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# Insurance Companies and the Growth of Corporate Loans' Securitization

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## **Insurance Companies and the Growth of Corporate Loans' Securitization**

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### **Abstract**

Insurance companies nonupled their CLO investments in the post-crisis period. This growth has far outpaced that of loans and bonds and is characterized by a strong preference for mezzanine tranches over triple-A tranches. Conditional on capital charges, insurance companies invest more in bonds and CLO tranches with higher yields but prefer the latter because these carry higher yields. Preferences increased following the 2010 regulatory reform, resulting in them holding 44 percent of outstanding investment-grade rated mezzanine tranches. In the process, insurance companies contributed positively to the rise of corporate loan securitization and availability of bank credit, particularly to riskier borrowers.

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

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# 1 Introduction

CLO issuance in the U.S. increased by a factor of thirteen in the post crisis-decade, with the volume of outstanding CLOs more than doubling and reaching \$650B by 2019 (Figure 1). This growth has caught the attention of researchers who have investigated its impact on the cost and risk of corporate loans, the amplification of credit cycles, and the stability of the financial system.<sup>1</sup> However, to date little attention has been devoted to understanding the drivers of that growth. 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, the key factors behind that role, and the implications for the primary credit market.

Insurance companies have almost nonupled their CLO holdings in the post-crisis decade, reaching \$126B in 2019. Their growth in CLO investments has far outpaced that of corporate loans and bonds, and was characterized by a preference for mezzanine tranches (Aa, A or Baa rated) over triple-A tranches. Insurers' proclivity towards mezzanine tranches rated investment grade within the CLO asset class, and towards CLOs relative to corporate bonds reflects a search for yield behavior.

Similar to Becker and Ivashina (2015), we argue that insurers' incentives to reach for yield stem from their capital regulation's coarse treatment of risk. In contrast to their focus on corporate bond investments, we show that those incentives extend and are even more prevalent among CLO investments. More importantly, we show that the regulation's similar treatment of corporate bonds and CLO tranches makes the latter relatively more attractive to insurance companies. Insurance capital requirements for fixed income investments are defined according to six buckets of securities' credit quality named "NAIC designations" (NAIC, 2018, 2020). Insurers assign a NAIC designation to each investment (other than U.S. Treasuries and MBS) based on a mapping from credit

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<sup>1</sup>See Wang and Xia (2010); Shivdasani and Wang (2011); Benmelech et al. (2012); Nadauld and Weisbach (2012); Bord and Santos (2015); Ivashina and Scharfstein (2010); and IMF (2020); BoE (2019); FSB (2019); Ivashina and Vallée (2020); SEC (2020), respectively.

ratings. While the NAIC 1 category is mapped to three credit ratings (Aaa, Aa and A), all the other NAIC buckets are associated only to one rating during our sample period. This implies that investments 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. Therefore, conditional on the NAIC designation, our first hypothesis conjectures that insurance companies have an incentive to invest more heavily in securities (corporate bonds and CLO tranches) with higher yields. Further, given that the yield dispersion is higher among CLO tranches, insurance companies should have higher incentives to search for yield within CLO tranches.

Our second hypothesis builds on insurance capital regulation equal treatment of corporate bonds and CLO tranches (except in certain circumstances described next). Given that CLO debt tranches (other than triple-A rated) tend to carry higher yields than corporate bonds with the same credit rating, this gives insurance companies a preference for CLOs' mezzanine tranches over corporate bonds. These preferences were enhanced after 2010 when the National Association of Insurance Commissioners (NAIC) enacted a regulatory change of capital requirements for CLO holdings.<sup>2</sup> 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. This further increased insurance companies' incentives to invest in higher yielding CLO tranches.

Insurance companies' preference for CLO mezzanine tranches together with their growing importance in this segment likely played a role in the CLO market. This is the focus of our third hypothesis. In particular, we investigate whether CLO deals in which insurance companies invest more heavily are characterized by a larger fraction of mezzanine tranches and a riskier pool of underlying collateral loans. We complement

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<sup>2</sup>That change was part of a broader reform initiated in 2009 focused on mortgage-backed securities (MBS), 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., 2022; NAIC, 2021).

this investigation with a study of the returns on CLO tranches to ascertain whether investors in CLO equity tranches benefited from insurance companies' growing appetite for CLO investments.

Our final hypothesis is about whether the demand for CLOs from insurance companies had an effect in the primary market for bank credit. Towards this end, we investigate whether borrowers, in particular riskier borrowers, of syndicated loans with larger stakes from CLOs with insurance companies' investments are able to obtain larger loans. We also examine if increased investments by CLOs supported by insurance companies allowed banks to increase the volume of syndicated loans they arrange.

We use insurers' fixed income holdings at the security-company-year level to investigate insurance companies' search for yield incentives. We restrict our sample to CLO tranches and corporate bonds for which we have information on issuance and outstanding amounts throughout their lifetime. In addition, since the balance of CLOs might vary over time due to refinancing or principal amortization, we consider only insurers' first-time investments in each security.

We find that insurance companies invest more heavily in securities with higher yields within a NAIC 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 almost \$1 million for the median security in portfolio. Conditional on the capital requirement bucket, low-capitalized insurers hold higher fractions of high yielding securities, consistent with their higher risk-shifting incentives (Jensen and Meckling, 1976). Consistent with our priors, we find that insurance companies' search for yield is more prevalent within the CLO asset class, which is characterized by a higher dispersion of yields. Also insurers' search for yield within the CLO asset class increased during the years the 2010 regulatory reform was in place. Further, our results show that insurance companies that stood to benefit from the 2010 reform are more prone to search for yield following the implementation of the new rules.

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. We focus on securities rated investment grade which account for most of the assets in insurers' portfolios.

We first show that the average 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, and that the yields differential widens for decreasing levels of credit quality. These patterns map to insurers' investment preferences in a one-to-one fashion. 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 rated securities. Further, 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' new investments in CLOs to the average yield of insurers' new investments in corporate bonds for each specific rating-year combination. Lastly, we find that insurers' preference for CLOs over corporate bonds is concentrated during the period in which the 2010 regulatory regime gave special treatment to CLOs.

In the final part of our paper, we study the implications of insurance companies' search for yield for the CLO market and the primary market for bank credit. Our investigation shows that deals in which insurance companies have larger investments are characterized by larger mezzanine tranches rated investment grade. This relationship tends to be more pronounced among CLOs issued during the 2010 reform period *and* CLOs held by insurance companies that stood to benefit from the reform, pointing to a direction of causation. Further, CLO deals with a larger holding share by insurance companies have a larger fraction of debt tranches with a fixed-rate coupon and are more likely to be tailor made repackaged CLO deals, both features indicating that CLO managers construct CLO deals that are attractive to insurance companies.

We also find that CLO deals with larger investments by insurers invest in riskier

loans, but the higher returns of these loans are catered only to holders of CLOs' equity tranches. Investors in equity tranches of CLOs with larger investments by insurance companies earn higher abnormal returns, confirming that CLO equity holders rather than debt holders have benefited from insurance companies' strong preference for CLO mezzanine tranches.<sup>3</sup>

We end our empirical investigation documenting that insurance companies' demand for CLOs had an effect on the syndicated loan market. Using data from the Shared National Credit program, which contains comprehensive information on loan syndicates, including participants' loans shares, we show that borrowers whose term loans have larger stakes from CLOs in which insurance companies have investments are able to take out larger loans. This evidence is more prevalent during the 2010 reform period and among loans taken by riskier borrowers. This is important because the former coincide with the time period when there was an increase in the demand for CLOs from insurance companies and the latter were favored by CLOs held by insurance companies.

These results continue to hold when we aggregate the loan data at the lead bank-origination year level. Together, this evidence reveals that lead banks were able to capitalize on CLOs with insurance companies' investments to increase the volume of syndicated loans they arrange. This increase unlikely captures the total effect of insurance companies' preference for CLOs on the market for bank credit. Their growing presence in the mezzanine-tranche segment of the CLO market played a role in the growth of corporate loan securitization that goes beyond the size of their CLO holdings. Insurance companies' CLO market share almost quintupled between 2003 and 2019 and that increase was mostly driven by mezzanine tranches rated investment grade, whose market share soared in the post-crisis decade (from 5% in 2009 to 44% in 2019). Mezzanine tranches play a critical role in the origination of CLOs not only because they account for about 26% of CLO deals but also, and perhaps more importantly,

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<sup>3</sup>Consistent with this assertion, we find that CLO deals with a larger holding share by insurance companies have a shorter non-call period and are more likely to be refinanced.

because their junior position allows for the creation of the triple-A tranches. While there is plenty of demand for Aaa rated tranches, especially from banks due to the favorable treatment in capital regulation, banks play only a marginal role when it comes to mezzanine tranches (DeMarco et al., 2020; IMF, 2020). But that is precisely where insurance companies' preferences are. In other words, insurance companies by owning a large fraction of the risky tranches that are not attractive to banks have become a critical player in the securitization of corporate loans.

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. (2022) and Liu (2019).<sup>4</sup> Becker and Ivashina (2015) document how capital regulation generates incentives to invest in higher yielding corporate bonds conditional on a NAIC designation. Becker et al. (2022), in turn, document the effect of the 2009-2010 capital regulatory reform on insurance companies' propensity to purchase mortgage-backed securities. We show that insurance companies' risk-taking incentives extend, and are even more prevalent, when it comes to investments in CLO tranches. We also show that capital regulation tilted insurance companies' investment preferences towards CLO tranches over corporate bonds and that these preferences were further increased during the time capital regulatory reform for CLOs was in place (2010-2018).

Perhaps more importantly, our results show that insurance companies' CLO investments had an impact not only on the design of CLO deals, but also on the credit supply in the primary market for syndicated loans. Our results unveil an important role played by insurance companies as investors in the CLO market, contributing to the expansion of corporate loan securitization observed in the last decade.

Our paper is also related to studies of the growth of corporate loan securitization (Ivashina and Scharfstein, 2010; Wang and Xia, 2010; Shivdasani and Wang, 2011; Ben-

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<sup>4</sup>Studies of 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).



melech et al., 2012; Nadauld and Weisbach, 2012; Bord and Santos, 2015; Ivashina and Vallée, 2020), and studies of the returns to investors in CLO equity tranches (Fabozzi et al., 2021; Cordell et al., 2023). Our paper expands this literature by documenting the role of insurance companies as investors in CLOs.<sup>5</sup> Their role affected not only the design of CLO deals, including their share of mezzanine tranches and risk of collateral loans, but also the return of CLO equity tranches. We expand Cordell et al. (2023), who show that CLO equity tranches earn abnormal risk-adjusted returns, by documenting that insurance companies' strong demand for mezzanine debt tranches is a contributing factor for the abnormal returns that the CLO equity holders enjoy.

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.<sup>6</sup>

The rest of our paper is organized as follows. Section 2 describes insurance companies' capital regulation and 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 CLOs over corporate bonds. Section 6 presents evidence on the implications of insurance companies' preference for CLOs on the CLO market and the primary market for syndicated loans. Section 7 concludes the paper.

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<sup>5</sup>Foley-Fisher et al. (2023) document the increasing participation of insurance companies as CLO issuers through their affiliated asset managers. Bhardwaj et al. (2023) in turn provide evidence that when insurance companies' operating cashflow increases they raise their CLO investments.

<sup>6</sup>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 with a given security held in the portfolio.

## 2 Insurance Companies' Preference for CLOs: Hypotheses

### 2.1 Insurance Companies' Investments Over Time

Insurance companies are known for investing in corporate bonds and loans (Becker and Ivashina, 2015; Bord and Santos, 2012). What is perhaps less understood is their increasing preference for CLOs (Figure 1). Between 2009 and 2019, insurance companies' investments in corporate bonds went from \$1,142B to \$1,781B (a 56% increase) and their investments in loans went from \$18B to \$41B (a 128% increase).<sup>7</sup> In the case of CLOs, their investments went from \$13B to \$126B, a 869% increase.

Further, insurance companies showed a clear preference for the mezzanine tranches rated Aa, A or Baa over the safest triple-A rated tranche. In 2011, 55% of their CLO investments were in triple-A tranches and 40% in mezzanine tranches rated investment grade. 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 81% invested in bonds rated A or Baa.

Insurance companies' increasing preference for mezzanine tranches has potentially important implications for the CLO market. Insurers' market share of CLO tranches moved from 4% in 2003 to 19% in 2019 (Figure 2).<sup>8</sup> This growth was mostly driven by investments in mezzanine tranches Aa, A or Baa rated, whose aggregate market share went from 5% in 2009 to 44% in 2019 (Figure 3).<sup>9</sup> Further, these tranches correspond, on average, to 22% of a CLO deal at issuance (triple-A tranches represent 62%, with

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<sup>7</sup>If we account for fixed-income securities that we could not identify with certainty but that are likely private placements, we observe that insurers' investments in corporate bonds went from \$1,486B in 2009 to \$2,298B in 2019 (a 54% increase). See Internet Appendix B for further information on insurance companies' investments in private placement bonds.

<sup>8</sup>By contrast, insurance companies' market share of corporate bonds declined from 23% in 2003 to 18% in 2019. This downward trend is common across bonds rated Aa and below, whilst the market share of triple-A bonds increased somewhat (Figure 3).

<sup>9</sup>Our estimates represent a lower bound because of the conservative approach we adopted to identify CLO tranches. Indeed, 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. According to Liu and Schmidt-Eisenlohr (2019), Cayman-issued U.S. CLOs represent approximately 74% of total U.S. CLO securities in 2018.

junior tranches accounting for the remaining 16%). Interestingly, the rise in insurance companies' investment in mezzanine tranches coincided with a rise in the average share of mezzanine tranches in CLO deals (Figure 4).

Differences in the yields of CLO tranches and bonds likely played a role in insurance companies' growing preference for CLOs' mezzanine tranches. In the post-crisis decade, yields on CLO tranches rated investment grade were systematically higher than yields on equally rated bonds (Figure 5). As we argue next, capital regulation also likely played a role in insurance companies' preference for CLOs' mezzanine tranches.

## 2.2 Insurance Companies' Capital Regulation

The first relevant feature of capital regulation is the absence of a strictly increasing relationship between capital requirements and asset risk. Capital requirements for fixed income investments are calculated as a weighted sum of the book value of these investments, with weights equal to a risk-based capital charge.<sup>10</sup> The capital charges were defined for six buckets of credit quality named "NAIC designations" (NAIC, 2018, 2020) until June 2021, when a regulatory reform broke down those six buckets into 20 sub-brackets. Insurance companies assign the NAIC designation to fixed-income securities (other than Treasuries and MBS) according to a mapping from credit ratings. During our sample period (2003-2019), securities rated Aaa, Aa or A received the NAIC 1 designation and were subject to a (post-tax) risk-based capital charge of 0.3% (Table 1). Lower credit ratings were associated with higher NAIC designations and risk-based capital weights. While the NAIC 1 designation was mapped to three different credit ratings (Aaa, Aa, A), all of the other NAIC categories were associated to a unique rating. This design required insurance companies to set aside the same amount of capital for a subset of investments that, nonetheless, carried different yields (those rated Aaa, Aa, A).

The second feature of insurance companies' capital regulation that likely played

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<sup>10</sup>Internet Appendix B provides a broad overview on insurers' capital regulation.

a role in their preference for CLOs is the equal treatment it gives to different debt securities with the same credit rating. The reason is that CLO tranches, other than those rated triple A, usually carry higher yields than equally rated corporate bonds.

The final feature is the regulatory change implemented after the Great recession. The mapping presented in Table 1 was in effect during our sample period for fixed-income securities other than treasuries, with the exception of MBS and CLOs starting in 2009 and 2010, respectively. In 2009, the NAIC changed the capital requirements for residential MBS to provide relief to the insurance industry following the wave of downgrades in the MBS market during the subprime crisis (Becker et al., 2022; NAIC, 2021). The new regulation was extended to commercial MBS and CLO investments in 2010 (Foley-Fisher et al., 2023), although the capital requirements for CLOs and MBS under the new regime were substantially different (NAIC, 2017).

The new framework introduced the so-called “modified filing exempt”, MFE, method, which allowed insurers to assign CLO tranches purchased at discount or highly impaired a lower NAIC designation than that implied by the rating-based system of Table 1.<sup>11</sup> This regulatory regime remained in place for CLOs until the reporting year 2018 (NAIC, 2019b). Starting in 2019, the ratings-based approach of Table 1 was restored. Insurance companies exploited this regulatory reform to reduce the capital charges associated with their CLO investments. As we can see from Figure A.1 in Internet Appendix A, the percentage of NAIC 1 CLO investments acquired under the MFE approach is indeed different from zero during the time period when the reform was in place (2010-2018) and reached its peak of 16% in 2015.

### 2.3 Hypotheses

We build on the features of the capital regulation discussed above to specify the four hypotheses which we investigate. The six-bucket designation system used in insurance

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<sup>11</sup>Internet Appendix A.1 describes in detail the 2010 regulatory reform.

companies' capital regulation implies that the relationship between asset risk and cost of capital is a step function and, hence, not strictly increasing. Following Becker and Ivashina (2015) conjecture on insurance companies' corporate bond investments, this leads us to hypothesize that insurers have incentives to search for yield *both* in the corporate bond and the CLO markets.

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

The capital regulatory framework of insurance companies does not distinguish CLO tranches from corporate bonds. However, as we document, CLO tranches, other than the triple-A rated, carry higher yields than corporate bonds with the same credit rating. This gives us our second hypothesis.

*Hypothesis 2: Insurance companies have a preference for CLO mezzanine tranches (those rated Aa, A and Baa) over corporate bonds with the same credit rating.*<sup>12</sup>

The 2010-18 modified regulatory regime, which applied to both legacy and new investments in CLOs, likely further tilted insurance companies' preferences for CLOs, particularly for the risky tranches that are more likely to be downgraded, bear a loss, or be purchased at discount. We capitalize on this reform to consider two variants of our Hypotheses 1 and 2 where we postulate that insurance companies' search for yield and preference for CLO tranches (relative to bonds), respectively, increased after the 2010 regulatory reform.

Our third hypothesis is about the impact of insurance companies on the market for CLOs. Banks, the major investor in CLO senior tranches, have strong disincentives to invest in CLO tranches that are not rated triple-A. Yet, those tranches are critical for the creation of banks' favored triple-A tranches. Given insurance companies' preference

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<sup>12</sup>We focus on mezzanine tranches above investment grade because insurance companies invest little in below-investment grade securities.

for CLO mezzanine tranches, we hypothesize they had an impact on the CLO market.

*Hypothesis 3: CLO deals in which insurance companies invest more heavily have a (1) larger fraction of mezzanine tranches (rated investment grade); (2) a riskier pool of underlying collateral loans; and (3) their equity tranches earn higher risk-adjusted returns.*

This brings us to the last hypothesis we investigate. The growth in CLOs induced by insurance companies' demand might have a positive effect on the primary market for bank credit.

*Hypothesis 4: Borrowers whose loans are acquired by CLOs in which insurance companies make investments have more access to bank credit. This effect, which should increase with the relative size of insurance companies' CLO investments, should benefit particularly riskier borrowers.*

### **3 Data Sources and Sample Characterization**

#### **3.1 Data Sources**

Our main data source is "Schedule D-Part 1" of the annual financial statement filings that insurance companies submitted to the NAIC during 2003-2019. That schedule reports comprehensive information at the security level on virtually all insurance companies' fixed-income holdings at the end of the year.

Our focus is on securities related to corporate debt. Given that Schedule D does not identify all types of securities, we rely on a suite of matching exercises to identify CLOs and corporate bonds.<sup>13</sup> To that end, we use data from Moody's Analytics Structured Finance Portal and Mergent Fixed Income Securities Database (FISD), re-

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<sup>13</sup>While we are able to identify insurance companies' bank loan investments, we do not consider them because bank loans often lack a unique identifier across data sets/providers. As we have already showed, bank loans account for a small portion of insurers' investments.

spectively.

We complement our data on insurance companies' asset holdings with data on CLOs from Moody's Analytics Structured Finance Portal. We are able to match this data using cusips for 99.8% of all insurers' CLO holdings. Our information on CLOs is available up to the beginning of November 2019 and, therefore, does not cover the full year of 2019. Also, we have the entire rating history (from Moody's) for 84% of the tranches in our sample. For the remaining tranches, we use issuance ratings (from Standard's & Poors and Fitch) and assume they do not change throughout the tranche's lifetime.<sup>14</sup> We also rely on Moody's Analytics Structured Finance Portal as a data source on the structure of CLO deals.

We get data on corporate bonds from Mergent Fixed Income Securities Database (FISD) and Moody's via cusip matching. Additionally, we obtain information on the balance sheet and income statement of insurance companies from SNL financial.

Finally, we rely on data from the Shared National Credit (SNC) program to investigate the impact of insurance companies' CLO investments on the primary bank credit market. The SNC program gathers confidential information on syndicated loans that exceed \$20 million and are held by three or more federally supervised institutions at the end of each calendar year throughout the life of the loan.<sup>15</sup> The program also reports information about the identity and loan shares of the lead arranger and *all* syndicate participants. We complement the SNC data with information from Moody's, Intex, Capital IQ and the Federal Reserve National Information Center to identify the types of loan investors, and with information on loan spreads from Dealscan.<sup>16</sup> Additionally, we rely on the Reports of Condition and Income to get financial information on the lead

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<sup>14</sup>We observe rating changes only for 22% of tranches rated by Moody's and most of the changes (downgrades and subsequent upgrades) occurred in 2009 and 2011. This is consistent with Griffin and Nickerson (2021), who document that credit agency actions on CLOs are very limited even during the Covid-19 shock.

<sup>15</sup>Starting in 2018 the loan cutoff was raised to \$100 million.

<sup>16</sup>Dealscan also reports information on syndicated loans, but unlike the SNC it does not provide comprehensive information on loan syndicates. See Bord and Santos (2012) for a comparison of SNC and Dealscan.

bank in the syndicate.

### 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.<sup>17</sup> Their full portfolio of securities 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%. Once we restrict to investments in USD-denominated CLOs and corporate bonds, we are left with 6,391,358 observations of which 129,453 are in CLOs. After we aggregate investments that insurance companies report in the same security in a given year, we are left with 6,253,581 observations of which 128,642 are in CLOs.<sup>18</sup>

In the econometric analysis presented in sections 4 and 5, we restrict our sample to first-time investments of insurers in CLOs and corporate bonds, i.e., we keep only the observations corresponding to the year in which the original purchase of the asset took place. This leaves us with a panel of 1,676,686 observations, with 57,492 pertaining to CLOs. Panel A of Table 2 reports summary statistics of the continuous variables used in the empirical analysis performed on this dataset.

Our CLO sample, which we use in section 6, contains information on their structure, refinancing and returns earned by equity holders for 2,211 USD deals issued between 2003 and 2019. Panel B of Table 2 reports summary statistics of the continuous variables pertaining to the empirical analysis performed on this dataset.

Finally, our sample of syndicated term loans, which we also use in section 6, contains information at origination for 13,912 loans issued between 2003 and 2020. Panel C of Table 2 reports summary statistics for these loans and their syndicates.

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<sup>17</sup>Data is organized at the company level because the current regulatory framework sets capital requirements at the legal entity level (and not at the consolidated level).

<sup>18</sup>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 interest rate, and calculating a weighted average yield with weights equal to the par value of each investment.



## 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 corporate bonds) within a NAIC designation bucket (Hypothesis 1). Next, we investigate the impact of the 2010 regulatory reform on those incentives. We close the section with a discussion of some robustness tests.

### 4.1 Insurance Companies' Preference for higher yielding securities

We start our empirical analysis of Hypothesis 1 with a graphical inspection of insurance companies' new investments in CLOs and corporate bonds with a NAIC 1 designation as a percentage of the outstanding volume of those securities by percentiles of their distribution of yields.<sup>19</sup> Yields represent the effective rate of return on the investment in a given security as reported by the insurance company. In line with Hypothesis 1, Figure 6 shows that there is a clear preference for the riskiest CLO tranches and corporate bonds within NAIC 1.

The search for yield behavior in CLOs is very pronounced both in the pre-crisis period, when interest rates were relatively high, and 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 66th percentile is 25 to 60 percentage points higher than that of tranches with yields in the bottom tercile, whilst from 2011 onward 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 given the CLO market freeze during the financial crisis (Figure 1 and Figure C.2 in Internet Appendix C). Note that the three market shares experience a drop in 2019, after the regulatory reform of 2010 was repealed.

