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Abstract

We show that insurance companies have almost nonupled their investments in collateralized loan obligations (CLOs) in the post-crisis period, reaching total holdings of $125 billion in 2019. The growth in CLOs' investments has far outpaced that of loans and corporate bonds, and was characterized by a strong preference for mezzanine tranches rated investment grade over triple-A rated tranches. We document that these phenomena reflect a search for yield behavior. Conditional on capital charges, insurance companies invest more heavily in bonds and CLO tranches with higher yields. Preferences for CLO tranches derived from tranches' higher yields relative to bonds with the same rating, and increased following the 2010 capital regulatory reform, resulting in insurance companies holding more than 40 percent of mezzanine tranches outstanding in 2019. In the process, insurance companies created the demand for the risky tranches that are critical to the CLO issuance.

Key words: insurance companies, CLOs, regulatory arbitrage, corporate loans, securitization

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1 Introduction

There has been an extraordinary growth of collateralized loan obligations (CLOs) over the last decade. U.S. CLO issuance increased by a factor of thirteen in the post crisis-decade, with the volume outstanding CLOs more than doubling and reaching almost $647B by 2019 (Figure 1-2).[1] This growth has caught the attention of researchers who have investigated its impact on such things as the cost and risk of corporate loans, the amplification of credit cycles, and the stability of the financial system.[2]

However, to date little attention has been devoted to the drivers of that phenomenon. That is the subject of this paper. We are particularly interested in understanding the role that insurance companies have played in the growth of corporate loans' securitization and identify the key factors behind that role.

We begin by analysing the investment behavior of insurance companies towards fixed-income securities related to non-financial corporate debt. We focus on investments in CLO tranches, corporate bonds and bank loans. We document that insurance companies have almost nonupled their CLO holdings in the last decade, reaching $125B in 2019. The growth in CLO investments has far outpaced that of loans and corporate bonds, and was characterized by a preference for mezzanine tranches (Aa, A or Baa rated) over triple-A tranches. Insurers' proclivity towards CLOs vis-à-vis other securities, and towards mezzanine tranches rated investment grade within the CLO asset class, reflect a search for yield behavior.

Similar to Becker and Ivashina (2015), we argue that insurers' incentives to reach for yield stem from the capital adequacy regulation's coarse treatment of risk. In contrast

[1]Figures estimated on data from Moody's Analytics Structured Finance Portal. Similar figures are reported for the time period 2003-2018 by (NAIC, 2018b) and SFIMA at `https://www.sifma.org/resources/research/us-fixed-income-securities-statistics/`. Our figures underestimate the 2019 values because our data ends in November 2019.

[2]Researchers have investigated the impact of corporate loan securitization on the risk and cost of bank loans (Wang and Xia, 2010; Shivdasani and Wang, 2011; Benmelech et al., 2012; Nadauld and Weisbach, 2012; Bord and Santos, 2015); amplification of credit cycles (Ivashina and Scharfstein, 2010), and and the risk to financial stability (IMF, 2020; BoE, 2019; FSB, 2019; Ivashina and Vallée, 2020; SEC, 2020).

to Becker and Ivashina (2015), we show those incentives also arise from the regulation's similar treatment of corporate bonds and CLO tranches and are more prevalent in CLO investments. Specifically, capital requirements for asset risk associated to fixed income investments are defined for six macro buckets of securities' credit quality named "NAIC designations" (NAIC, 2018a, 2020). Insurers assign a NAIC designation (and the associated risk-based capital charge) to each investments according to a mapping from credit ratings. For example, a security rated triple-A, Aa or A falls into the NAIC 1 designation (i.e., the NAIC bucket corresponding to the highest credit quality), whereas a security rated Baa is designated as NAIC 2. While the NAIC 1 category is mapped to three notches of credit rating (Aaa, Aa and A), all the other NAIC buckets are associated only to one rating class. This implies that asset holdings falling into the NAIC 1 designation are characterized by a significantly marked heterogeneity in terms of credit risk, albeit requiring the same amount of regulatory capital. In light of this discontinuous structure of capital requirements for asset risk, we conjecture that, conditional on the NAIC designation bucket, insurance companies invest more heavily in assets with higher yields.

The monotonic relationship between asset risk and cost of capital implied by the rating-based mapping was partially altered in 2010, when the National Association of Insurance Commissioners (NAIC) enacted a regulatory change of capital requirements for CLO holdings. That change was part of a broader reform initiated in 2009 and focused on mortgage-backed securities (MBS) as well, which aimed at providing capital relief to the insurance sector amid the massive wave of downgrades on asset-backed securities during the financial crisis (Becker et al., 2021; NAIC, 2021). The new capital regime for CLO investments remained effective until the reporting year 2018 and was eventually repealed in 2019. In essence, the reform allowed insurance companies to report CLO tranches purchased at discount or highly impaired in a lower NAIC category than that implied by the rating-based mapping. The scope of this rule was broad, as it

encompassed both legacy and new investments in CLOs, potentially affecting insurers' investment behavior. We, thus, hypothesize that, conditional on the capital charge, insurance companies' incentives to invest in higher yielding CLO tranches increased after the 2010 regulatory reform.

In contrast to bank capital regulation which treats corporate bonds differently from CLO tranches, the capital regulatory framework of insurance companies does not distinguish between these securities (perhaps with the exception of the modified regime we discuss above). Yet, as we document, CLO mezzanine tranches, other than the triple-A tranche, tend to carry higher yields than corporate bonds with the same credit rating. This gives us our third hypothesis that insurance companies have a preference for CLOs' mezzanine tranches over corporate bonds with the same credit rating.

Insurance companies' preference for the CLO mezzanine tranches together with their growing importance in this segment of the CLO market likely played a role in the rise of the CLO issuance we observed in the last decade. This is our last hypothesis. In particular, we investigate whether CLO deals in which insurance companies invest more heavily are characterized by a larger fraction of mezzanine tranches. Mezzanine tranches are critical for CLOs because their junior position allows for the production of triple-A tranches. However, in contrast with the latter which are sought by banks, there is far less demand for mezzanine tranches. This is because bank capital regulation treats triple-A tranches favorably while at the same time taxes heavily banks' investments in all of the other CLO tranches.

We use granular data on insurers' fixed income holdings at the security-company-year level to investigate if insurance companies hold a larger share of securities offering a higher yield within a NAIC designation bucket (once having accounted for asset size, maturity date and insurer's conditions). We restrict our sample to CLO tranches and corporate bonds for which we have information on issuance and outstanding amounts

throughout their lifetime.[3] In addition, since the balance of CLOs might vary over time due to refinancing or principal amortization once the reinvestment period has ended, we consider only first-time investments of each insurance company in a given security.

In line with our prediction, we find that insurance companies invest more heavily in securities with higher yields within a NAIC designation bucket. An increase in the yield by one standard deviation implies an increase in the insurer's holding share by 14 basis points, which corresponds to an additional investment of $93 million for the median security in portfolio. Moreover, insurance companies search for yield primarily within the CLO asset class, which is characterized by a higher dispersion of yields.

We next explore a potential heterogeneity in insurers' investment behavior over time periods and across firm attributes. We document that insurance companies search for yield both in the pre-crisis period, when interest rates were relatively high, and in the post-crisis period, when interest rates were close to the zero lower bound, whereas they did not invest significantly more in higher yielding securities during the financial crisis. Overall, this suggests that insurers' propensity to search for yield is stronger in periods of economic expansion, regardless of the level of interest rates. However, in terms of magnitude, the phenomenon is more pronounced in the post-crisis decade than the pre-crisis period, pointing to a higher risk-taking in an environment of contained interest rates compared to a context of relatively high interest rates. Consistent with our second hypothesis, insurers' search for yield within the CLO asset class increased during the years the 2010 regulatory reform was in place.

With regards to firm attributes, we find that, conditional on the capital requirement bucket, lowly capitalized insurers hold higher fractions of high yielding securities, consistent with their higher risk-shifting incentives (Jensen and Meckling, 1976). We also find that among property and casualty (P&C) insurers, those highly affected by the devastating natural disasters of 2017 (as captured by the yearly change in net income)

[3]This information is not available for corporate loans in our sample.

are more prone to search for yield vis-à-vis lowly affected companies in that year.

In the second part of our empirical analysis, we document how insurers' search for yield behavior translated into a preference for CLO over corporate bond investments. To this end, we focus the attention on securities rated investment grade which account for most of the assets in portfolio. We first show that, on average, the yield on new investments by insurance companies in CLOs is significantly higher than the yield on new investments in corporate bonds with the same rating. In addition, the yields differential widens for decreasing levels of credit quality, as captured by the assets' ratings. These patterns map to insurers' investment preferences in a one-to-one fashion. We find that insurance companies purchase a larger portion of CLO tranches compared to corporate bonds with the same rating and this behavior is more pronounced for the lower rating classes. We extend our analysis to directly link the share of a security (CLO or corporate bond) held by insurance companies and the difference in yields between the two asset classes. We show that insurance companies purchase a larger portion of CLO tranches compared to corporate bonds with the same rating the larger is the ratio of the average yield on insurers' investments in CLOs to the average yield of insurers' investments in corporate bonds for each specific rating-year combination.

We explore how insurers' preference for CLOs over corporate bonds evolved over time. We find that, in the pre-crisis period, when CLOs carried roughly the same or even a lower yield than corporate bonds, insurance companies purchased a lower portion of CLO tranches compared to corporate bonds with the same rating. But when the yields on CLOs became significantly higher than the yields on corporate bonds during the financial crisis and especially in the post-crisis decade, insurance companies changed their investment behavior exhibiting a marked preference for CLOs over corporate bonds with the same rating. As an alternative approach to explore the preference of insurers for CLOs vis-à-vis corporate bonds, we focus the attention on a different metric, namely the amount of insurers' CLO holdings as a percentage of the total new investments in

CLOs and corporate bonds. We show that insurance companies allocate a larger share of their portfolio to CLO tranches the larger is the yields differential between CLOs and corporate bonds.

In the third part of our empirical analysis, we study the implications of insurance companies' search for yield for the CLO market. We show that, while insurers' market share of corporate bonds decreased somewhat from 2003 to 2019, that of CLOs almost quintupled over the same time period. Importantly, that increase was mostly driven by mezzanine tranches rated investment grade (Aa, A or Baa rated), whose market share increased by a factor of eight (from 5% in 2009 to 44% in 2019). This phenomenon was particularly pronounced for A rated tranches, with insurance companies holding more than 50% of their outstanding volume at year-end 2019. Our investigation of the role of insurance companies on the design of CLO deals shows that deals in which insurance companies have larger investments do have larger mezzanine tranches rated investment grade.

We complement our analysis presenting some evidence that speaks to the direction of causation. We show that the positive correlation between the share of a CLO deal held by insurance companies and the size of the mezzanine tranches (rated Aa, A or Baa) relative to the deal is larger for as long as the 2010 regulatory reform was in place. Additionally, we find that CLO deals with higher insurance companies' investments are more likely to be refinanced. Overall, this adds support to our thesis that insurance companies' preference for CLOs played a role in the growth of corporate loan secularization over the last decade.

Our paper is most closely related to the literature on insurance companies' search for yield by arbitraging regulation, including Becker and Ivashina (2015), Becker et al. (2021) and Liu (2019).[4] Becker and Ivashina (2015) document how capital regulation

[4]Studies looking at banks' risk-taking incentives due to regulatory arbitrage include Kroszner and Strahan (2011); Acharya and Steffen (2015); Karolyi and Taboada (2015); Boyson et al. (2016); Demyanyk and Loutskina (2016); Boyer and Kempf (2020); Buchak et al. (2020).

applied to insurers' bond holdings generates incentives to invest in higher yielding corporate bonds conditional on a NAIC designation bucket. We show that such incentives extend beyond corporate bonds also affecting investments in CLO tranches, as well as the portfolio allocation between these two asset classes. More importantly, we document that insurers' search for yield is more pronounced within the CLO space compared to corporate bonds and that, over time, insurers' bias towards higher yielding CLOs has had an impact on the design of CLO deals. Our results unveil an important role played by insurance companies as investors in the CLO market, potentially contributing to the expansion of corporate loan securitization observed in the last decade.

Becker et al. (2021) study the effect of the 2009-2010 regulatory reform of capital requirements for investments in mortgage-backed securities on insurance companies' propensity to purchase and hold these assets. We show that, while the extension of the scope of the reform to CLO holdings reinforced insurers' incentives to search for yield within the CLO asset class, these incentives are at work even prior to the reform and depend crucially on the rating-based framework of capital requirements. In addition, our work takes one step forward exploring how insurers' appetite for CLOs affected the design of corporate loan securitization.

Exploiting a change in state laws that legalized in-state financial reinsurance veichles, Liu (2019) investigates how a decrease in insurers' cost of equity affects their underwriting growth and investment risk. Our work explores, instead, insurers' search for yield incentives conditional on the capital requirement (and, hence, the cost of capital) associated to a given security held in portfolio.

Additionally, our paper is related to the literature on the growth of securitization, in particular corporate loan securitization (Ivashina and Scharfstein, 2010; Wang and Xia, 2010; Shivdasani and Wang, 2011; Benmelech et al., 2012; Nadauld and Weisbach, 2012; Bord and Santos, 2015; Ivashina and Vallée, 2020). To the best of our knowledge,

ours is the first paper studying the role of insurance companies as investors in CLOs.[5] We show that, as of 2019, insurance companies account for about half of the investor base of CLO mezzanine tranches rated investment grade, contributing substantially to the demand of mezzanine tranches which is crucial in the origination process of CLOs as it allows for the creation of the highly sought triple-A tranches.

Lastly, our paper is related to the literature on the search for yield incentives during protracted periods of low interest rates. Most of the studies so far, including Peydro and Maddaloni (2011), Jimenez et al. (2014), Ioannidou et al. (2015), Dell'Ariccia et al. (2017), and Paligorova and Santos (2017) focused on banks. Our paper adds to this literature by uncovering a link between low interest rates and insurance companies' search for yield.

The rest of our paper is organized as follows. Section 2 describes the capital regulation applicable to insurance companies' investments in CLOs and corporate bonds, including the changes introduced in the 2010 regulatory reform. That section also lays out the hypotheses we investigate. Section 3 describes our data sources and characterizes our sample. Section 4 presents the results of our investigation of insurance companies' search for yield in the CLO and corporate bond markets. Section 5 discusses how insurers' search for yield behavior translated into a preference for CLO tranches over corporate bonds. Section 6 presents evidence from the CLO market from insurance companies' preference for CLOs over corporate bonds. Section 7 concludes the paper.

2 Hypotheses: Insurance Companies' Preferences for CLOs

2.1 Insurance Companies' Investments Over Time

Insurance companies are known for investing heavily in corporate bonds (Becker and Ivashina, 2015). They have also been known for investing in syndicated corporate loans,

[5]Foley-Fisher et al. (2020) document the increasing participation of insurance companies as CLO issuers through their affiliated asset managers. Our focus, instead, is on insurance companies' participation in the CLO market as investors.

particularly on term loans (Bord and Santos, 2012). What is perhaps less understood is their increasing preference for CLOs (NAIC, 2018b), particularly in the post Great Recession era (Figure 3). Between 2009 and 2019, insurance companies' investments in corporate bonds went from $1,143B to $1,784B, corresponding to a 56% increase. During that same period of time, their investments in corporate loans went from $18B to $42B, a 132% increase. In the case of CLOs, their investments went from $13B to $125B, a 863% increase.[6]

The increase in insurance companies' CLO investments is remarkable in many ways. Back in 2009, CLO investments were much lower than corporate bond investments, but they were comparable to loan investments. Yet, over the decade that followed CLO investments' growth was more than six times larger than loan investments'. Further, insurance companies showed a clear preference for the mezzanine tranches (rated Aa, A or Baa) over the safest triple-A rated tranches (Figure 5). In 2011, 56% of insurance companies' CLO investments were in triple-A rated tranches while 40% were in mezzanine tranches.[7] By 2019, the former had declined to 44% while the latter had risen to 52%. For comparison, over the same time period the rating composition of insurance companies' bond investments remained mostly unchanged, with 80% invested in bonds rated single A or Baa (Figure 4).[8]

The growing preference for mezzanine tranches does not appear to be solely due to changes in the relative yields. In the post-crisis decade, yields on bonds held by insurers declined across all rating categories (Figure 6). In contrast, yields remained flat for CLO tranches rated investment grade and increased for the riskiest tranches (Figure 7). While this difference may explain insurance companies' relative preference

[6]Figures are calculated by aggregating the par-value of insurers' investments in bonds, loans and CLOs. For reference, NAIC (2018b) reports that insurance companies' CLO exposure in 2018 was $122B, which is somewhat higher than our estimate for that year ($113B). It is worth noting, though, that we consider CLOs issued in USD only.

