Monetary Policy, Interest Rates, and Reaching for Yield: Evidence from Life Insurance Companies

Ali Ozdagli and Zixuan (Kevin) Wang

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Abstract

Using a long time series of insurance regulatory data that captures the universe of life insurance companies in the US, we find that life insurance companies invest in higher yield corporate bonds (reach for yield) under loose monetary policy regimes when interest rates are lower. We also find that insurers with weaker balance sheets tend to reach for yield more and the effect of interest rates on reaching for yield behavior is also stronger for these insurers compared to those with stronger balance sheets. We present evidence that these results are consistent with an “income targeting” channel, that is, insurance companies need to generate additional investment income during a low interest rate environment as their liabilities are pre-determined. We also show that most of the effect of interest rates on reaching for yield behavior of insurance companies come from reaching for duration. Mutual funds take the opposite side of this trade by avoiding duration risk during low interest rate environment and instead loading on credit risk.

1Ozdagli: ali.ozdagli@bos.frb.org; Federal Reserve Bank of Boston, 600 Atlantic Avenue, Boston, MA 02210. Wang: zixuanwang@fas.harvard.edu; Harvard Business School, Baker Library 220E. We thank Charlie Perkins for excellent research assistance.
1 Introduction

Monetary policy’s effect on financial institutions’ risk taking behavior has recently been the center of attention of academics, policymakers, and the media. Since the 2008 financial crisis, central banks have targeted interest rates at historical lows. Policymakers have raised concerns that a prolonged period of low interest rates potentially heightens incentives of financial institutions to “reach for yield” (Bernanke 2013; Stein 2013; Rajan 2013; Yellen 2014). The so-called “risk taking channel” of monetary policy (Adrian and Shin 2009; Borio and Zhu 2012) emphasizes the effect of monetary policy on the perception and pricing of risk by market participants. The empirical literature has documented reaching for yield behavior in insurance companies (Becker and Ivashina 2015), corporate bond mutual funds (Choi and Kronlund 2017), commercial banks (Jiménez, Ongena, Peydró and Saurina 2014; Hanson and Stein 2015), and argued that investors’ risk-taking appetite is stronger when interest rates are low (Chodorow-Reich 2014, Barbu, Fricke and Moench 2016, Eber 2016, Ma, Lian and Wang 2017, Di Maggio and Kacperczyk 2017).

How does the tendency to reach for yield varying over the a long period of time (the past 23 years) in different expansionary and contractionary interest rate cycles? How is reaching for yield related to financial health of an institution’s balance sheet? When financial institutions with heterogeneous liability structures and regulatory rules have greater incentives to reach for yield in equilibrium, do they have comparative advantage in taking different risks? We try to answer these questions using a long time series (1994Q1-2016Q4) of insurance regulatory data that captures the universe of life insurance companies in the US. We use 1 year treasury yield as a proxy of monetary policy because the short end of the yield curve is more directly controlled by central banks in most of our sample period.

We find that monetary policy significantly influences the reaching for yield behavior of life insurance companies, the largest institutional holders of corporate bonds: in times of monetary easing with a gradual decrease in interest rates, life insurers have a stronger tendency to reach for yield; while in times
of monetary tightening with a gradual increase in interest rates, life insurers reduce their tendency to reach for yield. In other words, the reaching for yield by life insurance companies is negatively correlated with the level of short term interest rates. Among corporate bonds with highest regulatory rating, we find a decrease in 1 year treasury of 1 percentage point is associated with an increase in the yield on life insurance sector’s bond portfolio of 9.4 bps relative to the market benchmark. This reaching for yield effect could be decomposed into a yield increase of 12.9 bps relative to the market benchmark in the bonds life insurers acquire, and a yield reduction of 5.1 bps in the bonds they dispose. This relationship is also strong and significant in the primary market.

We also find that the reaching for yield behavior is closely related to the financial health of insurance companies. Insurance companies with more financial distress, facing more regulatory pressure, and having more asset-liability cash flow mismatch reach for yield more. Accordingly, we identify an “income targeting” channel where life insurers with more (exogenous) income short-fall reach for yield more. Moreover, the reaching for yield behavior of insurers with weak financial health is strongest when interest rates are low as these insurers struggle to meet their obligations, especially when they fail to generate income from investments due to low interest rates.

We find the insurers’ tendency to reach for yield displays a strong “duration tilt” and further evidence suggests that insurers are essentially “reaching for duration.” On the other hand, we find mutual funds exhibit the opposite behavior as interest rates decrease: they tilt away from high duration bonds, suggesting that they are accommodating the “reaching for duration” by life insurers. In addition, mutual funds also tilt toward higher credit risk bonds when interest rates decline.

We argue that this may be an equilibrium outcome due to the comparative advantage of mutual funds and insurers in their risk taking, which depends on their liability structure and regulatory constraints. In a low interest rate environment, both insurers and mutual funds, the two largest institutional holders of corporate bonds, have stronger incentive to reach for yield in the bond market. When the yield curve moves around, bonds with high duration have
greater price volatility. If these assets are held by an intermediary with unstable source of funding, the fluctuations can potentially cause runs from the investor side which might lead to large fire-sale losses.

There are crucial differences between life insurers and mutual funds in terms of their comparative advantage in risk taking. First, life insurance companies have stable and long term liabilities. In addition, the statutory accounting by life insurance companies allows them to report bond asset values using historical cost, rather than mark-to-market, accounting which helps them remain solvent in the face of short term market value fluctuations of high duration bonds. In comparison, corporate bond mutual funds are open ended and their outflows are sensitive to bad performance (Goldstein, Jiang and Ng 2017) and, therefore, the fragility of their funding side makes them unprotected from asset value fluctuations of high duration assets. Second, due to the risk based capital (RBC) requirements, life insurance companies are regulated based on the credit rating of their bond holdings. Unlike insurance companies, mutual funds are not regulated based on their asset holdings. Thus they have the freedom to take more credit risk when their yield chasing appetite is strong. Thus, in equilibrium, insurance companies have a comparative advantage in taking duration risk whereas mutual funds have an advantage of taking credit risk. Accordingly, we show that, on average, the bond holdings of insurance companies have higher duration and lower credit risk than the bond holdings of mutual funds in the data.

The decline in interest rates can lead to increased yield-chasing appetite of investors, which will show up in the portfolio of different investors differently based on their comparative advantage in risk taking. In particular, as interest rates decline, insurance companies may reach for more duration risk and less credit risk while mutual funds may do the opposite, which we also confirm in the data. Our results are consistent with the point made in Hanson, Shleifer, Stein, and Vishny (2015): intermediaries with a stable source of funding (e.g. life insurers) have comparative advantage at holding fixed-income assets that have only modest credit risk but have substantial transitory price volatility.
To complement our main results, we also document that the “duration tilt” by life insurance companies is higher when the yield curve is steeper.

Our research is related to the “Fed recruitment” view of how monetary policy affects long term real rates (Stein 2013, Hanson and Stein 2015). As interest rates decline, life insurers tilt toward higher duration bonds, and this outward shift in the demand curve of high duration assets in turn pushes down the term premium. This is different from the usual expectations channel where short term interest rates influence long term real rates. It’s also related to the recent policy debate whether monetary policy framework should include financial stability considerations (Woodford 2012; Stein 2014). One the real economy side, insurance sector’s “duration tilt” could potentially reduce the funding cost of firms who finance through long term bonds while mutual fund sector’s “credit risk tilt” might lead to a misallocation of credit to finance projects with excessive risk.

The remainder of the paper is organized as follows. Section 2 gives an overview of regulations and accounting rule of life insurance companies. Section 3 describes the data. Section 4 presents results that reaching for yield is closely related to monetary policy. Section 5 identifies the “income targeting” channel of reaching for yield. Section 6 discusses the comparative advantage in risk taking by insurers and mutual funds. Section 7 concludes.

2 Life Insurance Companies and Regulations

To understand the reaching for yield behavior of insurance companies, ones needs to first understand their liability structure, regulation rules and accounting standard. These features determines what risks insurance companies have advantages to load on when they reach for yield.

Compared to P&C insurers, life insurers have long term liabilities because most life insurance products are long term. Most term life insurance product

\[\text{(e.g. high duration and low credit risk bonds)}\]

The credit risk is referred to as “fundamental risk” in the terminology of Hanson, Shleifer, Stein, and Vishny (2015).
have policy period span from 10 to 30 years. Universal life and whole life, on the other hand, provide permanent coverage that remain in force for the insured’s entire lifetime. Life insurance companies earn profits from the spread between their portfolio earnings and their payout on insurance policies. Some insurance products guarantees fixed rate payout for a specified term or for lifetime. For example, fixed annuities often guarantee a minimum rate higher than the equivalent risk free rate for a period of 1 to 10 years. In a low interest rate environment, life insurer’s investment income might be insufficient to meet the required payouts to policy holders. As most life insurers have liabilities with longer duration than the assets they could purchase, they face the risk of reinvesting their assets at a lower rate.

