Earnings Up/Liabilities Down: Do Corporations Strategically Manage Pension Discount Rates?

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Abstract

A significant number of U.S. publicly listed firms failed to sufficiently lower discount rates used to discount their future pension obligations when interest rates decreased. This results in an understatement of their pension liabilities and a reduction in charges against earnings. Firms with poor operating performance, firms experiencing poor investment returns and with greater pension contributions were less likely to decrease the rate used to discount their pension liabilities when interest rates indicated they should do so, and thereby possibly understating the present value of these pension liabilities, possibly to avoid higher pension charges against earnings during financial difficulties. The phenomenon is most pronounced during the recent financial crisis. Moreover, we find that such strategic pension discount rate "stickiness" are most severe among firms whose ratings are close to the investment grade cutoff. The imperfect elasticity of pension discount rates to market interest rates allows firms to manipulate their earnings while reducing the constraints of defined benefit pension plans.

I. Introduction

Pension obligations, and the need to fund them, may have significant effects on a firm. The Employee Retirement Income Security Act (ERISA) of 1974 requires firms to set aside a certain amount of assets to meet their pension obligations. These pension liabilities are considered as an integral part of a firm's financial liabilities (Treynor, 1977; Bodie, Light, Morck, and Taggart, 1985; Friedman, 1983; Jin, Merton, and Bodie, 2006). The amount of assets needed to be held for the pension plan is therefore a function of the present value of the pension liabilities. A pension plan is underfunded if the value of pension assets drops below the present value of projected future pension obligations. Pension underfunding has significant impacts on corporate earnings due to the mandatory pension contribution requirement; should the present value of future pension obligations exceed the value of the plan's assets, ERISA and other rules require mandatory contributions to the underfunded pension plan. These mandatory contributions require cash infusions and are then charged against current earnings. Rauh (2006) estimates that for every dollar of mandatory contribution to underfunded pension plans, a firm is forced to reduce its capital expenditure by $0.60 to $0.70. Firms' R&D investments and acquisition decisions could be similarly affected.[1]

Corporations must therefore contribute funds to their employees' retirement plans based on the projected liabilities adjusted by appropriate discount rates, known as pension discount rates. The current standard practice on setting pension discount rates is SFAS 158 (FASB 2006), which states that "… the projected benefit obligation would equal the current market value of a portfolio of *high-quality* zero coupon bonds whose maturity dates and amounts would be the same as the timing and amount of the expected future benefit payments." Subsequently, the EITF (a short name for the Emerging Issues Task Force) report No D-36, a Securities and Exchange Commissioner (SEC) staff report, suggests that "fixed-income debt securities that receive one of the two highest ratings given by a recognized ratings agency be considered high quality (for example, a fixed-income security that receives a rating of Aa or higher from Moody's Investors Service, Inc.)". EITF

[1]For a plan that is less than 90% funded, ERISA requires the sponsoring firm to make additional contributions to the plan to reduce the funding deficits within three to five years. If a plan is over 80% funded today and was more than 90% funded for the past two years, the additional contribution requirement is waived. However, the Pension Equity Act 2006 set new funding targets. Beginning in 2008, sponsors are required to fund to 100% of all liabilities (including lump sum distributions and early retirement benefits) accrued to participants and beneficiaries within seven years. It should be further noted that the Pension Relief Bill passed in 2008 provides pension funding relief for plan sponsors affected by the economic downturn, by allowing underfunded firms to fund their plans over an extended period.

reports only offer guidance about accounting standards. The use of yields of debt seucurities receiving one of the two highest ratings is not mandatory. Managers can exercise broad discretion in setting pension discount rates, resulting in large changes in their pension liabilities -- firms can raise or lower their pension liabilities by billons simply by changing pension discount rate (e.g., Schultz, 2011).[2]

While firms should change their pension discount rate upon changes in general interest rates,[3] a possible way for a firm to lower its pension liability (thereby reducing pension underfunding) and improve its earnings is to inflate the discount rate it applies to the future pension obligations. Doing so would lower the present value of the pension obligations, and therefore lower the amount of underfunding, and thus likely lower pension funding charges against current earnings and cash flow. During the Great Recession, many firms would have suffered with a double hit on their pension gap – the value of their plan assets may have fallen with the large market downturn for equities and higher rated bonds, while the drop in the general level of interest rates would imply notably higher pension liabilities. While a firm cannot do anything about the value of publicly traded assets, they do have some discretion on the choice of pension discount rates. During times of dramatic drops in the market value of plan assets, firms may have additional incentives to not exacerbate the blow of lower pension assets by not simultaneously increasing their pension liabilities and thereby reduce the magnitude of the charge on earnings due to pension obligations, particularly during an economic downturn when revenues and earnings are likely under pressure due to a recession.

While there a large literature on the misuse of discount rates for public pensions, to our knowledge no academic work has systematically studied the practice of corporate pension discount rate setting. In this study, we attempt to fill in this gap by examining the potential misuse of the corporate pension discount rates. While it is possible that pension discount rates could be artificially managed to be either too high or too low, our study focuses on inflation in pension discount rates in light of the significant underfunding in U.S. corporate pensions. A particular

[2] From FASB (2006), page 62, *italics added*: "B32. Gains and losses are changes in measures of the benefit obligation or plan assets that occur during a period because of differences between experience and assumptions or that occur because of changes in one or more actuarial assumptions. For example, gains and losses can arise from differences between the expected return and actual return on plan assets, *from changes in the benefit obligation due to changes in discount rates*, or from changes in assumptions about future compensation, retirement dates, mortality rates, employee turnover, retiree participation rates, health care cost trend rates, or government subsidies."

[3] FASB (2006), page 99, "Assumed discount rates shall be reevaluated at each measurement date. If the general level of interest rates rises or declines, the assumed discount rates shall change in a similar manner."

emphasis is on pension discount rate misuses after the recent financial crisis. The overall level of interest rates in the US have been and have remained notoriously low during the crisis and the subsequent Federal Reserve's quantitative easing programs. These historically low rates have had a variety of effects, but one effect should be a historically low discount rate on future pension obligations, resulting in a high pension liability.

We address the following questions. First, do firms on average set a relatively high pension discount rate when the interest rates are low? Second, what are the attributes of firms that are more likely to manage their pension discount rates? In particular, would poorly performing firms be more likely to be slow to reduce their pension discount rate in a falling interest rate environment? Our main findings are follows.

First, pension discount rates are significantly and positively correlated with yields on Aaa rated corporate bonds. However, there is always a positive gap between the average pension discount rate and the yield of Aaa rated bonds throughout the sample period -- firms typically set the discount rates for pensions higher than the yield for Aaa bonds. More interestingly, we find the spreads between pension discount rates and Aaa bond yields to be positively skewed. The standard deviations and semi-variance of the spreads are correlated with the macro-economic condition and they reach the peaks during the financial crisis. The over-time pattern in is consistent with the pension discount rate management hypothesis.