[7]The sharp drop and rebound in the share of triple-A tranches in 2008-11 reflect rating downgrades during the financial crisis and subsequent upgrades.

[8]Limited availability of information on credit ratings assigned to bank loans prevents us from decomposing the time series of loan investments across rating categories.

for CLO tranches over corporate bonds it does not explain their growing preference for CLOs' mezzanine tranches. As we will show in Section 4, the driver for this preference is insurance companies' capital regulation. Further, as we will argue in Section 6, insurance companies' preference for CLOs' mezzanine tranches was a critical factor for the post-Great Recession growth in the securitization of corporation loans.

2.2 Insurance Companies' Capital Regulation

Capital adequacy is the cornerstone of solvency regulation for insurance companies. While the U.S. insurance industry is regulated at the state level, regulatory capital requirements are harmonized across states thanks to NAIC's coordination role.[9] All states have adopted the risk-based capital framework designed by the NAIC and first implemented in the early 1990s. Similar to bank capital regulation, that framework defines a minimum amount of capital that insurance companies must maintain in relation to their size and risk profile, and specifies a series of actions that will be implemented against non-compliers. The risk-based capital regime is intended to limit risk-taking of insurers and provide a safety buffer to policyholders and bondholders against insolvency.

The risk-based capital requirement, denoted "authorized control level" (ACL) risk-based capital, is calculated as a function of insurers' exposures to different types of risk. Broadly speaking, the framework classifies risks into three macro categories: asset risk, underwriting risk, and all other business risk. Subcategories of those risks depend on the the specific type of insurer, implying that the capital formula slightly differs across the three main lines of business, i.e. life, P&C, and health. Importantly, the current regulatory framework sets the required capital at the legal entity level (and not at the consolidated level).[10]

[9]The NAIC is an organization governed by the chief insurance regulators from the 50 states, the District of Columbia and the five U.S. territories. State regulators coordinate through the NAIC to define common standards, conduct peer review, and oversee the insurance industry.

[10]NAIC created a "Group Capital Calculation Working Group" that is currently developing a capital requirement to be applied at the group level.

The assessment of insurers' solvency conditions is based on the "risk-based capital ratio" — the ratio of "total adjusted capital" (which is essentially the insurer statutory capital and surplus) to the ACL risk-based capital. A capital shortage may trigger four levels of regulatory actions, which are progressively more severe for decreasing values of the risk-based capital ratio. For example, if total adjusted capital falls below 200% of the risk-based capital requirement, this indicates the company breached the "company action level" (CAL) and is required to submit a plan to restore its level of capitalization.

Important for us are the capital requirements for asset risk associated to fixed income investments, including corporate bonds, loans and CLOs. These are calculated as a weighted sum of the book value of fixed income investments, with weights equal to a risk-based capital charge that captures the credit risk of each asset. The risk-based capital charge is defined for six different buckets of assets' credit quality named "NAIC designations" (NAIC, 2018a, 2020). A NAIC 1 designation corresponds to securities with the highest credit quality, whereas a NAIC 6 designation corresponds to securities with the lowest credit quality. Insurance companies assign a NAIC designation (and the associated risk-based capital charge) to fixed income investments according to a mapping from credit ratings (Table 1). For example, securities rated Aaa, Aa or A receive the NAIC 1 designation and are subject to a (post-tax) risk-based capital charge of 0.3%. This means that for an investment of $100 in a NAIC 1 security, an insurance company must hold $0.3 in equity capital. Lower credit ratings are associated with higher NAIC designations and risk-based capital weights.[11] While the NAIC 1 designation is mapped to three different credit ratings (Aaa, Aa, A), all of the other NAIC categories are associated to a unique rating. This design implies that insurance companies are required to set aside the same amount of regulatory capital for a subset of investments exposing them to different levels of credit risk.

With regards to the book value of an asset, it corresponds to "amortized cost" for

[11] Post-tax risk-based capital charges for NAIC designations 2 through 6 differ slightly across insurers' lines of business.

NAIC 1-5 holdings of life insurers and NAIC 1-2 holdings of P&C and health insurers, unless the asset is impaired. Amortized cost means that the purchase premium or discount is amortized throughout the life of the investment. The book value corresponds, instead, to the lower between the amortized cost and the fair value for NAIC 6 assets of life insurers and NAIC 3-6 of P&C and health insurers. Securities that are not temporarily impaired should be reported at fair value.

The mapping presented in Table 1 remained unchanged and was applied during the time period considered in our study (2003-2019), except for CLOs and mortgage backed securities (MBS) which were subject to a different regime from 2010 to 2018 and from 2009, respectively. In 2009, the NAIC changed the capital requirements for investments in residential MBS to provide some relief to the insurance industry which was negatively affected by the wave of downgrades in MBS during the subprime crisis (Becker et al., 2021; NAIC, 2021). The new regulation was extended to commercial MBS and CLO investments in 2010 (Foley-Fisher et al., 2020), but the calculation of capital requirements for CLOs and MBS under the new regime were substantially different (NAIC, 2017).

The new framework allowed insurers to assign CLO tranches purchased at discount or highly impaired a lower NAIC designation than the designation implied by the rating-based system of Table 1. Specifically, insurers could adopt the following multi-step process (named "modified filing exempt", MFE):

1. convert the credit rating of a CLO tranche into a NAIC designation according to the mapping of Table 1. If the conversion results in a NAIC 1 or a NAIC 6 designation, assign this class of risk.

2. It the conversion results in a NAIC 2-5 category, compare the ratio $\textit{book value} \times 100/\textit{par value}$ to the breakpoints of Table 2 to determine the "initial NAIC designation". If this corresponds to NAIC 1-5, assign this class of risk. For example, suppose that the credit rating conversion delivers a NAIC 2. This designation may

be replaced with a NAIC 1 if the book value is lower than 97.88% of the investment's par value.

3. If the initial designation obtained in the previous step is NAIC 6, then compare the ratio $\min(\textit{book value}, \textit{fair value}) \times 100/\textit{par value}$ to the pricing matrix of Table 2 and assign the final designation accordingly.

This multi-step process was applied until the reporting year 2018 (NAIC, 2019). Starting in 2019, the ratings-based approach of Table 1 was restored.

As we will discuss in section 3, insurance companies submit to the NAIC annual statement filings reporting information on asset holdings, including book value, par value and NAIC designation of each security in the portfolio. As per statutory guidelines, the NAIC designation of CLOs determined according to points 2 and 3 of the MFE process must be reported with the suffix "AM". While a NAIC designation including this substring does not automatically signal an exception to the baseline rating mapping for the NAIC 2-6 categories, all NAIC 1 designations including the "AM" suffix identify tranches whose credit rating would not translate into a NAIC 1. This means that, for the NAIC 1 category, we are able to exactly identify the volume of CLOs reported based on the 2010 reform. Figure shows that the percentage of NAIC 1 CLO investments subject to the MFE process is different from zero during the time period where the reform was in place (2010-2019) and reaches its peak of 15% in 2015. As a complementary exercise, we look at the percentage of NAIC 1 CLO holdings that have a rating different from Aaa, Aa or A. This metrics shows a very similar pattern to the one of the previous measures, and the two almost perfectly overlap starting in 2013. This suggests that insurance companies exploited the regulatory reform to reduce capital charges associated with their CLO investments.

2.3 Hypotheses

The risk-based capital regulation of the insurance sector implies that investments are associated to a higher cost of capital for increasing levels of risks. However, due to the six-bucket designation system, the relationship between asset risk and cost of capital is a step function and, hence, not strictly increasing. Similar to Becker and Ivashina (2015), this leads us to conjecture that, given the same risk-based capital charge, insurers have incentives to maximize the return on their investments, i.e., to search for yield.

Hypothesis 1: Insurance companies have an incentive to invest in higher yielding securities (CLO tranches and bonds) within a NAIC designation bucket.

The modified regulatory regime applied to CLOs in 2010-2018 altered the monotonic relationship between asset risk and cost of capital implied by the rating-based mapping. This is especially true for the risky tranches that are more likely to be downgraded, bear a loss, or be purchased at discount. In fact, there is a positive probability that these tranches are assigned a lower NAIC designation than the designation they would receive based on the rating mapping. Importantly, since the regulatory reform applied to both legacy and new investments in CLOs, we predict the reform affected the behavior of insurers on new investments. We, thus, formulate the following additional hypothesis.

Hypothesis 2: Insurance companies' incentives to invest in higher yielding CLO tranches within a NAIC designation bucket increased after the 2010 regulatory reform.

The capital regulatory framework of insurance companies does not distinguish CLO tranches from corporate bonds with the same rating (perhaps with the exception of the modified regime we discuss above). However, as we document, CLO tranches, other than the triple-A tranche, tend to carry higher yields than corporate bonds with the same credit rating. This gives us our third hypothesis.

Hypothesis 3: Insurance companies have a preference for CLO mezzanine tranches (those rated Aa, A and Baa) over corporate bonds with the same credit rating.

We focus on mezzanine tranches above investment grade because insurance companies usually do not invest in below-grade rated securities (Figure 4 and Figure 5).

Insurance companies' preference for the CLO mezzanine tranches together with their growing importance in the CLO market and the fact that banks, the other major investor in this market, have strong disincentives to invest in CLO tranches that are not rated triple-A, gives us our last hypothesis about the impact of insurance companies in the CLO market.

Hypothesis 4: CLO deals in which insurance companies invest more heavily are characterized by a larger fraction of mezzanine tranches above investment grade.

We test these four hypotheses in the next three sections.

3 Data Sources and Sample Characterization

3.1 Data Sources

Our main data source for this project is "Schedule D-Part 1" of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC during 2003-2019 and retrieved from SNL Financial. That schedule includes information at the security level on virtually all fixed-income holdings of insurance companies (government and corporate bonds, bank loans, MBS, CLOs and other structured securities) as of December 31 of each year. The schedule reports for each security investment: the par value, book value, purchase cost, nominal interest rate, effective yield, NAIC designation, purchase date, and maturity date.

Schedule D-Part 1 is organized in subsections by types of issuers (e.g., government, industrial and miscellaneous, parent, subsidiaries and affiliates) and different

macro-classes of assets (e.g., issuer obligations, RMBS, CMBS, other loan-backed and structured securities). Given Schedule D does not identify the types of assets we are interested in (CLOs, corporate bonds, and bank loans), we rely on a suite of matching exercises and textual analysis.[12] In particular, we identify CLO holdings via CUSIP matching and fuzzy matching using historical data on CLO tranches from Moody's Analytics Structured Finance Portal. We identify corporate bonds via CUSIP matching using data from Mergent Fixed Income Securities Database (FISD). Finally, we identify corporate loans via textual analysis, as well as CUSIP matching and fuzzy matching combining data on syndicated loans from DealScan and Loan Syndications and Trading Association (LSTA), loan funds' holdings from Lipper and Morningstar, and loans in the collateral pool of CLO tranches from Moody's Analytics Structured Finance Portal.

We conduct fuzzy matches to identify CLO and loan holdings by insurance companies using the denomination and maturity date of the asset. The reason why we also carry out a textual analysis (beside CUSIP matching) to identify CLO tranches and corporate loans is because CUSIP identifiers are not always available in all data sources for these securities, especially for corporate loans. We follow a conservative approach discarding CUSIP matches in which the maturity date of the asset and the issuer name do not correspond in the pair of matching data sets. In addition, we check that all insurers' holdings identified as CLO tranches, corporate bonds and corporate loans do not fall into other asset classes using textual analysis and CUSIP matches with data from Capital IQ.

Of the three asset categories we consider, corporate loans are the ones that pose the biggest challenges because they often lack a unique identifier across different data sets/providers. However, a simple exercise using the 2018 and 2019 bank-loan subsections of Schedule D-Part 1 mentioned above shows that our approach allows us to identify 99.9% of the corporate loans held by insurance companies in those two years.

[12]The only exception are corporate loans for the years of 2018 and 2019 which are reported in two separate subsections named "bank loans issued" and "bank loans acquired".

This leads us to believe that our approach to identify the various asset classes is reliable.

We complement our data set on insurance companies' asset holdings with data on CLO tranches, corporate bonds, and insurers' financial conditions. We get historical data on the offering amount, outstanding balance, maturity or expiration date, and credit ratings disclosed in CLOs Trustee reports from Moody's Analytics Structured Finance Portal. We only associate the aforementioned list of variables to tranches identified via CUSIP matching to make sure that we assign them correctly. This is a minor limitation as CLO tranches obtained by matching the CUSIP identifiers represent 99.8% of all insurers' holdings identified as CLOs. There are two important caveats related to data obtained by Moody's Analytics Structured Finance Portal. First, information on CLO tranches is available up to beginning of November 2019. As a result, that data source does not cover the full year of 2019. Second, we have the entire rating history of CLOs only for a subset of tranches that are rated by Moody's (63% of all CLO tranches in our sample). Information on credit ratings is available only at issuance for CLO tranches evaluated by other rating agencies (Standard's & Poors and Fitch). We, thus, assume that those tranches do not experience a change in credit rating and we keep the rating assigned at issuance throughout their lifetime. This is a reasonable assumption as we observe a change in rating bucket (e.g., from Aaa to Aa) only for 16% of tranches rated by Moody's and most of the changes relate to downgrades and subsequent upgrades occurred in 2009 and 2011. This is consistent with Griffin and Nickerson (2021), who documents that credit agency actions on CLO tranches are very limited even during the covid-19 shock.

We get data on the offering amount at issuance, outstanding volume and credit ratings of corporate bonds from Mergent Fixed Income Securities Database (FISD) and Moody's. Since we have limited information on outstanding volumes and credit ratings of corporate loans, we focus our investigation on insurance companies' investments in CLOs and corporate bonds. Finally, we obtain information on the balance sheet and

income statement of insurance companies from SNL financial.

Finally, we get data on the structure of CLO deals from Moody's Analytics Structured Finance Portal which we use in section 6 to investigate the implications of insurance companies' preference for CLO mezzanine tranches.

3.2 Sample Characterization

Our sample comes from the fixed-income holdings of 5,685 life, P&C and health insurance companies between 2003 and 2019. The full portfolio of securities of these companies over that time period contains 16,620,911 observations. Life and P&C insurers each account for about 45% of these observations, whereas health insurance companies account for the remaining 11% observations. After we restrict to investments in CLOs, corporate bonds and loans, we are left with 6,572,218 observations of which 129,440 are in CLOs, 6,272,915 are in corporate bonds, and 169,863 are in loans. Finally, after we aggregate investments that insurance companies report in the same security in a given year we are left with 6,434,425 observations of which 128,917 are in CLOs, 6,135,645 are in bonds and 169,863 are in loans.[13]

In the econometric analysis presented in section 4 and section 5, we restrict our sample to first-time investments of insurers in CLOs and corporate bonds, i.e., for each insurance company-security pair we keep only the observations corresponding to the year in which the original purchase of the asset took place. We do this because insurance companies make most of their investments when securities are first issued. Also, recall that we drop from the analysis loan investments because we do not have comprehensive information on loan ratings. This leaves us with a panel of 1,714,609 observations, with 57,507 pertaining to CLO investments and 1,657,102 pertaining to corporate bonds.

Lastly, we use two data sets to investigate the impact of insurance companies'

[13]We aggregate these observations at the security-company-year level by summing up the par value, book value and actual cost of the investments, averaging the nominal interest rate, and calculating a size-weighted average of the effective yield with weights equal to the par value of each investment.

preference for CLOs on the design of CLO deals that we report in section 6. The first data set includes information on CLO deals at issuance. The second data set contains information on outstanding balance and refinancing of CLO deals throughout their lifetime. The former is a cross section of 2,327 CLO deals issued between 2003 and 2019, whilst the latter is a panel of 15,289 (annual) observations covering the same set of deals.

4 Insurance Companies' Search for Yield

In this section, we begin by investigating insurance companies' incentives to invest in higher yielding securities (CLO tranches and bonds) within a NAIC designation bucket (Hypothesis 1). Next, we investigate how those incentives varied over time to ascertain both the potential role of low interest rates and the 2010 regulatory reform (Hypothesis 2) on insurance companies' search for yield incentives. Following this, we investigate the heterogeneity of these incentives depending on insurance companies' capitalization and their exposure to losses triggered by large natural disasters.

