may find reaching for yield appealing, it is generally viewed unfavorably from a regulatory standpoint. Reaching for yield often involves investing in riskier assets, increasing the likelihood of default and price volatility. Hence, reaching for yield can increase risk exposure and contribute to systemic risk and significant losses during economic downturns. It could undermine the insurance sector's financial stability and adversely impact policyholders. Therefore, regulators should prevent insurers from excessive risk-taking and promote prudent behavior. Capital regulation must protect policyholders' interests and avoid insolvency by establishing appropriate capital adequacy requirements.

The NAIC implicitly allowed for reaching for yield under the old RBC structure, which captures investment risk coarsely. Specific bond ratings have the same capital requirements despite apparent differences in riskiness. Several ratings, e.g., Aaa-A3, are grouped into one risk bucket with the same RBC bond factor. The RBC bond factors determine the rating-specific capital requirements. They are measured as percentages that must be multiplied by the bond's book value to calculate the RBC for a specific bond.

Reaching for yield was possible as the number of risk buckets did not coincide with the number of ratings. Hence, a new proposed RBC regulation recommended a more granular RBC structure for corporate bonds and was developed and implemented between 2011 and 2021 (AAA, 2011; NAIC, 2021). Under the new RBC structure, the number of risk buckets (RBC bond factors) was expanded from six to 20 such that for each rating from an official rating agency, e.g., S&P, Moody's, and Fitch, a specific RBC bond factor exists. The RBC bond factor changes were the first of their kind since the development of the capital requirements in the 1990s. The new regulatory change is characterized by high regulatory uncertainty and a long time to implementation. As all bond ratings are affected differently by this regulation, this is an excellent setting to analyze insurers' investment behavior in depth.[2] To my knowledge, the analysis of the revision of the RBC bond factors in the last decade is novel to the literature.

New RBC bond factors were initially announced only for life insurers in 2015 for the first

[2]This is different from existing literature on capital regulation in banking which looks at changes in total levels of capital requirements see e.g. Gropp et al. (2018).

time and were subject to possible further adjustments in terms of magnitudes (percentages) (AAA, 2015).[3] Therefore, this paper focuses on life insurers. Almost all ratings were affected by the proposed RBC changes, with most ratings experiencing increases in RBC bond factors. Specific ratings showing a relatively small increase in RBC bond factors may become more attractive.

The proposed RBC changes are expected to significantly impact the investment behavior of life insurers and require them to hold higher amounts of capital. These changes in capital requirements are potentially a challenge, especially for life insurers offering products with guaranteed minimum rates of returns. Life insurers need to optimize the risk-return trade-off as the expected RBC changes have to be considered. Life insurers' reaching for yield behavior is expected to be reduced as rating cliffs are eliminated due to the expansion from six to 20 RBC bond factors. However, reaching for yield can still exist after the RBC changes as more priced risk might be taken within a given risk bucket (rating) by buying bonds with higher yields closer to the next risk bucket. Modifying RBC bond factors to enhance the identification of potentially weakly capitalized companies represents a positive and progressive step forward. By increasing the granularity of the RBC bond factors, the NAIC can incentivize insurers to maintain adequate capital buffers, ensuring a more secure environment for policyholders and fostering a more robust insurance industry that can better withstand economic fluctuations.

Life insurers, driven by their long-term liabilities arising from policyholder claims, use asset-liability management (ALM) strategies to match long-term assets to their long-term liabilities, thus reducing interest rate sensitivity (Gerstner et al., 2008). Typically, they invest in long-duration bonds and hold these assets until maturity. The proposed RBC changes are highly relevant for life insurers as typical buy-and-hold investors, whose investment portfolios comprise half of bonds (see Figure 1). Investment grade bonds amount to approx. 90% of total bonds (see Figure 2).[4]

When life insurers faced the decision to adjust their portfolios for the first time, they still faced regulatory uncertainty about the proposed RBC bond factors, which were still subject to further changes. The question arises when the optimal timing for life insurers

[3] The proposed factors in 2015 look relatively concrete regarding the technical analysis conducted and possible implementation (AAA, 2015). I am only aware that in 2017 the implementation of the RBC bond factors was planned for 2019 (CIPR, 2017).

[4] IG bonds consist of NAIC class 1 and class 2.

is to reallocate portfolios based on the proposed RBC bond factors. Put differently, there is a trade-off between early and late adjustment of the bond portfolios. Early adjustment implies giving up yields for the period in the old RBC structure but paying lower transaction costs for reallocating the portfolios. However, the uncertainty surrounding regulatory changes add complexity, as early adjustment could result in the need for further portfolio adjustments if the final RBC structure deviates from insurers' expectations. On the contrary, late adjustment suggests having optimal portfolios under the old RBC structure, which appear more favorable on a risk-return adjusted basis before adopting the new RBC structure. Waiting until the RBC changes are implemented would provide certainty about the new RBC bond factors. However, this approach may lead to ex ante not optimized portfolios. At the time of implementing this strategy would entail substantial transaction costs due to the disposal of illiquid bonds and the acquisition of new bonds. Additionally, forming efficient portfolios under the new RBC structure on short notice can be challenging if corporate bonds with specific characteristics, such as ratings and duration, are in short supply.

I argue that life insurers need to adapt the bond portfolios to the new RBC structure. Life insurers consider the proposed RBC changes and actively adjust their portfolios accordingly in a period before the implementation of the new RBC structure when the old RBC bond factors were still applicable. It incurs costs to form efficient portfolios and implies reallocations after the RBC announcements. Insurers can optimize their portfolios to align with the forthcoming regulatory requirements by considering all relevant information about the proposed RBC changes. Since credit risk adjustments often require time without selling existing bonds, initiating portfolio changes ahead of time becomes advantageous, given their preference for long-duration bonds. Rather than choosing early disposals with high transaction costs, it appears more plausible that life insurers gradually roll over holdings into new risk buckets.

I show in a theoretical model, which is an extension of the reaching for yield model by Becker and Ivashina (2015), that not only the probability of a downgrade to a lower rating needs to be considered but also the expected magnitude of a change in RBC bond factors. I show that larger expected RBC changes reduce reaching for yield. The main empirical results are in line with my model. After the first announcement of the proposed RBC changes, reaching for yield was reduced due to large expected changes in RBC and a higher level of uncertainty. After the subsequent updates (revisions) of the proposed

RBC factors, reaching for yield is more pronounced due to smaller expected changes in RBC. I conduct my analysis in a period when the old RBC structure of six risk buckets is still applicable.[5]

I analyze changes in the life insurers' investment behavior of corporate bonds acquisitions at issuance from 2011 to 2019. This paper focuses on corporate bond acquisitions of life insurers, as the first draft of the proposed RBC factors was initially announced only for life insurers on corporate bonds in 2015 (AAA, 2015). My emphasis is on IG bonds as insurance companies barely hold high-yield bonds due to capital regulation (Nanda et al., 2019). Additionally, Becker and Ivashina (2015) only find reaching for yield for IG bonds. Acquisitions at issuance are extremely important for life insurers as newly issued bonds account for more than half of insurers' corporate bond acquisitions (Nikolova et al., 2020).

I use both NAIC bond holdings data and Refinitiv's emaxx bond holdings data on the CUSIP level.[6] Mutual funds have similar investment characteristics but no capital requirements in place. As mutual funds are unaffected by the regulation, I use them as a control group.[7] Calculating a quantitative measure of the expected RBC changes suggests that life insurers take the expected RBC changes and transition probabilities in their bond acquisitions into account, which aligns with the predictions of my model.

On the aggregated level, compared to mutual funds, life insurers invest a higher (lower) fraction in those bond ratings with lower (higher) expected increases in RBC bond factors after the proposed RBC announcements. I find significant results, especially for categories (ratings) with more extensive expected changes in RBC. In my empirical analysis, I group ratings into categories similarly affected by the expected RBC changes in relative percentage changes. This pattern is observed across most categories but especially holds for A1, A2, and A3 (decrease) which aligns with my expectation. This effect is even more substantial after the updates of the proposed RBC factors in 2017.

Moreover, I test if capital-constrained insurers react differently to the proposed RBC changes and analyze acquisitions of corporate bonds in a subset of constrained life insurers. I find that life insurers for whom the capital constraint is more binding react more strongly to the proposed RBC changes. In particular, these constrained insurers

[5]In this period, the old RBC bond factors are used to calculate RBC.
[6]I observe which specific bonds life insurers and mutual funds acquire in each quarter.
[7]A similar procedure is used by Becker and Ivashina (2015) and discussed in Section 5 in detail.

more rapidly acquire bonds that are ex-ante more attractive based on the proposed RBC factors. This effect is even more substantial after the subsequent RBC updates. One explanation is that capital-constrained life insurers face higher expected regulatory costs if they fall below the threshold RBC level because raising equity and costs of capital are more expensive for constrained companies. These results are in line with Cheng and Weiss (2013), who find that weakly-capitalized property-liability insurers adjusted their capital and risk more rapidly than well-capitalized insurers after the implementation of the RBC requirements in 1993.

It might be possible that life insurers wait until the implementation of the proposed RBC bond factors to adjust portfolios when new capital requirements are in place. Early adjustment of portfolios would imply giving up potential yields as the old RBC bond factors are still applicable. However, life insurers are buy-and-hold investors and need to form efficient portfolios considering all relevant information about the proposed RBC changes. In this context, I test if life insurers with low portfolio turnover adjust their acquisitions more in line with the proposed RBC bond factors compared to life insurers with high portfolio turnover. Indeed, I partially find evidence that this is the case for bond ratings with the highest or lowest expected changes in RBC bond factors. It seems plausible, as life insurers with high portfolio turnover are possibly more willing to adjust their portfolios on short notice.

Potential concerns arise regarding the attractiveness of bonds relative to other asset classes in times of the proposed RBC changes. Other asset classes, such as stocks or alternative investments, remain unaffected by the RBC bond changes. This divergence in capital requirements could imply that these alternative asset classes become more appealing to insurers. Consequently, it is crucial to analyze insurers' overall portfolio allocation and shifts to other asset classes.

Capital adequacy requirements can affect financial institutions' risk-taking behavior as highlighted in previous studies, such as Chen et al. (2019). In this context, an equal increase in fixed income risk due to higher capital requirements implies an increase in the marginal RBC cost, which may decrease the optimal level of fixed income risk. The lower attractiveness of fixed income could lead to a potential shift in the composition of insurers' portfolios to other asset classes. Supporting this argument, Becker et al. (2021) suggest that a change in capital requirements for separate reform of capital regulation on mortgage-backed securities (”MBS”) is expected to impact the allocation of other asset classes within insurers' portfolios. What alleviates this concern is that the share of bonds is relatively stable, only slightly decreasing from 52.4% to 48.1% between 2011 and 2019 (see Figure 1). In the context of this paper, the primary focus lies on the bond portfolios of life insurers, given that bonds represent the largest asset class in their investment portfolios. Consequently, the analysis does not explicitly delve into the potential interactions between the RBC factor changes of bonds and other asset classes.

Related Literature. This paper contributes to existing literature that focuses on the impact of capital regulation on the investment decisions of firms see, e.g., Ellul et al. 2011; Becker and Ivashina 2015; Cheng and Weiss 2013. Accounting standards can affect how financial institutions engage in trading activities as they are linked with capital regulations (Ellul et al., 2015). Becker and Ivashina (2015) show that investors have the propensity to buy riskier bonds to reach for higher yields. Imperfect risk metrics in the evaluation of investment managers can create incentives for them to prioritize assets that align with benchmarks but entail significant risks in other aspects, resulting in a reaching for yield behavior. They also find that insurers who are active in reaching for yield also faced larger losses in the Financial Crisis compared to non-active ones. My research considers the impact of the expected changes in RBC regulations on reaching for yield behavior. One key distinction between Becker and Ivashina (2015) and my paper is the consideration of regulatory uncertainty. Unlike their paper, which assumes no regulatory uncertainty, I consider the proposed RBC changes for life insurers. Whereas Becker and Ivashina (2015) uses a shock of the Financial Crisis which affects downgrade probabilities, I measure variation in reaching for yield by the channel of the proposed RBC changes. My analysis aims to capture the potential effects of this regulatory uncertainty on reaching for yield behavior in times of economic expansion. This paper offers valuable insights into the investment decisions of life insurers in times of regulatory uncertainty.

The proposed RBC changes have broad implications for portfolio adjustments since capital requirements for almost all ratings were expected to increase. In the Financial Crisis the structure of six risk buckets remained constant, and a downgrade especially for investment-grade bonds did not necessarily had to lead to a change in capital requirements if the downgraded bond was included in the same risk bucket.[8] Hence, investment-grade

[8] A hypothetical downgrade e.g. from Aaa to Aa1 did not trigger any changes in capital requirements under the old RBC structure.

portfolios of life insurers might be more directly affected by the changes in RBC bond factors compared to the Financial Crisis.

U.S. corporate bond mutual funds reach for yield as a consequence of the low-interest rate environment by shifting towards riskier bonds (Choi and Kronlund, 2018). Similarly, due to very low short-term interest rates, money funds invest in riskier asset classes and increase their portfolios' risk on average (Di Maggio and Kacperczyk, 2017). Notably, insurers can take different measures to reach for yield. For example, Lenciauskaite (2019) finds that insurers buy a higher share of high-yield bonds if they mature before year-end, as RBC requirements are calculated only at year-end. I show that reaching for yield can be motivated by taking expected RBC changes into account.

It has been shown in the literature that the asset side of insurers' balance sheets is affected by capital regulation in times of financial distress see e.g. Merrill et al. (2012) or Ellul et al. (2015). Becker et al. (2021) analyze a separate reform of capital regulation on MBS for U.S. insurance companies, which lowered capital requirements after the financial crisis. Consequently, insurers hold a higher fraction of MBS. My paper is similar as it also analyzes a change in regulatory requirements for an asset class and the effect on life insurers' investment behavior.

Cheng and Weiss (2013) find a faster speed of reaction for constrained property-liability insurers to their asset risk ratios compared to unconstrained insurers after the RBC implementation in 1993. In line with those results, I find that capital-constrained insurers react more strongly to the proposed RBC changes as they are more detrimental to them. The selling behavior of insurers can also have an impact on market stability. Ellul et al. (2011) argue that fire sales are more likely caused by constrained insurers selling corporate bonds downgraded to HY due to RBC requirements. Related to fire sales, Chaderina et al. (2022) show that financial institutions sell more commonly-held liquid bonds in liquidity shocks and find that liquid bonds have higher price impacts during fire sales. They conclude that holding more liquid assets can cause a higher commonality and thereby be a threat to financial market stability.

The remainder of this paper is organized as follows. In Section 2, I provide additional institutional information, Section 3 includes the model and hypotheses development, Section 4 gives an overview of the data, Section 5 provides the methodology and results, and Section 6 concludes.

2 Institutional Background

2.1 RBC and regulatory reporting requirements

The NAIC in the U.S. introduced the concept of RBC to reduce the risk of insolvencies for fixed-income securities (C1o fixed income risk) in 1993 (NAIC, 2022). In the initial RBC structure, bonds can take a value from 1 (the highest quality) to 6 (the lowest quality). This structure was used by the local states' regulators until 2021 to determine the magnitude of capital requirement for a specific bond.[9] [10]

Regulators use RBC as a central measure of capital adequacy due to low minimum capital requirements (McShane et al., 2010). The RBC requirement represents a statutory minimum level of capital. It should help regulators identify weakly capitalized insurers and ensure they meet their financial obligations to policyholders (NAIC, 2022).