Insurers have two main tools to address the pressure in a persistent low rate environment. First, life insurers could lower the guaranteed rates of new policies and thereby progressively lower their liabilities. Second, they can invest in higher-yielding assets. However, compromising credit quality for yield can result in large losses in the event of a borrower's default. Because of this, life insurers might not actively reach for credit risk despite the adverse economic conditions. Instead, they might try to reach for duration risk by increasing the maturity of their bond investments. As long as the yield curve is upward sloping, there’s significant economic benefit from increasing asset duration. As insurance liabilities are typically long run, the insurance companies have a long time period to harvest the higher term spread provided by higher duration assets (a strategy known as “riding the yield curve”).

The regulation of the life insurance sector might also leave them the room to load on duration risk, while eliminating the room to load on credit risk. For the protection of policyholders—the main creditor of insurance companies—insurers are monitored closely by state regulators to make sure they are financially solvent. Specifically, the Risk-Based Capital (RBC) method is adopted to limit the amount of risk an insurance company can take. It requires an insurer with

\[\text{NAIC (2012)}\] find that insurers are not compromising the credit quality of their investment portfolios by noticeably investing in riskier assets with higher yields. [http://www.naic.org/capital_markets_archive/120824.htm](http://www.naic.org/capital_markets_archive/120824.htm)
a higher amount of investment risk and insurance operational risk to hold a higher amount of capital. Accordingly, the NAIC has 6 designations for bonds based on their rating. The current RBC formula gives insurance companies’ bond investments different capital charge in each NAIC designation.

For example, an insurance company’s high yield corporate bond investment faces higher capital charge than its investment grade bond investment, thus an insurance company with greater amount of high yield corporate bonds on its balance sheet has to set aside more capital. Under the RBC regulation, an insurance company’s total adjusted capital is compared to the amount of required risk-based capital. The total adjusted capital is equal to the net worth of an insurance company (i.e. the “equity” portion) with certain adjustments. Because of the RBC regulation, insurance companies invest the biggest portion of their portfolio in bonds with highest ratings, which have low capital charge. By the end of 2015, life insurers hold 61.6% of their bonds in NAIC1 designation (equivalent to S&P rating AAA to A-) and 32.4% in NAIC2 designation (equivalent to S&P rating BBB+ to BBB-).\textsuperscript{4} Thus they hold roughly 94% in invest grade bonds. And the remaining 6% are invested in high yield bonds (i.e. NAIC designation 3-6), most of which is in designation NAIC3, the highest rating notch below invest grade. Note that the maturity of an asset is not considered in RBC formula, thus insurance companies do not fact any capital charge when they load on duration risk.

The accounting rule of life insurance companies also protects them from regulatory distress or “run like” behavior of policy holders, even if they load on excessive duration risk. The state regulatory authorities use the statutory accounting principles (SAP) to measure the financial condition of regulated insurers. Insurance companies are thus required to file annual and quarterly financial statements to regulators using SAP, in order to be compliant with solvency and other standards. Moreover, statutory rules also determine how insurers should establish reserves for life insurance policy (policy reserve), which is the main liability item on an insurer’s balance sheet and reflect obligations

\textsuperscript{4}Summarized in NAIC Capital Markets Special Report [http://naic.org/capital_markets_archive/160606.htm](http://naic.org/capital_markets_archive/160606.htm)
that must be met in the future.

According to statutory accounting principle, the bond investments in NAIC designation 1-5 by life insurance companies are valued at amortized historical cost, while only bonds with NAIC 6 designation (around 0.1% of their total bond portfolio) are valued at the lower of amortized cost and market value.[5] In other words, more than 99% of the bond investment by life insurance companies are not marked-to-market in their accounting.[6] Previous research (Allen and Carletti 2008, Plantin, Sapra, and Shin 2008) have argued mark-to-market accounting may lead to fire-sales and induces suboptimal real decisions in times of crisis, while historical cost accounting could avoid fire-sales and contagion which helps financial institutions remain solvent. As the yield curve moves around, life insurers with high duration portfolios face greater market value fluctuations. However, under historical cost accounting, the market value of their portfolios remain opaque as long as the assets are not sold, which relieves concerns of fragility such as a “run on insurance companies”. Neither will the market value fluctuations impose additional regulatory pressure on life insurers.

3 Data

We construct our dataset by combining data from several sources. The data of life insurance company’s corporate bond holdings is from NAIC statutory filings. Schedule D of insurance filings has detailed information on investment by life, health, and property and causality (P&C) insurance companies, including corporate bonds, stocks, and municipal bonds. We obtain our data of insurance company holdings directly from NAIC through a special agreement with the Federal Reserve. The data has a complete coverage of all the

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[6] For property & casualty insurance companies, however, all the bonds in NAIC designation 3-6 (i.e. high yield bonds) are valued at the lower of amortized cost and market value. Ellul, Jotikasthira, Lundblad and Wang (2015) explore the implications of this difference in accounting rule for life v.s. P&C insurers on their trading behavior.
NAIC-reporting insurance companies from 1994Q1 to 2016Q4. The Schedule D has both annual files with year end portfolio holdings information, and quarterly files which contain asset acquisition and disposal information within each quarter. The exact date and amount of each insurance company’s acquisition/disposal transactions are documented, thus we could know their portfolio rebalancing behavior at a very granular level.

Figure 1 plots the level of 1 year treasury rate in our sample period. Our sample covers a relatively high interest rate period from 1994 to 2000 and the post-recession low interest environment from 2010 to 2016. As far as we know, our sample has a longer time span compared to other papers that investigate reaching for yield patterns of financial institutions in the bond market.

An alternative data source of insurance company portfolio information is SNL (Eber 2016). But the data from SNL is only available starting from 2001. With a long sample of 23 years, we are able to study how reaching for yield is related to monetary policy. Lipper eMAXX is another data source that has quarter-end corporate bond holding information for insurance companies, mutual funds, and pension funds. It was used in Becker and Ivashina (2015) to show that insurance companies have higher propensity to reach for yield relative to mutual funds and pension funds. However, Lipper eMAXX does not comprehensively cover insurance companies’ positions in corporate bonds. When we aggregate corporate bond holdings by life insurance companies in NAIC statutory filing data and compare the total par value to that in Lipper eMAXX we find that Lipper eMAXX data incorporate about 25% of that in the NAIC data.\footnote{In Lipper eMAXX, life and health insurers are grouped into one investor type, thus we calculated the total par value of the life/health sector in eMAXX. The total par value of bonds held by life insurers alone would be even smaller in eMAXX.}

The corporate bond pricing information comes from Mergent FISD NAIC bond transactions (1994-2002) and TRACE (2002-2016). The Mergent FISD bond transactions consists of all transactions of publicly traded corporate bonds beginning in January 1994 by life insurance companies, property and causality insurance companies, and health insurance companies. Previous re-
search has shown the FISD data is representative of corporate bond transactions (Warga 2000, Campbell and Taksler 2003). The TRACE data has transaction reports for all corporate bonds back to July 2002. The data is cleaned using the filtering algorithm in Dick-Nielsen (2009). We obtain the bond issuance information from Mergent FISD which provides coupon, maturity, offering amount, and rating. The expected default frequency (EDF) information comes from Moody’s Credit Edge, which started in 1999.

Corporate bond holdings information by mutual funds is obtained from Morningstar. The data starts in 2002Q1 and ends in 2016Q3.

4 Monetary Policy and Reaching for Yield

4.1 Measuring Reaching for Yield by Insurance Companies

Insurance companies are the largest institutional holders of corporate and foreign bonds. According to the U.S. Flow of Funds Accounts, in 2015Q4, life insurers hold $2.36 trillion of corporate and foreign bonds, quantitatively similar to mutual and pension funds taken together. Insurance regulations require insurance companies to maintain minimum levels of capital on a risk-adjusted basis, called risk-based capital (RBC). To determine the capital requirement for credit risk, corporate bonds are sorted into six broad categories (National Association of Insurance Commissioners (NAIC) risk categories 1 through 6) based on their credit ratings, with higher categories subject to higher capital requirements. As discussed in Becker and Ivashina (2015), due to the regulations and the presence of government guarantees, insurance companies may attempt to increase the yield in their bond portfolio through taking on extra priced risk, while leaving capital requirements unaffected. Therefore, we focus

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8Mutual funds and pension funds are the second and third largest institutional holders in US corporate bond market, with holdings of $1.74 and $0.7 trillion respectively

9The NAIC categories map into S&P ratings in the following way: $\text{NAIC1} = \{\text{AAA, AA, A}\}, \text{NAIC2} = \text{BBB}, \text{NAIC3} = \text{BB}, \text{NAIC4} = \text{B}, \text{NAIC5} = \text{CCC}, \text{NAIC6} = \{\text{CC, C, D}\}$
on corporate bond holdings of insurance companies, conditional on NAIC risk categories.

