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Reaching-for-yield—the propensity to buy riskier assets in order to achieve higher yields—is believed to be an important factor contributing to the credit cycle. This paper analyses this phenomenon in the corporate bond market. Specifically, we show evidence for reaching for yield among insurance companies, the largest institutional holders of corporate bonds. Insurance companies have capital requirements tied to the credit ratings of their investments. Conditional on ratings, insurance portfolios are systematically biased toward higher yield, higher CDS bonds. This behavior appears to be related to the business cycle, being most pronounced during economic expansions. It is also more pronounced for the insurance firms for which regulatory capital requirements are more binding. The results hold both at issuance and for trading in the secondary market and are robust to a series of bond and issuer controls, including issuer fixed effects as well as liquidity and duration. Comparison of the ex-post performance of bonds acquired by insurance companies does not show outperformance, but higher volatility of realized returns.

Key words: Fixed income; Reaching for yield; Financial intermediation; Insurance companies
JEL Codes: G11, G22, G30

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A key principle of finance is that there is a positive relation between the expected return and risk of an asset. Comparison of returns, therefore, is only meaningful on a risk-adjusted basis. But risk cannot be measured perfectly. This creates an important shortcoming in delegation of investment decisions. When investment managers are evaluated based on imperfect risk measure, they may face an incentive to buy assets that comply with a set benchmark but are risky on other dimensions, i.e. to "reach for yield".[1] For example, if financial intermediaries' incentives are a function of risk-adjusted performance, and retail investors' (e.g., households') understanding of risk is pinned down by some discrete and/or static benchmark (e.g., credit ratings), the intermediary has an incentive to maximize priced risk that is not reflected by such benchmark. This could lead to persistent distortion of investments and, potentially, amplification of the overall risk in the economy.

Risk measurement is particularly problematic for illiquid and complex securities. For fixed income, risk is often assessed using credit ratings. The advantage of credit ratings as a risk measure is that, unlike market-based measures of risk, ratings are comprehensible (due to standardized and well-established scales) and have broad coverage for many asset classes. Ratings are also not affected by liquidity or market conditions. Not surprisingly, ratings are commonly used for contracting and regulation purposes. Covenants on bonds and loans, as well as loan pricing, are often tied to ratings. Similarly, mutual fund investment mandates typically constrain portfolios to broad rating categories.[2] Banks and insurance companies have capital requirements that are based on ratings. However, ratings tend to be updated slowly (Cornaggia and Cornaggia, 2011) and are subject to concerns about the accuracy of rating methodologies (Benmelech and Dlugosz 2009) and may be subject to agency conflicts (Becker and

[1] We use the term "reaching for yield" to describe investors' preference for assets with higher expected or promised returns regardless of risk, conditional on compliance with investment limits such as those prescribed in an investment mandate or by a regulation. Cox (1967) used the term to describe banks' tendency to lend to high risk borrowers as a way of increasing the promised yield.

[2] See Chernenko and Sunderam (2012).

Milbourn, 2011).[3] Given the discrepancy between credit ratings and market perception of risk, fixed income investors evaluated and/or regulated based on credit ratings may reach for yield.

In this paper, we examine reaching for yield in the context of corporate bonds. We show that investments by insurance companies in corporate bonds exhibit patterns that reflect reaching-for-yield. This is an important finding given the size of insurance companies' bond portfolio. According to U.S. Flow of Funds Accounts, insurance companies are the largest institutional holder of corporate and foreign bonds. In 2010, their holdings represented $2.3 trillion or more than bond holdings of mutual and pension funds taken together (Figure 1). Investment decisions of insurance companies are also important because, like banks, insurance companies have liabilities to a broad population base.

The reaching-for-yield in insurance companies' portfolio arises due to regulation. Insurance companies are required to maintain minimum levels of capital (often referred as "RBC", risk-based capital). Given that, on average, 91% of all securities holdings by insurance companies are in fixed income (Nissim, 2010), the treatment of fixed income investments is an important component of the RBC calculation. To determine the credit risk component of RBC, corporate bonds are sorted into six categories (National Association of Insurance Commissioners, "NAIC", risk categories 1 through 6) based on their credit ratings. Capital requirements are progressively higher for lower rated bonds.

The NAIC risk classifications are broad, and there is variation in risk within each category. (Another important ingredient of reaching-for-yield is incentives and, as we discuss below, insurance companies' and specifically portfolio manager's incentives are tied to performance conditional on

[3] In particular, several issues have been raised about rating of structured products (e.g., Benmelech and Dlugosz, 2009). Some of these issues led to a recent departure of insurance companies from using rating for risk assessment. From NAIC website: "*The NAIC retained PIMCO Advisors to undertake the modeling of expected losses for the more than 20,000 RMBS held by the insurance industry. Regulators' goal in adopting the new RMBS process was to increase the accuracy in assessing expected losses, and to use the improved assessment to determine a more appropriate capital requirement for RMBS. The new approach reduces regulatory reliance on rating agencies, and allows for greater regulatory input into the modeling process and the assumptions used. […] This new process thus allows for a more precise assessment of expected loss and capital need for individual insurers, benefiting consumers and the insurance market.*"

regulatory compliance.) Reaching-for-yield predicts that insurance companies may attempt to maximize their yield through taking on extra risk, while complying with regulation.

To test this prediction, we examine how the credit risk of bonds issued by insurance companies relates to the identity of the bonds' owners. We examine purchases of bonds at issuance as well as on the secondary market, *conditional* on NAIC risk categories. We consider bond promised yields (relative to similar maturity treasuries, i.e. the yield spread) and spreads on issuer credit default swaps (CDS) to capture market perceptions of credit risk. Theses spreads largely reflect credit risk (Longstaff Mithal and Neis 2005). A CDS is essentially an insurance contract that guarantees the payoff in case a bond defaults. A higher spread — higher cost of insurance — is associated with higher default probability. Both yield spreads and CDS spreads should be unaffected by the yield curve. Blanco, Brennan and Marsh (2005) document that the bond and CDS markets tend to price credit risk equally. While CDS spreads and yield spreads are strongly related to credit risk, the two measures have complementary features. Yield spreads can vary across different bonds of the same issuer, reflecting e.g. differences in seniority, while CDS contracts refer to issuers (i.e. at any given time, only one bond will be the cheapest-to-deliver under a particular contract). Therefore, yields provide more variation and better precision. CDS spreads have the advantage of being standardized in maturity and contractual details, so are easier to interpret. For at least some issuers, CDS spreads may be more timely than yield spreads (Blanco et al 2005). We study CDS spreads for the most liquid firms, reducing likelihood that prices are noisy or uninformative.[4] Our results are similar for these two measures.

Because the reaching-for-yield hypothesis for insurance companies is based on regulation, our analysis of their investment behavior is benchmarked against mutual funds and pension funds, i.e., large fixed income investors that are not subject to capital requirements based on ratings. Although mutual

[4] We focus on bond issuers that were part of the CDX Markit index between the index inception in 2003 and 2010. The CDX index includes issuers with the most liquid CDS contracts, constrained to some sector balance and reset periodically.

funds and pension funds might explicitly commit to invest all or part of their portfolio in investment grade, they are not evaluated by its investors solely on its compliance with the specified mandate.[5] For insurance companies the risk is assessed by regulators, and it is done in accordance with the established benchmark. (Note that even basic statistics like risk adjusted capital of insurance firms are not easily available to the general public.)

We find that, across regulatory risk categories, insurance companies exhibit a strong preference for safer bonds (Figure 2, Panel A). This is consistent with risk-weighted capital requirement. However, within investment grade, insurance companies selectively acquire high yield (and high CDS) bonds, both in the primary and secondary markets. For example, at issuance, for investment grade securities (NAIC risk category 1, 2) insurance companies hold 75% (of all bonds held by insurance companies, pension or mutual funds) in the lowest yield spread quartile, but 82% in the highest yield spread quartile (Figure 2, Panel B). This difference is statically and economically significant. The differences insurance holdings are slightly larger for CDS spreads.

We also find that reaching-for-yield behavior is absent for bonds with lower ratings. This can be explained by convexity of downgrade probabilities and capital requirements. For lower rated bonds, the likelihood of a downgrade is high and increasing in CDS spreads, so that reaching-for-yield would be less attractive. (In Section 2, we develop this argument in more detail).

Our findings are robust to controlling for a set of bond and issuer characteristics, such as duration, issue size, year of issuance, bond liquidity, and detailed credit rating, so they are unlikely to be driven by investor preferences over those characteristics. One possible concern is that the higher yields on bonds that insurance companies favor might reflect higher expected returns. This could occur if insurance companies possess superior investment ability ("alpha") or if they had access to better opportunities thanks to their size and importance. To address this, we examine bond return performance following

[5] For example, as any fund, fixed income funds available through Fidelity offer detailed information on fund risk, including historical standard deviation and market beta.

issuance. We find that bonds preferred by the insurance companies have lower returns and higher volatility, both in absolute terms and on a market-adjusted basis. This result is inconsistent with the hypothesis that insurance companies have a special ability for picking bond or special access to investment opportunities.[6] Another explanation for higher yields is that insurance companies are more tolerant of illiquidity than other investors (presumably thanks to their tendency to hold assets to maturity). If illiquid bonds have higher yields and returns, this could explain the high yields on bonds favored by insurance companies. However, the low ex post returns of bonds favored by insurers appear inconsistent with this hypothesis. Also, we find that controlling directly for bond liquidity does not affect our findings that higher yield bonds are preferred by insurance companies. Finally, the absence of reaching for yield in speculative grade would be surprising if the high yields on insurance companies' bonds reflected illiquidity (since illiquidity should be rewarded among riskier bonds as well). We conclude that liquidity is likely not an important component in the reaching for yield we document.

During economic downturns the incentive to reach for yield is much weaker, for several reasons. First, downgrade probabilities rise during economic recessions. Given that higher CDS bonds are more likely to be downgraded, there is a lower incentive to reach for yield. But reaching-for-yield could be also curtailed because of increased scrutiny of investment managers, or because investors no longer neglect unlikely risks (Gennaioli, Shleifer and Vishny, 2012), or because a shift in risk-preferences makes reaching-for-yield less attractive by reducing the shadow cost of regulatory constraints. Our finding that insurance companies relative propensity to pick high yield, high CDS bonds within given NAIC risk

[6] We also show that CDS spread is a good predictor of ratings downgrades: within NAIC1, the lowest CDS quartile has a 1% probability of a downgrade over the next quarter, but for the highest CDS quartile this probability is 6%.We define downgrade as a change in rating that moves an issuer from one NAIC to any lower NAIC. The overall frequencies are comparable to what rating agencies provide for historical transition densities (e.g. Moody's Investor Service 2002).

category disappears in 2008-2010 period is consistent with this statement.[7] Although we cannot definitively show what makes reaching-for-yield disappear, the fact that reaching-for-yield is a phenomenon that manifested during the expansion of the credit cycle, and potentially could be a contributing force, is an important finding in itself. In addition, it is not clear why an ability to produce superior returns would be time-varying, so bond acquisition patterns that disappear in an economic downturn are unlikely to reflect investment ability. Thus, the cyclicality results are also inconsistent with insurance investment ability.

More broadly, there are a few explanations for reaching-for-yield. It could be driven by attempts to inflate accounting earnings, which could lead managers to neglect risk. Alternatively, reaching-for-yield could be a reflection of a desire to hold more risk and a desire to offset constraints imposed on risk taking by regulation.[8] Competition in product markets could exacerbate both these forces. Finally, insurance companies have low levels of equity. This could lead to an incentive to risk-shift as in Jensen and Meckling (1976). To tackle the different predictions of these theories, we also examine reaching-for-yield behavior in a cross-section of insurance firms. We finds that insurance firms for which the regulatory capital constraint is more binding tend to reach for yield more. This is supportive of the argument that (some) insurance companies attempt to increase the credit risk they hold despite regulation in the opposite direction. In addition, controlling for regulatory capital constraints, publicly listed firms do not appear to reach for yield more than privately held companies. This suggests that earnings management or short-run performance pressure—to the extent that this is stronger for managers of public firms—is unlikely to motivate the observed investment behavior of companies that reach for yield. Finally, high leverage is not associated with more reaching-for-yield when controlling for regulatory capital constraints. This suggests

[7] If we do our analysis by year, we find a positive and significant relation between CDS spread and the relative share of insurance companies holdings in 2004, 2005, 2006 and 2007; similarly, for bond yields. However, the sign reverses for 2008, 2009 and 2010 period.