Rated bonds are classified into a risk bucket, a mapping from approved rating organizations such as S&P or Moody's.[11] The number of risk buckets differs between the old and the new RBC structure. The old RBC structure defines only six risk buckets for 20 ratings. Therefore, several ratings are grouped into one risk bucket. For investment-grade (IG) bonds, the ratings Aaa – A3 are grouped in the first risk bucket NAIC1, and ratings Baa1 – Baa3 are grouped in the second risk bucket NAIC2.[12] The RBC bond factors represent percentages that need to be multiplied by the bond's book value to calculate the RBC for a specific bond. All bonds in a specific risk bucket have the same capital factors irrespective of the underlying risk of the bond, e.g., 0.4% for Aaa – A3 bonds. As the old RBC structure captures investment risk coarsely due to the limited number of risk buckets for insurers, the RBC bond factors were revised between 2011 and 2021. The number of risk buckets was expanded from six to 20 such that for each rating a specific risk factor exist.

[9] The NAIC developed different risk models to calculate RBC for other types of fixed income assets such as mortgage-backed securities (MBS) after the Financial Crisis. The changes in RBC bond factors in the last decade were initially only announced for corporate bonds.

[10] The NAIC assists state insurance departments in their regulatory oversight of insurance firms.

[11] The NAIC Security Valuation Office (SVO) is responsible for assigning a designation. If a rating is available, the designation is based on NAIC Approved Ratings Organizations such as S&P, Moodys, and Fitch. This category is denoted as filing exempt securities. If no rating is available, the SVO uses ratings of the issuer's other rated positions or its own analysis. Importantly, insurers do not have any discretion to assign their own designations.

[12] I use the rating designations by Moody's, but those designations are applicable identically for, e.g., S&P or Fitch.

Different RBC bond factors, which are proposed at various points in time, are shown in Figure 3 for IG bonds and in Figure 4 for HY bonds. A detailed discussion of the proposed RBC bond factors is provided in Section 2.2. Furthermore, RBC bond factors are updated to reflect the latest corporate default probabilities and loss-given default rates. The intention of the NAIC, together with the AAA (AAA, 2015)[13] is to capture the underlying risk of bonds more accurately and reduce cliff effects between the ratings.

The proposed changes in RBC refer to C-1o Aggregates fixed income asset & reinsurance credit risk. However, other risk categories exist in which risk levels are aggregated to generate total RBC. Total RBC for life insurers consists of the main components: Asset risk, Insurance risk, Interest rate risk, Business risk, and Miscellaneous risks see Figure 5. The RBC risk components are specific for life insurers and differ for other types of insurers (CIPR, 2017).

It is essential to highlight that fixed income risk (C-1o), affected by its proposed RBC changes, is highly relevant for life insurers due to their large share of corporate bonds in their investment portfolios. Figure 6 gives an overview of life RBC risk components as a percentage of total RBC. The proposed RBC bond factors affect life insurers' most important risk component, the C-1o Aggregates fixed income asset & reinsurance credit risk (30.3%) (NAIC, 2020). This paper focuses only on C-1o fixed income risk, which stems from life insurers' corporate bond portfolios. The portfolio credit quality is considered the main component for the insurers' RBC ratio (Murray and Nikolova, 2022).

It is crucial to understand how RBC is calculated. Capital regulation is linked to statutory accounting rules which impact insurers' investment behavior (Ellul et al., 2015). Insurers must create statutory financial statements following statutory accounting principles (SAP). These principles are detailed within the NAIC Accounting Practices and Procedures Manual and comprise the RBC calculation. Statutory Accounting Principles' primary purposes are consistency and standardized financial reporting among insurers. It is important to note that SAP is based on the framework established by U.S. GAAP (Generally Accepted Accounting Principles) (NAIC, 2023).[14]

[13] The AAA provides recommendations of the changes in RBC structure with updates in RBC bond factors to the NAIC. The letters are publicly available and include the date of publication, which is used as the announcement date in my empirical analysis.

[14] There are distinct differences between SAP and GAAP. Unlike SAP, which primarily focuses on the balance sheet and the solvency of insurance companies, GAAP is typically more oriented towards providing helpful information for investors.

Corporate bonds are held at book value for statutory and regulatory reporting. Insurers need to impair their assets if a permanent reduction of the nominal value of an asset occurs because the fair value of a company's assets falls below its book value (Sen and Sharma, 2020). The book/adjusted carrying value (BACV) is multiplied by the specific RBC bond factor for calculating the RBC required capital for a given bond (CIPR, 2017). Then, the individual risk components are adjusted for taxes and aggregated by considering covariances to calculate the Authorized Control Level RBC [15] by the formula in Figure 5. The RBC ratio for an individual insurer is an essential capital adequacy measure for regulators see, e.g., (Ellul et al., 2015; Dong et al., 2022) and is defined as follows:

$$RBC Ratio = \frac{\text{Total Adjusted Capital}}{\text{Authorized Control Level RBC}} \tag{1}$$

The total adjusted capital can also be expressed as the ratio of statutory equity capital to required capital (Ellul et al., 2015). Regulators use the RBC ratio to take regulatory action if it falls below the defined threshold of 200% (CIPR, 2017). RBC ratios can deteriorate due to impairments, which frequently occur in times of crises because the total adjusted capital is reduced due to a downward revision of the value of bonds (numerator) and an increase in Authorized Control level RBC (denominator) due to rating downgrades (Sen and Sharma, 2020).

Insurers may try to optimize their portfolios by choosing those assets to keep their RBC ratios above the RBC threshold level to avoid negative regulatory consequences. The proposed RBC changes see increases in RBC bond factors for most categories due to the expansion from six to 20 factors and the updates of corporate default probabilities. Hence, overall RBC levels are expected to be reduced. Possible ways to maintain or increase the RBC levels in addition to rebalancing their portfolios are higher profits, capital injections, or decreasing portfolio risk. Early rebalancing of the portfolios seems to be most plausible as a response to the RBC bond factor changes since this action is feasible and not as costly as the other measures. Capital injections are unlikely as they have several side effects, such as high administrative and legal expenses. Higher profits depend on many factors not directly controllable by the insurance company. A decrease in portfolio risk by disposing of riskier assets with higher RBC requirements can have the

[15] Summation of RBC based on all possible risk categories represents total RBC.

drawback that returns expectations may not be fulfilled.

2.2 The development of the new RBC structure for bond factors

The development of the new RBC structure was a lengthy decision-making process as several parties, such as the NAIC, the AAA, and the American Council of Life Insurers ("ACLI"), were involved. The calibration of actual data was challenging. In 2011, a more granular set of RBC bond factors was planned by the NAIC together with the AAA without knowing the exact magnitude of proposed RBC bond factors (AAA, 2011). The granular RBC bond factors for individual ratings were proposed in August 2015 for the first time, with relative changes between -30% and 225% for IG bonds (AAA, 2015). This first announcement was followed by updates which proposed relatively lower bond factors for most IG categories. Although the magnitudes of the proposed RBC bond factors primarily changed between 2015-2017, the new RBC structure came into effect by the end of 2021 (see Figures 3 and 4).

It is crucial to provide a detailed discussion of the RBC bond factor announcements to better understand the exact timing. I rely on publicly available correspondence between the AAA and NAIC. In 2011, for the first time, the NAIC and AAA planned a more granular set of risk buckets (AAA, 2011). As the old RBC bond factors are based on credit loss data for U.S. public corporate bonds from 1970-1990, the NAIC planned to update bond capital factors to reflect the latest corporate default probabilities and loss-given default rates (Moody's, 2021). At that time, life insurers knew that RBC changes were planned, but no information was publicly available which exact RBC bond factors would be applicable for various ratings.

The proposed RBC bond factors were initially announced only for life insurers in August 2015 (AAA, 2015).[16] For the sake of completeness also, HY bond factors are shown but are not discussed in detail as they are not the focus of my paper.[17] At this first announcement, the RBC changes are expected to substantially increase overall costs for

[16]Separate models for fixed-income assets other than corporate bonds were not developed at that time. In the future, the factors should also be applied to other non-modeled fixed-income assets. Other fixed-income securities, such as structured securities, have a different modeling process. However, capital requirements should be analyzed in the next step for this type of securities.

[17]Life insurers barely hold high-yield bonds due to capital regulation.

life insurers as almost all ratings are affected.[18] Only Aaa shows a decrease in the RBC bond factor (from 0.40% to 0.28%). The largest increase in RBC bond factor for IG bonds occurs for rating A3 (from 0.40% to 1.30%). Lower-rated IG ratings Baa1 (from 1.3% to 1.49%) and Baa2 (from 1.3% to 1.68%) show relatively low increases in RBC bond factors. In June 2017, the AAA proposed new RBC bond factors are closer to the first announcement of RBC bond factors and experience a substantial decrease for all categories, especially for NAIC2 categories (Baa1, Baa2, Baa3) (AAA, 2017b).[19] This update is closer to the historical factors than the proposed factors in 2015, especially for the lower-rated IG bonds. Even smaller than historical RBC bond factors are announced for Aaa and Aa1. The categories A1 to A3 remain relatively unattractive due to high RBC bond factors. For Baa1, a lower RBC bond factor is proposed compared to the historical level (from 1.3% to 1.13%), Baa2 is revised back close to the historical level (from 1.3% to 1.32%), and the RBC bond factor for Baa3 only slightly increases (from 1.3% to 1.57%).

The American Council of Life Insurers ("ACLI") appreciated the reduction of the RBC bond factors but still had concerns about the RBC update (ACLI, 2017). In October 2017, the AAA announced a second update of RBC bond factors to capture an increase in the safety level from the 92nd to 96th percentile (AAA, 2017a). This update was closer to the proposed RBC bond factors in 2015. The ALCI expressed serious concerns about the second update, as especially small life insurers would be negatively affected by these changes (ACLI, 2018). Notably, the NAIC informed the AAA to reconsider their updated version, as the proposed RBC bond factors seem too high (AAA, 2018a).[20] In the practitioner literature, e.g. (J.P. Morgan Investment Management, 2021) expects a 9%

[18] The AAA recommended in 2017 to implement RBC updates also for P&C and health insurers (AAA, 2017a).

[19] In addition to the main category of RBC bond factors, portfolio adjustment factors are introduced which scale the C-1 factors and should incentivize insurers to increase the number of issuers in the bond portfolio to increase diversification (AAA, 2017a). The proposed adjustment factors are also updated over time. The adjustment factors are displayed below, with the number of issuers in brackets. In 2017, the following adjustment factors were proposed: 2.5 (up to 50), 1.3 (next 50), 1.0 (next 300), and 0.9 (over 400). The new structure in 2017 proposes the following adjustment factors: 7.8 (up to 10), 1.75 (next 90), 1.00 (next 100), 0.8 (next 300), and 0.75 (over 500). I do not find any changes in the number of issuers after the announcement.

[20] At the beginning of 2018, the U.S. adopted the reform Tax Cuts and Jobs Act (TCJA) of its federal corporate income tax rate which was reduced from 35% to 21%. The new proposed RBC bond factors were not implemented then; the AAA recommended that the old C1 pre-tax RBC bond factors for bonds be multiplied by a factor of 0.97 to reflect a higher post-tax discount rate (AAA, 2018b).

decrease in the RBC ratio for a company with the median RBC level due to the changes in RBC bond factors.[21] In 2021, the NAIC engaged Moody's Analytics to independently calculate the RBC bond factors (Moody's, 2021), which became effective by year-end 2021 RBC filings. These changes were also accepted by the ACLI (NAIC, 2021). Notably, the final RBC bond factors were closer to the first update in June 2017. Relative percentage changes of the three proposed changes in RBC bond factors for IG ratings in August 2015, June 2017, and October 2017 compared to their actual levels under the old RBC structure are displayed in Table 1. In columns 3-5, the relative percentage changes of the three proposed changes compared to their actual levels under the old RBC structure are displayed. In columns 6-8, ordinal rankings for investment grade ratings are shown from 10 with the most considerable favorable change (decreases in RBC bond factors) to 1 with the most unfavorable change (increases in RBC bond factors). Notably, the order remains the same for the three different periods for almost all ratings except for Aa2 and Baa3, which only change by one rank.

The period of 2015Q4-2017Q2 includes a single announcement of the RBC bond factors and no RBC updates. The first update of RBC bond factors in June 2017 could be still relevant after the announcement of the second update in October 2017. As even the NAIC expressed concerns about the second update (October 2017) of RBC changes (AAA, 2018a), this might give an idea of which magnitudes the NAIC envisages for the final RBC bond factors. Notably, the AAA only makes recommendations, and the NAIC does not necessarily need to follow them, which was the case when the NAIC accepted the recommendation by Moody's Analytics instead of AAA. Based on these insights, life insurers might perceive the second update (October 2017) as an upper bound of RBC bond factors with a certain probability that changes would align more with the first update (June 2017). Notably, the final RBC bond factors look closer to the proposed factors in June 2017 compared to the updated factors in October 2017.

[21] As this calculation is based on 2019 figures and the latest RBC update, the expected impact of RBC requirements in 2015 should have been higher.

3 Model & Hypotheses Development

3.1 Reaching for yield model

I theoretically analyze the expected RBC changes in capital requirements on reaching for yield in a simplified model with two assets and two periods in the spirit of Becker and Ivashina (2015).[22] In the original setting, the investment decision is made by a manager who optimizes the expected yield against the risk of being downgraded. The manager is employed by a principal, such as an investor or a regulator, who has an aversion to risk. For the sake of simplification, the model abstracts from the manager's risk aversion and possible penalties. There is an allocation of USD 1 between one safer (asset 1) and one riskier asset (asset 2), both initially have the same rating A, but asset 2 is closer to the next rating and therefore has higher yields. As I am interested in the impact of the expected changes in capital requirements on reaching for yield, the expected RBC changes are added to the model by the probability and the magnitude of a change in capital requirements for different ratings. After the initial rating might have changed, the evaluation of returns and capital requirements occurs in period two. The probability of downgrade from A to B: $p_i^- \in [0, 1]$. Asset 2 is more likely to be downgraded since $p_1^- < p_2^-$. The expected capital requirements for Asset 1 are

$$c_A + q_A\lambda_A + p_1^-(\Delta + q_B\lambda_B) \tag{2}$$

and for asset 2

$$c_A + q_A\lambda_A + p_2^-(\Delta + q_B\lambda_B) \tag{3}$$

where c_A is the old capital requirement for asset A, q_A is the probability and λ_A is the magnitude of a change in a capital requirement for rating A, Δ is the increase in the old capital requirement for rating B compared to rating A, q_B is the probability and λ_B is the magnitude of a change in a capital requirement for rating B compared to the old capital requirements for rating B. Capital requirements of c_B can be expressed as follows $c_B = c_A + q_A\lambda_A + \Delta + q_B\lambda_B > c_A + q_A\lambda_A$ The expected capital requirements of the two assets differ with respect to the downgrade probabilities, as the expected changes in capital requirements are the same for the two assets. This leads to the following

[22] The model by Becker and Ivashina (2015) is provided in their internet appendix.

optimization problem:

$$\max_{\alpha_1,\alpha_2} \alpha_1 r_1 + \alpha_2 r_2 - \alpha_1[c_A + q_A\lambda_A + p_1^-(\Delta + q_B\lambda_B)] - \alpha_2[c_A + q_A\lambda_A + p_2^-(\Delta + q_B\lambda_B)] \tag{4}$$

s.t.

$$\sum_i \alpha_i = 1$$

α_1 and α_2 are the weights invested in asset 1 and asset 2. The constraint $\alpha_1+\alpha_2 = 1$ can be written as $\alpha_1 = \alpha$ and $\alpha_2 = 1-\alpha$. This constraint is plugged into the objective function, which results in an unconstrained optimization problem. The first-order condition of the optimization problem w.r.t. α and rearranging terms gives:

$$FOC\ w.r.t\ \alpha$$

$$r_2 - r_1 \geq (p_2^- - p_1^-)(\Delta + q_B\lambda_B) \tag{5}$$

The Inequality 5 can be interpreted that reaching for yield is more attractive if the difference in yields $(r_2 - r_1)$ between asset 2 and asset 1 compensates for the higher probability of a downgrade and expected capital requirements for rating B. Moreover, reaching for yield is more attractive in case of a smaller difference in old capital requirement Δ between assets 1 and 2, a smaller difference in probability of a downgrade $(p_2^- - p_1^-)$ and a smaller expected change in capital requirement $q_B\lambda_B$ for rating B. The term $q_A\lambda_A$ drops out in the FOC, as this term would affect both assets. Due to linearity, the manager optimizes the problem by choosing a single asset in the portfolio.