Second, we find that firms with lower pension asset returns, poorer operating performance are more likely to manage their pension discount rate. Firms having greater required pension contributions are inclined to not lower their pension discount rates when general interest rates fall. Further, we find that it is particularly those firms for which an increase in pension liabilities would be most binding and cause the most financial difficulties that appear to delay a reduction in their pension liabilities. Specifically, small firm size and higher financial leverage as well as worse lagged pension funded status appear correlated with consistently higher pension discount rates. We present evidence that the documented phenomenon becomes more significant during the recent financial crisis, when falling asset prices increased the pension underfunding gap and interest rates fell to historic lows.

Finally, our empirical evidence shows that firms whose credit ratings are on the border of investment grade and non-investment grade have more incentives to manipulate pension discount rate. This finding is consistent with earnings management conjecture. The financing cost of firms

below investment grade is much higher than those having an investment grade. This provides firms just at the border of investment/non-investment grade cutoff a high incentive to manipulate their pension discount rates so as not to affect earnings or other liabilities and suffer a downgrade from the rating agencies. The increased focus on maintaining investment grade ratings may also have been particularly intense during the Great Recession, as investment grade ratings were important to generate financing and to maintain trade credit from suppliers. Firms during this period would have additional incentive to use whatever discretion available to avoid the expansion of their pension obligations simply from a drop in interest rate changes.

Our findings have clear policy implications. It is well known that there are two types of retirement plans in practice – defined benefit corporate pension and defined contribution plans. Corporations using defined benefit plans have a relative lack of flexibility to cope with financial difficulties, as under defined benefit pensions, firms are mandated to contribute to the plans while firms with defined contribution plans do not have such constraints. The opportunity to "misuse" pension discount rates provides DB firms an opportunity to gain some flexibility to handle the difficult conditions like the financial crisis. Firms could, for example, argue that the market interest rates typically follow a certain dynamic and that interest rates in the recent years are at their historical lows after the financial crisis due to the Federal Reserve's adoption of quantitative easing.

Due to the requirement to fund pension obligations, there is a real cost to the variance in interest rates and therefore pension discount rates. Due to the high duration of long-distant pension obligations, minor changes in long-term pension discount rates could result in notable changes in the present value of pension obligations. Firms could reasonably prefer not to have additional drain on their earnings during the low interest rate environment during a recession when revenues and earnings are already under pressure, only to see the pressure reversed during a recovery period when interest rates rise (and underling revenues and earnings recover). A policy requiring a highly elastic response of pension discount rates to market interest rates may not be optimal. Even so, our results suggest that it is those firms for which this variance is most costly that appear to delay lowering pension discount rates relative to their peers, and therefore understate their liabilities and possibly overstate their earnings and retain excess cash flow to the detriment of the pension plan.

The remainder of the paper is organized as follows. In Section II, we provide background information about the misuse of pension discount rate in the practice. We discuss our hypotheses

in Sections III, followed by data and empirical findings in Section IV and V. Section VI concludes.

II. Background

II.1 Regulatory Requirements Regarding Corporate Pension Discount Rates

The specific rules to set pension discount rates are provided in the Paragraph 44 of the Statement of Financial Accounting Standards (SFAS) 87 and 158, and amended by the EITF (Emerging Issue Task Force) Abstract, No D-36. Specifically, effective in 1986 (year), SFAS 87 states that "assumed discount rates shall reflect the rates at which the pension benefits could be effectively settled. In making those estimates, employers may also look to rates of return on high-quality fixed-income investments currently available and expected to be available during the period to maturity of the pension benefits." It also mandates "assumed discount rates are used in measurements of the projected, accumulated, and vested benefit obligations and the service and interest cost components of net periodic pension cost".

Effective in 2006, SFAS 158 subsequently provides more specific requirements on pension discount rates. "… the projected benefit obligation would equal the current market value of a portfolio of high-quality zero coupon bonds whose maturity dates and amounts would be the same as the timing and amount of the expected future benefit payments. Because cash inflows would equal cash outflows in timing and amount, there would be no reinvestment risk in the yields to maturity of the portfolio."

Note that neither SFAS 87 nor 158 provides a clear definition of "high quality" bonds. The Securities and Exchange Commissioner (SEC) staff report, the EITF report No D-36, suggests that "fixed-income debt securities that receive one of the two highest ratings given by a recognized ratings agency be considered high quality (for example, a fixed-income security that receives a rating of Aa or higher from Moody's Investors Service, Inc.)". The EITF reports offer guidance within the framework of the Accounting Standards Codification to reduce diversity in practice. As a result, the yields of AA rating bonds as the minimum discount rate mentioned in the EITF report D-36 regarding corporate pension funds are not mandated. Significant divergence prevails in practice.

II.2 Anecdotal Evidence on Corporate Pension Discount Rates Practice

The discount rates used to measure liabilities for pension benefits generally reflect the then current level of interest rates. The low interest rate environment in US and around the world impose significant pressure on corporate. Boeing's discount rate, for example, fell from 6.2% in 2007 to 3.8% in 2012. Nevertheless, given that the very long-term nature of pension obligations and the mechanics of discounting, very small changes in pension discount rates can result in outsize increases in pension obligations. For example, Boeing indicated in a securities filing that a 0.25-percentage-point decrease in its discount rate would add $3.1 billion to its pension liabilities. Meanwhile, exactly as falling interest rates have created a massive hole in pension funding, pension plans could quickly recover if interest rates start to climb.[4] Monga (2013) reports that actuarial consulting firm Milliman found that a 0.27-percent increase in the discount rate and strong equity returns in January 2013 helped the deficit of the 100 largest corporate pension plans shrink by $106 billion.

Nevertheless, whether and when interest rates would increase are highly uncertain. Therefore, a strategy that firms may employ to "improve" their financial status is to respond only slowly to the lowering of general interest rates. Such a strategy smooths, but understates, pension liabilities. Pension discount rate smoothing therefore not only hides the true financial health of a firm, but it also may artificially boost earnings (Levitt, 2005). In addition, the delay of lowering pension discount rates may have other cash flow effects, such as preventing firms from making additional contributions to the Pension Benefit Guaranty Corporation (PBGC) that they might otherwise be obligated to make if their real financial status were revealed.

The ramification of applying a relatively low pension discount rate was reported in business presses. For example, many auto makers, including GM and Ford, have lowered their discount rates in the past several years, as interest rates have fallen (Solomon and Hawkins, 2005).[5] Lower pension discount rates can and do have real financial accounting effects. For example, according to financial filings of GM, a 0.25% decrease in its discount rate would increase its annual pretax pension expense by $160 million and raise its pension-benefit liability by $2.3 billion.[6] Jannaron

[4]A report by actuarial consulting firm Milliman found that a 0.27-percentage-point increase in the discount rate and strong equity returns in January helped the deficit of the 100 largest corporate pension plans shrink by $106billion in 2013 (Monga, 2013).