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<sup>19</sup>We restrict our sample to first-time investments of each insurance company in a given security because, for example, the share of a CLO tranche that an insurance company owns may vary due to refinancing or changes in the outstanding balance of the CLO (e.g., amortization of principal).

We obtain a similar picture when we look at tranche ratings rather than yields (Figure C.1 in Internet Appendix C). In this case, the market shares of mezzanine tranches rated Aa and single A are consistently above that of triple-A tranche, except for the financial crisis when the three market shares overlap.

Insurance companies' reach for yield within the NAIC 1 bucket seems to be more prevalent within CLOs than bonds (Figure 6 and Figure C.1 in Internet Appendix C). As we noted above, the market share of CLO tranches with yields above the 66th percentile is 10 to 60 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 66th percentile and yields below the 33th percentile does not exceed 18 percentage points. This was expected given that the yields of CLO tranches are more disperse than corporate bonds' yields, thereby creating more opportunities to search for yield (Figure 7).<sup>20</sup>

Next, We test formally Hypothesis 1 by estimating the following model:

$$\frac{Holdings_{sct} \times 100}{Outstanding\ amount_{st}} = \alpha + \beta_1 Yield_{sct} + \beta_2 Time\ to\ maturity_{st} + \beta_3 Outstanding\ amount_{st} + \mu_{d(s),t} + \mu_{c,t} + \mu_{a(s)} + \mu_{l(c)} + \varepsilon \quad (1)$$

where the dependent variable is the amount held by insurance company  $c$  in security  $s$  with NAIC designation  $d$  in year  $t$  when the insurer makes its first investment in that security,  $Holdings_{sct}$ , as a percentage of the outstanding volume of that security at year-end,  $Outstanding\ amount_{st}$ . The key variable of interest is  $Yield_{sct}$ , the yield of security  $s$  reported by company  $c$  in year  $t$ . We expect the coefficient on this variable,  $\beta_1$ , to be positive, in line with the premise that insurers invest more heavily in securities offering higher yields within a NAIC category.

We control for the time to maturity of the security in years,  $Time\ to\ maturity_{st}$ ,

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<sup>20</sup>Both the standard deviation of yields and the difference in yields between triple-A and single-A securities is significantly larger for CLO tranches compared to corporate bonds reported in the NAIC 1 designation.

and the outstanding volume of security  $s$ ,  $Outstanding\ amount_{st}$ . These allow us to disentangle search for yield from time and issue size preferences of insurance companies. We include NAIC designation-year fixed effects,  $\mu_{d(s),t}$ , to investigate reach for yield within each bucket of risk-based capital charges. Finally, we saturate our model with: company-year fixed effects,  $\mu_{c,t}$ , to control for company-specific time varying and time invariant conditions that may affect insurers’ incentives to invest in a given security; type of asset (CLO tranche 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 of life, P&C and health insurance companies which may impact their investment choices. Standard errors are clustered at the company level.<sup>21</sup>

The first column of Table 3 reports the results of model 1. The coefficient of  $Yield_{st}$  is positive and highly statistically significant, corroborating the hypothesis that insurance companies invest more in securities with higher yields within a NAIC designation bucket. An increase in the yield by one standard deviation (2.14 percentage points in the subsample where this regression is estimated) implies a 14 basis points increase in insurers’ holding share, which is higher than the median holding share (0.11%). The median outstanding volume of CLOs and corporate bonds 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 almost \$1 million for the median security in the portfolio.

In columns 2 and 3 we replace company-year fixed effects with a set of company-specific controls. These include size (natural logarithm of total assets), ROE (net income to surplus as regards policyholders), capital ratio (surplus as regards policyholders to total assets), and either “company action level” (CAL) risk-based capital ratio (column 2) or “authorized control level” (ACL) risk-based capital ratio (column 3). While the ACL

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<sup>21</sup>We select the clustering level following Petersen (2009), Cameron et al. (2011), and Cameron and Miller (2015).

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 first capital threshold that triggers regulators' oversight actions. We lose 33,563 observations (out of 1,653,746) in columns 2 and 3 due to missing information on financial metrics for some insurers that are covered in the holdings data starting in 2019 but are not covered in the SNL Financial's data. Irrespective of the risk-based capital ratio used, the yield's coefficient is very close to that of the baseline regression but somewhat larger.

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 column 1.

Finally, in column 5 we take a first look at insurers' relative incentives to search for yield within CLOs vs. corporate bonds conditional on each NAIC bucket. The coefficient of the CLO dummy suggests that, *ceteris paribus*, insurance companies hold a higher share of CLO tranches compared to corporate bonds. More importantly, and in line with the investment patterns depicted in Figures 6 and Figure C.1 in Internet Appendix C, insurers' search for yield appears to be more pronounced in the CLO asset class. The positive and statistically significant coefficient of the interaction term between 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 2.36 percentage points higher than that of corporate bonds. This result suggests that insurance companies have better opportunities to search for yield within the CLO space. We investigate this hypothesis thoroughly in the next section.

Overall, the results presented above confirm Hypothesis 1 that the discontinuous

buckets of capital charges generate incentives for insurers to search for yield both in the CLO and corporate bond market segments.

## 4.2 Importance of the 2010 regulatory reform

As we discussed in section 2, the 2010 regulatory reform, which allowed insurance companies to assign CLO tranches purchased at discount a lower NAIC designation, likely increased their incentives to reach for yield within CLOs. Indeed, the percentage of NAIC 1 CLO investments that would have been in another NAIC designation absent of the reform is positive between 2010 and 2018, with a peak of 16% in 2015 (Figure A.1 in Internet Appendix A). More to the point, as we can see from column 1 of Table 4, the coefficient of the triple interaction between the yield, the CLO dummy and a dummy equal to one for the 2010-2018 time period is positive and statistically significant. Therefore, during the years the regulatory reform was in place (2010-2018), insurance companies increased their investments in CLOs relative to bonds within NAIC buckets.

We capitalize on the 2010 reform to do the following additional test. Given that the reform implied a positive and presumably exogenous shock to some insurers, i.e. those that had CLO tranches at the end of 2009 that could be assigned a lower NAIC designation following the reform, we hypothesize that these insurance companies have an additional incentive to invest in riskier assets following the reform.

Column 2 of Table 4 tests that hypothesis in a diff-in-diff setup. The treatment and control groups are formed by insurance companies that, based on their CLO holdings at year-end 2009, stood to benefit or not from the 2010 reform, respectively. The positive and statistically significant coefficient of the triple interaction confirms that insurers that stood to benefit from the 2010 reform are more prone to search for yield following the implementation of the new regime. As for the validity of our diff-in-diff approach, we present some graphical evidence comparing holdings of CLOs with a given credit quality of treated and control insurers before and after 2010. Figure 8 plots the time series

of the estimated coefficients of a linear model where we regress the aggregate volume of CLO tranches held by insurance companies at the time of their first investment in these tranches as a percentage of their total volume outstanding by NAIC designation buckets on year dummies and NAIC designation fixed-effects for the treated and the control groups. The parallel trend assumption is satisfied prior to the reform, whereas after 2010 affected insurers appear to purchase a higher portion of CLOs.

#### 4.2.1 Other robustness tests

In Internet Appendix C, we carry out three additional robustness tests. First, we explore differences in insurers' search for yield over time. This is important because our sample period (2003-2019) encompasses a protracted time of low interest rates, which has been linked to increased risk-taking by the banking industry.<sup>22</sup> Our results show that insurance companies searched for yield both in the years immediately leading up to the financial crisis (when interest rates were relatively high) and in the post-crisis period (when interest rates were relatively low), but this behavior is much stronger during the latter time period.

Second, we investigate the heterogeneity in insurers' search for yield behavior across their capital standards. In the banking literature, well capitalized banks are believed to be less prone to take on risk.<sup>23</sup> Therefore, we expect stronger evidence of search for yield among insurers with lower capital ratios.<sup>24</sup> Irrespective of the capitalization metric adopted (capital ratio, CAL RBC ratio, and ACL RBC), we find that insurance companies with a lower capital ratio, or closer to the minimum capital requirement, are more prone to search for yield.

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<sup>22</sup>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).

<sup>23</sup>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.

<sup>24</sup>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 literature, there are different views on the impact of capital on banks' risk taking incentives (e.g. Rochet (1992)).

Finally, we investigate whether P&C insurers that were hard hit by disaster events, as captured by the yearly change in their net income, search for yield more aggressively relative to less affected companies.<sup>25</sup> Insurance companies experiencing higher losses may try to boost their net income by investing in securities offering higher returns. Indeed, poorly performing insurance companies search for yield more actively in 2017, the year in our sample period with record losses from natural disasters.

Altogether, the evidence presented in this section confirms that insurance companies search for yield both in corporate bond and CLO investments. In the next section, we go a step further and investigate whether regulation tilts insurance companies' preference for searching for yield through CLOs over corporate bonds (Hypothesis 2).

## 5 Insurance Companies' Preference for CLOs over Bonds

As we discussed in Section 2, our Hypothesis 2 posits that insurance companies have a preference for CLO mezzanine tranches rated Baa and above over corporate bonds with the same credit rating. This is because insurance companies' capital regulation treats CLO and corporate bond investments alike. Yet, as Figure 5 shows, the average yield on insurers' new investments in CLOs is higher than the average yield on insurers' new investments in corporate bonds for all rating categories, except the triple-A, starting in 2005.<sup>26</sup>

We investigate this prediction in this section, starting with a granular comparison of the yields on CLO tranches and corporate bonds held by insurers. To this end, we estimate the following model:

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<sup>25</sup>According to the Billion-Dollar Weather and Climate Disasters Database of the National Oceanic and Atmospheric Administration, the aggregate value of nationwide damages from weather and climate disasters peaked in 2017, reaching record-high \$367B and implying significant insured losses. This reflects 2017's devastating hurricane season with hurricanes Harvey, Irma and Maria and an unprecedented break out of wildfires in northern California.

<sup>26</sup>Using the effective yield reported by insurance companies for CLOs and corporate bonds acquired at the same time, ensures that our comparison is reliable despite the different type of coupon (fixed versus floating) of the two asset classes. Also, our results are in line with the evidence presented by Cordell et al. (2023), who show that CLO tranches have higher yields than corporate bonds even after accounting for the different duration between the two asset classes.

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

where  $Yield_{sct}$  is the yield of security  $s$  with rating  $r$  reported by company  $c$  at time  $t$  (when the insurer makes its first investment in the security) and  $\mu_{r(s),t}$  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 investment grade (the dominant rating category of insurance companies' investments). Column 1 of Table 5 reports the estimate of this regression. We find a positive and statistically significant coefficient for the CLO dummy, indicating 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 in column 2, we find that the difference in yields between the two asset classes is statistically significant 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.

A natural question is why securities with the same credit rating offer different yields, conditional on their size and time-to-maturity. Higher CLO tranche yields may derive from their higher exposure to systematic risk (Coval et al., 2009), their lower liquidity in bad times (Cordell et al., 2023), their inflated ratings (Nickerson and Griffin, 2017), and/or their embedded prepayment option (Cordell et al., 2023). To the extent that some of the yields differential derives from a difference in default risk, this will likely give insurance companies a preference for CLO tranches over corporate bonds given that both securities receive the same treatment under their capital regulation. We investigate this hypothesis next, starting with the following econometric specification:



$$\frac{Holdings_{cst} \times 100}{Outstanding\ amount_{st}} = \alpha + \beta_1 dummy\ CLO_s + \beta_2 Time\ to\ maturity_{st} + \beta_3 Outstanding\ amount_{st} + \mu_{r(s),t} + \mu_{c,t} + \mu_{l(c)} + \varepsilon \quad (3)$$

where the dependent variable is the amount held by insurer  $c$  in the security  $s$  with rating  $r$  at time  $t$  (when the insurer makes its first investment in the security) as a percentage of the outstanding volume of the security in that year. Columns 3-4 of Table 5 show the results of this exercise. The large and highly significant coefficient of the CLO dummy in column 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, i.e., as the difference in yields between CLOs and corporate bonds widens (column 4).

Next, we relate insurance companies' preference for CLOs over corporate bonds to the difference in yields between the two asset classes. To that end, we extend model 3 to include the interaction between the CLO dummy and the CLO-bond "yields ratio" (i.e., the ratio of the average yield on insurers' new investments in CLOs to the average yield on insurers' new investments in corporate bonds). Column 5 of Table 5 reports the result of this analysis. The interaction between the yields ratio and the CLO dummy is positive and statistically significant, confirming that insurance companies purchase a larger portion of CLO tranches compared to corporate bonds the larger is the difference between the yields on CLO investments and the yields on bond investments within a given rating.

### 5.1 The 2010 reform and insurance companies' preference for CLOs

Following the approach we adopted in the previous section, we investigate whether the sensitivity of insurers' preference for CLOs to the yields ratio increased with the passage of the 2010 reform. The results of this exercise are reported in Table 6. The positive

and statistically significant coefficient of the triple interaction of the CLO dummy with the reform dummy and the yields ratio in column 1 indicates that insurance companies' response to the yields differential is more pronounced during the reform period. In addition, insurers that stood to benefit from the reform exhibit a stronger preference for CLO tranches vis-à-vis corporate bonds compared to other insurers after the 2010 regulatory reform, albeit being less sensitive to the yields ratio (column 2). Together, these results add further support to our thesis that the design of capital regulation tilts insurance companies' preferences towards CLO investments.

In Internet Appendix D, we present two additional tests. We examine how the effect of insurance companies' capitalization interacts with the yields ratio (columns 1-3 of Table D1). 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 making their investments in CLO tranches and corporate bonds with the same rating. These results further suggest that higher leverage brings stronger incentives to search for yield. We also look more closely at the sensitivity of insurers' preference for CLOs over corporate bonds to the yields ratio over time (column 4 of Table D1). We find that insurance companies' response to the yields ratio is more pronounced during the post-ZLB period.

## **5.2 Insurance sector preference for CLOs: Aggregate results**

The evidence documented in Table 5 showing insurance companies' preference for CLO tranches over corporate bonds was unveiled based on models estimated at the security-company-year level. A natural question to ask is whether this preference had a material impact on insurers' portfolio at a more aggregated level. Also, did the 2010 regulatory reform affect insurance companies' portfolio allocation? We investigate these questions next.

As a first step, we consolidate securities holdings at the insurer-asset class-rating-

year level.<sup>27</sup> This way we can calculate the volume of insurers' first-time investments in CLOs as a percentage of the total first-time investments in CLOs and corporate bonds within a given rating class and a specific year. Next, and following our security level analysis, we estimate the following model at the insurance company level:

$$\frac{CLO\ holdings_{rct} \times 100}{Total\ holdings_{rct}} = \alpha + \beta_1 \frac{Yield\ CLOs_{rt}}{Yield\ Bonds_{rt}} + \beta_2 \frac{CLOs\ Outstanding\ amt_{rt}}{Bonds\ Outstanding\ amt_{rt}} \quad (4)$$

$$+ \mu_r + \mu_{c,t} + \mu_{l(c)} + \varepsilon$$

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,  $\frac{Yield\ CLOs_{rt}}{Yield\ bonds_{rt}}$ .  $\frac{CLOs\ Outstanding\ amt_{rt}}{Bonds\ Outstanding\ amt_{rt}}$  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  $t$ .

The results of this exercise are reported in Table 7. Column 1 shows that 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.<sup>28</sup> Column 2 documents that insurance companies shift their portfolio towards CLOs during the time period in which the 2010 regulatory reform was in place. Column 3 shows that this behavior is more pronounced for insurers that stood to benefit from the new regulatory regime in the post-reform period. In column 4 we estimate a modified version of model 4 to pinpoint the impact of the 2010 reform more precisely. To that end, we restrict the sample

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<sup>27</sup>Using this level of aggregation rather than the security-level is also important to reduce the mechanic impact from the rise in the number of insurance companies investing in CLOs over the sample period on the time heterogeneity analysis.

<sup>28</sup>Before the crisis, insurance companies that invested in CLOs tended to be large. As the time went by, a progressively higher fraction of smaller insurance companies began investing in CLOs. To rule out concerns that our findings are driven by new entrants, which may not be influential investors, we re-estimated column 1 on the subsample of insurance companies that invest in CLO tranches both in the 2003-2008 time period and in the post-crisis decade (2009-2019). The coefficient of the yields ratio remained similar in magnitude and highly significant. This suggests that the largest and more sophisticated insurers are actually the main drivers of the shift from corporate bonds to CLOs investments observed in the insurance industry.

period to ten years, from 2005 to 2014, and regress the dependent variable on year dummy variables. We find that the coefficients of the year dummies turn positive and statistically significant exactly in 2010 when the new regulatory reform was enacted and their magnitude increases throughout the reform period.<sup>29</sup>

In Internet Appendix D, we present one additional test analysing insurers' portfolio allocation over time (column 5 of Table D1). We show that during the financial crisis, when issuance in the CLO market froze, insurance companies reduced their investments in CLOs relative to corporate bonds. However, as soon as CLO issuance resumed and CLO yields became much larger than corporate bond yields in 2009, insurers' preference flipped towards CLOs and became progressively stronger in the post-crisis decade.

Finally, we complement our analysis on insurers' preference for CLOs vis-à-vis corporate bonds by exploring their aggregate behavior towards each security following the approach adopted by Becker and Ivashina (2015). The results are presented in Tables D2 and D3 of Internet Appendix D. We find that, on aggregate, insurance companies tend to hold a higher share of securities offering a higher yield conditional on the credit rating. Again, this translated into a collective preference for CLOs over corporate bonds, especially after the implementation of the 2010 regulatory reform.

In sum, the results we reported in this section provide supporting evidence for Hypothesis 2 that capital regulation's similar treatment of corporate bonds and CLO tranches gave insurers an incentive to invest in the latter, in particular CLO mezzanine tranches rated investment grade. In the next section, we examine to what extent these insurance companies' preferences affected the market for CLOs and the primary market for bank credit.

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<sup>29</sup>Column 5 of Table D1 in Appendix D presents additional results on the time heterogeneity in insurers' preference for CLOs throughout the economic cycle. This specification reveals that insurance companies exhibit a large preference for CLOs over corporate bonds in the post-crisis decade, especially in the post-zero lower bound period.

## 6 Implications of Insurance Companies' Preference for CLOs

In this section, we investigate to what extent insurance companies' preference for CLOs has had an effect on the CLO market (CLOs' capital structure, collateral pool, and tranche returns) and the primary market for bank credit (bank credit supply).

### 6.1 Implications for the CLO market

#### 6.1.1 Design of CLO Deals

We start by testing Hypothesis 3.1 that CLO deals with a larger holding share by insurance companies have a larger fraction of mezzanine tranches. We consider a comprehensive sample of 2,211 USD CLO deals issued between 2003 and 2019.<sup>30</sup> During our sample period, insurance companies invest in tranches pertaining to 1,881 CLO deals, holding on average 14% of each CLO deal and 32% of the mezzanine tranches rated investment grade in the year of origination. A casual look at Figure 4 shows that the relative importance of mezzanine tranches rated investment grade increased during our sample period, contrasting with the equity and triple-A rated tranches whose importance declined somewhat. We investigate Hypothesis 3.1 formally by estimating the following regression on CLO deals at issuance:

$$\frac{Tranche_{rdmt} \times 100}{Issue\ amount_{dmt}} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Issue\ amount_{dmt}} + \mu_{mt} + \varepsilon \quad (5)$$

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  $t$ ,  $Issue\ amount_{dmt}$ . Both the numerator and the denominator of the dependent variable is calculated by excluding combo notes pertaining to the same CLO deal (i.e. notes that consist in a repackaging of two or more

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<sup>30</sup>Our original sample from Moody's Analytics Structured Finance Portal includes 2,386 CLO deals. We exclude 28 multi-currency CLO deals for which we cannot determine the balance in USD of all their tranches.

tranches of the CLO deal) to avoid double counting.  $Insurers\ holdings_{dmt}$  is the par value of insurers' aggregate holdings of CLO deal  $d$  in the year of origination. We saturate the regression including manager-issuance year fixed effects,  $\mu_{mt}$ . The coefficient of interest is  $\beta_1$ , which captures the correlation between the percentage of a CLO deal represented by tranches with a given rating and the percentage of the CLO deal held by insurance companies. Standard errors are clustered by manager.

Table 8 reports the results of this exercise. Column 1 indicates that the triple-A tranches' share is inversely correlated to the percentage of the CLO deal held by insurance companies. When we move to mezzanine tranches rated investment grade, the coefficient of insurers' holding share flips sign, while remaining statistically significant (column 4). The correlation is negative for the subset of tranches rated below investment grade (column 7) and not significant for equity tranches (column 10). 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 (15 percentage points in the subsample where this regression is estimated) is associated with an increase of 6 percentage points in the share of mezzanine tranches rated investment grade.

The results we unveiled are consistent with our priors, but they cannot be interpreted as causal because insurance companies may select themselves into CLOs with a larger fraction of mezzanine tranches. We attempt to provide supporting evidence that there is a causal link between insurance companies' CLO preferences and the design of CLO deals by exploiting the 2010 regulatory reform. Following our findings in section 4 that insurance companies increased their investments in CLOs relative to bonds after the 2010 reform, we would expect an increase in the relative size of mezzanine tranches rated investment grade in CLO deals issued after the reform. Indeed, the results reported in column 5 of Table 8 support this assertion.

Similarly, we would expect CLO deals with larger investments from insurance companies that stood to benefit from the reform to have larger mezzanine tranches. This follows from our evidence in section 4 that insurance companies with larger investments in CLO tranches purchased at discount benefited more from the reform and made larger CLO investments afterwards. The results reported in column 6, estimated on a diff-in-diff setup with continuous treatment, are in line with our expectations. The coefficient of the triple interaction is positive and statistically significant for the share of mezzanine tranches rated investment grade, whereas it is negative and statistically significant or not significant for the shares of triple-A and below investment grade tranches, respectively.

We conduct two additional tests whose results we report in Table E1 of Internet Appendix E. One of the tests builds on the coupon type of CLO tranches. While CLO tranches are typically floating-rate securities, about 7% of debt tranches in our sample have a fixed-rate coupon. Life insurance companies, which account for 78% of insurers' aggregate holdings of CLOs and corporate bonds in 2019, typically fund themselves with long-term insurance products and therefore will likely have a preference for fixed rate tranches. Indeed, we find that CLO deals in which insurance companies invest more heavily are characterized by a larger share of fixed-rate tranches.

Our second test builds on repackaged CLOs. These are CLO deals associated with a set of combo notes produced by repackaging part or all debt and equity tranches of other CLO deals. Combo notes, which are often structured as principal-only securities, may carry a better rating than some of the underlying tranches (NAIC, 2019a; Morningstar, 2019).<sup>31</sup> They are typically structured in bilateral transactions to help meet investors' specific coupon and rating target (NAIC, 2019a; Morningstar, 2019). Thus, the extent to which insurance companies invest in repackaged CLO deals is a signal of whether they lean towards custom-made CLOs. Indeed, our investigation shows that insurance companies invest more heavily in repackaged CLO deals.

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<sup>31</sup>NAIC (2019a) notes that rating agencies methodologies identify a loss or default only when interest payments are not met.

Altogether, the results reported in this subsection show that insurance companies' growing preference for CLOs, particularly after the 2010 regulatory reform, had an effect on the design of CLO deals. In the next subsection, we investigate whether this effect extended to CLOs' underlying collateral.

### 6.1.2 CLOs' collateral pool

Our evidence that CLO deals with larger investments from insurance companies have a larger fraction of mezzanine tranches rated investment grade and a smaller share of triple-A tranches suggests that CLO managers will find it easier to include riskier loans in the collateral pool of CLOs they place with insurance companies. This is our Hypothesis 3.2, which we investigate next.

As before, we consider USD CLO deals issued between 2003 and 2019, but focus now on their loan investments.<sup>32</sup> We rely on the loan's interest rate spread to ascertain its risk and estimate the following regression:

$$Spread_{ldmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Outstanding\ volume_{dmt}} + \mu_{mt} + \varepsilon \quad (6)$$

where  $Spread_{ldmt}$  is the spread of loan  $l$  in the collateral pool of CLO deal  $d$  managed by manager  $m$  at origination year  $t$ . We include CLO manager-issuance year fixed effects and cluster standard errors by manager.