3.2 Hypotheses Development

Although the model is a simplified two-period model, it allows me to explain the reaching for yield behavior after the proposed RBC changes. I want to analyze if the RBC updates with changing magnitudes of RBC bond factors at different points in time affect life insurers' reaching for yield behavior. For simplicity, I assume similar differences in yield $r_2 - r_1$ over time, a stable probability q_B and constant downgrade probabilities (p_2^- and

p_1^-) which seem to be plausible in a time of economic expansion in the last decade.[23]

Based on these assumptions, Inequality 5 implies that the magnitude of the change in the RBC bond factor λ_B is the critical variable of interest for the reaching for yield behavior. After 2015, the proposed RBC changes λ_B are high in magnitude and increase the right-hand side of the inequality. Therefore, it becomes more difficult to satisfy the inequality, and reaching for yield becomes less attractive. After 2017, the magnitude of the proposed RBC changes λ_B is revised downwards for most ratings, which lowers the right-hand side of the inequality and thus relaxes the inequality. Put differently, reaching for yield is expected to become more attractive after the RBC updates in 2017.[24]

Moreover I want to test if life insurers adapt expectations of the proposed changes in RBC bond factors and reallocate their portfolios as the relative attractiveness of specific rating changes over time. Based on the predictions of the model, I formulate the first hypothesis:

Hypothesis I: Reaching for yield is decreasing in the magnitude of the expected changes in RBC bond factors.

I test this hypothesis by examining life insurers' acquisitions of corporate bonds at issuance compared to mutual funds. Both groups are affected by similar economic conditions, but mutual funds do not have a capital regulation in place and are not affected by the changes in RBC bond factors.

In the literature, differences in the investment behavior between constrained and unconstrained insurers are detected, e.g., (Ellul et al., 2011; Becker et al., 2021). Ellul et al. (2011) show that fire sales can be caused by constrained insurers selling downgraded corporate bonds due to RBC requirements. I also expect a more substantial effect of the proposed RBC changes on life insurers for whom the capital constraint is more binding. Capital-constrained life insurers potentially acquire those bonds with ratings that appear relatively more favorable than the unconstrained ones. One explanation is that expected regulatory costs are higher for capital constrained insures.

[23] A stable probability q_B is a simplifying assumption. Although NAIC intended to implement the RBC changes on time, the probability of implementation seems to be higher after 2017 compared to 2015. However, quantifying the probability of a change in a capital requirement q_B over time is impossible.

[24] However, it should be noted that the magnitude of reaching for yield is less apparent after the RBC updates 2017 because the proposed RBC changes λ_B were revised downwards in June 2017 and revised upwards in October 2017.

Hypothesis II: The proposed changes in RBC bond factors have a stronger effect on corporate bond investments of capital-constrained life insurers.

I test the second hypothesis by comparing corporate bond acquisitions between constrained insurers (low RBC level) and unconstrained insurers (high RBC level) based on the median.

4 Data

4.1 Bondholdings data

I analyze the investment behavior of life insurers as a consequence of the changing proposed RBC bond factors from 2011 to 2019. The sample period starts in 2011 to exclude possible effects from the Great Financial Crisis 2008-09 and ends by year-end 2019 to exclude the impact of the Covid-19 crisis.[25] I compare the investment behavior of life insurers to mutual funds as the latter have similar investment characteristics. However, no rating-specific capital requirements exist for mutual funds; therefore, the regulation does not affect them.

I use NAIC bond holdings data on life insurers and Refinitiv's emaxx bond holdings data on mutual funds. Becker and Ivashina (2015) only use emaxx data, I additionally also use NAIC data. The NAIC data set is more comprehensive and covers the total universe of life insurers, which is, for example, used by (Girardi et al., 2021; Chaderina et al., 2022). This data set is more granular and more appropriate for my purpose. As the data on pension funds are limited for the last decade, I compare the investment behavior of life insurers only to mutual funds. In contrast to insurance companies and mutual funds, which have an obligation to disclose holdings due to NAIC or SEC, pension fund holdings are disclosed voluntarily (Baker et al., 2018). Statutory filings of life insurers on bond holdings from NAIC are accessed through the S&P Capital IQ Pro database. The NAIC company code is used to identify life insurers on the company code level.[26] My sample comprises 852 life insurers in 2011 and 754 in 2019. I use schedule D part 1 to identify bond holdings and parts 3 and 5 to identify acquisitions of bonds at issuance.[27] Part 3 includes bonds acquired throughout a given year, and part 5 contains all bonds acquired and fully disposed of throughout the year. The data include all acquisitions of bonds on the 9-digit CUSIP level with information on the date, par value, and entity name. I merge aggregated acquisitions of life insurers from NAIC bond holdings and mutual funds from emaxx on the CUSIP level to calculate differences between these groups for a given corporate bond at issuance. One issuer can have multiple issues over time. The issuer

[25] As bond prices shortly after the Great Financial Crisis are depressed, I start in 2011 to avoid this impact. The sample period ends in 2019, as the the global pandemic might have reduced the risk-taking behavior of life insurers.

[26] NAIC distinguishes between P&C, health, and life insurers.

[27] Part 4 includes all bonds disposed or redeemed throughout a year.

is identified by the six-digit CUSIP. I only keep corporate bond acquisitions in the first quarter of bond issuance for companies with available RBC ratio and balance sheet data for total assets, investments, and surplus. To analyze life insurers on the company level, I only keep companies that do not have an RBC ratio in the top 5% and bottom 5%, similar to (Ellul et al., 2011). After these steps, I arrive at a number of 102,571 corporate bond acquisitions at issuance.

Emaxx quarter-end bond holding data on US corporates at the security level for mutual funds are used, including information on bond characteristics and issuers. The bond acquisitions can be identified by the changes in holdings between any two periods. The data set is survivorship-bias free, but one limitation of emaxx is the missing of exact acquisition dates (Cai et al., 2019). In addition, the quarter-end portfolio holdings do not allow to observe round-trip transactions within a quarter.

I restrict my sample to US dollar-denominated, fixed coupon corporate bonds to exclude currency risk. I exclude mortgage-backed securities due to a separate reform in capital regulation in 2009 and 2010 (Becker et al., 2021).[28] Bond characteristics and ratings are obtained from the Mergent Fixed Income Securities Database (FISD). Similarly to Becker et al. (2021), if for a specific corporate bond, ratings from two rating agencies exist, I use the lower one. If ratings from three rating agencies exist, I use the middle rating. Data on offering yield spreads are also taken from FISD, calculated as the difference between the yield to maturity at issuance of a specific corporate bond and a corresponding treasury bond. I exclude bonds for which I do not have information about the issuance volume, issuance date, and maturity date. Corporate bond transaction data are obtained from TRACE to calculate the trading volume of a respective bond in the first quarter divided by total par value outstanding as a control variable in my regression specifications. I use one-year transition probabilities from Fitch Global Corporate Finance Transition Matrices for 2015-2019 to calculate an expected RBC change measure, which captures transition probabilities for specific ratings over time.

4.2 Sample statistics

In this section, descriptive statistics of my sample are shown. In Figure 2, I show the bond allocation of life insurers across the NAIC classes 1-6 as a share of total bonds

[28]In 2015, the RBC bond factors are only proposed for corporate bonds.

between 2011 and 2019. The share of investment-grade bonds (NAIC1 and NAIC2) of about 90% dominates. Interestingly, the total share of classes 1 and 2 remains relatively stable, but there seems to be a switch from class 1 to class 2.

In Table 2, I provide descriptive statistics for firm characteristics of life insurers and bond characteristics. The average life insurer has total assets of 74,836 USDm (median of 2,260 USDm), investments of USD 40,273 (median of 1,621 USDm), and a surplus of 5,113 USDm (median of 453 USDm). The RBC ratios across life insurers range from 4.8 (10p) to 69.9 (90p), with a median of 10.1. Only a few insurers have very low RBC ratios. The bond characteristics for rated investment grade bonds are Offering Yield Spread, Length Years, and Offering Amount. The average bond has an average Offering Yield Spread of 1.320% (median 1.200%), a Length of 9.2 years (median 10.0 years), and an Offering Amount of 655.9 USDm (median 600.0 USDm).

5 Methodology and Results

5.1 Reaching for yield - Aggregated bond acquisitions

I analyze the effect of the proposed RBC changes on the reaching for yield behavior. I provide empirical evidence for my hypotheses that reaching for yield is decreasing in the magnitude of the expected increase in RBC bond factors. I use a similar approach as Becker and Ivashina (2015)[29] in which acquisitions of corporate bonds at issuance between life insurers and mutual funds are analyzed in an OLS regression analysis.[30] Relative differences in acquisition intensity for a specific stock b (%Diff Acqu Int_b) between life insurers and mutual funds are used as the dependent variable. I use mutual funds as a benchmark as they have similar investment characteristics with strong exposure to corporate bonds. Both types of investors should be similarly affected by the state of the economy, but life insurers have capital requirements for bonds in place, but mutual funds do not. I focus on IG corporate bonds since both types of investors heavily tilt their portfolios to IG, complying with their investment mandates. There might be a concern regarding the heterogeneity of mutual funds in their investment styles, suggesting that not all funds are suitable for comparison with life insurers. To address this concern, I exclusively consider U.S. mutual funds and exclude those funds with names containing terms such as "equity", "stock", "balanced", "mixed", "convertible" and "high". [31] Furthermore, I conduct additional analyses to demonstrate the consistency and robustness of the results when considering all types of mutual funds.

Investments in lower-rated IG bonds may become more favorable during economic expansion due to lower default probabilities. As life insurers and mutual funds are expected to invest similarly, this effect should be canceled using mutual funds as a control group. The relative differences in acquisition intensity (%Diff Acqu Int_b) should be explained by expected changes in RBC bond factors (capital requirements) for life insurers. %Diff Acqu Int_b is the difference between life insurers' and mutual funds' acquisition

[29] Due to limited data availability in my sample period, I do not include pensions fund, also explained in Section 4. I focus only on life insurers, as the proposed RBC changes were initially only announced for this insurance sector.

[30] There is no heterogeneity in the U.S. states' implementation of the RBC changes, I cannot use a staggered difference-in-difference approach.

[31] This selection criterion has been employed previously by Becker and Ivashina (2015) who implemented a similar method in their study's appendix to confirm the robustness of their findings.

intensities for a specific IG bond b:

$$\%\text{Diff Acqu Int}_b = (\text{Life insurers' acqu intensity}_b - \text{ Mutual funds' acqu intensity}_b) \cdot 100 \tag{6}$$

where life insurers' and mutual funds' acquisitions intensities are calculated as follows:

$$\text{Life insurers' acqu intensity}_b = \frac{\sum_i \text{Life insurers' bond acqu}_{i,b,t}}{\text{Total bond acqu of life insurers}_t}$$

$$\text{Mutual funds' acqu intensity}_b = \frac{\sum_j \text{Mutual funds' bond acqu}_{j,b,t}}{\text{Total bond acqu of mutual funds}_t}$$

I use the following regression specification:

$$\%\text{Diff Acqu Int}_b = \beta_0 + \beta_1 \text{ Offering yield spread}_b + \gamma_1 X_b + \gamma_2 \text{NAIC2} + \mu_z + \epsilon_b \tag{7}$$

The main coefficient of interest is the Offering yield spread, which determines the magnitude of reaching for yield. I add the following controls X_b for bond characteristics ln(Offering Amount), ln(Length Years), and ln(Trading Volume) as life insurers might have preferences for long-duration bonds (illiquidity premium), smaller bonds, and bonds with little trading volume (Becker and Ivashina, 2015). Due to the different capital requirements of NAIC2 bonds with ratings Baa1, Baa2, and Baa3 in the old RBC structure, I include a dummy variable equal to one for bonds in NAIC2, a standard procedure in the literature.

Results are shown in Table 3. I divide my sample into three different sub-periods: before the first RBC announcement (2011Q1-2015Q3), after the first RBC announcement (2015Q4-2017Q2), and after the first RBC update in 2017 (2017Q3-2019Q4). Regression models 1, 3 and 5 do not include fixed effects. I also want to test if life insurers, compared to mutual funds, prefer those bonds with higher yields within a rating. This preference should become more important after the announcement of the proposed RBC changes, which introduce an increase in the number of risk buckets. To test this possibility, models 2, 4, and 6 include 'rating x year fixed effects' (μ_z).[32]

[32] The dummy variable for the NAIC2 category drops out in this specification. In Section 5.2, I also analyze if preferences for specific ratings change over time.

The coefficient Offering Yield Spread captures the magnitude of reaching for yield and shows a plausible pattern in the direction. This coefficient is insignificant before the proposed RBC change (column 1), becomes negative after 2015Q4 (column 3), and becomes positive after the updates of the proposed RBC changes (column 5). The coefficient Offering Yield Spread of 0.048 after the RBC updates can be interpreted that a 100bps increase in the Offering Yield Spread corresponds to an increase in the difference in acquisition intensity between life insurers and mutual funds for a specific bond of 4.8bps. Although the coefficients are economically small in magnitude, it should be noted that the means of the acquisition intensities are low, which are 0.37% for life insurers and 0.40% for mutual funds. These sizes are reasonable due to the considerable number of bond issuances based on the calculation in Equation 6. Conditional on rated issues, life insurers prefer those corporate bonds that are smaller (Offering Amount), have a longer duration (Length Years) compared to mutual funds. These results are plausible and documented in, e.g., Becker and Ivashina (2015).

The reaching for yield model in Section 3.1 can explain the directions of the coefficient Offering Yield Spread. After 2015, the magnitude of changes λ_B increased the right-hand side of the Inequality 5, which implies that reaching for yield becomes less attractive. The overall magnitude of reaching for yield is less apparent after the RBC updates 2017 because the magnitudes of the proposed RBC changes λ_B were revised downwards in June 2017 and revised upwards in October 2017.

Using 'rating x year fixed effects' (columns 2, 4, and 6) also confirms the pattern of reaching for yield over time, where the coefficients point in the same direction and are similar in magnitude. Notably, closer to the implementation date of the RBC changes in specification 6, life insurers, compared to mutual funds, highly prefer those bonds with higher yields within a given rating. The coefficient of 0.129 is significant at the one percent level. These findings confirm that the proposed RBC changes also matter when the old RBC bond factors are still applicable.

I also conduct the regression analysis for each quarter separately to get further insights into how the reaching for yield behavior changes over time. Details are shown in Figure 7 (no fixed effects) and Figure 8 (rating fixed effects). The coefficients Offering Yield Spread of quarterly regressions are plotted with 90% confidence intervals. The magnitudes of these coefficients substantially change after the proposed revisions in RBC bond factors.

A plausible time-varying reaching for yield pattern is found, which the model's predictions can largely explain. These results confirm my hypothesis I. Notably, after the initial RBC announcement in August 2015, both figures show a substantial decrease in the Offering yield spread coefficient. The coefficient becomes larger during the first update to the proposed RBC bond factors in June 2017. This change is intuitive as the update in June 2017 saw smaller RBC bond factors compared to the announcement in 2015, which is expected to promote reaching for yield. Following the subsequent update in October 2017, reaching for yield decreased. Subsequently, as the proposed RBC changes come closer to implementation, the coefficients revert to levels observed before the initial announcement of the RBC changes in 2015. Although the coefficient is not distinguishable from zero in every period, a plausible trend can be seen. In the Appendix, I also plot the reaching for yield behavior for life insurers (Figure 9) as well as mutual funds (Figure 10) on a stand-alone basis. [33]

5.2 Changes in rating-specific bond acquisitions

I analyze if rating-specific bond acquisitions change after the announcements of the proposed RBC bond factors due to changes in preferences for specific ratings. I expect that life insurers acquire a higher (lower) share of bond ratings with lower (higher) expected capital requirements relative to mutual funds to reach for yield. These changes are tested by adding interaction terms CAT_i x YEARS_i (both are dummy variables) to the regression 7. I group ratings into categories CAT_i that are similarly affected by the expected RBC changes in terms of the relative percentage change. CAT_i takes the value of 1 if the specific bond rating is included in the respective category. YEARS_i takes the value of 1 if the bond acquisition occurs after the RBC updates 2015Q4-2017Q2, 2017Q3-2019Q4, and 2015Q4-2019Q4.