[5]GM's discount rate in 2004 was 5.75%, down from 7.8% in 1999, in line with a portfolio of bonds rated Aa by Moody's Investors Service Inc., according to GM (Solomon and Hawkins, 2005).

[6] Of course, when interest rates rise the reverse is also true. Prior (2014) notes that AT&T Inc., increased its assumed

(2009）illustrates that corporate-bond yields, as a discount rate, were about 1% lower in 2009 as compared with year 2008, which translated to tens of billions of dollars in additional pension liabilities in the depths of the Great Recession. Richardson (2006) notes that the Center for Financial Research and Analysis suggested that a company can manage its earning by changing various assumptions such as pension discount rate, and suggested that "red flags" are likely to show up frequently in the accounting of pension-fund assets and liabilities.[7]

II.3 Public Pensions Discount Rates: The Debate

An intensive debate is on the discount rates for public pensions. On one side, Brown and Wilcox (2009) indicate that state and local pensions are more underfunded than are generally reported using the appropriate discount rate reflecting the riskiness of liabilities, not assets, rather than their selected one that is the expected return on assets held in the pension trust. Consistent with this view, Novy-Marx and Rauh (2011) find that these relative large differences between their calculation and the state's calculation of state pensions mostly stem from discount rate, implying the rate of around 8% used by most states at all horizons is far too high. Public pension liabilities should be discounted based on much lower Treasury note yields while lowering the discount rate could mean governments would have to contribute more to pension funds with the money coming from taxpayers or employees (Corkery, 2010).

Conversely, Mixon (2015) argues that as pension liabilities should be estimated based on the benefits expected to be paid — i.e., future cash flows, it is more appropriate to value future cash flows using a discount rate that reflects the riskiness of the payments. Amounts that are extremely likely to be paid will have lower risk, and therefore a lower discount rate, than amounts that are less likely to be paid. Mixon (2015) continues to argue that, if appropriately set, pension liabilities based on risk-free rate of return, proposed by Novy-Marx and Rauh (2011, will reflect an estimate that is much closer to the actual cost of pension benefits and therefore the liabilities of the system. In contrast, discounting these liabilities using a hypothetical bond rate reflects an estimate of the future value of these benefits to plan members. Therefore, it is a more appropriate

discount rate to 5%, resulting in an actuarial gain of about $7.9 billion.

[7] Richardson (2006) notes: "Red flags are likely to show up frequently this year in the accounting of pension-fund assets and liabilities …. A company can manage its earnings by changing various assumptions that go into calculating its pension costs, such as the discount rate -- the interest rate used to calculate the present value of future cash flows -- and the expected rate of return on the pension plan's assets."

approach.

III. Hypotheses Development

We develop our hypotheses based on the following simple identity regarding pension funding:

$$PFD_t = PA_t - PL_t$$
$$= PA_{t-1} * (1 + AR_t) + CONT_t - \sum B_{t+i} / (1+DR_t)^i \quad (1)$$

In the above expression, PFD denotes an individual firm's pension funding, also broadly classified into overfunded if PFD is positive and underfunded if negative. PA denotes the firm's pension assets. PL denotes the firm's pension liability. AR is the pension asset return of the firm. CONT is the amount of pension contributions made by the firm in time t. B is the projected promised benefit the firm would pay to its employees in a future time. DR is the discount rate set at time t. That is, PL is a discounted value of projected promised benefits.

Firms are required to hold positive funding (that is overfunded to reduce the risk of default) in their pensions. According to Pension Protection Act of 2006 aiming to improve the funded status, for firms with underfunded plans, if pension assets are less than 80% of pension liabilities, are not allowed to adopt amendments that increase plan liabilities and provide lump sum distributions or other accelerated forms of benefits. In a more serious case, if a firm's pension assets are less than 60% of pension liabilities, firms are prohibited from all future benefit accruals. Meanwhile, it is certain that the larger the underfunded proportion is, the more contributions to pension plan, especially in the current year, are made, which might be instantly reflected in the stock market. Whatever, the unfavorable funded status definitely makes constrains on investment and financing of firms in the following periods, even if not briskly. Therefore, firms would have incentives to manage their pension discount rates when PA is low and when PL is high.

Intuitively, a lower interest rate corresponds to a lower pension discount rate, which results in a greater pension liability. As noted, a small change in assumptions can result in a large change in pension plan value, making the funded status of pension plans extremely volatile and pension accounting an area ripe for potential earnings management (Picconi, 2006). Actually, two successive accounting principles are highly relevant to the determination of discount rates for

corporate defined benefit pensions. The first is SFAS 87 (FASB 1985) requiring that the assumed discount rates shall reflect the rates at which the pension benefits could be effectively settled, seeming implicit and general, with the effective time period of 1986 to 2006; the second is, as of now, SFAS 158 (FASB 2006) which also regards the rate of return on fixed income security, denoting interest rate, as a feasible reference of pension discount rate. Impersonally, SFAS 158, being apt to reduce the risk of manipulating something like earning visa discount rate, is more specific and practicable relative to SFAS 87.

Additionally, different from corporate pension, public pension is supervised by GASB similar to FASB. Here list one more rule closely regarding the discount rate that is GASB 25 stipulating public pension liabilities are to be discounted at the expected rate of return on pension assets. As noted before, this rule counters to the logic of financial economics: financial streams of payment should be discounted at a rate that reflects their risks (Modigliani and Miller, 1958) and in particular their covariance with priced risks (Treynor, 1961). Indeed IAS 19 (2011) states that the discount rate reflects the time value of money rather than the actuarial or investment risk, and also measures the currency and the estimated timing of benefit payments.

As mentioned in the previous sections, firms try to overcome the occurrence of underfunded by manipulating some assumptions such as pension discount rate. The motivation should become more obvious if market interest rate (hereafter interest rate) is pretty low, which drives up the first hypothesis of our study (the time series prediction related to corporate pension discount rate management):

H1: Firms in aggregate would have more incentive to overstate pension discount rates when the interest rates (INT) are low.

Moreover, when the interest rate is low, pension asset return would be low, which correspondingly lowers PA. To increase the chance for a firm to have a positive pension funding, firms are more likely to set a higher pension discount rate than the otherwise appropriate rate.

Further, the pension funding identity (Eq. (1)) gives rise to various cross sectional predictions related to pension discount rate managements. All else constant, firms with poorer pension asset returns would have a lower PA logistically and theoretically. They therefore have a greater incentive to manage their pension discount rates. This leads to the second hypothesis.

H2: Pension discount rates are negatively related to pension asset return (AR), all else

equal.

