Do Pension Deficits Affect the Expected Growth Implied by Analysts' Forecasts of Earnings and Stock Prices?

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ABSTRACT

Pension liabilities are debt equivalent obligations. While pension contributions and pension deficits may not necessarily affect a company's capital expenditure depending on its dividend policy and employees' wage bargaining power, we find that pension deficits have severe negative impact on companies' expected future growth. Our results show that the extent and effects of pension deficits depend on a company's profitability, non-working cash holdings and financial constraints as well as the actuarial assumptions the company applied. Our findings have policy implications for companies in managing their pension deficits and strategic investment and financial decision-making.

JEL classification: J32, G32.

Keywords: Pension deficit; Expected growth; Profitability; Financial constraints; Non-working cash

I. Introduction

The funding status of defined benefit (DB) pension plans in the US and other developed countries has deteriorated in recent years. About three-quarters of all public companies in the US are in pension deficits in 2018. The increased pension contributions and pension deficits immensely constrain companies' financial flexibility and investment activities, and even affect their daily operations.[1] A substantial literature in finance and accounting studies the effects of defined benefit pension plans on corporate valuation and strategic decision-making over the last two decades. Yet, the mandatory pension contributions and the potential distress caused by pension deficits on companies' *expected* growth are overlooked in academic research. In this paper, we address the extent to which pension deficits affect companies' expected growth.

Various measurements of corporate growth have been employed in the extant literature. Ex post asset growth, sales growth, and capital expenditure, for instance, are used as proxies for a company's growth. On the one hand, it is understandable that ex post growths have limited explanatory power for predicting future economic outcomes due to unexpected events. On the other hand, pension deficits may affect the ex post growth and expected growth through different channels. High pension deficits do not necessarily mean low capital expenditure. Large pension deficits may increase pressure to employees on their pay or wage bargaining. Should wages be reduced, firms may have more capital to investment in expenditure (Benmelech, Bergman, and Enriquez (2012)). Cutting current dividend payments is another way of releasing funds to maintain capital expenditure (Liu and Tonks (2013)). These corporate decisions, however, may have adverse effects on the market expectation on companies' future growth. After all, it is the expected growth rate that is one of the companies' key value drivers, and hence is important for management strategic decision-making. Therefore, we are particularly interested in the relationship between DB pension deficits and the expected future growth. The expected growth rate is, unfortunately, not observable. In this paper, we develop a novel approach to estimate firm-specific expected growth rate implied from analysts' forecasts of future earnings and stock prices as well as industry-wide information all available at the current period. That is, the expected growth is induced by the

[1] Glen A. Barton, the chairman and chief executive of Caterpillar and a member of the Business Roundtable, once wrote "companies cannot commit to building new plants, launching new research projects or hiring new employees if that cash is needed to fund pensions." (M. W. Walsh, The New York Times, June 22, 2003)

market perception of the company's growth. Since current stock price reflects all expected future cash flows for a going concern, we view this growth rate as a company's average long-term growth rate.

Our interest is in defined benefit (DB) pension plans, which promise a specific payment after an employee retirement.[2] The amount of promised payment is usually determined by the employees' working age, final salary and expected longevity. It can be regarded as a long-term debt-equivalent obligation to shareholders. To ensure the solvency of a company's defined benefit pension plan, regulators need to constantly monitor the company's funding status. For the sake of external investors, pension laws set strict requirements about the pension information releasing. The sponsors of defined benefit pension plans are required to file the Form 5500 with details of pension information. Due to the time lag, the source of the pension-related information to all stakeholders comes from companies' financial statements. The pension accounting rules require that the relevant financial statements must provide complete and up-to-date information for stakeholders' economic decision-making. For this purpose, the Statement of Financial Accounting Standards (SFAS) No.87 requires companies to disclose the components of net pension costs, projected benefit obligation, the cost of pensions over employee's service periods and a minimum liability to stakeholders to help them to understand the pension plan's true status in a timely manner. Accordingly, pension plan assets are measured in the fair value and the present value of pension obligations are estimated based on some explicit actuarial assumptions. Pension deficits that reflect a company's pension plan funding status are the difference between the projected benefit obligations and the value of pension assets. Specifically, the pension deficit is defined as the difference between the estimated present value of all future vested or non-vested pension benefits and the fair value of pension assets. Therefore, pension asset returns and actuarial assumptions are two of the important determinants of pension deficits.

The U.S. Pension Protection Act of 2006 regards the pension plan with a 100 percentage funding status as full-funded. If the plan is fully funded, sponsors are only required to fund the new accrual pension benefits during the year. In contrast, firms with pension deficits need to amortize their deficits over the next several years and their annual pension contributions must meet a legal minimum requirements. The amount of minimum pension contributions is determined by the prior-

[2] Companies' pension plans can generally be categorized as the defined benefit and defined contribution plans.

period's pension deficits. In addition to the mandatory pension contributions, the pension plans with deficits are required to pay a higher level of insurance fees to the Pension Benefit Guaranty Corporation (PBGC). Thus, if a company has pension deficits in the current period, it is more likely to be exposed to cash pressure in the near future and may have an adverse effect on their operating activities.