Column 1 of Table 9 reports the estimates of this model. The positive and statistically significant coefficient of the insurance companies' holding share suggests that CLO deals in which insurance companies invest more heavily are backed by riskier loans. In the next specification we replace the dependent variable with the weighted average spread of loans in the collateral pool of CLO deals at origination to account for

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<sup>32</sup>We exclude bond investments (they account only for a small fraction of the collateral pool of CLOs), and investments in credit lines, revolvers, and term loans A because they are non-typical underlying loans for CLO deals (they represent only 2% of the cross section of loan investments in the collateral pool of CLO deals at origination). In addition, we drop repackaged CLO deals as their collateral is composed by CLO tranches rather than bank loans.



the relative size of loans in the collateral pool. The estimates of Column 2 show that not only our result is confirmed, but the magnitude is somewhat higher. A one standard deviation increase in insurance companies' holding share (corresponding to 15%) implies an increase in the weighted average spread of collateral loans by 7 basis points.

This evidence that CLOs with a larger ownership stake of insurance companies hold a riskier pool of collateral loans poses an interesting question: who benefits from the larger returns of these loans? We attempt to shed light on this question next.

### 6.1.3 Returns on CLOs' tranches

We focus on returns on CLO tranches because we do not have comprehensive data on CLO managers' compensation arrangements. To that end, we start by looking at the interest rate of debt tranches at issuance using the following econometric model:

$$\textit{Weighed average interest rate}_{rdmt} = \alpha + \beta_1 \frac{\textit{Insurers holdings}_{dmt} \times 100}{\textit{Issue amount}_{dmt}} + \mu_{mt} + \varepsilon \quad (7)$$

where  $\textit{Weighed average interest rate}_{rdmt}$  is the weighted average interest rate of debt tranches with rating  $r$  of CLO deal  $d$  issued in year  $t$  in the first payment year after origination.

The estimates reported in columns 3-5 of Table 9 show that senior tranches and mezzanine tranches of CLO deals with a larger holding share by insurance companies do not pay a higher interest rate at origination, despite their ownership of a riskier pool of collateral loans. This suggests that the higher returns of these loans are passed through to CLO equity holders rather than CLO debt holders. The much smaller coefficient of the holding share for CLO mezzanine tranches (when compared to senior tranches) corroborates that assertion because it likely reflects the additional demand for these tranches from insurance companies.

Next, we turn our attention to the returns (including risk-adjusted returns)

earned by equity holders of CLO deals in which insurance companies invest more heavily. Following Fabozzi et al. (2021) and Cordell et al. (2023), we calculate different metrics for the returns to the equity tranche of CLO deals and estimate the following type of regression:

$$Equity\ return_{dmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Issue\ amount_{dmt}} + \mu_{mt} + \varepsilon \quad (8)$$

where  $Equity\ return_{dmt}$  is a measure of the return to the equity tranche of CLO deal  $d$  managed by manager  $m$  and originated in year  $t$ .

We start with a simple measure of equity returns for our full set of CLO deals, including those that have not matured or terminated yet. We follow Fabozzi et al. (2021) and compute the average of the annualized returns earned by holders of the equity tranche in each pay period until the minimum of the reinvestment end date, the first refinancing date (if the deal is refinanced in our sample period), or the last pay period in 2019.<sup>33</sup> We consider only the time frame up to the end of the reinvestment period because it is difficult to distinguish between interest and principal payments in many CLO deals and we want to exclude principal amortization from our calculations. In addition, we drop observations after the first refinancing date to capture returns to the equity tranche that are driven solely by the original structure of the CLO deal.

The estimates reported in column 6 of Table 9 indicate that equityholders of CLO deals with larger investments from insurance companies earn higher returns. A one standard deviation increase in insurance companies' holding share (15%) implies a 57 basis points increase in the average annualized returns of equityholders.

Next, we consider the internal rate of return (IRR) to gauge the returns to the equity tranche throughout its lifetime. We compute the IRR using the historical record of interest and principal payments to equityholders during the entire life of the CLO

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<sup>33</sup>We exclude repackaged CLOs, which typically do not have an equity tranche, and deals for which the equity tranche is not consistently reported over time. The equity tranche of the underlying CLOs or repackaged CLO deals is usually repacked with debt tranches to generate the combo notes that compose the repackaged deal.

deal. By construction, we can generate this measure only for CLO deals that reached maturity or were terminated by the end of our sample period. Further, we drop deals for which we miss the full history of payments to the equity tranche. This leaves us with a sample of 732 deals. To deal with the fact that a small number of managers have issued more than two of such restricted subset of deals, and thus avoid dropping a significant amount of observations, we include in our specification only the CLO deal issuance year fixed effects (i.e., we compare the IRR of terminated/matured CLO deals that are originated in the same year). The estimates reported in column 7 reveal that the IRR experienced by holders of equity tranches is higher for CLO deals with larger investments by insurance companies. A one standard deviation increase in insurance companies' holding share (15%) implies an increase of 2.3 percentage points in the IRR.

A limitation of the two equity return metrics used so far is that they do not account for risk, arguably important given our finding that CLO deals with larger investments from insurance companies have riskier pools of collateral loans. Towards that end, we begin by considering the public market equivalent (PME) of Kaplan and Schoar (2005) to estimate the returns earned by equityholders on a risk-adjusted basis. This approach is equivalent to obtaining risk-adjusted returns under the assumption that the beta of CLO equity tranches is equal to one. We compute the PME versus the S&P 500, meaning that we discount each cash flow to the equity tranche of a CLO deal using the returns on the S&P 500. A PME greater than one would indicate that CLO equity tranches outperform the S&P 500. Table 2 shows that the average PME of equity tranches of CLO deals is 1.31 in our sample, suggesting that these securities earn abnormal returns. Our goal, though, is to ascertain whether the PME of equity tranches varies across CLO deals with different insurance companies' investments.

The positive and significant coefficient of *% CLO held by ICs* in column 8 of Table 9 suggests that equityholders of CLO deals with larger insurers' investments earn higher returns even on a risk-adjusted basis. A one standard deviation increase in insurance

companies' holding share (15%) implies an increase in the PME by 0.04.

Given the intrinsic riskiness of CLO equity tranches, however, it is reasonable to think that those securities have a beta greater than one. To address this issue and following Cordell et al. (2023), we consider a more sophisticated measure of risk-adjusted returns which accounts for systematic risk — the generalized public market equivalent (GPME) of Korteweg and Nagel (2016).<sup>34</sup> To get statistical inference and mimic the analysis presented in Table 9, we compare the GPME of equity tranches of CLO deals with high versus low holdings by insurance companies conditional on the issuance year of the CLO deal. Further, to ensure that we estimate the GPME on a sufficiently large set of CLO deals, we group deals based on whether their origination year falls into six time intervals of two or three years (2003-2004, 2005-2006, 2007-2008, 2010-2011, 2012-2013, 2014-2016).<sup>35</sup> Then, for each time interval, we calculate the GPME of equity tranches of CLO deals whose insurance companies' holding share at origination is above or below the median for that time frame. To estimate the GPME, we consider a general CAPM stochastic discount factor (SDF). Specifically, the SDF parameters are identified to correctly price benchmark funds that receive the same inflows as the CLO equity tranches but that invest in the CRSP value-weighted index and one-month T-bills.

The estimates presented in Table 10 reveal that holders of the equity tranche of CLO deals with larger insurers' investments earn risk-adjusted abnormal returns throughout our sample, with the only exception of equity investors in CLO deals originated during 2012-2013. More importantly, these equityholders consistently experience higher returns on a risk-adjusted basis than equityholders of CLO deals where insurance companies do not invest or invest little.

Cordell et al. (2023) show that, unlike CLO debt tranches, equity tranches earn

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<sup>34</sup>We thank Arthur Korteweg and Stefan Nagel for providing us with the matlab code for the GPME estimation on their websites.

<sup>35</sup>There are only two CLO deals issued in 2009 and terminated/matured by the end of 2019 in our sample and none of them complies with our quality control tests. Thus, we exclude CLO deals issued in 2009 from these calculations.

abnormal risk-adjusted returns, suggesting that equityholders earn economic rents at the expense of debtholders. We also find that CLO equity tranches earn abnormal returns on a risk-adjusted basis (our GPME estimate of 0.667 is very close to the 0.664 reported by Cordell et al. (2023) in a similar setup). Cordell et al. (2023) speculate that these rents could derive from the demand for credit (i.e., borrowers willing to pay higher loan spreads) or the demand for CLO debt tranches (i.e. investors in debt tranches willing to accept lower spreads relative to the risk of the underlying collateral). The evidence presented in Table 9, combined with the regulatory arbitrage we documented in the previous sections, provides empirical support to the latter suggestion, that is CLO equityholders benefit from the lower returns that mezzanine debt holders earn in response to insurance companies' strong demand for these debt tranches.<sup>36</sup>

In Table E1 of the Internet Appendix E we provide two additional pieces of evidence that support this assertion. We show that CLO deals in which insurance companies' have larger investments tend to have shorter non-call periods, and are more likely to be refinanced. Both of these are valuable for equityholders. At the end of the non-call period, CLO managers have the option to refinance the deal to benefit from a potential reduction in market spreads on CLO debt or to extend the CLO maturity.

In conclusion, the results we unveiled in this subsection show that insurance companies' preference for mezzanine tranches rated investment grade has contributed to an increase in the relative importance of these tranches in CLO deals. This rise was accompanied by an increase in the risk of the underlying collateral. Further, the higher returns generated by the underlying riskier collateral are catered to holders of equity tranches. In the next subsection, we investigate whether insurance companies' impact on the CLO market extends to the supply of collateral for CLO deals, i.e., the primary market of bank credit.

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<sup>36</sup>This evidence is in line with Acharya et al. (2022) finding that investors' preference for investment grade corporate bonds during the Federal Reserve Quantitative Easing led to a reduction in the cost of funding for risky firms just above the investment grade threshold.

## 6.2 Implications for the primary market of bank credit

Between 2003 and 2019, the outstanding volume of CLOs increased by \$557B, with about one fourth of this increase (\$131B) relating to mezzanine tranches rated investment grade.<sup>37</sup> Insurance companies funded 48% of the increase in mezzanine tranches rated investment grade, raising their market share in these tranches from 13% in 2003 to 44% in 2019. Their investment is particularly important because investment-grade mezzanine tranches are critical for the origination of the much sought triple-A tranches. Therefore, insurance companies' investments in CLOs likely helped borrowers, in particular riskier borrowers, to increase access to bank credit. This is our last hypothesis, which we investigate next.

We capitalize on our access to data from the Shared National Credit (SNC) program which reports complete information on *all* investors in each syndicated loan, including their individual loan investments. We merge the SNC data with several data sources (Moody's, Intex, Capital IQ and the Federal Reserve National Information Center) to identify the types of investors in loan syndicates, and use "Schedule D-Part 1" of insurance companies' NAIC filings to identify CLOs whose tranches are acquired by insurance companies. Lastly, given the SNC data lacks information on borrowers' risk, we hand-match it with Dealscan to gather information on loan spreads which we use to identify risky borrowers. We restrict the analysis in this section to term loans because CLOs rarely invest in credit lines.

Between 1988 and 2020, the total volume of outstanding syndicated term loans in the SNC program went from \$219B to \$1,984B (in 2017 dollars). Over the same time period, banks' term-loan market share declined from 90% to 40%. In parallel, banks' average loan share declined from 91% to 67% (Figure 9). This decline, which afforded banks the opportunity to increase lending elsewhere, was made possible by the rise of funding coming from funds and CLOs, in particular insurance CLOs (CLOs

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<sup>37</sup>These tranches accounted for 18.9% of CLOs' funding in 2003, but by 2019 their funding share had reached 22.9%.

with investments by insurance companies). An inspection of the syndicated term loans originated over the sample period reveals further evidence consistent with our Hypothesis 4. For example, the average (real) size of loans originated in 2020 which were acquired by non-insurance CLOs was 56% higher than the average size of loans originated in 2003 and also acquired by non-insurance CLOs.<sup>38</sup> For loans acquired by insurance CLOs, their average (real) size increased by 81% over the same time period. Of course these are just univariate comparisons. We take a close look at the impact of insurance companies' CLO investments on credit availability by estimating the following model:

$$\begin{aligned} \text{Log}(\text{Loan amount})_{lfbt} = & \alpha + \beta_1 \text{INS-CLO}sh_{lt} + \beta_2 \text{NINS-CLO}sh_{lt} + \mathbf{Loan}'_{lt}\beta_3 \\ & + \mathbf{Syndicate}'_{lt}\beta_4 + \mathbf{Bank}'_{bt}\beta_5 + \mu_f + \mu_b + \mu_t + \varepsilon \end{aligned} \quad (9)$$

where  $\text{Log}(\text{Loan amount})_{lfbt}$  is the log of the (real) size of term loan  $l$  arranged by lead bank  $b$  and extended to firm  $f$  in year  $t$ . The two key variables of interest in this model are  $\text{INS-CLO}sh_{lt}$  and  $\text{NINS-CLO}sh_{lt}$ , the shares of the loan owned by insurance and non-insurance CLOs, respectively. The former are CLOs whose tranches are acquired by insurance companies in the origination year while the latter are CLOs without investments from insurance companies.  $\text{Loan}_{lt}$  is a set of loan controls, including its maturity, dummy variables to account for the purpose of the loan, and a dummy variable to identify loans rated "pass".<sup>39</sup>  $\text{Syndicate}_{lt}$  is a set of syndicate controls, including the share of the loan retained by the lead bank, and the shares of the loan held by funds (loan funds, hedge funds, pensions funds), finance companies, private equity firms and insurance companies, respectively.  $\text{Bank}_{bt}$  is a set of bank controls for the lead bank including the log assets, the portion of assets in C&I loans, the deposit-asset ratio, the capital ratio and measures of bank performance (ROA and charge-offs).

Because investors' decisions are more likely to affect the loan size at issuance,

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<sup>38</sup>Our data on insurance companies' investments in CLOs goes back only to 2003.

<sup>39</sup>Banks rate loans (including portions of the loan) into five categories: "pass", "special mention", "sub standard", "doubtful" and "loss", with "pass" being the highest category and accounting for the vast majority of loans.

we focus our analysis on syndicated term loans at the time of their origination; we, nonetheless, consider an extension to the model where we account for the entire history of loans as reported in the SNC program data. Since a large number of borrowers in our dataset are privately held corporations for which we lack comprehensive financial information, we do not control for firm-specific variables, but, instead, rely on borrower fixed effects ( $\mu_f$ ). We include bank fixed effects to account for (time invariant) conditions of the lead arranger, Lastly, to capture macroeconomic conditions, we saturate the model with year fixed effects given that the frequency of the SNC data is annual. We cluster standard errors by borrower.

Table 11 presents the estimates of model 9 together with a series of extensions. Column 1 shows that CLOs' investments are associated with larger loans. A one percentage point increase in CLOs' average loan share is associated with a 0.6 percent increase in the average size of the loan. Column 2 shows that effect is driven by "insurance CLOs". A one percentage point increase in insurance CLOs' average loan share is associated with a 1.4% percent increase in the average size of the loan. By contrast, an increase in the loan share of non-insurance CLOs is not associated with a statistically significant effect on the size of the loan. Column 3 shows that these results, which were estimated at the time of the loan origination, persist when we expand the sample to include the loan ownership throughout its entire life.

The evidence from columns 1-3 shows that there is a strong association between insurance CLOs' loan investments and the size of these loans but does not establish causality. We designed three tests to help establish the importance of insurance companies' CLO investments on the loan-size effect. The first test builds on the 2010 capital regulatory reform, which, as we documented above, made it more attractive for insurance companies to invest in CLOs. As we can see from column 4, in the pre-reform era, larger investments by both insurance and non-insurance CLOs are associated with larger loans. Importantly, during the reform era only insurance CLOs' investments be-



come more important to explain the size of corporate loans, in line with the additional investments made by insurance companies in CLOs.<sup>40</sup> This contrasts with the decline in importance of non-insurance CLOs' investments over the same period of time.

Our second test builds on the evidence we unveiled in subsection 6.1.2 showing that the collateral pool of insurance CLOs is made of riskier loans. It follows that credit availability should be higher for riskier borrowers of insurance CLOs. As we noted above, because the SNC program lacks information on borrowers' risk, we merge the SNC data with loan facilities in Dealscan to gather information on loan spreads. We classify borrowers as risky if their loans at origination have a spread of at least 250 basis points (the median of the spread of term loans in our sample). As we can see from column 5, in line with our hypothesis, risky borrowers whose loans are held by insurance CLOs are able to take out larger loans, an effect that is not present among risky borrowers whose loans are held by non-insurance CLOs. In columns 6 and 7, we re-estimate our reform-period specification (column 4) on the subsamples of risky and safe loans, respectively. We see that the effect of insurance CLOs is stronger among risky loans during the period in which the regulatory reform was in place.

Thus far we have distinguished between insurance and non-insurance CLOs, depending on whether CLOs have insurance companies' investments. In our third test, we factor in the portion of a CLO deal held by insurance companies at origination. Specifically, we weight the share of the loan each CLO owns by the portion of the CLO debt tranches owned by insurance companies at the end of the issuance year. As we can see from column 8, borrowers whose loans are held by CLOs with larger insurance company investments are able to take out larger loans.

In the presentation of our results above, we have not discussed the controls in our models in the interest of space. Nonetheless, we would like to highlight the statistical

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<sup>40</sup>While the insurance capital reform was in place between 2010 and 2018, for this exercise, we fix the beginning of the reform period in 2011 because our loan data reports information at year-end and loans issued in the early 2010 are unlikely to be affected by the reform since they were negotiated either earlier in the year or in 2009.

significance of investors' loan shares, including funds, private equity companies, and the lead arranger, thereby, showing the importance of controlling for the credit supply of other institutions in the syndicated loan market. Lastly, by including our set of bank controls for the lead bank, we lose about one third of the observations of the original dataset, corresponding to term loans arranged by foreign banks that only file a simplified version of the Call reports. Table E2 of Internet Appendix E replicates the econometric analysis of Table 11 without bank controls. The estimates are largely unchanged.

The results reported in Table 11 were derived relying on a loan-level analysis to help with identification. To ascertain the economic significance of our findings, we aggregate the syndicated loans data at the lead bank-origination year level. Next, we investigate whether the insurance-CLO share of the loans arranged by a lead bank in a given year helps explain the total volume of syndicated loans arranged by the lead bank in that year. Following our loan-level analysis, we account for non-insurance CLOs', other investors' and lead bank's shares of the loans it arranged each year as well as the set of bank controls used in Table 11. Additionally, we control for the lead bank's investments in loans originated in the same year but for which it only acts as a participant bank because these can affect its capacity to arrange new loans. Following the approach above we control for bank and year fixed effects, and cluster standard errors by bank.

The results of this exercise are reported in Table 12. Column 1 shows that insurance-CLOs, but not non-insurance CLOs, helped lead banks to arrange a larger volume of syndicated loans during the regulatory reform period although neither effect is statistically significant. However, in line with our previous findings, we see from columns 2 and 3, that there is a statistically significant insurance-CLO effect in the reform period which is concentrated on risky loans. Even though these results indicate a differential effect of insurance- and non-insurance CLOs conditional on bank conditions and the origination year, one may still worry they are driven by banks' growth over time. To address this concern, in columns 4 through 6 we repeat the analysis, but this time by

scaling the total volume of loans the lead bank arranges in the year by its lagged assets. The estimates confirm the previous finding that investments by insurance CLOs helped lead banks to arrange a larger volume of syndicated term loans, particularly to riskier borrowers, during the reform era.

In sum, our results show that borrowers whose syndicated term loans were acquired by insurance CLOs were able to take out larger loans. Banks that attracted larger investments in the loans they arranged from insurance CLOs were able to arrange a larger volume of syndicated loans. The fact that these results are more prevalent during the regulatory reform period when insurance companies made larger CLO investments, and among riskier borrowers, which were favored by CLOs with ties to insurance companies, suggests that insurance companies' growing investments in CLOs contributed to an increase in the availability of syndicated bank credit.

## **7 Conclusions**

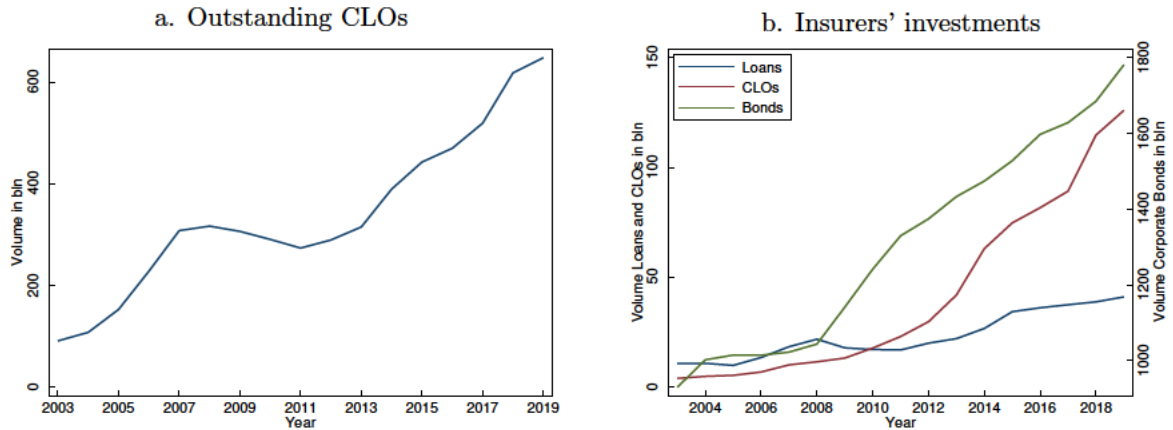
Using data on asset holdings of insurance companies over 2003-2019, we document an increasing preference for CLO investments vis-à-vis corporate bond investments. That preference is particularly strong for mezzanine tranches rated investment grade. We show that this is consistent with a search for yield behavior. 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 between the two asset classes.

Insurance companies' increasing preference for CLOs had an impact on the CLO market and the primary market for bank credit. CLO deals with higher insurers' investments are characterized by a larger share of mezzanine tranches rated investment grade, a riskier pool of collateral loans, and a higher return on their equity tranches even when we account for risk. Borrowers, in particular riskier borrowers, whose syndicated loans

are acquired by CLOs with higher insurers' investments are able to take out larger loans. Altogether, our results suggest that insurance companies played an important role in the rise of loans' securitization observed in the last decade and in the process contributed to an expansion of credit to riskier corporate borrowers.

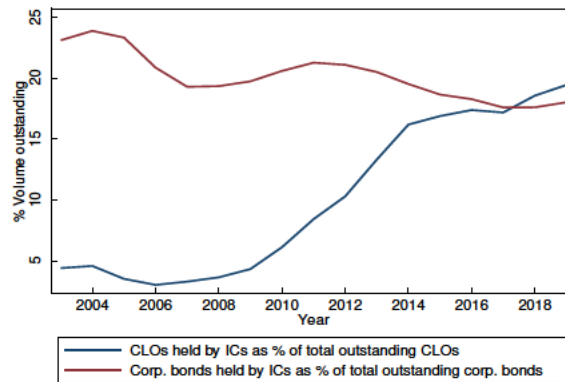
Our findings provide some important economic insights. They confirm that regulation is able to strongly affect firms' incentives to take on risk. They also show that insurance companies play a complementary role to banks in the securitization of corporate loans and, by extension, in the growth of the shadow banking sector. Lastly, loans' securitization together with differences between banks' and insurers' capital regulation has contributed to the transfer of a substantial portion of credit risk from the banking sector to the insurance sector. This suggests two relevant questions for future research. To what extent the current intermediation structure is better suited to guarantee funding to corporations over the business cycle than one based on banks alone? Is the allocation of credit risk throughout the financial system promoted by the current structure optimal?