Applying the same reasoning, firms having poor operating performance are less likely to make adequate contributions to their pension plans, leading to a lower PA. This would increase the firm's chance to manage their pension discount rates. The more important, the market is unable to fully distinguish between inflated pension earnings and operating earnings, in particular in the short run (Bergstresser et al., 2006). Thus, pension discount rate is naturally a key role to cover up poor operating performance of firms, which brings up our third hypothesis.

H3: Pension discount rates are negatively related to firm profitability, e.g., firms' returns on equity (ROEs).

Note that the relationship between pension discount rate and operating performance may not be monotonic. When firms' operating performance is good, the negative relationship between corporate ROEs and pension discount rates may be nonexistent. However, such a relation is strong among firms whose operating performance is poor. As a result, there is a potential a concave relation between ROE and pension discount rates. To capture this, we additionally include squared ROE in the regression, and expect a positive relationship between pension discount rate and the squared ROE.

Moreover, based on Eq. (1), the larger the underfunded proportion is, the more contributions to pension plan are made, and vice versa, consistent with the Pension Protection Act of 2006 under which there is likely to be a more direct relationship between the funded status of a company's pension plans and its required pension contributions. Specially speaking, firms with well-funded plans (PA is greater than 80% of PL) will probably not see a meaningful change in their required contributions; and firms with under-funded plans (PA is between 65% and 80% of PL) will face larger increases in their required pension contributions; and firms with "at-risk" plans (PA is less than 65% of PL) will likely see a significant increase in pension contributions. Normally, many firms will experience an increase in volatility of required pension contributions if the funded status of their pension plans remains volatile (Moody, 2006).Take Well Star for example, from fiscal 2001 to 2011, the average annual payment into the fund was about $17 million due to underfunded pension plan, said David Anderson, its executive vice president of human resources. And in fiscal 2012, because of low pension discount rate, the contribution soared to $50 million.

Therefore, firms with lower pension contributions may have greater incentive to take higher pension discount rates. Thus we have the following hypothesis:

H4: Pension discount rates are negatively related to pension contributions (CONT), all else equal.

Some manipulations of Eq. (1) gives rise to the following expression:

$$PFD_t = PA_t - PL_t$$

$$= PA_{t-1} * (1 + AR_t) + CONT_t - PL_{t-1} - \Delta PL_t$$

$$= PFD_{t-1} + PA_{t-1} * AR_t + CONT_t - \Delta PL_t \quad (2)$$

All else being equal, a higher pension discount rate set in year t result in lower ΔPL_t. Therefore, Eq. (2) has the following cross sectional implications:

- Lower PFD_{t-1} firms set a high discount rate
- Firms with a lower pension asset return would set a high discount rate
- Firms with greater change in service cost and interest costs would set a higher discount rate.

Indeed service cost[8] and interest cost[9] are in general most components of ΔPL. Without any change in discount rate, service cost generally increases 2%-10% from year to year due to the methods used to value the plan and aging of the population, and correspondingly interest cost component will typically increase between 5% and 12% (Waite,2015)

The second point above is addressed in Hypothesis 2. Based on the above, firms are expected to take some actions in order to avoid the underfunded pension plans in light of regulations and impacts. This expectation should become much stronger if it has an experience of underfunded. We therefore have the following hypothesis:

H5: Pension discount rates are negatively related to $PFD_{t-1,}$ but positively associated with service costs (SCOST) and interest costs (ICOST).

[8]Service cost is the portion of the present value of participants' accrued benefits that is attributable to having worked during the year. A 25-basis-point drop in discount rate is expected to increase service cost by additional 3% to 5% (Waite, 2015).

[9]Interest cost is the cost of the plan due to the passage of time, calculated by multiplying the PBO by the discount rate. For generalized estimation purposes, the interest cost will be unchanged for variation in discount rate (Waite, 2015) .

Finally, investors are typically restricted from investing in non-investment grade bonds, which makes firms at the border of investment grades and non-investments to have high incentives to manipulate their earnings as well as their pension discount rates. This gives rise to the last hypothesis of the study.

H6: Pension discount rate is related to bond rating (THRESH).

IV. Data

Data for pension discount rates and financial status as well as firm characteristics are from COMPUSTAT. In fact we combine two data sets of COMPUSTAT, Pension Annual and Fundamentals Annual in our analysis by firm name and year. The sample period is from 1991 to 2014. The data for pension discount rates in earlier years is noisy thus excluded.

We start with pension discount rate firms with zero or missing value of which are deleted over the sample period, resulting in the observations of 48,415. The rule to judge the firm sponsoring defined benefit (DB) pension plan is that both PA and PL jointly exist, where PA, the fair market value of plan assets, is calculated as the sum of COMPUSTAT data items PPLAO (data for overfunded pension plans) and PPLAU (data for underfunded pension plans), and PL, the projected pension liabilities, is calculated as the sum of PBPRO and PBPRU. PFD in Eq. (1) and Eq. (2) is the difference between PA and PL, denoting the pension funded status. The key variable pension discount rate (DR) is directly from COMPUSTAT data item PBARR (data for firms with DB pension plan)

The descriptive statistics of the variables are reported in in Table 1. Apart from mean, median and Standard deviation of all the variables employed in our paper, their variance, skewness and kurtosis are also performed, which have more information on the distributions. To be specific, the average firm-year pension discount rate (DR) is 6.359 percent, and the median is 6.500 percent higher than the mean, indicating that the higher pension discount rates are, the bigger their frequency seems, which is basically supported by the evidence from the positive skewness of 0.561. Different from pension discount rates, interest rate (INT) denoted by seasoned Aaa bond yield from Federal Reserve monthly has much higher mean of 6.065 percent than its median of 5.790 percent. Note that pension discount rate is higher than interest rate regardless of mean and median. It is also true when the standard deviation of them is compared, which means that the volatility of pension discount rate is stronger.

The average pension asset return in our sample is 0.062, with an annual operating return (ROE) of 0.116. The more important, most of firms in our sample, on average, are underfunded with pension funding (PFD)'s mean and median of -0.539 and -0.152, respectively. Moreover, its variance and kurtosis seem extremely large, which indicates the difference mainly focusing on pension status among firms should attract more attention seriously. The mean and median of pension contributions as well as service cost and interest cost are always positive, consistent with common sense. It is also worth mentioning that, for a typical firm, the 6.726% of total asset exist in the pension section. In addition, the average firm age, calculated as the time between the first appearing in the Fundamentals Annual section of COMPUSTAT and the contemporaneous pension status observations (consistent with other pension data in the same year) also in the Pension Annual of COMPUSTAT, is 23.869 years. The mean of financial leverage is 67.6%, seeming a bit higher but in the control, with the EPS of 0.308 during the sample period.