As an important non-operating activity, defined benefit pension plans have been documented to be integrated into companies' overall investment and financial policies. For instance, prior literature suggests that decisions on capital expenditure, overall capital structure and investment choice are associated with the funding status of a company's defined benefit pension plan. Rauh (2006) documents that mandatory pension contributions reduce firms' contemporary capital expenditure. He argues that the pension funding limits the available capital to be used in investments in operating activities. Shivdasani and Stefanescu (2009) find that firms consider their net pension obligations, a debt equivalent liability, when they make decisions on capital structure. Most recently, Duygun, Huang, Qian, and Tam (2018) find that the status of DB plan affects corporate investment choices between diversifying and non-diversifying investments. Jin, Merton, and Bodie (2006) suggest that a company's systematic risk (beta) is correlated with its pension asset's risk. Campbell, Dhaliwal, and Schwartz Jr (2011) find that a company's weighted average cost of capital is affected by its pension plan performance. Guan and Tang (2018) also suggest that firms incorporate employees' risk attitudes towards to pension obligations into corporate policies. Cocco and Volpin (2013) argue that the uncertainty associated with companies' pension obligations is a source of risk and acts as a deterrent when an acquirer makes a takeover decision.

While there is a direct effect of pension deficits on companies' current operating, financing and investment activities, pension plans also have implications on companies' future economic activities. Franzoni and Marin (2006) find that under funded pension plans have negative impact on companies' future earnings and cash flows. The current pension deficits are implicit capital rationing, and large deficits can cause considerable distress to the sponsors of DB pension plans. Pension funding status, therefore, may affect companies' growth expectations, particularly the expected longer-term growth. In this paper, we examine the impact of pension deficits on companies' expected growth rates implied in analysts' forecasts of earnings, stock prices as well as industry-wide information. Our results show that the pension deficits have a significant and negative effect on companies' expected long-term growth as well as short-term growth. The effect is resilient even if pension accounting is manipulated and discount rates in determining pension liabilities are artificially raised. We find that the extent to which the effect of pension deficits on a company's expected future growth depends on the company's fundamental characteristics. Firstly, profitability of the company affects the role of its pension policy. As the pension laws allow pension sponsors to make pension deficit recovery plan in some degree based on their current financial circumstance, the deficits could be amortized over next several years. Profitable companies may rationally use this leeway to delay the deficit contributions and try to minimize the impact on the current economic activities. In other words, managers of profitable companies could actively take actions to manage their pension deficits. We should, therefore, expect that the negative effect of pension deficits on expected growth is less severe for profitable companies at least in the short term. Our results confirm this intuition. Secondly, since companies with financial constrains have difficulty to raise capital from external capital markets, pension contributions and the pressure to reduce the accumulated past deficits may restrict those companies' investments in tangible and intangible assets. We expect and find that the effect of pension deficits on expected growth for companies with higher-level financial constraints is more severer than for companies with lower-level financial constraints. Thirdly, turning into a company's internal funding, if a company have sufficient non-working capital to cover predicted future mandatory pension contributions, then the pension deficits should have less influence on its normal operating activities and the expected future growth. Our evidence indeed shows that the negative effect of pension deficits on expected growth is less severe for companies with more non-working or excess cash holdings.

Establishing the relationship between pension deficits and companies' expected future growth has important implications in practice. It will help corporate managers in pension policy-making and better management of pension deficits in the interest of the company's long-term growth as well as short-term growth, which in turn will affect stakeholders value.

The rest of the paper proceeds as follows. Section 2 introduces the expected growth and estimation procedure. Section 3 presents a number of hypotheses. Section 4 describes the data of interest. Section 5 provides empirical results. Section 6 examines the robustness of our analysis. Finally, Section 7 concludes the paper.

II. Measurement of Firm-Specific Expected Growth

One may view capital expenditure (net of replacement of existing assets) as a proxy of a company's ex post growth since growth in fixed assets is supposed to expand and grow the entity and to increase future sales revenues. However, whether capital expenditure is a reasonable proxy for future growth depends on whether the investment have a positive NPV and how the capital is efficiently utilized. It also depends on which industry the company belongs to. For example, Hi-tech companies may have low capital expenditure, but they can have high growth. We motivate our study from a different angle, and aim to answer whether and how pension deficits affect a company's expected growth. Our expected growth estimates are based on the industry-wide information, in addition to firm-specific characteristics and stock market information. While pension contributions restrict actual cash available for capital expenditure and cash outflow is tangible, pension deficits are implicit capital rationing. Management has discretion over the timing and amounts of deficits to be reduced when considering new investments and the expected growth. For instance, managers could examine the trade-off between future investment benefits and costs from delaying to take actions to reduce pension deficits. In other words, managers may consider opportunity costs when they make pension policy. Therefore, pension deficits should have impacts not only on companies' ex post growth but more importantly on the expected growth, which is one of the key value drivers.

Since a firm's expected growth is unobserved, we need to estimate it from available accounting and market information. Our estimation builds on Ashton and Wang (2013), who establish an intrinsic relation between the one-period ahead earnings and fundamental accounting numbers and stock prices:

$$E_t[x_{t+1}] = \delta_1 P_t + \delta_2 x_t + \delta_3 b_t + \delta_4 b_{t-1} + \delta_5 P_{t-1}, \tag{1}$$

where x_t, b_t and P_t are the firm's earnings, book value and price at time t respectively. At the portfolio level, they show that the implied growth rate (g) and cost of capital ($r \equiv R - 1$) as well as other valuation multiples can be expressed in terms of above coefficients δ_s (s=1-5):

$$g = \frac{1 + \delta_2 + \delta_3 - \delta_5 + \sqrt{(1 + \delta_2 + \delta_3 - \delta_5)^2}}{2} - 1, \tag{2}$$