The following regression specifications are used:

$$\begin{aligned}\%\text{Diff Acqu Int}_b = \beta_0 + \beta_1 \text{Offering yield spread}_b + \gamma_1 X_b + \gamma_2 \text{NAIC2} + \gamma_3 \text{CAT}_i + \\ \gamma_4 \text{YEARS}_i + \gamma_5 \text{CAT}_i \text{ x } \text{YEARS}_i + \epsilon_b\end{aligned} \tag{8}$$

[33] This analysis shows that the reaching for yield effect observed is similar to the results using only life insurers. However, the strong increase in reaching for yield after 2018Q4 is amplified by the investment behavior of mutual funds.

where CAT_i x YEARS_i should capture differences in bond acquisitions after the announcements of RBC changes in 2015 and 2017. As the ordinal ranking in Table 1 is very stable over time, this allows me to group ratings that are similarly affected by the changes in RBC bond factors only once based on their rankings.[34]

I test various interaction terms CAT_i x YEARS_i in different specifications. Then, based on the ranks of the defined categories, I form expectations if the interaction terms are positively or negatively associated with a change in acquisition intensity. In fact, for higher (lower) ranks, I expect a higher (lower) difference in acquisition intensity between life insurers compared to mutual funds and, therefore, a positive (negative) coefficient of the interaction term. Put differently, life insurers buy a relatively higher (lower) share of corporate bonds of these categories compared to mutual funds. The category CAT(Aaa,Aa1) is affected most favorably compared to other IG ratings for all RBC updates due to a reduction or slight increase in proposed RBC bond factors. In contrast, the proposed RBC bond factors for CAT(A1,A2,A3) increase more strongly than for all other IG ratings. Therefore, I expect a decrease in acquisitions.

Relatively small increases in proposed RBC bond factors for CAT(Baa1,Baa2) occur. The rating Baa1 even showed a slight decrease in June 2017. This category (ranks 8 and 7) represents the lowest increase of lower IG ratings (NAIC2). Therefore, for these categories, I expect an increase in differences in acquisition intensity.[35] It is difficult to disentangle the effect of both RBC updates in June and October 2017 on the difference in acquisition intensity, as the updates in 2017 are very close in time.[36] Therefore, I analyze the two periods, 2015Q4-2017Q2 and 2017Q3-2019Q4.

Regression results are shown in Table 4 for the sub-periods 2011Q1-2017Q2 (Panel A)

[34] I group ratings Aaa and Aa1 (ranks 10 and 9), ratings A1, A2, and A3 (ranks 1, 2, and 3), and ratings Baa1 and Baa2 (ranks 8 and 7). In addition, I also analyze the category NAIC2, which consists of Baa1, Baa2, and Baa3 (ranks 8, 7, and 5/6) because of the same actual RBC requirements under the old RBC structure. Baa3 (rank 5/6) is particularly interesting due to its proximity to non-investment grade.

[35] A decrease in relative attractiveness is expected for CAT(Baa3) for 2015Q4-2017Q2 compared to 2011Q1-2015Q3 due to a substantial increase in RBC bond factors. However, it may become more favorable after the proposed RBC updates in 2017. The direction for CAT(Baa1, Baa2,Baa3) is ambiguous for the update in 2015 as it consists of CAT(Baa1,Baa2) with relatively low increases and higher increases for CAT(Baa3). For the period 2017Q3-2019Q4 compared to 2015Q4-2017Q2 I expect an increase in acquisition intensity for CAT(Baa1,Baa2,Baa3), CAT(Baa1,Baa2) and CAT(Aaa,Aa1) and a decrease for CAT(A1,A2,A3).

[36] The number of bond issues of a specific rating in a given quarter is low.

and 2015Q4-2019Q4 (Panel B).[37] The main results of the different interaction terms of Table 4 together with my expected directions for the difference in acquisition intensity are summarized in Table 5.[38] I find evidence that differences in acquisition intensity between life insurers and mutual funds can be explained largely by the proposed RBC bond factors. Life insurers, compared to mutual funds, invest a higher (lower) share in those bond ratings with lower (higher) expected increases in capital requirements after the proposed RBC announcements, which hold for most categories. This is especially true for 2017Q3-2019Q4, in which four out of five coefficients align with my expectations.[39] After the updates of RBC bond factors in 2017, the difference in acquisition intensity is more considerable, supported by the size and significance of the coefficients.

In Table 4 (Panel A), most coefficients of the interaction terms are indistinguishable from zero except for CAT(Baa3) x 2015Q4-2017Q2. A reduction in acquisition intensity occurs for Baa3 corporate bonds after 2015Q4, which is in line with the prediction. The rating Baa3 is of particular interest due to its proximity to HY. In the literature, e.g., Ellul et al. (2011) find that capital-constrained insurers are more likely to dispose of IG bonds downgraded to HY bonds. In that respect, a reduction in Baa3 bonds in case of higher expected capital requirements for life insurers appears plausible.

5.3 Transition probabilities

My theoretical model predicts that reaching for yield is more attractive if the return of asset 2 compensates for the higher probability of a downgrade and expected capital requirements for rating B (see Section 3.1). I want to test a quantitative measure of the expected RBC changes ($ExpChange_{i,t}$) in regression analysis, which should capture both the additional capital requirements triggered by the proposed RBC changes and time-varying downgrade probabilities of specific ratings. The aim is to find further evidence

[37] I also include the variables YEARS_i and CAT_i separately in my regressions, but for clarity, I do not report the results.

[38] The tax reform TCJA in 2018 may distort results for the second period, as it can be seen as a boost to the overall U.S. economy. However, this reform should affect life insurers and mutual funds to a similar degree as they have similar investment characteristics. There should be no differences between life insurers and mutual funds in terms of risk shifting. Hence, the tax effect should be relatively negligible. NAIC took the tax reform into account by multiplying all historical RBC bond factors by a factor of 97%, meaning that all ratings are affected equally based on the tax change. Therefore, no specific rating should dominate the others based on the tax effect.

[39] CAT(Baa1,Baa2) is insignificant, but very close to the 10% level.

if the expected RBC changes correspond to changes in the acquisition intensity. As the theoretical model is a two assets and two periods model, for the empirical analysis, the right side of Inequality 5 $(p_2^- - p_1^-)(\Delta + q_B\lambda_B)$ needs to be measured in a way which should better reflect reality.

As different RBC bond factors were proposed, it is somewhat unclear which final factors life insurers expect at each point in time. Under the old RBC structure, Δ is the difference in capital requirements between two risk buckets, which the dummy variable NAIC2 for IG bonds captures. I assume q_B to be one and thus use the magnitude of a change in a capital requirement λ_B as the expected RBC changes.[40] I implicitly assume that the implementation of the proposed RBC bond factors is concrete and equally likely for all ratings up to the point when the new factors are proposed.

For the expression $(p_2^- - p_1^-)$, I use time-dependent transition probabilities stemming from transition matrices from Fitch ratings. Based on these assumptions, I test the following measure, which should capture the expected RBC changes:

$$\text{Exp Change}_{i,t}^{A} = \sum_{j=1}^{J} p_{ij,t}\lambda_{j,t} \tag{9}$$

where Exp $\text{Change}_{i,t}^{A}$ is the expected RBC change of rating i at time t, $p_{ij,t}$ is the transition probability from rating i to ratings j at time t. j is a vector representing all existing ratings $j = \{Aaa, Aa1, \ldots, D\}$. The transition probability can be either a downgrade probability, an upgrade probability, or the probability of remaining in the same rating. $\lambda_{j,t}$ is the difference between the proposed $RBC_{i,t}^{pro}$ and the actual RBC_{i}^{act} bond factors and measures the additional increase (decrease) in capital requirements as a percentage for a specific rating at a given point in time.

In a separate specification, I only use the difference between the proposed and the actual RBC bond factors without considering transition probabilities:

$$\text{Exp Change}_{i,t}^{B} = RBC_{i,t}^{pro} - RBC_{i}^{act} \tag{10}$$

[40]This is a simplifying assumption, as I cannot observe real-world probabilities of the proposed RBC changes. It was not foreseeable that many revisions of the RBC bond factors in terms of magnitudes would occur.

Exp Change$^B_{i,t}$ is also time-dependent as the latest proposed RBC bond factor is used.

Table 6 shows the results of regressing the life insurer's bond acquisitions on Exp Change$^A_{i,t}$ or Exp Change$^B_{i,t}$ The coefficient Expected Change is negative in both periods, which points out that an increase in the expected RBC changes is associated with a decrease in the share of acquisitions of the specific rating. Notably, the expected RBC change coefficients of -1.683 and -1.358 are only significant in the second period (2017Q3-2019Q4), suggesting that the updates of proposed RBC changes in 2017 play a more critical role than the first announcement of RBC changes in 2015.

5.4 RBC bond factors - Life insurer-specific bond acquisitions

Additionally, using insurer fixed effects, I analyze life insurers' acquisitions at issuance on the insurer level instead of the aggregated level. Although measuring the difference in acquisition intensity between life insurers and mutual funds may be superior in case of possible confounding events (see Section 5.1), the analysis on the insurer level should provide additional results to better understand the investment behavior of life insurers after the proposed RBC changes. The dependent variable is the share of specific IG corporate bond acquisitions of insurer i scaled by total corporate bond acquisitions of the life insurer i in a given quarter:

$$\begin{aligned}\text{Life insurer's acqu int}_{i,b} = \beta_0 + \beta_1 \text{ Offering yield spread}_b + \gamma_1 X_b + \gamma_2 \text{NAIC2}+ \\ \gamma_3 \text{CAT}_i + \gamma_4 \text{YEARS}_i + \gamma_5 \text{CAT}_i \text{ x YEARS}_i + \mu_z + \epsilon_b\end{aligned} \tag{11}$$

where

$$\text{Life insurer's acqu int}_{i,b} = \frac{\text{Life insurer's bond acqu}_{i,b,t}}{\text{Total bond acqu of life insurer}_{i,t}} \cdot 100\%$$

I calculate 'Life insurer's acqu int' if a life insurer acquires more than one bond in a quarter. Results are shown in Table 7 for the periods 2011Q1-2017Q2 (Panel A) and the period 2015Q3-2019Q4 (Panel B). In Panel A, I do not find evidence that life insurers on the insurer level purchased specific categories after the first RBC announcement in 2015 in line with the proposed RBC bond factors. On the other hand, Panel B provides results that life insurers adjusted their acquisitions in response to the RBC bond factors in the expected direction. In particular, life insurers acquired a larger share of corporate bonds with ratings Baa1 and Baa2 (coefficient of 0.384) but a lower share of ratings A1, A2, and A3 (coefficient of -0.477) after 2017Q3. The interaction term for CAT(Aaa,Aa1) of -0.351 is insignificant but similar to the result in Table 4 Panel B. One possible explanation for the negative sign might be that life insurers must fulfill returns expectations, and certain lower-rated IG bonds have higher risk-adjusted returns than higher-rated IG bonds with ratings such as Aaa and Aa1.

Overall, the analysis of the life insurer-specific bond acquisitions is in line with the results in Table 4 (acquisitions on the aggregated level) and confirms that the update in RBC bond factors in 2017 played a more important role for the acquisition of specific bond ratings as the than the first announcement in 2015.

5.5 Constrained v.s. unconstrained life insurers

I want to examine if life insurers, for whom the capital constraint is more binding, respond more strongly to the proposed RBC changes. Similar to Lenciauskaite (2019), I use the life insurers' lagged RBC ratios to group them into constrained or unconstrained companies based on the median RBC ratio of all life insurers. A specific life insurer is constrained (unconstrained) if its reported RBC ratio is below (above) the median of all life insurers. For example, Cheng and Weiss (2013) show that constrained insurers should react ahead of unconstrained insurers to regulatory changes.

To test this hypothesis, I add the triple interaction term 'CAT$_i$ x Years$_i$ x constrained' in Equation 11 to identify differences between constrained and unconstrained life insurers for specific ratings after 2015 and 2017. Life insurer's specific corporate bond acquisition scaled by its total corporate bond acquisitions in a given quarter is regressed on 'CAT$_i$ x Years$_i$ x constrained' and control variables and all its terms interacted with 'constrained' using insurer fixed effects.

Results are shown in Table 8 for the period 2011Q1-2017Q2 in Panel A (Years$_i$: 2015Q4-2017Q2) and the period 2015Q4-2019Q4 in Panel B (Years$_i$: 2017Q3-2019Q4).[41] I find significant differences in acquisitions between constrained and unconstrained life insurers only after 2017Q3 (Panel B), where capital-constrained life insurers react more in line with the proposed changes. This holds true for NAIC2, CAT(Baa3) and CAT(A1,A2,A3). I

[41] In all specifications all variables mentioned are included but not displayed for better readability.

also analyze if the difference between constrained and unconstrained life insurers becomes stronger when more time after the RBC updates in 2017 passes, which is indeed the case. Results are shown in the Appendix in Table A-4 and explained in Section 5.6 in detail.

5.6 Robustness tests

I find a time-varying reaching for yield pattern, which can be largely explained by the model's predictions (see Figure 7). There might be the concern that the control group mutual funds distort the picture when looking at differences between these two types of investors. To alleviate this concern, I also calculate the reaching for yield behavior separately for life insurers and mutual funds on a stand-alone basis. In the Appendix, Figure 9 plots the Offering Yield Spread coefficients of quarterly regressions using the Life insurers' acqu intensity$_b$ as the dependent variable in Equation 8 and the 90% confidence intervals. Similarly, Figure 10 uses the Mutual funds' acqu intensity$_b$ as the dependent variable. The reaching for yield effect observed is similar to the results using only life insurers. In Table A-1, I demonstrate the robustness of the reaching for yield results when considering all types of mutual funds.

I find that life insurers adjust their acquisitions in times before the full implementation of the new RBC bond factors. One argument for the early adjustment is that life insurers are buy-and-hold investors and need to form efficient portfolios considering all relevant information about the proposed RBC changes. Nevertheless, there might be heterogeneity in the trading behavior of life insurers. I want to exploit this variation to see whether certain life insurers postpone their portfolio adjustments until after the implementation of the proposed RBC bond factors.

To explore this, I will assess whether life insurers with a low portfolio turnover rate (ptr) tend to align their acquisitions more closely with the proposed RBC bond factors than their counterparts with a high ptr. The ptr for a life insurer's corporate bond portfolio is defined in line with Schreiner (1980) as follows:

$$\text{ptr}_{t,i} = \frac{(\text{acquisitions}_{t,i} + \text{disposals}_{t,i})/2}{(\text{holdings}_{t,i} + \text{holdings}_{t-1,i})/2}$$

The triple interaction terms 'CAT$_i$ x Years$_i$ x ptr high' should capture differences between companies with high and low portfolio turnover after the RBC changes for specific ratings. 'ptr high' is a dummy variable that takes the value of one if a particular company has a portfolio turnover in the fourth quantile in a given year. The results are shown in Table A-2 for the sub-periods 2011Q1-2017Q2 (Panel A) and 2015Q4-2019Q4 (Panel B). I find evidence that life insurers with low ptr adjusted their acquisitions more in line with the proposed RBC bond factors than those with high ptr. Life insurers with high ptr preferred higher risk-adjusted returns under the old RBC structure. They did not fully consider the new RBC bond factors when subject to further changes. In particular, this is the case for bond ratings with the highest or lowest expected changes in RBC bond factors. This result seems plausible as life insurers with high ptr have more flexibility to reallocate their portfolios on short notice. After 2015Q4 (Panel A), life insurers with high ptr acquired the category least favorable with the highest increases in proposed RBC bond factors CAT(A1,A2,A3) and reduced the category most favorable CAT(Aaa).[42] Differences in acquisitions are reverted in the period 2017Q3-2019Q4 (Panel B) as the triple interaction terms CAT(A1,A2,A3) and CAT(Aaa) become negative.