Our main hypothesis is that the incentives of insurance companies to invest in higher yield bonds within a given NAIC rating category is related with the level of interest rates. As a preliminary evidence, Figure 2 provides a comparison of insurance companies’ corporate bond holdings in the NAIC1 category during the high interest rate environment of 1994–2000 and during the low interest rate environment of 2010–2016. In panel A, we sort all corporate bonds in the market into quartiles based on the yield-to-maturity with the last quartile being the highest yield bonds within the NAIC1 category. For each quartile, we calculate the fraction of the outstanding bonds held by insurance companies by dividing the dollar amount acquired by the insurance companies to the total dollar amount of outstanding bonds in that particular quartile.

The left figure in panel A of Figure 2 shows that, during the high interest rate environment of 1994–2000, the fraction of bonds held by insurance companies were relatively evenly distributed across different yield quartiles. However, during the low interest rate environment of 2000–2016, the insurance companies significantly tilted their holdings towards higher yield bonds, as shown in the right figure of panel A.

One concern with the results in panel A is that they are driven by the fact that insurance companies are not purchasing higher yield bonds in the low interest environment but rather the bonds that they purchase are more sensitive to interest rates, and this relationship mechanically generates the pattern we observe in panel A. In order to address these issues, panel B of Figure 2 provides a comparison of insurance companies’ purchases of the primary market issues in the NAIC1 category during the high interest rate environment of 1994–2000 and during the low interest rate environment of 2010–2016. Note that the yields of the primary market issues are determined at the time of the issue and is the same for all potential investors of these bonds, thereby eliminating the concern that the tilt in the yield distribution of bonds is mechanical. Similar to our previous exercise, we sort all primary market issues in the market into quartiles based on the yield-to-maturity with the last quartile
being the highest yield bonds within NAIC1 category. For each quartile, we calculate the fraction of the primary market issues acquired by the insurance companies by dividing the dollar amount acquired by the insurance companies to the total dollar amount issued in that particular quartile.

The left figure in panel B of Figure 2 shows that, during the high interest rate environment of 1994–2000, the fraction of bonds acquired by insurance companies in the primary market were relatively evenly distributed across different yield quartiles. However, during the high interest rate environment of 2000–2016, the insurance companies significantly tilted their fraction of acquisitions towards higher yield bonds, as shown in the right panel. Overall, this pattern is consistent with panel A, which suggests that the level of interest rates is a significant driving force behind the reaching-for-yield behavior in insurance companies.

The main challenge in our paper is to come up with a measure of the degree of reaching for yield that allows us to study both the time series and cross-sectional properties of reaching for yield behavior. To address this challenge, we define $RfY_{i,t}$ in NAIC1 designation as the average yield of insurance company $i$’s NAIC1 bond portfolio relative the the average yield of all the outstanding NAIC1 bonds in the market:

$$RfY_{i,t} = \frac{\sum_j H_{i,j,t} y_{i,t}}{\sum_j H_{i,j,t}} - \frac{\sum_k A_{k,t} y_{k,t}}{\sum_k A_{k,t}}$$

\begin{align*}
\text{Avg yld on quarter end} & \quad \text{Avg yld on bonds} \\
\text{holding portfolio (NAIC1)} & \quad \text{outstanding (NAIC1)}
\end{align*}

where $H_{i,j,t}$ is the amount of bond $j$ held by insurance company $i$ and $A_{k,t}$ is the amount of bond $k$ outstanding, both measured in face value at the end of quarter $t$. This measure also gives the reaching for yield in the aggregate insurance market when we let $i$ be the combination of all insurance companies.

Comparing the relative yield of insurance company’s portfolio to the market within an NAIC designation allows us to control for the unobservable factors that drives variation in the market yield. We can further narrow the bond space of $RfY$ to the primary market, and define $RfY_{i,t}$ as the average yield
of bonds acquired by insurance company $i$ from primary market to the newly issued bonds in a specific quarter. The $RfY$ in primary market captures the marginal acquisition behavior by insurance companies, but it also has two drawbacks. First, it doesn’t capture their disposal behavior. In addition, the offering yield in primary market might be biased if bond issuers have relationship with insurance companies, which makes the $RfY$ measure less informative. Thus we present our main results based on $RfY$ measured from insurance company’s quarter end holdings, and also provide $RfY$ in primary market as a robustness check. The results are consistent with both measures.

Similarly, we could also define the $RfY_{i,t}$ in NAIC2 designation. The main results we present in the paper are based on $RfY$ in NAIC1 designation. Table 1 provides summary statistics for the $RfY_{i,t}$ variable constructed from the quarterly panel of life insurer bond portfolios in NAIC1 designation.

### 4.2 Reaching for Yield and Level of Interest Rate

We use the 1-year treasury yield as a proxy for the monetary policy stance as our sample period spans 1994–2016, which includes the recent zero-lower-bound period. Using 2-year treasury yields, as in Gertler and Karadi (2015), do not change the results significantly. The upper panel of Figure 3 plots the $RfY$ of life insurance sector and the quarter-lagged 1-year treasury yield from 1994Q1 to 2016Q4 in bond market of NAIC1 designation. We see that the life insurance sector has a positive $RfY$ in most of the quarters, which means they tend to hold higher yield bonds (except for 2008Q3, the quarter when Lehman Brothers collapsed, in which life insurers "flight to safety" and had negative $RfY$).

Moreover, $RfY$ goes up when interest rate declines, as seen in Figure 3 (panel B left figure). From 1994 to 2000, a period in our sample with relatively high interest rate, we don’t see much tendency to reach for yield, with

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10 Over 60% of corporate bond holdings of insurance companies is in NAIC1 category, with over an additional 30% in NAIC2 category. The robustness of our results using NAIC2 category bond holdings are available upon request. Since the holdings in the remaining NAIC categories are less than 10% of their total corporate bond holdings, we do not study other categories.
$RfY$ scattered in between a range of 0 to 20 bps. While in the recent post-crisis period where the federal funds rate has reached its zero-lower-bound, life insurers exhibit strong tendency to reach for yield with an average $RfY$ of 60 bps. Quantitatively, a 1% decline in the 1-year treasury rate is associated with a 9.4 bps higher $RfY$ with an $R^2$ of 0.77.

To see that this is not a trivial quantity, one could do the following mental exercise. According to NAIC, the US life insurance sector allocates 2.69 trillion assets to the bond market.\footnote{http://www.naic.org/capital_markets_archive/150622.htm This includes both corporate bonds and agency bonds. We don’t have data to estimate $RfY$ in agency bonds. The mental exercise assumes the same reach for yield behavior in agency bonds.} If the 1-year interest rate declines from 2.8% in June 2008 to 0.11% in January 2012, the associated $RfY$ in insurance companies is 25.6 bps ($= 9.5 \times (2.8 - 0.11)$). This extra $RfY$ is equivalent to 6.87 billion extra income per year for the insurance sector.

Right figure in panel B of Figure 3 shows the quantitative magnitude is similar in primary market. One may notice that the primary market has smaller $R^2$. This is possibly results from the two caveats we mentioned above which could potentially bias the primary $RfY$ measure.

Panel A in Table 2 reports the negative relationship between reaching for yield and interest rates in a regression framework. The first two columns in panel A confirms our discussion above for the aggregated insurance companies using both quarter-end holdings and primary market acquisitions. Note that an insurance company could reach for yield either by acquiring higher yield bonds relative to the market or dispose lower yield bonds, one might want to see a decomposition of $RfY$ in these two directions. The last two columns repeat the regressions using corporate bond acquisitions (column 3) and disposals (column 4) by life insurance companies, which is defined as the excess yield of the bonds an insurance company acquires/disposes relative to the market. We multiply excess disposal yield by -1 to get the left hand side variable $RfY_t^{Disp}$ in the regression, so that a positive value means disposing lower yield bonds relative to the market. We see a similar behavior of reaching for yield confirming our previous results. In addition, we see that the reaching for yield
through acquisition is stronger than reaching for yield through disposal. This is probably because insurance companies could only dispose bonds that are already in their portfolio, but when they acquire bonds from the whole market there’s more scope to reach for yield. Panel B in Table 2 reports the regression of $RfY_{i,t}$ on the 1-year treasury yield for firm-quarter observations where we observe similar results.