$$r = (1 + g)(1 + \frac{\delta_1 + \delta_5}{1 + g - \delta_2}) - 1, \tag{3}$$

$$\alpha_1 = 1 + \frac{\delta_4 + \delta_5}{(1+g) - \delta_2}, \tag{4}$$

$$\alpha_2 = 1 + \frac{\delta_2 - \delta_4 - \delta_5}{(1+g) - \delta_2}, \tag{5}$$

$$\lambda = \frac{(1+g)\delta_5}{(1+g) - \delta_2}. \tag{6}$$

Based on their equations (1) and (7), we can also show that one-period ahead stock returns can be written as

$$\begin{aligned} r_{t+1} &= g + (1+g)\frac{d_t}{P_t} + \alpha_1 \frac{b_t - (1+g)b_{t-1}}{P_t} \\ &+ (\alpha_1 + \alpha_2)\frac{x_{t+1} - (1+g)x_t}{P_t} + \lambda(\frac{P_t + d_t - P_{t-1} - x_t}{P_t}) + \frac{\epsilon_{t+1}}{P_t}, \end{aligned} \tag{7}$$

where $r_{t+1} = \frac{P_{t+1}+d_{t+1}}{P_t} - 1$ and d_{t+1} is dividend at time t+1. That is, one-period ahead stock returns can be written in terms of growth rate, dividend yield, abnormal growth in companies' book value, and abnormal-growth in forward earnings adjusted by an accounting conservatism term (λ).

Following Ashton and Wang (2013), we use analysts' forecasts of earnings ($feps_{t+1}$) as a proxy of market expectation of firm's future earnings and regress one-period ahead analysts' consensus forecasts of earnings on current stock price, earnings, book value, lagged book value and lagged price at the industry level. We then estimate industry-level cost of capital and other valuation parameters based on the estimated coefficients of $\delta_1 - \delta_5$ as (3)-(6). Following common industry practice, we can use industry-level valuation multiples as a proxy for those of individual firms in the industry for the purpose of valuation.

We can therefore use industry-level valuation parameters, $(\overline{\alpha}_{1,it}, \overline{\alpha}_{2,it}, \overline{\lambda}_{it}, \overline{r}_{it})$ in (7), to build a link between firm-level fundamental accounting ratios, one period ahead forecasts of earnings and expected growth as follows:

$$\begin{aligned} \overline{r}_{it} &= g + (1+g)\frac{d_t}{P_t} + \overline{\alpha}_{1,it} \frac{b_t - (1+g)b_{t-1}}{P_t} \\ &+ (\overline{\alpha}_{1,it} + \overline{\alpha}_{2,it})\frac{feps_{t+1} - (1+g)x_t}{P_t} + \overline{\lambda}(\frac{P_t + d_t - P_{t-1} - x_t}{P_t}) - 1, \end{aligned} \tag{8}$$

where $\overline{r}_{it}$ is the implied industry cost of capital. We use it as a proxy of expected one-period ahead return of individual firms in the industry based on information at time t. We can then estimate the firm-level growth rate (g) based on equation (8). We call it the implied firm-level expected long-term growth rate.

In estimating the firm-specific expected growth rate, we implicitly assume that firms within the same industry have equal cost of equity capital and valuation multiples in the same year. To eliminate the impact of outliers from our estimates of expected growth rates, we also winsorize the firm-year-specific growth rate within the industry as an additional measure. Specifically, we first estimate the standard deviation and the average value of expected firm-year-specific growth rates in an industry by using the jackknifing method. We then retain the firm-year-specific growth rate if a company's expected growth rate is in the range of the average value $\pm$ one standard deviation, otherwise we assign the growth rate to be its boundary value. We call it the modified expected growth rate.

In our model implementation, we divide both sides of equation (1) by the adjusted price in order to minimize the effect of endogenous. To increase our sample observations, we use two-year rolling window regressions and Fama and French 5-industry classification.[3]

III. Developing Hypotheses

We are interested in examining the relationship between the current DB pension funding status and companies' expected growth. The pension funding status in our paper is measured by the difference between the estimated present value of DB pension obligations and the value of DB pension assets, or pension deficits scaled by total assets. The higher value of this ratio, the worse a company's pension funding status. Note that the pension law requires sponsors to contribute their pension plans based on the prior-period funding status, and the current period pension deficits should be closely related to one-period ahead mandatory pension contributions. The higher the current period pension deficits, the lower the one-period ahead available cash for companies' investments. The shortfall in pension plan funding has shown to have negative effects on companies' economic activities and financial flexibility (Franzoni and Marin (2006); Rauh (2006)). Pension deficits may affect a company's expected growth not only because pension contributions may reduce available cash for future NPV >0 investments, but high deficits may also cause distress to investors and managers in the capital market as well as some key stakeholders. The negative effect

[3] See `https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/det_5_ind_port.html`

of pension deficits on the expected growth is also consistent with behavioral explanations. Managers of companies with severe pension deficits have more incentive to manipulate pension accounting for mitigating reported pension deficits and improving the reported corporate earnings (Bergstresser, Desai, and Rauh (2006); Picconi (2006); An, Lee, and Zhang (2014)). However, capital market participants are not fooled. As outlined above, our expected growth rate is implied by analysts forecasts of future earnings, stock prices and the industry-wide information. If management manipulates pension incomes, the company's reported earnings cannot be sustainable. Capital market would downgrade the expectation of the company's future growth. Therefore, current pension deficits may have negative effects on market perception about a company's future growth. Our first hypothesis follows.