4.1 Insurance Companies' Preference for higher yielding securities

We start our empirical analysis of Hypothesis 1, which states that insurance companies have the incentive to invest in the higher yielding CLO tranches and bonds within a NAIC designation bucket, with a graphical inspection of insurance companies' investment choices. To this end, we restrict our sample to first-time investments of each insurance company in a given security (CLO tranche or corporate bond).[14] Figure 10 shows the time series of insurers' new CLOs holdings that fall into the highest credit quality designation (NAIC 1) as a percentage of the total volume outstanding of these tranches based on percentiles of the distribution of CLOs yields for each year. Yields

[14]This is important because the share of a CLO tranche that an insurance company owns may vary not only due to changes in the invested amount but also because of refinancing or changes in the outstanding balance of the CLO (e.g., amortization of principal).

represent the effective rate of return on the investment in a given security as reported by the insurance company.

In line with our hypothesis, there is a clear preference for the riskiest tranches within NAIC 1 (those with yields above the 66th percentile) throughout the sample period, with the exception of the financial crisis where all yields are squeezed at their minimum levels. Interestingly, the search for yield behavior of insurance companies in CLOs pertaining to the NAIC 1 bucket is very pronounced both in the pre-crisis period, when interest rates were relatively high, and in the post-crisis period, when short-term interest rates were close to the zero lower bound. In 2003-2006, the market share of CLO tranches with yields above the the 66th percentile is 25 to 40 percentage points higher than that of tranches with yields in the bottom tercile, whilst from 2011 onwards the gap between the extreme buckets ranges from 10 to 35 percentage points. The compression of the three market shares in 2007-2010 is hardly surprising in light of the CLO market freeze observed during the financial crisis (Figure 1). Note that the three market shares experience a drop in 2019, after the regulatory reform of 2010 was repealed.

We obtain a very similar picture when we look at tranche ratings rather than yields (Figure 11). In this case, the market share of the two mezzanine tranches in NAIC 1, that is those rated Aa and single A, is consistently above that of triple-A tranches throughout the sample period, except for the financial crisis when the three market shares overlap.

When we replicate this exercise for the corporate bonds, the evidence seems to suggest that insurance companies' reach for yield within the NAIC 1 bucket is more prevalent within CLOs than bonds (Figure 12-12). As we noted above, the market share of CLO tranches with yields above the 66th percentile is 10 to 40 percentage points higher than that of tranches with yields in the bottom tercile throughout our sample period. By contrast, the difference in the market share of corporate bonds with yields above the the 66th percentile and yields below the 33th percentile does not exceed 10

percentage points. Also, it seems that in both asset classes, and in line with Becker and Ivashina (2015), insurers are more prone to search for yield in periods of economic growth.

We, next, test more formally our Hypothesis 1 by estimating the following baseline econometric model:

$$\begin{aligned}\frac{Holdings_{sct} \times 100}{Outstanding\ amount_{st}} =& \alpha + \beta_1 Yield_{sct} + \beta_2 Time\ to\ maturity_{sct} \\ &+ \beta_3 Outstanding\ amount_{st} + \mu_{NAIC\ designation,t} \\ &+ \mu_{c,t} + \mu_{a(s)} + \mu_{l(c)} + \varepsilon\end{aligned} \tag{1}$$

where the dependent variable is the amount held by insurance company c in security s in year t when the insurer makes its first investment in that security, $Holdings_{sct}$, as a percentage of the volume outstanding of security s at year-end t, $Outstanding\ amount_{st}$. The key variable of interest is $Yield_{sct}$, the effective yield of security s reported by company c in year t. We expect the coefficient on this variable, β_1, to be positive, in line with the premise that insurers invest more heavily in securities offering higher yields within a NAIC category.

We attempt to identify that effect controlling for the time to maturity of the security in years (as reported by the insurance company), $Time\ to\ maturity_{sct}$, and the volume outstanding of security s at issuance, $Outstanding\ amount_s$, which allow us to disentangle search for yield from time and issue size preferences of insurance companies. Importantly, we include NAIC designation-year fixed effects, $\mu_{NAIC\ designation,t}$, to investigate reach for yield within each bucket of risk-based capital charges. Finally, we saturate our econometric model with company-year fixed effects, $\mu_{c,t}$, to control for company-specific time varying and time invariant conditions that may affect its incentives to invest in a given security, type of asset (CLO or corporate bond) fixed effects, $\mu_{a(s)}$, to account for asset-specific characteristics that may affect insurers' preference for a security class, and line of business fixed effects, $\mu_{l(c)}$, to control for differences in the

business model and regulation of life, P&C and health insurance companies which may impact their investment choices. Standard errors are clustered at the company level and year level (two-way clustering).[15]

Table 3 reports the results of our estimation of model 1. The first column reports the estimates of our baseline model. In line with our priors, the coefficient on $Yield_{st}$ is positive and highly statistically significant, corroborating the hypothesis that insurance companies invest more in securities with higher yields within a NAIC designation bucket. In terms of magnitude, an increase in the yield by one standard deviation (2.14 percentage points in the subsample where this regression is estimated) implies an increase in the holding share of insurers by 14 basis points, which is somewhat above the median holding share (0.12). The median outstanding volume of CLOs and corporate bonds in portfolio in the subsample where we estimate the model is \$650 million. Thus, a 14 basis points increase in the holding share of an insurer corresponds to an additional investment of \$93 million for the median security in portfolio. Looking at the control variables, we observe a negative and statistically significant coefficient for the outstanding amount, in line with the idea that insurance companies hold a lower fraction of an asset the larger is its size.

In columns 2 and 3 we replace company-year fixed effects with a set of variables capturing company characteristics that may affect insurers' incentives to invest in a given security. These include size (natural logarithm of total admitted assets), ROE (net income to total adjusted capital), capital ratio (total adjusted capital to total admitted assets), and either CAL risk-based capital ratio (column 2) or ACL risk-based capital ratio (column 3).[16] While the ACL risk-based capital ratio captures the distance from the minimum capital requirement that insurance companies must comply with to run their business, the CAL risk-based capital ratio captures the distance from the

[15] We select the proper clustering level following Petersen (2009), Cameron et al. (2011), and Cameron and Miller (2015).

[16] Similar to Koijen and Yogo (2015), we use total adjusted capital as a measure of insurers' equity.

first capital threshold that triggers oversight actions from insurance regulators. It is worth noting that we lose 37,462 observations (out of 1,691,393) in columns 2 and 3 due to missing information on financial metrics for some insurers that are covered in the holding data starting in 2019 but are not covered in the SNL Financial's balance sheet and income statements data.[17] For this reason, we use as baseline model the econometric specification including company-time fixed effects rather than firm controls. Irrespective of the risk-based capital ratio used, the yield's coefficient is very close to that of the baseline regression but somewhat larger. In addition, the positive and statistically significant coefficient of size and the two risk-based capital ratios suggest that insurers' holding share of CLOs and corporate bonds positively correlates with firm size and level of capitalization.

Column 4 extends our baseline specification to include issuer fixed effects to account for insurance companies' preference towards certain issuers. These fixed effects are largely collinear with the security type fixed effects, as no CLO issuer is also a corporate bond issuer and vice versa. Thus, not surprisingly, this regression delivers results which are virtually the same to those of the baseline model.

Finally, in column 5 we take a first look at insurers' relative incentives to search for yield differ across the CLOs and corporate bonds within each NAIC bucket. The coefficient of CLO dummy suggests that, ceteris paribus, insurance companies hold a higher share of CLO tranches compared to corporate bonds. Importantly, and in line with the patterns observed in Figure 10 and Figure 12, the search for yield behavior of insurers appears to be more pronounced within the CLO asset class. This is not surprising if we note, for example, that the yields of CLO tranches are much more disperse than the yields of corporate bonds in the NAIC 1 designation bucket hereby creating better opportunities to search for yield (Figure 6 and Figure 7).

The positive and statistically significant coefficient of the interaction term be-

[17] These companies began to submit their financial filings with life insurers in 2019.

tween the yield and the CLO dummy indicates that a one standard deviation increase in the yield (2.14 percentage points in the subsample where this regression is estimated) implies an increase in the holding share of CLO tranches in a given NAIC bucket that is 2.38 percentage points higher than that of corporate bonds. These results are in line with our Hypotheses 3 that insurance companies have a preference for CLOs over corporate bonds with the same credit rating. We investigate this hypothesis more directly at the end of this section.

Overall, the results from this part of our analysis confirm Hypothesis 1 that the design of the insurance sector's capital regulation for asset risk with discontinuous buckets of capital charges generates incentives for insurers to search for yield both in the CLO and corporate bond market segments.

4.2 Heterogeneity over Time

We next explore possible differences in insurers' search for yield over time. This is important because our sample period (2003-2019) encompasses a protracted period of low interest rates, which has been linked to increased risk-taking by the banking industry.[18] It also overlaps with the 2010 regulatory reform, which, following our Hypothesis 2, made it easier for insurance companies to search for yield in the CLO market segment. The results of our investigation on the heterogeneity of the effects over time are reported in Table 4.

Column 1 of Table 4 extends the baseline model to include the interaction between asset yield and year dummies. For the sake of readability, we report the simple slopes of the yield for each time period. The interaction coefficients are broadly positive and statistically significant in the pre-crisis period (2003-2006), with the exception of 2004 and 2005. The interaction is still positive and significant at the early stage of the financial crisis in 2007, but it turns negative in the midst of the crisis in 2008, to revert

[18]See, for example, Altunbas et al. (2014), Peydro and Maddaloni (2011), Dell'Ariccia et al. (2017), Jimenez et al. (2014), Ioannidou et al. (2015) and Paligorova and Santos (2019).

again in the following year. During the post-crisis decade (2009-2019), the interaction coefficients are positive, highly significant (except for 2009 and 2019), and are 60% to 4.5 times the highest value of the pre-crisis period observed in 2006.

To further investigate whether insurance companies' incentives to reach for yield changed across different economic and monetary policy regimes, in column 2 we perform a similar exercise where we split our sample into four time periods: pre-crisis (2003-2006), financial crisis (2007-2008), zero lower bound (ZLB) period (2009-2015) and post-ZLB (2016-2019). Similar to the column 1 specification, the interaction terms between the yield and the time dummies suggests that insurance companies searched for yield both in the pre-crisis period (when interest rates were relatively high) and the post-crisis period (when interest rates were relatively low), but this behavior is stronger (more than triple in magnitude) during the latter time period.

Interestingly, in the post-crisis decade, insurers' incentives to invest in higher yielding securities within a NAIC category is more pronounced in the post-ZLB sample, when the policy rate increased, compared to the ZLB-period. This remains true even when we control for the asset class (column 3), but the difference in the interaction coefficients of the ZLB period and the post-ZLB shrinks significantly. Overall, this suggests that the economic cycle affects significantly firms' propensity to search for yield, with insurers investing in higher yield securities within a NAIC bucket in periods of economic growth, irrespective of the levels of interest rates. However, monetary policy seems also to play a role, as this phenomenon is reinforced in an environment of low interest rates. It is worth noting that, while new issuance of CLOs plummeted during the financial crisis (Figure 1) making reaching for yield de facto not viable for CLO investments at that time, new issuance of corporate bonds also dropped but did not freeze (Figure 14). However, given insurance companies' apparent preference for searching for yield within the CLO asset class (column 5 of Table 3), the collapse in new issuance of CLOs in 2008-2010 (as a result of a broader aversion of investors towards

asset-backed securities) might be the key driver behind insurers' vanished propensity to invest in higher yield securities during the financial crisis.

Finally, we test our second hypothesis, namely that insurers' incentives to reach for yield within the CLO asset class is stronger for as long as the regulatory reform of 2010 was in place (i.e., 2010-2018). To this end we include a triple interaction between the yield, the CLO dummy and a dummy equal to one if the year falls into the 2010-2018 time period and zero otherwise. As we can see from column 6, the coefficient of the triple interaction is large, positive and statistically significant. Thus, consistently with our prediction, following the 2010 regulatory reform which allowed (under certain conditions) insurers to assign CLOs purchased at discount a lower NAIC designation than the designation implied by the rating-based system, insurance companies increased their investments in CLOs relative to bonds within NAIC buckets.

4.3 Heterogeneity across Insurance Companies

Our next tests explore the heterogeneity in insurers' search for yield behavior across firm attributes. We begin by considering insurance companies' capitalization. In the banking literature, well capitalized banks are believed to be less prone to take on risk. Repullo (2000) shows this link in a model where capital is used as a cushion against adverse contingencies, and Jimenez et al. (2014) and Dell'Ariccia et al. (2017) find evidence consistent with this insight. Therefore, we expect stronger evidence of search for yield among insurers with a low level of capitalization.[19] Columns 1 through 3 of Table 5 report the results for three different measures of capital. Column 1 considers insurance companies' level of capitalization as captured by the capital ratio; column 2 uses the CAL RBC ratio, and column 3 relies on the ACL RBC ratio. Irrespective of the capitalization metric adopted, we find that insurance companies with a lower capital ratio or closer to

[19]Of course this builds on the assumption that the banking insight applies to insurance companies. It is also worth noting that, even within the banking industry, there are different views on the impact of capital on banks' risk taking incentives. For example, Rochet (1992) shows that well-capitalized banks are less risk-averse when capital is more costly than other funding sources, giving rise to a typical moral hazard problem.

the minimum capital requirements are more prone to search for yield.

Our next test on the search for yield heterogeneity across firms focuses on P&C companies, which is the category of insurers that are affected by particularly adverse events related to weather and climate disasters during our sample. Figure 15 shows the time series of nationwide property damage from federally-designed disasters from 1964 to 2018. During the last two decades, major disasters occurred in 2005, when hurricane Katrina caused large-scale devastation in the Gulf Coast region, and in 2017, which saw a devastating hurricane season with hurricanes Harvey, Irma and Maria and an unprecedented break out of wildfires in Northern California. The aggregate value of nationwide property damage peaked exactly in 2005 and 2017, reaching almost $100B in both years and implying significant insured losses.

We, thus, investigate if P&C insurers that were hard hit by disaster events, as captured by the yearly change in their net income, were more aggressive searching for yield in 2005 and 2017 vis-à-vis less affected companies. The idea behind this conjecture is that insurers experiencing higher losses on their policies may try to boost their net income by investing in securities offering higher returns. To this end, we generate a dummy variable equal to one if the change in net income of a P&C insurer in a given year is below the median (henceforth abridged "below median dummy") and zero otherwise and we interact this variable with the effective yield and a time dummy for 2005 and 2017, respectively. The results of this investigation is reported in column 5 of Table 5.

We find that there is not a significant difference in the investment behavior of insurance companies whose change in net income is below and above the median throughout the sample period, with the exception of 2005 and 2017 when below median firms had significant higher incentives to search for yield compared to above median firms. Specifically, while the interaction between the yield and the below median dummy is not statistically significant, the triple interactions of the yield, the below median dummy, and the time dummies for 2005 and 2017 are both positive and significant. Since the

coefficient of the triple interaction of 2017 is more than twice that of 2005, this suggests the search for yield in response to the increase in insured losses due to catastrophic events was much stronger in 2017 than 2005.

A natural question that arises from these findings is whether hard hit P&Cs changed their investment behavior only temporarily or in a persistent way. We perform this exercise separately for 2005 and 2017 by estimating a regression model on the subsample of P&C insurers whose yearly change in net income is below the median in 2005 (column 6) and 2017 (column 7), respectively. In each specification, we interact the yield with a time dummy corresponding to the year of the event (2005 or 2017) and a time dummy indicating the post-event period. In the specific case of the analysis focused on the 2005 natural disaster, we limit the sample to the period prior to the financial crisis (2003-2006) to eliminate this confounding factor. Both interaction terms are not statistically significant in column 6, suggesting that P&C highly affected by the devastating effects of hurricane Katrina did not change their investment behavior over time. We find different results on column 7 which focuses on the 2017 losses. The coefficient of the yield is positive but not statistically significant, and the interaction coefficient of the yield with the post-2017 dummy is also insignificant. However, the interaction coefficient of the yield with the 2017 time dummy is positive and statistically significant. This means that P&C insurers highly affected by the devastating events of 2017 invested significantly more in higher yielding securities within a NAIC bucket only in that year, but this increased search for yield behavior did not persist over time.

This finding corroborates our previous results on low-capital adding support to our evidence that insurance companies seek to exploit the design of their capital regulation taking on more risk in search for yield. Thus far, we focused on documenting insurance companies' search for yield through their investments in both corporate bonds and CLO tranches. In the next section, we go a step further and investigate whether regulation tilted insurance companies' preference for searching for yield using CLOs over

corporate bonds (Hypothesis 3).

5 Insurance Companies' Preference for CLOs over Bonds

As discussed in Section 2, capital requirements for asset risk applied to insurance companies treat CLO and corporate bond investments alike. While the regulatory reform of 2010-2018 partially modified the assignment of CLO tranches to a NAIC designation, it has always been the case that corporate bonds and CLOs falling into the same NAIC bucket are subject the same capital requirement.