[8] This is similar to Peltzman's (1975) "belted-milquetoast-turned-daredevil" effect.

that regulation, rather than risk shifting at the expense of creditors, is the likeliest explanation for reaching behavior.

In the final set of results, we examine insurance companies' stock returns during the 2008. Consistent with reaching for yield being associated with higher risk taking, we find bigger losses of equity value for those firms that had reached for yield more in their portfolio.

Reaching-for-yield had been identified as one of the core factors contributing to the buildup of credit that preceded the financial crisis (Yellen, 2011 and Rajan, 2010).[9] This paper provides an economically important example of this phenomenon. Reaching for yield may be equally prominent in other areas. For example, in the context of securitization, several studies have shown evidence of agency-related problems that are consistent with reaching-for-yield among investment managers. For example, Keys et al. (2010) show that securitization reduces incentives of financial intermediaries to screen borrowers above and beyond a specific benchmark. Lax screening may produce the type of high-risk good-rating assets that comply with requirements for investors. Indeed, Coval, Jurek and Stafford (2009) show that leading to 2008 senior collateralized debt obligation (CDO) tranches appeared to misprice the systematic risk exposures. Their finding is indicative of investors focusing exclusively on credit ratings. Our paper provides an explanation for why demand for such assets may behave in this way. This is a hypothesis only, since we examine corporate bond markets, for which generalization of findings on structured products is non-trivial. Like insurance companies, banks face capital requirements that rely on classification of risk (sometimes external credit ratings, sometimes other risk measures), and may have incentives to increase risk taking while complying with limits to measured risk.

By studying quantities, we provide direct evidence of distortions to credit allocation. The effects on individual firms and their investment choices are beyond the scope of this paper, but may be important. Directionally, we would expect easier access to credit for firms that are risky *within* their ratings category.

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[9] Rajan (2010) refers to this phenomenon as "searching for alpha".

Broadly speaking, our paper is related to the large literature on agency problems in delegated investment management, such as Chevalier and Ellison (1999). Investors and regulators alike possess imperfect information about risk and expected returns, making delegation and regulation of portfolio decisions difficult. For example, to the extent that constraints imposed by principals (regulators or principals) are binding, it can be expected that agents take actions to offset regulatory constraints. When many firms are restricted based on particular risk metric, the financial system as a whole will have a strong incentive to produce assets with low risk classifications by that metric but high risk (by other measures). As pointed out above, this may have been a powerful motivator behind regulatory arbitrage in the recent credit boom (see also Acharya and Richardson 2009),

Because imperfect risk measurement is itself a fundamental feature of financial markets, there are no easy fixes to reaching for yield. Rules that discourage risk taking also provide incentives to reach for yield (within categories). Using finer categories might appear to reduce the scope for reaching for yield, but would also raise the incentives for the financial system to produce miss-classified assets. This may be one reason private contracts tend to make less fine distinctions (for example, mutual funds tend to only rely on two categories: investment grade and high yield).

1. Insurance companies: Some institutional details

A. Capital requirement

Insurance companies' investment portfolio size and composition vary substantially depending on their main product. There are three main lines of insurance business: (i) life, (ii) property and casualty, and (iii) reinsurance. Life insurance companies have the largest assets under management. At the end of 2010, life insurance total financial assets represented $5,177 billion, as compared to $1,403 billion for property and casualty insurance companies (Table I). The core of insurance companies' financial assets is invested in medium- and longer-term fixed-income assets. Nearly 40% of the life insurers' financial assets are invested in corporate and foreign bonds, making them the largest institutional holder of this

asset class. According to Allstate 2010 annual statement, corporate bonds represented 38% of its overall financial assets, while foreign government bonds only represented 3%.

[TABLE I]

Similar to the banks, insurance companies are subject to risk-adjusted capital requirements on their investments. Companies that fail to comply with the capital requirement may be taken over by state insurance departments.[10] In principle, insurance companies are regulated at the state level. For firms with multiple subsidiaries, each subsidiary is subject to state laws and regulations. However, the regulatory standards are coordinated through NAIC which was created and is governed by state regulators. As part of this study, we contacted the department of insurance in fifty states and received an explanation about state-level regulation of capital from all but three states (Georgia, New York and New Jersey). In summary, there is some variation at the state level on statutory capital (capital required in order to retain a business license), but every state uses risk-based capital weights formulated by NAIC.

Capital requirements for credit risk are determined as a weighted sum of investments in different risk-categories. Capital weights are summarized in Table II; these risk factors had been constant over our sample period. Direct obligations of the U.S. government are exempted from capital requirement. The remaining securities are assigned to one of six risk categories (NAIC Category 1 through 6). For bonds, NAIC categories are determined based on the credit risk ratings. Issues rated AAA, AA or A are classified as Category 1. Each subsequent rating corresponds to a different NAIC risk category. Corresponding capital requirement increases exponentially. For each $100 invested in Category 1, the insurer has to put $0.30 of equity capital. For Category 2 (BBB), the capital requirement would be $0.96, more than three times larger. Similar investment in Category 5 (CCC) would command $16.96 or nearly 57 times more of equity capital.

[10] Weiss Ratings reports that between 2008-2011 there were 82 insurance companies that were taken over by the state regulator (www.weissratings.com/ratings/track-record/insurer-failures.aspx).

In addition to credit risk, total risk-based capital formula includes capital charges for equity risk, interest rate risk, affiliated and off-balance sheet risk, and other business risks. Each capital requirement component is computed separately. But rather than taking a simple sum of the components, risk-based formula rewards a company for diversifying its risks (the discount is often referred to as the "covariance adjustment").

B. Incentives to reach for yield

An important ingredient of reaching-for-yield is that there must be an incentive to maximize returns, conditional on compliance with risk benchmark. Capital requirement for insurance companies leads to a target distribution of the portfolio by NAIC risk category, with the skew toward investment grade bonds. In fact, according to Allstate annual statement, as of the end of 2010, 91.6% of its consolidated fixed income securities portfolio was rated investment grade. However, *within* the NAIC risk category, there is an incentive for the insurance firm and investments' manager to maximize the yield on their investments. For example, Allstate, which is the largest publically held U.S. insurance company, explicitly states in its 2010 report to shareholders that: "*The return on our investment portfolios is an important component of our financial results.*" It also specifies that the investment strategy balances "the pursuit of competitive returns" with liquidity needs given its overall corporate capital structure.

The insurance industry reports financial accounts using both statutory accounting principles (SAP) and general agreed accounting principles (GAAP). SAP accounts are presented to state insurance commissioners, and may vary slightly by state. GAAP accounts are primarily used for filings to the SEC. There is a significant overlap between the two accounting systems in the treatment of investment portfolios. Under GAAP, fixed income securities intended to be held to maturity—the majority of insurance companies' bond holdings—are accounted for using the "amortized amount", i.e., the premium or discount at which a bond is bought, relative to its par value, is amortized evenly over time (as long as

the bond is not in default).[11] Under SAP, all bonds are treated this way. Under amortized treatment of bonds, the impact of non-defaulted bonds on insurers' income is the yield to maturity at which the bond was acquired. In other words, promised yields—and not coupon yields, or market values—determine earnings.[12]

It is also worth understanding the incentives to reach-for-yield at the manager level. According to the Insurance Asset Manager 2010 Annual Survey (World Trade Executive, 2011), in 2006 over 78% (or $3.25 trillion) of insurance investments were managed in-house. It is primarily insurance companies with assets under $3 billion who outsource their portfolio management. The decision to outsource investments also varies by asset class. Portfolio management outsourcing is more likely for complex asset classes, but most of the fixed income allocations observed in our sample are internal. According to NAIC (2011), a trained investment professional with a modest amount of supporting analytic tools should be able to manage a high-grade corporate portfolio.

Compensation of in-house portfolio managers tends to be similar to other asset managers. Insurance company annual investment management fees for core fixed-income mandates are generally in the range of 10 to 25 basis points of assets under management. There is some variation in these fees by portfolio size (with larger portfolios typically paying lower fees) and investment needs (with more complex investment strategies commanding higher fees.) The investment manager's objective is to outperform the investment target. "*If the manager outperforms the index by as much or more than the specified margin while meeting the other constraints, the investment manager would be considered to have successfully managed the investment portfolio.*" (NAIC, 2011)

2. Hypotheses

[11] An exception to this rule are property and casualty insurance companies which carry speculative grade corporate bonds (NAIC 3-6) at the lower of fair value or cost.
[12] See Myhr and Markham (2004) for more detail on these issues.

In the empirical tests, we aim to examine (a) the existence of reaching-for-yield, (b) how it depends on macroeconomic conditions, (c) how it varies across firms. We also document some effects of reaching for yield, such as ex post portfolio performance. In this section, we develop a model that captures some of the effects in a simple setting.

A portfolio manager that is reaching-for-yield will pick the highest yielding security for a given risk benchmark (assuming there are no costs to doing this.) For an investor whose risk is evaluated exclusively using credit ratings, bonds with higher yield within a rating appear more attractive, regardless of their actual risk. In the extreme, a manager would want to allocate a whole portfolio to the single highest-yielding asset. However, for a forward-looking manager and in the presence of ratings changes, the allocation decision is more intricate. In this dynamic setting, the portfolio decision balances expected yield against the risk of being downgraded (for insurance companies, this raises future capital requirements). To fix ideas, we formalize the investment decisions of a portfolio manager in a simple two-period, two-asset model:

Consider a portfolio manager deciding to allocate $1 between two securities. The manager invests an amount α_i in security i. The manager works for a principal who dislikes risk; this could be a regulator or an ultimate investor who has delegated the portfolio decision. The principal and manager agree that the promised return of asset i is $\overline{r_i}$. Securities are assigned ratings, which can be A or B, where A reflects a safer asset, by a third party. Both securities have an *A* rating, but asset 1 has a lower yield: $\overline{r_1} < \overline{r_2}$.

Case 1: Consider the case where the principal imposes no penalties and where the manager gets a linear contract based on returns. In this scenario, the manager maximizes her expected utility $U(x) = \pi + \tau E[x]$ for the linear sharing rule $\{\pi, \tau\}$. As long as τ is positive, it is optimal for the manager to simply maximize $E[x]$:

$$\max_{\alpha \epsilon [0,1]} \sum_i \alpha_i \, \overline{r_i}, \quad s.t. \sum_i \alpha_i = 1 \qquad (1)$$

The optimum is a corner solution, where the manager puts the whole portfolio in the security offering the highest return (second security). This manager favors high yielding securities even if they are riskier, because there is no cost associated with it.

Case 2: We now allow for capital requirements or, more broadly, penalties based on ratings. Penalties are c_A and $c_B = c_A + \Delta > c_A$ for assets rated A and B, respectively. Penalties are assessed in period two at which point the initial rating may have changed (recall, both assets are assigned rating A at the start). The probability of a downgrade from A to B is $p^- \in [0,1]$, so that the expected capital requirement for the (initial) A securities is $(1 - p_i^-)c_A + p_i^- c_B = c_A + p_i^- \Delta$.[13] We assume that the higher yielding security is more likely to be downgraded, so that $p_1^- < p_2^-$. In this setting the investor solves the following problem:

$$\max_{\alpha \epsilon [0,1]} \sum_i \alpha_i \bar{r_i} - \alpha_1[c_A + p_1^- \Delta] - \alpha_2[c_A + p_2^- \Delta], \quad s.t. \sum_i \alpha_i = 1$$

or

$$\max_{\alpha \epsilon [0,1]} \sum_i \alpha_i [\bar{r_i} - p_i^- \Delta], \quad s.t. \sum_i \alpha_i = 1 \qquad (2)$$

Due to the linearity of this problem, the manager will again concentrate his portfolio in a single asset. From the first order conditions we conclude that asset 1 is preferred to asset 2 (i.e., the marginal utility of investing in asset 1 is higher) if $\bar{r_2} - \bar{r_1} \geq \Delta(p_2^- - p_1^-)$. In other words, the manager favors the higher yielding security if its excess return outweighs its higher probability of a downgrade. For certain values of the parameters the manager will reach for yield: First, when the ratings-based penalty (Δ) is large, reaching-for-yield is less attractive. Second, when the risk of downgrades (p_2^-) is higher (for the higher yielding security), the reaching behavior becomes weaker.[14]

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[13] Note that this setting can be easily modified to allow for ratings updates without changing the intuition. In practice, the probability of upgrades is about a third of the probability of a downgrade (Figure 3, Panel B). Hence, this is less important for the purpose of planning for capital needs.