**Figure 1: U.S. CLO outstanding and insurance companies' investments in CLOs, corporate bonds, and bank loans**



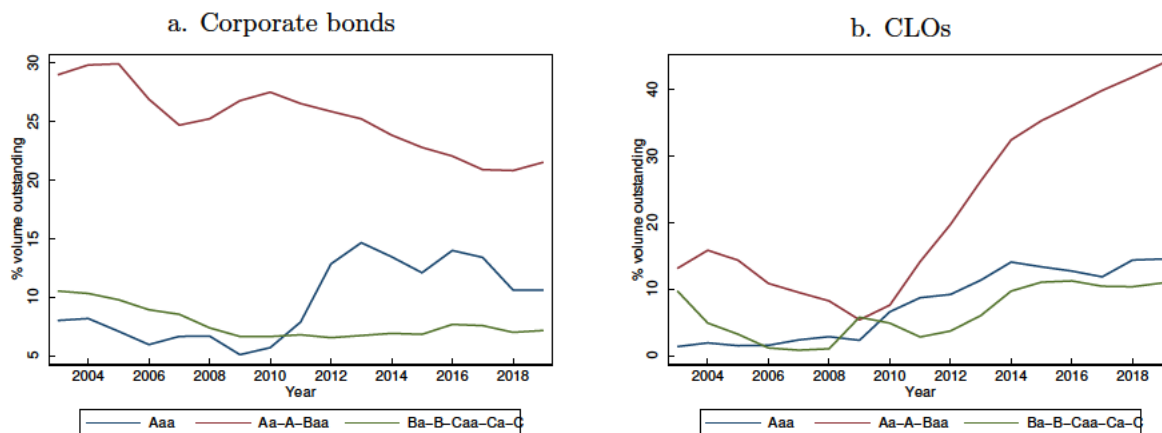
This figure plots i) the time series of the total outstanding volume of CLO tranches denominated in USD on a yearly basis (a), and ii) the time series of insurance companies' holdings of USD-denominated CLOs, corporate bonds, and bank loans as of December 31 of each year, over the time period 2003-2019 (b). The data covers CLOs outstanding up to November 8, 2019. Insurance companies' holdings of CLOs, corporate bonds and bank loans are identified by matching insurers' financial statements with data from Moody's Analytics Structured Finance Portal, Mergent Fixed Income Securities Database (FISD), and a collection of loan data (DealScan, Lipper, LSTA, Moody's, Morningstar), respectively. Source: Authors' calculations based on data from Moody's Analytics Structured Finance Portal and 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 2: Insurance companies' market shares of CLOs and corporate bonds**



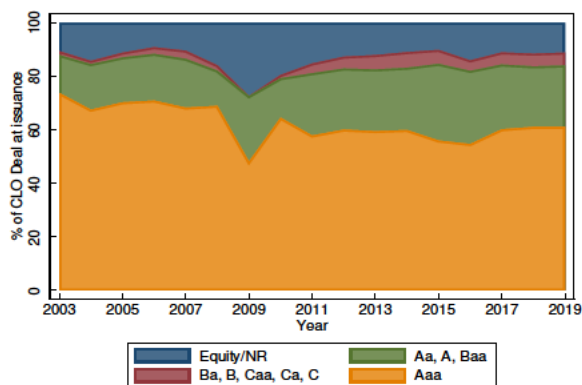
This figure plots the time series of i) the aggregate volume of CLO holdings of insurance companies as a percentage of the total volume outstanding of CLO tranches (blue line) and ii) the aggregate volume of corporate bond holdings of insurance companies as a percentage of the total volume outstanding of corporate bonds (red line) as of December 31 of each year during the time period 2003-2019. Source: Authors' calculations based on data from 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 Analytics Structured Finance Portal.

Figure 3: Insurance companies' market shares of corporate bonds and CLOs by rating



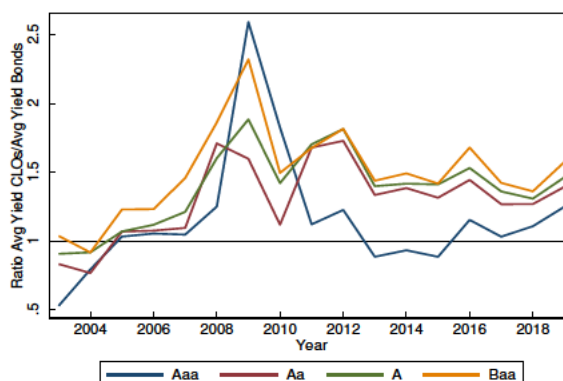
This figure plots the time series of i) the aggregate volume of corporate bond holdings of insurance companies as a percentage of the total volume outstanding of corporate bonds by credit rating (a) and ii) the time series of the aggregate volume of CLO holdings of insurance companies as a percentage of the total volume outstanding of CLO tranches by credit rating (b), as of December 31 of each year during the time period 2003-2019. Source: Authors' calculations based on data from 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; Moody's Analytics Structured Finance Portal.

Figure 4: Composition of CLO deals over time



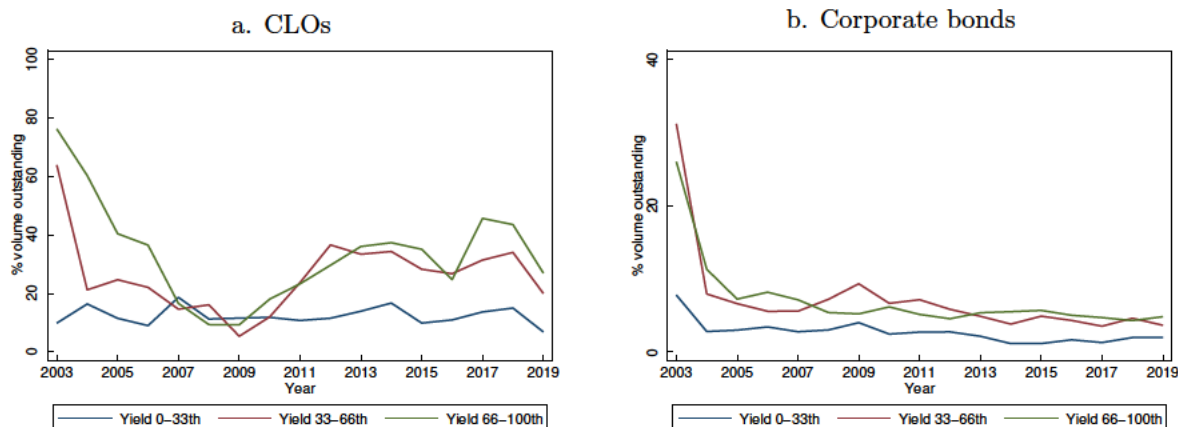
This figure plots the time series of the average share of CLO deals at origination represented by i) triple-A tranches, ii) Aa, A and Baa rated tranches, iii) below investment grade tranches, and iv) equity tranches, during the time period 2003-2019. Source: Authors' calculations based on data from Moody's Analytics Structured Finance Portal.

**Figure 5: Yield on insurance companies' investments in CLOs to yield on insurance companies' investments in corporate bonds by rating**



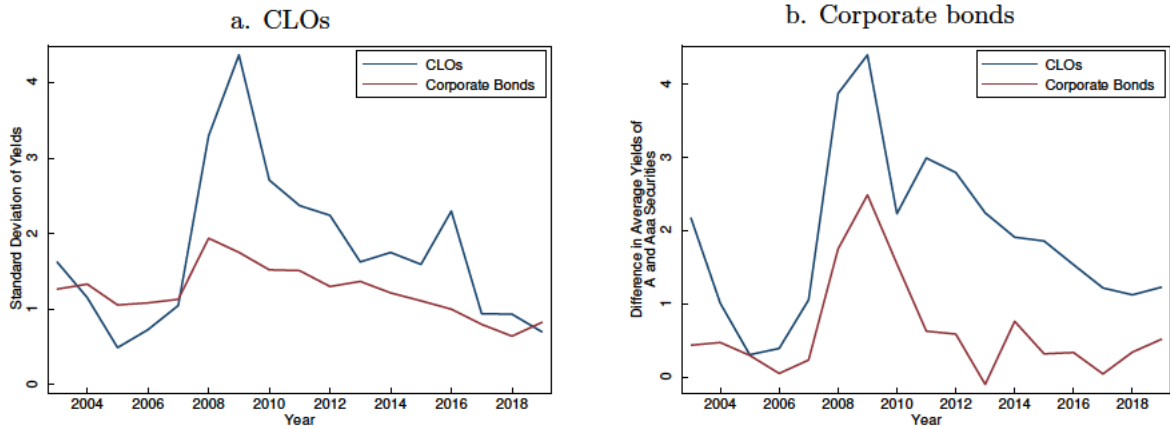
This figure plots the time series of the “yields ratio” of insurers’ first-time investments in CLO tranches and corporate bonds, that is the ratio of the average yield of new investments in CLOs to the average yield of new investments in corporate bonds, by credit rating as of December 31 of each year during the time period 2003-2019. New CLO and corporate bond holdings and are identified as first-time investments in a given CLO tranche and a given corporate bond by an insurance company. Source: Authors’ calculations based on data from 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; Moody’s Analytics Structured Finance Portal.

**Figure 6: Share of CLOs and corporate bonds held by insurance companies in the NAIC 1 designation by percentiles of the distribution of yields**



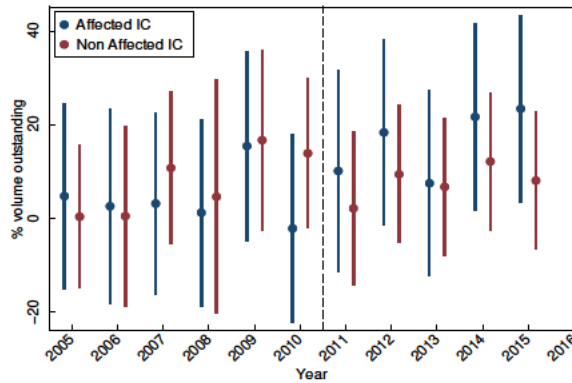
This figure plots i) the time series of insurers’ new CLO holdings in the NAIC 1 designation bucket as a percentage of the total volume outstanding of these CLO tranches based on percentiles of the distribution of CLOs’ yields reported by insurance companies (a) and ii) the time series of insurers’ new corporate bond holdings in the NAIC 1 designation bucket as a percentage of the total volume outstanding of these corporate bonds based on percentiles of the distribution of corporate bonds’ yields reported by insurance companies (b), as of December 31 of each year during the time period 2003-2019. New CLO and corporate bond holdings and are identified as first-time investments in a given CLO tranche and a given corporate bond by an insurance company. Source: Authors’ calculations based on data from 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 7: Yields' dispersion of CLOs and corporate bonds in the NAIC 1 designation



This figure plots i) the time series of the standard deviation of the yields of insurers' new CLO and corporate bond holdings in the NAIC 1 designation bucket (a) and ii) the time series of the difference in the average yield (in percentage points) of single-A and triple-A new insurers' holdings of CLO tranches and corporate bonds (b), as of December 31 of each year during the time period 2003-2019. New CLO and corporate bond holdings are identified as first-time investments in a given CLO tranche or corporate bond by an insurance company. Source: Authors' calculations based on data from 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; Moody's; Mergent Fixed Income Securities Database (FISD).

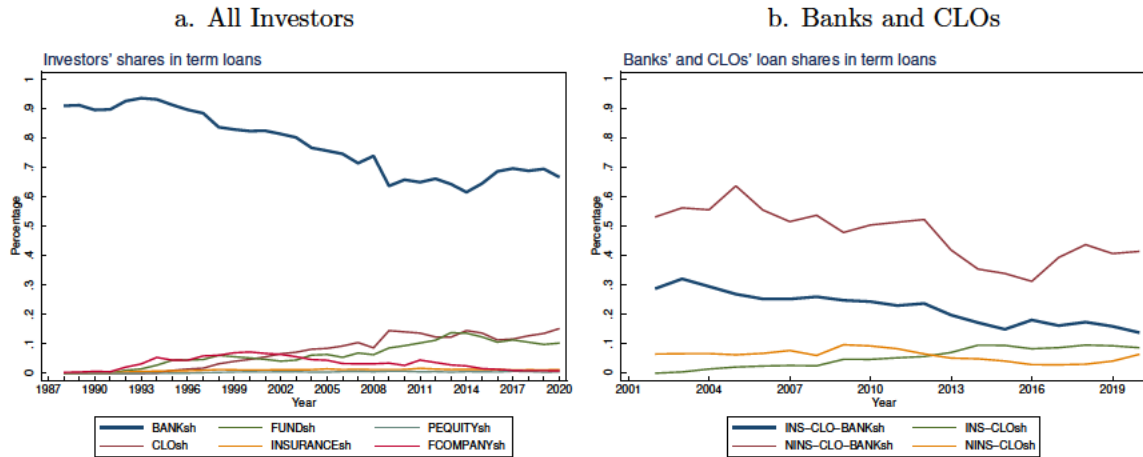
Figure 8: Share of CLOs held by insurance companies affected and not affected by the 2010 regulatory reform



This figure plots the time series of the estimated coefficients, along with their 95% confidence intervals, of a linear model where we regress the aggregate volume of CLO tranches held by insurance companies at the time of their first investment in the asset as a percentage of the total volume outstanding of these tranches by NAIC designation buckets on year dummies and including NAIC designation fixed-effects for (i) insurance companies that stood to benefit (blue line) and (ii) did not stand to benefit (red line) from the 2010 regulatory reform based on their CLO holdings as of December 31, 2009. Source: Authors' calculations based on data from 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 9: Investors' loan shares in syndicated loans over time



This figure plots the time series of the holding shares of different investors in outstanding term loans reported in the Shared National Program. Plot (a) shows the average holding share of banks, insurance companies, private equity firms, funds, and CLOs in outstanding term loans. Plot (b) shows i) the average holding share of insurance CLOs and non-insurance CLOs in outstanding term loans and ii) the average holding share of banks in term loans owned by insurance CLOs and non-insurance CLOs. Insurance (non-insurance) CLOs are CLOs whose tranches are (are not) owned by insurance companies at origination. Source: Authors' calculations based on data from the Shared National Program; 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.

Table 1: Risk-Based Capital Requirements for Asset Risk

NAIC Designation	RBC charge (%)			Credit Rating
	Life (pre-tax)	Life (post-tax)	P&C and Health	
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, D

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: Summary statistics**

Panel A: Insurance companies						
	N	mean	std dev	25th pct	median	75th pct
New investment / outstanding vol (%)	1,663,959	0.92	4.25	0.03	0.11	0.49
Yield (%)	1,669,753	4.39	2.14	3.03	4.20	5.51
Time-to-maturity (year)	1,676,661	9.52	7.64	5.00	8.00	10.00
Outstanding Amount (\$bln)	1,671,293	0.94	0.93	0.40	0.65	1.19
NAIC designation	1,676,552	1.83	0.98	1.00	2.00	2.00
Size	1,676,541	14.36	2.48	12.60	14.28	16.26
ROE	1,673,221	0.07	0.24	0.02	0.07	0.14
Capitalization	1,673,436	0.30	0.22	0.09	0.29	0.45
CAL RBC ratio	1,643,220	6.39	14.44	2.71	3.91	5.37
ACL RBC ratio	1,643,220	12.78	28.88	5.42	7.82	10.75
Panel B: CLOs						
	N	mean	std dev	25th pct	median	75th pct
Aaa Tranches as % of CLO	2,211	61.98	13.34	60.35	62.87	66.19
Aa-A-Baa Tranches as % of CLO	2,211	22.30	11.77	19.17	22.21	23.74
Ba-B-Caa-Ca-C Tranches as % of CLO	2,211	4.15	2.48	3.17	4.39	5.63
Equity Tranches as % of CLO	2,211	10.24	5.65	8.06	9.27	10.39
% of CLO held by ICs	2,210	14.37	14.95	3.43	11.57	19.82
% of CLO held by ICs Benefit Reform	2,211	7.18	11.61	0.50	4.09	8.82
Fixed-rate Tranches as % of CLO	2,211	1.98	6.72	0.00	0.00	1.95
Length Non-call period (year)	2,169	2.89	1.59	2.00	2.00	4.00
Weighted Avg Spread Loans (%)	2,064	3.58	0.96	3.16	3.60	3.91
Weighted Avg Interest Rate Aaa Tranches (%)	2,048	2.77	1.33	1.75	2.70	3.51
Weighted Avg Interest Rate Aa-A-Baa Tranches (%)	2,006	3.95	1.33	3.17	3.96	4.66
Weighted Avg Interest Rate Ba-B-Caa-Ca-C Tranches (%)	1,778	7.10	2.13	5.56	7.67	8.74
Average annualized rate of return (%)	1,824	19.53	8.34	14.70	19.09	23.07
Internal rate of return (%)	732	7.66	16.26	2.99	10.72	17.46
PME	732	1.31	0.69	0.78	1.12	1.82
Panel C: Syndicated term loans						
	N	mean	std dev	25th pct	median	75th pct
Amount (\$mln)	13,912	4390.17	7762.9	689.47	1983.71	4926.67
Maturity (year)	13,912	5.34	2.03	4.00	5.00	7.00
All-in-spread (Bps over Libor)	5,105	267.06	140.47	175.00	250.00	325.00
CLOs held by ICs' loan share	13,912	0.08	0.13	0.00	0.00	0.11
CLOs not held by ICs loan share	13,912	0.07	0.12	0.00	0.00	0.10
Lead bank loan share	13,912	0.15	0.17	0.00	0.09	0.24
Funds loan share	13,912	0.13	0.19	0.00	0.00	0.25
Finance companies loan share	13,912	0.03	0.07	0.00	0.00	0.01
Private equity loan share	13,912	0.01	0.04	0.00	0.00	0.00
ICs loan share	13,912	0.01	0.04	0.00	0.00	0.01

This table reports the summary statistics of the continuous variables pertaining to i) the panel dataset on insurers' new investments in CLOs and corporate bonds at the security-company-year level (panel A), ii) the dataset on the structure and returns of CLO deals at the CLO deal level (panel B), and (iii) the panel dataset on syndicated term loans and their syndicate members at origination (panel C).

**Table 3: Search for yield: Baseline regressions**

Dependent variable	(1)	(2)	(3)	(4)	(5)
	Insurance company's holding as a percentage of volume outstanding				
Yield	0.066*** (0.01)	0.068*** (0.01)	0.068*** (0.01)	0.072*** (0.01)	0.002 (0.01)
dummy CLO					4.731*** (0.79)
dummy CLO x Yield					1.102*** (0.17)
Time-to-maturity	-0.003 (0.00)	-0.002 (0.00)	-0.002 (0.00)	-0.001 (0.00)	0.001 (0.00)
Outstanding Amount	-0.302*** (0.02)	-0.333*** (0.02)	-0.333*** (0.02)	-0.386*** (0.02)	-0.298*** (0.02)
Size		0.250*** (0.02)	0.250*** (0.02)		
ROE		-0.222 (0.19)	-0.222 (0.19)		
Capital ratio		0.027 (0.13)	0.027 (0.13)		
CAL RBC ratio		0.002** (0.00)			
ACL RBC ratio			0.001** (0.00)		
constant	0.940*** (0.05)	-2.640*** (0.24)	-2.640*** (0.24)	0.965*** (0.05)	0.872*** (0.03)
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
One-way clustering	Insurer	Insurer	Insurer	Insurer	Insurer
N	1653746	1620183	1620183	1652930	1653746
$R^2$	0.2956	0.2084	0.2084	0.3944	0.3032
$Adj - R^2$	0.2779	0.2084	0.2084	0.3754	0.2857
F-stat	125.759***	77.601***	77.601***	119.600***	84.057***
Degrees of freedom	(3, 4334)	(7, 4332)	(7, 4332)	(3, 4334)	(5, 4334)

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 effective rate or return) in % 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 if it is a corporate bond; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln; *Size* is the natural logarithm of total assets of the insurer in \$000s; *ROE* is the ratio of net income to surplus as regards policyholders; *Capital ratio* is the ratio of surplus as regards policyholders to total 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 clustering at the insurer level. Fixed effects are included, "Yes", or not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 4: Search for yield: The 2010 Regulatory Reform**

Sample	(1)	(2)
Dependent variable	Insurance	Insurers that are operative in 2009
	company's holding	company's holding as a percentage
		of volume outstanding
Yield	-0.018*	0.029***
	(0.01)	(0.01)
dummy CLO	6.949***	
	(1.18)	
dummy CLO x Yield	0.536***	
	(0.19)	
dummy Reform x Yield	0.034***	
	(0.01)	
dummy Reform x dummy CLO	-2.847**	
	(1.12)	
dummy Reform x dummy CLO x Yield	0.762***	
	(0.25)	
Year>2009 x Yield		0.083***
		(0.02)
Benefit Reform		1.408***
		(0.41)
Benefit Reform x Yield		-0.142***
		(0.04)
Benefit Reform x Year>2009		-1.187***
		(0.45)
Benefit Reform x Year>2009 x Yield		0.162**
		(0.07)
Time-to-maturity	0.000	-0.003
	(0.00)	(0.00)
Outstanding Amount	-0.298***	-0.351***
	(0.02)	(0.02)
Size		0.237***
		(0.02)
ROE		-0.216
		(0.20)
Capital ratio		0.074
		(0.12)
constant	0.879***	-2.535***
	(0.03)	(0.25)
NAIC designation x Year FE	Yes	Yes
Security type (CLO or bond) FE	No	Yes
Type insurer FE	Yes	Yes
Insurer x Year FE	Yes	No
One-way clustering	Insurer	Insurer
N	1653746	1513159
$R^2$	0.3040	0.2163
$Adj - R^2$	0.2865	0.2163
F-stat	54.850***	51.692***
Degrees of freedom	(8,4334)	(11,3055)

This table reports panel regression estimates of a series of extensions to the linear regression model of equation 1 analyzing the heterogeneity of insurers' search for yield based on the 2010 regulatory reform. 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 2 is estimated on the subsample of insurance companies operating in 2009. 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 effective rate or return) in % 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 if it is a corporate bond; *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; *Benefit Reform* is a dummy variable equal to one if, based on the CLO holdings at 2009 year-end, the insurer benefits from a positive shock to its RBC ratio as a result of the 2010 regulatory reform; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln; *Size* is the natural logarithm of total assets of the insurer in \$000s; *ROE* is the ratio of net income to surplus as regards policyholders; *Capital ratio* is the ratio of surplus as regards policyholders to total assets of the insurer; *CAL RBC ratio* is the CAL 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 clustering at the insurer level. Fixed effects are included, "Yes", or not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 5: Insurance companies' preference for CLOs vis-à-vis corporate bonds**

Sample	(1)	(2)	(3)	(4)	(5)
	Assets with Aaa, Aa, A and Baa rating				
Dependent variable	Yield		Insurance company's new holding as a percentage of volume outstanding		
dummy CLO	0.708*** (0.05)	0.275*** (0.03)	10.504*** (0.72)	4.792*** (0.62)	-1.273 (2.26)
Yield CLO/Yield Bond ratio					0.596*** (0.15)
dummy CLO x Yield CLO/Yield Bond ratio					8.415*** (1.71)
Rating=Aa		0.485*** (0.01)		-0.211*** (0.04)	
Rating=A		0.706*** (0.01)		-0.366*** (0.05)	
Rating=Baa		1.226*** (0.01)		-0.498*** (0.06)	
Rating=Aa x dummy CLO		0.204*** (0.03)		5.844*** (0.59)	
Rating=A x dummy CLO		0.646*** (0.05)		7.314*** (0.83)	
Rating=Baa x dummy CLO		1.288*** (0.06)		7.916*** (1.30)	
Time-to-maturity	0.058*** (0.00)	0.059*** (0.00)	-0.000 (0.00)	-0.001 (0.00)	-0.001 (0.00)
Outstanding Amount	0.084*** (0.00)	0.074*** (0.00)	-0.287*** (0.02)	-0.287*** (0.02)	-0.275*** (0.02)
constant	3.211*** (0.01)	2.338*** (0.02)	0.880*** (0.03)	1.329*** (0.05)	0.056 (0.22)
Rating	-	-	-	-	Yes
Rating x Year FE	Yes	No	Yes	No	No
Type insurer FE	Yes	Yes	Yes	Yes	Yes
Insurer x Year FE	Yes	Yes	Yes	Yes	Yes
One-way clustering	Insurer	Insurer	Insurer	Insurer	Insurer
N	1328063	1328063	1328000	1328000	1328000
$R^2$	0.6859	0.6828	0.3107	0.3173	0.3086
$Adj - R^2$	0.6761	0.6729	0.2892	0.2960	0.2870
F-stat	2043.398***	1763.139***	138.457***	50.366***	87.222***
Degrees of freedom	(3, 4320)	(9, 4320)	(3, 4329)	(9, 4329)	(5, 4329)

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 3-5) 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 effective rate or return) in % of the security reported by the insurer; the dependent variable of columns 3-5 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 if it is a corporate bond; *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' first-time investments in CLOs to the average yield of insurers' first-time investments in corporate bonds for each rating-year pair; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for clustering at the insurer 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: The 2010 regulatory reform**