In Table A-3, I provide additional results comparing life insurers' acquisitions at issuance to mutual funds. In this specification, I use the period after the announcement of RBC changes 2015Q4-2019Q4 in the interaction term and compare acquisitions to 2011Q1-2015Q3 as RBC bond factors were not proposed. Results are shown in Table A-3. I only find a highly significant positive coefficient of the interaction terms for CAT(Baa1,Baa2). The results support that the individual sub-periods matter after the first RBC bond factor announcement and after the RBC bond factor updates.

In Table A-4, I analyze differences in bond acquisitions between constrained vs. unconstrained for the sub-period 2015Q4-2019Q4 using 2018Q1-2019Q4 instead of 2017Q3-2019Q4 as a dummy variable in the triple interaction term.[43] The intuition is that life insurers may take time to update their investment strategies and adjust their portfolios after the RBC updates as uncertainty is prevalent. As expected, large and significant triple interaction terms (larger compared to Table 8, Panel B) provide additional evidence that constrained life insurers adjusted their acquisitions of corporate bonds more in line with the proposed RBC changes compared to their counterparts.

[42] Aaa even saw a decrease in the proposed RBC bond factor.

[43] The second update of RBC bond factors took place in 2017Q4.

6 Conclusions

In this paper, I provide new insights into how life insurers adjust their reaching for yield behavior in response to the proposed regulatory changes in RBC for corporate bonds. I find that reaching for yield is decreasing in the magnitude of the expected RBC changes. A reduction in reaching for yield after the first announcement in 2015 with large expected changes in RBC for almost all ratings is followed by an increase in reaching for yield after the proposed RBC updates in 2017 with lower expected changes in RBC.

Overall, many changes in life insurers' acquisition of corporate bonds at issuance can be explained by the proposed RBC changes. Compared to mutual funds, life insurers invest a higher (lower) share in those bond ratings with lower (higher) expected increases in capital requirements after the proposed RBC announcements, which hold for most categories. The effect is even more substantial for the period after the updates in RBC factors in 2017 compared to the first announcement of RBC changes in 2015. This might be explained by the probability of a timely change becoming higher and the full implementation becomes more concrete.

Capital-constrained life insurers react more strongly to the proposed RBC changes by reducing those categories with the most substantial expected increases in RBC factors and acquiring those ratings which appear more favorable in the future. This pattern especially holds after the RBC updates in 2017, which supports the view that life insurers adjust their investment behavior when the final RBC factors were more likely to be implemented. Future research may examine the interplay of regulatory RBC changes and the impact on other asset classes.

References

AAA (2011). Report of the invested assets work group regarding the c-1 framework, . https://www.actuary.org/sites/default/files/files/publications/C1_Framework_Report_061011.pdf, Last accessed on 2023-12-12.

AAA (2015). Model construction and development of rbc factors for fixed income securities for the naic's life risk-based capital formula, . https://www.actuary.org/sites/default/files/files/imce/Academy%20C1WG%20Documentation%20Corp%20Bond%20Factors%20%20Aug%203%202015%20Final.pdf, Last accessed on 2023-12-12.

AAA (2017a). Updated recommendation of corporate bond risk-based capital (rbc) factors, . https://www.actuary.org/sites/default/files/files/publications/Academy_C1WG_Comments_to_NAIC_IRBC_101017.pdf, Last accessed on 2023-12-12.

AAA (2017b). Updated recommendation of corporate bond risk-based capital (rbc) factors, . https://www.actuary.org/sites/default/files/files/publications/C1WG_bond_rec_NAIC_IRBC_060817.pdf, Last accessed on 2023-12-12.

AAA (2018a). Capital adequacy (e) task force: July 17, 2018, . https://www.actuary.org/sites/default/files/files/publications/Academy_C1WG_RP_Assumptions_071718.pdf, Last accessed on 2023-12-18.

AAA (2018b). Rbc tax reform work group (trwg). https://www.actuary.org/sites/default/files/files/publications/Academy_Life_RBC_Tax_Reform_WG_Comment_Letter_to_LRBC_031618.pdf, Last accessed on 2023-12-18.

ACLI (2012-2019). Life insurers fact books. Last accessed on 2022-04-10.

ACLI (2017). Academy's june 2017 report comment letters. Last accessed on 2022-04-20.

ACLI (2018). Academy's october 2017 report comment letters. Last accessed on 2022-04-20.

Baker, M., Bergstresser, D., Serafeim, G., and Wurgler, J. (2018). Financing the response to climate change: The pricing and ownership of us green bonds. Technical report, National Bureau of Economic Research.

Becker, B. and Ivashina, V. (2015). Reaching for yield in the bond market. *The Journal of Finance*, 70(5):1863–1902.

Becker, B., Opp, M. M., and Saidi, F. (2021). Regulatory forbearance in the us insurance industry: The effects of removing capital requirements for an asset class. *Swedish House of Finance Research Paper*, (20-6).

Cai, F., Han, S., Li, D., and Li, Y. (2019). Institutional herding and its price impact: Evidence from the corporate bond market. *Journal of Financial economics*, 131(1):139–167.

Chaderina, M., Mürmann, A., and Scheuch, C. (2022). The dark side of liquid bonds in fire sales. *Available at SSRN 2995544*.

Chen, T., Goh, J. R., Kamiya, S., and Lou, P. (2019). Marginal cost of risk-based capital and risk-taking. *Journal of Banking & Finance*, 103:130–145.

Cheng, J. and Weiss, M. A. (2013). Risk-based capital and firm risk taking in property-liability insurance. *The Geneva Papers on Risk and Insurance-Issues and Practice*, 38:274–307.

Choi, J. and Kronlund, M. (2018). Reaching for yield in corporate bond mutual funds. *The Review of Financial Studies*, 31(5):1930–1965.

CIPR (2017). Risk-based capital requirements on fixed income assets to change, . https://content.naic.org/sites/default/files/inline-files/topic_risk_based_capital_rbc_requirements_on_fixed_income_assets_to_change.pdf, Last accessed on 2023-06-18.

Di Maggio, M. and Kacperczyk, M. (2017). The unintended consequences of the zero lower bound policy. *Journal of Financial Economics*, 123(1):59–80.

Dong, Q., Kim, S., and Ryan, S. G. (2022). Accounting rule–driven regulatory capital management and its real effects for u.s. life insurers. *Available at SSRN: http://dx.doi.org/10.2139/ssrn.397564*.

Ellul, A., Jotikasthira, C., and Lundblad, C. T. (2011). Regulatory pressure and fire sales in the corporate bond market. *Journal of Financial Economics*, 101(3):596–620.

Ellul, A., Jotikasthira, C., Lundblad, C. T., and Wang, Y. (2015). Is historical cost accounting a panacea? market stress, incentive distortions, and gains trading. *The Journal of Finance*, 70(6):2489–2538.

Gerstner, T., Griebel, M., Holtz, M., Goschnick, R., and Haep, M. (2008). A general asset–liability management model for the efficient simulation of portfolios of life insurance policies. *Insurance: Mathematics and Economics*, 42(2):704–716.

Girardi, G., Hanley, K. W., Nikolova, S., Pelizzon, L., and Sherman, M. G. (2021). Portfolio similarity and asset liquidation in the insurance industry. *Journal of Financial Economics*, 142(1):69–96.

Gropp, R., Mosk, T., Ongena, S., and Wix, C. (2018). Banks Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment. *The Review of Financial Studies*, 32(1):266–299.

J.P. Morgan Investment Management (2021). Rbc, find out what it means to me - u.s. life insurance bond factor changes. https://am.jpmorgan.com/us/en/asset-management/institutional/investment-strategies/insurance/.

Koijen, R. S. and Yogo, M. (2017). Risk of life insurers: Recent trends and transmission mechanisms.

Lenciauskaite, G. (2019). Seasonal bond maturities in the u.s. insurance industry. *Working paper*.

McShane, M. K., Cox, L. A., and Butler, R. J. (2010). Regulatory competition and forbearance: Evidence from the life insurance industry. *Journal of Banking & Finance*, 34(3):522–532.

Merrill, C. B., Nadauld, T. D., Stulz, R. M., and Sherlund, S. (2012). Did capital requirements and fair value accounting spark fire sales in distressed mortgage-backed securities? Technical report, National Bureau of Economic Research.

Moody's (2021). Revisions to the rbc c1 bond factors, . https://content.naic.org/sites/default/files/inline-files/2021%20Revisions%20to%20the%20RBC%20C1%20Bond%20Factors%205-24.pdf, Last accessed on 2024-01-20.

Murray, S. and Nikolova, S. (2022). The bond-pricing implications of rating-based capital requirements. *Journal of Financial and Quantitative Analysis*, 57(6):2177–2207.

NAIC (2020). Aggregated life rbc and annual statement data, . https://content.naic.org/sites/default/files/inline-files/Life%20and%20Fraternal%20RBC%202019%20statistics.pdf, Last accessed on 2022-03-24.

NAIC (2021). Capital adequacy (e) task force - rbc proposal form, . https://content.naic.org/sites/default/files/inline-files/2021-11-L%20Life%20Bond%20Factors%20%28ACLI%29.pdf, Last accessed on 2023-12-18.

NAIC (2022). Risk-based capital, . https://content.naic.org/cipr-topics/risk-based-capital, Last accessed on 2022-03-07.

NAIC (2023). Statutory accounting principles. Last accessed on 2023-07-20.

Nanda, V., Wu, W., and Zhou, X. A. (2019). Investment commonality across insurance companies: Fire sale risk and corporate yield spreads. *Journal of Financial and Quantitative Analysis*, 54(6):2543–2574.

Nikolova, S., Wang, L., and Wu, J. J. (2020). Institutional allocations in the primary market for corporate bonds. *Journal of Financial Economics*, 137(2):470–490.

Schreiner, J. (1980). Portfolio revision: a turnover-constrained approach. *Financial Management*, pages 67–75.

Sen, I. and Sharma, V. (2020). Internal models, make believe prices, and bond market cornering. Technical report, Harvard Business School Working Paper.

Figure 1: Asset allocation of life insurers

This figure shows the asset allocation of life insurers based on ACLI (2019) for the asset classes bonds, stocks, miscellaneous assets, mortgages, policy loans, and real estate as a share of total assets between 2011 and 2019.

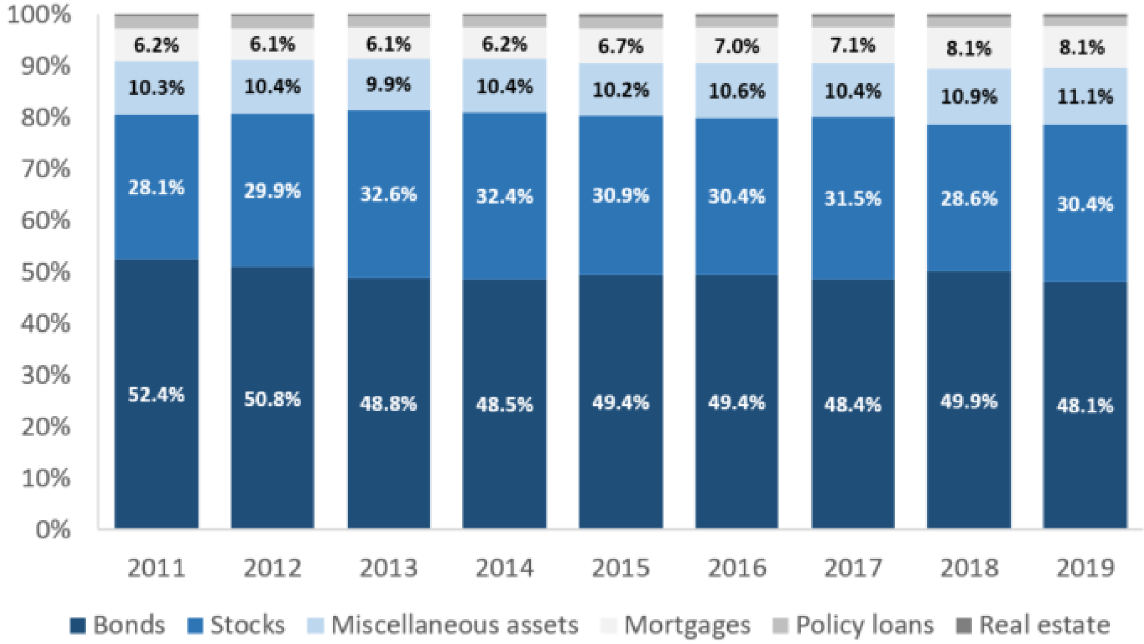

Figure 2: Bond allocation of life insurers

This figure shows the bond allocation of life insurers across the NAIC classes 1-6 as a share of total bonds between 2011 and 2019. Different NAIC classes have different RBC bond factors in place and consist of the following ratings: NAIC1 (Aaa, Aa1, Aa2, Aa3, A1, A2, A3), NAIC2 (Baa1, Baa2, Baa3), NAIC3 (Ba1, Ba2, Ba3), NAIC4 (B1, B2, B3), NAIC5 (Caa1, Caa3, Caa3) and NAIC6 which includes bonds in default.

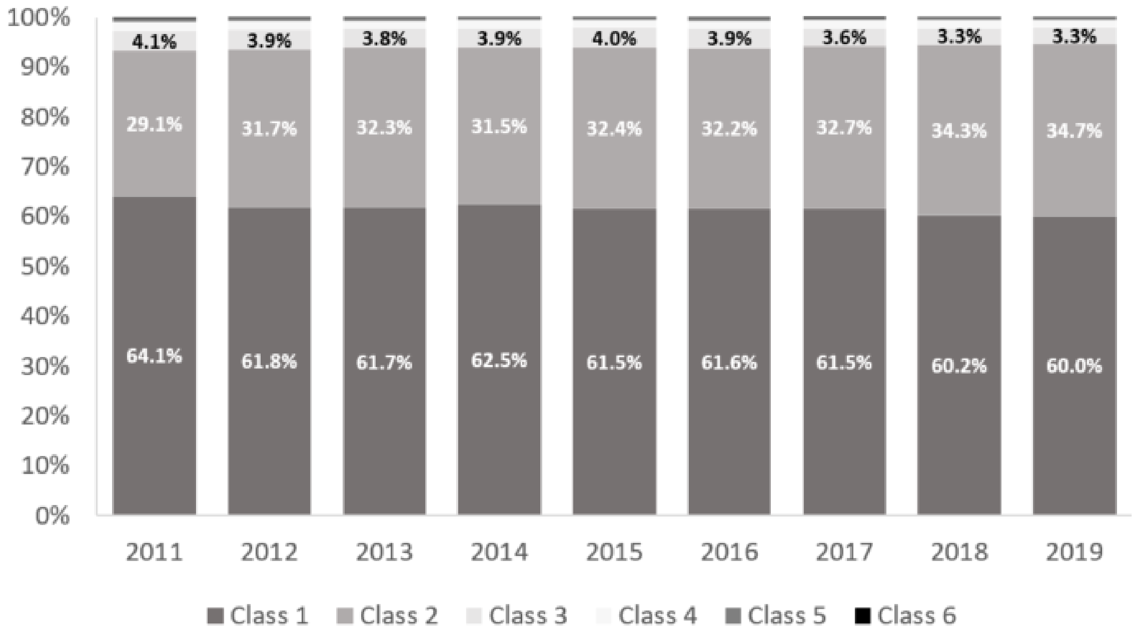

Figure 3: Proposed RBC bond factors for corporate bonds - IG
This figure shows the historical RBC bond factors for investment grade (IG) bonds with ratings Aaa to Baa3 compared to the proposed RBC bond factors by the American Academy of Actuaries in August 2015, June 2017, and October 2017, and the final RBC bond factors, which were implemented by year-end 2021.