[14] This result corresponds to Becker's (1968) prediction of the effect of punishment on crime rates: crime will be lower when the probability of getting caught is higher and also when the penalty conditional on getting caught is higher.

We have abstracted from the risk aversion of the manager, and the choice of penalties by the principal. It is also outside of the scope why some principals use penalties as we model them here (e.g., regulatory capital requirements), while others use absolute quantitative rules (e.g., some mutual funds invest exclusively in investment grade bonds).

The conclusion that higher downgrade probabilities weaken the incentive to reach for yield has a straightforward, testable prediction: Any bond that faces a higher downgrade probability is less attractive for a manager reaching-for-yield. For insurance companies, both the cost of a downgrade and the probability of a downgrade are increasing in measurable risk (NAIC categories). As discussed earlier, capital requirements are convex in NAIC risk categories. In addition, as illustrated in Figure 3, Panel A the probability of a downgrade is also convex in NAIC risk category. Probability of NAIC 2 asset in the highest CDS quartile to be downgraded is 9%. However, probability of NAIC 3 asset in the highest CDS quartile to be downgraded is 12%. For the lowest CDS quartile, the corresponding probabilities are only 0% and 1%. To avoid raising capital, insurance companies could sell its bonds when it is downgraded, but such a strategy has a non-trivial economic cost (e.g., Ellul, Jotikasthria and Lundblad, 2011; Bao, Pan, and Wang, 2011).[15] There is also an additional source of convexity given that highly rated bonds are cheaper to trade than low-rated bonds. Edwards, Harris and Piwowar (2007) point out that, while the difference between investment grade bonds is negligible, high-yield bonds are almost twice as costly to trade as investment grade bonds. What this amounts to is that reaching-for-yield—loading on high CDS within rating category—should be less likely in NAIC categories that correspond to speculative grade ratings.

[FIGURE 3]

Our sample covers the financial crisis, and we need to consider carefully how that may affect the propensity to reach for yield. There are at least two reasons why reaching-for-yield should be less likely

[15] We document below (Figure 6) that U.S. insurance companies have very little debt apart from their policy liabilities.

in the crisis. First, downgrades are cyclical, so all bonds face higher downgrade probabilities. As explained above, this should reduce reaching. Second, it may well be that in a period of high risk and high risk premia such as the crisis, other reasons to avoid risk dominate regulatory constraints. For example, investors may become sufficiently risk averse that they no longer consider capital regulation binding. Kashyap and Stein (2004) develop this argument in the context of bank capital.

3. Data

The data for the analysis was compiled from multiple data sources and covers the 2004:Q1-2010:Q3 period. We have data on bond holdings from Lipper eMAXX. This database has a comprehensive coverage of quarterly fixed income holdings for insurance companies, mutual funds and pension funds. Insurance companies constitute approximately half of holdings, by number and by dollars, throughout our sample. The data contains both manager (e.g., Fidelity) and ultimate investor (e.g., Allstate). eMAXX classifies investors into categories based on type (e.g., mutual funds vs. insurance companies). The coverage of foreign bond buyers and hedge funds is limited. eMAXX does not cover households, banks, and governments. We exclude convertible bonds, preferred stock or other preferred securities, and government or government sponsored enterprises' bonds. Over the sample period, we use over 4 million individual corporate bond holdings in a total of 10,045 bonds. The dollar value of holdings in the sample is $336 billion in 2004:Q1, rising to $472 in 2010:Q4, with a reported face value of $1 to $1.4 trillion, again depending on the quarter. The fraction of ownership covered by eMAXX is stable over time.

We examine holdings at issue and trading by insurance companies over time. Our new issues sample consists of 3,709 bonds issued by 276 firms (124 of which issued at least one investment grade bond) between 2004:Q3 and 2010:Q4. As illustrated in Figure 4, most of the bond issuance in our sample is investment grade. NAIC risk categories1 and 2 include 2,467 issues with a total of $152 billion raised. Issues rated non-investment grade, NAIC risk categories 3-6, amount to 1,242 issues (half the issue count for investment grade) and only a third in term of issue volume.

[FIGURE 4]

We collect issuer credit ratings and bond characteristics from Mergent FISD. Ratings are issued by S&P, Moody's or Fitch, and are combined into a single rating for each bond according to NAIC rules.[16] That is, if the bond is rated by two rating agencies, we use the lowest rating. If the issuer is rated by all three rating agencies, we use the middle rating. Ratings are translated to a numerical scale for the purpose of averaging. The rating AAA is assigned the value 28, AA+ is 26, AA 25, AA- 24, A+ 23, etc. all the way down to CCC- which is 9, CC which is 7 and C which is 4. Table II describes how ratings are organized into NAIC categories for the purpose of capital requirements. Because our focus is on yields and yields are not reported for floating coupon bonds, we exclude them from the sample. The majority of U.S. corporate bonds are fixed coupon bonds, so this is not something that significantly reduces our sample. We also collect promised yields at issue from Mergent FISD. In tests of bond holdings at issuance, we consider the spread between the promised yield to maturity and a matched treasury bond, reported by MergentFISD. When MergentFISD does not report a spread, we estimate it using the contemporaneous yield curve and a bond's yield to maturity.

We also study bond acquisitions by insurance companies both at issuance and on the secondary market. For secondary market tests, we need to track measures of risk through time. We employ the Trade Reporting and Compliance Engine (TRACE) database which reports dates, yields, prices at which bonds trade. We exclude trades that are canceled or corrected, and when multiple similar trades occur very close in time, we discard all but one transaction (assuming it is a pass-through transaction). For a given bond we calculate the median yield of all transactions taking place on the last active trading day in a given month, or quarter. We calculate bond returns as the change in price from the end of a month to the end of the next month, adding in the coupon yield.

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[16] The NAIC allows ratings from a group raters (these were called acceptable ratings organizations – AROs – until 2012 when the nomenclature has changed to credit rating providers -- CRPs), For the period studied, this set of raters was a subset of the SEC's nationally recognized statistical ratings organizations (NRSROs), with some additional requirements. Moody's, S&P and Fitch were all AROs the whole period.

We compute two measures of bond liquidity: the log of total transaction volumes relative to outstanding par value in the preceding quarter (based on TRACE), and the log of the number of investors reporting changed positions in the bond over the preceding quarter (based on eMAXX). We also estimate bond durations, based on detailed cash flow (e.g., coupon times and amounts) data from Mergent FISD and yields (from Mergent FISD at issue or from eMAXX transactions for later dates).

CDS spreads come from Credit Market Analysis, downloaded using Datastream. The CDS spread is a quarterly premium (quoted on an annualized basis) that the CDS buyer pays the seller. In exchange, the seller commits to pay the buyer bond's face value upon bond's default. We use the data for 5-year senior default spreads. In the last ten years, the CDS market has become increasingly important. In 2001 notional value of CDS market was $630 billion; in 2009, despite retraction of the market, the notional amount was $36 trillion.[17] Yet, for most bonds, the CDS market remains illiquid; this is one reason why CDS spreads are slow to be adopted in contracts and regulation as a measure of risk. To assure that bonds in our sample have liquid CDSs we constrain the sample to bonds that had been part of CDX Markit Index, one of the primary tradable index families. The inclusion in the index is determined by liquidity rankings, constrained so that the index has a balanced industry representation.[18] The 5-year maturity contracts are considered to be the most liquid segment of the market. CDS is not specific to individual bonds; upon default several fixed income securities might be considered to be a deliverable under the contract. We use median across daily observations of the spreads for a particular issuer, in order to to account for outliers, but our results are the same using the average spread.

We assign all issuers to CDS quartiles, from low to high, among all firms in a ratings group in a given quarter. By construction, our sample of CDS spreads is a representative pool of senior bonds with

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[17] U.S. Government Accountability Office, "Regulatory Oversight and Recent Initiatives to Address Risk Posed by Credit Default Swaps", testimony before the Subcommittee on Capital Markets, Insurance, and Government Sponsored Enterprises.

[18] We include bonds that had been either part of investment grade (CDX.NA.IG) or non-investment grade index (CDX.NA.HY), Series 1 through 16. Series 1 of CDX Markit Index was rolled out in October 2003.

liquid CDSs. The sample of bonds with CDS data is therefore slightly limited compared to regressions without this control.

Table III compares sample bonds across different CDS quartiles. (In the analysis, we will use a continuous measure of CDS spread. In this table, we summarize it by quartiles for purposes of expositions.) Quartile 4 (high CDS spreads within NAIC category) bonds are characterized by higher yields, but not the longer maturities, than low CDS bonds. The high CDS bonds' issuers have lower ratings, higher book leverage and lower return on assets (and higher CDS spreads, obviously). The size of issuers is not statistically different. This is consistent with the CDS spread capturing financial performance of the company that might not be fully reflected in the credit ratings. Table III is conditional on investment grade bonds (NAIC category 1 and 2), but as one can see with the exception of the lowest CDS quartile, there are no differences in average credit ratings across the CDS categories.

[TABLE III]

We collect additional information about insurance companies. First, we gather daily stock return data for publicly listed insurers for the 2001 to 2011 period from CRSP, and calculate betas and volatilities as well as the stock returns during the crisis. The average stock return for the crisis period, defined as June 2008 to February 2009, is -46.3% and the standard deviation is 30.6%. We also collect regulatory capital for insurance companies from S&P CapitalIQ. Our measure of regulatory capital cushion surplus is the difference between required capital and reported capital, normalized with book value of assets. When a subsidiary company appears in our data, we use the ultimate parent's capital. Across 97 parent companies, the mean of 2004 capital surplus is 17% and the standard deviation is 11%. To characterize insurers, we also define an indicator for publicly listed firms, and a lagged measure of leverage (the ratio of assets to equity in 2004) and size (the log of asset book value in 2004). Mean leverage is 8.8 and standard deviation 26.0 (this measure includes policy liabilities). Mean book assets is $70 billion.

4. Results

A. Benchmark results: Holdings at bonds issuance

Our first set of results focuses on investment choices near the bond issuance. Insurance portfolios have little turnover. As mentioned earlier, the core of insurance assets are managed by life insurers. Unlike property and casualty companies, life insurers to do not anticipate paying benefits in a short run on their average policy, so most of their investments are held to maturity. According to NAIC (2011), portfolio turnover is in the range of 20 -25% per year or less for the core fixed-income insurers' holdings. That is why looking at investment choices at issuance is central for understanding their behavior. Overall, total new issues in our sample amount to approximately $2 trillion. We have holding data on 6,154 bonds of which 3,807 are issued during the 2004:Q3-2010:Q3 sample period.

We should note that the holding data is quarterly, so we do not observe the date of the transaction. The fact that there is little turnover and that we see that a large fraction of the bonds appearing in insurance companies' portfolio in the quarter immediately following bond issuance helps to ameliorate this problem. In other words, the bond positions we observe in the first quarter were most likely largely acquired at issue. It is very likely that the yield at issuance (as reported in Mergent FISD) is the yield at which these bonds were acquired.

The results for bond purchases at issuance are reported in Tables IV (yield spreads) and V (CDS spreads). Each observation in the sample corresponds to a different bond. The dependent variable is a sum of insurance investors' holdings of a given bond scaled by the total recorded holdings in the eMAXX data; insurance companies' investment decision is benchmarked against aggregate holdings of mutual and pension funds. This scaling and aggregation of holdings takes care of the fact that bond issues can be of different sizes potentially generating volatility in the absolute holdings for a given insurance company. The reporting date is not standardized for different investors. To allow for reporting delays, we look at the bond holdings in the second calendar quarter following the date of bond issuance. We cluster standard errors by issuer because same companies can have several issues over our sample. (In addition, CDS contracts are not specific to the deliverable.)