Sample	(1)	(2)
	Assets with Aaa, Aa, A and Baa rating	
Dependent variable	Insurance company's new holding as a percentage of volume outstanding	
dummy CLO	25.407*** (3.62)	38.093*** (7.32)
Yield CLO/Yield Bond ratio	0.409*** (0.11)	0.142 (0.09)
dummy CLO x Yield CLO/Yield Bond ratio	-11.485*** (2.35)	-16.099*** (4.33)
dummy Reform x dummy CLO	-33.098*** (3.83)	
dummy Reform x Yield CLO/Yield Bond ratio	-0.401* (0.22)	
dummy Reform x dummy CLO x Yield CLO/Yield Bond ratio	24.915*** (2.76)	
Year>2009 x dummy CLO		-50.333*** (7.22)
Year>2009 x Yield CLO/Yield Bond ratio		0.326 (0.20)
Year>2009 x dummy CLO x Yield CLO/Yield Bond ratio		31.865*** (4.32)
Benefit Reform x dummy CLO		0.052 (8.65)
Benefit Reform x Yield CLO/Yield Bond ratio		1.109*** (0.42)
Benefit Reform x dummy CLO x Yield CLO/Yield Bond ratio		0.796 (4.91)
Benefit Reform x Year>2009 x dummy CLO		24.431*** (9.07)
Benefit Reform x Year>2009 x Yield CLO/Yield Bond ratio		0.598 (0.94)
Benefit Reform x Year>2009 x Yield CLO/Yield Bond ratio x dummy CLO		-15.345*** (5.49)
Time-to-maturity (years)	-0.001 (0.00)	0.003 (0.00)
Outstanding Amount (\$bln)	-0.278*** (0.02)	-0.305*** (0.02)
constant	0.705*** (0.22)	0.147 (0.26)
Rating FE	Yes	Yes
Type insurer FE	Yes	Yes
Insurer x Year FE	Yes	Yes
One-way clustering	Insurer	Insurer
N	1328000	1204130
$R^2$	0.3148	0.3344
$Adj - R^2$	0.2935	0.3144
F-stat	55.352***	39.944***
Degrees of freedom	(8, 4329)	(14, 3002)

This table reports panel regression estimates of extensions of the linear regression model of equation 3 analyzing how the sensitivity of insurers' preference for CLOs over corporate bonds to the yields ratio varies based on the 2010 regulatory reform. 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 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 if it is a corporate bond; *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' first-time investments in CLOs to the average yield of insurers' first-time investments in corporate bonds for each rating-year pair; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for clustering at the insurer level. Control variables and fixed effects are included, "Yes". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 7: Insurance companies' preference for CLOs vis-à-vis corporate bonds: Aggregate results**

Sample	(1)	(2)	(3)	(4)
	Holdings with Aaa, Aa, A and Baa rating			
	2005-2014			
Dependent variable	Insurance company's aggregate new holdings of CLOs as a percentage of total new holdings of CLOs and corporate bonds by rating			
Yield CLO/Yield Bond ratio	8.481*** (0.38)			
dummy Reform		1.273*** (0.16)		
Year>2009			2.021*** (0.18)	
Benefit Reform x Year>2009			9.145*** (1.81)	
Year=2006				-0.207* (0.11)
Year=2007				-0.301** (0.12)
Year=2008				-0.644*** (0.13)
Year=2009				-0.134 (0.13)
Year=2010				0.409** (0.16)
Year=2011				0.714*** (0.20)
Year=2012				1.303*** (0.26)
Year=2013				1.871*** (0.28)
Year=2014				2.842*** (0.32)
Outstanding CLO/ Outstanding Bond ratio	18.561*** (0.51)	18.962*** (0.50)	19.154*** (0.53)	14.801*** (0.69)
Size		2.149*** (0.26)	1.534*** (0.28)	0.298 (0.41)
ROE		0.810** (0.34)	0.949** (0.37)	1.022*** (0.34)
Capitalization		-0.118 (1.08)	-2.023* (1.19)	-2.993*** (0.86)
CAL RBC ratio		0.043*** (0.01)	0.046*** (0.01)	0.015** (0.01)
constant	-10.885*** (0.57)	-27.253*** (3.31)	-19.707*** (3.60)	-3.266 (5.12)

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Table 7 - continued from previous page

Rating FE	Yes	Yes	Yes	Yes
Type insurer FE	Yes	Yes	Yes	Yes
Insurer FE	-	Yes	Yes	Yes
Insurer x Year FE	Yes	No	No	No
One-way clustering	Insurer	Insurer	Insurer	Insurer
N	112165	114536	101638	65521
$R^2$	0.6184	0.3776	0.3804	0.3334
$Adj - R^2$	0.4287	0.3539	0.3618	0.2946
F-stat	671.156***	249.714***	201.436***	37.687***
Degrees of freedom	(2, 4237)	(6, 4184)	(7, 2946)	(14, 3580)

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 at the aggregate level. Models are estimated on a dataset at the insurer-rating-year level covering first-time investments by insurance companies in CLO tranches and corporate bonds rated Aaa, Aa, A or Baa. Model 4 is estimated on the time period 2005-2014. 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 a percentage of the total volume of first-time 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' first-time investments in CLOs to the average yield of insurers' first-time investments in corporate bonds for each rating-year pair; *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; *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 assets of the insurer in \$000s; *ROE* is the ratio of net income to surplus as regards policyholders; *Capital ratio* is the ratio of surplus as regards policyholders to total assets of the insurer; *CAL RBC ratio* is the CAL 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 clustering at the insurer 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: Capital structure of CLO deals**

Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dependent variable		Aaa			Aa-A-Baa Tranches as a % of CLO			Ba-B-Caa-Ca-C		Equity
% of CLO held by ICs	-0.321*** (0.06)	-0.100* (0.06)	-0.257*** (0.09)	0.378*** (0.08)	0.026 (0.03)	0.300*** (0.09)	-0.031*** (0.01)	-0.008 (0.01)	0.003 (0.05)	-0.015 (0.02)
dummy Reform x % of CLO held by ICs		-0.241*** (0.09)			0.385*** (0.09)			-0.026** (0.01)		
Year>2009 x % of CLO held by ICs			0.310*** (0.12)			-0.385*** (0.13)			0.004 (0.05)	
% of CLO held by ICs Benefit Reform			0.134 (0.21)			-0.242 (0.16)			-0.007 (0.05)	
% of CLO held by ICs Benefit Reform x % of CLO held by ICs			0.003 (0.00)			-0.001 (0.00)			0.000 (0.00)	
Year>2009 x % of CLO held by ICs Benefit Reform			0.197 (0.24)			-0.115 (0.21)			0.009 (0.06)	
Year>2009 x % of CLO held by ICs Benefit Reform x % of CLO held by ICs			-0.013*** (0.00)			0.013*** (0.00)			-0.001 (0.00)	
constant	66.582*** (0.91)	66.419*** (0.84)	61.402*** (0.79)	16.909*** (1.14)	17.169*** (1.04)	23.157*** (0.96)	4.700*** (0.09)	4.683*** (0.09)	4.280*** (0.13)	10.345*** (0.29)
Manager x Issuance Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
One-way clustering	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager
N	1708	1708	1708	1708	1708	1708	1708	1708	1708	1708
R <sup>2</sup>	0.6490	0.6520	0.7208	0.5460	0.5555	0.6781	0.6359	0.6369	0.6514	0.6299
Adj - R <sup>2</sup>	0.4749	0.4788	0.5804	0.3209	0.3344	0.5162	0.4553	0.4564	0.4762	0.4463
F-stat	27.080*** (1, 131)	16.096*** (2, 131)	196.174*** (6, 131)	24.571*** (1, 131)	13.700*** (2, 131)	184.611*** (6, 131)	24.460*** (1, 131)	12.817*** (2, 131)	51.276*** (6, 131)	0.638 (1, 131)

This table reports regression estimates of the linear regression models of equation 5 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 and whose tranches are denominated in USD. 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) equity tranches (column 10), in the year of the issuance. Both the numerator and the denominator of the dependent variable exclude combo notes pertaining to the CLO deal. 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 (the numerator of this variable includes holdings of combo notes pertaining to the CLO deal whereas the denominator does not); *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; % CLO held by ICs *Benefit Reform* is the percentage of the CLO deal held by insurance companies that stood to benefit from the 2010 regulatory reform based on their CLO holdings at year-end 2009 in the year of issuance of the CLO deal. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for clustering at the CLO manager level. Fixed effects are included, "Yes". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 9: Collateral pool, debt tranches and equity tranches of CLO deals**

Sample	(1) Collateral pool of CLO deals		(2) Debt tranches of CLO deals		(3) Aaa		(4) Aa-A-Baa		(5) Ba-B-Caa-Ca-C		(6) All CLO deals until min(reinv date, refi date)		(7) Matured and Terminated CLO deals		(8)
	Spread	Weighted average spread	Manager	Weighted average interest rate	Manager	Weighted average interest rate	Manager	Weighted average interest rate	Manager	Average interest rate	Internal rate of return	PME			
% of CLO held by ICs	0.002** (0.00)	0.005*** (0.00)	Yes	0.002 (0.00)	0.001 (0.00)	-0.004 (0.00)	0.038* (0.02)	0.151** (0.07)	0.003** (0.00)	0.038* (0.02)	0.151** (0.07)	0.003** (0.00)			
constant	3.532*** (0.02)	3.516*** (0.02)	Yes	2.735*** (0.03)	3.919*** (0.04)	7.428*** (0.06)	19.002*** (0.29)	6.231*** (1.32)	1.281*** (0.03)	19.002*** (0.29)	6.231*** (1.32)	1.281*** (0.03)			
Manager x Issuance Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No			
Issuance Year FE	-	-	-	-	-	-	-	-	-	-	Yes	Yes			
One-way clustering	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager	Manager			
N	421615	1583	1571	1533	1358	1412	732	732	732	732	732	732			
$R^2$	0.2279	0.8557	0.6382	0.5489	0.6533	0.5847	0.3461	0.6016	0.6016	0.5847	0.3461	0.6016			
$Adj - R^2$	0.2260	0.7822	0.4543	0.3212	0.4684	0.3733	0.3343	0.5943	0.5943	0.3733	0.3343	0.5943			
F-stat	4.521**	9.188***	0.934	0.232	0.779	3.551*	4.084**	5.208**	5.208**	4.084**	4.084**	5.208**			
Degrees of freedom	(1, 189)	(1, 125)	(1, 126)	(1, 125)	(1, 118)	(1, 117)	(1, 117)	(1, 138)	(1, 138)	(1, 117)	(1, 138)	(1, 138)			

This table reports panel regression estimates of three econometric models analyzing the riskiness of the underlying pool of loans of CLO deals based on equation 6 and its extension (models 1-2), the interest rate paid by debt tranches of CLO deals based on equation 7 (models 3-5), and the return earned by the equity tranche of CLO deals based on equation 8 (models 6-8) in relation to the share of the CLO deal held by insurance companies. Model 1 is estimated on a dataset at the loan investment-CLO deal-manager-issuance year level; models 2-7 are estimated on various datasets at the CLO deal-manager-issuance year level. The datasets cover information on CLO deals issued over the time period 2003-2019 and whose tranches are denominated in USD. The dependent variable of model 1 is the interest rate spread in % charged on a loan investment belonging to the collateral pool of a CLO deal at the end of the year of origination, excluding credit lines, revolving loans and Term Loan A facilities; the dependent variable of model 2 is the weighted average spread in % of loan investments in the collateral pool of a CLO deal in the year of issuance, excluding credit lines, revolving loans and Term Loan A facilities; the dependent variable of models 3-5 is the weighted average interest rate in % of debt tranches of CLO deals (excluding combo notes) by groups of credit ratings in the first payment year after origination of the deal; the dependent variable of model 6 is the average of the annualized rate of returns in % earned by the equity tranche of CLO deals (excluding deals that represent a repackaging of CLO tranches from another/other CLO deal/s) in each pay period during the life of the deal until the minimum between the end of the reinvestment period, the first refinancing date (in case the CLO deal is refinanced) and the last pay date in 2019 (when our sample ends); the dependent variables of model 7 is the internal rate of return (IRR) in % earned by the equity tranche of CLO deals matured or terminated during our sample period, excluding CLO deals that represent a repackaging of CLO tranches from another/other CLO deal/s; the dependent variable of model 8 is the public market equivalent (PME) of Kaplan and Schoar (2005) for the equity tranche of CLO deals matured or terminated during our sample period, excluding CLO deals that represent a repackaging of CLO tranches from another/other CLO deal/s, calculated by discounting the period cash flows to the equity tranche using the returns of the S&P 500. 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 (the numerator of this variable includes holdings of combo notes pertaining to the CLO deal whereas the denominator does not). For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors are corrected for clustering at the CLO manager 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: Generalized public market equivalent of equity tranches of CLO deals**

Sample CLO deal issuance year	(1)	(2)	(3)	(4)
	CLO deals with high % held by ICs		CLO deals with low % held by ICs	
	N deals	GPME	N deals	GPME
2003-2004	17	0.196*** [0.000]	18	-0.099* [0.052]
2005-2006	107	0.842*** [0.000]	108	0.791*** [0.000]
2007-2008	78	1.096*** [0.000]	90	0.902*** [0.000]
2010-2011	16	0.783*** [0.000]	16	0.024 [0.886]
2012-2013	77	0.024 [0.691]	77	-0.012 [0.933]
2014-2016	64	0.152*** [0.001]	64	0.144** [0.011]

This table reports the estimates of the generalized public market equivalent (GPME) of Korteweg and Nagel (2016) for the equity tranche of different subgroups of CLO deals matured or terminated by November 2019 (excluding deals that represent a repackaging of CLO tranches from another/other CLO deal/s). CLO deals are grouped based on i) their issuance year into six buckets of two-year/three-year periods and ii) whether the percentage of the CLO deal held by insurance companies in the year of origination is above (columns 1 and 2) or below (columns 3 and 4) the median for CLO deals issued in the corresponding time interval. Since there are only two CLO deals issued in 2009 and terminated/matured by the end of 2019 in our sample and none of them complies with our quality control constraints, we exclude CLO deals issued in 2009 from these estimates. The number of CLO deals pertaining to each subgroup is reported in columns 1 and 3. The estimates of the GPME for each subgroup of CLO deals are reported in columns 2 and 4. We consider a general CAPM stochastic discount factor (SDF). The SDF parameters are identified to correctly price benchmark funds that receive the same inflows as the CLO equity tranches but that invest in the CRSP value-weighted index and one-month T-bills. The p-values of the  $J$ -test that the GPME estimate is equal to zero are reported in square brackets under the GPME estimate. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 11: Insurance companies' CLO investments and the size of syndicated loans: Loan level analysis**

Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	New loans		Outstanding loans	New loans		New loans Risky	New loans Safe	New loans
	Log(Loan amount)							
CLOsh	0.640*** (5.41)							
INS-CLOsh		1.425*** (7.74)	1.365*** (8.33)	0.626 (1.25)	0.226 (0.61)	0.412 (0.86)	-1.001 (-0.78)	
NINS-CLOsh		-0.077 (-0.50)	0.061 (0.51)	0.696*** (2.79)	0.146 (0.51)	0.697** (2.16)	0.954* (1.94)	0.169 (1.07)
INS-CLOsh×Regref				1.042** (2.01)		1.231** (2.48)	1.259 (0.88)	
NINS-CLOsh×Regref				-1.483*** (-4.43)		-1.582*** (-3.95)	-1.555 (-1.41)	
INS-CLOsh×Postref				0.927 (1.61)		0.648 (1.10)	0.720 (0.39)	
NINS-CLOsh×Postref				-1.466*** (-2.83)		-0.473 (-1.15)	3.699 (1.24)	
Riskyloan					-0.078 (-1.52)			
INS-CLOsh×Riskyloan					0.845** (2.33)			
NINS-CLOsh×Riskyloan					-0.220 (-0.71)			
INS-CLOWsh								7.773*** (7.48)
LEADsh	-0.919*** (-5.31)	-0.927*** (-5.41)	-1.166*** (-10.90)	-0.920*** (-5.36)	-0.855*** (-4.31)	-0.797*** (-3.29)	-0.384 (-1.10)	-0.942*** (-5.54)
FUNDsh	0.447*** (2.93)	0.342** (2.32)	0.204 (1.59)	0.317** (2.15)	0.358** (2.42)	0.168 (1.01)	0.318 (0.79)	0.354** (2.39)
FCOMPANYsh	0.010 (0.04)	0.058 (0.21)	-0.267 (-1.42)	-0.004 (-0.02)	-0.098 (-0.31)	0.482 (1.16)	-0.662 (-1.28)	0.038 (0.14)
PEQUITYsh	-0.932*** (-2.82)	-0.853*** (-2.64)	-0.905*** (-3.76)	-0.875*** (-2.65)	-0.765** (-2.08)	-1.590*** (-4.27)	0.125 (0.16)	-0.874*** (-2.70)
INSURANCEsh	0.607 (1.51)	0.571 (1.48)	0.763** (2.39)	0.464 (1.25)	0.872 (1.27)	1.006 (1.03)	0.264 (0.29)	0.557 (1.44)
Matleft	0.101*** (9.36)	0.100*** (9.50)	0.121*** (22.48)	0.098*** (9.32)	0.097*** (8.23)	0.120*** (6.04)	0.083*** (5.10)	0.098*** (9.32)
Tloanb	-0.062* (-1.87)	-0.048 (-1.44)	-0.033 (-1.30)	-0.060* (-1.81)	0.185*** (4.48)	0.247*** (3.79)	0.196*** (2.95)	-0.041 (-1.24)
IG	0.013 (0.24)	0.005 (0.08)	-0.026 (-1.19)	-0.000 (-0.00)	-0.024 (-0.38)	-0.087 (-1.06)	0.083 (0.64)	0.006 (0.11)
Workcap	0.025 (0.60)	0.033 (0.78)	0.022 (0.90)	0.033 (0.77)	0.041 (0.92)	0.164** (2.18)	-0.016 (-0.25)	0.035 (0.82)
M&A	0.258*** (6.54)	0.256*** (6.49)	0.194*** (7.57)	0.255*** (6.50)	0.213*** (4.99)	0.279*** (4.30)	0.226*** (3.65)	0.256*** (6.46)
Recap	0.217*** (3.63)	0.221*** (3.68)	0.172*** (4.28)	0.223*** (3.77)	0.171*** (2.68)	0.291*** (3.06)	0.087 (0.89)	0.219*** (3.64)
Projfin	0.181 (0.88)	0.165 (0.81)	0.148* (1.88)	0.177 (0.86)	0.289* (1.80)	0.012 (0.04)	0.527** (2.39)	0.168 (0.82)
Capexp	-0.379*** (-2.70)	-0.379*** (-2.81)	-0.287*** (-3.93)	-0.374*** (-2.78)	-0.163 (-1.34)	-0.225 (-1.14)	-0.041 (-0.22)	-0.376*** (-2.77)
Debtrepay	0.124*** (2.99)	0.124*** (2.99)	0.104*** (3.33)	0.129*** (3.12)	0.016 (0.36)	0.105 (1.49)	0.011 (0.13)	0.130*** (3.15)
Lassets	0.313*** (3.14)	0.305*** (3.09)	0.172*** (3.80)	0.308*** (3.08)	0.101 (0.90)	-0.023 (-0.13)	0.408** (1.97)	0.315*** (3.19)
C&I	0.808 (0.88)	0.905 (1.00)	1.193*** (3.45)	0.896 (0.98)	1.636* (1.76)	1.104 (0.77)	3.505** (2.16)	0.995 (1.09)
ROA	5.741 (1.55)	5.386 (1.46)	0.597 (0.63)	5.646 (1.53)	10.265** (2.11)	1.408 (0.18)	19.903** (2.16)	5.480 (1.49)
Chargeoffs	16.775** (2.44)	16.806** (2.45)	0.091 (0.04)	14.804** (2.09)	15.704* (1.77)	4.641 (0.34)	25.708* (1.82)	15.223** (2.22)

Continued on next page

Capital	-0.552 (-0.43)	-0.642 (-0.50)	-0.187 (-0.40)	-0.615 (-0.48)	-1.026 (-0.73)	-3.673* (-1.74)	0.440 (0.17)	-0.482 (-0.38)
Deposits	-0.231 (-0.48)	-0.413 (-0.85)	-0.030 (-0.15)	-0.297 (-0.60)	-0.949 (-1.64)	-2.040** (-2.08)	-0.179 (-0.20)	-0.420 (-0.86)
constant	0.511 (0.24)	0.804 (0.38)	3.194*** (3.47)	0.694 (0.33)	5.432** (2.21)	8.716** (2.41)	-1.789 (-0.40)	0.602 (0.29)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
One-way clustering	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower
N	8937	8937	35794	8937	4772	2188	2159	8937
$R^2$	0.845	0.846	0.844	0.847	0.847	0.878	0.850	0.846

This table reports regression estimates of the linear regression models of equation 9 and its extensions analyzing the issuance of syndicated loans in relation to insurance companies' investments in CLOs. Models are estimated on a dataset at the loan-lead arranger bank-year level covering syndicated term loans issued between 2003 and 2020. The dependent variable is the log of the loan amount. Models 1-2, 4-5, and 8 are estimated on the subsample of new syndicated term loans in the year of origination; model 3 is estimated on the sample of outstanding syndicated term loans throughout their lifetime as covered by the Shared National Credit Program; models 6-7 are estimated on the subsamples of risky, respectively safe, newly originated syndicated term loans.  $CLOsh$  is the share of the loan held by CLOs.  $INS-CLOsh$  and  $NINS-CLOsh$  are the share of the loan held by CLOs with and without investments by insurance companies at origination, respectively.  $Regref$  is a dummy equal to one for loans issued between 2011 and 2018, while  $Postref$  is a dummy equal to one for loans issued post 2018. We fix the beginning of the reform period in 2011 rather than 2010 because our loan data is reported at year-end and loans issued in the early 2010 are unlikely to be affected by the reform since they were negotiated prior to the announcement of the new regulatory regime, i.e. either earlier in the year or in 2009.  $Riskyloan$  is a dummy equal to one for risky loans, identified as those with an all-in-drawn spread above 250 bps (the sample median), and zero for safe loans. The sample of model 5 is smaller compared to that of models 1-2 and 4 because only a portion of term loans in the the Shared National Credit Program can be matched with Dealscan, which is our source for loan spreads.  $INS-CLOWsh$  is the aggregate share of the loan held by CLOs where each portion of the loan owned by a given CLO is weighted by the portion of the CLO debt tranches held by insurance companies. See Internet Appendix E.2 for the definitions of the remaining controls used in the regressions. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors are corrected for clustering at the borrower level. Fixed effects are included, "Yes", or not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

**Table 12: Insurance companies' CLO investments and the size of syndicated loans: Aggregate analysis**

Sample	(1) New loans	(2) New loans Risky	(3) New loans Safe	(4) New loans	(5) New loans Risky	(6) New loans Safe
Dependent variable	Log(Loan amount)					
INS-CLOshbk	-2.101 (-0.65)	-18.504 (-1.53)	0.547 (0.04)	-0.009** (-2.27)	-0.003** (-2.19)	-0.002 (-1.53)
NINS-CLOshbk	-0.469 (-0.37)	9.870* (1.68)	9.413 (1.35)	0.002 (1.53)	0.001** (2.51)	0.001** (2.24)
INS-CLOshbk×Regref	2.506 (0.91)	28.900** (2.47)	-0.605 (-0.04)	0.009** (2.30)	0.003** (2.34)	0.002 (1.63)
NINS-CLOshbk×Regref	-2.638 (-1.31)	-17.696*** (-3.45)	-11.021** (-2.15)	-0.004 (-1.47)	-0.001** (-2.12)	-0.002*** (-2.68)
INS-CLOshbk×Postref	2.633 (0.93)	34.926* (1.87)	1.610 (0.08)	0.009** (2.23)	0.002* (1.71)	0.002 (1.42)
NINS-CLOshbk×Postref	-1.073 (-0.32)	-45.079** (-2.33)	-33.281* (-1.96)	-0.004* (-1.95)	-0.002** (-2.00)	-0.003** (-2.58)
FUNDshbk	2.643*** (2.64)	11.104*** (6.50)	-0.382 (-0.30)	0.001* (1.84)	0.001** (2.18)	0.000 (0.98)
INSURANCEshbk	2.489 (0.80)	7.691 (1.04)	1.471 (0.20)	0.005 (0.92)	-0.000 (-1.04)	-0.001*** (-3.21)
PEQUITYshbk	-0.852 (-0.30)	-0.889 (-0.13)	-8.370 (-1.57)	-0.002 (-0.92)	-0.001 (-1.04)	0.000 (0.56)
FCOMPANYshbk	3.502** (2.33)	16.529*** (3.10)	6.183 (1.22)	0.001 (1.51)	0.000 (1.44)	0.000 (1.12)
Lassets	0.284** (2.06)	0.681* (1.69)	0.377 (0.80)	-0.000 (-1.19)	-0.000 (-0.97)	0.000 (0.09)
C&I	1.160 (1.09)	4.089 (1.18)	4.876 (1.60)	-0.003 (-1.30)	0.000 (0.18)	0.000 (1.34)
ROA	1.889 (0.41)	-23.334 (-1.30)	3.634 (0.23)	-0.009 (-0.65)	-0.001 (-1.29)	0.000 (0.16)
Chargeoffs	-2.884 (-0.29)	-33.876 (-1.35)	-9.419 (-0.35)	-0.014 (-0.77)	-0.002 (-1.20)	0.002 (0.89)
Capital	-1.919 (-1.52)	3.981 (0.85)	7.499 (1.30)	0.001 (0.92)	-0.000 (-0.54)	0.001 (1.16)
Deposits	0.275 (0.35)	1.795 (0.89)	2.102 (1.07)	0.001 (1.17)	-0.000 (-1.30)	-0.000 (-1.55)
Leadamt	0.531*** (8.49)	0.699*** (6.74)	0.762*** (8.72)	0.000** (2.26)	0.000*** (3.45)	0.000*** (3.55)
Lpartamt	-0.068*** (-3.03)	-0.082 (-0.96)	0.023 (0.27)	-0.000 (-0.21)	0.000 (1.38)	0.000 (0.58)
constant	0.044 (0.02)	-15.252** (-2.15)	-11.554 (-1.37)	0.001 (0.55)	0.000 (0.44)	-0.000 (-0.47)
Lead Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
One-way clustering	Bank	Bank	Bank	Bank	Bank	Bank
N	737	737	737	737	737	737
R <sup>2</sup>	0.942	0.803	0.793	0.665	0.635	0.588

This table reports regression estimates of an aggregated version of models 4, 6 and 7 of Table 11, and their extensions, analyzing the issuance of syndicated loans in relation to insurance companies' investments in CLOs. Models are estimated on an dataset at the lead arranger bank-year level covering the aggregate volume of new syndicated term loans issued by each lead arranger bank between 2003 and 2020. The dependent variable is the log of the total amount of new term loans arranged by the lead bank over the year in models 1-3 and the same variable scaled by the lead banks' lagged assets in models 4-6. Models 2-3 and 5-6 are estimated on the subsamples of risky, respectively safe, newly originated syndicated term loans. Risky/safe loans are identified as those with an all-in-drawn spread above/below 250 bps (the sample median in the granular loan-level dataset). *INS-CLOshbk* and *NINS-CLOshbk* are the share of the loans arranged by the lead bank over the year held by CLOs with and without investments by insurance companies at origination, respectively. *Regref* is a dummy equal to one for loans issued between 2011 and 2018, while *Postref* is a dummy equal to one for loans issued post 2018. We fix the beginning of the reform period in 2011 rather than 2010 because our loan data is reported at year-end and loans issued in the early 2010 are unlikely to be affected by the reform since they were negotiated prior to the announcement of the new regulatory regime, i.e. either earlier in the year or in 2009. See Internet Appendix E.2 for the definitions of the remaining controls used in the regressions. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors are corrected for clustering at the lead bank level. Fixed effects are included, "Yes", or not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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Internet Appendix to  
Insurance companies and the growth of corporate loans'  
securitization

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# Internet Appendix to Insurance companies and the growth of corporate loans' securitization

## Overview

This appendix contains additional information and results for our paper “Insurance companies and the growth of corporate loans' securitization”. We begin by presenting information on insurance capital regulation that complements the description we presented in Section 2 of our paper. Specifically, Section A below describes in detail the capital regulation applicable to insurance companies and discusses the changes implemented in 2010 that are relevant for insurance companies' investment in CLOs.