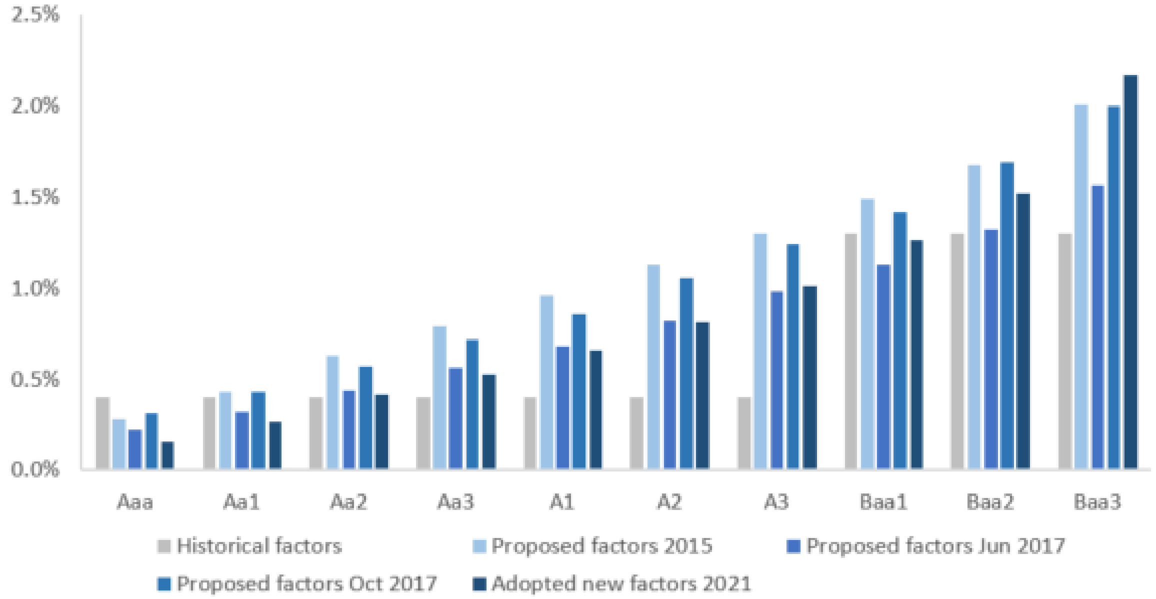

Figure 4: Proposed RBC bond factors for corporate bonds - HY
This figure shows the historical RBC bond factors for high-yield (HY) bonds with ratings Ba1 to Caa3 compared to the proposed RBC bond factors by the American Academy of Actuaries in August 2015, June 2017, and October 2017 and the final RBC bond factors, which were implemented by year-end 2021.

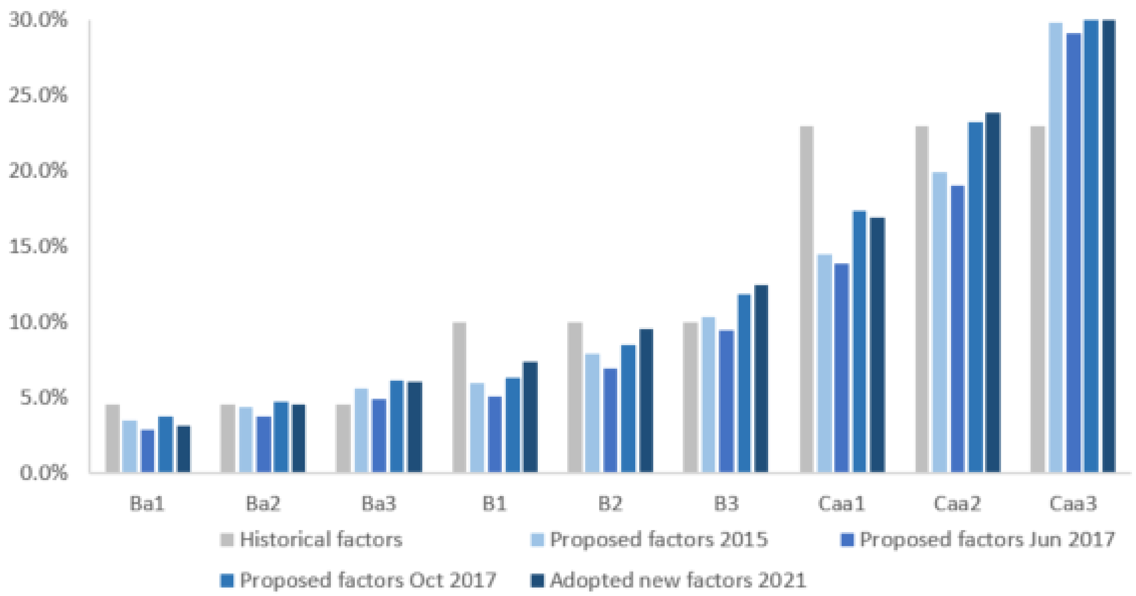

Figure 5: Overview of life RBC risk components

This figure shows the various RBC risk components for life insurers C-0 to C-4b. The proposed changes in RBC bond factors belong to the category C-1o: Aggregates fixed income asset & reinsurance credit risk. The Authorized Control Level RBC is the summation of all possible risk categories and represents the total RBC for a life insurer. It is calculated by aggregating all risk categories and considering covariances.

Life RBC Risk Components
C-0: Aggregates most affiliated Investment and (non-derivative) off-balance sheet
C-1cs: Aggregates unaffilated invested common stock asset risk
C-1o: Aggregates fixed income asset & reinsurance credit risk
C-2: Insurance risk
C-3a: Interest rate risk
C-3b: Health credit risk
C-3c: Market risk
C-4a: Business risk – guaranty fund assessment and separate account risk
C-4b: Business risk – health administrative expense risk

$$\text{Authorized Control Level RBC} = C0+\sqrt{(C1o+C3a)^2+(C1cs+C3c)^2+(C2)^2+(C3b)^2+(C4b)^2}+(C4a)$$

Figure 6: Percentage split of life RBC risk components

This figure shows the shares of various RBC risk components (C-0 to C-4b). An overview is shown in Figure 5 as a percentage of total RBC of life insurers in 2019.

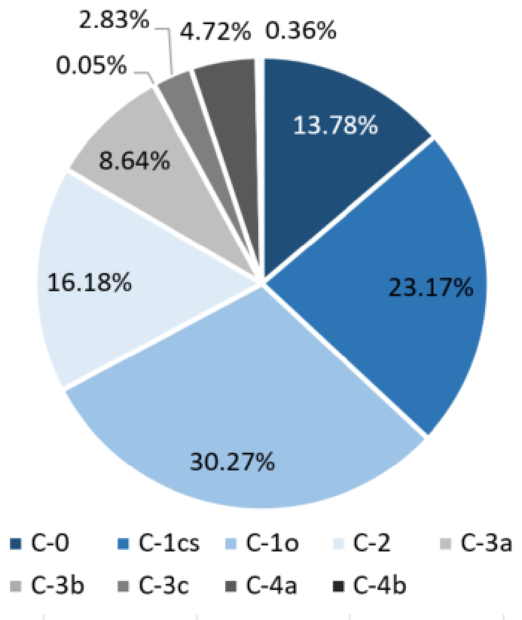

Figure 7: Reaching for yield behavior of life insurers v.s. mutual funds I
This figure shows the reaching for yield behavior of life insurers v.s. mutual funds over time using no fixed effects. The coefficients Offering Yield Spread of quarterly regressions based on Equation 8 are plotted with 90% confidence intervals.

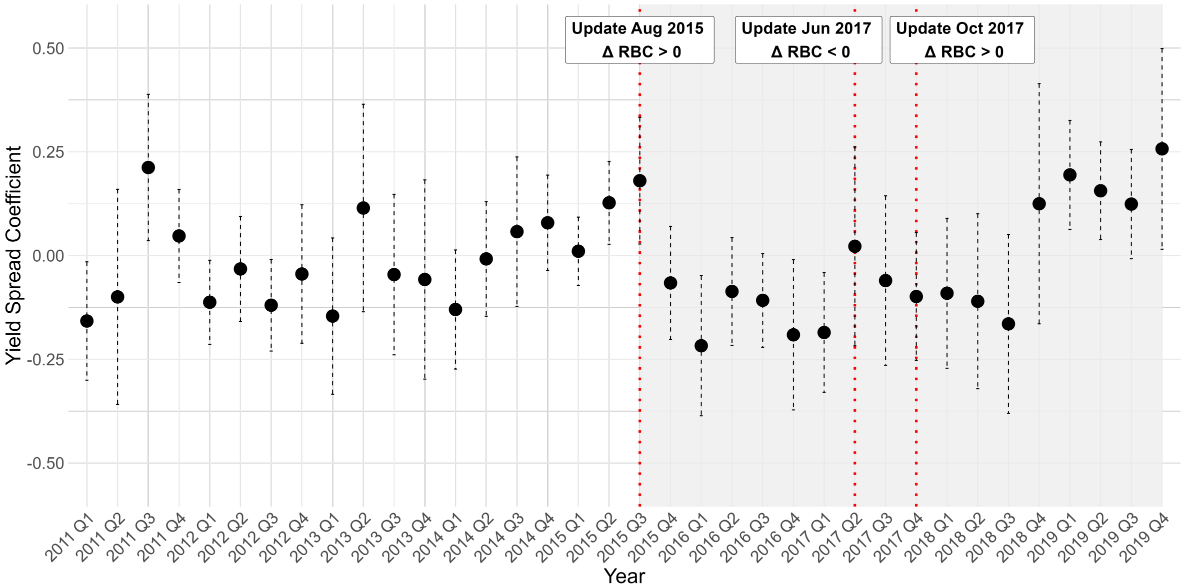

Figure 8: Reaching for yield behavior of life insurers v.s. mutual funds II
This figure shows the reaching for yield behavior of life insurers v.s. mutual funds over time using rating fixed effects. The coefficients Offering Yield Spread of quarterly regressions based on Equation 8 are plotted with 90% confidence intervals.

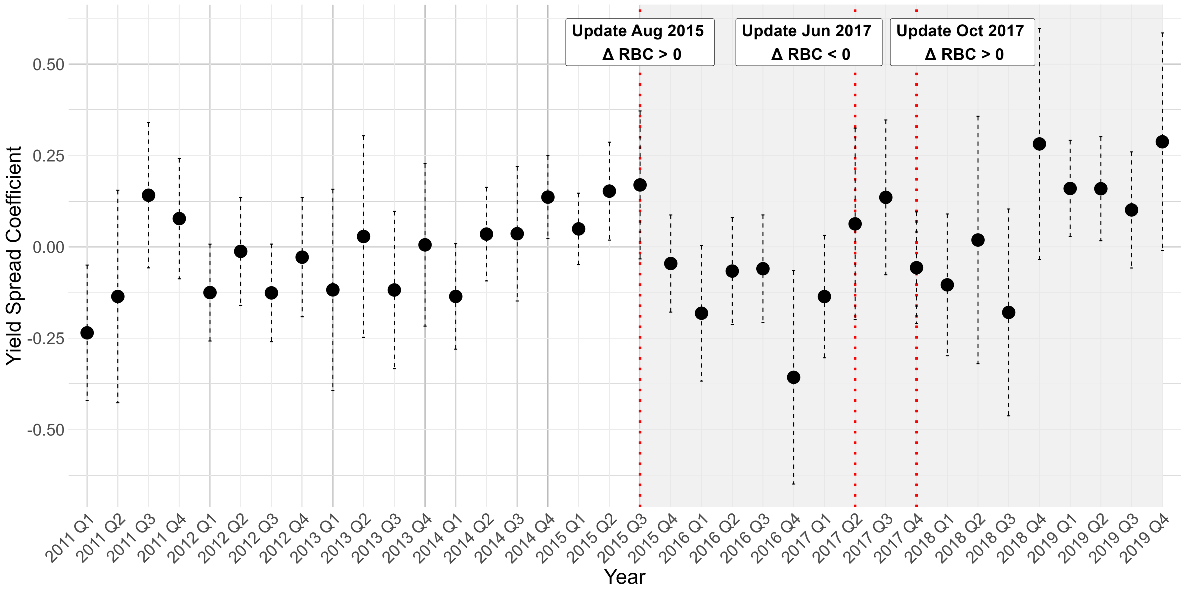

Table 1: Percentage changes of the proposed RBC factors

This table gives an overview of the proposed RBC factors for the investment grade (IG) ratings Aaa to Baa3 by the American Academy of Actuaries (AAA) in August 2015, June 2017, and October 2017, together with ordinal rankings. In columns 3-5, the relative percentage changes of the three proposed changes compared to their actual (still applicable) levels under the old RBC structure are displayed. In columns 6-8, ordinal rankings are shown from 10 (most favorable change, i.e., a decrease in the proposed RBC factor) to 1 (most unfavorable change, i.e., an increase in proposed RBC factors).

		Aug 2015	June 2017	Oct 17	Aug 2015	June 2017	Oct 17
Aaa	1.A	-30.0%	-45.0%	-22.5%	10	10	10
Aa1	1.B	7.5%	-20.0%	7.5%	9	9	9
Aa2	1.C	57.5%	10.0%	42.5%	5	6	6
Aa3	1.D	97.5%	40.0%	80.0%	4	4	4
A1	1.E	140.0%	70.0%	115.0%	3	3	3
A2	1.F	182.5%	105.0%	165.0%	2	2	2
A3	1.G	225.0%	145.0%	210.0%	1	1	1
Baa1	2.A	14.6%	-13.1%	9.2%	8	8	8
Baa2	2.B	29.2%	1.5%	30.0%	7	7	7
Baa3	2.C	54.6%	20.8%	53.8%	6	5	5

Table 2: Descriptive Statistics

This table shows descriptive statistics for the corporate bond acquisitions in my sample. Firm characteristics are Total Assets, Investments, Surplus (all in USDm), and the RBC Ratio (numeric variable). The bond characteristics included are Offering Yield Spread (%), Lenght Years (Years), and Offering Amount (USDm). Variables are winsorized at the 1% level.