Figure 8 shows that the average yield on insurers' investments in CLOs is systematically higher than the yield on insurers' investments in corporate bonds for all rating categories, except the triple-A, starting in 2005. In addition, as noted earlier, insurance companies hold mainly investment grade CLOs and corporate bonds (Figure 4 and Figure 5). This lead us to our third hypothesis, namely that insurance companies have a preference for CLO mezzanine tranches rated Baa and above over corporate bonds with the same credit rating.

We explore this prediction, starting with a granular comparison of yields on CLO tranches and corporate bonds. To this end, we estimate the following type of model:

$$\begin{aligned} Yield_{sct} =& \alpha + \beta_1 dummy\ CLO_s + \beta_2 Time\ to\ maturity_{sct} \\ &+ \beta_3 Outstanding\ amount_{st} + \mu_{Rating,t} \\ &+ \mu_{c,t} + \mu_{l(c)} + \varepsilon \end{aligned} \tag{2}$$

where $Yield_{sct}$ is the yield of security s reported by company c at time t and $\mu_{Rating,t}$ stands for rating-year fixed effects. We estimate the model on the subsample of insurers' first time investments in CLO tranches and corporate bonds rated Aaa, Aa, A and Baa. Column 1 of Table 6 reports the estimate of this regression. We find a positive and statistically significant coefficient for the CLO dummy, suggesting that, on average,

the yield on insurers' new investments in CLOs is 0.7 percentage points higher than the yield on new investments in corporate bonds with the same rating. When we interact the CLO dummy with the rating, we find that the difference in yields between the two asset classes is statistically significant only for securities rated Aa and below. Importantly, this difference increases monotonically from 0.5 percentage points for the Aa rating class to 1.6 percentage points for the Baa rating class.

We, next, explore the implications of that difference in yields on insurers' preference for CLOs vis-à-vis corporate bonds by estimating the following econometric specification:

$$\begin{aligned}\frac{Holdings_{cst} \times 100}{Outstanding\ amount_{st}} =& \alpha + \beta_1 dummy\ CLO_s + \beta_2 Time\ to\ maturity_{st} \\ &+ \beta_3 Outstanding\ amount_{st} + \mu_{Rating,t} \\ &+ \mu_{c,t} + \mu_{l(c)} + \varepsilon\end{aligned} \tag{3}$$

where the dependent variable is the amount held by insurer c in the security s and at time t (when the insurer makes its first investment in the security) as a percentage of the volume outstanding of the security in that year. Columns 3-7 of Table 6 show the results of this exercise. The large and highly significant coefficient of the CLO dummy in model 3 confirms that insurance companies have a strong preference for CLOs over corporate bonds with the same credit rating. Consistent with the evidence presented in column 2, this preference increases with risk, as the difference in yields between CLOs and corporate bonds widens. In the next three specifications, we test if there is any heterogeneity in the investment behavior of insurance companies depending on their level of capitalization by interacting the CLO dummy with the capital ratio, the CAL risk-based capital ratio and the ACL risk-based capital ratio, respectively. The estimates of all these three models suggest that less capitalized insurers have a strong preference for CLOs vis-à-vis corporate bonds within the same rating category, in line with the idea that higher leverage brings stronger incentives to search for yield.

We next relate insurance companies' preference for CLOs over corporate bonds to the difference in yields between the two asset classes more directly. To that end, we construct a ratio of the average yield on insurers' investments in CLOs to the average yield of insurers' investments in corporate bonds for each rating-year pair (henceforth abridged "yields ratio"). Then, we extend model 3 by interacting the CLO dummy with the yields ratio. Column 8 of Table 6 reports the result of this econometric model. The interaction between the yields ratio and the CLO dummy is positive and statistically significant, suggesting that insurance companies purchase a larger portion of CLO tranches compared to corporate bonds the larger is the difference between the yields on CLOs investments and the yields on corporate bonds investments within a given rating class. In columns 9-11 we further extend the analysis to include the triple interaction of the CLO dummy with the yields ratio and the variables capturing firm capitalization. While the simple capital ratio does not imply any differential effect, we find that firms closer to the minimum capital requirements are more sensitive to the yields ratio when deciding the extent of their investments in CLO tranches and corporate bonds.

The analysis presented so far is cross-sectional in nature, as all the models of Table 6 (except those exploring the heterogeneity across firms based on their level of capitalization) include insurer-year fixed effects. In this sense, the study conducted up to this point sheds light on the preference for CLOs over corporate bonds by a given insurance company in a specific year and within a certain rating class. As a natural extension, we would like to explore the time series dimension of this phenomenon, assessing how insurance companies' preference for CLOs over corporate bonds has evolved over time. However, the granular dataset at the firm-security-year level is not ideal for this purpose. An important caveat to bear in mind is that the composition of insurance companies investing in CLOs has changed significantly throughout our sample period. In 2003-2008, only 4% of insurers invested in CLOs, whereas in the post-crisis decade

this percentage jumps to 26%.[20] Also, the average percentage of a CLO tranche held by an insurer moved from 22% in 2003-2008 to 10% in 2009-2019. This means that, in the post-crisis decade, a larger number of insurance companies competed to invest in the CLOs space and, as a result, firms ended up holding a lower portion of individual CLO tranches compared to what they did in the time period 2003-2008. At the same time, though, we also observe that insurance companies invested in a much wider set of CLO tranches in the post-crisis decade compared to the 2003-2008 period (17% versus 52% of the total number of tranches outstanding, respectively).

The proper way to gauge insurers' preference for CLOs over corporate bonds over time requires an analysis at a more aggregate level, i.e., at the insurer-asset class-rating-year level. To that end, we construct this a dataset aggregating up the granular data at the company-security-year level, so that we can calculate the volume of insurers' first-time investments in CLOs (or corporate bonds) as a percentage of the total volume outstanding of these securities with a given rating category and a specific year.[21] We, then, estimate the following model:

$$\begin{aligned}\frac{Holdings_{arct} \times 100}{Outstanding\ amount_{art}} =& \alpha + \beta_1 dummy\ CLO_a + \beta_2 Time\ to\ maturity_{arct} \\ &+ \beta_3 Outstanding\ amount_{art} + \boldsymbol{X'_{ct}\beta_4} + \mu_r \\ &+ \mu_c + \mu_{l(c)} + \varepsilon\end{aligned} \tag{4}$$

where the dependent variable is the amount of first-time investments by company c in the asset class a (CLO tranches or corporate bonds) with rating r in year t as a percentage of the total volume outstanding of the asset class with that rating in that year. The key variable of interest is the CLO dummy variable $dummy\ CLO_a$. $Time\ to\ maturity_{arct}$ is the average time-to-maturity of all new investments by insurer c in the asset class a

[20] Differently, all insurance companies invested in corporate bonds in both time periods.

[21] By construction, this dataset includes observations pertaining to insurers' "zero investments" in a given asset class-rating category. For example, if a company does not hold any CLO tranche rated Baa in a given year, the percentage of Baa-rated CLOs held by that company in that year is reported with a value of zero.

with rating r in year t, $\boldsymbol{X'_{ct}}$ is a set of firm controls, and $\mu_{r(a)}$ stands for rating fixed effect.

The results of this exercise are shown in Table 7. Column 1 reports the estimates of model 4. As expected, the coefficient of the CLO dummy is positive and statistically significant, confirming that insurance companies purchase a larger fraction of CLOs compared to corporate bonds. In the next two specifications, we saturate the model with year fixed effects (column 2) and rating-year fixed effects (column 3) to mimic the cross-sectional analysis of model 3 of Table 6. The coefficient of the CLO dummy remains positive and both its magnitude and its statistical significance increase.

In model 4 we test how insurers' preference for CLOs over corporate bonds evolved over time. To this end, we extend the econometric specification of column 1 by interacting the CLO dummy with a dummy identifying four time periods: pre-crisis (2003-2006), financial crisis (2007-2008), zero lower bound (ZLB) period (2009-2015) and post-ZLB (2016-2019). To ease the interpretation, we report the interaction terms as simple slopes of the CLO dummy for each time period. We find that in the pre-crisis period, when the yields ratio was between 0.5 and 1.25 for all investment grade rating classes, insurance companies purchased a lower portion of CLO tranches compared to corporate bonds with the same rating, suggesting a preference for corporate bonds over CLOs. However, Their preference flipped starting with the financial crisis when the yields differential between CLOs and corporate bonds widened. In the post-crisis decade, as the yields ratio continued to be at relatively high levels, insurers' preference for CLOs over corporate bonds with the same rating became much more pronounced. Replacing rating fixed effects with rating-year fixed effects in column 5 does not alter the results. In the subsequent specification we interact the CLO dummy with a dummy identifying the time period in which the 2010 regulatory reform was into effect (2010-2018). We find that insurers' preference for CLOs over corporate bonds is concentrated exactly during the period in which the new regulatory regime was in place.

In the last three specifications of Table 7 we directly link insurers' preference for CLOs over corporate bonds to the difference in yields offered by CLO tranches and corporate bonds by interacting the CLO dummy with the yields ratio. Since our sample includes a large number of observations where insurance companies have zero investments in CLO tranches, especially in the pre-crisis period, we limit the analysis to the sub-sample of non-zero investments by insurance companies in each asset class-rating pair. These three models (column 6-8) differ only in the set of fixed effects included, which replicates the setup of columns 1-3. Irrespective of the combination of fixed effects, and hence on the emphasis put on the time dimension or the cross-section dimension, we find a positive and highly significant coefficient for the interaction between the CLO dummy and the yields ratio, confirming that insurance companies tend to purchase a larger portion of CLO tranches compared to corporate bonds the higher is the yields differential between CLOs and corporate bonds.

Up to this point, we have investigated insurers' preference for CLO tranches vis-à-vis corporate bonds focusing on the amount of new investments in CLOs and corporate bonds by insurance companies in proportion to the total volume outstanding of these two asset classes. An alternative and, perhaps, more intuitive way to explore the preference of insurers for one asset type versus the other would be to look at the the amount of, e.g., CLO holdings as a percentage of the total new investments in CLOs and corporate bonds made by insurance companies. We implement this alternative approach, by estimating the following econometric specification:

$$\begin{aligned}\frac{CLO\ holdings_{rct} \times 100}{Total\ holdings_{rct}} =& \alpha + \beta_1 \frac{Yield\ CLO_{rt}}{Yield\ Bond_{rt}} + \beta_2 \frac{CLOs\ Outstanding\ amount_{rt}}{Bonds\ Outstanding\ amount_{rt}} \\ &+ \boldsymbol{X'_{ct}\beta_3} + \mu_r + \mu_c \\ &+ \mu_{l(c)} + \mu_t + \varepsilon \end{aligned} \tag{5}$$

where the dependent variable is the amount of first-time investments by company c

in CLO tranches with rating r in year t as a percentage of the total volume of new investments in CLOs and corporate bonds with that rating in that year. The key variable of interest is the yields ratio, $\frac{Yield\ CLO_{rt}}{Yield\ bond_{rt}}$. $\frac{CLOs\ Outstanding\ amount_{rt}}{Bonds\ Outstanding\ amount_{rt}}$ is the ratio of the total outstanding amount of CLO tranches with rating r in year t to the total outstanding amount of corporate bonds with rating r in year t.

Column 1 of Table 8 reports the estimates of this model. The coefficient of the yields ratio is positive and statistically significant, indicating that insurance companies direct a larger portion of their new investments within a given rating class towards CLOs the higher is the yields ratio. In the following specification, we focus on the variation within firm-year by saturating the model with company-time fixed effects. The coefficient of the yields ratio remains virtually unchanged, suggesting that even within the same year, an insurance company tends to allocate a larger fraction of its investments to CLO tranches (relative to corporate bonds) the higher is the yields differential between CLOs and corporate bonds with a given rating.

As we mentioned earlier, there has been an important shift in the composition of insurance companies investing in CLO tranches after the financial crisis. Presumably, before the crisis, only large and sophisticated insurers invested in CLOs, given the complex nature and opacity of this asset class. As the time went by, a progressively higher fraction of smaller and unsophisticated insurance companies entered the CLO market. A potential concern about the relevance of the observed preference for CLOs over corporate bonds in terms of implications for markets dynamics would be that this phenomenon is mostly driven by the set of new entrants, which may not be influential investors, especially in the CLOs space. To rule out this concern, we re-estimate models 1-2 on the subsample of insurance companies that invest in CLO tranches both in the time period 2003-2008 and in the post-crisis decade (2009-2019). The coefficient of the yields ratio remains highly significant and, if anything, increases in magnitude. This suggests that the largest and more sophisticated insurers are actually the main

drivers of the progressive shift from corporate bonds to CLOs investments observed in the insurance industry.

6 Implications of Insurance Companies' Preference for CLOs

In the previous section, we documented insurance companies' increasing preference for CLOs, and particularly CLO mezzanine tranches, over corporate bonds, in connection with their search for yield. This has potentially relevant implications for the market for CLOs. Figure 16 shows that insurance companies' market share of corporate bonds exhibits a slightly downward trend (although with a twist in the immediate post-crisis period) over the course of 2003-2019, moving from 21% in 2003 to 18% in 2019. When we split the market share by ratings, we observe that this downward trend is common across bonds rated Aa and below, whilst the market share of triple-A bonds remained stable around 6% up to 2010, experienced a parabolic path in 2011-2017, and came back to its original value in 2018-2019 (Figure 17).

Differently, insurers' market share of CLO tranches exhibits a monotonic and large increase throughout the sample period, moving from 4% in 2003 to 19% in 2019. Figure 18 shows that this growth was mostly driven by mezzanine tranches Aa, A or Baa rated, whose aggregate market share octupled in the post-crisis decade, rising from 5% in 2009 to 44% in 2019. The par value of A-rated tranches held by insurance companies in 2019 is above 50% of their total outstanding volume, while the market share of Aa and Baa tranches is 42% and 39%, respectively. It is worth noting that our estimates represent a lower bound, given the conservative approach we adopted to identify CLO tranches held in insurers' portfolio, as described in section 3.[22]

Importantly, in our sample, investment grade rated mezzanine tranches (Aa, A

[22]Indeed, our estimate is close, but somewhat below, DeMarco et al. (2020) estimate that domestic insurance companies held approximately 60% of Cayman-issued U.S. CLO tranches Aa, A or Baa rated in 2018 using Treasury International Capital (TIC) data. According to Liu and Schmidt-Eisenlohr (2019), Cayman-issued U.S. CLOs represent approximately 74% of total U.S. CLO securities in 2018.

and Baa rated) correspond to 23% of a CLO deal at issuance, whereas triple-A tranches represent on average 62%, with the remaining 15% being junior tranches and the equity tranche. There is plenty of demand for Aaa rated tranches, especially from banks due to the favorable treatment in capital regulation of triple-A securities vis-à-vis assets with lower credit quality. The investor base of mezzanine tranches looks quite different, with banks playing only a marginal role (DeMarco et al., 2020; IMF, 2020). For example, DeMarco et al. (2020) document that, in 2018, insurance companies held more than 50% of (Cayman-issued) CLO tranches Aa, A or Baa rated, whereas the remaining investor based is fragmented with various categories of investors (mutual funds, banks, funds or other investment vehicles, pension funds, and non-financial organizations) holding less than 10% each.

Putting these estimates together, we see that mezzanine tranches rated investment grade account for on average 23% of a CLO deal and insurance companies owned as of 2019 about half of those tranches. In other words, insurance companies by owning such a large fraction of the risky tranches of CLOs, those for which there is arguably less demand in part because they are not attractive to banks, have become a critical player in the securitization of corporate loans. This brings us to our fourth hypothesis, namely that CLO deals with a larger holding share by insurance companies are characterized by a larger fraction of mezzanine tranches. To investigate this hypothesis, we estimate the following regression on CLO deals at issuance:

$$\frac{Tranche_{rdmt} \times 100}{Issue\ amount_{dmt}} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Issue\ amount_{dmt}} + \mu_m + \mu_t + \varepsilon \tag{6}$$

where the dependent variable is the par value of a tranche/tranches with rating r of CLO deal d issued in year t and managed by manager m, $Tranche_{rdmt}$, as a percentage of the total issue amount of CLO deal d in year t, $Issue\ amount_{dmt}$. $Insurers\ holdings_{dmt}$ is the par value of insurers' aggregate holdings of CLO deal d in the year of the issuance. We saturate the regression including manager fixed effects, μ_m, and year fixed effects,

μ_t, to account for any manager's characteristics and issuance year's macro conditions that may affect the securitization structure of the CLO deal.