Section B provides detailed information on the identification of corporate bond holdings in the portfolio of insurers.

Section C complements the analysis reported in Section 4 of the paper on insurance companies' search for yield. Here we report further graphical evidence and the results of three additional robustness tests investigating (i) differences in insurers' search for yield over time; (ii) the heterogeneity in insurers' search for yield behavior across their capital standards; (iii) the search for yield heterogeneity across P&C companies in response to natural disasters.

Section D complements the analysis reported in Section 5 of the paper on insurance companies' preferences for CLOs over corporate bonds. Specifically, we investigate how these preferences manifested themselves before, during and after the financial crisis. Additionally, we investigate how these preferences vary with insurance companies' capital standards.

Finally, Section E complements the analysis reported in Section 6 of our paper on the impact of insurance companies on the CLO market and the primary market for

bank credit. Specifically, we examine to what extent insurance companies played a role on (i) the composition of the coupon type of CLO tranches, (ii) the creation of CLO deals backed by CLO tranches from other deals, (iii) the length of the non-call period, and (iv) the refinancing of CLO deals. Lastly, we report the results of a robustness test investigating if the positive impact of insurance companies' investments in CLOs on the issuance of syndicated loans, especially to risky borrowers, is confirmed when we consider a broader set of lead arrangers including foreign bank organizations.

## **A Insurance Companies' Capital Regulation**

Capital adequacy is the key microprudential tool 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 the NAIC's coordination role.<sup>1</sup> 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,

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<sup>1</sup>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.

the current regulatory framework sets the required capital at the legal entity level (and not at the consolidated level).<sup>2</sup>

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 plus adjustments) 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 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. As explained in Section 2, the risk-based capital charge is defined for different buckets of assets' credit quality named "NAIC designations" (NAIC, 2018, 2020). The original regulatory framework defined 6 different NAIC designations, which have been broken down into 20 sub-categories starting in 2021. 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 in our sample assign a NAIC designation (and the associated risk-based capital charge) to fixed income investments (other than Treasuries and MBS) by converting credit ratings according to the mapping presented in Table 1.

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

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<sup>2</sup>NAIC created a "Group Capital Calculation Working Group" that is currently developing a capital requirement to be applied at the group level.

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.

### **A.1 The 2010 Reform of Capital Requirements for CLO Investments**

In 2010, the NAIC introduced a new methodology to calculate capital requirements for CLO investments (Foley-Fisher et al., 2023). The new framework allowed insurers to assign CLO tranches purchased at discount or highly impaired a lower NAIC designation than that implied by the rating-based mapping 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. If the conversion results in a NAIC 2-5 category, compare the ratio  $book\ value \times 100 / par\ value$  to the breakpoints of Table A1 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  $\min(book\ value, fair\ value) \times 100 / par\ value$  to the pricing matrix of Table A1 and assign the final designation accordingly.

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

As per statutory guidelines, the NAIC designation of CLOs determined according

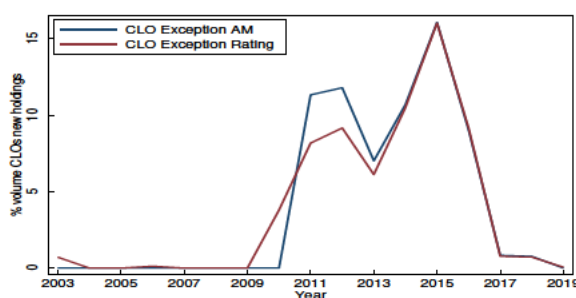
to points 2 and 3 of the MFE process must be reported with the suffix “AM”. While a NAIC designation including this substring does not automatically signal an exception to the baseline rating mapping for the NAIC 2-6 categories, all NAIC 1 designations including the “AM” suffix identify tranches whose 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.

**Table A1: 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.

**Figure A1: Insurance companies’ share of NAIC 1 investments reported according to the MFE process**



This figure plots the time series of (i) the percentage of first-time investments in CLO tranches with a NAIC 1 designation reported according to the “modified filing exempt” approach, MFE, as identified from the “AM” suffix included in the NAIC designation (blue line), and (ii) the percentage of first-time investments in CLO tranches with a NAIC 1 designation that have a credit rating different from Aaa, Aa or A (red line). Source: Authors’ calculations based on data from 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.

## B Insurance Companies' Corporate Bond Holdings

As described in Section 3, we identify corporate bonds in the fixed-income portfolio of insurance companies by matching their granular holdings data from “Schedule D-Part 1” of the financial statement filings with data on corporate bonds from Mergent Fixed Income Securities Database (FISD). To perform this matching we use the cusip identifier of the security and validate the match by looking at various attributes of the bond (including issuance date, issuer and maturity date).

While Mergent FISD provides full coverage on virtually all publicly offered U.S. corporate bonds, it may not be as comprehensive when it comes to private placements. Typically, privately placed bonds held by insurance companies receive a special identifier by CUSIP Global Services named “Private Placement Number” (PPN). This identifier has the same format as a cusip identifier, with the exception that it contains a special character (@, # or \*) in position 6, 7 or 8.<sup>3</sup> We, thus, attempt to pinpoint privately placed corporate bonds in the portfolio of insurers that are outside of the scope of Mergent FISD by identifying the cusips reported in the subsections “issuer obligations” of Schedule D-Part 1 that include these special characters. While this approach does not guarantee to be entirely error-free, it likely allows us to identify the full set of private placements corporate bonds held by insurance companies.

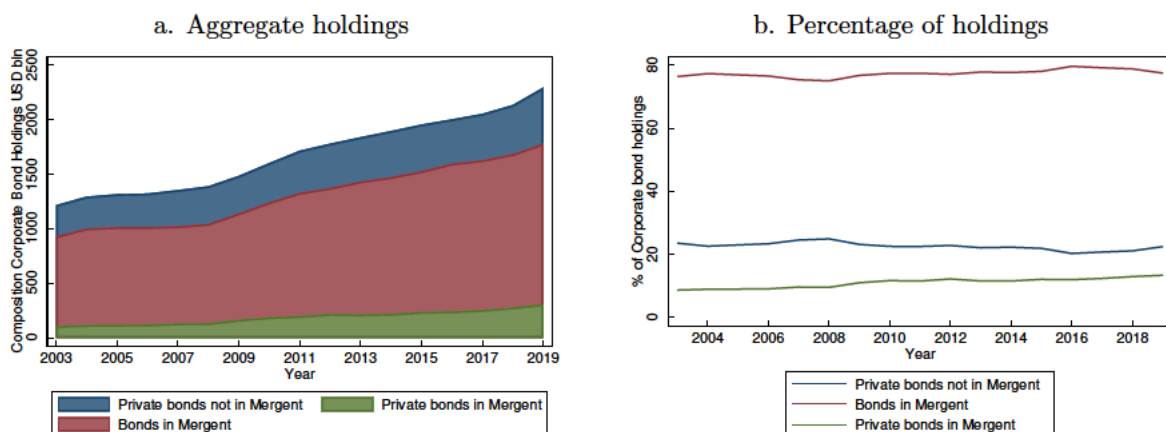
Figure B1 shows the composition of insurance companies' corporate bond holdings over time as identified according to the cusip matching and textual methodology described above. Insurance companies' investments in corporate bonds went from \$1.217B in 2003 to \$2,297B in 2019. Corporate bonds covered by Mergent FISD account for about 80% of total holdings throughout the sample period, with the remaining accounted for by privately placed corporate bonds not cover by Mergent FISD. Private placements covered by Mergent FISD account for 9% to 13% of total holdings during our sample

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<sup>3</sup>See <https://www.access.cusip.com/access/help-center/glossary-logged-out.html>

period, somewhat above half of the corresponding percentage for privately placed corporate bonds not covered by Mergent FISD. Overall, this indicates that corporate bonds matched with Mergent FISD represent a comprehensive fraction of insurance companies' corporate bond holdings throughout the sample period.

**Figure B1: Insurance companies' holdings of corporate bonds**



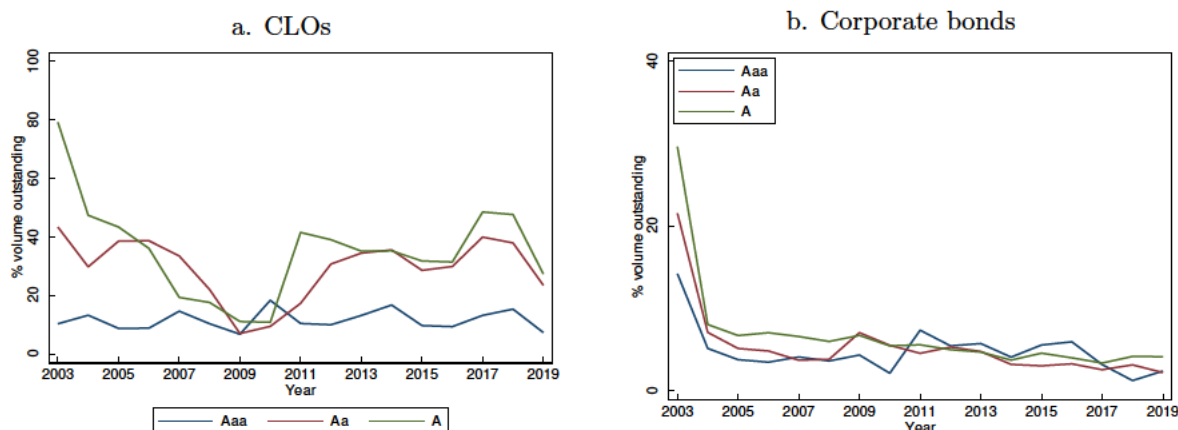
This figure plots the composition of insurance companies' corporate bond holdings over time. Plot (a) shows the time series of the aggregate volume of insurance companies' investments in USD-denominated i) private placement corporate bonds not covered in Mergent Fixed Income Securities Database (FISD), ii) private placement corporate bonds covered in Mergent FISD, and iii) all corporate bonds covered in Mergent FISD as of December 31 of each year, over the time period 2003-2019. Plot (b) shows the time series of the aggregate volume of insurance companies' investments in the three categories of bonds as a percentage of total corporate bond holdings. Source: Authors' calculations based on data from 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).

## C Insurance companies' search for yield: Additional results

In this section, we report the counterpart of Figure 6 based on the credit rating rather than the distribution of yields of insurers' investments in CLOs and corporate bonds (Figure C1). In addition, we present the results of three additional robustness tests investigating (i) differences in insurers' search for yield over time; (ii) the heterogeneity in insurers' search for yield behavior across their capital standards; (iii) the search for yield heterogeneity across P&C companies in response to natural disasters.



Figure C1: Share of CLOs and corporate bonds held by insurance companies by rating



This figure plots i) the time series of insurers' new CLO holdings in the NAIC 1 designation bucket as a percentage of the total volume outstanding of these CLO tranches by credit rating (a) and ii) the time series of insurers' new corporate bond holdings in the NAIC 1 designation bucket as a percentage of the total volume outstanding of these corporate bonds by credit rating (b) as of December 31 of each year during the time period 2003-2019. New CLO and corporate bond holdings and are identified as first-time investments in a given CLO tranche or corporate bond by an insurance company. Source: Authors' calculations based on data from 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; Moody's; Mergent Fixed Income Securities Database (FISD).

## C.1 Search for yield over time

We begin by exploring 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.<sup>4</sup> It also overlaps with the 2010 regulatory reform, which made it easier for insurance companies to search for yield in the CLO market. The results of our investigation on the heterogeneity of the effects over time are reported in Table C1.

Column 1 of Table C1 investigates how insurance companies' incentives to reach for yield changed across the years in our sample period. The interaction terms between the yield and the year dummies suggest that insurance companies searched for yield both in the years immediately leading up to the financial crisis (when interest rates were relatively high) and the post-crisis period (when interest rates were relatively low), but this behavior is much stronger during the latter time period (roughly double in magnitude

<sup>4</sup>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).

starting in 2012 compared to 2006). In column 2 of Table C1 we replicate the analysis by splitting the sample into four different economic and monetary policy regimes: pre-crisis (2003-2006), financial crisis (2007-2008), zero lower bound (ZLB) period (2009-2015) and post-ZLB (2016-2019). The interaction terms between the yield and the time dummies confirm that insurance companies' search for yield behavior becomes material from 2009 onwards.

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 period, when the policy rate increased, compared to the ZLB-period. Overall, this suggests that the economic cycle affects firms' propensity to search for yield, with insurers investing more in higher yield securities within a NAIC bucket in periods of economic growth. Monetary policy seems also to play an important role, as this phenomenon is stronger in an environment of low interest rates. It is worth noting that, while new issuance of CLOs plummeted during the financial crisis 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 C2). 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.

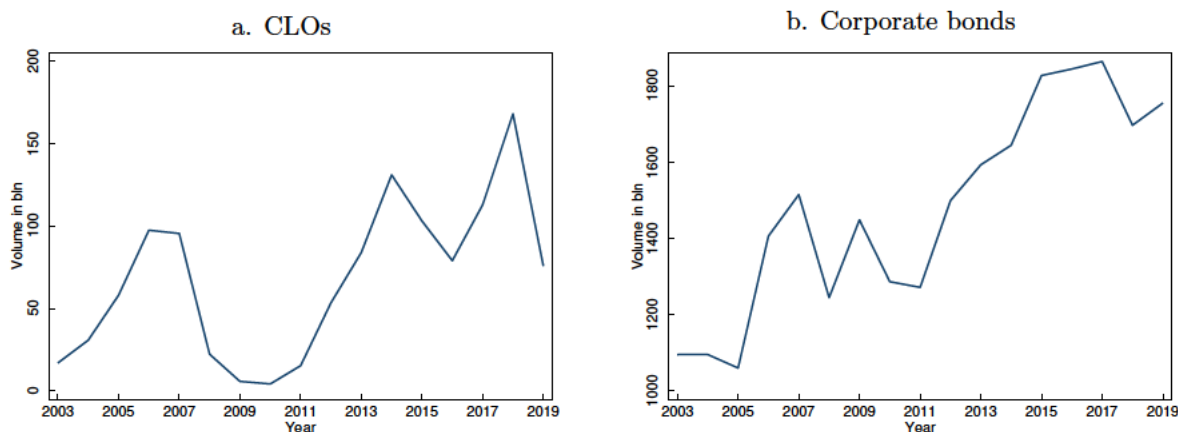
## **C.2 Heterogeneity across insurance companies' capital standards**

Our next tests explore the heterogeneity in insurers' search for yield behavior across insurance companies with different capital standards. In the banking literature, well capitalized banks are believed to be less prone to take on risk.<sup>5</sup> Therefore, we expect

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<sup>5</sup>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.

Figure C2: New issuance of U.S. CLOs and corporate bonds



This figure plots the time series of i) the volume of total new issuance of CLO tranches denominated in USD excluding refinanced tranches (a) and the volume of total new issuance of corporate bonds denominated in USD (b), over the time period 2003-2019 on a yearly basis. The data covers CLOs issuance up to November 8, 2019. Source: Moody's Analytics Structured Finance Portal and Moody's Analytics Structured Finance Portal.

stronger evidence of search for yield among insurers with a low level of capitalization.<sup>6</sup> Columns 3 through 5 of Table C1 report the results for three different measures of insurance companies' capitalization: capital ratio, CAL RBC ratio, and ACL RBC ratio, respectively. Irrespective of the capitalization metric adopted, we find that insurance companies with a lower capital ratio or closer to the minimum capital requirements are more prone to search for yield.

### C.3 Heterogeneity across insurance companies' exposures to natural disasters

Our final test on the search for yield heterogeneity across firms focuses on P&C companies, the category of insurers in our sample more exposed to natural disasters. Figure C3 shows the time series of nationwide damages from weather and climate disasters over the time period 1980-2022. 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

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<sup>6</sup>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 (e.g. Rochet (1992)).

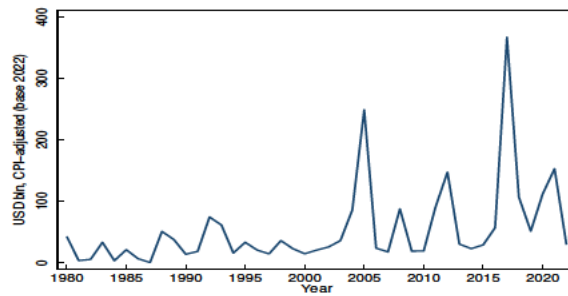
aggregate value of nationwide damage peaked exactly in 2005 and 2017, reaching \$249B in the former and \$367B in the latter and implying significant insured losses.

We, thus, investigate if P&C insurers that were hard hit by disaster events, as captured by the yearly change in their net income, search for yield more aggressively in 2005 and 2017 relative to less affected companies. The idea is that insurance companies experiencing higher losses 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 yearly change in net income scaled by lagged total assets 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 are reported in column 6 of Table C1.

While the triple interaction of the yield, the below median dummy, and the time dummy for 2005 is positive but not statistically significant, the triple interaction of the yield, the below median dummy, with the time dummy for 2017 is positive and significant. This indicates that poorly performing insurance companies search for yield more actively in 2017, the year with record high losses from natural disasters in our sample period. We instigated in column 7 whether insurance companies’ response continued after 2017 and found no evidence of persistence, suggesting that their additional search for yield was indeed to compensate for the record losses experienced in that year.

This finding corroborates our previous results on low-capital, adding support to our evidence that insurance companies exploit the design of their capital regulation and search for yield through their investments in both corporate bonds and CLO tranches.

Figure C3: Weather and climate disaster events



This figure plots the estimate of nationwide aggregate costs generated by weather and climate disasters from the Billion-Dollar Weather and Climate Disasters Database of the National Oceanic and Atmospheric Administration. Values are adjusted for CPI inflation with base year 2022.

**Table C1: Search for yield: Heterogeneity analysis**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	All insurers				P&C insurers Years 2016-2019		
Dependent variable	Insurance company's holding as a percentage of volume outstanding						
Yield	-0.074*	-0.008	0.126***	0.073***	0.073***	0.030***	0.033*
	(0.04)	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)
Year=2004 x Yield	0.089*						
	(0.05)						
Year=2005 x Yield	0.060						
	(0.05)						
Year=2006 x Yield	0.119**						
	(0.05)						
Year=2007 x Yield	0.132***						
	(0.05)						
Year=2008 x Yield	0.053						
	(0.04)						
Year=2009 x Yield	0.079*						
	(0.04)						
Year=2010 x Yield	0.097**						
	(0.04)						
Year=2011 x Yield	0.132***						
	(0.05)						
Year=2012 x Yield	0.192***						
	(0.05)						
Year=2013 x Yield	0.254***						
	(0.05)						
Year=2014 x Yield	0.241***						
	(0.07)						
Year=2015 x Yield	0.188***						
	(0.05)						
Year=2016 x Yield	0.211***						
	(0.05)						
Year=2017 x Yield	0.221***						
	(0.06)						
Year=2018 x Yield	0.247***						
	(0.06)						
Year=2019 x Yield	0.104**						
	(0.05)						
Year=2007-2008 x Yield		0.005					
		(0.03)					
Year=2009-2015 x Yield		0.093***					
		(0.03)					
Year=2016-2019 x Yield		0.126***					
		(0.03)					
Capital ratio x Yield			-0.178***				
			(0.04)				
CAL RBC ratio x Yield				-0.001***			
				(0.00)			
ACL RBC ratio x Yield					-0.000***		
					(0.00)		
Year=2005 x Yield						-0.020	
						(0.02)	
Year=2017 x Yield						-0.027	-0.013
						(0.02)	(0.02)
Year>2017 x Yield							0.028
							(0.02)
Below Median ΔNet Income						0.007	
						(0.03)	
Below Median ΔNet Income x Yield						-0.003	
						(0.01)	
Below Median ΔNet Income x Year=2005						-0.085	
						(0.20)	
Below Median ΔNet Income x Year=2017						-0.381**	
						(0.18)	
Below Median ΔNet Income x Year=2005 x Yield						0.028	
						(0.04)	
Below Median ΔNet Income x Year=2017 x Yield						0.103**	
						(0.05)	

Continued on next page

Table C1 - continued from previous page

Below Median $\Delta$ Net Income 2017							-0.161*
							(0.09)
Below Median $\Delta$ Net Income 2017 x Yield							0.023
							(0.02)
Below Median $\Delta$ Net Income 2017 x Year=2017							-0.263*
							(0.15)
Below Median $\Delta$ Net Income 2017 x Year>2017							-0.052
							(0.12)
Below Median $\Delta$ Net Income 2017 x Year=2017 x Yield							0.085*
							(0.05)
Below Median $\Delta$ Net Income 2017 x Year>2017 x Yield							0.016
							(0.03)
Time-to-maturity	-0.005**	-0.004*	-0.002	-0.002	-0.002	0.000	-0.002
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Outstanding Amount	-0.305***	-0.303***	-0.333***	-0.333***	-0.333***	-0.223***	-0.167***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)
Size			0.251***	0.250***	0.250***		
			(0.02)	(0.02)	(0.02)		
ROE			-0.212	-0.221	-0.221		
			(0.19)	(0.19)	(0.19)		
Capital ratio			0.767***	0.033	0.033		
			(0.20)	(0.13)	(0.13)		
CAL RBC ratio			0.001	0.004***			
			(0.00)	(0.00)			
ACL RBC ratio					0.002***		
					(0.00)		
Size (t-1)						0.154***	0.161***
						(0.02)	(0.02)
ROE (t-1)						-0.000	0.000
						(0.00)	(0.00)
Capital ratio (t-1)						0.001	0.002
						(0.00)	(0.00)
CAL RBC ratio (t-1)						0.000	-0.000
						(0.00)	(0.00)
constant	0.928***	0.948***	-2.910***	-2.658***	-2.658***	-1.507***	-1.701***
	(0.05)	(0.05)	(0.25)	(0.24)	(0.24)	(0.23)	(0.26)
NAIC designation x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Security type (CLO or bond) FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Type insurer FE	Yes	Yes	Yes	Yes	Yes	No	No
Insurer x Year FE	Yes	Yes	No	No	No	No	No
One-way clustering	Insurer	Insurer	Insurer	Insurer	Insurer	Insurer	Insurer
N	1653746	1653746	1620183	1620183	1620183	632061	219179
R <sup>2</sup>	0.2961	0.2958	0.2087	0.2084	0.2084	0.1310	0.1570
Adj - R <sup>2</sup>	0.2784	0.2781	0.2087	0.2084	0.2084	0.1308	0.1569
F-stat	24.529***	64.243***	69.260***	68.066***	68.066***	25.076***	17.584***
Degrees of freedom	(19, 4334)	(6, 4334)	(8, 4332)	(8, 4332)	(8, 4332)	(15, 2563)	(15, 1618)

This table reports panel regression estimates of a series of extensions to the linear regression model of equation 1 analyzing the heterogeneity over time and 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. Models 6-7 are estimated on the subsample of P&C insurers; model 7 covers the time period 2016-2019. 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 effective rate or return) in % of the security reported by the insurer; *Below Median  $\Delta$ Net Income* is a dummy variable equal to one if the yearly change in net income of a P&C insurer is below the median; *Below Median  $\Delta$ Net Income 2017* is a dummy variable equal to one if the yearly change in net income of a P&C insurer is below the median in 2017; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln; *Size* is the natural logarithm of total assets of the insurer in \$000s; *ROE* is the ratio of net income to surplus as regards policyholder; *Capital ratio* is the ratio of surplus as regards policyholders to total 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 clustering at the insurer level. Fixed effects are included, "Yes", or not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

## **D Insurers' preferences for CLOs: Additional results**

In this section, we report the results of two additional tests investigating (i) how insurance companies' preference for CLOs over corporate bonds varies with insurance companies' capital standards and over time (before, during and after the financial crisis); (ii) insurers' collective preference for CLOs over corporate bonds, as in Becker and Ivashina (2015).