### 4.3 Reaching for Yield and Financial Health

Next, we answer the following question: how does the financial health of insurance companies influence their reaching for yield behavior? Our hypothesis is that more financially distressed insurers or insurers facing more regulatory pressure are more likely to reach for yield than other insurance companies. We use three variables to measure the financial health of insurers: book leverage, risk based capital (RBC) ratio, and adequacy ratio. The first variable (book leverage) is defined as total liabilities divided by total assets. Intermediaries with higher leverage have weaker balance sheets as they would be affected more by the fluctuation of investment income and value additional funding more (Adrian and Shin 2014).

The second variable is the RBC ratio, defined as an insurer’s regulatory capital over minimum necessary capital, which measures if an insurance company is well capitalized from a regulator’s perspective. The minimum necessary capital is calculated by NAIC according to a risk score, which gives a theoretical amount of capital and surplus an insurance company should maintain. When the RBC ratio falls below 200%, an insurer is required to submit a plan of corrective actions to the regulator, if it falls below 100%, commissioners could place the insurer under regulatory control, i.e., rehabilitate or liquidate the insurance company. The variable thus captures the actual distance to “regulatory insolvency” for insurance companies.

The third variable is adequacy of investment income, a key ratio created by NAIC to measure the health of life insurance companies. It’s defined as the ratio of investment income to interest requirement, where interest requirement
is a model-based expected payout to policyholders from NAIC. Low adequacy ratio indicates that an insurer’s investment yield is not adequate to meet its interest requirements. As argued in Eber (2016), the mismatch between “low investment income” and high “interest requirement” is one channel that insurers reach for yield in a low rate environment.

The data we use for financial health are from SNL which come from annual regulatory filings by insurers. As the original data is annual, we convert the annual observations into quarterly by filling in the observations of each quarter using the year-end report. Thus we are running regression of current RfY against the financial health of an insurance company at the end of the past year. In the regression, we winsorize all three measures of financial health at top and bottom 0.5%. Table I provides summary statistics of the three financial health variables we use.

The insurer-quarter level regression we run has the following specification

$$RfY_{i,t} = \alpha + \beta y_{t-1}^{(1)} + \gamma * FinancialHealth_{i,t-1} + \theta * y_{t-1}^{(1)} * FinancialHealth_{i,t-1} + \epsilon_{i,t}$$

and we are mainly interested in the interaction term $\theta$.

Our hypothesis is that insurers with worse financial health reach for yield more, and the effect of interest rates on reaching for yield behavior is amplified by weaker financial health. Column 1–2 of Table III Panel A reports the results when we regress $RfY_{i,t}$ on lagged book leverage, interacted with the level of interest rate. A standard deviation higher in book leverage is associated with a 23.7 basis point higher RfY. With a 1 percent decrease in interest rate, insurance companies with leverage of one standard deviation below the mean reach for yield more by 5.2 basis points. The interaction effect is large and significant. Using the fact that the 1-year Treasury yield has an average of about 3 percent during our sample period, it is straightforward to calculate that an insurance company with leverage one standard deviation below the mean reaches for yield more by about $9 (= 23.7 - 3 * 4.9)$ basis points. The remaining columns show a pattern for RBC ratio and adequacy of investment income similar to that we obtain for leverage: Firms with weaker balance
sheets, i.e. those with low RBC ratio and adequacy of investment income, tend to reach for yield more and their reaching for yield behavior is more sensitive to interest rates. Panel B of Table 3 presents the results when RfY is constructed from primary market. The results are quantitatively consistent with the quarter end holding results.

Overall our results suggest that lower interest rates incentivize reaching for yield behavior in an insurance company more the weaker the financial health of the insurance company is. In the next section we provide evidence that this result is consistent with an “income targeting” behavior in insurance companies.

5 Identifying the “Income Targeting” Channel of Reaching for Yield

The evidence in section 4 establishes a connection between level of interest rates directly affected by monetary policy and the tendency to reach for yield in insurance companies, and how this tendency depends on insurer’s financial health. In this section, we present evidence that these results are consistent with an “income targeting” channel.

One of the key goal of insurance risk management is to match their assets with their liabilities so that policyholders could always get paid. Life insurance companies provide predetermined payouts in cases of insured’s death, disability or retirement. In order to guarantee they have sufficient asset to meet these liabilities, insurance companies need to make sure that they can generate enough income.

The two main sources of income are income from insurance operations and investment income. The net income from insurance operations depend on the premiums they receive from underwriting and their operational cost. Two main sources of life insurer’s operational cost are from verifying and paying insured

\[12\text{Variable annuity products, which are backed by separate account assets, have payments tied to the performance of an asset class and thus are less interest rate sensitive. We focus only on holdings of general accounts.}\]
losses (loss and loss adjustment expenses) as well as insurance underwriting expenses (commissions paid to agents, premium taxes and general expenses). This portion of their income is largely independent of market fluctuations and interest rates. Variations in life insurer’s investment income, on the other hand, are driven by fluctuations of the asset values the insurer holds.

An important reason life insures target income is to maintain a stable cash flow from asset side in order to match their liability cash flow. Asset liability management (ALM) is known to be a fundamental element to insurance company’s operations. Under the standard valuation law (model #820), life insurance companies have to post an additional reserve when they are detected a significant mismatch between asset and liability cash flow. This will exert additional regulatory pressure to their balance sheet. By year end 2012, life insurance industry posted an additional asset/liability cash flow risk reserve of $9.7 billion (NAIC 2017). As insurance companies have long term liabilities, managing interest rate risk is very important. In a low interest rate environment where both the short end and the long end of the yield curve remains low, insurance companies are faced with low expected returns when they reinvest their matured bond portfolios. In order to meet the required cash flow from insurance liabilities, they have to actively search for assets that deliver extra yield.

Overall, an income shortfall of an insurance company would increase its leverage and reduce its risk-based capital while giving the company incentives to bridge the income gap via reaching for yield. Moreover, in a low interest rate environment their income shortfall widens and insurers will want to reach for yield even more in order to attenuate this negative impact. One identification challenge to test this hypothesis in our context is that the aggregate income of insurance companies are correlated with our $RfY$ measure, because their investment income is partially dependent on the yield of their bond portfolio. Therefore, we focus on net income from insurance operations which is largely independent of market fluctuations and interest rates. This income source is mostly determined by mortality rate and underwriting expenses as well as the premiums they receive, thus relatively exogenous to their investment portfolios.
One valid concern here is that the premiums life insurers receive are dependent on their underwriting behavior, which is endogenous. Specifically, Koijen and Yogo (2015) documented life insurers underwrite long-term policies at deep discounts relative to actuarial value during the financial crisis. We argue that it’s unlikely our “income from insurance operations” variable picks up this effect. Insurance premium are paid in advance for protection in a specified period. However, premiums are “earned” only after the insurance protection has been provided. Under insurance accounting rules, only “earned premiums” are considered part of insurer’s income. The underwriting behavior Koijen and Yogo (2015) documented will only influence as "unearned premium" in the short run which does not enter into our “income from insurance operations” variable.

Column 1–2 in Table 4 reports our main finding. One standard deviation of insurance operating income below the mean leads to a 14.3 bps higher RfY. When the interest rate is one percentage point lower, this effect is 1.8 bps stronger. The result is still significant when we add insurer fixed effect. In fact, the interaction effect of interest rate and low insurance operating income becomes even stronger (2.7 bps higher RfY). The results from primary market acquisitions provide quantitatively similar results both for the direct effect of income targeting channel and the amplification effect of this channel from the sensitivity of reaching for yield to interest rates.

6 Insurers’ Comparative Advantage in Risk Taking

6.1 Monetary Policy and Duration Risk Tilts

We have documented that insurance companies tend to reach for yield as the level of interest rate decreases. Another important question is what kind of risks they are taking in exchange for the extra yield and what the consequences will be. The two most common risks in the fixed income market, or more specifically the corporate bond market, are duration risk (interest rate
risk) and credit risk. The risk-based-capital regulation limits an insurance company’s ability to hold low rated bonds, so they might not be able to tilt their portfolios to high credit risk. Therefore, a more natural way for insurance companies to reach for extra yield in a low interest rate environment may be taking on duration risk.