The coefficient of interest in model 6 is β_1, which captures the correlation between the percentage of a CLO deal represented by tranches with a given rating and the percentage of the deal held by insurance companies. This regression is estimated on the full sample of CLO deals issued between 2003 and 2019. Standard errors are clustered by manager and issuance year (two-way clustering).

Table 9 reports the results of this exercise. We estimate the regression of equation 6, along with two extensions, for the subgroups of Aaa tranches (columns 1-3), mezzanine tranches rated investment grade (columns 4-6), tranches rated below investment grade (columns 6-9), and equity tranches (columns 10-12). The first specification suggests that the triple-A share of CLO tranches pertaining to a deal is inversely correlated to the percentage of the deal held by insurance companies. When we move to the subgroup of tranches Aa, A and Baa rated, the coefficient of insurers' holding share flips sign and is statistically significant (column 4). The correlation is, instead, negative for the subset of tranches below investment grade (column 7) and not significant for equity tranches (column 10). Consistently with our priors, this evidence suggests that CLO deals in which insurance companies invest more heavily are characterized by a larger fraction of mezzanine tranches rated investment grade. A one standard deviation increase in the share of a CLO deal held by insurance companies (14.18 percentage points in the subsample where this regression is estimated) is associated to an increase in the share of mezzanine tranches rated investment grade (Aa, A or Baa rated) by 4.17 percentage points.

This positive correlation cannot be interpreted as causal, though, as it might be confounded by reverse causality. While CLO managers may design the structure of a CLO deal in order to meet insurers' preference for mezzanine tranches Aa, A or Baa rated, insurance companies may select themselves into CLO deals characterized by a

larger fraction of mezzanine tranches rated investment grade. We attempt to shed some light on the direction of causation exploiting the regulatory reform on capital treatments of insurers' investments in CLOs enacted in 2010. Recall that this reform introduced a form a capital relief for certain CLOs purchased at discount or highly impaired and was applied both to existing and new investments. As we documented in the previous section, and consistent with our hypothesis 2, following the 2010 regulatory reform, insurance companies increased their investments in CLOs relative to bonds within NAIC buckets. As such, we would expect an increase in the relative size of mezzanine tranches in CLO deals issued after the implementation of the reform.

To investigate that hypothesis, we extend the baseline model including an interaction between insurance companies' holding share of the CLO deal and a dummy equal to one for the time period in which the reform was in place (2010-2018) and zero otherwise (columns 2, 5, 8 and 11). The coefficient of the interaction term is statistically significant only for the subgroup of mezzanine tranches. The positive coefficients suggests that the correlation between insurers' holding share and the percentage of mezzanine tranches rated investment grade is stronger for as long as the reform was in place. We next replicate this exercise by splitting the sample into three time periods: the pre-reform period (2003-2009), the reform period (2010-2018) and the post-reform period (2019). We report the interaction between insurers' holding share and the time dummies as simple slopes for each time period. The correlation between the percentage of tranches belonging to a given rating class and the percentage of the deal held by insurance companies is negative and statistically significant for the subgroup of triple-A tranches during the reform and the subgroup of tranches below investment grade in the time periods 2003-2009 and 2010-2019. By contrast, the correlation is positive and statistically significant for the mezzanine tranches both in the pre-reform and the reform periods, but the coefficient of the interaction term of the latter is more than twice that of the former.

The previous results point to a possible adjustment in the design of corporate loans' securitization to satisfy the increasing demand for mezzanine tranches by insurance companies in the wake of the capital requirements reform. While these results help ease concerns with reverse causality, they are still only suggestive of a causal link between insurance companies' CLO preference and the design of CLO deals. To further help establish this link, we designed a test based on the CLO deals that are refinanced.

At the end of the reinvestment period (which typically lasts between 2 and 5 years), CLO managers have the option to refinance the deal. They do so usually to take advantage of a reduction in market spreads on CLO debt or to extend the maturity of a CLO, or both, in order to benefit equity holders. This process can involve either individual tranches or the full set of tranches in the deal (also known "reset"). In the former case, some of the existing tranches are called and re-issued at current market spreads, whereas the rest of the CLO deal (including the other tranches, the reinvestment period and the maturity date) remains unchanged. In case of a reset, instead, all tranches belonging to the deal are called and re-issued at a lower spread and both the reinvestment period and the maturity date are extended. Refinancing has become a common phenomenon starting in 2015 due to a tightening in CLO spreads (Ellington, 2018). The share of refinanced deals increased from 2% in 2015 to 21% in 2017, but followed a downward path in 2018-2019 (Figure 19).[23] We identify refinanced deals in our sample as those satisfying the following two conditions: (i) tranches belonging to the CLO deal are issued in two or more different years, and (ii) the balance of at least one of the deal's original tranches falls to zero before the maximum of its maturity date and the last trustee report date. A CLO deal is typically refinanced once, but there are cases of deals with multiple refinancing up to a maximum of 3.

We then investigate if insurers' holding share is related to the likelihood that

[23] As mentioned earlier, information on CLOs in 2019 is partial as we have data on issuance only up to November 2019. So, it is possible that we underestimate the share of refinanced deals in 2019.

a deal is refinanced or not.[24] Given our evidence on insurance companies' preference for CLO securities vis-à-vis corporate bonds and on their increased role as investors in the CLO market we posit that CLO managers will find it easier to refinance CLOs heavily owned by insurance companies. To test this hypothesis, we consider all CLO deals during their lifetime and estimate the following regression:

$$dummy\ Refinancing_{dmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt-1} \times 100}{Outstanding\ volume_{dmt-1}} + \mu_m + \mu_t + \varepsilon \qquad (7)$$

where $dummy\ Refinancing_{dmt}$ is a dummy equal to one if CLO deal d managed by manager m is refinanced in year t and zero otherwise. $Insurers\ holdings_{dmt-1}$ is the amount held by insurance companies in deal d in year $t-1$ (hence lagged of one period), and $Outstanding\ volume_{dmt-1}$ is the total volume outstanding of tranches belonging to deal d at year-end $t-1$. Similar to the previous analysis, we include manager fixed effects and year fixed effects, to control for any manager and year-specific conditions that may affect the likelihood of a refinancing. Standard errors are clustered by manager and year (two-way clustering).

The first specification of Table 10 reports the estimates of this regression. Consistent with our priors, the coefficient of insurers' lagged holding share is positive and statistically significant. We estimate this regression using a linear model rather than a probit model because we need to include two sets of fixed effects to identify the correlation of interest in a clean way (manager and year fixed effects). Nonlinear models with fixed effects are known to suffer from the so called "incidental parameters problem" (Neyman and Scott, 1948; Lancaster, 2000), which makes the maximum likelihood estimator (MLE) inconsistent. Using a linear model to fit a regression where the outcome variable is binary, on the other hand, exposes to inconsistent estimates. As a robustness check, we re-estimate equation 7 using a probit model (column 2) including time dum-

[24] In principle, it would be preferable to investigate the likelihood that mezzanine tranches given insurance companies' preferences for these tranches. However, it is difficult to cleanly identify the refinancing of each tranche with the data available.

mies and manager dummies for the individual specific effect. Note that the sample on which this non-linear model is estimated shrinks compared to that of column 1, due to the fact that some observations pertaining to year and manager dummy variables that perfectly predict the outcome variable (also known as "perfect separation") need to be dropped to avoid infinitely large maximum likelihood estimates.[25] For ease of interpretation and comparison with the previous specification, we report the marginal effect of insurers' lagged holding share keeping all the other regressors constant at the sample means. As in the linear model, CLO deals with higher insurance companies' investments are more likely to be refinanced.

In the last specification, we extend the baseline model of column 1 exploring a possible heterogeneity in the correlation during the time period in which the regulatory reform of 2010 remained in place. We find that the extent of insurers' holding of a CLO deal is positively associated with the likelihood of a refinancing exactly during the time of the reform (2010-2018).

The results we reported in the previous section show a very clear preference of insurance companies for CLOs, in particular their mezzanine tranches, over corporate bonds. They also show that these preferences increased following the 2010 reform of the insurance companies' capital standards. While we do not have a test that cleanly shows a causal impact of insurance companies' preferences on the origination of CLOs, the evidence we presented in this section strongly suggests they did impact the relative size of mezzanine tranches in CLO deals. Mezzanine tranches play a critical role in the origination of CLOs not only because they account for about 25% of CLO deals but also because their junior position allows for the creation of the highly sought triple-A tranches. Therefore, insurance companies' growing preference for these tranches, particularly after 2010, together with their dominant role in the market for these tranches

[25] Also, we cluster standard errors only by year, as two-way clustering is not supported by the probit function and software used. This represents, though, a minor limitation, given that we include manager fixed effects and the data set is characterized by a much a higher serial correlation than cross correlation of residuals.

(they owned more that 44% of outstanding mezzanine tranches by 2019) likely played a key role in the rise of corporate loan securitization we have observed over the last decade.

7 Conclusions

Using data on asset holdings of insurance companies over 2003-2019, we document an increasing preference in CLO investments vis-à-vis corporate bond investments. That preference is particularly strong for mezzanine tranches rated investment grade (i.e., Aa, A and Baa rated). We show that this is consistent with a search for yield behavior. Conditional on the asset type and capital charges, insurance companies invest more in securities offering higher yields. That search for yield behavior is linked to insurers' increasing preference for CLOs over corporate bonds. Conditional on the credit rating of the security, insurance companies tend to purchase a higher fraction of CLO tranches compared to corporate bonds the larger is the difference in the yields carried by the two asset classes. Similarly, we find that the share of new securities in portfolio represented by CLO tranches grows for increasing levels of the yields differential.

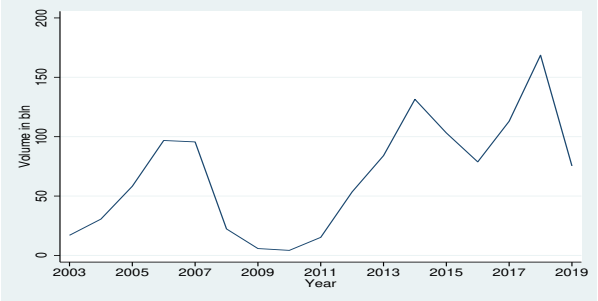
We explore the implications of the observed proclivity of insurance companies towards CLOs for the CLO market. We show that insurance companies have become an important class of investors in CLO securities, representing roughly half of the investor base in CLO mezzanine tranches rated investment grade. The demand for mezzanine tranches is critical for the issuance of CLOs as their junior position allows for the creation of senior tranches rated triple-A. In addition, we document that insurers' preference for CLO mezzanine tranches had an impact on the design and refinancing of CLO deals. In particular, we find that CLO deals with higher insurers' investments are characterized by a larger share of mezzanine tranches rated investment grade and are more likely to be refinanced. Overall, this suggests that insurance companies played an important role

in the expansion of corporate loans' securitization observed in the last decade.

Our findings provide three interrelated economic insights. First, they confirm that regulation is able to strongly affect firms' incentives to take on risk. While most of the literature has explored this link focusing on banks, our findings show that it is also present among insurance companies and highlight an important implication from the different design of capital regulation applied to banks and insurance companies. Second, our results show that insurance companies have been playing a complementary role to banks in the securitization of corporate loans and, by extension, in the growth of the shadow banking sector. Third, corporate loans' securitization together with the differences between banks' and insurers' capital regulation has contributed to the transfer a substantial portion of credit risk from the banking sector to the insurance sector.

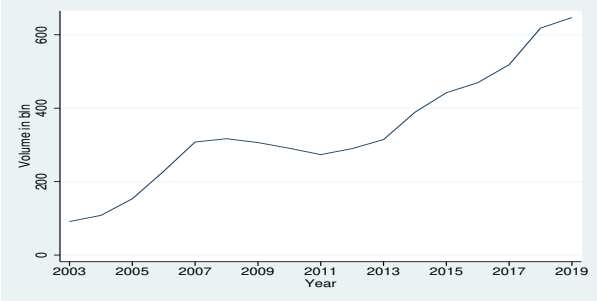
This brings us to some potentially important questions for future research. For example, is this allocation of credit risk throughout the financial system optimal? Is the current structure of financial intermediaries involved in the provision of bank credit better suited to guarantee funding to corporations over the business cycle than one based on banks alone?

Figure 1: U.S. CLOs New Issuance



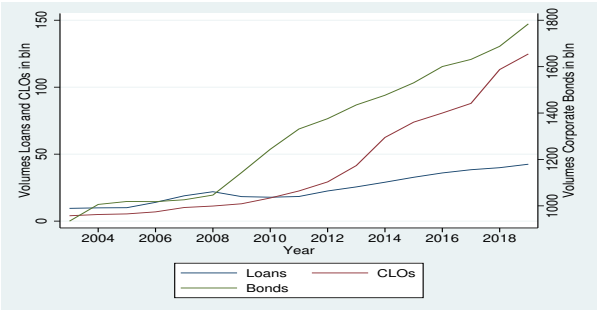
This figure plots the time series of the volume of total new issuance of CLO tranches denominated in USD, excluding refinanced tranches, over the time period 2003-2019 on a yearly basis. The data covers CLOs issuance up to November 8, 2019. Thus, the data point corresponding to 2019 represents the total volume of CLO tranches issued between January 1, 2019, and November 8, 2019. Source: Moody's Analytics Structured Finance Portal.

Figure 2: U.S. CLOs Outstanding



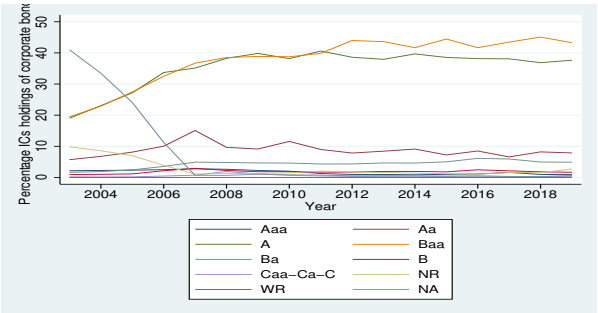
This figure plots the time series of the total outstanding volume of CLO tranches denominated in USD over the time period 2003-2019 on a yearly basis. The data covers CLOs outstanding up to November 8, 2019. Thus, the data point corresponding to 2019 represents the total volume of CLO tranches outstanding between January 1, 2019, and November 8, 2019. Source: Moody's Analytics Structured Finance Portal.

Figure 3: Insurance Companies' Investments Over Time



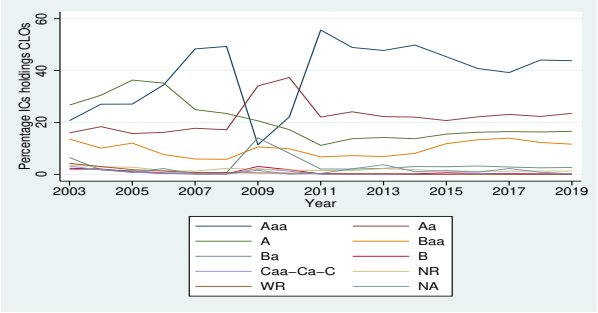
This figure plots the time series of insurance companies' holdings of bonds, corporate loans and CLOs as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial.

Figure 4: Insurance Companies' Investments in Corporate Bonds Over Time by Rating



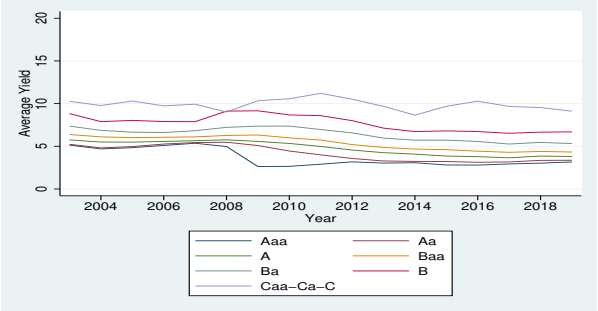
This figure plots the time series of the volume of corporate bond holdings by credit rating as percentage of the total volume of corporate bonds held by insurance companies as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of corporate bonds comes from Mergent Fixed Income Securities Database (FISD) and Moody's.

Figure 5: Insurance Companies' Investments in CLOs over Time by Rating



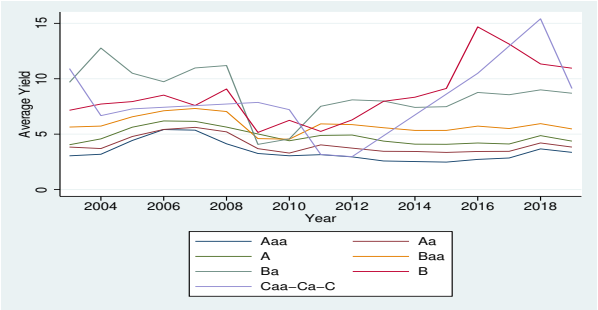
This figure plots the time series of the volume of CLO holdings by credit rating as percentage of the total volume of CLO tranches held by insurance companies as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of CLOs comes from Moody's Analytics Structured Finance Portal.