Both Table IV and V report results for pre-crisis (2004:Q3-2007:Q2, specifications (1) - (4)) and crisis period (2007:Q3-2010:Q4, specifications (5)-(7)).[19] In Table IV the explanatory variable of interest is the spread at issuance. Specifications (1)-(3) show that, compared to other institutional investors, the propensity of insurance companies to invest in new bonds is an increasing function of the yield. In other words, there is reaching-for-*yield*. The first column of Table IV reports the baseline regression. The coefficient on the treasury spread is positive and significantly different from zero, indicating that in the pre-crisis period, within NAIC 1 and 2, bonds with higher yields ended up with insurance investors, more than other bonds. The coefficient estimate implies that a 100 basis point increase in the yield (a standard deviation is 128 bps) corresponds to a 7% higher fraction of insurance holdings. This corresponds to a quarter of a standard deviation of the dependent variable.

In specifications (1)-(3), the sample is constrained to bonds rated investment grade at issuance (NAIC risk category 1 and 2). Because NAIC 1 and NAIC 2 have different capital treatment, we include a dummy variable equal one for bonds rated BBB+, BBB or BBB- (NAIC 2) and zero otherwise. In columns (2) and (3) we add controls for bond and issuer characteristics. The concern is that insurance companies (*or* the control investor group) have preferences for certain bond or issuer characteristics. If these features are correlated with yield, reaching-for-yield may be hard to distinguish from the investors' preferences. In column (2), we control for bond duration and offering amount. The offering amount captures the size of the issue (insurance companies may ignore small issues) and liquidity (larger bond issues are more liquid).[20] In column (3), we extend the set of controls to include ratings (AAA, AA, A, BBB) *interacted* with year of the bond issuance. (The dummy for NAIC 2 drops out in this specification.) Fixed effects absorb a lot of the variation in the sample, raising the *R*-squared from 3%, in

[19] Because eMAXX has comprehensive coverage we detect new issues when a bond appears in the data for the first time. New issues for 2004:Q1 and 2004:Q2 are difficult to identify from the data because old bonds also appear for the first time in these quarters. Hence, the sample starts in 2004:Q3.

[20] In our tests of the secondary market (trades of bonds after issuance), we include explicit controls for bond liquidity.

the baseline, to 31%. But the coefficient of interest remains positive, economically large and statistically significant.

[TABLE IV]

Specification (4) is the same as specification (3), but applied to non-investment (speculative) grade issues as opposed to investment grade. The coefficient on the yield spread is now statistically insignificant, which is consistent the hypothesis that reaching-for-yield should be less appealing for lower ratings (where the probability of downgrades and capital requirements are higher).

In columns (5) through (7) we repeat the same analysis for the "crisis" period, defined as the period following second half of 2007 (2007:Q3-2010:Q4).[21] The idea is to allow for possible changes in investment behavior during the financial crisis. Specifically, we expect reaching-for-yield over this period to become weaker due to rise in downgrade probabilities, increase in scrutiny, rise in awareness of previously neglected risks, or a shift in risk-preferences. The coefficient on the yield spread is reversed during the crisis. As discussed in the introduction, during the economic downturn, the incentives to reach for yield are likely to be much weaker. This is consistent with the time-varying pattern identified in the data. This finding also helps with the interpretation of our results because it means that time-invariant institutional differences—e.g., superior investment ability, or institutional investment preferences—cannot explain our findings.

The results reported in Table IV imply that insurance companies, relative to other investor categories, favor bonds with high yield spreads within investment grade. We next turn to CDS spreads, the alternative credit risk measure. In Table V we repeat the analysis using logarithm of the median CDS spread in the quarter of issue as the main explanatory variable.[22] We expect the same sign on spreads as on yields. In all of the benchmark specifications, the holdings of insurance companies load positively on

[21] Arguably, the financial crisis was over before this period ends; the National Bureau of Economic Research dates the associated economic recession as December 2007 through June 2009. We revisit detailed time pattern below in Table VII.

[22] Logs avoids a disproportionate influence on regression by a few outliers (results are similar with the spread itself

the CDS spread. In column (1), which presents the baseline results, a one standard deviation increase in the CDS spread (an 80% increase in the log of the spread) corresponds to a 5.8 percentage point increase in the insurance share of holdings at issue. The coefficient estimates are even larger in we include controls for maturity, issue size, year of issuance and credit rating (columns 2 and 3). As before, this result only holds for investment grade bonds and disappears during the crisis.

[TABLE V]

Note that data on yields and CDS spreads are not always available, so the sample sizes differ between Table IV and Table V. In Figure 5, we examine the relation between the two variables for all bond issues where both are available. The relationship is positive and significant. This helps with the concern that the results shown for yields and CDS spreads correspond to different samples of issuers. It also makes the point that yields and CDS spreads can differ (this is consistent with earlier studies, e.g. Blanco et al 2005), suggesting that it is a conservative approach to use both as measures of risk taking in bond portfolios.

[FIGURE 5]

Taken together, the results on insurance holdings of corporate bonds at issue suggest that, conditional on regulatory risk category, insurance companies have a preference for higher yielding, higher risk bonds, i.e., tend to reach for yield.

The dependent variable in Table V and VI is the holdings of insurance companies scaled by the total holdings of insurance companies, mutual funds and pension funds. The variable could be sensitive to shifts in the relative demand by these investor categories, e.g. due to fund flows or the ability to lever up in response to investment. If insurance companies have the ability to raise funds in response to investment opportunities they might invest (relatively) more at times when yields are high. Mutual funds and pension funds have little to no leverage, so it is unlikely that they can time the market in this way. This also appears to be the case for the insurance industry.

Figure 6 shows the capital structure of U.S. insurance companies. In total, over 70% of insurance companies' liabilities are composed of the obligations generated by underwriting. Long-term debt

represents 5% and short-term debt only 1% of liabilities. The minimal amount of debt indicates that time-varying investment patterns by insurance companies, as compared to mutual funds and pension funds, cannot be explained by fluctuation in capital structure.

[FIGURE 6]

B. Benchmark results: secondary market trading

Most of the investment activity in fixed income occurs at issuance. However, there is a secondary market in corporate bonds. If our hypotheses are correct, then reaching-for-yield should also manifest itself in secondary market trading. There is an additional advantage to looking at secondary market trading. Because we can follow a bond over time, it allows us to rule out cross-sectional differences in characteristics.

To test reaching-for-yield in the secondary market, we look at how the holdings of insurance companies change between successive quarters. The sample is now a *panel* (bond times quarter), as opposed to a cross-section. We use yields to maturity on the over-the-counter secondary market transactions reported in TRACE. The results are reported in Table VI. The dependent variable is the log quarterly change in the total face value of a bond held by insurance companies. (Maturing bonds are excluded). In order to control for time-invariant and time-varying firm characteristics we include firm-times-quarter fixed effects. We also include controls for time-varying bond characteristics: duration and liquidity. We include two measures of liquidity: the log of total transaction volume relative to outstanding par value in the preceding quarter (based on TRACE), and the log of the number of investors reporting changed positions in the bond over the preceding quarter (based on eMAXX). Albeit, given that the analysis includes firm-times-quarter fixed effects, controls for liquidity pick up within firm-quarter variation in liquidity, which may not be important.

[TABLE VI]

The economic and statistical significance of the benchmark result, specification (1), indicates that insurance companies buy more (or sell less) of outstanding bonds that have a higher yield. A one hundred

basis point increase in a bond's yield corresponds to a predicted increase in insurance acquisitions in the secondary markets of 4% of insurance holdings. This is consistent with findings at issue: Insurance companies systematically buy high yield corporate bonds (within investment grade).

Similarly, we find that this result is specific to the pre-crisis period. As mentioned earlier, the time variation in reaching-for-yield is important for the interpretation of our results. In Table VII, we extent the benchmark specification to include quarter dummies interacted with the yield to maturity. These time-varying coefficient estimates can capture the evolution of reaching behavior over time. Since there are relatively few new issues in some quarters, these coefficients may be hard to identify. Nevertheless, we find a consistent pattern in the quarter-by-quarter results. The coefficients indicate pronounced cyclicality in reaching-for-yield. We find consistently positive coefficients for the pre-crisis period, mixed signs during the crisis (as defined by the NBER recession indicator), and again positive coefficients after the crisis has abated.[23]

[TABLE VII]

These regression results are consistent with reaching-for-yield driven by regulatory capital requirement, as we illustrate in Section 2. The return of positive slope estimates in the short post-crisis period we have in our data suggests that reaching was not unique to the 2004-2007 period, but may in fact be a pattern that appears repeatedly outside of a financial crisis. Because the post-crisis sample is short, this is a tentative conclusion.

C. Insurance firms' portfolio returns

We find that insurance companies systematically prefer high yielding investment grade bonds, compared to other investors (pension funds and mutual funds). We argue these higher yields may reflect risk. But higher yields can also be the sign of bond underpricing. Could it be that the higher yield on

[23] Notably, the drop in coefficient in 2005:Q2 coincides with the downgrade of GM and Ford to junk, an important shock to the bond market.

bonds held by insurance companies are just a reflection of their superior ability to identify (or better access to) underpriced bonds? There are several reasons why this alternative interpretation is weak. First, we observe no reaching-for-yield in speculative grade bonds. This is consistent with a regulation-driven explanation of reaching-for-yield, since speculative grade bonds require much higher capital. But the absence of reaching-for-yield in speculative grade is hard to reconcile with a general ability to identify underpriced bonds; one would need to understand why such an ability is restricted to investment grade. Second, the reaching-for-yield that we document prior to the crisis disappears during the economic downturn. This observation also appears inconsistent with investment ability as an explanation of reaching-for-yield (it seems unlikely that bond underpricing disappeared in the crisis, since there were massive falls in bond prices generally at that time).

We can also address the hypothesis of superior investment ability directly. To implement a test of portfolio "alphas", we study the monthly evolution of bond prices. We focus on newly issued investment grade bonds for 2004 to 2007, the period when we observe reaching-for-yield. Using prices from the TRACE database of bond trades, we calculate the monthly equal-weighted return (including the coupon yield) on two portfolios of investment grade bonds. Each month, all newly issued bonds are sorted based on the fraction acquired by insurance companies (relative to mutual funds and pension funds). Bonds are divided into two portfolios, above and below the median insurance share (in each quarter). After issuance, a bond is kept in the portfolio for one year (or two years, in an alternative specification). Excess returns for the two portfolios are reported in Table VIII.

[TABLE VIII]

Using both, a 12- and a 24-month holding period, the alpha is negative for the portfolio with high insurance holdings and positive for the low insurance holdings portfolio (the difference is not significant). Also, the variability, as measured by the standard deviation of returns, is higher for the high insurance holdings portfolio. An *F*-test rejects that the two standard deviations are similar at the 1% significance level (for the 24 month holding period, the test rejects at the 5% level). These returns and volatilities are

consistent with our hypothesis that reaching-for-yield reflects increased risk, and inconsistent with the alternative hypothesis involving alphas.

Finally, we look at the relation between monthly excess returns and the excess return on the stock market. The beta estimates confirm that bonds preferred by insurance companies have higher risk. Even controlling for the market exposure, the alpha on the portfolio with higher insurance holdings is negative (although still insignificant). Taken together, the evidence from post-issuance performance suggests that insurance companies that, as a group, reach for yield, generate poor investment performance. Bonds favored by insurance companies have higher risk and, if anything, lower returns.[24]

D. Insurance firms' characteristics

The reaching-for-yield we document for insurance companies has a pronounced time series pattern (pro-cyclical). The cross-section of firms can add additional insights into the mechanisms involved. So, to further understand the drivers of reaching-for-yield, we now turn to *individual* insurance firms' investment decisions. Specifically, we want to test how reaching-for-yield relates to capital constraints and financial leverage. If risk-shifting unrelated to regulation is the driver behind reaching for yield, we would expect the behavior to be more pronounced among firms with higher financial leverage. On the other hand, if firms reach for yield in order to increase the amount of risk in their bond portfolio relative to the regulatory capital required, we would expect the behavior to be more pronounced among firms with lower cushions of regulatory capital.