Hypothesis 1: *Current pension deficits have a negative effect on companies' expected growth implied by analysts' forecasts of earnings and stock price.*

The extent to which a company's pension contribution affects its future growth is determined by how profitable the company is, at least in the short term. The expected growth rate in Section II is the implied firm-level expected long-term growth rate, which differs from the one-year ahead expected short-term growth rate introduced in Fama and French (2006).[4] Profitability is a key to channel tangible and intangible investments to a company's growth. One marginal dollar investment from more profitable companies will grow quicker than from those less profitable companies. On the one hand, the pension law requires that the sponsors of pension plans with deficits not only have to pay pension expenses as mandatory pension contributions during the current year, but also pay an annual deficit reduction contributions. On the other hand, managers may determine their pension policy by trading off the potential benefits from new NPV >0 investments and possible penalty to dishonour funding the DB pension plans. For more profitable companies, managers may have no incentive to adjust their current economic activities. It may be the best interest for profitable companies to delay payments to pension plans, and efficiently use scarce capital in investing profitable projects. Since pension laws allow sponsors to amortize pension deficit reduction contributions in several years, and require the company to retain pension plan full-fund status in the long term, we expect that the more profitable companies have less severe negative

[4]The one-year ahead short-term growth in Fama and French (2006) is the fitted value of asset growth rate. It will be detailed in the following analysis.

effects of pension deficits on the expected short-term growth, and the impact of pension deficits on the long-term growth is less dependent on companies' profitability. More profitable companies are also likely able to raise cheaper finance in the short term from external capital market to release the pressure from past pension deficits.

Hypothesis 2: *Profitable companies have less severe negative impact of pension deficits on the expected short-term growth.*

Since the mandatory pension contributions in the DB pension plans reduce companies' available capital for new investments, it potentially causes cash pressure for companies with high pension deficits and affects their financial and investment decision-making. Managers in companies with lower financial constraints may raise relatively cheap external capital to satisfy the capital requirements for new investments or invest strategically important tangible and intangible assets, while companies with high financial constraints may have difficulties to raise finance from external capital markets when they face cash pressure. Pension deficits have been considered as one of the financial constraints (Rauh (2006); Almeida and Campello (2007); Campbell, Dhaliwal, and Schwartz Jr (2010)). Hence current pension deficits should have more severe impact on companies' expected growth for companies with high financial constraints.

Hypothesis 3: *The effect of pension deficits on expected growth for companies with higher-level financial constraints is more severer than for companies with lower-level financial constraints.*

Pension obligations are estimated based on a number of actuarial assumptions. An artificially increased discount rate in estimating pension liabilities could substantially reduce the amount of pension deficits in financial reporting. For our purpose, we construct a number of benchmark discount rates in estimating pension liabilities. A discount rate is called aggressive if it is higher than the benchmark discount rate. If an aggressive discount rate is employed, the actual funding status will be worse than that is reported in financial statements. Our estimated long-term growth rate will capture this manipulation in estimating of pension obligations.

Hypothesis 4: *The negative effects of pension deficits on the expected growth are more severe for companies that apply aggressive discount rates in estimating pension liabilities.*

A company's holding cash is no doubt one of the main funding sources to the defined benefit pension contributions. Instead of using predicted uncertain free cash flow to reflect a company's financial flexibility (Rauh (2006); Campbell et al. (2011)), a company's present cash holding position is more relevant to the company's mandatory DB plan contributions, which is determined by the prior period's pension plan funding status. Cash holdings are often grouped into two categories in a company's fundamental and practical analysis: the working cash and non-working cash. While there is no formal definition of working cash, it is often viewed as the cash necessary for daily operating activities or on-going operations, the non-working cash, also called excess cash is mainly used to fund non-operation activities and not directly related to companies' normal daily operations. Hence, the DB pension contributions should be more sensitive to a company's non-working cash holdings. We compare a company's current non-working cash holdings with the predicted next period mandatory pension contributions based on Moody's Investors Service (2006) prediction method. If the current excess cash holdings are not sufficient to cover the mandatory pension contributions, we expect that the negative effects of pension deficits on the expected growth are more severe.

Hypothesis 5: *The negative effects of pension deficits on a company's expected growth rate are more severe if the company's current excess cash holdings are not sufficient to cover the predicted mandatory pension contributions.*

IV. Data and Sample Descriptive Statistics

Our sample includes all public companies which sponsor defined benefit pension plans in the US and covers period from 1988 to 2016. The sponsors of DB plans are required to file Form 5500 with their pension plan information. Due to the time lag of the Form 5500, the pension information in 10-K report is more direct and timely information source for the capital market participants. The Statement of Financial Accounting Standards (SFAS) No.87 requires the sponsors of defined benefit pension plans to report the pension funding status in the main body of financial statements. It leads to information on DB obligations and pension assets more accessible for external markets. Our sample period starts from 1988 to ensure that all companies comply with the new requirements and report pension relevant information under SFAS 87.

We collect all relevant pension data items from Compustat Capital IQ North American Pension

Annual database. There are two structural breaks in the accounting report rules about pension accounting items in estimating the fair values of pension assets and liabilities. The first break is from the reform of SFAS No.87, which changes the pension-related items in Compustat from 1986. The second break is the SFAS No.132, which is effective from December 1997.[5] Following Franzoni and Marin (2006), pension assets in our analysis are the sum of over-funded pension assets (PPLAO) and the under-funded pension assets (PPLAU), while the projected benefit obligations are the sum of the over-funded pension benefit obligations (PBPRO) and underfunded pension benefit obligations (PBPRU) between 1988 and 1997. After the fiscal year 1997, pension assets equal to the pension plan assets (PPLAO), and the benefit obligations equal to the projected benefit obligations (PBPRO).[6] We scale both pension assets and liabilities by dividing the company's book value of assets (AT). We delete all the observations with missing value in calculating pension deficits. Pension deficits that reflect a company's pension plan funding status are the difference between the projected benefit obligations and the value of pension assets. The higher the pension deficits, the worse the pension funding performance.