Figure 6: Yield on Insurance Companies' Investments in Corporate Bonds by Rating



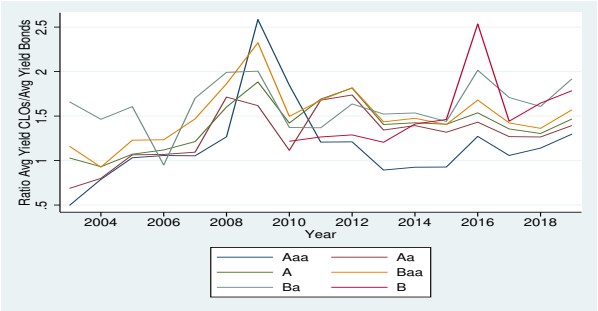
This figure plots the time series of the average yield of corporate bond holdings reported by insurance companies by credit rating as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of corporate bonds comes from Mergent Fixed Income Securities Database (FISD) and Moody's.

Figure 7: Yield on Insurance Companies' Investments in CLOs by Rating



This figure plots the time series of the average yield of CLO holdings reported by insurance companies by credit rating as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of CLOs comes from Moody's Analytics Structured Finance Portal.

Figure 8: Yield on Insurance Companies' Investments in CLOs to Yield of Insurance Companies' Investments in Corporate Bonds by Rating

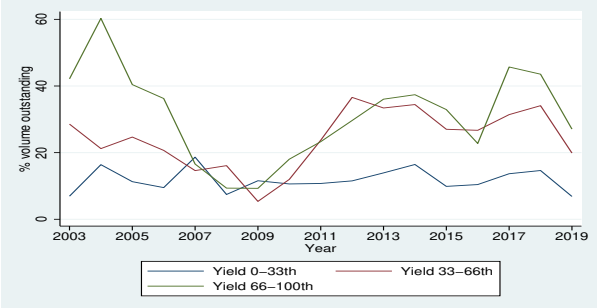


This figure plots the time series of the "yields ratio" of insurers' first-time investments in CLO tranches and corporate bonds, that is the ratio of the average yield on new investments in CLOs to the average yield of new investments in corporate bonds, by credit rating as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of corporate bonds comes from Mergent Fixed Income Securities Database (FISD) and Moody's, whereas information on the credit rating of CLOs comes from Moody's Analytics Structured Finance Portal.

Figure 9: Insurance Companies' Share of NAIC 1 Investments Reported According to the MFE Process

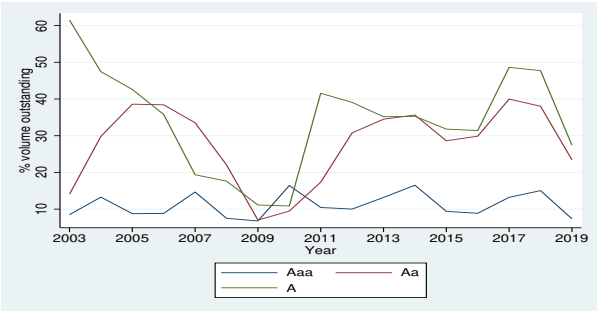
This figure plots the time series of (i) the percentage of CLO holdings in the NAIC 1 designation bucket reported according to the "modified filing exempt" approach, MFE, as identified from the "AM" suffix included in the NAIC designation (blu line), and (ii) the percentage of CLO holdings in the NAIC 1 designation bucket that have a credit rating different from Aaa, Aa or A (red line). Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of CLOs comes from Moody's Analytics Structured Finance Portal.

Figure 10: Share of CLOs Held by Insurance Companies by Percentiles of the Distribution of Yields



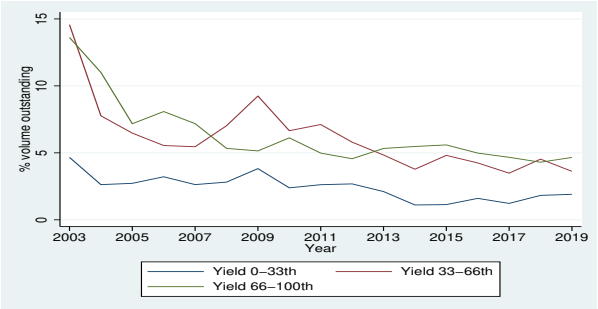
This figure plots the time series of insurers' new CLO holdings in the NAIC 1 designation bucket as percentage of the total volume outstanding of these CLO tranches based on percentiles of the distribution of CLOs yields reported by insurance companies as of December 31 of each year during the time period 2003-2019. New CLO holdings are identified as first-time investments in a given CLO tranche by an insurance company. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial.

Figure 11: Share of CLOs Held by Insurance Companies by Rating



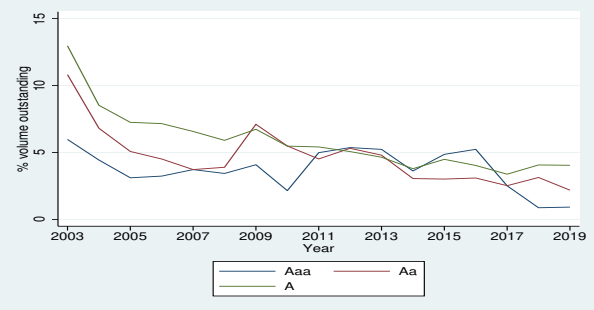
This figure plots the time series of insurers' new CLO holdings in the NAIC 1 designation bucket as percentage of the total volume outstanding of these CLO tranches by credit rating as of December 31 of each year during the time period 2003-2019. New CLO holdings are identified as first-time investments in a given CLO tranche by an insurance company. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of CLOs comes from Moody's Analytics Structured Finance Portal.

Figure 12: Share of Corporate Bonds Purchased by Insurance Companies by Percentiles of the Distribution of Yields



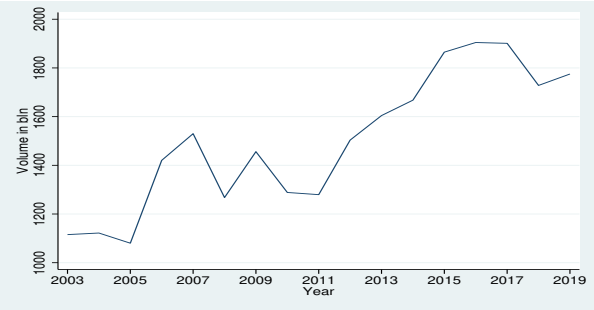
This figure plots the time series of insurers' new corporate bond holdings in the NAIC 1 designation bucket as percentage of the total volume outstanding of these corporate bonds based on percentiles of the distribution of corporate bonds yields reported by insurance companies as of December 31 of each year during the time period 2003-2019. New corporate bond holdings are identified as first-time investments in a given corporate bond by an insurance company. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial.

Figure 13: Share of Corporate Bonds Held by Insurance Companies by Rating



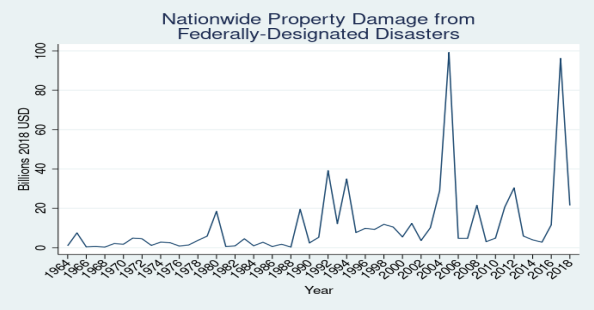
This figure plots the time series of insurers' new corporate bond holdings in the NAIC 1 designation bucket as percentage of the total volume outstanding of these corporate bonds by credit rating as of December 31 of each year during the time period 2003-2019. New corporate bond holdings are identified as first-time investments in a given corporate bond by an insurance company. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial. Information on the credit rating of corporate bonds comes from Mergent Fixed Income Securities Database (FISD) and Moody's.

Figure 14: U.S. Corporate Bonds New Issuance



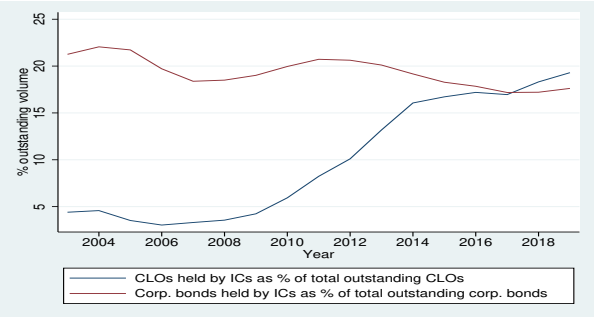
This figure plots the time series of the volume of total new issuance of corporate bonds denominated in USD over the time period 2003-2019 on a yearly basis. Source: Mergent Fixed Income Securities Database (FISD).

Figure 15: Weather and Climate Disaster Events



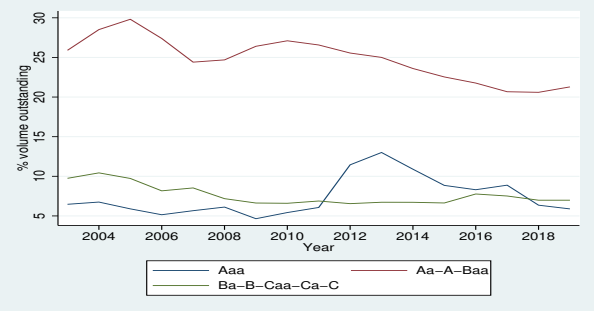
This figure plots the time series of nationwide property damage from federally-designed disasters from 1964 to 2018. Source: Spatial Hazards Events Database for the United States (Sheldus).

Figure 16: Insurance Companies' Market Shares of CLOs and Corporate Bonds



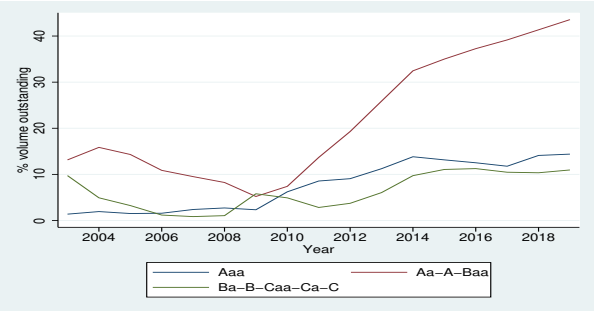
This figure plots the time series of (i) the aggregate volume of CLO holdings of insurance companies as percentage of the total volume outstanding of CLO tranches (blue line) and (ii) the aggregate volume of corporate bond holdings of insurance companies as percentage of the total volume outstanding of corporate bonds (red line) as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial; Moody's Analytics Structured Finance Portal; Mergent Fixed Income Securities Database (FISD).

Figure 17: Insurance Companies' Market Shares of Corporate Bonds



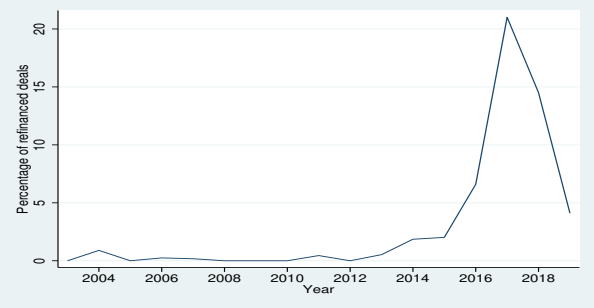
This figure plots the time series of the aggregate volume of corporate bond holdings of insurance companies as percentage of the total volume outstanding of corporate bonds by credit rating as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial; Mergent Fixed Income Securities Database (FISD); Moody's.

Figure 18: Insurance Companies' Market Shares of CLOs



This figure plots the time series of the aggregate volume of CLO holdings of insurance companies as percentage of the total volume outstanding of CLO tranches by credit rating as of December 31 of each year during the time period 2003-2019. Source: Schedule D-Part 1 of the annual financial statement filings of life, P&C and health insurance companies submitted to the NAIC and retrieved from SNL Financial; Moody's Analytics Structured Finance Portal.

Figure 19: Percentage of Refinanced CLOs



This figure plots the time series of the percentage of refinanced CLO deals on a yearly basis over the period 2003-2019. Source: Moody's Analytics Structured Finance Portal.

Table 1: Risk-Based Capital Requirements for Asset Risk

	RBC charge (%)			
NAIC Designation	Life (pre-tax)	Life (post-tax)	P&C and Health	Credit Rating
1	0.40%	0.30%	0.30%	Aaa, Aa, A
2	1.30%	0.96%	1.00%	Baa
3	4.60%	3.39%	2.00%	Ba
4	10.00%	7.38%	4.50%	B
5	23.00%	16.96%	10.00%	Caa
6	30.00%	19.50%	30.00%	Ca, C

This table reports the risk-based capital charges for asset risk applied to fixed income investments of Life, P&C and Health insurance companies. The regulation defines risk-based capital charges associated to fixed income securities held by Life insurers both on a pre-tax and post-tax basis, whereas no tax adjustment is required in the case of P&C and Health insurers. Source: NAIC.

Table 2: Modified Filing Exempt Approach

	NAIC Designation Breakpoints				
Life	1>2	2>3	3>4	4>5	5>6
NAIC 2	97.88	100.00	104.69	116.23	132.04
NAIC 3	93.49	95.52	100.00	111.02	126.12
NAIC 4	84.22	86.04	90.08	100.00	113.61
NAIC 5	74.13	75.73	79.29	88.02	100.00
P&C and Health	1>2	2>3	3>4	4>5	5>6
NAIC 2	99.14	100.00	101.81	106.20	123.13
NAIC 3	97.28	98.22	100.00	104.31	120.94
NAIC 4	93.36	94.16	95.87	100.00	115.94
NAIC 5	80.52	81.22	82.69	86.25	100.00

This table reports the NAIC designation breakpoints used in the "modified filing exempt", MFE, approach introduced by the 2010 regulatory reform to assign a NAIC designation to CLO tranches rated Baa to Caa. The MFE approach remained into effect from the reporting year 2010 to the reporting year 2018. Source: NAIC.