V. Results

V.1 Evidence on Aggregate Pension Discount Rates over Time

Table 2 reports that the number and various statistics of corporate pension discount rates in each year. Among all the firms with DB pension, the number of pension discount rate increases modestly from 1600 in 1991 to 1781 in 2014. The bigger with more than 2200 during 2002 through 2006. Regardless of the mean and median of pension discount rate yearly as well as other percentiles such as 25th percentile and 75th percentile, the trend over time is totally declining, but in curious contrast the opposite is true for the standard deviation. Just to be specific, in and after 2007, the cross sectional standard deviation of pension discount rates is higher than that in the period before the financial crisis, though the means of pension discount rates are lower than those before the financial crisis.

We first plot the pension discount rates over time. As illustrated in Figure 1, pension discount rates typically lie between the average seasoned Aaa bond yield and the average seasoned Baa bond yield. This pattern is in line with the regulation binding the pension discount rate practice. The discount rate is more close to the average yield of Aaa bonds before year 2007 (the recent FC), but it is distanced from the AAA rated bond yield afterwards (called as post-FC), particularly in year 2008 where the spread between pension discount rate with Aaa rated bond yield is dramatically large. This indicates that firms on average set more a much higher discount rate in

the crisis period based on our finding.

Next, we analyze the determinants of deviations of pension discount rates from the yields of AAA bonds. We evaluate the deviation with the cross-sectional standard deviation and semi-variance of the difference between pension discount rates in each year and regress them on various macroeconomic variables. The macroeconomic variables include short-term interest rate, term premium, default premium, aggregate dividend yield, the aggregate earnings-to-price ratio in year t, denoted by TB, TERM, DEF, DIV, and EP, respectively. We use the one-month T-bill yield as the short-term interest rate. The term premium is the yield spread between the 10-year T-bond and one-month T-bill. The default premium is the average yield spread between Moody's Baa-rated and Aaa-rated corporate bonds. The aggregate dividend yield and earnings-to price ratio are based on the S&P 500 index. The variables are from the Global Insight database. The result is reported in Table 3.

We find that the standard deviation and semi-variance of the spreads between pension discount rates and the average yield for Aaa bonds are both statistically significantly negatively associated with T-bill rates, term premium and earning price ratios, but still significantly positively correlated with default premium and dividend yield. These signs indicate pension discount rates are correlated with the macro economic conditions. Thus, firms and/or their pension managers do take advantage of some of publicly available macroeconomic information when they adjust their pension discount rate if permitted. But they don't solely rely on those macroeconomic variables to choose pension discount rate. That is, firms and/or pension managers may possess micro information more closed to their pension status beyond what is contained in the five macro variables. Identifying such information of this kind remains a more valuable task.

V.2 Cross Sectional Variations in Pension Discount Rates

We first look into the conditional distributions of yield spreads between the pension discount rates and AAA bond yields in different periods. To do so, we pool all the observations together and sort them into decile groups based on yield spreads. Firms in the D1 group has the lowest spreads and firms in the D10 group has the highest spreads. We then categorize our sample years into before and after the financial crisis, corresponding to years before 2007 and years after 2009. We look at how the observations distribute in the decile groups given a specific year category. Plotted in Figure 2, for the "post-crisis" group, over 30 percent of observations during reside in

the D10 group while roughly 7 percent of the observations are in the D1 group. The distributions are relatively flat before the financial crisis. The evidence is consistent with the conjecture that firms during FC typically are more likely to set a higher discount rate even if interest rate is extremely declining.

We look into the specific drivers for the yield spreads with panel regressions. Our tests are in line with Eq. (1) and Eq. (2). Consistent with the finding of Figure 2, Table 4 presents the regression results along with three subsamples sorting by FC. Shown in Column (1) when the full sample period is included, there is a positive relation between pension discount rate and interest rate at the significant level of 1 percentage. Moreover, the relationship during and after FC in Column (3) and (4) is highly closed with the coefficients of 0.870 and 0.636 respectively bigger than of 0.605 over the full sample period. Together any increase in INT will bring a significantly positive impact on pension discount rate, inconsistent with our H1 but implies most of firms are more likely to obey the rule of regulation. Actually this result of regression is easily accepted. That is, pension discount rate should be in line with market interest rate in principle, not pretty sure whether it works anytime, in particularly when market interest rate is very low.

Further in Table 4, we report the coefficients of other explanatory variables as well. As for pension asset return denoted by AR ever shown in Eq. (1) and Eq. (2) whose relationship with pension discount rate is all significantly negative regardless of the full sample period and subsample periods. Similar to INT, the effects of AR during and after FC are much higher than before FC, doubtlessly and typically supporting our H2. However, the converse arises for the squared item making the positive impact on pension discount rate before and after FC. That is, the increase of one unit in AR before FC brings up the change of -0.136+2*0.023*AR in pension discount rate given a particular time; accordingly after FC it is -0.320+2*0.005*AR as well. Obviously, we can see that the above change in pension discount rate is negative only if AR is less than 2.956 (32) before (after) FC larger than the mean of AR, to some extent further consistent with our H2. What's more, the effect becomes significantly negative at the level of 1 percentage during FC regardless of AR and its squared item, indicating the effect of AR on pension discount rate in the same period is more severe. It is by nature more likely to be underfunded when pension asset return is very low. In light of avoidance of the terrible occurrence, one underlying approach employed is to adjust pension discount rate. It seems fine and beneficial for the firms only if no other outsiders know more about this issue. That is why the relation between pension asset return

and pension discount rate is generally negative, being more obvious and common after FC.

Different from AR, ROE and its squared item don't have a significant impact on discount rate in most cases, but the effect of ROE is still significantly positive in the full sample, not supporting our H3. The performance of firms mainly consists of operating and non-operating performance. Therefore, for the outside investors knowing about the firms from the financial statements, any movement from one part to other part is not easy to be identified. Moreover, we intend to assume that the manager realizes this and prefers to choose the tricky to serve for their goals. That is, firms would have used some tools such as pension discount rate to make non-operating performance polish firms' ultimate performance which is really cared about by wide-ranging investors. However, this understanding and/or assumption failed to be gotten any evidence from our regression result.

Firms' contributions to pension plans are negatively correlated with pension discount rate, particularly significantly during FC, consistent with H4. More contributions to pension plans allow the firms to pay off their obligations gradually, no hurry to use the tools like pension discount rate quickly to achieve the purpose of positive pension funded status given a special period. On the contrary, if so, it is likely to set the lower pension discount rate in order to keep the certain space for the future adjustment.

As noted in Table 4, pension funded denoted by PFD and its squared item are significantly positively related to pension discount rate before and during FC, but the effect of PFD over the full sample period is significantly negative, partially supporting our H5. To be clear, the lagged pension funded serves as a signal of choosing the appropriate pension discount rate. In general, the worse the firm's PFD seems, the more likely pension discount rate set in the following year slightly increases. The reason is almost similar to the H2.