Table IX reports results from cross-sectional regressions of insurance companies' corporate bond purchases at issue for the period 2004:Q3-2007:Q2. To capture reaching for yield, we use the average yield within a capital regulation category. The dependent variable in specifications (1)-(3) is the average

[24] Most bond positions are held to maturity by insurers, so it may be slightly unfair to measure returns over 12-24 months only. However, it would appear surprising if insurance companies could pick bonds with poor performance over the 24 month horizon, *yet* good performance over longer horizons. Measuring hold-to-maturity returns is trickier, so testing this kind of long run ability is difficult.

treasury spread of acquired bonds in NAIC 1 (i.e., bonds rated AAA, AA and A). In specification (4), the dependent variable is the average promised yield to maturity of an insurance company's acquisitions of NAIC 1 bonds. In specification (5), the dependent variable is the average log of CDS spread for the issuers of the NAIC 1 bonds acquired. All the averages are value-weighted (i.e. larger bond holdings get more weight). The information on insurance companies' capital surplus comes from CapitalIQ. Compared to the U.S. banking industry, for example, there are relatively few large insurance companies. Due to lack of data on regulatory capital, we lose several observations. There are only 96 parent companies with regulatory capital data and with data on bond acquisitions in our pre-crisis sample. In this sample, we examine the propensity of individual firms to buy portfolios of high average yield. The variable of interest is regulatory capital surplus, i.e. the difference between regulatory capital and required regulatory capital, measured as of 2004, normalized by book assets. This ratio ranges from 2.1% to 47.3%, with an average of 17%. The standard deviation is 11%.

[TABLE IX]

In column (1), we report a simple regression of the average treasury spread of NAIC 1 bonds acquired in the pre-crisis period on the regulatory capital surplus. The coefficient is negative and significant. A one standard deviation decrease in the capital surplus (11%) corresponds to an 8 basis points increase in the spread of an insurance company's NAIC 1 bond portfolio. This is a one-tenth of the average spread and a one-third of the cross-firm standard deviation of spreads. The results are consistent with the regulation hypothesis: Firms with lower capital surplus are more likely to reach for yield.

In column (2) we control for whether a firm is publicly traded, to examine whether such firms reach for yield due to the incentives generated by reporting and earnings management. The point estimate is similar. In column (3) we add controls for firm size and leverage. Size is the log of 2004 assets. Leverage is the ratio of liabilities to equity in 2004. Highly levered firms do not appear to buy higher yielding bonds, in fact buy lower yielding bonds. This suggests that risk shifting in the Jensen and Meckling (1976) sense is not the driver of reaching for yield behavior. Because insurance companies do not use much leverage (apart from policy-related liabilities), this may not be the right setting for testing the

overall relevance of risk shifting vis-à-vis debt investors. Also, column (3) documents that large firms do not reach for yield more. This does not address any specific theoretical predictions about who might reach for yield, it is important econometrically because of the correlation between size and regulatory capital (small firms tend to have bigger capital cushions).

In column (4), we use the yield to maturity instead of spreads, and in column (5) the log average issuer CDS spread. The negative correlation between capital and reaching remains, although it is only marginally significant for CDS spreads.

These cross-sectional findings provide support for the argument that attempts to circumvent, avoid, or manage regulatory capital constraints drive the reaching-for-yield phenomenon (at least in good times). This may reflect causality from capital surplus to investment choices. Alternatively, it may reflect cross-sectional variation in risk-preferences of insurance companies (leading to low capital and reaching for yield). Although more benevolent in nature, such cross-sectional variation might be an important factor to understand for purposes of regulation.

5. Performance of insurance companies during the crisis

The 2008 financial crisis involved considerable losses for many insurance companies, often related to their investment portfolios. Three companies (AIG, Hartford Fin Services and Lincoln National) received government support under the troubled asset relief (TARP) program, and one (AIG) was partially taken over by the Federal Reserve in September 2008. If reaching for yield reflects higher risk taking, we might expect bigger losses of equity value for insurance companies that had reached more in their bond portfolios. This appears to be the case. In Figure 7, we plot the stock returns for the nine months June 2008 to February 2009 of public insurance companies against the average spread of the same companies NAIC 1 bonds. The returns range from -99% (AIG) to 38% (Industrial Alliance Insurance and Financial Services). As predicted, there is a strong negative relation between crisis stock performance and the amount of reaching for yield.

[FIGURE 7]

In Table X, we examine crisis returns in a multivariate setting. The specification in column (1) replicates the pattern observed in Figure 7, and shows that the negative relation between pre-crisis reaching and crisis returns is statistically significant. For a standard deviation increase in bond spreads(18 basis points), a firm is predicted to have lost 14.6% more equity value in the crisis (half of the cross-firm standard deviation of crisis returns). In column (2), we use the average pre-crisis offering yield instead of the yield spread, with similar results (the standard deviation for yields is higher, implying that the economic magnitude is slightly larger).

[TABLE X]

In columns (2) and (3), we replicate the result for excess returns, defined as the raw return minus equity beta multiplied by -47.5% (the S&P500 return over the period). This is likely over-controlling since higher risk in an insurance company's investment portfolio could affect its systematic risk (beta). Controlling for beta may thus eliminate the effect of reaching for yield on firm risk. The results nevertheless indicate that reaching is associated with negative excess returns. In other words, the insurers with most reaching for yield showed negative returns in the crisis even beyond what their systematic risk would have predicted. In columns (5) and (6) we use raw returns as dependent variable, and allow for the coefficient on beta to be statistically determined. We also include controls for stock price volatility and a TARP recipient (AIG, Hartford Fin Services, Lincoln National) indicator. The negative correlation remains.

The negative returns during the crisis that we document for firms more engaged in reaching for yield can represent one or more of the following effects: (1) losses on the riskier bond portfolios held by such firms as a direct effect of their reaching for yield; (2) losses on other assets reflecting higher risk choices elsewhere (e.g., reaching for yield in structured products). In either case, the results suggest that reaching for yield is not innocuous in terms of the ultimate risks taken on by insurance companies.

6. Conclusions

Reaching for yield —investors' propensity to buy riskier bonds in order to achieve higher yields—may limits the effectiveness of capital regulation to a time-varying and unpredictable extent, may allow regulated entities to become riskier than regulators and legislators intend, and may impose distortions on the corporate credit supply. It has been argued that reaching-for-yield have been an important driver behind the dislocations in the credit market during financial booms, such as 2004-2007. Despite the potential importance, how reaching-for-yield works and where it manifests is not well understood. In this paper, we examine reaching-for-yield in the corporate bond market by looking among insurance companies, the largest institutional investor in this market. Insurance companies have capital requirements tied to the credit ratings of their investments. We show that, conditional on ratings, insurance portfolios, compared to those of pension funds and mutual funds, are systematically biased toward higher yield, higher CDS bonds. This result holds both at issue and in the secondary market. Importantly, reaching-for-yield is absent during the crisis.

We address several alternative interpretations. One concern is that high yield is correlated with some bond characteristics that might be attractive to insurance companies for other reasons. Such explanations would have to fit the time series variation we document in reaching-for-yield. Furthermore, when looking at secondary market trading, we follow a bond over time, thus ruling out any cross-sectional differences in characteristics. Another concern is that insurance companies might have the ability to make superior investments in fixed income ("generate alpha"). If high yield bonds are underpriced on average, this investment ability would result in portfolios tilted toward higher yielding bonds. We believe this is unlikely to explain the patterns we document. First, a firm's CDS spread is a strong predictor of future downgrades and upgrades. This is a sign that the spread reflects risk. Second, it is not clear why the ability to find underpriced bonds would disappear during a downturn. This explanation therefore seems inconsistent with important patterns in the data.

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Figure 1
Aggregate Holdings of Corporate and Foreign Bonds

This figure is based on U.S. Flow of Funds Accounts (Table L.212). The numbers correspond to 2010:Q4. The focus is on insurance companies' holdings. Note that 86% of all insurance holdings correspond to life insurers. Financial includes U.S. chartered commercial banks, bank holding companies, finance companies, real estate investment trusts, security brokers and dealers, funding corporations, and savings institutions. Pension funds include state and local government pension plans and corporate pension plans.

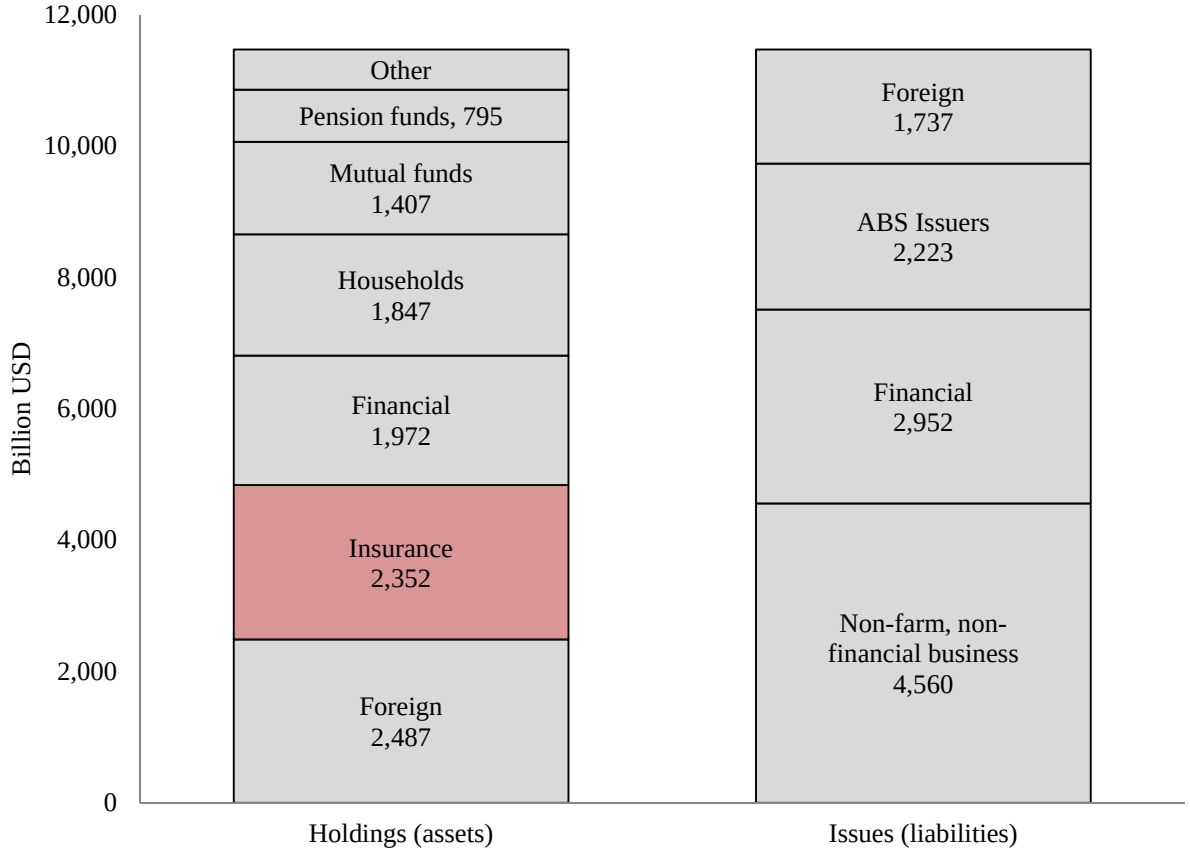
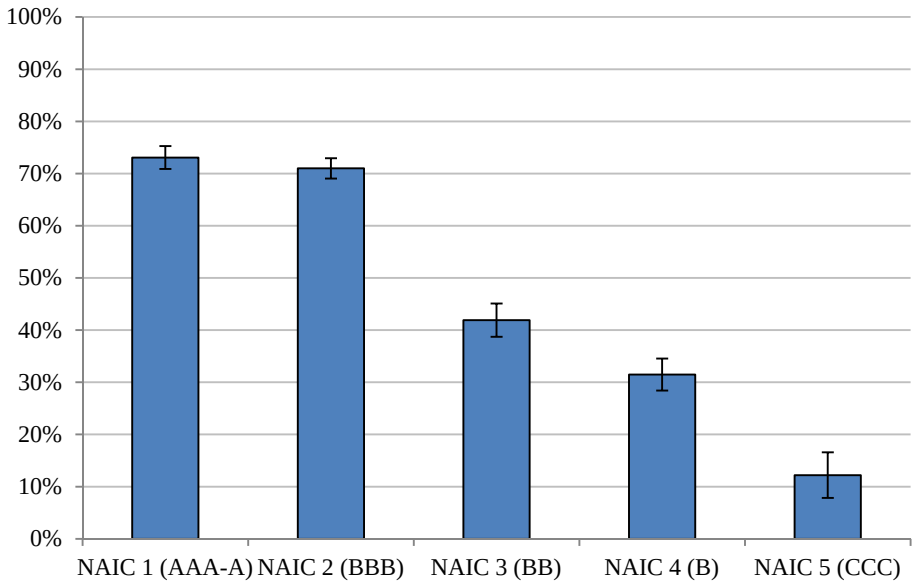