Table 3: Search for yield: Baseline regressions

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Insurance company's holding as percentage of total volume outstanding				
Yield	0.067***	0.069**	0.069**	0.069**	0.003
	(0.02)	(0.03)	(0.03)	(0.03)	(0.01)
dummy CLO					4.680***
					(0.86)
dummy CLO x Yield					1.114***
					(0.22)
Time-to-maturity	-0.003	-0.002	-0.002	0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Outstanding Amount	-0.299***	-0.330***	-0.330***	-0.307***	-0.296***
	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)
Size		0.256***	0.256***		
		(0.02)	(0.02)		
ROE		-0.325	-0.325		
		(0.21)	(0.21)		
Capital ratio		0.036	0.036		
		(0.13)	(0.13)		
CAL RBC ratio		0.002***			
		(0.00)			
ACL RBC ratio			0.001***		
			(0.00)		
constant	0.944***	-2.717***	-2.717***	0.906***	0.880***
	(0.10)	(0.32)	(0.32)	(0.09)	(0.05)
NAIC designation x Year FE	Yes	Yes	Yes	Yes	Yes
Security type (CLO or bond) FE	Yes	Yes	Yes	Yes	No
Security issuer FE	No	No	No	Yes	No
Type insurer FE	Yes	Yes	Yes	Yes	Yes
Insurer x Year FE	Yes	No	No	Yes	Yes
Two-way clustering	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year
N	1691393	1653931	1653931	1690436	1691393
R^2	0.2915	0.205	0.205	0.4224	0.2991
$Adj - R^2$	0.274	0.205	0.205	0.4041	0.2818
F-stat	25.318***	26.425***	26.425***	28.863***	32.32***
Degrees of freedom	(3, 16)	(7, 16)	(7, 16)	(3, 16)	(5, 16)

This table reports panel regression estimates of the linear regression model of equation 1 and its extensions analyzing insurers' search for yield in the CLO and corporate bond asset classes. The models are estimated on a granular dataset at the security-company-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds. The dependent variable is the amount held by an insurance company in a given security and in a certain year (when the insurer makes its first investment in the security) as a percentage of the volume outstanding of the security in that year. As for the independent variables, *Yield* is the yield (i.e., the effect rate or return) of the security reported by the insurer; *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero otherwise; *Time-to-maturity* is the time to maturity of the security in years reported by the insurer; *Outstanding Amount* is the volume outstanding of the security; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 4: Search for yield: Heterogeneity over time

	(1)	(2)	(3)	(4)
Dependent variable	Insurance company's holding as percentage of total volume outstanding			
Yield				-0.011
				(0.01)
Year=2003 x Yield	0.034***			
	(0.01)			
Year=2004 x Yield	0.014			
	(0.01)			
Year=2005 x Yield	-0.015			
	(0.01)			
Year=2006 x Yield	0.041**			
	(0.01)			
Year=2007 x Yield	0.064***			
	(0.01)			
Year=2008 x Yield	-0.019***			
	(0.00)			
Year=2009 x Yield	0.006			
	(0.01)			
Year=2010 x Yield	0.025***			
	(0.01)			
Year=2011 x Yield	0.057***			
	(0.02)			
Year=2012 x Yield	0.120***			
	(0.02)			
Year=2013 x Yield	0.182***			
	(0.02)			
Year=2014 x Yield	0.168***			
	(0.04)			
Year=2015 x Yield	0.114***			
	(0.03)			
Year=2016 x Yield	0.136***			
	(0.02)			
Year=2017 x Yield	0.148***			
	(0.04)			
Year=2018 x Yield	0.171***			
	(0.03)			
Year=2019 x Yield	0.007			
	(0.03)			
Year=2003-2006 x Yield		0.032*	0.02	
		(0.02)	(0.01)	
Year=2007-2008 x Yield		0.014	-0.001	
		(0.03)	(0.02)	
Year=2009-2015 x Yield		0.115***	0.086**	
		(0.04)	(0.03)	
Year=2016-2019 x Yield		0.363***	0.113***	
		(0.07)	(0.04)	
dummy CLO				6.641**
				(2.59)
dummy CLO x Yield				0.598**
				(0.26)
dummy Reform x Yield				0.024*
				(0.01)
dummy Reform x dummy CLO				-2.567
				(2.58)
dummy Reform x dummy CLO x Yield				0.708**
				(0.33)

Continued on next page

Table 4 - continued from previous page

Dependent variable	(1)	(2)	(3)	(4)
	Insurance company's holding as percentage of total volume outstanding			
Time-to-maturity	-0.005	-0.011*	-0.004	0.000
	(0.00)	(0.01)	(0.00)	(0.00)
Outstanding Amount	-0.302***	-0.571***	-0.300***	-0.296***
	(0.05)	(0.06)	(0.05)	(0.05)
constant	0.928***	0.890***	0.942***	0.885***
	(0.06)	(0.09)	(0.07)	(0.05)
NAIC designation x Year FE	Yes	Yes	Yes	Yes
Security type (CLO or bond) FE	Yes	No	Yes	No
Security issuer FE	No	No	No	No
Type insurer FE	Yes	Yes	Yes	Yes
Insurer x Year FE	Yes	Yes	Yes	Yes
Two-way clustering	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year
N	1691393	1691393	1691393	1691393
R^2	0.2919	0.1919	0.2916	0.2998
$Adj - R^2$	0.2744	0.1719	0.2741	0.2825
F-stat	-	14.456***	11.556***	25.199***
Degrees of freedom	(19, 16)	(6, 16)	(6, 16)	(8, 16)

This table reports panel regression estimates of a series of extensions to the linear regression model of equation 1 analyzing the heterogeneity over time of insurers' search for yield in the CLO and corporate bond asset classes. The models are estimated on a granular dataset at the security-company-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds. The dependent variable is the amount held by an insurance company in a given security and in a certain year (when the insurer makes its first investment in the security) as a percentage of the volume outstanding of the security in that year. As for the independent variables, *Yield* is the yield (i.e., the effect rate or return) of the security reported by the insurer; *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero otherwise; *dummy Reform* is a dummy equal to one if the year falls into the time period 2010-2018, when the 2010 regulatory reform was into effect, and zero otherwise; *Time-to-maturity* is the time to maturity of the security in years reported by the insurer; *Outstanding Amount* is the volume outstanding of the security; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 5: Search for yield: Heterogeneity across insurance companies

	(1)	(2)	(3)	(4)	(5)	(6)
Sample		All insurers		P&C insurers	Years 2003-2006 P&C insurers with 2005 Δ*Net Income* below the median	P&C insurers with 2017 Δ*Net Income* below the median
Dependent variable	Insurance company's holding as percentage of total volume outstanding					
Yield	0.127**	0.073**	0.073**	0.033**	0.001	0.022
	(0.04)	(0.03)	(0.03)	(0.01)	(0.01)	(0.02)
Capital ratio x Yield	-0.173**					
	(0.06)					
CAL RBC ratio x Yield		-0.001**				
		(0.00)				
ACL RBC ratio x Yield			-0.000**			
			(0.00)			
Year=2005 x Yield				-0.033**	-0.013	
				(0.01)	(0.01)	
Year=2017 x Yield				-0.025*		0.065**
				(0.01)		(0.03)
$Year > 2005$ x Yield					0.004	
					(0.01)	
$Year > 2017$ x Yield						-0.011
						(0.63)
Below Median ΔNet Income				0.038		
				(0.04)		
Below Median ΔNet Income x Yield				-0.005		
				(0.01)		
Below Median ΔNet Income x Year=2005				-0.074		
				(0.08)		
Below Median ΔNet Income x Year=2017				-0.367***		
				(0.07)		
Below Median ΔNet Income x Year=2005 x Yield				0.035*		
				(0.02)		
Below Median ΔNet Income x Year=2017 x Yield				0.101***		
				(0.02)		
Time-to-maturity	-0.002	-0.002	-0.002	-0.001	0.000	0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Outstanding Amount	-0.330***	-0.330***	-0.330***	-0.213***	-0.479***	-0.224***
	(0.05)	(0.05)	(0.05)	(0.03)	(0.06)	(0.03)
Size	0.257***	0.256***	0.256***	0.157***	0.229***	0.168***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
ROE	-0.311	-0.324	-0.324	-0.059	0.004	-0.133
	(0.21)	(0.21)	(0.21)	(0.10)	(0.14)	(0.28)
Capital ratio	0.757***	0.041	0.041	0.053	0.188	-0.238
	(0.25)	(0.13)	(0.13)	(0.13)	(0.29)	(0.20)
CAL RBC ratio	0.001**	0.004***		0.000	0.000	0.001
	(0.00)	(0.00)		(0.00)	(0.00)	(0.00)
ACL RBC ratio			0.002***			
			(0.00)			
constant	-2.989***	-2.730***	-2.730***	-1.544***	-2.120***	-1.550***
	(0.34)	(0.32)	(0.32)	(0.25)	(0.43)	(0.34)
NAIC designation x Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Security type (CLO or bond) FE	Yes	Yes	Yes	Yes	Yes	Yes
Security issuer FE	No	No	No	No	No	No
Type insurer FE	Yes	Yes	Yes	No	No	No
Insurer x Year FE	No	No	No	No	No	No
Two-way clustering	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year
N	1653931	1653931	1653931	620644	43891	321247
R^2	0.2053	0.205	0.205	0.1301	0.0851	0.1444
$Adj - R^2$	0.2053	0.205	0.205	0.13	0.0844	0.1441
F-stat	25.362***	26.342***	26.342***	-	-	19.889***
Degrees of freedom	(8, 16)	(8, 16)	(8, 16)	(15, 15)	(9, 3)	(9, 16)

This table reports panel regression estimates of a series of extensions to the linear regression model of equation 1 analyzing the heterogeneity across companies of insurers' search for yield in the CLO and corporate bond asset classes. The models are estimated on a granular dataset at the security-company-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds. Model 4 is estimated on the subsample of P&C insurers; model 5 and model 6 are estimated on the subsamples of P&C insurers whose yearly change in net income is below the median in 2005 and 2017, respectively. The dependent variable is the amount held by an insurance company in a given security and in a certain year (when the insurer makes its first investment in the security) as a percentage of the volume outstanding of the security in that year. As for the independent variables, *Yield* is the yield (i.e., the effect rate or return) of the security reported by the insurer; *Below Median* Δ*Net Income* is a dummy variable equal to one if the change in net income of a P&C insurer is below the median; *Time-to-maturity* is the time to maturity of the security in years reported by the insurer; *Outstanding Amount* is the volume outstanding of the security; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 6: Insurance Companies' Preference for CLOs vis-à-vis Corporate Bonds

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Sample	Assets with Aaa, Aa, A and Baa rating										
Dependent variable	Yield (%)		Insurance company's new holding as percentage of total volume outstanding								
dummy CLO	0.704***		10.530***		14.331***	10.422***	10.422***	-0.684	6.584	-1.708	-1.708
	(0.11)		(0.81)		(1.02)	(0.82)	(0.82)	(3.73)	(5.11)	(3.81)	(3.81)
Yield CLO/Yield Bond ratio								0.563	-0.926*	-0.472	-0.472
								(0.39)	(0.46)	(0.28)	(0.28)
dummy CLO x Yield CLO/Yield Bond ratio								7.909**	5.27	8.360**	8.360**
								(2.87)	(3.91)	(2.99)	(2.99)
Capital ratio x dummy CLO					-20.711***				-16.48		
					(2.07)				(10.80)		
CAL RBC ratio x dummy CLO						-0.053***				0.053	
						(0.01)				(0.05)	
ACL RBC ratio x dummy CLO							-0.027***				0.026
							(0.00)				(0.03)
Capital ratio x Yield CLO/Yield Bond ratio									1.519**		
									(0.64)		
CAL RBC ratio x Yield CLO/Yield Bond ratio										0.003**	
										(0.00)	
ACL RBC ratio x Yield CLO/Yield Bond ratio											0.002**
											(0.00)
Capital ratio x dummy CLO x Yield CLO/Yield Bond ratio									-3.52		
									(8.31)		
CAL RBC ratio x dummy CLO x Yield CLO/Yield Bond ratio										-0.090*	
										(0.05)	
ACL RBC ratio x dummy CLO x Yield CLO/Yield Bond ratio											-0.045*
											(0.02)
Rating=Aaa		-0.677***		0.369**							
		(0.21)		(0.13)							
Rating=Aa		-0.214***		0.141**							
		(0.03)		(0.05)							
Rating=Baa		0.532***		-0.132***							
		(0.04)		(0.02)							
Rating=Aaa x dummy CLO		0.238		4.780***							
		(0.27)		(0.66)							
Rating=Aa x dummy CLO		0.473***		10.654***							
		(0.11)		(1.04)							
Rating=A x dummy CLO		0.927***		12.136***							
		(0.11)		(0.96)							
Rating=Baa x dummy CLO		1.556***		12.708***							
		(0.14)		(1.33)							
Time-to-maturity (years)	0.061***	0.062***	-0.001	-0.001	0.006**	0.000	0.000	-0.002	0.003	-0.003	-0.003
	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Outstanding Amount ($bln)	0.071***	0.062***	-0.257***	-0.268***	-0.298***	-0.284***	-0.284***	-0.250***	-0.325***	-0.308***	-0.308***
	(0.01)	(0.01)	(0.05)	(0.04)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.06)	(0.06)

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Table 6 - continued from previous page

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Sample	Assets with Aaa, Aa, A and Baa rating										
Dependent variable	Yield (%)		Insurance company's new holding as percentage of total volume outstanding								
Size					0.269***	0.268***	0.268***		0.257***	0.257***	0.257***
					(0.02)	(0.02)	(0.02)		(0.02)	(0.02)	(0.02)
ROE					-0.308	-0.287	-0.287		-0.269	-0.243	-0.243
					(0.19)	(0.19)	(0.19)		(0.19)	(0.20)	(0.20)
Capital ratio					0.577***	0.084	0.084		-1.734*	-0.004	-0.004
					(0.17)	(0.13)	(0.13)		(0.88)	(0.12)	(0.12)
CAL RBC ratio					0.002***	0.003***			0.001**	-0.002	
					(0.00)	(0.00)			(0.00)	(0.00)	
ACL RBC ratio							0.001***				-0.001
							(0.00)				(0.00)
constant	3.159***	2.986***	0.847***	0.943***	-3.115***	-2.924***	-2.924***	0.068	-1.477**	-1.942***	-1.942***
	(0.07)	(0.08)	(0.04)	(0.05)	(0.35)	(0.34)	(0.34)	(0.57)	(0.59)	(0.40)	(0.40)
Rating	-	-	-	-	-	-	-	Yes	Yes	Yes	Yes
Rating x Year FE	Yes	No	Yes	No	Yes	Yes	Yes	No	No	No	No
Type insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer x Year FE	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	No
Two-way clustering	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year
N	1275763	1275763	1276043	1276043	1245616	1245616	1245616	1276043	1245616	1245616	1245616
R^2	0.6849	0.6821	0.3131	0.3197	0.2554	0.2250	0.2250	0.3100	0.2491	0.2165	0.2165
$Adj - R^2$	0.6748	0.6719	0.291	0.2979	0.2554	0.2249	0.2249	0.2878	0.2491	0.2165	0.2165
F-stat	70.687***	38.091***	58.055***	26.209***	39.543***	35.369***	35.369***	31.976***	30.208***	27.247***	27.247***
Degrees of freedom	(3, 16)	(9, 16)	(3, 16)	(9, 16)	(8, 16)	(8, 16)	(8, 16)	(5, 16)	(12, 16)	(12, 16)	(12, 16)

This table reports panel regression estimates of (i) the linear regression model of equation 2 and its extensions (columns 1-2) and (ii) the linear regression model of equation 3 and its extensions (columns 3-11) analyzing insurers' preference for CLOs over corporate bonds. The models are estimated on a granular dataset at the security-company-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds rated Aaa, Aa, A or Baa. The dependent variable of columns 1-2 is the yield (i.e., the effect rate or return) of the security reported by the insurer; the dependent variable of columns 3-11 is the amount held by an insurance company in a given security and in a certain year (when the insurer makes its first investment in the security) as a percentage of the volume outstanding of the security in that year. As for the independent variables, *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero otherwise; *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' new investments in CLOs to the average yield of insurers' new investments in corporate bonds for each rating-year pair; *Time-to-maturity* is the time to maturity of the security in years reported by the insurer; *Outstanding Amount* is the volume outstanding of the security; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included,"Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 7: Insurance Companies' Preference for CLOs vis-à-vis Corporate Bonds

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Sample	Holdings with Aaa, Aa, A and Baa rating								
Dependent variable	Insurance company's new holding of asset classes by rating as percentage of total volume outstanding								
dummy CLO	0.291**	0.297***	0.313***			-0.025	-3.593*	-3.148	-4.660*
	(0.10)	(0.10)	(0.10)			(0.16)	(1.85)	(2.05)	(2.32)
Year=2007-2008				-0.441***					
				(0.09)					
Year=2009-2015				-0.534***					
				(0.11)					
Year=2016-2019				-0.943***					
				(0.12)					
Year=2003-2006 x dummy CLO				-0.400***	-0.395***				
				(0.08)	(0.08)				
Year=2007-2008 x dummy CLO				0.082**	0.094***				
				(0.03)	(0.03)				
Year=2009-2015 x dummy CLO				0.309***	0.327***				
				(0.09)	(0.10)				
Year=2016-2019 x dummy CLO				0.969***	0.994***				
				(0.09)	(0.09)				
dummy Reform x dummy CLO						0.581***			
						(0.10)			
Yield CLO/Yield Bond ratio							-0.392	-0.181	0.000
							(0.38)	(0.41)	(0.00)
dummy CLO x Yield CLO/Yield Bond ratio							6.776***	6.770***	7.959***
							(1.62)	(1.71)	(1.93)
Time-to-maturity (years)	0.106***	0.106***	0.107***	0.103***	0.103***	0.105***	-0.013*	-0.006	-0.008
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.00)
Outstanding Amount ($bln)	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	0.000***	(0.00)	(0.00)	(0.00)
Size	0.114***	0.205***	0.201***	0.182***	0.199***	0.200***	0.168**	0.653***	0.631***
	(0.03)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)	(0.06)	(0.06)	(0.06)
ROE	0.026	-0.024	-0.024	-0.023	-0.024	-0.024	0.04	-0.158*	-0.151*
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.08)	(0.08)	(0.08)
Capitalization	-0.128	0.124*	0.124*	0.074	0.124*	0.124*	-0.542***	0.650***	0.620***
	(0.08)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	-0.18	-0.14	-0.14
CAL RBC ratio	0.001***	0.001***	0.001***	0.001***	0.001***	0.001***	0.000	0.001***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
constant	-1.440***	-2.648***	-2.621***	-1.841***	-2.600***	-2.611***	-0.311	-7.252***	-7.238***
	(0.43)	(0.32)	(0.32)	(0.30)	(0.31)	(0.32)	(0.72)	(1.04)	(0.78)
Rating x Year FE	No	No	Yes	No	Yes	Yes	No	No	Yes
Rating FE	Yes	Yes	-	Yes	-	-	Yes	Yes	-
Type insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Insurer FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	-	No	-	-	No	Yes	-
Two-way clustering	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year	Insurer, Year
N	335276	335276	335276	335276	335276	335276	114655	114655	114655
R^2	0.3610	0.3623	0.3661	0.3708	0.3753	0.3698	0.5865	0.5971	0.6053
$Adj - R^2$	0.3527	0.3540	0.3577	0.3626	0.3671	0.3615	0.5709	0.5818	0.5902
F-stat	82.975***	90.583***	90.135***	3395.678***	-	82.103***	43.692***	57.241***	58.741***
Degrees of freedom	(7, 16)	(7, 16)	(7, 16)	(13, 16)	(10, 16)	(8, 16)	(9, 16)	(9, 16)	(8, 16)