Apart from PFD, service cost and interest cost are also significantly positive during FC, thus H5 is supported in part as well. It seems that service cost is more inclined to be negatively associated with pension discount rate, particularly over the full sample and after FC, almost consistent with Waite (2015) but interest cost is positive after FC. By the definitions of service cost and interest cost actually, they should impose different impacts on pension funded status as well as pension discount rate. Based on the result, the higher interest costs are, and /or the lower service costs become, the higher pension discount rate is assumed.

We use PCT, SIZE, AGE, LEVERAGE, and EPS as control variables. As reported in Table

4, we find that AGE, LEVERAGE and EPS are significantly positively related to pension discount rates. This result is more pronounced during the financial crisis, suggesting that the older the firm is and /or the higher its financial leverage is employed and /or earning per share is earned, the more likely the discount rate is set to be higher. As for SIZE, it varies over the sample, making a significantly positive impact on pension discount rate before FC but it is negative during and after financial crisis when small firms are in particularly urgent to achieve the goal of overfunded pension status. The remaining variables have no significant impacts on pension discount rate. Despite so, it is necessary to control them to make sure the conclusion is persuadable, not limited to endogeneity problem.

How would firms' credit ratings affect their pension discount rate decisions? In the last set of analysis, we further look into the last hypothesis regarding credit ratings of a firm and its pension discount rate choice. Specifically, we sort firms into two groups based on the rating. Dummy variable THRESH is 1 if a firm' S&P Domestic long term credit rating is BBB or BB, otherwise it becomes zero. Doing this is to test whether firms of lower credit rating are more likely to manipulate pension discount rate. Table 5 present the corresponding regression result.

Relative to firms with high credit ratings, firms at the border of investment and non-investment grades have more incentive to manipulate pension discount rates. The finding is consistent with this conjecture – we find that the coefficients on the interactions between THRESH and each of the key individual explanatory variables typically are significant and they have the same signs as the coefficients on the individual explanatory variables in most cases. This finding suggests the stronger pension discount rate manipulation for firms with a threshold rating occurs, basically supporting our H6. As noted, compared with firms of high credit rating, firms with relative low credit ratings have the higher coefficients of INT and AR, both of which are binding closely with pension discount rate, inconsistent with H1 and consistent with H2 again. The same as Table4, Table 5 shows no significant impact of ROE on pension discount rate either, still not supporting our H3. It is worth deserving that CONT during FC is indeed significantly negative although firms with relative low credit rating show a relatively weak effect, still supporting our H4. Moreover, PFD and its squared item are still significantly positively related to pension discount rate before and during FC, consistent with Table 4 and inconsistent with our H5. Similarly the impact of interest cost for the above firms attracts more attention over the sample period, in part supporting our H5. Lastly, in most cases, no obvious distinction in both groups for controlling

variables with the exception of AGE (LEVERAGE) after (before) FC occurs.

In sum, the findings are generally consistent with the hypotheses highlighted in section 3. The misuses of pension discount rates appear to be mainly determined by corporate characteristics rather than macroeconomic information except the financial crisis.

VI. Conclusion

Defined benefit pension plans are notoriously inflexible. Interestingly, the supermajority of S&P 500 firms use DB pension plans. In this study, we provide an extra source of benefit of DB pension (in addition to the conventional benefits documented in the literature, such as increasing employee retention rate and improve productivity) – there is ambiguity in the regulation of pension discount rate assumption, which provides leeway for firms to manipulate their pension contributions.

We find that a significantly larger number of firms fail to increase the pension discount rates when interest rates went down during and after the financial crisis, in line with the assumption firms manually inflate their earnings through setting a relatively high pension discount rate. Moreover, we find that the pension discount rate manipulation is intensive among firms with poor operating performance and those experiencing bad investment returns and pension service costs are high. These findings further reinforce the pension discount rate manipulation hypothesis.

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Table 1：Summary Statistics

This table reports the characteristics of pension discount rate and financial status as well as the firms in the sample. DR is the pension discount rate used to discount pension obligations. INT is the average rate for all Aaa bonds. AR is pension asset return. ROE is the return on asset of an individual firm. PFD is a firm's pension funding in year t-1, evaluated as the difference in PA and PL scaled by pension asset. CON, SCOST, and ICOST are total pension contributions and voluntary pension contributions made to a firm's pension plan, service cost and interest cost to pension plan all scaled by pension asset as of year t-1, respectively. PCT is the ratio of a firm's pension assets to its total assets. AGE is the life of firms being included in COMPUSTAT, where the firm life is defined as the time between the first appearing in the Fundamentals Annual section and the corresponding reported pension funded status (consistent with other pension data in the same year) in the Pension Annual section of COMPUSTAT, varying over time. A little different from other literature, Size is measured by natural logarithm of firm market value more reflecting the current state rather than total asset. LEVERAGE is defined as financial leverage, which is total liability divided by total asset. EPS is also natural logarithm of diluted earnings per share. The sample period is from 1991 to 2014. "Stdev" denotes the standard deviation in cross-sectional data.

Variable	Mean	Median	Stdev	Variance	Skewness	Kurtosis	N
DR	6.359	6.500	1.547	2.393	0.561	17.736	48415
INT	6.065	5.790	1.329	1.768	0.027	2.164	48415
AR	0.062	0.082	0.421	0.177	-57.681	11846.190	27760
ROE	0.116	0.115	7.722	59.623	36.638	9865.781	45547
PFD	-0.539	-0.152	45.785	2096.231	97.819	22434.280	44961
CONT	0.137	0.052	2.610	6.811	85.427	8362.840	27618
SCOST	0.108	0.034	3.395	11.524	106.888	13426.930	41675
ICOST	0.110	0.072	3.402	11.574	15.259	10561.470	41649
SIZE	0.129	0.063	0.512	0.263	93.008	10615.590	47216
PCT	6.726	6.829	2.291	5.247	-0.304	3.344	38578
AGE	23.869	20.014	16.961	287.688	0.488	2.098	48415
LEVERAGE	0.676	0.655	0.439	0.193	34.694	2264.501	48348
EPS	0.308	0.457	1.186	1.408	-0.214	9.142	32156

Table 2: Summary Statistics

This table presents the distributions of corporate pension discount rates in each year. Again, the standard deviations are higher in years after 2006. "St dev" denotes the standard deviation of pension discount rate in each year.