### **D.1 Heterogeneity across insurance companies' capital standards**

We begin by exploring the role of insurer's capital standards. Models 1-3 of Table D1 extend model 5 of Table 5 to include a triple interaction of the CLO dummy with the yields ratio and each of the variables capturing firm capitalization used before (capital ratio, CAL risk-based capital ratio and ACL risk-based capital ratio). 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 vis-à-vis corporate bonds with the same rating. This result is in line with the idea that higher leverage brings stronger incentives to search for yield.

### **D.2 Heterogeneity over time**

Next, we investigate the sensitivity of insurers' preference for CLOs over corporate bonds to the yields ratio over time. As in the previous section, we consider four macroeconomic regimes: pre-crisis (2003-2006), financial crisis (2007-2008), zero lower bound (ZLB) period (2009-2015) and post-ZLB (2016-2019). The estimates of column 4 in Table D1 indicate that insurance companies' response to the yields ratio is more pronounced during the post-ZLB period.

Following the approach we adopted in section 5.2 of the paper, we carry out one



last exercise where we examine the evolution over time in insurers' appetite for the CLO asset class relative to the corporate bond asset class using consolidated asset holdings at the insurer-asset class-rating-year level. In particular, we aggregate up the granular data at the security-company-year level so that we can calculate the volume of insurers' first-time investments in CLOs as a percentage of the total first-time investments in CLOs and corporate bonds within a given rating class and a specific year.<sup>7</sup> We, thus, test if insurers' preference for CLOs over corporate bonds varied over the four time periods considered above (pre-crisis, financial crisis, ZLB and post-ZLB).

The results are reported in column 5. We find that during the financial crisis, when issuance in the CLO market froze, insurance companies reduced their investments in CLOs relative to corporate bonds. Their preference flipped starting in 2009 as CLOs issuance resumed and the yields differential between CLOs and corporate bonds widened compared to pre-crisis levels. During the ZLB period, when the yields ratio hovered around 1.5 for investment grade securities other than triple-A, insurance companies allocated a larger fraction of their new investments to CLOs conditional on the rating bucket. Insurers' preference for CLOs over corporate bonds with the same rating became much more pronounced in the post-ZLB period, as the yields ratio continued to be at relatively high levels.

### **D.3 Insurance companies' collective preference for CLOs**

In Table 7 and Table D1 we analyse if insurance companies' proclivity towards CLOs shows up at the macro level and varies over time by consolidating the granular security holdings data at the insurer-asset class-rating-year level. An alternative way to gauge the evolution over time of insurers' appetite for CLOs relative to corporate bonds at the macro level is to explore their collective behavior towards each security following the

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<sup>7</sup>By construction, this dataset includes observations pertaining to insurers' "zero investments" in CLOs within a rating category. For example, if a company does not make new investments in any CLO tranche rated Baa in a given year, the percentage of Baa-rated CLOs newly acquired by that company in that year is reported with a value of zero.

**Table D1: Insurance companies' preference for CLOs vis-à-vis corporate bonds: Heterogeneity analysis**

Sample	(1)	(2)	(3)	(4)	(5)
Dependent variable	Assets with Aaa, Aa, A and Baa rating			Insurance company's aggregate new holdings of CLOs as a percentage of total new holdings of CLOs and corporate bonds by rating	
	Insurance company's new holding as a percentage of volume outstanding				
dummy CLO	5.633 (3.59)	-2.610 (2.51)	-2.610 (2.51)	30.478*** (10.88)	
Yield CLO/Yield Bond ratio	-0.865*** (0.11)	-0.454*** (0.06)	-0.454*** (0.06)	-0.477 (0.34)	
dummy CLO x Yield CLO/Yield Bond ratio	6.027** (2.65)	9.125*** (1.94)	9.125*** (1.94)	-5.001 (10.24)	
Capital ratio x dummy CLO	-15.445* (8.49)				
Capital ratio x Yield CLO/Yield Bond ratio	1.505*** (0.23)				
Capital ratio x dummy CLO x Yield CLO/Yield Bond ratio	-5.117 (6.63)				
CAL RBC ratio x dummy CLO		0.068 (0.07)			
CAL RBC ratio x Yield CLO/Yield Bond ratio		0.007*** (0.00)			
CAL RBC ratio x dummy CLO x Yield CLO/Yield Bond ratio		-0.107* (0.06)			
ACL RBC ratio x dummy CLO			0.034 (0.03)		
ACL RBC ratio x Yield CLO/Yield Bond ratio			0.003*** (0.00)		
ACL RBC ratio x dummy CLO x Yield CLO/Yield Bond ratio			-0.054* (0.03)		
Year=2007-2008					-0.551*** (0.10)
Year=2009-2015					0.885*** (0.19)
Year=2016-2019					5.009*** (0.30)
Year=2007-2008 x dummy CLO				-13.916 (14.05)	
Year=2009-2015 x dummy CLO				-32.153*** (11.31)	
Year=2016-2019 x dummy CLO				-40.030*** (10.71)	
Year=2007-2008 x Yield CLO/Yield Bond ratio				-0.014 (0.34)	
Year=2009-2015 x Yield CLO/Yield Bond ratio				1.058*** (0.35)	
Year=2016-2019 x Yield CLO/Yield Bond ratio				2.153*** (0.45)	
Year=2007-2008 x dummy CLO x Yield CLO/Yield Bond ratio				3.347 (12.37)	
Year=2009-2015 x dummy CLO x Yield CLO/Yield Bond ratio				14.355 (10.65)	
Year=2016-2019 x dummy CLO x Yield CLO/Yield Bond ratio				18.966* (10.12)	

Continued on next page

Table D1 - continued from previous page					
Time-to-maturity	0.004** (0.00)	-0.001 (0.00)	-0.001 (0.00)	-0.001 (0.00)	
Outstanding Amount	-0.351*** (0.02)	-0.334*** (0.02)	-0.334*** (0.02)	-0.292*** (0.02)	
Outstanding CLO/ Outstanding Bond ratio					18.209*** (0.49)
Size	0.256*** (0.02)	0.256*** (0.02)	0.256*** (0.02)		0.800*** (0.28)
ROE	-0.199 (0.19)	-0.176 (0.20)	-0.176 (0.20)		1.207*** (0.33)
Capital ratio	-1.716*** (0.32)	-0.036 (0.13)	-0.036 (0.13)		-2.626** (1.08)
CAL RBC ratio	0.002* (0.00)	-0.006*** (0.00)			0.034*** (0.01)
ACL RBC ratio			-0.003*** (0.00)		
constant	-1.542*** (0.25)	-1.955*** (0.23)	-1.955*** (0.23)	-0.133 (0.20)	-10.121*** (3.53)
Rating FE	Yes	Yes	Yes	Yes	Yes
Type insurer FE	Yes	Yes	Yes	Yes	Yes
Insurer FE	No	No	No	-	Yes
Insurer x Year FE	No	No	No	Yes	No
One-way clustering	Insurer	Insurer	Insurer	Insurer	Insurer
N	1298029	1298029	1298029	1328000	114536
R <sup>2</sup>	0.2492	0.2163	0.2163	0.3211	0.3860
Adj - R <sup>2</sup>	0.2492	0.2163	0.2163	0.3000	0.3626
F-stat	55.918***	50.487***	50.487***	41.642***	191.154***
Degrees of freedom	(12, 4323)	(12, 4323)	(12, 4323)	(14, 4329)	(8, 4184)

This table reports panel regression estimates of various extensions of the linear regression model of equation 3 (columns 1-4) and of the linear regression model of equation 4 (column 5) analyzing insurers' preference for CLOs over corporate bonds over time. Models 1-4 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 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. Model 5 is estimated on a dataset at the insurer-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 CLOs with a given rating in a certain year as a percentage of the total volume of first-time investments in CLOs and corporate bonds with that rating in the year. As for the independent variables, *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero if it is a corporate bond; *Yield CLO/Yield Bond ratio* is ratio of the average yield on insurers' first-time investments in CLOs to the average yield of insurers' first-time investments in corporate bonds for each rating-year pair; *Time-to-maturity* is the time to maturity of the security in years; *Outstanding Amount* is the volume outstanding of the security in \$bln; *Capital ratio* is the ratio of surplus as regards policyholders to total 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 clustering at the insurer 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.

approach adopted by Becker and Ivashina (2015). We present this analysis next.

As a first step, we aggregate insurers' holdings data at the security-year level. Specifically, we start with the full dataset of insurance companies' investments in CLOs and corporate bonds from Schedule D - Part I of the annual financial statement filings. We limit the sample to securities rated investment grade and held by insurers in the year of issuance. Then, we consolidate the data at the security-year level by taking the aggregate par value and the average yield of all portfolio holdings by insurance companies in the security.

Next, we estimate the following model:

$$\frac{Holdings_{st} \times 100}{Outstanding\ amount_{st}} = \alpha + \beta_1 Yield_{st} + \beta_2 Time\ to\ maturity_{st} + \beta_3 Outstanding\ amount_{st} + \mu_{r(s),t} + \mu_{a(s)} + \varepsilon \quad (10)$$

which mimics column 3 of Table 4 in Becker and Ivashina (2015) and is similar to equation (1) but adapted to the new aggregated dataset. The dependent variable is the aggregate volume of insurers' holdings of security  $s$  in year  $t$  when the security is issued,  $Holdings_{st}$ , as a percentage of the outstanding volume of that security at year-end,  $Outstanding\ amount_{st}$ . The key variable of interest is  $Yield_{st}$ , the average yield of security  $s$  reported by insurance companies in year  $t$ . We control for the outstanding volume and the time-to-maturity of the asset,  $Outstanding\ amount_{st}$  and  $Time\ to\ maturity_{st}$ , and we saturate the model with rating-year fixed effects,  $\mu_{r(s),t}$ , and security type (CLO or corporate bond) fixed effects,  $\mu_{a(s)}$ . We expect the coefficient  $\beta_1$  to be positive, in line with the idea that insurers invest more heavily in securities offering higher yields within a rating notch.

Results are presented in Table D2. Consistent with our baseline results on insurers' search for yield (Table 3), we find that on aggregate insurance companies tend to hold a higher share of securities offering a higher yield conditional on the credit rating.

Subsequently, we explore if this behavior translated into a preference for CLOs

over corporate bonds, especially in recent years, following a similar methodology to that adopted in Section 5. The estimates presented in column 2 reveal that, on average, the yield of new investments by insurers in CLO tranches is higher than the yield of new investments in corporate bonds within a rating bucket. Insurance companies exhibit a preference for CLOs over corporate bonds (column 3) and this preference is stronger the larger is the difference in yields between CLOs and corporate bonds, as captured by the ratio of the average yield on newly issued CLOs to the average yield of newly issued corporate bonds held by insurers (column 4).

When we examine if insurance companies' preference for CLOs vis-à-vis corporate bonds is more pronounced during the time period in which the 2010 regulatory reform was in place, we find a statistically significant coefficient for the interaction between the CLO dummy and the reform dummy (column 5). Once we zoom into the years around the implementation of the reform (column 6), we observe that the incremental loading of the CLO dummy turns positive in the post-crisis decade and exhibits a marked upward jump between 2010 and 2011 (from 7.854 to 19.989) becoming highly significant. The 2010 regulatory reform was announced in the NAIC Spring 2010 National Meeting and likely deployed its full effects starting in 2011. This conjecture is confirmed by Figure A1 of Internet Appendix A, which documents that insurance companies started to take advantage of the new regulatory regime (aka "MFE approach") in that year. Thus, the upward jump in the slope of the CLO dummy between 2010 and 2011 in column 6 is consistent with the implementation of the 2010 reform.

Lastly, when we break down our sample into i) pre-crisis, ii) crisis, iii) ZLB and iv) post-ZLB periods, we find that insurance companies' proclivity towards CLOs emerges in the last two periods. Overall, these findings are fully consistent with the results presented in Section 4 and Section 5 of the paper.

The robustness tests we presented so far, following the approach of Becker and Ivashina (2015), rely on insurance companies' holdings data. By construction, this data

covers only CLO tranches and corporate bonds in the portfolio of insurers. A natural question to ask is whether our results continue to hold in the full universe of CLO tranches and corporate bonds issued at any point in time. We perform this exercise by combining data on CLO tranches and corporate bonds at origination from Moody's and Mergent FISD, respectively. Therefore, we construct a dataset at the security-issuance year level for all CLO debt tranches and corporate bonds rated investment grade originated between 2003 and 2019.

For each security, we collect information on the outstanding volume, the time-to-maturity, and the credit rating at the end of the issuance year. We construct a measure for the interest rate spread of each security by exploiting the pricing information available for CLOs and corporate bonds in our sample (interest rate spread and offering yield, respectively). For CLO tranches, which are typically floating rate, this corresponds to the interest rate spread over the benchmark reported at origination. For corporate bonds, this is the interest rate spread over the nearest maturity Treasury bond. We calculate this metric starting from the offering yield reported in Mergent FISD for fixed-rate corporate bonds, which account for 62% of corporate bonds in our sample (with the remaining being floating-rate bonds and zero coupon bonds), Next, following Boyarchenko et al. (2022), we compute the interest rate spread as the difference between the offering yield and the yield on a Treasury bill/note with the closest maturity. In particular, for corporate bonds with less than 4.5 month maturity, we compute the spread over the 3 month Treasury bill; for corporate bonds with maturity of  $[4.5, 9)$  months, we compute the spread over the 6 month Treasury bill; for corporate bonds with maturity of 9 months or more and less than 1.5 years, we compute the spread over the 1 year Treasury note; for corporate bonds with maturity of  $[1.5, 2.5)$  years, we compute the spread over the 2 year Treasury note; for corporate bonds with maturity of  $[2.5, 4)$  years, we compute the spread over the 3 year Treasury note; for corporate bonds with maturity of  $[4, 6)$  years, we compute the spread over the 5 year Treasury note;

for corporate bonds with maturity of  $[6, 8.5)$  years, we compute the spread over the 7 year Treasury note; for corporate bonds with maturity of  $[8.5, 20)$  years, we compute the spread over the 10 year Treasury bond; for corporate bonds with maturity above 20 years, we compute the spread over the 20 year Treasury bond. Given the different coupon type of the two securities (floating-rate CLO tranches and fixed-rate corporate bonds), we acknowledge that our measure of interest rate spread is not fully coherent. Nonetheless, we believe it represents a useful metric to ascertain insurance companies' preferences towards securities offering different yields.

We re-estimate the econometric models presented in Table D2 on the new extended sample covering all newly issued CLO debt tranches and corporate bonds by substituting the yield of the security with the interest rate spread described above. Results are reported in Table D3. The estimates show a very similar picture to that of Table D2. The only notable difference is in specification (6), where we explore the evolution of insurers' preference for CLOs vis-à-vis corporate bonds over the years around the 2010 regulatory reform. In this case, we find that insurance companies' appetite for CLOs exhibits a marked upward jump already in 2010. However, column 6 in both Table D2 and Table D3 indicates that insurers' preference for CLOs versus corporate bonds reached its peak in 2011.

In sum, insurance companies collectively purchase a higher fraction of CLOs compared to corporate bonds conditional on the credit rating of the security. This behavior is driven by the difference in yields between the two asset classes and is particularly strong during the time period when the 2010 regulatory reform was in place.

**Table D2: Insurance companies' preference for CLOs vis-à-vis corporate bonds: Security-level analysis using insurers' holdings**

Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
		CLOs and corporate bonds rated Aaa, Aa, A and Baa held by insurance companies in the year of issuance						
						2005-2014		
Dependent variable	Insurance companies' aggregate holdings as a percentage of volume outstanding	Yield			Insurance companies' aggregate holdings as a percentage of volume outstanding			
Yield	2.517*** (0.37)							
dummy CLO		1.052*** (0.04)	25.459*** (0.90)	-2.247 (5.66)	20.698*** (1.55)	15.665*** (3.59)	11.786*** (2.16)	
Yield CLO/Yield Bond ratio				4.107 (4.01)				
dummy CLO x Yield CLO/Yield Bond ratio				20.854*** (3.86)				
dummy Reform					-4.981*** (0.87)			
dummy Reform x dummy CLO					5.301*** (1.37)			
year=2005						3.828* (2.12)		
year=2006						-1.253 (2.15)		
year=2007						-4.183** (2.10)		
year=2008						-3.803* (2.19)		
year=2009						1.181 (2.37)		
year=2010						-1.788 (2.70)		
year=2011						-2.205 (2.51)		
year=2012						-5.276** (2.40)		
year=2013						-5.314** (2.26)		
year=2014						-8.985*** (2.15)		
year=2015						-5.435** (2.13)		
Year=2005 x dummy CLO						-10.351** (4.41)		
Year=2006 x dummy CLO						-6.282 (4.48)		
Year=2007 x dummy CLO						-3.393 (4.29)		
Year=2008 x dummy CLO						9.035 (6.96)		
Year=2009 x dummy CLO						6.850* (3.80)		
Year=2010 x dummy CLO						7.854 (7.92)		
Year=2011 x dummy CLO						19.989*** (4.55)		
Year=2012 x dummy CLO						13.298*** (4.14)		
Year=2013 x dummy CLO						10.737*** (3.87)		
Year=2014 x dummy CLO						13.011*** (3.71)		
Year=2015 x dummy CLO						8.011** (3.72)		

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Table D2 - continued from previous page

Year=2007-2008							-5.087*** (1.18)
Year=2009-2015							-5.407*** (1.40)
Year=2016-2019							-8.206*** (1.34)
Year=2007-2008 x dummy CLO							2.445 (3.02)
Year=2009-2015 x dummy CLO							13.463*** (2.20)
Year=2016-2019 x dummy CLO							16.320*** (2.12)
Outstanding Amount	-6.364*** (0.65)	-0.033 (0.03)	-6.474*** (0.67)	-6.461*** (0.70)	-6.658*** (0.70)	-5.894*** (0.81)	-6.188*** (0.67)
Time-to-maturity	0.367*** (0.04)	0.071*** (0.00)	0.550*** (0.03)	0.562*** (0.03)	0.544*** (0.03)	0.548*** (0.04)	0.552*** (0.03)
constant	18.945*** (1.16)	2.988*** (0.04)	20.122*** (0.90)	14.407*** (5.49)	23.485*** (1.20)	24.264*** (2.21)	25.139*** (1.53)
Year FE	-	-	-	Yes	No	No	No
Rating FE	-	-	-	Yes	Yes	Yes	Yes
Rating x Year FE	Yes	Yes	Yes	No	No	No	No
Security type (CLO or bond) FE	Yes	No	No	No	No	No	No
One-way clustering	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N	33416	33762	33527	32509	33527	19520	33527
R <sup>2</sup>	0.2652	0.5277	0.2532	0.2446	0.2325	0.1922	0.2364
Adj - R <sup>2</sup>	0.2637	0.5267	0.2516	0.2440	0.2323	0.1910	0.2361
F-stat	114.215***	1050.171***	1181.068***	864.655***	718.603***	161.432***	450.679***
Degrees of freedom	(3, 4632)	(3, 4645)	(3, 4636)	(5,4579)	(5,4636)	(25,3199)	(9,4636)

This table reports panel regression estimates of the model of equation 10 and its extensions analyzing insurers' preference for CLOs over corporate bonds over time. Models are estimated on a dataset at the security-year level obtained by aggregating the granular data on insurers' holdings of CLOs and corporate bonds. To this end, we start with the full dataset of insurance companies' investments in CLOs and corporate bonds from Schedule D - Part I of the annual financial statement filings. We limit the sample to securities rated investment grade (Aaa, Aa, A or Baa) and held by insurers in the year of issuance. We consolidate the data at the security-year level by taking the aggregate par value and the average yield of all portfolio holdings by insurance companies in the security. Model 6 is estimated on the subsample of years 2005-2014. The dependent variable is insurance companies' aggregate holdings of a given security in the year of issuance as a percentage of the volume outstanding of the security in model 1 and models 3-7, and the average yield (i.e., the effective rate or return) in % reported by insurers for a given security in model 2. As for the independent variables, *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero if it is a corporate bond; *Yield CLO/Yield Bond ratio* is ratio of the average yield on newly issued CLOs to the average yield of newly issued corporate bonds held by insurers and with the same credit rating and origination year of the security; *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; *Outstanding Amount* is the volume outstanding of the security in \$bln. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for clustering at the security issuer 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 D3: Insurance companies' preference for CLOs vis-à-vis corporate bonds: Security-level analysis using all new issues**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sample	CLOs and corporate bonds rated Aaa, Aa, A and Baa held by insurance companies in the year of issuance 2005-2014						
Dependent variable	Insurance companies' aggregate holdings as a percentage of volume outstanding	Spread	Insurance companies' aggregate holdings as a percentage of volume outstanding				
Spread	0.314** (0.14)						
dummy CLO		0.571*** (0.15)	18.665*** (1.03)	3.005** (1.20)	7.893*** (1.12)	4.936** (2.17)	-0.275 (1.21)
Spread CLO/Spread Bond ratio				-1.173* (0.63)			
dummy CLO x Spread CLO/Spread Bond ratio				8.376*** (0.51)			
dummy Reform					-1.055 (1.06)		
dummy Reform x dummy CLO					19.636*** (1.36)		
year=2005						1.429 (1.01)	
year=2006						0.357 (1.06)	
year=2007						-0.822 (1.17)	
year=2008						-0.549 (1.30)	
year=2009						6.121*** (1.74)	
year=2010						3.664* (2.05)	
year=2011						1.742 (2.12)	
year=2012						0.445 (1.92)	
year=2013						-0.842 (2.29)	
year=2014						-2.206 (1.91)	
year=2015						-0.176 (1.76)	
Year=2005 x dummy CLO						-6.854*** (2.22)	
Year=2006 x dummy CLO						-8.067*** (2.14)	
Year=2007 x dummy CLO						-7.786*** (2.19)	
Year=2008 x dummy CLO						-4.555 (3.04)	
Year=2009 x dummy CLO						-4.460 (3.31)	
Year=2010 x dummy CLO						17.634** (7.30)	
Year=2011 x dummy CLO						24.916*** (4.55)	
Year=2012 x dummy CLO						16.440*** (3.15)	
Year=2013 x dummy CLO						21.087*** (3.15)	
Year=2014 x dummy CLO						22.346*** (2.79)	
Year=2015 x dummy CLO						18.255*** (2.73)	