This table reports panel regression estimates of the linear regression model of equation 4 and its extensions analyzing insurers' preference for CLOs over corporate bonds. The models are estimated on a dataset at the insurer-asset class-rating-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds rated Aaa, Aa, A or Baa. The dependent variable is the amount of first-time investments of an insurance company in one asset class (CLO or corporate bond) with a given rating in a certain year as percentage of the total volume outstanding of the asset class with that rating in that year. As for the independent variables, *dummy CLO* is a dummy variable equal to one if the asset class consists in CLO tranches and zero otherwise; *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' new investments in CLOs to the average yield of insurers' new investments in corporate bonds for each rating-year pair; *Time-to-maturity* is the average time-to-maturity of all new investments of the insurer in the asset class for each rating-year pair; *Outstanding Amount* is the total volume outstanding of the asset class for each rating-year pair; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Insurance Companies' Preference for CLOs vis-à-vis Corporate Bonds

	(1)	(2)	(3)	(4)
Sample	Holdings with Aaa, Aa, A and Baa rating			
	All insurers		Insurers investing in CLOs in the whole sample	
Dependent variable	Insurance company's new holding of CLOs by rating as percentage of total new holdings of CLOs and corporate bonds			
Yield CLO/Yield Bond ratio	10.613**	10.145**	15.290**	14.371*
	(3.99)	(3.78)	(7.00)	(6.85)
Outstanding CLO/Outstanding Bond ratio	27.106***	25.574***	34.891***	33.743***
	(4.70)	(4.48)	(5.25)	(5.19)
Size	0.525*		2.242	
	(0.28)		(1.65)	
ROE	1.366***		0.641	
	(0.43)		(1.34)	
Capital ratio	-2.388**		-2.191	
	(1.09)		(9.12)	
CAL RBC ratio	0.011**		0.035	
	(0.00)		(0.03)	
constant	-19.970**	-13.368**	-50.293	-12.922
	(7.90)	(5.66)	(29.13)	(9.78)
Rating FE	Yes	Yes	Yes	Yes
Type insurer FE	Yes	Yes	Yes	Yes
Insurer x Year FE	No	Yes	No	Yes
Insurer FE	Yes	-	Yes	-
Year FE	Yes	-	Yes	-
N	113610	110660	7980	7936
R^2	0.3833	0.6107	0.4857	0.6473
$Adj - R^2$	0.3598	0.4163	0.4743	0.5099
F-stat	9.923	18.183	10.755	22.61
Degrees of freedom	(6, 16)	(2, 16)	(6, 16)	(2, 16)

This table reports panel regression estimates of the linear regression model of equation 5 and its extensions analyzing insurers' preference for CLOs over corporate bonds. The models are estimated on a dataset at the insurer-asset class-rating-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds rated Aaa, Aa, A or Baa. Models 3-4 are estimated on the subsample of insurance companies that invest in CLO tranches both in the time period 2003-2008 and in the post-crisis decade (2009-2019). The dependent variable is the amount of first-time investments of an insurance company in CLO tranches with a given rating in a certain year as percentage of the total volume of new investments in CLOs and corporate bonds with that rating in that year. As for the independent variables, *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' new investments in CLOs to the average yield of insurers' new investments in corporate bonds for each rating-year pair; *Outstanding CLO/Outstanding Bond ratio* is the ratio of the total outstanding amount of CLO tranches to the total outstanding amount of corporate bonds for each rating-year pair; *Size* is the natural logarithm of total admitted assets of the insurer; *ROE* is the ratio of net income to total adjusted capital of the insurer; *Capital ratio* is the ratio of total adjusted capital to total admitted assets of the insurer; *CAL RBC ratio* is the CAL risk-based capital ratio of the insurer; *ACL RBC ratio* is the ACL risk-based capital ratio of the insurer. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the insurer and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 9: Structure of CLO deals

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Sample		Aaa			Aa-A-Baa			Ba-B-Caa-Ca-C			NR	
Dependent variable						Tranches as % of CLO						
% CLO held by ICs	-0.215*	-0.019		0.294*	0.045		-0.023**	-0.017		-0.052	0.011	
	(0.12)	(0.04)		(0.14)	(0.05)		(0.01)	(0.01)		(0.04)	(0.06)	
Year=2003-2009 x % CLO held by ICs			-0.057			0.132*			-0.040*			-0.045
			(0.10)			(0.07)			(0.02)			(0.08)
Year=2010-2018 x % CLO held by ICs			-0.235*			0.319*			-0.023**			-0.058
			(0.12)			(0.15)			(0.01)			(0.05)
Year=2019 x % CLO held by ICs			0.01			-0.019			-0.001			0.052
			(0.03)			(0.02)			(0.01)			(0.04)
dummy Reform x % CLO held by ICs		-0.216			0.274*			-0.006			-0.069	
		(0.13)			(0.15)			(0.01)			(0.07)	
constant	65.063***	64.868***	64.866***	18.096***	18.343***	18.347***	4.521***	4.515***	4.514***	11.793***	11.730***	11.728***
	(1.63)	(1.45)	(1.45)	(2.07)	(1.86)	(1.86)	(0.13)	(0.12)	(0.12)	(0.54)	(0.50)	(0.50)
Manager FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Issuance Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Two-way clustering	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year	Manager, Year
N	2167	2167	2167	2167	2167	2167	2167	2167	2167	2167	2167	2167
R^2	0.359	0.363	0.363	0.320	0.328	0.329	0.383	0.383	0.384	0.251	0.252	0.252
$Adj - R^2$	0.303	0.307	0.307	0.261	0.269	0.270	0.329	0.329	0.329	0.186	0.186	0.186
F-stat	3.472*	1.982	1.319	4.109*	2.354	3.024*	5.206**	3.408*	2.63*	1.495	0.844	1.459
Degrees of freedom	(1, 16)	(2, 16)	(3, 16)	(1, 16)	(2, 16)	(3, 16)	(1, 16)	(2, 16)	(3, 16)	(1, 16)	(2, 16)	(3, 16)

This table reports regression estimates of the linear regression model of equation 6 and its extensions analyzing the design CLO deals in relation to the share of the CLO deal held by insurance companies. The models are estimated on a dataset at the CLO deal-manager-issuance year level covering information on CLO deals issued over the time period 2003-2019. The dependent variable is the percentage of a CLO deal represented by tranches rated (i) triple-A (columns 1-3), (ii) Aa, A and Baa (columns 4-6), (iii) Ba, B, Caa, Ca, C (columns 7-9), or (iv) not rated (columns 10-12) in the year of the issuance. As for the independent variables, *% CLO held by ICs* is the percentage of the CLO deal held by insurance companies in the year of issuance of the CLO deal; *dummy Reform* is a dummy equal to one if the year falls into the time period 2010-2018, when the 2010 regulatory reform was into effect, and zero otherwise. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for multiclustering at the CLO manager and year level. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Table 10: Likelihood of CLO Refinancing

Model Dependent variable	(1) Linear dummy Refinancing	(2) Probit dummy Refinancing	(3) Linear dummy Refinancing
% of CLO held by ICs_{t-1}	0.003**	0.002***	0.000
	(0.00)	(0.00)	(0.00)
dummy Reform x % of CLO held by ICs_{t-1}			0.004***
			(0.00)
constant	0.047***	-2.153***	0.048***
	(0.01)	(0.23)	(0.01)
Manager FE	Yes	Yes	Yes
Issuance Year FE	Yes	Yes	Yes
Two-way clustering	Manager, Year	Year	Manager, Year
N	11499	8047	11499
R^2 (Pseudo R^2 for probit)	0.164	0.207	0.168
$Adj - R^2$	0.148		0.152

This table reports panel regression estimates of the regression model of equation 7 and its extensions analyzing the likelihood of refinancing of CLO deals in relation to the share of the CLO deal held by insurance companies. The models are estimated on a dataset at the CLO deal-manager-year level covering information on CLO deals outstanding during the time period 2003-2019. The dependent variable is a dummy equal to one if a CLO deal is refinanced in a given year and zero otherwise. As for the independent variables, *% CLO held by* ICs_{t-1} is the percentage of the CLO deal held by insurance companies lagged of one year; *dummy Reform* is a dummy equal to one if the year falls into the time period 2010-2018, when the 2010 regulatory reform was into effect, and zero otherwise. Model 1 and models 3-6 report the estimates of a linear regression. Model 2 reports the estimates of a probit model. The coefficient of *% CLO held by* ICs_{t-1} in model 2 represents the marginal effect of insurers' lagged holding share keeping all other regressors constant at the sample means. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors of model 1 and models 3-6 are corrected for multiclustering at the CLO manager and year level. Standard errors of model 2 are clustered by year. Fixed effects are included, "Yes", not included, "No", or subsumed by other fixed effects, "-". ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

References

Acharya, V. and Steffen, S. (2015). The "greatest" carry trade ever? Understanding eurozone bank risks. *Journal of Financial Economics*, 115(2):215–236.

Altunbas, Y., Gambacorta, L., and Marques-Ibanez, D. (2014). Does monetary policy affect bank risk? *International Journal of Monetary Policy*.

Becker, B. and Ivashina, V. (2015). Reaching for yield in the bond market. *Journal of Finance*, 70(5):1863–1901.

Becker, B., Opp, M., and Saidi, F. (2021). Regulatory forbearance in the U.S. insurance industry: The effects of eliminating capital requirements. *Review of Financial Studies, forthcoming*.

Benmelech, E., Dlugosz, J., and Ivashina, V. (2012). Did securitization affect the cost of corporate debt? *Journal of Financial Economics*, 106:91–113.

BoE (2019). Financial stability report. Issue No. 46, December 2019.

Bord, V. and Santos, J. (2012). The rise of the originate-to-distribute model and the role of banks in financial intermediation. *Federal Reserve Bank of New York Economic Policy Review*, pages 21–34.

Bord, V. and Santos, J. (2015). Does securitization of corporate loans lead to riskier lending? *Journal of Money, Credit and Banking*, 47 (2-3):415–444.

Boyer, P. and Kempf, H. (2020). Regulatory arbitrage and the efficiency of banking regulation. *Journal of Financial Intermediation*, 41:1–17.

Boyson, N., Fahlenbrach, R., and Stulz, R. (2016). Why don't all banks practice regulatory arbitrage? Evidence from usage of trust-preferred securities. *Review of Financial Studies*, 29(7):1821–1859.

Buchak, G., Matvos, G., Piskorski, T., and Seru, A. (2020). Fintech, regulatory arbitrage, and the rise of shadow banks. *Journal of Financial Economics*, 130:453–483.

Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2011). Robust inference with multiway clustering. *Review of Business and Economic Statistics*, 29.

Cameron, A. C. and Miller, D. L. (2015). A practitioner's guide to cluster-robust inference. *Journal of Human Resources*, 50.

Dell'Ariccia, G., Laeven, L., and Suarez, G. (2017). Bank leverage and monetary policy's risk-taking channel: Evidence from the united states. *Journal of Finance*, 72(2):613–654.

DeMarco, L., Liu, E., and Schmidt-Eisenlohr, T. (2020). Who owns U.S. CLO securities? An update by tranche. FEDS Notes. Washington: Board of Governors of the Federal Reserve System, June 25, 2020. Available at `https://doi.org/10.17016/2380-7172.2592`.

Demyanyk, Y. and Loutskina, E. (2016). Mortgage companies and regulatory arbitrage. *Journal of Financial Economics*, 122(2):328–351.

Ellington (2018). Understanding CLOs: Exploring the impacts of various dynamics on market spreads. Available at `https://ellingtonincomefund.com/wp-content/uploads/2019/10/EIOF-Alternative-Credit-Insights-October-2018.pdf`.

Foley-Fisher, N., Heinrich, N., and Verani, S. (2020). Capturing the illiquidity premium. *Working Paper, SSRN*.

FSB (2019). Vulnerabilities associated with leveraged loans and collateralised loan obligations. December 2019.

Griffin, J. M. and Nickerson, J. (2021). Are CLO collateral and tranche ratings disconnected? *Working Paper, SSRN*.

IMF (2020). Global financial stability report: Markets in the time of covid-19. April 2020.

Ioannidou, V., Ongena, S., and Peydro, J. (2015). Monetary policy, risk-taking and pricing: Evidence from a quasi-natural experiment. *Review of Finance*, 19:95–144.

Ivashina, V. and Scharfstein, D. (2010). Loan syndication and credit cycles. *American Economic Review Papers and Proceedings*, 100(2):57–61.

Ivashina, V. and Vallée, B. (2020). Weak credit covenants. *Working Paper, SSRN*.

Jensen, M. C. and Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4):305–360.

Jimenez, G., Saurina, J., Ongena, S., and Peydro, J. (2014). Hazardous times for monetary policy: What do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? *Econometrica*, 82:463–505.

Karolyi, A. and Taboada, A. (2015). Regulatory arbitrage and cross-border bank acquisitions. *Journal of Finance*, 70(6):2395–2450.

Koijen, R. S. J. and Yogo, M. (2015). The cost of financial frictions for life insurers. *American Economic Review*, 105.

Kroszner, R. and Strahan, P. (2011). Financial regulatory reform: Challenges ahead. *American Economic Review: Papers & Proceedings*, 101(3):242–246.

Lancaster, T. (2000). The incidental parameters problem since 1948. *Journal of Econometrics*, 95.

Liu, E. and Schmidt-Eisenlohr, T. (2019). Who owns U.S. CLO securities? FEDS Notes. Washington: Board of Governors of the Federal Reserve System, July 19, 2019. Available at `https://doi.org/10.17016/2380-7172.2423`.

Liu, W. S. (2019). Regulatory capital, business growth, and investment risk: Evidence from life insurance companies. *Working Paper, SSRN*.

Nadauld, T. and Weisbach, M. (2012). Did securitization affect the cost of corporate debt? *Journal of Financial Economics*, 105:332–352.

NAIC (2017). Purposes and procedures manuel of the NAIC investment analysis office. December 31, 2017.

NAIC (2018a). Investment RBC charges. Available at `https://www.naic.org/documents/committees_e_capad_investment_rbc_wg_related_irbc_factors.pdf`.

NAIC (2018b). U.S. insurance industry's exposure to collateralized loan obligations as of year-end 2018.

NAIC (2019). Purposes and procedures manuel of the NAIC investment analysis office. December 31, 2019.

NAIC (2020). Risk-based capital. Available at `https://content.naic.org/cipr_topics/topic_riskbased_capital.htm`.

NAIC (2021). Structured securities project. Available at `https://content.naic.org/cipr_topics/topic_structured_securities_project.htm`.

Neyman, J. and Scott, E. L. (1948). Consistent estimates based on partially consistent observations. *Econometrica*, 16.

Paligorova, T. and Santos, J. (2017). Monetary policy and bank risk-taking: Evidence from the corporate loan market. *Journal of Financial Intermediation*, 30:35–49.

Paligorova, T. and Santos, J. (2019). The side effects of shadow banking on liquidity provision. *Working Paper, SSRN*.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *Review of Financial Studies*, 22.

Peydro, J. and Maddaloni, A. (2011). Bank risk-taking, securitization, supervision, and low interest rates: Evidence from the euro area and U.S. lending standards. *Review of Financial Studies*, 24:2121–2165.

Repullo, R. (2000). Who should act as lender of last resort? An incomplete contracts model. *Journal of Money, Credit, and Banking*, 32.

Rochet, J.-C. (1992). Capital requirements and the behavior of commercial banks. *European Economic Review*, 36.

SEC (2020). U.S. credit markets: Interconnectedeness and the effects of the covid-19 economic shock. October 2020.

Shivdasani, A. and Wang, Y. (2011). Did structured credit fuel the LBO boom? *Journal of Finance*, 66:1291–1328.

Wang, Y. and Xia, H. (2010). Bank monitoring and corporate loan securitization. *Working Paper, University of Texas at Dallas.*