Year	Mean	St dev	10%	25%	Median	75%	90%	N
1991	8.30	0.798	7.50	8.00	8.50	8.60	9.00	1600
1992	8.16	0.780	7.50	8.00	8.20	8.50	9.00	1935
1993	7.51	0.740	7.00	7.00	7.50	7.80	8.25	1998
1994	8.03	0.742	7.20	7.50	8.00	8.50	8.75	2019
1995	7.51	0.996	7.00	7.25	7.50	7.75	8.25	1982
1996	7.53	0.675	7.00	7.40	7.50	7.75	8.00	2001
1997	7.28	0.598	7.00	7.00	7.25	7.50	7.90	1928
1998	6.82	0.658	6.50	6.75	6.75	7.00	7.25	1903
1999	7.32	0.852	6.50	7.00	7.50	7.75	8.00	1878
2000	7.33	0.839	6.50	7.00	7.50	7.75	8.00	2035
2001	7.05	0.864	6.20	7.00	7.25	7.44	7.50	2030
2002	6.63	0.868	6.00	6.50	6.75	7.00	7.25	2258
2003	6.10	0.825	5.50	6.00	6.25	6.25	6.50	2271
2004	5.81	0.890	5.25	5.75	5.80	6.00	6.25	2265
2005	5.44	0.975	4.63	5.25	5.50	5.75	5.90	2247
2006	5.58	0.930	4.70	5.25	5.75	5.95	6.00	2229
2007	5.91	1.024	5.05	5.64	6.00	6.26	6.50	2133
2008	6.20	1.159	5.40	6.00	6.25	6.52	7.13	2076
2009	5.87	1.171	5.10	5.60	5.89	6.10	6.75	2027
2010	5.34	1.066	4.65	5.10	5.40	5.60	5.95	1977
2011	4.78	1.159	4.00	4.40	4.75	5.10	5.57	1963
2012	4.09	1.752	3.25	3.70	4.00	4.25	4.61	1932
2013	4.56	1.027	3.61	4.30	4.70	4.90	5.10	1793
2014	3.90	1.120	2.75	3.70	4.00	4.20	4.50	1781

Table 3: Macroeconomic Determinants on the standard deviation and semi-variance of Spreads of Pension Discount Rate and Aaa bond Yields

This paper reports the result of contemporaneous regressions of the standard deviations of the spreads between the pension discount rates and the average yield of Aaa bonds along with semi-variance. The explanatory variables, TB, TERM, DEF, DIV, EP respectively denote short-term interest rate, term premium, default premium, aggregate dividend yield, aggregate earnings-to-price ratio in year t, respectively. We use the one-month T-bill yield as the short-term interest rate. The term premium is the yield spread between the 10-year T-bond and one-month T-bill. The default premium is the average yield spread between Moody's Baa-rated and Aaa-rated corporate bonds. The aggregate dividend yield and earnings-to price ratio are based on the S&P 500 index. The coefficient estimates capture the effects of macro-variables on the distribution of pension discount rate. The T-values for these coefficients are reported in the parentheses underneath. "Stdev" and "Svar" denote the cross-sectional standard deviation and semi-variance, respectively.

	Mean(Spread)	Stdev	Svar
INTERCEPT	0.149	0.833***	0.147***
	(0.42)	(6.84)	(3.02)
TB	-37.84	-100.662***	-42.006***
	(-0.69)	(-5.80)	(-5.73)
TERM	-3.88	-15.619***	-6.751***
	(-0.43)	(-4.57)	(-4.65)
DEF	37.02*	28.631***	12.842***
	(1.87)	(4.47)	(4.92)
DIV	-38.01	683.488**	352.709***
	(-0.24)	(2.86)	(3.15)
EP	-5.72	-43.008**	-24.146**
	(-0.43)	(-2.46)	(-2.88)

Table 4: Determinants of Pension Discount Rates

This table reports the panel regression results. In addition to the full sample, with a breakdown according to FC, we construct three subsamples similar to Figure 2. The dependent variable is the pension discount rate. The explanatory variables and their meaning are well explained in table 1. The coefficient estimates do capture the effects of micro variables highly correlated to the firm's conditions on the pension discount rate set. The T-values for these coefficients are also reported in the parentheses underneath. The time fixed effect is considered.

	(1) Full sample	(2) Before FC	(3) During FC	(4) After FC
INT	0.605***	0.442***	0.870***	0.636***
	(34.26)	(20.10)	(13.37)	(25.82)
AR	-0.050***	-0.136***	-0.792***	-0.320***
	(-3.74)	(-2.95)	(-10.48)	(-3.50)
AR^2	0.000	0.023**	-0.078***	0.005**
	(1.43)	(2.39)	(-4.29)	(2.11)
ROE	0.003*	0.002	0.004	0.001
	(1.88)	(0.77)	(0.75)	(0.51)
ROE^2	-0.000	-0.000	-0.000	-0.000
	(-1.12)	(-0.61)	(-0.21)	(-0.25)
PFD	-0.005*	0.009*	0.283***	0.007
	(-1.85)	(1.91)	(7.33)	(1.13)
PFD^2	-0.000	0.000**	0.004***	-0.000***
	(-1.60)	(2.09)	(5.65)	(-3.76)
CONT	0.007	0.002	-0.495***	0.006
	(0.80)	(0.27)	(-4.15)	(0.32)
SCOST	-0.013**	-0.001	0.536***	-0.075**
	(-2.26)	(-0.20)	(3.38)	(-2.08)
ICOST	0.010	0.006	1.021***	0.414***
	(1.02)	(0.37)	(4.82)	(3.85)
PCT	0.030	0.046	-0.404	-0.284**
	(0.60)	(0.73)	(-1.35)	(-2.22)
SIZE	-0.010	0.020*	-0.148***	-0.068***
	(-1.25)	(1.91)	(-4.17)	(-2.84)
AGE	-0.157	-0.118	1.657*	0.115
	(-1.47)	(-0.92)	(1.73)	(0.55)
LEVERAGE	0.113***	-0.042	0.319***	-0.112
	(3.12)	(-0.82)	(2.96)	(-1.11)
EPS	-0.000	-0.009	0.038**	0.001
	(-0.03)	(-1.50)	(2.10)	(0.15)
Intercept	5.746***	6.465**	-43.872*	-0.481

	(2.87)	(2.36)	(-1.65)	(-0.08)
Dummy year	Y	Y	Y	Y
RSQ	0.817	0.827	0.274	0.701
F-Statistics	2064.658	1278.674	40.599	499.441
N	17915	8864	3347	5704

Table 5: The regression additionally including Interaction of Explanatory Variable and a Dummy for Firms close to Thresholds

The table reports the result of the regressions similar to table 4 while including the interaction of a threshold dummy and the explanatory variables. The dependent variable is also the pension discount rate. We consider firms with a S&P long term credit rating of BBB and BB to be threshold firms.