Figure 2
Insurance Company Holdings of Newly Issued Bonds

This figure plots the fraction of newly issued bonds acquired by insurance companies between 2004:Q2-2007:Q2, sorted by NAIC risk categories (Panel A), yields and CDS spreads (Panel B). The fraction of holdings is computed with respect to the total dollar holdings by insurance companies, pension and mutual funds. We report equally-weighted averages across bonds. Bars correspond to 95% confidence intervals (based on the standard deviation across individual bonds). In panel A, bonds are sorted by NAIC categories (except NAIC 6 which has few issues).In Panel B, investment grade bonds (NAIC 1 and 2) are sorted into quartiles of yield spread at issue or CDS Spread.

A. Holdings by NAIC categories



B. Holdings by yields and CDS spreads (investment grade bonds)

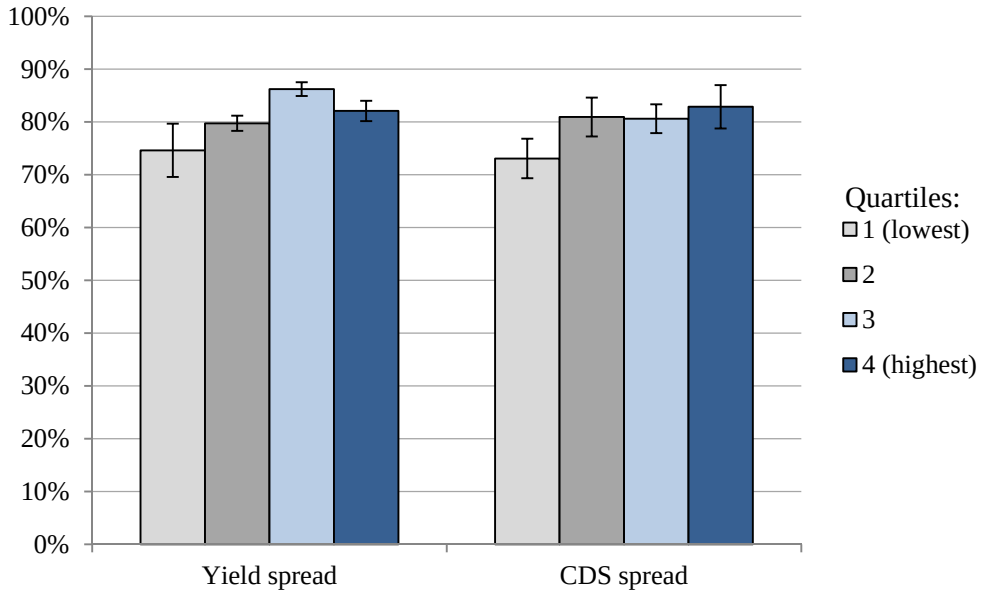
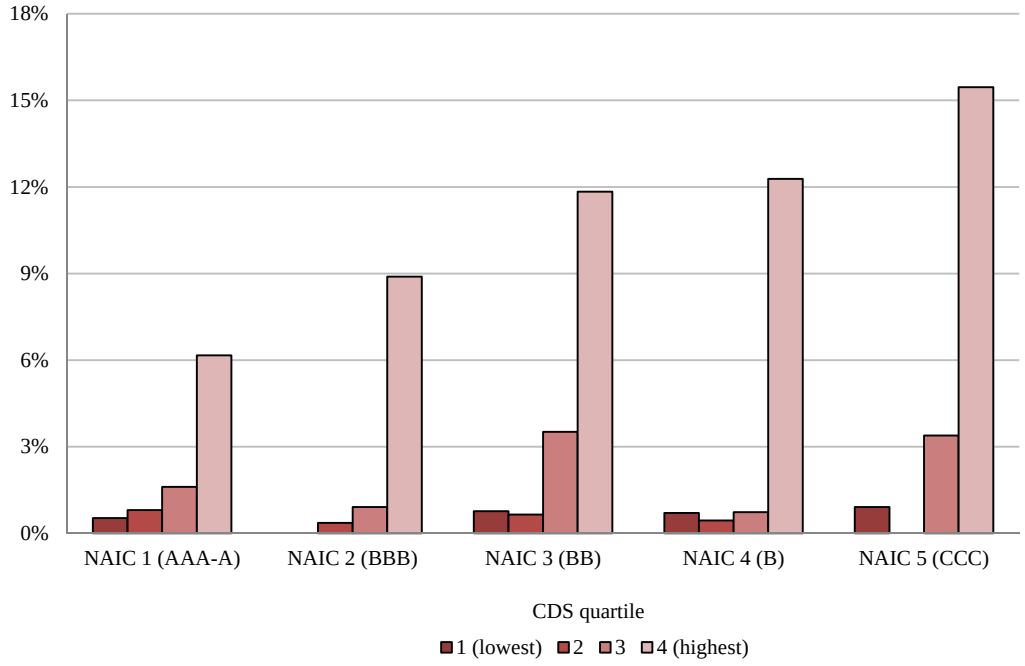


Figure 3
NAIC Quarterly Transition Probability by CDS Quartile

This figure shows probability of downward (Panel A) and upgrade (Panel B) transition between different NAIC risk categories sorted by CDS quartiles. For example, probability of NAIC 2 asset in the highest CDS quartile to be downgraded is 9%. However, probability of NAIC 3 asset in the highest CDS quartile to be downgraded is 12%. We define downgrade as a change in rating that moves an issuer from one NAIC to any lower NAIC within the quarter of issuance.

A. Downgrades



B. Upgrades

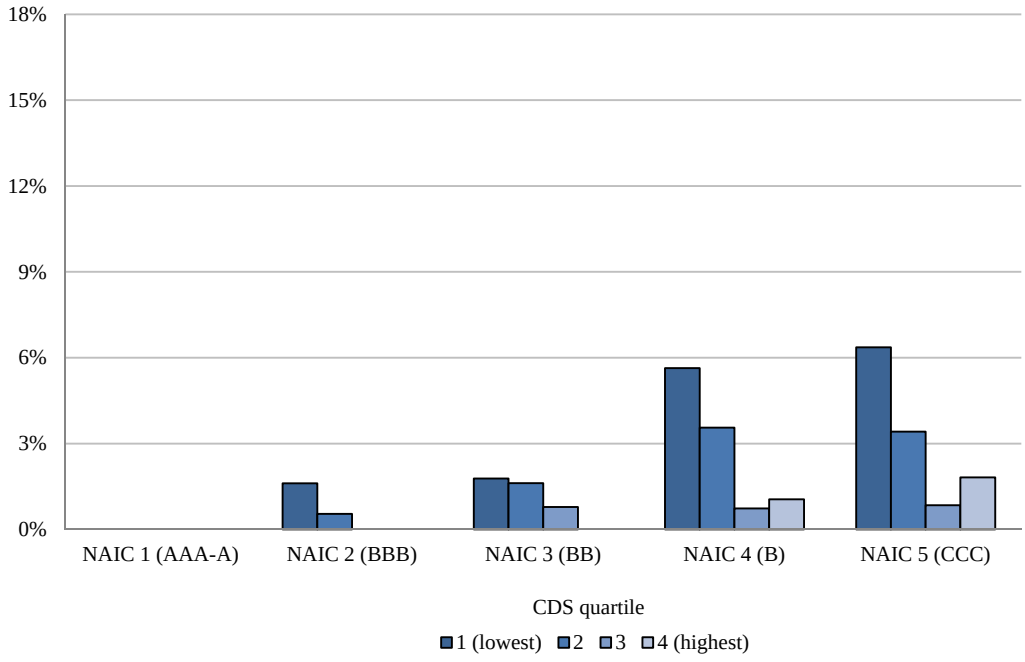


Figure 4
Newly Issued U.S. Corporate Bonds, 2004:Q3-2010:Q4

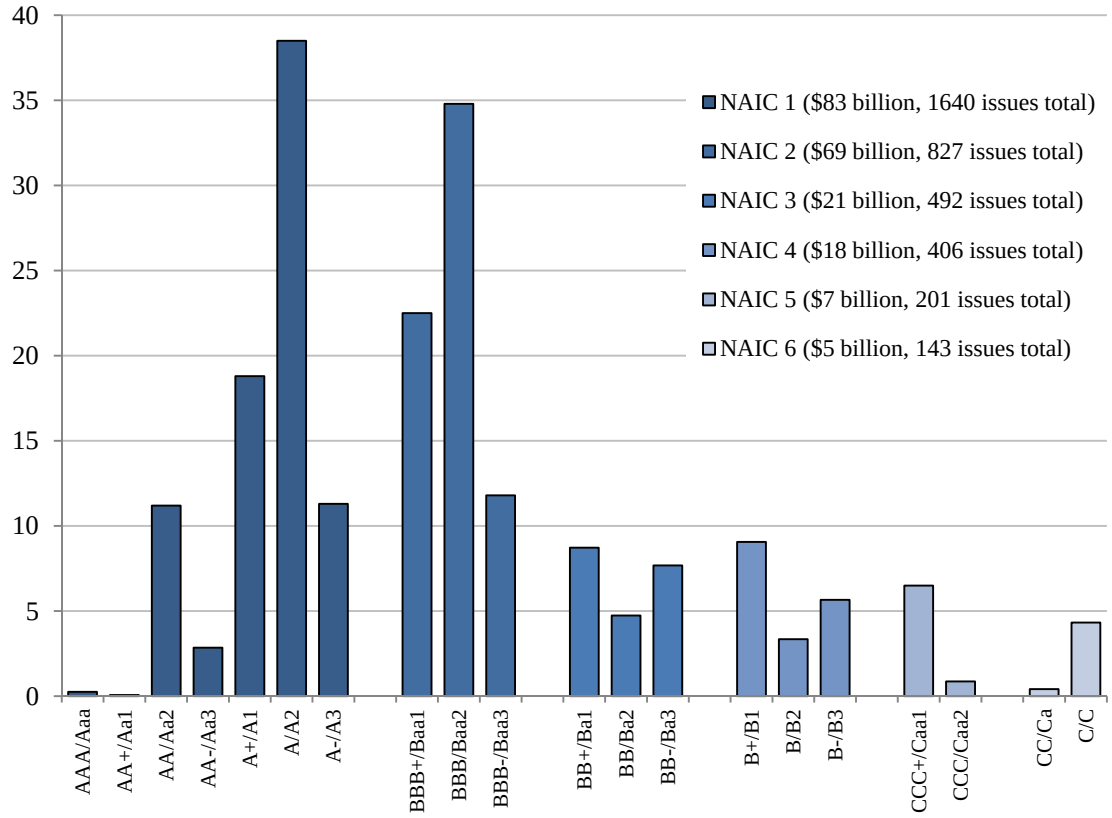


Figure 5
Relation between CDS Spread and Yield at Bond Issuance

The figure compares bond yield spreads (yield to maturity at issue minus the contemporaneous yield on a similar maturity treasury bonds) and issuer CDS spreads for corporate bonds issued 2004Q1-2007Q2. Investment grade (AAA, AA, A, BBB; NAIC 1 and 2) and high yield (BB, B, and CCC; NAIC 3, 4, and 5) are indicated by different markers. Three high yield bond issues are off the chart. The correlation between the two variables is 0.893.