Firm Characteristics	mean	median	10%	25%	75%	90%
Total Assets (USDm)	74,836.3	2,259.7	76.2	259.3	19,146.8	143,823.6
Investments (USDm)	40,273.3	1,620.6	61.9	196.1	13,089.2	83,110.3
Surplus (USDm)	5,113.1	453.2	33.5	100.8	2,557.4	11,625.8
RBC Ratio	35.5	10.1	4.8	6.9	18.4	69.9
Bond Characteristics						
Offering Yield Spread (%)	1.320	1.200	0.600	0.850	1.650	2.200
Length in Years (Y)	9.191	10.014	3.027	5.022	10.275	30.025
Offering Amount (USDm)	655.9	600.0	300.0	400.0	1,000.0	1,500.0

Table 3: Reaching for Yield in the corporate bond market at issuance

This table shows the regressions of life insurers' bond acquisitions at issuance compared to mutual funds for 2011Q1-2015Q3, 2015Q4-2017Q2, and 2017Q3-2019Q4. The dependent variable is the difference in acquisition intensity for bond b between life insurers and mutual funds ($\%Diff$ Acqu Int_b). Only U.S. mutual funds are considered, and those funds with names containing terms such as "equity", "stock", "balanced", "mixed", "convertible" and "high" are excluded. One observation is one corporate bond at issuance. Offering Yield Spreads are taken from FISD, which is the difference between the yield to maturity at issuance of a specific corporate bond and a corresponding treasury bond. Bond characteristics and ratings are obtained from FISD. I add the following controls for bond characteristics: ln(Offering Amount), ln(Length Years), which is a proxy for duration, and ln(Trading Volume), which is the trading volume of the respective bond in the first quarter divided by total par value outstanding and is taken from TRACE. I include a dummy variable equal to one for NAIC2 bonds with ratings Baa1, Baa2, and Baa3 due to different capital requirements in the old RBC structure. I show standard errors in parentheses corrected for heteroscedasticity and clustered at the issuer level. ***, **, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable:	$\%Diff$ Acqu Int_b					
	2011Q1-2015Q3		2015Q4-2017Q2		2017Q3-2019Q4	
	(1)	(2)	(3)	(4)	(5)	(6)
Offering Yield Spread	−0.021	−0.033	−0.077**	−0.054	0.048	0.129***
	(0.022)	(0.026)	(0.037)	(0.047)	(0.032)	(0.040)
ln(Offering Amount)	−0.179***	−0.179***	−0.237***	−0.242***	−0.258***	−0.276***
	(0.021)	(0.023)	(0.032)	(0.032)	(0.047)	(0.047)
ln(Length Years)	0.468***	0.467***	0.440***	0.424***	0.354***	0.326***
	(0.018)	(0.019)	(0.026)	(0.026)	(0.027)	(0.027)
ln(Trading Volume)	−0.041***	−0.032**	0.061**	0.058*	0.087***	0.103***
	(0.015)	(0.016)	(0.030)	(0.031)	(0.030)	(0.032)
NAIC2	0.158***		0.112**		0.217***	
	(0.028)		(0.047)		(0.053)	
Num.Obs.	3,940	3,940	1,652	1,652	2,027	2,027
R^2 Adj.	0.280	0.283	0.258	0.269	0.221	0.240
FE: Rating x Year	No	Yes	No	Yes	No	Yes

Clustered issuer standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 4: Comparison of life insurer's bond acquisitions to mutual funds
This table shows the results of regressions of life insurers' bond acquisitions at issuance compared to mutual funds for the periods 2011Q1-2017Q2 (Panel A) and 2015Q4-2019Q4 (Panel B). I group ratings into categories that are similarly affected in terms of relative percentage change by the expected RBC changes. CAT_i are dummy variables that take the value of 1 if the specific bond rating is included in the respective category. The dependent variable is the difference in acquisition intensity for bond b between life insurers and mutual funds ($\%Diff$ Acqu Int_b).One observation is one corporate bond at issuance. Offering Yield Spreads are taken from FISD, which is the difference between the yield to maturity at issuance of a specific corporate bond and a corresponding treasury bond. I add the following controls for bond characteristics: ln(Offering Amount), ln(Length Years), which is a proxy for the duration, and ln(Trading Volume), which is the trading volume of the respective bond in the first quarter divided by the total par value outstanding and is taken from TRACE. I include a dummy variable equal to one for NAIC2 bonds with ratings Baa1, Baa2, and Baa3 due to different capital requirements in the old RBC structure. I show standard errors in parenthesis, corrected for heteroscedasticity, and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent variable: $\%Diff$ Acqu Int_b	(1)	(2)	(3)	(4)	(5)
Panel A: Period 2011Q1-2017Q2					
Offering Yield Spread	−0.035*	−0.028	−0.029	−0.036*	−0.031
	(0.019)	(0.021)	(0.021)	(0.019)	(0.019)
ln(Offering Amount)	−0.195***	−0.197***	−0.196***	−0.194***	−0.201***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)
ln(Length Years)	0.461***	0.459***	0.459***	0.460***	0.459***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)
ln(Trading Volume)	−0.017	−0.018	−0.016	−0.018	−0.015
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
NAIC2	0.161***	0.114***	0.151***	0.162***	0.147***
	(0.026)	(0.036)	(0.025)	(0.056)	(0.025)
NAIC2 × 2015Q4-2017Q2	−0.057				
	(0.039)				
CAT(Baa1,Baa2) × 2015Q4-2017Q2		0.032			
		(0.038)			
CAT(Baa3) × 2015Q4-2017Q2			−0.167***		
			(0.053)		
CAT(A1,A2,A3) × 2015Q4-2017Q2				0.058	
				(0.041)	
CAT(Aaa,Aa1) × 2015Q4-2017Q2					0.034
					(0.111)
Num.Obs.	5,592	5,592	5,592	5,592	5,592
R^2 Adj.	0.272	0.272	0.273	0.272	0.272
Panel B: Period 2015Q4-2019Q4					
Offering Yield Spread	−0.016	0.014	0.013	−0.020	−0.015
	(0.026)	(0.032)	(0.031)	(0.026)	(0.026)
ln(Offering Amount)	−0.249***	−0.249***	−0.249***	−0.243***	−0.253***
	(0.029)	(0.029)	(0.029)	(0.030)	(0.030)
ln(Length Years)	0.407***	0.396***	0.396***	0.406***	0.406***
	(0.021)	(0.022)	(0.022)	(0.021)	(0.021)
ln(Trading Volume)	0.073***	0.073***	0.075***	0.071***	0.072***
	(0.022)	(0.022)	(0.022)	(0.023)	(0.022)
NAIC2	0.086**	0.085	0.202***	0.221***	0.191***
	(0.044)	(0.061)	(0.038)	(0.074)	(0.039)
NAIC2 × 2017Q3-2019Q4	0.176***				
	(0.053)				
CAT(Baa1,Baa2) × 2017Q3-2019Q4		0.085			
		(0.052)			
CAT(Baa3) × 2017Q3-2019Q4			0.185***		
			(0.058)		
CAT(A1,A2,A3) × 2017Q3-2019Q4				−0.139**	
				(0.058)	
CAT(Aaa,Aa1) × 2017Q3-2019Q4					−0.171
					(0.197)
Num.Obs.	3,580	3,580	3,580	3,580	3,580
R^2 Adj.	0.241	0.241	0.242	0.240	0.239

Clustered issuer standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 5: Summary results of life insurers' bond acquisitions to mutual funds
In this table, I compare my expectations of how various categories CAT_i (different ratings are grouped into one category) are associated with ($\%Diff$ Acqu Int_b) after the RBC announcements in 2015 and 2017 based on Table 4. In detail I test the following interaction terms CAT_i x 2015Q4-2017Q2$_i$ compared to 2011Q1-2015Q3 (columns 2-4) and CAT_i x 2017Q3-2019Q4$_i$ compared to 2015Q4-2017Q2 (columns 5-7). The categories are defined based on similar relative percentage changes of the proposed RBC factors. Based on the ranks of the defined categories, I form expectations of whether the interaction terms are positively or negatively associated with a change in the difference in acquisition intensity.

	2015Q4-2017Q2 v.s. 2011Q1-2015Q3			**2017Q3-2019Q4 v.s. 2015Q4-2017Q2**		
	Expectation	Result	Effect	Expectation	Result	Effect
CAT(Baa1,Baa2,Baa3)	stable	stable	insignificant	increase	increase	✓
CAT(Baa1,Baa2)	increase	stable	insignificant	increase	increase	insignificant
CAT(Baa3)	decrease	decrease	✓	increase	increase	✓
CAT(A1,A2,A3)	decrease	stable	insignificant	decrease	decrease	✓
CAT(Aaa,Aa1)	increase	increase	insignificant	increase	decrease	insignificant

Table 6: A measure for expected RBC changes

In this regression, acquisition intensity for life insurer i and bond b (value of acquisition for bond b scaled by total acquisitions of life insurer i in a given quarter t) is regressed on the measure $Exp\,Change_{i,t}$, which is the expected RBC change of rating i at time t. I analyze the two periods 2015Q4-2017Q2 and 2017Q3-2019Q4. In models 1 and 3, I use the Exp $\text{Change}^{A}_{i,t} = \sum_{j=1}^{J} p_{ij,t}\lambda_{j,t}$, which is the transition probability $p_{ij,t}$ from rating i to ratings j at time t taken from Moody's Analytics multiplied by $\lambda_{j,t}$, which measures the magnitude of a change to ratings j at a given time t. In models 2 and 4, I use Exp $\text{Change}^{B}_{i,t} = RBC^{pro}_{i,t} - RBC^{act}_{i}$, which is the difference between the proposed (pro) and the actual (act) RBC factor for a respective rating i. I add the following controls: Offering Yield Spread, ln(Offering Amount), ln(Length Years), and NAIC2. ***, **, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable:	Life insurer's acqu $\text{int}_{i,b}$			
	2015Q4-2017Q2		2017Q3-2019Q4	
Model:	(1)	(2)	(3)	(4)
Expected Change	-0.1596	-0.0700	-1.683***	-1.358***
	(0.3964)	(0.2935)	(0.4707)	(0.3393)
Offering Yield Spread	0.1710	0.1638	1.054***	1.148***
	(0.1467)	(0.1510)	(0.2547)	(0.2600)
ln(Offering Amount)	0.7798***	0.7857***	0.6378***	0.6360***
	(0.0881)	(0.0864)	(0.1199)	(0.1179)
ln(Length Years)	0.0944	0.0978	-0.0998	-0.1333
	(0.0862)	(0.0871)	(0.1162)	(0.1179)
NAIC2	-0.6386***	-0.6110***	-1.152***	-1.138***
	(0.2170)	(0.2041)	(0.2443)	(0.2306)
Fixed-effects				
Insurer	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	21,455	21,455	21,295	21,295
R^2	0.5828	0.5827	0.5505	0.5507

Clustered issuer standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 7: Life insurer's bond acquisitions, 2011-2017

This table shows regression results of acquisition intensity for life insurer i and bond b (value of acquisition for bond b scaled by total acquisitions of life insurer i in a given quarter t) for the periods 2011Q1-2017Q2 (Panel A) and 2015Q4-2019Q4 (Panel B), which are regressed on the Offering yield spread ln(Offering Amount) ln(Length Years) and NAIC2. In Panel A, I add the interaction terms CAT_i x 2015Q4-2017Q2. In Panel B I add the interaction terms CAT_i x 2017Q3-2019Q4 I show standard errors in parenthesis, which are corrected for heteroscedasticity and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent variable: Life insurer's acqu $int_{i,b}$	(1)	(2)	(3)	(4)	(5)
Panel A: Period 2011Q1-2017Q2					
Offering Yield Spread	0.2322***	0.1770*	0.1761*	0.2512***	0.2485***
	(0.0875)	(0.0931)	(0.0930)	(0.0874)	(0.0874)
ln(Offering Amount)	0.5956***	0.6004***	0.6026***	0.5676***	0.5819***
	(0.0638)	(0.0639)	(0.0639)	(0.0644)	(0.0638)
ln(Length Years)	0.3666***	0.3873***	0.3881***	0.3658***	0.3658***
	(0.0625)	(0.0635)	(0.0638)	(0.0622)	(0.0630)
NAIC2	-0.4893***	-0.3047**	-0.5759***	-0.9821***	-0.5318***
	(0.1086)	(0.1535)	(0.1010)	(0.1744)	(0.1024)
NAIC2 × 2015Q4-2017Q2	-0.1889				
	(0.1848)				
CAT(Baa1,Baa2) × 2015Q4-2017Q2		-0.1389			
		(0.1729)			
CAT(Baa3) × 2015Q4-2017Q2			-0.1099		
			(0.2697)		
CAT(A1,A2,A3) × 2015Q4-2017Q2				0.3485*	
				(0.1866)	
CAT(Aaa,Aa1) × 2015Q4-2017Q2					-1.351*
					(0.7732)
Num.Obs.	83,579	83,579	83,579	83,579	83,579
R^2 Adj.	0.4859	0.4859	0.4859	0.4860	0.4860
Panel B: Period 2015Q4-2019Q4					
Offering Yield Spread	-0.0584	-0.0742	-0.0738	-0.0496	-0.0750
	(0.1470)	(0.1577)	(0.1589)	(0.1474)	(0.1467)
ln(Offering Amount)	0.8267***	0.8280***	0.8363***	0.8206***	0.8475***
	(0.0948)	(0.0935)	(0.0940)	(0.0981)	(0.0976)
ln(Length Years)	0.3384***	0.3441***	0.3382***	0.3393***	0.3400***
	(0.0787)	(0.0822)	(0.0827)	(0.0788)	(0.0793)
NAIC2	-0.3264*	-0.1468	-0.1654	-0.3586*	-0.1762
	(0.1678)	(0.2176)	(0.1461)	(0.2110)	(0.1465)
NAIC2 × 2017Q3-2019Q4	0.3692				
	(0.2455)				
CAT(Baa1,Baa2) × 2017Q3-2019Q4		0.3842			
		(0.2386)			
CAT(Baa3) × 2017Q3-2019Q4			-0.0377		
			(0.3116)		
CAT(A1,A2,A3) × 2017Q3-2019Q4				-0.4772*	
				(0.2518)	
CAT(Aaa,Aa1) × 2017Q3-2019Q4					-0.3513
					(0.5669)
Fixed-effects					
Insurer	Yes	Yes	Yes	Yes	Yes
Num.Obs.	44,040	44,040	44,040	44,040	44,040
R^2 Adj.	0.5213	0.5213	0.5212	0.5214	0.5213

Clustered issuer standard-errors in parentheses

*p<0.1; **p<0.05; ***p<0.01

Table 8: Life insurer's bond acquisitions constrained vs. unconstrained
This table shows regression results of acquisition intensity for constrained vs. unconstrained life insurer i and bond b (Life insurer's i specific corporate bond acquisition i scaled by total corporate bond acquisitions of the life insurer i in a given quarter t) for the periods 2011Q1-2017Q2 (Panel A) and 2015Q4-2019Q4 (Panel B). Life insurer i is constrained (unconstrained) if its reported RBC ratio is below (above) the median of all life insurers. The dependent variable is regressed on the triple interaction term CAT_i x Years_i x constrained and control variables Offering Yield Spread, ln(Offering Amount), ln(Length Years), and NAIC2 and all its interaction terms. I show standard errors in parenthesis, which are corrected for heteroscedasticity and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Model:	(1)	(2)	(3)	(4)	(5)
Dependent Variable:			Life insurer's acqu $\text{int}_{i,b}$		
Panel A: Period 2011Q1-2017Q2					
NAIC2 × 2015Q4-2017Q2 × constrained	-0.1468				
	(0.2515)				
CAT(Baa1,Baa2)× 2015Q4-2017Q2 × constrained		-0.0481			
		(0.2456)			
CAT(Baa3) × 2015Q4-2017Q2 × constrained			-0.1810		
			(0.3287)		
CAT(A1,A2,A3) × 2015Q4-2017Q2 × constrained				0.1620	
				(0.2625)	
CAT(Aaa,Aa1) × 2015Q4-2017Q2 × constrained					-0.3285
					(0.4324)
Num.Obs.	83,485	83,485	83,485	83,485	83,485
R^2 Adj.	0.4860	0.4861	0.4860	0.4861	0.4861
Panel B: Period 2015Q4-2019Q4					
NAIC2 × 2017Q3-2019Q4 × constrained	0.6945**				
	(0.3300)				
CAT(Baa1,Baa2) × 2017Q3-2019Q4 × constrained		0.2951			
		(0.3167)			
CAT(Baa3) × 2017Q3-2019Q4 × constrained			0.6784*		
			(0.3909)		
CAT(A1,A2,A3) × 2017Q3-2019Q4 × constrained				-0.8861***	
				(0.3432)	
CAT(Aaa,Aa1) × 2017Q3-2019Q4 × constrained					-0.8028
					(0.8710)
Num.Obs.	44,040	44,040	44,040	44,040	44,040
R^2 Adj.	0.5216	0.5216	0.5216	0.5217	0.5215
Fixed-effects					
Insurer	Yes	Yes	Yes	Yes	Yes

Clustered issuer standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Appendix

Figure 9: Reaching for yield behavior of life insurers

This figure shows the reaching for yield behavior of life insurers over time. The coefficients Offering Yield Spread of quarterly regressions based on Equation 8 using the Life insurers' acqu intensity$_b$ as the dependent variable are plotted with 90% confidence intervals.