	(1)	(2)	(3)	(4)
	Full sample	Before FC	During FC	After FC
INT	0.619***	0.430***	0.593***	0.643***
	(34.54)	(19.30)	(7.61)	(24.55)
THRESH	-0.142	-0.204	-2.518***	0.145
	(-1.33)	(-1.46)	(-3.64)	(0.60)
INT* THRESH	0.019**	0.041***	0.404***	-0.014
	(2.26)	(3.27)	(3.60)	(-0.61)
AR	-0.374***	-0.174***	-0.922***	-0.227
	(-9.25)	(-3.03)	(-10.80)	(-1.60)
AR* THRESH	-0.103*	0.039	-0.246*	-0.263
	(-1.83)	(0.50)	(-1.92)	(-1.30)
AR^2	-0.007***	0.034	-0.089***	-0.094
	(-4.74)	(0.49)	(-4.02)	(-0.90)
AR^2* THRESH	0.014***	-0.030	0.378**	0.101
	(7.05)	(-0.43)	(2.04)	(0.96)
ROE	0.002	0.000	0.004	0.001
	(1.12)	(0.03)	(0.66)	(0.24)
ROE* THRESH	0.001	0.007	0.006	0.001
	(0.24)	(0.98)	(0.38)	(0.19)
ROE^2	-0.000	0.000	-0.000	-0.000
	(-0.58)	(0.07)	(-0.23)	(-0.19)
ROE^2* THRESH	0.000	-0.000	0.000	-0.000
	(1.05)	(-0.80)	(0.89)	(-0.15)
PFD	-0.003	0.011*	0.906***	0.013
	(-0.76)	(1.73)	(12.55)	(0.91)
PFD* THRESH	0.014**	0.020	-0.366***	0.022
	(2.17)	(1.12)	(-4.71)	(1.19)
PFD^2	-0.000	0.000*	0.060***	-0.000
	(-0.98)	(1.89)	(10.75)	(-0.30)
PFD^2* THRESH	-0.000***	0.000	-0.053***	-0.000
	(-7.53)	(1.10)	(-9.57)	(-0.91)
CONT	-0.006	0.004	-0.607***	0.160**
	(-0.57)	(0.53)	(-4.08)	(2.20)

CONT* THRESH	-0.015	-0.043	0.590***	-0.150**
	(-0.70)	(-1.05)	(2.58)	(-1.97)
SCOST	0.000	-0.005	0.720***	-0.256***
	(0.01)	(-0.59)	(3.71)	(-2.68)
SCOST* THRESH	-0.100***	-0.004	-1.234	-0.444
	(-4.59)	(-0.11)	(-1.59)	(-1.39)
ICOST	0.031*	0.002	0.321	0.387***
	(1.83)	(0.13)	(1.23)	(2.89)
ICOST* THRESH	0.671***	0.219	0.656	0.451
	(7.37)	(1.52)	(0.78)	(1.57)
PCT	0.063	0.069	-0.734**	-0.231
	(1.19)	(1.07)	(-2.13)	(-1.47)
PCT* THRESH	-0.007	-0.067	0.166	-0.131
	(-0.12)	(-0.85)	(0.40)	(-0.89)
SIZE	-0.003	0.014	-0.153***	-0.055**
	(-0.42)	(1.25)	(-3.95)	(-2.19)
SIZE* THRESH	0.001	0.015	0.012	-0.031
	(0.14)	(1.36)	(0.29)	(-1.40)
AGE	-0.155	-0.104	1.324	0.101
	(-1.45)	(-0.81)	(1.43)	(0.48)
AGE* THRESH	0.001	-0.001	0.001	0.006***
	(1.48)	(-1.29)	(0.33)	(3.30)
LEVERAGE	0.129***	-0.028	0.325***	-0.103
	(3.22)	(-0.50)	(2.76)	(-0.94)
LEVERAGE* THRESH	-0.056	-0.150*	0.052	0.049
	(-1.03)	(-1.74)	(0.44)	(0.32)
EPS	0.002	-0.002	0.037	0.008
	(0.36)	(-0.27)	(1.62)	(0.72)
EPS* THRESH	-0.007	-0.018	-0.022	-0.023
	(-0.80)	(-1.61)	(-0.67)	(-1.19)
INTERCEPT	5.594***	6.263**	-33.072	-0.199
	(2.81)	(2.29)	(-1.28)	(-0.03)
DUMMY YEAR	Y	Y	Y	Y
RSQ	0.819	0.828	0.327	0.703
F-Statistics	1405.896	781.969	26.698	272.903
N	17915	8864	3347	5704

Figure 1: The figure shows the relationship between discount rate and bond yield during 1991 through 2014. The average annual yields of Aaa and Baa corporate bonds (Moody's ratings) are obtained from Federal Reserve System.

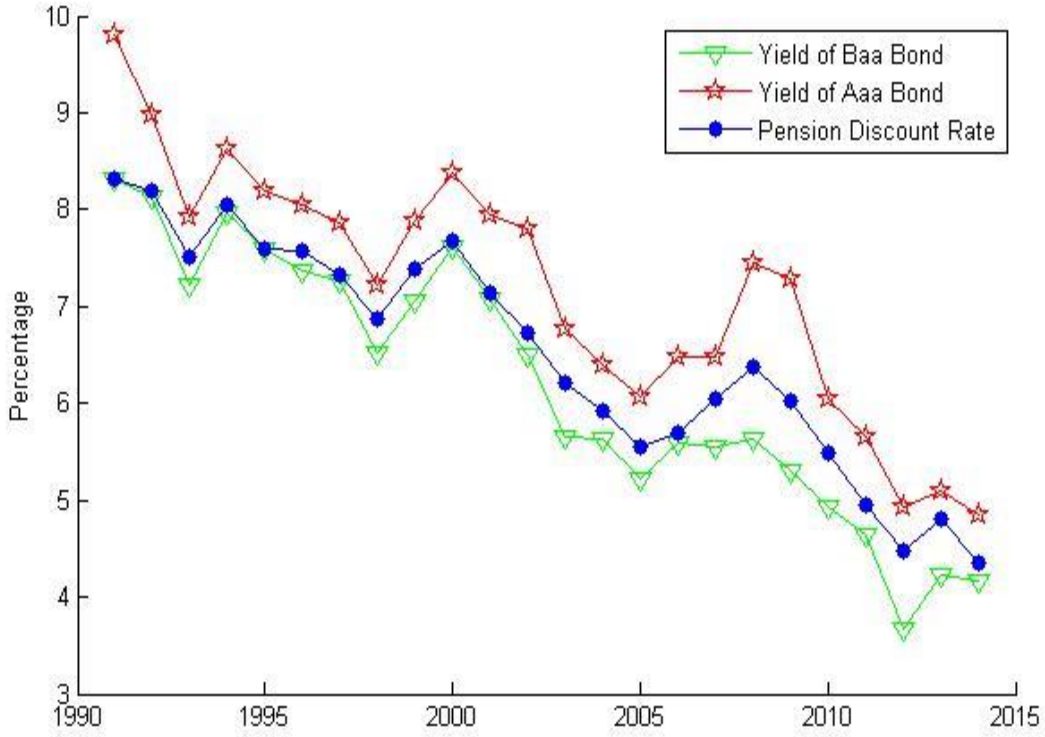

Figure 2: This figure shows the distribution of the spreads between the pension discount rates and the average yield of Aaa bonds across the decile groups sorted by the spreads pre- and post-crisis. FC denotes financial crisis, which always works below.