All other accounting items are collected from Compustat Capital IQ database. Prices are collected from the Center for Research in Security Prices (CRSP). Prices are adjusted for stock splitting and dividends by using the cumulative adjustment factor from the CRSP. Following prior literature, we use the adjusted price three months after the fiscal year-end to ensure that the financial statement information is fully reflected in prices in our analysis. Analysts' forecasts of earnings are from the I/B/E/S. We use the first available median consensus forecasts of earnings per share after the corresponding I/B/E/S-reported prior-year earnings announcements as one-year ahead earnings. Firm's market capitalization is the adjusted price multiplied by the number of shares outstanding. Stock returns are adjusted for the firm's delisting. The observations with negative book values (CEQ) or missing value of any used accounting items are deleted from our sample. We also exclude financial firms (SIC 6000-6999) and utilities (SIC 4900-4999). Moreover, we only include companies with at least two-year observations. In the process of constructing our

[5]SFAS No.87 requires that the sponsors of defined benefit pension plans report over-funded and under-funded pension plans separately. However, the SFAS No.132 amends this requirement and requires sponsors compound these two types of pension plans into one accounting item.

[6]After adoption of SFAS No.158, sponsors are required to calculate their pension liabilities using the projected benefit obligations instead of the accumulated benefit obligations. For consistency, we omit the potential incremental liabilities recognized on an annual report.

dataset, 1 percent at the top and bottom of relevant variables are deleted to avoid the impact of outlier. In table 1, we show the sample statistics and Pearson correlation of variables used in our analysis. g is our firm level expected growth rate, PD is the company's pension deficits scaled by the total assets. Tobin's Q is measured by the market-to-book ratio of assets, and Z is the Altman Z score. $Size$ is the log total assets and age is the company's existing period. The accruals is the company's total accounting accruals.[7]

[Insert Table I Here]

There are 16,681 firm-year observations in total in our sample. Panel A of Table 1 shows that there are around 25 percent observations with negative expected growth rate over our sample period. It also shows that about a quarter of all firm-year observations with pension surplus or negative pension deficits. The Pearson correlation shows that current period firms' pension deficits have significant negative impact on the estimated one-period ahead expected growth.

V. The Empirical Results

A. Pension deficits and companies' expected growth

In this section, we show how a company's expected growth is affected by the company's DB pension deficits. In this exercise, we control for a number of variables that have been documented to be associated with future growth of a company in prior literature. First, the Tobin's Q is widely used in corporate finance to represent a company's investment opportunities (see, e.g., Erickson and Whited (2000); Fama and French (2006); Rauh (2006); Aharoni, Grundy, and Zeng (2013); Campbell et al. (2010)). Second, the Altman-Z score has been used to measure the probability of a company's distress. Distressed firms tend to have negative expectation on future growth. Besides, Anantharaman and Lee (2014) argue that, after controlling for the operating cash flows, a distressed company is more likely to under-fund their pension plans. To improve the solvency condition, a distressed company may have strong incentive to manipulate the applied actuarial assumptions to underestimate its DB pension deficits (Amir and Gordon (1996); Bartram (2016,

[7]The total accounting accruals are the difference between earnings and operating cash flows scaled by the book value of equity

2018)). We, therefore, take a company's probability of bankruptcy into account. Third, we control for companies' size and age. Small and young firms in general grow fast. Firms that sponsor defined benefit pension plans tend to be older and larger than firms that do not (Bartram (2018)). Finally, we also control for accounting accruals. Fairfield, Whisenant, and Yohn (2003) suggest that the accruals bias the expectation of future growth, and investors fail to appreciate the difference between the accruals and the growth in long-term net operating assets.[8] The primary regression analysis is based on the following equation:

$$g_{i,t} = \beta_1 PD_{i,t} + \beta_2 Q_{i,t} + \beta_3 Z_{i,t} + \beta_4 Size_{i,t} + \beta_5 Age_{i,t} + \beta_6 Accrual_{i,t} + \epsilon_{i,t}. \tag{9}$$

That is, after controlling for the Tobin's Q, Altman-Z, size, age and accounting accruals, we examine how pension deficits (PD) affect a company's expected future growth (g) for company i in year t. We also consider industry and year fixed effects in our analysis.