As mentioned in a recent study by NAIC, increasing the duration of their bond portfolios to narrow the duration gap between liabilities and assets is at core of life companies’ interest rate strategies. In order to see how the reaching for yield incentive in a low interest rate environment tilts insurance companies’ bond portfolio towards high duration, we use a similar method as in section 4. We first weight each bond’s duration with the par value held on an insurer’s balance sheet, then compare the insurance company’s portfolio duration with that of the market. We use the modified duration in our calculation because modified duration measures the sensitivity of bond prices to changes in the interest rate and therefore captures the exposure to interest rate risk better. We obtain very similar results when we use Macaulay Duration in our unreported robustness tests.

Figure 4 panel A plots the life insurance (NAIC1) corporate bond portfolio duration and market duration of NAIC1 bonds over time. The life insurance duration is weighted using par value of bonds held by insurance companies and the market duration is weighted using par value of bonds outstanding. We see that during the high interest environment from 1994 to 2000, there’s almost no gap between the duration of life insurance portfolio and the market while in the post crisis period where interest rates are low, the duration gap increased gradually. For example, in 2015Q4, the duration of the market is 6.02 while the life insurance portfolio duration is 8.23, leaving a 2.21 duration gap. This means if interest rates increase by 1 percentage point, the bond market would drop 6.02% in price, and the value of insurer’s bond portfolio drops by 8.23%.

Next, we want to study how much the tilt toward high duration is related to variation in interest rates. Figure 4 panel B plots the excess duration of life insurance sector relative to the market, which is the simple difference of

http://www.naic.org/cipr_topics/topic_low_interest_rates.htm
the duration values in panel A, against the level of lagged interest rate. We see that as interest rates decline, insurance companies tilt their portfolio to take more duration risk. A one percentage point decline in interest rate is associated with an increase in excess duration of 0.29, with an $R^2$ of 0.76 in the linear regression.

Overall, these results suggest that investors exhibit a significant “duration tilt” as interest rates decline. In section 6.1.2, we will discuss how much of reaching for yield (RfY) is explained by this “duration tilt”. Before doing so, we show that mutual funds are on the opposite side of the trades by insurers in the next section.

6.1.1 Mutual Funds Accommodating Life Insurer’s Duration Tilt

The results about the “duration tilt” raises a natural question: As insurers tilt toward higher duration assets, who is accommodating this portfolio shift? We compiled mutual fund data from Morningstar which has holdings of US open ended corporate bond mutual funds from 2002Q1 to 2016Q3.\footnote{One caveat is that mutual funds in our dataset have shorter samples than life insurance companies. However, in order to compare the two sectors, we put them together in Figure 4 Panel B and Figure 6 Panel B.} The data suggest that mutual funds might have been on the other side of the trade when insurance companies tilt towards high duration assets in low interest rate environment. In fact, as interest rates decrease, mutual funds tend to decrease their portfolio’s duration relative to the market. As shown in panel A of Figure 4, the mutual fund sector holds bonds with duration below the market average starting from 2009 when the Fed has lowered the interest rate. Panel B of Figure 4 suggests that, opposite to the life insurance sector, the excess duration of the mutual fund sector (in NAIC1 bonds) is positively correlated with the level of interest rate. We see that indeed mutual funds tilted toward lower duration as interest rate decreases. With a 1 percentage point decrease in interest rate, mutual funds accommodate by decreasing the duration of their portfolio by 0.19 (while for insurance companies the point estimate is -0.29).
6.1.2 How much of the RfY is explained by “duration tilt”? 

In order to provide additional evidence that insurance companies reach for yield in the form of “duration tilt”, this section studies how much RfY is left after we control for duration of the bonds. In particular, for every NAIC1 bond that insurance companies hold on their balance sheet in a given quarter, we find 10 bonds among all the bonds outstanding that have the closest duration to the bond we want to match with, excluding the bond itself. Then we subtract the average yield of the 10 duration matched bonds from the yield of the bond that insurers hold. We call this excess yield “duration-matched yield” of the bond. The “duration-matched RfY” is the weighted average “duration-matched yield” of an insurance company’s bond portfolio. It captures an insurance company’s reaching for yield behavior that loads on risks other than duration. The duration-matched RfY for the insurance sector is the weighted average using the par amount of each bond held by all life insurance companies.

Figure 5 plots the duration matched RfY against the lagged level of 1 year treasury yield (red dots) in comparison to the RfY constructed in section 4.15. We see that the duration matched RfY no longer increases as the interest rate declines. This suggests that the reaching for yield by insurance companies when interest rate declines is essentially a “duration tilt”. In fact, we even see a slight decline in duration-matched RfY when interest rates decline. This might be a result of the fact that insurers are reducing the credit risk in their corporate bond portfolio, which we’ll discuss in section 6.2.

6.1.3 Duration Tilt and Slope of Yield Curve

We have shown that insurance companies have a duration tilt when interest rates are low. So far, we have used the 1-year treasury yield as our main policy variable because the short end of the yield curve is directly controlled by central banks, thus it fits into our question of how reaching for yield relates to monetary policy. Although not the main question we tackle in this paper,

\begin{footnote}
15RfY in Figure 5 is the same as that in Figure 3 (panel B left figure), except we excluded 2008Q3 in the latter.
\end{footnote}
one might also be interested in how the duration tilt in the insurance sector is related to the whole term structure of interest rate. Empirical studies have found that more than 99% of the movements in treasury bond yields are attributable to three factors, namely “level”, “slope” and “curvature”. And “level” and “slope” alone captures more than 95% of the variations (Scheinkman and Litterman 1991). English, Van den Heuvel, and Zakrajsek 2014 studies how shocks to “level” and “slope” of the yield curve influence stock returns of bank, an intermediary which engage in maturity transformation. In this section, we want to study how life insurers’ asset allocation shifts when the “slope” of the yield curve moves around.

For this purpose, we use two methods to construct the yield curve slope. The first one is the term spread measured using the difference between the 10-year treasury yield and 1-year treasury yield. However, the slope of the treasury bond might not be accurately reflecting the yield curve for corporate bonds. Our second method thus measures the time varying yield curve slope of corporate bonds with a cross-sectional regression every quarter. In every quarter $t$, we run a cross-sectional regression of yield spread on bond duration, controlling for the expected default frequency (EDF)

$$Y_{i,t} - Rf_{i,t} = \alpha + \beta_t DUR_{i,t} + \gamma_t EDF_{i,t} + \varepsilon_{i,t}.$$ 

The coefficient $\beta_t$ is our estimate of the corporate bond yield curve “slope.” It turns out $\beta_t$ is highly correlated with the treasury term spread.

Then we use the slope we estimated to run the following panel regression for insurer-quarter observations

$$ExcessDUR_{j,t} = \theta S_t + D_j + u_t$$

where $S_t$ is either the treasury term spread or the corporate bond yield curve slope $\beta_t$ we estimated above, $ExcessDUR_{j,t}$ is the excess duration (constructed as in panel B of Figure 4), and $D_j$ is the insurer fixed effect. The sensitivity

$^{16}$Data downloaded from FRED with tickers DGS10 and DGS1.
of insurers’ duration tilt to yield curve slope is $\theta$\textsuperscript{17}. Table 5 reports the result of this panel regression.\textsuperscript{18} We see that a one percentage point increase in the treasury term spread is associated with a 0.10 increase in the excess duration. Similarly, we find that an increase in corporate bond “slope” by 1 percentage point is associated with 0.16 increase in insurance company’s duration tilt.\textsuperscript{19} The results show insurance companies tilt toward high duration bonds more when the yield curve is steep, to make profits as the yields fall with the declining bond maturity. Note that we’ve shown at the beginning of section 6.1 that a 1 percentage point decrease in interest rate is associated 0.29 increase in duration tilt, the “level” of yield curve seem to have stronger impact than “slope” on insurers’ “reaching for duration” behavior. The primary market results in the last two columns are quantitatively very similar but have somewhat lower statistical significance because there are not too many bonds issued every quarter, which limits the quality of our excess duration measure.

6.2 Monetary Policy and Credit Risk Tilts

Previous research has argued that the relative performance ranking of delegated asset managers created incentives for mutual funds to chase yield (Stein 2013, Morris and Shin 2014, Feroli et al. 2014, La Spada 2017). In support of this view, Choi and Kronlund (2017) find that mutual funds that reach for yield can outperform their peers, especially so during a low rate environments, although on average the mutual fund sector does not reach for yield. Consistent with the findings of Choi and Kronlund (2017), we do not find mutual funds reach for yield on average. However, by unpacking their asset holdings, this section finds a shift in mutual fund sector’s risk profile: they tilt toward

\textsuperscript{17}As a robustness check, we study the duration tilt in NAIC2 bonds separately, in which case $\beta_t$ is also estimated separately. Results are available upon request.

\textsuperscript{18}The regression is from 1999Q1 to 2016Q4. We started in 1999Q1 since the EDF data from Moody’s is not available before then.