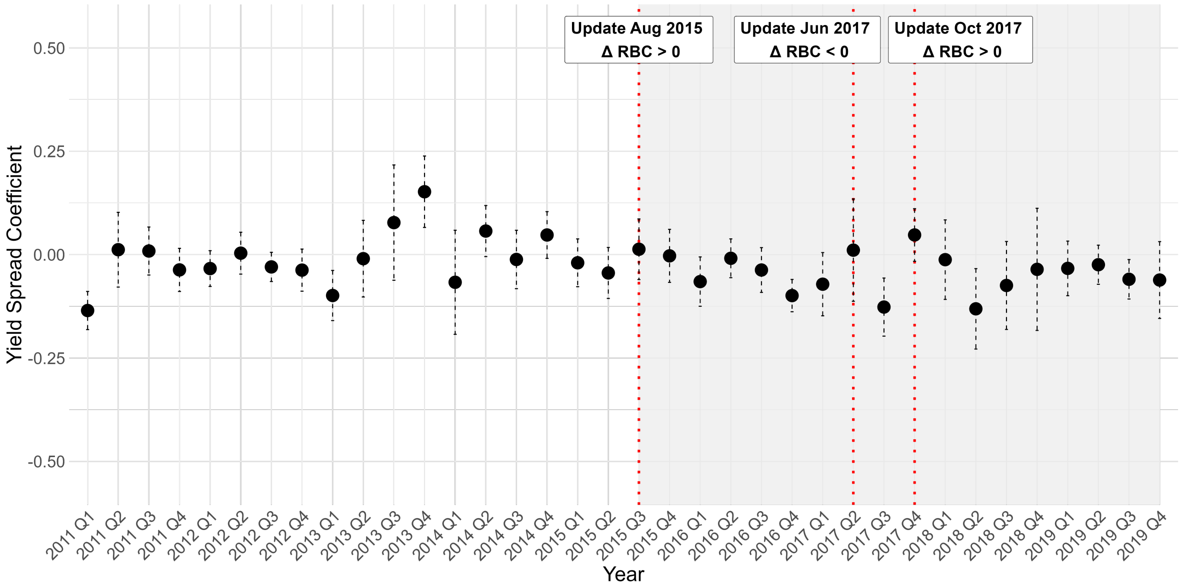

Figure 10: Reaching for yield behavior of mutual funds

This figure shows the reaching for yield behavior of mutual funds over time. The coefficients Offering Yield Spread of quarterly regressions based on Equation 8 using the Mutual funds' acqu intensity$_b$ as the dependent variable are plotted with 90% confidence intervals.

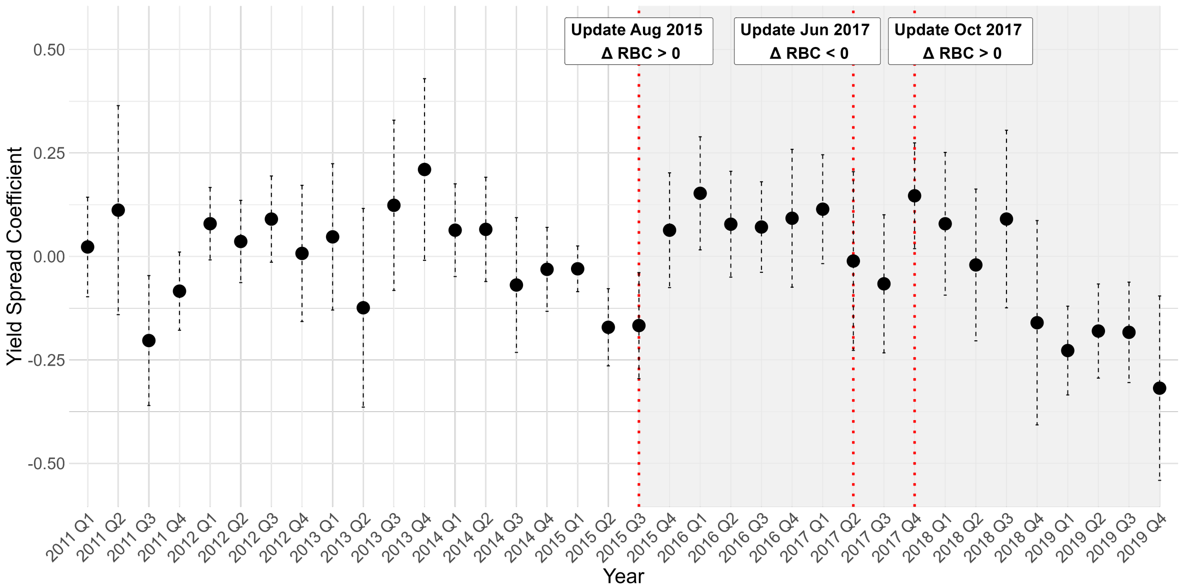

Table A-1: Reaching for Yield in the corporate bond market at issuance
This table shows the regressions of life insurers' bond acquisitions at issuance compared to mutual funds for 2011Q1-2015Q3, 2015Q4-2017Q2, and 2017Q3-2019Q4. The dependent variable is the difference in acquisition intensity for bond b between life insurers and mutual funds ($\%Diff$ Acqu Int_b). All mutual funds on Emaxx are used. One observation is one corporate bond at issuance. Offering Yield Spreads are taken from FISD, which is the difference between the yield to maturity at issuance of a specific corporate bond and a corresponding treasury bond. Bond characteristics and ratings are obtained from FISD. I add the following controls for bond characteristics: ln(Offering Amount), ln(Length Years), which is a proxy for duration, and ln(Trading Volume), which is the trading volume of the respective bond in the first quarter divided by total par value outstanding and is taken from TRACE. I include a dummy variable equal to one for NAIC2 bonds with ratings Baa1, Baa2, and Baa3 due to different capital requirements in the old RBC structure. I show standard errors in parentheses, corrected for heteroscedasticity and clustered at the issuer level. ***, **, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable:	$\%Diff$ Acqu Int_b					
	2011Q1-2015Q3		2015Q4-2017Q2		2017Q3-2019Q4	
	(1)	(2)	(3)	(4)	(5)	(6)
Offering Yield Spread	−0.028**	−0.044***	−0.046*	−0.032	−0.009	0.041
	(0.014)	(0.016)	(0.028)	(0.035)	(0.026)	(0.032)
ln(Offering Amount)	−0.163***	−0.155***	−0.172***	−0.174***	−0.192***	−0.197***
	(0.016)	(0.017)	(0.027)	(0.027)	(0.038)	(0.038)
ln(Length Years)	0.314***	0.317***	0.346***	0.335***	0.236***	0.219***
	(0.011)	(0.012)	(0.019)	(0.020)	(0.021)	(0.021)
ln(Trading Volume)	−0.040***	−0.041***	0.015	0.012	0.023	0.031
	(0.009)	(0.010)	(0.020)	(0.022)	(0.020)	(0.022)
NAIC2	0.116***		0.075**		0.209***	
	(0.019)		(0.036)		(0.041)	
Num.Obs.	3,973	3,973	1,672	1,672	2,045	2,045
R^2 Adj.	0.280	0.283	0.258	0.269	0.2205	0.240
FE: Rating x Year	No	Yes	No	Yes	No	Yes

Clustered issuer standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A-2: Life insurer's bond acquisitions - high vs. low portfolio turnover
This table shows regression results of acquisition intensity for life insurers with high vs. low portfolio turnover rates. The dependent variable is the Life insurer's i specific corporate bond acquisition i scaled by total corporate bond acquisitions of the life insurer i in a given quarter (Life insurer's acqu $\text{int}_{i,b}$) for the periods 2011Q1-2017Q2 (Panel A) and 2015Q4-2019Q4 (Panel B). Life insurer i has a high portfolio turnover rate (ptr high) if it is in the fourth quarter of all life insurers. The dependent variable is regressed on the triple interaction term CAT_i x Years_i x ptr high and control variables Offering Yield Spread, ln(Offering Amount), ln(Length Years), and NAIC2 and all its interaction terms. I show standard errors in parenthesis, which are corrected for heteroscedasticity and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Model:	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Life insurer's acqu $\text{int}_{i,b}$				
Panel A: Period 2011Q1-2017Q2					
NAIC2 × 2015Q4-2017Q2 × ptr high	-0.5774*				
	(0.2969)				
CAT(Baa1,Baa2)× 2015Q4-2017Q2 × ptr high		-0.1665			
		(0.2922)			
CAT(Baa3) × 2015Q4-2017Q2 × ptr high			-0.7001**		
			(0.3546)		
CAT(A1,A2,A3) × 2015Q4-2017Q2 × ptr high				0.6722**	
				(0.3232)	
CAT(Aaa) × 2015Q4-2017Q2 × ptr high					0.0351
					(0.8188)
Fit statistics					
Num.Obs.	79,297	79,297	79,297	79,297	79,297
R^2 Adj.	0.4872	0.4872	0.4872	0.4874	0.4872
Panel B: Period 2015Q4-2019Q4					
NAIC2 × 2017Q3-2019Q4 × ptr high	0.4325				
	(0.3831)				
CAT(Baa1,Baa2) × 2017Q3-2019Q4× ptr high		0.1685			
		(0.3778)			
CAT(Baa3) × 2017Q3-2019Q4× ptr high			0.4446		
			(0.4791)		
CAT(A1,A2,A3) × 2017Q3-2019Q4 × ptr high				-0.4289	
				(0.3946)	
CAT(Aaa) × 2017Q3-2019Q4 × ptr high					-1.691***
					(0.3436)
Fit statistics					
Num.Obs.	42,163	42,163	42,163	42,163	42,163
R^2 Adj.	0.5222	0.5222	0.5221	0.5222	0.5221
Fixed-effects					
Insurer	Yes	Yes	Yes	Yes	Yes

Clustered issuer standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A-3: Comparison of life insurer's bond acquisitions to mutual funds 2011Q1-2019Q4

This table shows the results of regressions of life insurers' bond acquisitions at issuance compared to mutual funds for the period 2011Q1-2019Q4 with interaction terms CAT_i x 2015Q4-2019Q4. I group ratings into categories that are similarly affected by the expected RBC changes in terms of relative percentage change. CAT_i are dummy variables that take the value of 1 if the specific bond rating is included in the respective category. The dummy variable $2015Q4-2019Q4$ takes the value of 1 if the bond acquisition occurs after the RBC announcement. The dependent variable is the difference in acquisition intensity for bond b between life insurers and mutual funds ($\%Diff$ Acqu Int_b). One observation is one corporate bond at issuance. Offering Yield Spreads are taken from FISD, which is the difference between the yield to maturity at issuance of a specific corporate bond and a corresponding treasury bond. Bond characteristics and ratings are obtained from FISD. I add the following controls for bond characteristics: ln(Offering Amount), ln(Length Years), which is a proxy for the duration, and ln(Trading Volume), which is the log of trading volume of the respective bond in the first quarter divided by the total par value outstanding and is taken from TRACE. I include a dummy variable equal to one for NAIC2 bonds with ratings Baa1, Baa2, and Baa3 due to different capital requirements in the old RBC structure. I show standard errors in parenthesis, which are corrected for heteroscedasticity and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	Dependent variable: $\%Diff\,Acqu\ Int_b$				
	2011Q1-2019Q4				
	(1)	(2)	(3)	(4)	(5)
Offering Yield Spread	−0.023***	−0.012	−0.013	−0.025***	−0.023**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
ln(Offering Amount)	−0.142***	−0.143***	−0.142***	−0.137***	−0.143***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
ln(Length Years)	0.274***	0.271***	0.271***	0.273***	0.274***
	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)
ln(Trading Volume)	−0.016**	−0.016**	−0.016**	−0.018***	−0.015**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
NAIC2	0.106***	0.078***	0.127***	0.170***	0.120***
	(0.016)	(0.021)	(0.016)	(0.030)	(0.015)
NAIC2× 2015Q4-2019Q4	0.026				
	(0.023)				
CAT(Baa1,Baa2) × 2015Q4-2019Q4		0.051***			
		(0.022)			
CAT(Baa3) × 2015Q4-2019Q4			−0.035		
			(0.028)		
CAT(A1,A2,A3) × 2015Q4-2019Q4				−0.018	
				(0.024)	
CAT(Aaa,Aa1) × 2015Q4-2019Q4					0.044
					(0.051)
Num.Obs.	7,502	7,502	7,502	7,502	7,502
R2 Adj.	0.2741	0.2756	0.2750	0.2752	0.2739

Clustered issuer standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A-4: Life insurer's bond acquisitions constrained vs. unconstrained

This table shows regression results of acquisition intensity for constrained vs. unconstrained life insurer i and bond b (Life insurer's i specific corporate bond acquisition i scaled by total corporate bond acquisitions of the life insurer i in a given quarter t) for the period 2015Q4-2019Q4 with Years$_i$ for 2018Q1-2019Q4. Life insurer i is constrained (unconstrained) if its reported RBC ratio is below (above) the median of all life insurers. The dependent variable is regressed on the triple interaction term CAT_i x Years$_i$ x constrained and control variables Offering Yield Spread, ln(Offering Amount), ln(Length Years), and NAIC2 and all its interaction terms. I show standard errors in parenthesis, which are corrected for heteroscedasticity and clustered at the issuer level. ***,**, and *, indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Dependent Variable:	Life insurer's acqu int$_{i,b}$				
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
NAIC2 × 2018Q1-2019Q4 × constrained	0.8304**				
	(0.3345)				
CAT(Baa1,Baa2) × 2018Q1-2019Q4 × constrained		0.7663**			
		(0.3200)			
CAT(Baa3) × 2018Q1-2019Q4 × constrained			0.0551		
			(0.4323)		
CAT(A1,A2,A3) × 2018Q1-2019Q4 × constrained				-1.140***	
				(0.3429)	
CAT(Aaa,Aa1) × 2018Q1-2019Q4 × constrained					0.9707
					(0.9705)
Fixed-effects					
Insurer	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	44,040	44,040	44,040	44,040	44,040
R^2 adj.	0.5206	0.5206	0.5205	0.5207	0.5205

Clustered issuer standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A-5: Variable Definition

Variable	**Definition**
$ExpChange$	Expected RBC change of a specific rating
Life insurers' acqu intensity$_b$	Sum of life insurers' bond acquisitions for a specific bond at issuance scaled by total bonds acquisitions of life insurers
Life insurer's acqu int$_{i,b}$	Share of bond acquisitions of insurer i scaled by total bond acquisitions of the life insurer i multiplied by 100
ln(Length Years)	Natural logarithm of the bond's time until maturity
ln(Offering Amount)	Natural logarithm of the bond's offering amount
ln(Trading Volume)	Natural logarithm of the bond's trading volume
Mutual funds' acqu intensity$_b$	Sum of mutual funds' bond acquisitions for a specific bond at issuance scaled by total bonds acquisitions of mutual funds
$NAIC2$	Bonds with ratings Baa1, Baa2, and Baa3
Offering yield spread$_b$	Difference between the yield to maturity at issuance of a corporate bond and a corresponding treasury bond
ptr	Sum of life insurer's acquisitions and disposals divided by two and scaled by its average holdings
ptr high	Dummy variable if the portfolio turnover in the fourth quantile
RBC^{pro}	Proposed RBC bond factor
RBC^{act}	Actual RBC bond factor
X_b	A vector of control variables
$YEARS_i$	A dummy variable for a specific time period
%*Diff Acqu Int*$_b$	Difference between *Life insurers' acqu intensity*$_b$ and *Mutual funds' acqu intensity*$_b$ multiplied by 100