Our expected growth rate (g) is estimated based on time t available information. We argue that the expected growth rate follows a mean reverting property, i.e., g evolves towards its long-term average value over time. Therefore, we also consider the lagged expected growth rate in our regression analysis, accordingly we do not consider time fixed effect. We use the system GMM method to analyze the dynamic model below:

$$g_{i,t} = \beta_0 g_{i,t-1} + \beta_1 PD_{i,t} + \beta_2 Q_{i,t} + \beta_3 Z_{i,t} + \beta_4 Size_{i,t} + \beta_5 Age_{i,t} + \beta_6 Accrual_{i,t} + \epsilon_{i,t}. \tag{10}$$

Since the sponsors of the defined benefit pension plans are required to hire pension actuary to re-estimate the pension obligations every three years based on the actuary assumptions reflecting the latest pension information, we calculate the moving average of pension deficits ($\widehat{PD}_{i,3t}$) in the prior three years to capture the historical information on pension funding status. Coronado and Sharpe (2003) and Franzoni and Marin (2006) argue that the investors are slow in impounding pension information into the valuation of companies. Therefore, we also include $\widehat{PD}_{i,3t}$ in our analysis to incorporate historical information on pension funding status and control for the influence of changes

[8] The Financial Accounting Standards Board (FASB) Statement No. 87 set forth new accrual methodology to calculate pension expenses, which affect companies' total net accruals as the constituent of earnings.

in the actuary assumptions.

$$g_{i,t} = \beta_0 \widehat{PD}_{i,3t} + \beta_1 PD_{i,t} + \beta_2 Q_{i,t} + \beta_3 Z_{i,t} + \beta_4 Size_{i,t} + \beta_5 Age_{i,t} + \beta_6 Accrual_{i,t} + \epsilon_{i,t}. \quad (11)$$

The Pension Protection Act 2006 regards a defined benefit pension plan as fully-funded if the fair value of DB pension assets at least equals the present value of pension obligations. For a fully-funded DB plan, it is only required to fund the new accrual pension service costs during the year. We note that there are about a quarter of firm-year observations with DB pension surplus in our sample, and the implications of pension deficits and surplus in a company are substantially different on the expected growth rate from various stakeholders' point of view. Therefore, we also examine a sub-sample by eliminating all firm-year observations with pension surplus. To minimize the issue of sample selection bias, we use the Heckman method to calculate inverse Mills ratio in our regression in the sub-sample. The results are shown in the following table:

[**Insert Table II Here**]

Table 2 Panel A shows how our expected growth rates are affected by DB pension deficits in the full sample and sub-sample excluding observations with pension surplus, after controlling for the Tobin's Q, Altman-Z, size, age and accounting accruals. As expected, the sub-sample shows a much stronger negative relation between the expected growth and pension deficits. Consistent with prior literature, the Tobin's Q and accruals are positively and negatively related to companies' future growth respectively, while firm size is negatively related to future growth. Panel 2 Panel B shows how the modified expected growth rates after winsorization by industry are affected by DB pension deficits in the full sample and sub-sample excluding observations with pension surplus. We use one-standard-deviation winsorization of expected growth rates based on its industry mean value. That is, we set all firm-year growth outliers below (above) the one-standard-deviation from its industry-year mean to the industry-year mean minus (plus) one-standard-deviation. Again, current pension deficits have a significant negative effect on companies' expected growth rates for companies' with DB pension deficits after we adjust our results with Mills ratio. In the sixth column, we report the regression result by adding companies historical funding status ($\widehat{PD}_{i,3t}$) as an explanatory variable. It shows that both current period pension deficits and average deficit in the past three years have negative impacts on companies' expected growth, though current deficits are more significant in statistic term. We use Arellano-Bond estimator to estimate our dynamic model by incorporating the lagged expected growth (g_{t-1}) and show the results in the last column in Panel B.[9] The result confirms a mean reverting property of the expected growth with the coefficient of lagged growth rate being -0.08. We also note that distressed firms and firms' age also affect their future growth, while the size of companies' with DB pension deficits seems to be an advantage for the expected growth. In summary, the results above support our Hypothesis 1.

B. *When a company has high profitability*

Though large pension deficits may increases companies' pressure in investment decisions and future economic activities, and hence the expected growth, the extent of the impact depends on companies' characteristics. Since pension laws allow sponsors to make their pension deficit recovery plans, managers usually amortize the pension deficits over a number of years and have leeway to adjust their annual contribution during the pension deficit recovery period.[10] In particular, companies with high profitability have no strong incentive to adjust their current economic activities, and are more likely to delay the deficit reduction contributions. Because companies are expected to fully fund their defined benefit pension plans in the long term, profitable companies may have less severe negative impact of pension deficits only on the expected short-term growth, not our estimated long-term growth introduced in Section II.

We estimate our short-term growth based on Fama and French (2006). They run cross-sectional regression of asset growth on a number of explanatory variables to obtain the fitted value of firm-specific one-year ahead asset growth. The detail can be found in the appendix. We follow their approach to generate our-of-sample 1-,2-, 3- and 5-year ahead asset growth rate.[11] We then calculate

[9]We do not report the R square since it is not a reliable proxy for goodness of fit in this estimation. We also employ Sargan test to examine the over-identifying restrictions and describe the efficiency of our model by the valid instruments. The result of Sargan test does not reject the null hypothesis and confirm the over-identifying restrictions are valid (with p-value = 0.75)

[10]The pension deficit recovery period could last 5-30 years. After adoption the Pension Protection Act 2006, sponsors are required to amortize the pension deficits over 7 years. However, in the first year, the minimum contributions to the under-funded pension liabilities are based on min(0.3,0.3-0.25×(funding status-0.6)) and the remainder of the shortfall is amortized over a period of 3-5 years before 1994. The Retirement Protection Act of 1994 changes the minimum pension contributions in first-year to min(0.3,0.3-0.4×(funding status-0.6)).