\textsuperscript{19}Since the “slope” $\beta_t$ is not directly comparable to the term spread in magnitude, we scale it by a constant 9. The scaling gives the variable an economic interpretation of term spread between a corporate bond with 10 year duration and 1 year duration (measured in percentage points).
higher credit risk bonds and tilt away from high duration bonds. These two effects offset the aggregate risk on their portfolio, so we don’t see they reach for yield on average.

This may be an equilibrium outcome due to the comparative advantage of mutual funds and insurers in their risk taking, which depends on their liability structure and regulatory constraints. In a low interest rate environment, both insurers and mutual funds have stronger incentive to reach for yield in the bond market. When the interest rate fluctuates, bonds with high duration have greater price volatility. Intermediaries with unstable sources of funding have disadvantages in holding high duration assets, as such volatility can potentially cause runs from the investor side, which might then lead to large fire-sale losses.

There are crucial differences between life insurers and mutual funds in terms of their comparative advantage in risk taking. Life insurance companies have stable and long term liabilities. In addition, they follow a non mark-to-market statutory accounting rule to report bond asset values, which helps them remain solvent in the face of short term market value fluctuations of high duration bonds. In comparison, corporate bond mutual funds are open ended and their outflows are sensitive to bad performance (Goldstein, Jiang and Ng 2017) and, therefore, the fragility of their funding side makes them unprotected from asset value fluctuations of high duration assets. According to the risk based capital (RBC) requirements, life insurers are strictly regulated based on the credit rating of their bond holdings. Unlike insurance companies, mutual funds are not regulated based on their asset holdings\footnote{Although every mutual fund have an objective code in its prospectus which describes its risk profile and the main asset class it tends to invest, this is not a binding constraint.} Thus they have the freedom to take more credit risk when their yield chasing appetite is strong. Thus, in equilibrium, insurance companies have a comparative advantage in taking duration risk whereas mutual funds have an advantage of taking credit risk.

In order to see how much credit risk mutual funds take, we use a method similar to the construction of the $RfY$. In particular, we compare the credit risk of mutual fund’s corporate bond portfolio relative to the market. We
measure the credit risk of a bond using the expected default frequency (EDF) from Moody’s, which is a model-implied default probability in the next 5 years. As the EDF is computed at the firm (bond issuer) level, we merge it with our bond sample using the first 6 digits of CUSIP. To calculate the EDF of mutual fund portfolio, we weight the quarter end EDF of each bond based on the total par value of the bond held by mutual funds in our sample. The benchmark EDF is computed using the EDF of the whole market, which is a value weighted EDF of each bond based on the quarter end amount outstanding. We then compute the excess EDF of mutual fund sector using the EDF of mutual fund portfolio minus the market benchmark EDF. Since mutual funds are not subject to regulatory constraints, we don’t distinguish NAIC designations and instead study their reaching for yield behavior in all investment grade bonds, which corresponds to NAIC1 and NAIC2 categories. We calculate the excess EDF of insurance company portfolio in an analogous manner. Specifically, we also aggregate bonds with NAIC1 and NAIC2 designations into a single portfolio in order to show insurance companies have the opposite credit risk tilt behavior as mutual funds.\textsuperscript{21}

In the upper panel of Figure 6, we plot the EDF of the mutual fund sector (blue line), life insurance sector (red line) and the market (dashed green line) over time. We see that mutual funds are holding portfolios with similar credit risk as the market in the pre-2008 sample. And in the post-recession low interest rate period (2009Q3–2016Q4), they held investment grade bonds with an average default probability of 0.4 percentage point higher than the market. On the other hand, life insurance companies do not hold bonds with higher credit risk relative to the market. In fact, on average they hold bonds that have a 0.51 percentage point lower default probability than the market. During the great recession, insurers hold bonds with significantly lower credit risk relative

\footnotesize{\textsuperscript{21}Note that in section 6.1 we study duration tilt for bonds in a single NAIC designation for both life insurers and mutual funds. Here we study the credit risk tilt for all bonds with investment grade ratings (NAIC1&2) for both life insurers and mutual funds. This is because life insurance companies, who are regulated on NAIC designations, actively reach for duration risk and mutual funds passively take the other side of the trade. And on the other hand, mutual funds, who are not faced with NAIC regulations, actively reach for credit risk and life insurers passively take the other side of the trade.}
to the market. Bijlsma and Vermeulenb (2016) find evidence of “flight to quality” by insurance companies during European sovereign debt crisis. Our finding is consistent with “flight to quality” by insurers during market turmoil. The fact that mutual funds and life insurers have opposite credit risk tilts is consistent with our view that they have different comparative advantages in risk taking.

The lower panel of Figure 6 plots the excess EDF of mutual funds against the lagged level of 1-year treasury rate. A one percentage point decrease in interest rate is associated with a 10.7 basis point higher default probability on mutual funds’ investment grade bond portfolio, and a 5.2 basis point lower default probability on insurance companies’ portfolio. One caveat is that the credit risk proxy we use, EDF, is computed by Moody’s using a credit risk model (KMV), which only captures physical default probability. This is not exactly the same as the risk neutral default probability, which could be reflected in CDS spread.

7 Conclusion

In this paper, we have characterized the reaching for yield behavior in insurance companies and more importantly how monetary policy and interest rates affect this behavior. Our results suggest that life insurance companies invest in higher yield corporate bonds (reach for yield) under loose monetary policy regimes when interest rates are lower. We also find that insurers with weaker balance sheets tend to reach for yield more and the effect of interest rates on reaching for yield behavior is also stronger for these insurers compared to those with stronger balance sheets. We present evidence that these results are consistent with an “income targeting" channel, that is, insurance companies need to generate additional investment income during a low interest rate environment as their liabilities are pre-determined. We also show that most of the effect of interest rates on reaching for yield behavior of insurance companies come from reaching for duration. Mutual funds take the opposite side of this trade by avoiding duration risk during low interest rate environment and
instead loading on credit risk.

Our results have potential welfare implications that merit deeper attention. The reaching for duration by insurance companies suggest that the companies issuing the bonds purchased by insurers may find it easier to fund their long-term investment. We also note that while a jump in interest rates could translate to significant market value losses, the largest holders of U.S. corporate bonds (U.S. life insurance companies at $2.36 trillion) would likely be able to mitigate losses in a rising rate scenario via asset-liability management and regulatory capital levels will remain stable as statutory accounting rules heavily utilize book value when marking assets. However, there is also a potential risk of disintermediation. In particular, a spike in interest rates may induce policyholders lapse on existing policies in favor of investing in new policies with higher crediting rates. We hope that our results will trigger future research in this area.

References


Di Maggio, Marco, and Marcin Kacperczyk. 2017. "The Unintended Con-


Table 1: Summary Statistics
The table reports summary statistics of our sample of corporate bonds in the NAIC1 designation (both bonds outstanding and bonds issued in primary market), the characteristics of insurance companies and their bond portfolios. The insurer characteristics cover a quarterly panel of all life insurance companies from 1997Q1–2016Q4 (data from SNL). The bond characteristics summarize quarterly panels of all bonds outstanding or issued within NAIC1 designation. The insurer corporate bond portfolio summary aggregates the bond characteristics to a quarterly panel of insurance company portfolios (both holdings and acquisitions from primary market) from 1994Q1–2016Q4.

<table>
<thead>
<tr>
<th>Bond Characteristics (NAIC1 Bonds Outstanding)</th>
<th>Mean</th>
<th>St. dev.</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bond Duration</td>
<td>5.69</td>
<td>4.35</td>
<td>2.20</td>
<td>4.64</td>
<td>8.44</td>
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<tr>
<td>Bond Yield (%)</td>
<td>4.73</td>
<td>2.17</td>
<td>3.08</td>
<td>5.02</td>
<td>6.33</td>
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<tr>
<td>5 Year Cumulative EDF (%)</td>
<td>2.33</td>
<td>3.55</td>
<td>0.54</td>
<td>1.00</td>
<td>3.48</td>
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</table>