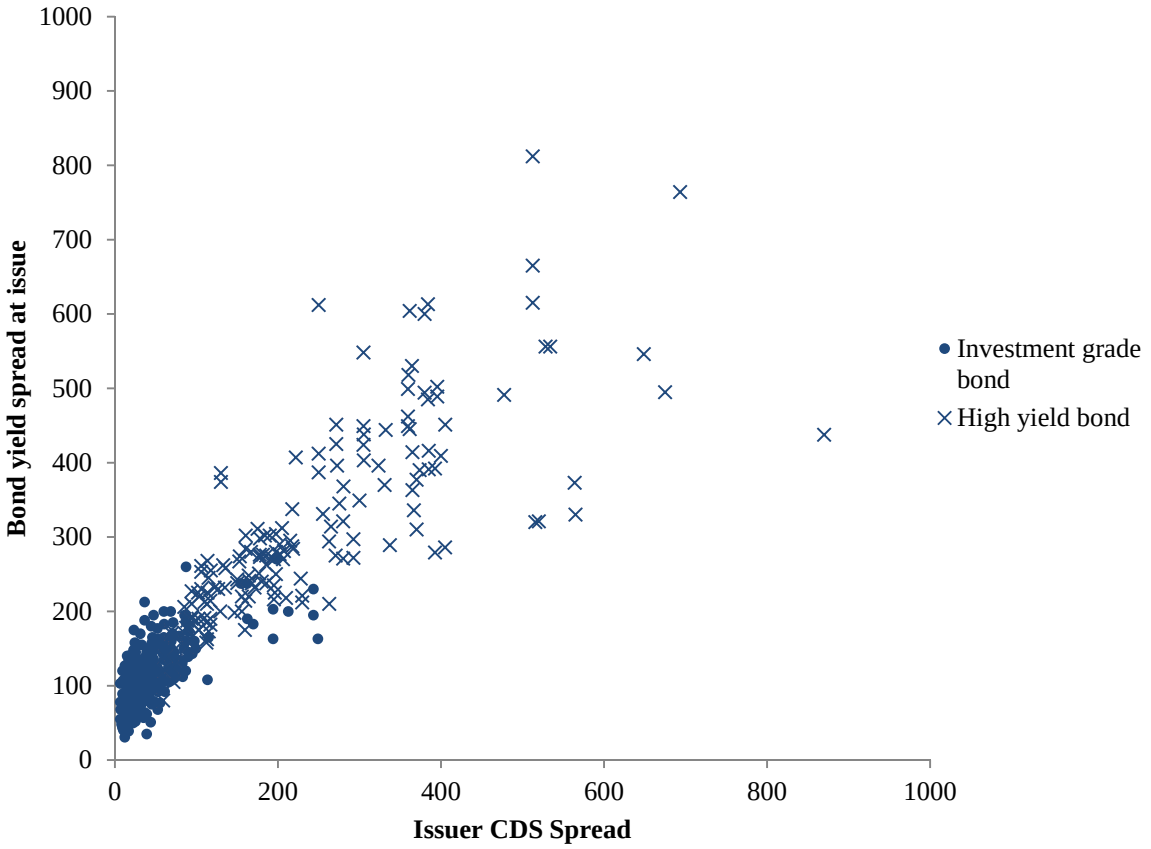


Figure 6
Insurance Companies' Capital Structure

The figure presents capital structure detail for U.S. insurance companies with more than $100 million dollars of assets, for the 2010 fiscal year. The figure was compiled using Capital IQ.

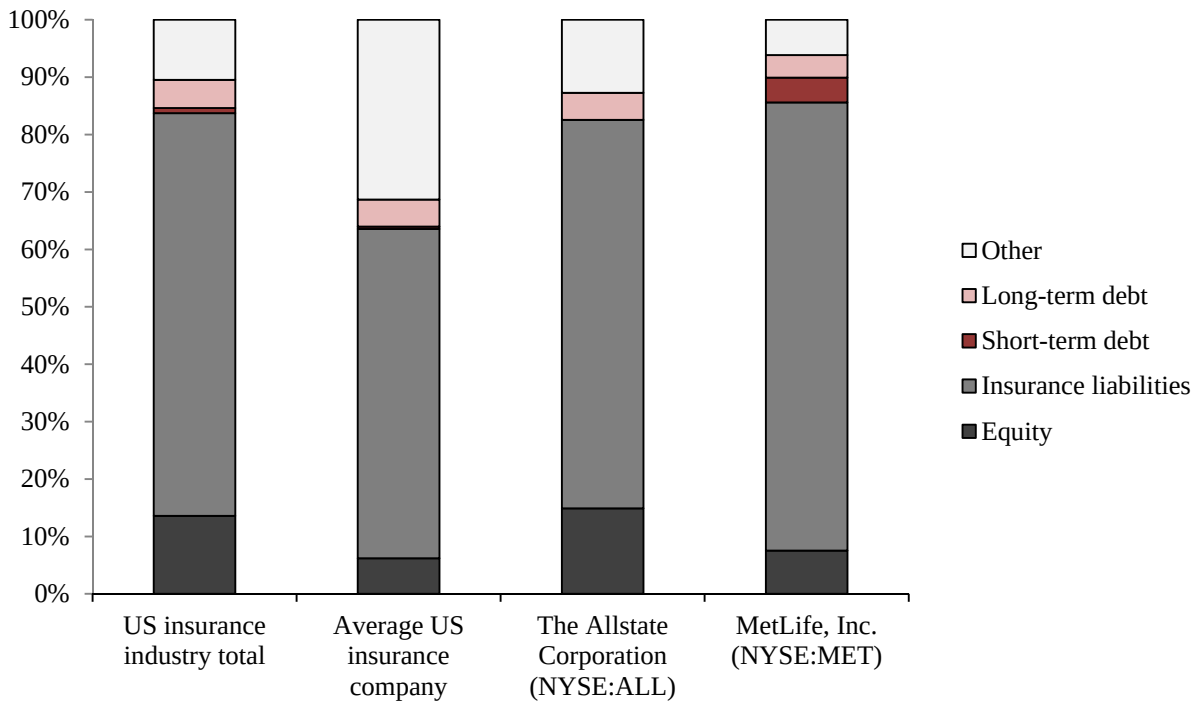


Figure 7
Insurance Companies' Stock Price Performance During Financial Crisis

The figure presents stock returns for the period June 2008- February 2009 relative to their bond investment choices pre-crisis. Spread is the value-weighted average spread of NAIC1 (AAA-A) corporate bonds acquired in the 2004:Q3-2007:Q2 period. The figure was compiled using CRSP data on sock returns, holdings data from eMAXX and yield data from MergentFISD. The picture displays tickers for the 16 largest firms in out sample based on 2004 assets; the largest is AIG (NYSE: AIG) and number 16 is MBIA (NYSE: MBI).

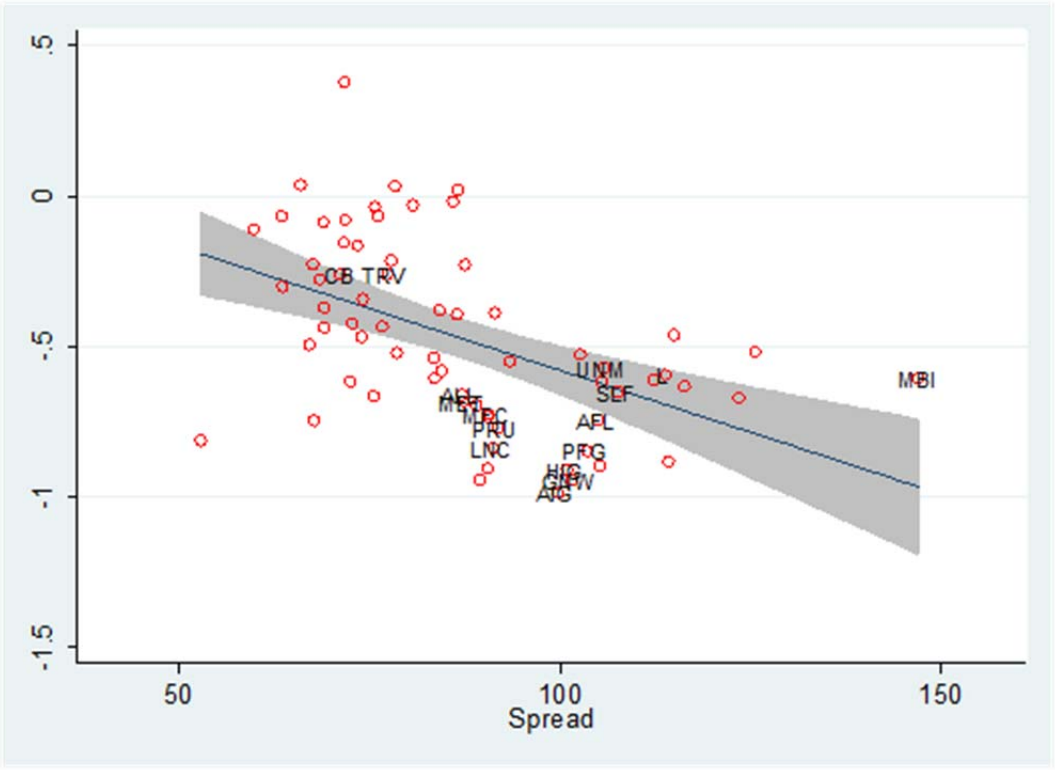


Table I
Assets Distribution

This figure is based on U.S. Flow of Funds Accounts. The numbers are in billions of U.S. dollars and correspond to amounts outstanding as of the end of 2010:Q4. Mutual funds include money market funds.

	Life insurance companies		Property-casualty insurance companies		Mutual funds		Private pension funds	
Total financial assets	5,176.8		1,403.4		7,963.4		6,079.6	
Treasury securities	161.6	(3%)	91.4	(7%)	296.0	(4%)	486.7	(8%)
Corporate and foreign bonds	2,022.7	(39%)	299.2	(21%)	1,255.0	(16%)	482.5	(8%)
Agency- and GSE-backed securities	357.0	(7%)	109.4	(8%)	786.7	(10%)	170.9	(3%)
Mortgages	318.0	(6%)	4.1	(0%)	--		15.1	(0%)
Municipal securities and loans	77.5	(1%)	369.8	(26%)	525.9	(7%)	--	
Corporate equities	1,423.2	(27%)	228.0	(16%)	4,801.4	(60%)	1,983.3	(33%)
Mutual fund shares	183.8	(4%)	32.1	(2%)	--		2,228.2	(37%)
Total:		88%		81%		96%		88%

Table II
NAIC Risk-Based Capital Requirement

This summarizes National Association of Insurance Companies (NAIC) post-tax capital requirement factors (NAIC Risk-Based Capital Newsletter, 10/12/2001). Default rates are from Fitch Ratings Global Corporate Finance 2010 Transition and Default Study.

NAIC categories	Credit ratings		Capital charge	5-year cumulative default rates (1990-2010)
Federal government			Exempt	
NAIC 1 (highest)	AAA, AA, A	Investment Grade	0.3%	0.00%, 0.09%, 0.69%
NAIC 2	BBB	Investment Grade	0.96%	2.62%
NAIC 3	BB	High Yield/Speculative Grade	3.39%	6.76%
NAIC 4	B	High Yield/Speculative Grade	7.38%	8.99%
NAIC 5	CCC	High Yield/Speculative Grade	16.96%	34.38%
NAIC 6 (lowest)	CC or below	High Yield/Speculative Grade	19.50%	

Table III

Bond and Issuer Characteristics across CDS Quartiles of Investment Grade Issuers

This table presents the median of selected issuer and bond characteristics throughout the sample period, for investment grade issuers. The characteristics are at bond issuance. Each entry reports the median and, in parenthesis, the standard deviation of a characteristic. For credit ratings, the standard deviation is in notches (the difference between A and A- is one notch).