[11]Fama and French (2006) first run the linear regression in cross-section, then calculate the mean value of coefficients of predictors as final multipliers. In our paper, this regression is done based on whole sample and standard error is corrected for cross-sectional correlation by White standard errors method.

the corresponding compound annual asset growth rates as below:

$$AG_{i,t} = (AT_{i,t+\tau}/AT_{i,t})^{1/\tau} - 1, \tau = 1, 2, 3, 5. \tag{12}$$

We use the return on assets (ROA), return on equity (ROE) and return on investment (ROI) to measure a company's profitability. ROA, ROE and ROI are estimated by using a company's earnings before extraordinary items divided by the total asset, book value of equity and total invested capital respectively. That is, ROA = IBCOM/AT, ROE = IBCOM/CEQ and ROI = IBCOM/ICAPT. They measure the efficiency of a company in utilizing its invested capital to generating profits. The higher these ratios, the smaller the investment required to generate revenue and, therefore, the higher the profitability of the company. These ratios give insight on the ability of companies to turn available capital into profits from different angles . In each year, we calculate ROA, ROE and ROI for each company, and their median values. A company is said to have a high ROA (ROE, ROI) if its ROA (ROE, ROI) is greater than the median value in the year. We use a dummy variable to indicate a company's profitability. That is, the dummy variable equals 1 if ROA (ROE, ROI) in a year is greater than its median value in the year, otherwise zero. To examine the role of a company's profitability on the relation between the expected growth rate and DB pension deficits, we introduce an interaction term, which is constructed by the pension deficits times the dummy variable. It is the variable of our interest in this analysis. The regression results are shown in the following table:

[Insert Table III Here]

First, consistent with Table 2, all Panels A, B and C in Table 2 show that DB pension deficits have negative impacts on the expected future growth no matter in the long or short term, after controlling for the interaction term, Tobin's Q, Altman-Z, size, age and accounting accruals. Second, for all three measurements of profitability, the results show that the coefficients of interaction terms for the short-term expected growth rate up to 3-year ahead are significantly positive. It confirms our hypothesis 2 that profitable companies have less severe negative impact of pension deficits on the expected short-term growth. However, the coefficients of interaction terms for the expected growth rate 5-year ahead on and for our long-term expected growth rate are not significantly different from zero. It suggests that the impact of pension deficits on the long-term growth is less dependent on companies' profitability.

C. When a company has financial constraints

In Modigliani and Miller (1958) economy, capital markets have no frictions. A company's capital structure is irrelevant to the company's value in a perfect market. Pension deficits should not affect companies' economic activities because companies can always raise capital from the external markets if they have no sufficient funds to pay mandatory pension contributions. Alternatively, they can raise capital internally since the cost of raising finance from the external markets is the same as the internal cost of capital. In the real world, the cost of raising external capital depends on the riskiness of the company's economic activities, and it can be costly for some companies. Though the pecking order theory suggests that a company should prefer to finance its activities internally through retained earnings in the first place, the company has to consider the external source of capital if the internal capital is unavailable. The internal capital is accordingly companies' first choice when they have to fund their pension plans, especially for those with financial constraints, a condition describes the likelihood of a company experiencing difficulties in financing their operations when external financial conditions tighten. Campbell et al. (2010) suggest that the DB pension deficits may have negative effects on companies' economic activities because companies with pension deficits are likely to be financially constrained. Market frictions prevent companies with high financial constraints from funding some positive NPV investments. Mandatory pension contributions, particularly large DB pension deficits reduce companies' financial flexibility.[12] Pension deficits as a potential sauce of financial constrains should have an adverse effects on companies' expected growth. In this paper, we use a number of commonly used methods to measure the probabilities of companies financial constraints. First, Kaplan and Zingales (1997) construct an index (KZ index) consisting of a linear combination of five accounting ratios to measure a company's financial constraints. Second, Hadlock and Pierce (2010) introduce a so-called SA index, which takes market information into consideration. The higher the two ratios, the higher the probability that a company will have financial constraints. We calculate the KZ index and SA index for each company,

[12]Bakke and Whited (2012) argue that mandatory pension contributions reducing capital expenditure documented in Rauh (2006) may be due to companies with severe pension deficits.

and their median values in each sample year. We call a company financially constrained if its KZ index (SA index) is greater than the median value of the index in the year. Third, since companies with DB pension plans are generally bigger, older and traditional dividend-paying companies, we also use their dividend payout ratio to measure potential financial constraints. It is calculated by the total dividends divided by total assets ((DVC+DVP)/AT). We call a company high dividend-paying if its dividend payout ratio is greater than the median value of dividend payout ratios in the year. Companies with financial constraints are likely to be low dividend-paying companies. Finally, we use a company's investment grade as a measurement of financial constraints. For this, we use the S&P's long-term domestic issuer credit rating. Following prior literature, companies with missing credit ratings or ratings lower than BBB are regarded as non-investment grade. The current economic activities in companies with non-investment grade should be more likely to be interrupted by their mandatory pension contributions. We simply group all companies into investment grades (unconstrained) and non-investment grades (constrained) in our analysis in the following table.

[**Insert table IV here**]

In general, Table 4 shows that the negative effects of DB pension deficits on the expected growth rate are significant for companies with financial constraints based on our four different measurements of financial constraints. While the DB pension deficits have negative effects on all companies, the impact is not significant at the 5 percent level for companies with less financial constraints and less pressure to raise external capital. In particular, for high dividend-paying companies in investment grades, DB pension deficits have less server negative impact on the expected future growth. All control variables have the predictable signs in our regressions as before.[13] Therefore, the results support our hypothesis 3.