<table>
<thead>
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<th>Bond Characteristics (NAIC1 Bonds Issued in Primary Market)</th>
<th>Mean</th>
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<th>25%</th>
<th>50%</th>
<th>75%</th>
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<tbody>
<tr>
<td>Bond Duration</td>
<td>5.29</td>
<td>4.11</td>
<td>1.74</td>
<td>4.45</td>
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<td>Bond Yield (%)</td>
<td>6.56</td>
<td>3.72</td>
<td>4.54</td>
<td>6.29</td>
<td>7.58</td>
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<td>5 Year Cumulative EDF (%)</td>
<td>2.51</td>
<td>2.59</td>
<td>0.55</td>
<td>1.14</td>
<td>4.02</td>
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<table>
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<th>Insurer Characteristics</th>
<th>Mean</th>
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<th>50%</th>
<th>75%</th>
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<tr>
<td>Leverage</td>
<td>0.73</td>
<td>0.26</td>
<td>0.60</td>
<td>0.84</td>
<td>0.92</td>
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<td>ACL Risk-Based Capital Ratio (%)</td>
<td>2355.76</td>
<td>7100.83</td>
<td>593.08</td>
<td>876.33</td>
<td>1521.23</td>
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<td>Adequacy of Investment Income (%)</td>
<td>221.40</td>
<td>145.33</td>
<td>138.54</td>
<td>169.33</td>
<td>243.23</td>
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<tr>
<td>Insurance Operating Income Over Assets (%)</td>
<td>-0.54</td>
<td>1.91</td>
<td>-1.16</td>
<td>-0.70</td>
<td>-0.04</td>
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<table>
<thead>
<tr>
<th>Insurer Corporate Bond Portfolio Summary (Quarter End Holdings of NAIC1 Bonds)</th>
<th>Mean</th>
<th>St. dev.</th>
<th>25%</th>
<th>50%</th>
<th>75%</th>
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</thead>
<tbody>
<tr>
<td>Average Bond Duration</td>
<td>5.71</td>
<td>2.55</td>
<td>3.94</td>
<td>5.38</td>
<td>7.21</td>
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<tr>
<td>Average Bond Yield (%)</td>
<td>5.32</td>
<td>1.80</td>
<td>3.92</td>
<td>5.64</td>
<td>6.76</td>
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<tr>
<td>Excess Duration</td>
<td>0.17</td>
<td>2.54</td>
<td>-1.66</td>
<td>-0.25</td>
<td>1.68</td>
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<tr>
<td>Reaching for Yield (%)</td>
<td>0.14</td>
<td>0.74</td>
<td>-0.22</td>
<td>0.07</td>
<td>0.47</td>
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<tr>
<td>5 Year Cumulative EDF (%)</td>
<td>2.68</td>
<td>1.74</td>
<td>1.59</td>
<td>2.35</td>
<td>3.34</td>
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<table>
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<tr>
<th>Insurer Corporate Bond Portfolio Summary (Primary Market Acquisitions of NAIC1 Bonds)</th>
<th>Mean</th>
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<th>50%</th>
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<tr>
<td>Average Bond Duration</td>
<td>7.86</td>
<td>3.09</td>
<td>5.72</td>
<td>7.43</td>
<td>9.09</td>
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<tr>
<td>Average Bond Yield (%)</td>
<td>5.43</td>
<td>1.60</td>
<td>4.27</td>
<td>5.63</td>
<td>6.66</td>
</tr>
<tr>
<td>Excess Duration</td>
<td>1.35</td>
<td>2.94</td>
<td>-0.59</td>
<td>1.01</td>
<td>2.61</td>
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<tr>
<td>Reaching for Yield (%)</td>
<td>0.39</td>
<td>0.82</td>
<td>-0.05</td>
<td>0.33</td>
<td>0.81</td>
</tr>
<tr>
<td>Average 5 Year Cumulative EDF (%)</td>
<td>2.23</td>
<td>1.97</td>
<td>0.74</td>
<td>1.49</td>
<td>3.22</td>
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Table 2: Relationship of reaching for yield and interest rate
Regression of reaching for yield of insurance companies within NAIC1 designation on quarter lagged 1 year treasury yield. We measure reaching for yield based on quarter end holdings (\(RfY_t^{Holding}\)) and primary market acquisitions (\(RfY_t^{Primary}\)) for the whole life insurance sector and individual insurers (\(RfY_{i,t}^{Holding}\) and \(RfY_{i,t}^{Primary}\)). The sample period is from 1994Q1 to 2016Q4. Robust standard errors are reported in parenthesis.

<table>
<thead>
<tr>
<th></th>
<th>Panel A. Regressions at the whole insurance sector</th>
<th>Panel B. Regressions at the individual insurance company level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1) (RfY_t^{Holding}) (2) (RfY_t^{Primary}) (3) (RfY_t^{Acq}) (4) (RfY_t^{Disp})</td>
<td>(1) (RfY_{i,t}^{Holding}) (2) (RfY_{i,t}^{Primary}) (3) (RfY_{i,t}^{Acq}) (4) (RfY_{i,t}^{Disp})</td>
</tr>
<tr>
<td>(y_{t-1})</td>
<td>-0.094*** (-21.01)</td>
<td>-0.082*** (-9.09)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.615*** (28.46)</td>
<td>0.616*** (15.10)</td>
</tr>
<tr>
<td>Sample Size</td>
<td>92</td>
<td>92</td>
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<tr>
<td>R–Squared</td>
<td>.76995</td>
<td>.38749</td>
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<td>Clusters (NAIC Code)</td>
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<td>Insurer FE</td>
<td>YES</td>
<td>YES</td>
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Table 3: Relationship of reaching for yield, monetary policy, and life insurer financial health

\[ RfY_{i,t} = \alpha + \beta \cdot y_{i,1,t}^{(1)} + \gamma \cdot FinancialHealth_{i,t-1} + \theta \cdot y_{i,1,t}^{(1)} \cdot FinancialHealth_{i,t-1} + \varepsilon_{i,t}. \]

Insurance’s financial health \( FinancialHealth_{i,t-1} \) is measured at the end of previous year (Q4). We use 3 measures of financial health: leverage, RBC ratio and adequacy of investment income. An increase in leverage, decrease in RBC ratio or decrease in adequacy of investment income reflects worsening of financial health. Each covariate’s value at (t-1) is calculated originally from annual data. We use the previous end of year value as the lagged observation for the following four quarters. The annual financial health data is obtained from SNL which starts in 1996. The regression is quarterly from 1997Q1 to 2016Q4. Robust standard errors are clustered by insurer and quarter.

<table>
<thead>
<tr>
<th>Panel A</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leverage</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
<td>( RfY_{i,t}^{(1) \text{Leverage}} )</td>
</tr>
<tr>
<td>( y_{i,1,t}^{(1)} )</td>
<td>-0.054***</td>
<td>-0.047***</td>
<td>-0.054***</td>
<td>-0.049***</td>
<td>-0.061***</td>
<td>-0.066***</td>
</tr>
<tr>
<td>Financial Health_{i,t-1}</td>
<td>0.329***</td>
<td>0.237***</td>
<td>-0.120***</td>
<td>-0.065**</td>
<td>-0.135***</td>
<td>-0.055***</td>
</tr>
<tr>
<td>( y_{i,1,t}^{(1)} \cdot Financial Health_{i,t-1} )</td>
<td>-0.049***</td>
<td>-0.052***</td>
<td>0.017***</td>
<td>0.021***</td>
<td>0.017***</td>
<td>0.022***</td>
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<tr>
<td>Sample Size</td>
<td>58,473</td>
<td>58,465</td>
<td>57,514</td>
<td>57,507</td>
<td>49,001</td>
<td>49,007</td>
</tr>
<tr>
<td>R-Squared</td>
<td>.10926</td>
<td>.49637</td>
<td>.03537</td>
<td>.48074</td>
<td>.05478</td>
<td>.49491</td>
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<td>1209</td>
<td>1197</td>
<td>1190</td>
<td>1049</td>
<td>1045</td>
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<td>Clusters (Quarter)</td>
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<td>80</td>
<td>80</td>
<td>80</td>
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<td>80</td>
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<tr>
<td>Insurer FE</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Time FE</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
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<table>
<thead>
<tr>
<th>Panel B</th>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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</thead>
<tbody>
<tr>
<td>Leverage</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
<td>( RfY_{i,t}^{(1) \text{Primary}} )</td>
</tr>
<tr>
<td>( y_{i,1,t}^{(1)} )</td>
<td>-0.000***</td>
<td>-0.000***</td>
<td>-0.004***</td>
<td>-0.101***</td>
<td>-0.101***</td>
<td>-0.114***</td>
</tr>
<tr>
<td>Financial Health_{i,t-1}</td>
<td>0.245***</td>
<td>0.182***</td>
<td>-0.111***</td>
<td>-0.049***</td>
<td>-0.095***</td>
<td>-0.012</td>
</tr>
<tr>
<td>( y_{i,1,t}^{(1)} \cdot Financial Health_{i,t-1} )</td>
<td>-0.038***</td>
<td>-0.033***</td>
<td>0.039***</td>
<td>0.011***</td>
<td>0.038***</td>
<td>0.017***</td>
</tr>
<tr>
<td>Sample Size</td>
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<td>28,554</td>
<td>28,432</td>
<td>28,351</td>
<td>25,861</td>
<td>25,700</td>
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<tr>
<td>R-Squared</td>
<td>.10245</td>
<td>.31187</td>
<td>.06471</td>
<td>.30396</td>
<td>.07952</td>
<td>.30081</td>
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<tr>
<td>Clusters (NAICCode)</td>
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<td>967</td>
<td>1038</td>
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<td>918</td>
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<td>Clusters (Quarter)</td>
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<tr>
<td>Insurer FE</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Time FE</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>
Table 4: The “income targeting” channel of reaching for yield by insurance companies

Regression of reaching for yield on lagged quarterly income from insurance operations, level of interest rate and their interaction terms. The income from insurance operations is normalized by the total asset of each individual insurer. The time period is 2001Q2 to 2016Q4. Robust standard errors are clustered by insurer and quarter.