Quartile	Bond yield	Bond maturity	CDS Spread	Credit rating	Assets (Billion USD)	Book leverage	Return on assets
1	5.69	9.8	16.9	A	25.7	0.24	0.067
	(1.72)	(13.2)	(14.1)	(2.3)	(120)	(0.13)	(0.047)
2	5.80	9.0	43.5	A	21.5	0.28	0.053
	(1.74)	(11.5)	(18.8)	(1.8)	(125)	(0.16)	(0.052)
3	6.04	10.0	57.8	A-	15.4	0.30	0.044
	(1.57)	(12.1)	(32.6)	(1.8)	(167)	(0.16)	(0.061)
4	6.10	9.2	156.8	A-	13.7	0.31	0.022
	(1.60)	(9.6)	(287.5)	(1.8)	(170)	(0.20)	(0.085)

Table IV
Reaching for Yield: Yield to Maturity

We look at the investment decision immediately following bond issuance. With the exception of specification (4), the sample is composed of investment grade issues (NAIC Categories 1 and 2). Specification (4) corresponds to non-investment/speculative grade. Treasury spread is the yield difference between a bond and a maturity-matched treasury bond. Duration is computed using bond information from Mergent FISD. Credit ratings fixed effects are AAA, AA+, AA, AA-, etc.. Standard errors clustered by issuer and are reported in brackets. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Insurance companies' holding as a fraction of insurance, mutual and pension funds holding amount						
	Benchmark (2004:Q3-2007:Q2)				Crisis (2007:Q3-2010:Q4)		
	Investment grade			Speculative	Investment grade		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Treasury spread	0.055*	0.067***	0.047**	0.018	-0.028	-0.042**	-0.038**
	[0.029]	[0.023]	[0.018]	[0.019]	[0.018]	[0.017]	[0.017]
NAIC Category 2 (BBB+, BBB, BBB-)	-0.003	-0.010	--	--	-0.049	0.014	--
	[0.050]	[0.022]			[0.062]	[0.036]	
Duration (years)	--	0.009**	0.008**	0.007	--	0.000	0.001
		[0.003]	[0.003]	[0.010]		[0.005]	[0.005]
Offering amount	--	-0.025***	-0.021***	-0.072***	--	-0.056***	-0.058***
		[0.003]	[0.004]	[0.012]		[0.006]	[0.007]
Fixed effects:							
Rating * Year (interacted)	No	No	Yes	Yes	No	No	Yes
Observations	589	589	589	188	325	325	325
Clusters (issuers)	141	141	138	78	93	93	91
R-squared	0.03	0.17	0.31	0.30	0.06	0.26	0.32

Table V
Reaching for Yield: CDS Spread

We look at the investment decision immediately following bond issuance. With the exception of specification (4), the sample is composed of investment grade issues (NAIC Categories 1 and 2). Specification (4) corresponds to non-investment/speculative grade. Duration is computed using bond information from MergentFISD. Credit ratings fixed effects are AAA, AA+, AA, AA-, etc.. Standard errors clustered by issuer and are reported in brackets. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Insurance companies' holding as a fraction of insurance, mutual and pension funds holding amount						
	Benchmark (2004:Q3-2007:Q2)				Crisis (2007:Q3-2010:Q4)		
	Investment grade			Speculative	Investment grade		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CDS spread	0.060**	0.049*	0.003	-0.038	-0.058	-0.110***	-0.113***
	[0.028]	[0.030]	[0.002]	[0.045]	[0.054]	[0.021]	[0.024]
NAIC Category 2 (BBB+, BBB, BBB-)	-0.057	-0.045	--	--	-0.052	0.014	--
	[0.050]	[0.039]			[0.061]	[0.032]	
Duration (years)	--	0.009**	0.005***	0.003	--	0.002	0.004
		[0.004]	[0.002]	[0.007]		[0.005]	[0.004]
Offering amount	--	-0.019***	0.012	-0.046**	--	-0.068***	-0.075***
		[0.06]	[0.023]	[0.018]		[0.008]	[0.007]
Fixed effects:							
Rating * Year (interacted)	No	No	Yes	Yes	No	No	Yes
Observations	686	547	547	188	395	325	325
Clusters (issuers)	139	126	123	78	106	93	91
R-squared	0.03	0.13	0.14	0.35	0.05	0.31	0.438

Table VI
Reaching for Yield: Secondary Market (Trades)

This table reports results from panel regressions of secondary market activity of insurance companies in investment grade corporate bonds. The dependent variable is the log quarterly change in the value of all insurance companies' holdings of a bond (maturing bonds are excluded). Observations where the dependent variable is above 1 are excluded. The sample is constrained to investment grade issues (NAIC Categories 1 and 2). Duration is computed using bond information from MergentFISD. Trading volume is the log of the value of transactions in TRACE for a given bond, divided by total par value outstanding, lagged one quarter. Number of trades is the log of the number of investors reporting a changed position in the previous quarter in eMAXX. Standard errors clustered by issuer and are reported in brackets. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Log change in value of insurance companies' total holdings since previous quarter		
	Benchmark (2004:Q3-2007:Q2)		Crisis (2007:Q3-2010:Q4)
	(1)	(2)	(3)
Yield to maturity	0.036***	0.039***	0.004
	[0.012]	[0.013]	[0.004]
NAIC Category 2 (BBB+, BBB, BBB-)	-0.009*	-0.014**	-0.107
	[0.005]	[0.005]	[0.068]
Duration	-0.003	-0.004*	0.003**
	[0.002]	[0.002]	[0.001]
Trading volume	--	0.004	-0.002
		[0.004]	[0.005]
Number of trades	--	-0.005	0.006
		[0.005]	[0.005]
Fixed effects:			
Firm-quarter	Yes	Yes	Yes
Observations	2,040	1,865	1,772
Clusters (issuers)	36	33	33
R-squared	0.25	0.28	0.38

Table VII
Reaching for Yield: Time Series Variation

This table reports results from panel regressions of secondary market activity of insurance companies in investment grade corporate bonds. The dependent variable is the log quarterly change in the value of all insurance companies' holdings of a bond (maturing bonds are excluded). The sample is constrained to investment grade issues (NAIC Categories 1 and 2). The coefficient on yield is allowed to vary by quarter. Standard errors clustered by issuer and are reported in a separate column. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Log change in value of insurance companies' total holdings since previous quarter	
	Coeff.	Std. error
Interaction terms (yield*quarter):		
2004:Q2	0.0186	[0.0129]
2004:Q3	0.0130	[0.0117]
2004:Q4	0.0348***	[0.0100]
2005:Q1	0.0161	[0.0107]
2005:Q2	0.0050	[0.0101]
2005:Q3	0.0419***	[0.0083]
2005:Q4	0.0341***	[0.0115]
2006:Q1	-0.0016	[0.0192]
2006:Q2	0.0538***	[0.0176]
2006:Q3	0.0356*	[0.0196]
2006:Q4	0.0316**	[0.0155]
2007:Q1	0.0598***	[0.0152]
2007:Q2	0.0157	[0.0207]
NBER recession 2007:Q3	-0.0096	[0.0138]
NBER recession 2007:Q4	0.0059	[0.0051]
NBER recession 2008:Q1	0.0033	[0.0037]
NBER recession 2008:Q2	-0.0022	[0.0064]
NBER recession 2008:Q3	-0.0032	[0.0034]
NBER recession 2008:Q4	0.0010	[0.0013]
NBER recession 2009:Q1	0.0002	[0.0014]
NBER recession 2009:Q2	0.0019	[0.0067]
2009:Q3	0.0153**	[0.0078]
2009:Q4	0.0246***	[0.0074]
2010:Q1	0.0092	[0.0088]
2010:Q2	0.0139	[0.0092]
2010:Q3	0.0059	[0.0099]
Firm-quarter fixed effects:	Yes	
Observations	7,948	
R-squared	0.27	

Table VIII
Bond Performance

This table examines bonds secondary market performance for 2004-2007. The test focuses on newly issued investment grade bonds. Returns are constructed using prices from non-cancelled transactions reported in TRACE. Monthly returns are computed using median trade price at the last day with trades of each calendar month and factor in bond coupons. We report equally-weighted excess returns for the portfolio with the highest and lowest insurance holdings, split around the median. Bonds are in one of the two portfolios for 12 or 24 months, depending on the column. Excess returns are returns in excess of the risk-free rate. The risk-free rate is from Ken French's website.

	12-month window		24-month window		12-month window	
	Mean return (basis points, monthly)	Std. dev.	Mean return (basis points, monthly)	Std. dev.	Beta	Alpha (basis points, monthly)
High insurance holdings at issuance	-12	162	-5	135	0.21**	-25
Low insurance holdings at issuance	14	100	13	98	0.11**	8
Diff.	-26	114	-18	90	--	33

Table IX
Reaching for Yield: Cross-Section of Insurance Firms

This table reports results from cross-sectional regressions of purchases of insurance companies of NAIC 1 corporate bonds (i.e., bonds rated AAA, AA and A). We look at purchases at bond issue, for the period 2004:Q3-2007:Q2. The dependent variable is either the average promised yield to maturity of an insurance company's acquisitions of NAIC 1 bonds, the average treasury spread, or the average CDS spread (of the bonds' issuers). Treasury spread is the yield difference between a bond and a maturity-matched treasury bond. This analysis only includes insurance companies with $100 million of assets in 2004. Regulatory capital surplus is normalized by assets and is measured in 2004. Size is the log of 2004 assets. Leverage is the ratio of liabilities to equity in 2004, and is capped at 20. Robust standard errors are reported in brackets. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Treasury spread			Offering yield	CDS spread
	(1)	(2)	(3)	(4)	(5)
Insurance companies characteristics:					
Regulatory capital surplus	-0.606***	-0.618***	-0.530***	-1.08***	-0.287*
	[0.157]	[0.164]	[0.168]	[0.296]	[0.148]
Public firm	--	3.68	5.31	--	--
		[4.06]	[3.98]		
Leverage	--	--	-0.054***	--	--
			[0.015]		
Size	--	--	0.966	--	--
			[0.755]		
Observations	96	96	96	96	96
R-squared	0.15	0.16	0.18	0.09	0.03

Table X

Reaching for Yield and Insurance company performance in the financial crisis

This table reports results from cross-sectional regressions of insurance company stock returns during the financial crisis on their pre-crisis portfolio choices. The dependent variable in columns (1), (2), (5) and (6) is the return for the June 2008 to February 2009 period (nine months). In column (3) and (4), the dependent variable is the excess return using a market model with betas estimated for the 2002-2010 period. Average Treasury Spread is the average spread recorded at issue for an insurance company's purchases of NAIC 1 corporate bonds (i.e., bonds rated AAA, AA and A) issued during the period 2004:Q3-2007:Q2. Each bond is weighted by the amount purchased. Average Offering Spread is calculated similarly. Stock Beta and Stock Volatility are estimated using daily data 2001-2011. TARP recipient indicates three insurance companies that received support under the Federal Reserves Troubled Asset Relief Program in the fall of 2008. Robust standard errors are reported in brackets. ***, **, * indicate statistical significance at 1%, 5% and 10% level, respectively.

Dependent variable:	Return		Excess return		Return	
	(1)	(2)	(3)	(4)	(5)	(6)
Insurance companies:						
Average Treasury Spread	-0.824***	--	-0.359*	--	-0.399**	--
	[0.191]		[0.188]		[0.184]	
Average Offering Spread	--	-0.423***	--	-0.222**	--	-0.183*
		[0.088]		[0.100]		[0.099]
TARP recipient indicator	--	--	--	--	-0.058	-0.059
					[0.068]	[0.073]
Stock Beta	--	--	--	--	-0.114	-0.146*
					[0.070]	[0.075]
Stock Volatility					-4.76***	-4.50***
					[1.435]	[1.601]
Observations	67	67	67	67	67	67
R-squared	0.25	0.21	0.06	0.08	0.52	0.51