Continued on next page

Table D3 - continued from previous page

Year=2007-2008							-1.954**
							(0.80)
Year=2009-2015							-0.023
							(1.51)
Year=2016-2019							-2.517*
							(1.35)
Year=2007-2008 x dummy CLO							-1.507
							(1.23)
Year=2009-2015 x dummy CLO							23.928***
							(1.76)
Year=2016-2019 x dummy CLO							31.471***
							(1.57)
Outstanding Amount	2.509**	-0.392***	2.814***	3.654***	4.066***	4.754***	4.056***
	(0.99)	(0.12)	(0.66)	(0.68)	(0.64)	(0.74)	(0.67)
Time-to-maturity	0.484***	-0.048***	0.455***	0.484***	0.493***	0.476***	0.490***
	(0.06)	(0.01)	(0.04)	(0.05)	(0.05)	(0.06)	(0.05)
constant	10.130***	2.372***	4.702***	5.434***	3.961***	3.001**	4.349***
	(0.90)	(0.31)	(0.68)	(1.22)	(0.63)	(1.18)	(0.80)
Year FE	-	-	-	Yes	No	No	No
Rating FE	-	-	-	Yes	Yes	Yes	Yes
Rating x Year FE	Yes	Yes	Yes	No	No	No	No
Security type (CLO or bond) FE	Yes	No	No	No	No	No	No
One-way clustering	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer	Issuer
N	49289	50899	78235	77715	78235	53655	78235
R <sup>2</sup>	0.2222	0.2909	0.2377	0.2310	0.2246	0.2081	0.2506
Adj - R <sup>2</sup>	0.2211	0.2899	0.2370	0.2308	0.2245	0.2077	0.2505
F-stat	26.939***	92.102***	278.761***	200.463***	509.241***	67.569***	409.515***
Degrees of freedom	(3, 4799)	(3, 4860)	(3, 5259)	(5,5240)	(5,5259)	(25,3774)	(9,5259)

This table reports panel regression estimates of a set of econometric models analyzing insurers' preference for CLOs over corporate bonds over time. Models are estimated on a dataset at the security-year level covering floating-rate CLO debt tranches and fixed-rate corporate bonds rated investment grade and originated between 2003 and 2019. This dataset combines data on CLO tranches and corporate bonds at origination from Moody's and Mergent FISD, as well as data on insurers' holdings of CLOs and corporate bonds from Schedule D - Part I of the annual financial statement filings. Model 6 is estimated on the subsample of years 2005-2014. The dependent variable is insurance companies' aggregate holdings of a given security in the year of issuance as a percentage of the volume outstanding of the security in model 1 and models 3-7, and the spread in % of a given security in model 2. The spread corresponds to the interest rate spread over the benchmark reported at origination for floating-rate CLOs and the interest rate spread over the nearest maturity Treasury bond for fixed-rate corporate bonds (calculated as in Boyarchenko et al. (2022)). As for the independent variables, *dummy CLO* is a dummy variable equal to one if the security is a CLO tranche and zero if it is a corporate bond; *Spread CLO/Spread Bond ratio* is the ratio of the average spread on newly issued CLOs to the average spread of newly issued corporate bonds with the same credit rating and origination year of the security; *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; *Outstanding Amount* is the volume outstanding of the security in \$bln. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the robust standard error that is corrected for clustering at the security issuer 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.

## E Additional Implications of Insurance Companies’ Preference for CLOs

In this section we report the results of three additional tests we carried out while investigating the potential impact of insurance companies on the design of CLOs. Specifically, we investigate to what extent insurance companies played a role on (i) the composition of the coupon type of CLO tranches, (ii) the creation of CLO deals backed by CLO tranches from other deals (henceforth abridged “repackaged CLOs”), (iii) the length of the non-call period, and (iv) the refinancing of CLO deals.

In addition, we present a robustness test where we examine if the results of the granular loan-level analysis on the impact of insurers’ appetite for CLOs on the primary market for bank credit are confirmed when we include foreign lead banks in the sample.

Lastly, we describe in detail the set of control variables used in the econometric analyses presented in Section 6.2.

### E.1 Insurance companies’ impact on CLOs’ design

We start by investigating the composition of the coupon type of CLO tranches. While CLO tranches are typically floating-rate securities, about 7% of debt tranches in our sample have a fixed-rate coupon. Life insurance companies, which account for 78% of insurers’ aggregate holdings of CLOs and corporate bonds in 2019, typically fund themselves with long-term insurance products. Thus, they have incentives to invest in long-duration assets such as fixed-rate securities to match the duration of their liabilities. This suggests that, *ceteris paribus*, CLO deals in which insurance companies invest more heavily are characterized by a larger share of fixed-rate tranches. We test this hypothesis by estimating a modified version of equation 5 where the dependent variable is  $\frac{Tranche_{fdmt} \times 100}{Issue\ amount_{dmt}}$ , the par value of a tranche/tranches with a fixed-rate coupon  $f$  of CLO deal  $d$  issued in year  $t$  and managed by manager  $m$ ,  $Tranche_{fdmt}$ , divided by the total

issue amount of CLO deal  $d$  in year  $t$ ,  $Issue\ amount_{dmt}$ . Our results reported in column 1 of Table E1 confirm our prior.

Next, we investigate repackaged CLOs. These CLO deals are associated with a set of combo notes. These notes are produced by repackaging part or all debt and equity tranches of CLOs. In some cases, CLO tranches can be combined with government bonds for principal protection. Combo notes can be structured either based on a CLO or as part of a separate special-purpose vehicle. We refer to repackaged CLO deals as those generated in the latter case. Combo notes are often structured as principal-only securities, meaning that the cash flows from the underlying CLO tranches are used to pay down the principal balance of the combo note. Depending on the composition of the underlying CLO tranches, this feature may allow combo notes to achieve a better rating than some of the individual underlying components (NAIC, 2019a; Morningstar, 2019).<sup>8</sup> Typically, combo notes are structured in bilateral transactions exactly to be tailor made to the investor’s specific coupon and rating target (NAIC, 2019a; Morningstar, 2019). The extent to which insurance companies invest in repackaged CLO deals is a signal of whether they lean towards custom-made CLOs. Thus, we estimated the following econometric model:

$$Repackaged\ CLO_{dmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Issue\ amount_{dmt}} + \mu_{mt} + \varepsilon \quad (11)$$

where  $Repackaged\ CLO_{dmt}$  is a dummy equal to one if CLO deal  $d$  issued in year  $t$  and managed by manager  $m$  is a repackaged deal and zero otherwise.

Column 2 of Table E1 reports the estimates of this model. The positive and statistically significant coefficient of the insurers’ holding share in the origination year reveals that insurance companies invest more heavily in repackaged CLO deals, i.e., deals that are most likely designed to meet their desired rating and return. We estimate this

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<sup>8</sup>NAIC (2019a) argues that most rating agencies methodologies identify a loss or a default only when interest payments are not met.

regression using a linear model rather than a probit model because we need to include a set of time-varying fixed effects to identify the correlation of interest in a clean way (manager-issuance 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 11 using a probit model (column 3) including manager-issuance year dummies. Note that the sample on which this non-linear model is estimated shrinks compared to that of column 2 due to the fact that many observations of the manager-issuance year dummies which perfectly predict the outcome variable (also known as “perfect separation”) need to be dropped to avoid infinitely large maximum likelihood estimates. For ease of interpretation and comparison with the previous specification, we report the average marginal effect of insurers’ holding share. The probit estimation confirms that insurance companies invest more in repackaged CLO deals.

Next, we look at the length of the non-call period and the refinancing of CLO deals. The non-call period is defined as the time frame where the CLO managers cannot call or refinance the CLO debt tranches. Typically, the non-call period lasts between two and seven years depending on the reinvestment period (the average length in our sample is three years). At the end of the non-call period, equity holders have the option to refinance the deal. Usually, they do so to take advantage of a reduction in market spreads on CLO debt or to extend the maturity of a CLO, or both. This process can involve either individual tranches or the full set of tranches in the deal (also known as “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 CLO deal are called and re-issued at a lower spread

and both the reinvestment period and the maturity date are extended.

Given our evidence on insurance companies' preference for CLO securities vis-à-vis corporate bonds we posit that, at the margin, CLO managers will find it easier to issue deals with a relatively short non-call period and place these with insurance companies. We test this hypothesis by estimating the following type of model:

$$Non\text{-}call\ period_{dmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt} \times 100}{Issue\ amount_{dmt}} + \mu_{mt} + \varepsilon \quad (12)$$

where  $Non\text{-}call\ period_{dmt}$  is the length in years of non-call period of CLO deal  $d$  issued in year  $t$  and managed by manager  $m$ . Consistent with our prior, the estimates reported in column 4 of Table E1 indicate that CLO deals characterized by a larger insurers' holding share at origination have a shorter non-call period.

Our final test on the design of CLO deals builds on CLOs' refinancing decisions. 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 E1).<sup>9</sup> We identify refinanced CLO deals by combining explicit information on refinancing, that is available from 2011 onward, with information on the issuance date and the outstanding balance of CLO debt tranches during the entire life of the deal. A CLO deal is typically refinanced once, but there are cases of deals with multiple refinancing up to a maximum of 3.

We investigate if the insurers' holding share is related to the likelihood that a deal is refinanced or not. Given insurance companies' 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:

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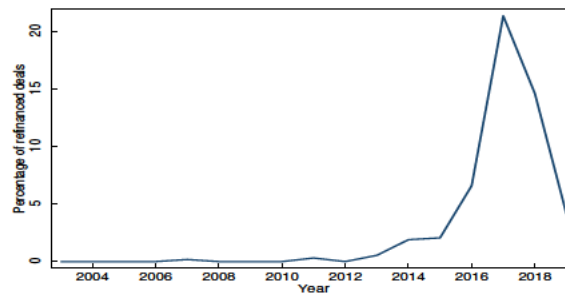
<sup>9</sup>As mentioned earlier, information on CLOs in 2019 is partial as we have data on issuance only up to November 2019. So, it is possible that we underestimate the share of refinanced deals in 2019.

$$dummy\ Refinancing_{dmt} = \alpha + \beta_1 \frac{Insurers\ holdings_{dmt-1} \times 100}{Outstanding\ volume_{dmt-1}} + \mu_{mt} + \varepsilon \quad (13)$$

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-year fixed effects effects, to control for any manager-year specific conditions that may affect the likelihood of a refinancing.

Column 5 of Table E1 reports the estimates of this regression. Consistent with our prior, the coefficient of insurers' lagged holding share is positive and statistically significant. We, next, re-estimate equation 13 using a probit model (column 6) to account for the binary dependent variable.<sup>10</sup> Also in this case, we report the average marginal effect of insurers' lagged holding share. As in the linear model, CLO deals with higher insurance companies' investments are more likely to be refinanced.

Figure E1: 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. The sample includes CLO deals outstanding during this time window and excluding multi-currency CLO deals. Source: Moody's Analytics Structured Finance Portal.

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<sup>10</sup>We lose a significant amount of observations that represent perfect predictors.



**Table E1: Fixed-rate tranches, repackaging, callability and refinancing of CLO deals**

Sample Model	(1)	(2)		(3)	(4)	(5)		(6)
	Linear	Issuance of CLO deals		Probit	Linear	Entire life of CLO deals		Probit
Dependent variable	Fixed-rate Tranches as % of CLO	Repackaged CLO			Length Non-call Period	Refinancing		
% of CLO held by ICs	0.107** (0.04)	0.005*** (0.00)	0.008*** (0.00)		-0.006** (0.00)			
% of CLO held by ICs (t-1)						0.003*** (0.00)	0.004*** (0.00)	
constant	0.461 (0.64)	-0.056*** (0.01)	-3.120*** (0.37)		3.011*** (0.04)	0.050*** (0.00)	-1.244*** (0.04)	
Manager x Issuance Year FE	Yes	Yes	Yes		Yes	Yes	Yes	
One-way clustering	Manager	Manager	Manager		Manager	Manager	Manager	
N	1708	1708	105		1681	10735	4674	
$R^2$ (Pseudo $R^2$ for probit)	0.3974	0.5493	0.4680		0.6156	0.2357	0.1476	
$Adj - R^2$	0.0985	0.3257			0.4244	0.1260		
F-stat	6.334**	27.342***			5.954**	111.823***		
Degrees of freedom	(1, 131)	(1, 131)			(1, 129)	(1, 149)		

This table reports panel regression estimates of a modified version of the regression model of equation 5 (column 1), the regression model of equation 11 and its extension (columns 2-3), the regression model of equation 12 (column 4), and the regression model of equation 13 and its extensions (columns 5-6), analyzing the design and the likelihood of refinancing of CLO deals in relation to the share of the CLO deal held by insurance companies. Models 1-4 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 and whose tranches are denominated in USD. The dependent variable of model 1 is the volume of CLO tranches with a fixed-rate coupon as a percentage of the CLO deal at origination; the dependent variable of models 2-3 is a dummy equal to one if the CLO deal is a repackaging of CLO tranches from another/other CLO deal/s and zero otherwise; the dependent variable of model 4 is the length of the non-call period of the CLO deal. Models 5-6 are estimated on a dataset at the CLO deal-manager-year level covering information on CLO deals outstanding during the time period 2003-2019 whose tranches are denominated in USD. 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* is the percentage of the CLO deal held by insurance companies in the year of issuance of the CLO deal in models 1-4 and the percentage of the CLO deal held by insurance companies lagged of one year with respect to *Refinancing* in models 5-6 (the numerator of this variable includes holdings of combo notes pertaining to the CLO deal whereas the denominator does not). Models 1-2 and 4-5 report the estimates of a linear regression. Models 3 and 6 report the estimates of a probit model. The coefficient of *% CLO held by ICs* in models 3 and 6 represents the average marginal effect of insurers' holding share. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors are corrected for clustering at the CLO manager level. Fixed effects are included, "Yes", not included, "No". \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

## E.1 Implications for the primary market of bank credit: Robustness test

Table 11 of Section 6.2 presents our loan-level analysis investigating if CLOs whose tranches are owned by insurance companies have an effect on the size of term loans they invest in. The econometric models reported in Table 11 include a set of bank controls for the lead arranger bank. These variables are unavailable for foreign banks that only file a simplified version of the Call reports, meaning that this subset of banks is excluded from the sample where those regressions are estimated.

We, thus, test if the findings of Table 11 are robust to the inclusion of foreign banks in the sample. To this end, we replicate the econometric analysis of Table 11 without bank controls. The estimates presented in Table E2 reveal that the results are largely unchanged.

## E.2 Implications for the primary market of bank credit: Control variables

This table provides definitions of the variables used in Tables 11-12 and Table E2 and not described in the caption of those tables.

Variable	Definition	Source
<b>LOAN CONTROLS</b>		
Matleft	Maturity left of the loan in years	SNC
Tloanb	Dummy variable equal to 1 if it is a term B (or higher) term loan	SNC
IG	Dummy variable equal to 1 if the loan is rated PASS by the lead arranger	SNC
Workcap	Dummy variable equal to 1 if the loan is for working capital	SNC
M&A	Dummy variable equal to 1 if the loan is for M&A activity	SNC
Recap	Dummy variable equal to 1 if the loan is for recapitalization	SNC
Projfin	Dummy variable equal to 1 if the loan is for project finance	SNC
Capexp	Dummy variable equal to 1 if the loan is for working capital	SNC
Debtrepay	Dummy variable equal to 1 if the loan is for debt repay	SNC
<b>SYNDICATE CONTROLS</b>		
LEADsh	Lead arranger's share of the loan	SNC
Leadamt	Log of the total amount the lead bank owned of loans it arranged over the year	SNC
Lpartamt	Log of the total amount the lead bank owned of loans it acted as a participant	SNC
FUNDsh	Share of the loan held by funds (loan, hedge and pension)	SNC
FCOMPANYsh	Share of the loan held by finance companies	SNC
PEQUITYsh	Share of the loan held by private equity firms	SNC

<b>Variable</b>	<b>Definition</b>	<b>Source</b>
INSURANCEsh	Share of the loan held by insurance companies	SNC
FUNDshbk	Share of the loans arranged by the lead bank held by funds (loan, hedge and pension)	SNC
FCOMPANYshbk	Share of the loans arranged by the lead bank held by finance companies	SNC
PEQUITYshbk	Share of the loans arranged by the lead bank held by private equity firms	SNC
INSURANCEshbk	Share of the loans arranged by the lead bank held by insurance companies	SNC
<b>BANK CONTROLS</b>		
Lassets	Log of bank assets in billion dollars	Y9C
Capital	Shareholders' equity capital over assets	Y9C
Deposits	Total deposits over assets	Y9C
C&I	C&I loans over assets	Y9C
ROA	Net income over assets	Y9C
Chargeoffs	Chargeoffs over assets	Y9C

**Table E2: Insurance companies' CLO investments and size of syndicated loans: Robustness test**

Sample	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	New loans		Outstanding loans	New loans		New loans Risky	New loans Safe	New loans
	Log(Loan amount)							
CLOsh	0.819*** (8.40)							
INS-CLOsh		1.823*** (14.65)	1.746*** (15.94)	1.231*** (3.26)	0.620** (2.13)	0.763* (1.81)	0.469 (0.41)	
NINS-CLOsh		-0.099 (-0.63)	0.101 (0.92)	0.570*** (3.14)	-0.308 (-1.22)	0.674*** (2.79)	0.008 (0.02)	0.126 (0.78)
INS-CLOsh×Regref				0.717* (1.87)		0.945** (2.26)	-0.359 (-0.28)	
NINS-CLOsh×Regref				-1.261*** (-5.01)		-1.402*** (-4.80)	-0.771 (-0.81)	
INS-CLOsh×Postref				0.645 (1.50)		0.179 (0.34)	-1.870 (-1.16)	
NINS-CLOsh×Postref				-0.788** (-2.16)		-0.626 (-1.26)	6.604*** (2.83)	
Riskyloan					-0.129*** (-2.84)			
INS-CLOsh×Riskyloan					0.747*** (2.79)			
NINS-CLOsh×Riskyloan					0.151 (0.59)			
INS-CLOWsh								10.428*** (15.40)
LEADsh	-0.589*** (-4.90)	-0.606*** (-5.05)	-1.034*** (-11.87)	-0.610*** (-5.07)	-0.505*** (-3.42)	-0.256 (-1.47)	-0.308 (-1.02)	-0.635*** (-5.31)
FUNDsh	0.432*** (3.42)	0.305*** (2.78)	0.250*** (2.96)	0.268** (2.53)	0.317*** (2.58)	0.214 (1.55)	0.895*** (2.62)	0.309*** (2.76)
FCOMPANYsh	-0.240 (-1.04)	-0.199 (-0.87)	-0.249 (-1.59)	-0.258 (-1.13)	-0.281 (-1.08)	-0.083 (-0.26)	-0.717 (-1.50)	-0.227 (-0.99)
PEQUITYsh	-1.375*** (-5.35)	-1.264*** (-5.35)	-0.981*** (-7.19)	-1.238*** (-5.11)	-1.048*** (-3.51)	-1.393*** (-5.88)	0.766 (1.56)	-1.286*** (-5.48)
INSURANCEsh	0.674** (2.11)	0.556* (1.81)	0.153 (0.62)	0.507* (1.68)	1.874*** (3.47)	2.230*** (3.49)	0.277 (0.31)	0.569* (1.85)
Matleft	0.090*** (10.62)	0.090*** (10.92)	0.109*** (23.96)	0.088*** (10.70)	0.086*** (9.18)	0.110*** (7.95)	0.066*** (4.50)	0.087*** (10.61)
Tloanb	-0.017 (-0.63)	-0.008 (-0.29)	-0.002 (-0.10)	-0.017 (-0.60)	0.239*** (7.18)	0.331*** (7.37)	0.164*** (2.63)	0.004 (0.13)
IG	0.058 (1.36)	0.050 (1.20)	-0.016 (-0.90)	0.050 (1.19)	-0.027 (-0.55)	-0.078 (-1.37)	0.126 (1.00)	0.052 (1.24)
Workcap	0.060 (1.62)	0.065* (1.74)	0.031 (1.45)	0.067* (1.80)	0.077* (1.95)	0.175*** (2.85)	0.010 (0.17)	0.067* (1.78)
M&A	0.231*** (7.40)	0.226*** (7.24)	0.193*** (9.32)	0.225*** (7.20)	0.180*** (5.29)	0.195*** (4.50)	0.263*** (4.30)	0.226*** (7.21)
Recap	0.209*** (3.96)	0.222*** (4.11)	0.153*** (4.46)	0.225*** (4.25)	0.178*** (3.26)	0.232*** (3.30)	0.039 (0.41)	0.218*** (4.04)
Projfin	0.285* (1.89)	0.270* (1.80)	0.196*** (3.44)	0.284* (1.89)	0.402** (2.39)	0.385 (1.48)	0.388 (1.56)	0.268* (1.79)
Capexp	-0.290*** (-2.70)	-0.296*** (-2.89)	-0.207*** (-3.73)	-0.286*** (-2.79)	-0.104 (-1.17)	-0.169 (-1.37)	-0.057 (-0.36)	-0.293*** (-2.85)

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Table E2 - continued from previous page								
Debtrepay	0.166*** (4.97)	0.159*** (4.75)	0.147*** (6.05)	0.165*** (4.93)	0.117*** (3.14)	0.183*** (3.85)	0.047 (0.60)	0.164*** (4.88)
constant	6.776*** (105.71)	6.777*** (106.18)	6.731*** (200.89)	6.801*** (107.06)	7.101*** (94.06)	6.582*** (67.24)	7.307*** (50.19)	6.792*** (107.32)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lead Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
One-way clustering	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower	Borrower
N	13912	13912	52803	13912	7315	4155	2587	13912
$R^2$	0.816	0.819	0.819	0.820	0.826	0.848	0.844	0.819

This table replicates the econometric analysis presented in Table 11 but excluding lead bank controls. This increases the sample size because we are unable to get financial information on lead banks consisting in foreign bank organizations that do not file Call reports or file a version which does not contain all of the variables we use. Models are estimated on a dataset at the loan-lead arranger bank-year level covering syndicated term loans issued between 2003 and 2020. The dependent variable is the log of the loan amount. Models 1-2, 4-5, and 8 are estimated on the subsample of new syndicated term loans in the year of origination; model 3 is estimated on the sample of outstanding syndicated term loans throughout their lifetime as covered by the Shared National Credit Program; models 6-7 are estimated on the subsamples of risky, respectively safe, newly originated syndicated term loans. *CLOsh* is the share of the loan held by CLOs. *INS-CLOsh* and *NINS-CLOsh* are the share of the loan held by CLOs with and without investments by insurance companies at origination, respectively. *Regref* is a dummy equal to one for loans issued between 2011 and 2018, while *Postref* is a dummy equal to one for loans issued post 2018. We fix the beginning of the reform period in 2011 rather than 2010 because our loan data is reported at year-end and loans issued in the early 2010 are unlikely to be affected by the reform since they were negotiated prior to the announcement of the new regulatory regime, i.e. either earlier in the year or in 2009. *Riskyloan* is a dummy equal to one for risky loans, identified as those with an all-in-drawn spread above 250 bps (the sample median), and zero for safe loans. The sample of model 5 is smaller compared to that of models 1-2 and 4 because only a portion of term loans in the the Shared National Credit Program can be matched with Dealscan, which is our source for loan spreads. *INS-CLOWsh* is the aggregate share of the loan held by CLOs where each portion of the loan owned by a given CLO is weighted by the portion of the CLO debt tranches held by insurance companies. See Internet Appendix E.2 for the definitions of the remaining controls used in the regressions. For each independent variable the first row reports the coefficient, the second row reports in parenthesis the standard error. Standard errors are corrected for clustering at the borrower level. Fixed effects are included, “Yes”, or not included, “No”. \*\*\*, \*\*, and \* indicate statistical significance at the 1%, 5% and 10% levels, respectively.

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