<table>
<thead>
<tr>
<th></th>
<th>Holdings</th>
<th>Primary Market Acquisitions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$RfY_{i,t}^{Holding}$</td>
<td>$RfY_{i,t}^{Primary}$</td>
</tr>
<tr>
<td>$y_{i,t-1}$</td>
<td>-0.058***</td>
<td>-0.053***</td>
</tr>
<tr>
<td></td>
<td>(-8.18)</td>
<td>(-7.73)</td>
</tr>
<tr>
<td>$(\frac{InsOp Income}{Asset})_{i,t-1}$</td>
<td>-0.143***</td>
<td>-0.062***</td>
</tr>
<tr>
<td></td>
<td>(-7.25)</td>
<td>(-5.40)</td>
</tr>
<tr>
<td>$y_{i,t-1} \cdot (\frac{InsOp Income}{Asset})_{i,t-1}$</td>
<td>0.018***</td>
<td>0.027***</td>
</tr>
<tr>
<td></td>
<td>(3.47)</td>
<td>(6.34)</td>
</tr>
</tbody>
</table>

Sample Size: 42871 42860 22464 22402
R-Squared: .03125 .54458 .05751 .33561
Clusters (NAICCode): 1025 1014 904 842
Clusters (Quarter): 63 63 63 63
Insurer FE: NO YES NO YES
Time FE: NO NO NO NO

Table 5: Duration tilt and the slope of the yield curve

Regression of excess duration duration of each insurance company $ExcessDUR_{j,t}$ on the yield curve slope in the concurrent quarter. The slope of the yield curve is measured using both corporate bond information $\beta_t$ (detailed construction in section 6.1.3 of the paper) and US treasury term spread $y_{t}^{(10)} - y_{t}^{(1)}$. The time period is from 1999Q1 to 2016Q4. Robust standard errors are clustered by insurer and quarter.

<table>
<thead>
<tr>
<th></th>
<th>Holdings</th>
<th>Primary Market Acquisitions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ExDUR_{j,t}^{Holding}$</td>
<td>$ExDUR_{j,t}^{Primary}$</td>
</tr>
<tr>
<td>Slope $\beta_t$</td>
<td>0.162***</td>
<td>0.162**</td>
</tr>
<tr>
<td></td>
<td>(4.89)</td>
<td>(2.22)</td>
</tr>
<tr>
<td>$y_{t}^{(10)} - y_{t}^{(1)}$</td>
<td>0.103***</td>
<td>0.095</td>
</tr>
<tr>
<td></td>
<td>(4.24)</td>
<td>(1.56)</td>
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</tbody>
</table>

Sample Size: 53848 53848 26709 26709
R-Squared: .66065 .65972 .36771 .36681
Clusters (NAICCode): 1214 1214 991 991
Clusters (Quarter): 63 63 72 72
Insurer FE: YES YES YES YES
Time FE: YES YES YES YES

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Figure 1. 1 year treasury yield in our sample period (1994Q1-2016Q4). Data from FRED 1-Year Treasury Constant Maturity Rate (DGS1).
Panel A: Reaching for yield in high (left subfigure) and low (right subfigure) interest rate environment (quarter end holdings)

Panel B: Reaching for yield in high (left subfigure) and low (right subfigure) interest rate environment (primary market)

Figure 2. Reaching for yield in high interest rate and low interest rate environment. In panel A, we sort all corporate bonds in the market (NAIC1 designation) into quartiles based on the yield-to-maturity with the last quartile being the highest yield bonds. Vertical axis is the fraction of the outstanding bonds in each quartile held by life insurance companies. 95% confidence of the mean fraction is added to the bar chart. The left hand side subfigure is from 1994 to 1997 (with average 1 year treasury rate of 5.6%) and right hand side subfigure is from 2013 to 2016 (with average 1 year treasury rate of 0.3%). In panel B, we sort all the primary market issues in the market (NAIC1 designation) into quartiles based on the yield-to-maturity with the last quartile being the highest yield bonds. Vertical axis is the fraction of amount offered acquired by life insurance companies.
Panel A: Life insurance sector reaching for yield and the level of interest rate over time (1994Q1-2016Q4)

Panel B: RfY and the level of interest rate. Left subfigure: quarter end holdings. Right subfigure: primary market.

Figure 3. Reaching for yield and the level of interest rate. In panel A, we plot the level of 1 year treasury yield (lagged) and reaching for yield measured by life insurance holdings $RfY_t^{Holding}$ among NAIC1 bonds for each quarter between 1994Q1 and 2016Q4. In panel B, the left subfigure plot the quarter end holding reaching for yield $RfY_t^{Holding}$ among NAIC1 bonds against the 1 year treasury yield (lagged). The right subfigure plot the primary market acquisition reaching for yield $RfY_t^{Primary}$ among NAIC1 bonds against the 1 year treasury yield (lagged). The fitted linear regression in the figures include all the quarterly observations from 1994Q1 to 2016Q4. However, we exclude a few outliers in the scatter plot so both plots have vertical scale between -0.2% and 1%. Specifically, 2008Q3 (RfY=-0.28%) is excluded from the left hand side subfigure, and 2008Q4 (RfY=1.97%) as well 2009Q1 (1.2%) are excluded from the right hand side figure.
Panel A: Duration of the life insurance sector and the mutual fund sector’s corporate bond portfolio v.s. market benchmark (NAIC1 designation)

Panel B: Excess duration of the life insurance sector and the mutual fund sector’s corporate bond portfolio (NAIC1 designation) and 1 year treasury yield

Figure 4 Monetary Policy and Duration Risk Tilts. In Panel A, we plot the average duration of the life insurance sector (1994Q1 to 2016Q4) and the mutual fund sector’s (2002Q1 to 2016Q3) corporate bond portfolio in NAIC1 designation (weighted by par amount held) and average duration of the market of NAIC1 bonds (weighted by par amount outstanding). In Panel B, we plot the excess duration of the life insurance sector and the mutual fund sector’s corporate bond portfolio in NAIC1 designation (the gap of the each sector’s average duration and market average duration) against the quarter lagged 1 year treasury yield.
Figure 5. Duration-matched RfY of life insurance sector against the level of interest rate. Duration-matched RfY is plotted against the quarter lag 1 year treasury rate (1994Q1 to 2016Q4, in red). The duration matched yield of each bond is computed as the difference between its own yield and the the average yield of the 10 bonds with the closest duration within each quarter (in NAIC1 designation). Then, we compute the duration matched RfY for the life insurance sector as the weighted average of duration matched yield using the par amount of each bond held by life insurers. To eliminate matching error, bonds are only considered in the calculation if the average duration of the 10 matched bonds is within 0.5 years of the duration of the original bond. As a comparison, we also plot the life insurance sector RfY (in blue).
Panel A. EDF of the life insurer sector and the mutual fund sector’s corporate bond portfolio v.s. market benchmark (investment grade)

Panel B. Excess EDF of the life insurance sector and the mutual fund sector’s corporate bond portfolio (investment grade) and 1 year treasury yield

Figure 6. Monetary Policy and Credit Risk Tilts. In Panel A, we plot the average expected default frequency (EDF) of the life insurance sector (1999Q1 to 2016Q4) and the mutual fund sector’s (2002Q1 to 2016Q3) corporate bond portfolio and the average EDF of the market for investment grade bonds (NAIC categories 1-2). EDF is measured using EDF9 (5 year cumulative, 1999Q1-2016Q4) from Moody’s CreditEdge, which measures the probability that a firm could default in the next 5 years. In Panel B, we plot the excess EDF of the life insurance sector and the mutual fund sector’s corporate bond portfolio for investment grade bonds (the gap of the each sector’s average EDF and market average EDF) against the quarter lagged 1 year treasury yield.