D. When a company raises its discount rate in estimating pension liabilities

The sponsors of defined benefit pension plans guarantee employees a specific amount of retirement benefits based on their final salary, years of service and inflation. The present value of DB pension plan obligations is estimated based on a number of complex actuarial projections. Among

[13] Our finding is not inconsistent with Campbell et al. (2011), who find that an increase in mandatory pension contributions increases the cost of capital, but only for companies facing greater external financing constraints.

a series of applied actuary assumptions, the discount rate used in estimating pension obligations is the most important one. It is not only directly related to the reported pension obligations, but it can be easily manipulated by managers to improve their funding status.[14] Managers could choose a higher discount rate to improve their reported plan funding status (Asthana (1999); Ananthara-man and Lee (2014)). If a higher discount rate is applied, the actual pension deficits can be more server than those appear in the financial reports. In this section, we examine whether the effects of pension deficits on the expected growth are affected by applying an aggressive discount rate in estimating the DB pension obligations. For our purpose, we need to define a benchmark discount rate for a company in each year. If a company applied a discount rate (DR) in estimating pension liabilities that is higher than the benchmark rate, we call it an aggressive discount rate. Suppose company i belongs to industry I located in state j. We use three different approaches to construct our benchmark discount rate (BMR).

Method 1. We consider company i's location, and implicitly assume that companies in the same state with similar funding status should apply the same actuary pension assumptions in the same year. We firstly calculate the mean ($\overline{PD}_{ij}$) and standard deviation ($\sigma_{PD_{ij}}$) of pension deficits for company i in state j since the start of DB pension plans. Then, we create a portfolio, which include all companies in state j with pension deficits within one standard deviation ($\sigma_{PD_{ij}}$) from the mean ($\overline{PD_{ij}}$) of company i's pension deficits. We assume that there are $N+1$ companies in the portfolio in year t. We then calculate the average discount rate for all companies except company i in the portfolio as the benchmark discount rate for company i in year t. That is,

$$\begin{aligned} BMR_{i,j,t} &= \frac{1}{N}\sum_{k=1,k\neq i}^{N} DR_{k,j,t}, \text{where} \\ DR_{k,j,t} &= \begin{cases} DR_{k,j,t}, & \text{if } PD_{k,j,t} \in (\overline{PD}_{i,j} - \sigma_{PD_{ij}}, \overline{PD}_{i,j} + \sigma_{PD_{ij}}) \\ 0, & \text{otherwise} \end{cases} \end{aligned} \tag{13}$$

Method 2. We do not consider a company's funding status, instead we consider company i's industry classification, and implicitly assume that companies in the same state (j) in the same industry (I) should apply the same actuary pension assumptions in the same year. We define

[14] The applied actuary pension assumptions include the discount rate in estimating pension benefits, expected return on pension assets, expected longevity and rate of compensation increase, etc.

the benchmark discount rate for company i in year t as the average discount rate applied for all companies ($N+1$ in total) except company i in the same industry (I) located in the same state j in year t. That is,

$$BMR_{i,I,j,t} = \frac{1}{N} \sum_{k=1,k\neq i}^{N} DR_{k,I,j,t} \tag{14}$$

Method 3. We consider company i's own distribution of historical discount rates applied in estimating DB pension liabilities, and implicitly assume that the company should apply a consistent discount rate in estimating pension deficits in normal circumstances. We firstly estimate the mean ($\overline{DR}_i$) and standard deviation ($\sigma_{DR,i}$) of pension benefit discount rate for company i since the start of DB pension plans. We then define the benchmark discount rate as its mean rate plus one standard deviation ($\sigma_{DR,i}$). In other words, we do not view that the company applies an aggressive pension accounting if company i applies a discount rate lower than one standard deviation above its long-term average ($\overline{DR}_i$). That is,

$$BMR_{i,t} = \overline{DR}_i + \sigma_{DR,i} \tag{15}$$

We compare the discount rate applied in estimating DB pension deficits for company i in year t with the benchmark discount rate. We introduce a dummy variable, which equals to 1 if the the applied discount rate is higher than the benchmark rate (aggressive) in year t, or zero, otherwise. We also introduce an interaction term, which is equal to the product of the dummy variable and pension deficits. The prior research suggests that distressed companies tend to apply aggressive pension assumptions in order to show a better DB pension plan funding status. We expect that a negative sign is attached to the interaction term. The regression results are reported in the table below:

[Insert Table V here]

Table 5 shows that DB pension deficits and lagged pension deficits are negatively related to the expected growth rates after controlling for benchmark discount rate dummy and other variables. More importantly, all interaction terms have negative signs, with t-statistics of -1.74, -1.72 and -2.77 for methods 1-3 respectively. They suggest that the negative effects of pension deficits on the expected growth are more severe for companies that apply aggressive discount rates in estimating pension liabilities. If an aggressive discount rate is applied in estimating DB pension deficits, market will downgrade the expectation of the company's future growth.

E. When a company has high excess cash holdings

We now move to the effect of a company's internal cash holdings on relation between DB pension deficits and expected future growth. Rauh (2006) argues that mandatory pension contributions can increase a company's cash pressure and restrict its capital expenditure. A sufficient internal cash holding can mitigate short-term cash pressure caused by mandatory pension contributions and buffer the potential negative implications. Since a company's internal cash holding is a convenient source to fund its pension deficits, we expect the impact of DB pension deficits on companies' expected growth is less severe for companies with sufficient cash holdings. In particular, non-working cash is a more relevant component of cash to fund a company's pension plan. As the non-operation activities, the firms pension policy should be mainly affected by the excess cash holding level. However, there is no commonly agreed approach to estimate the non-working cash. For example, Koller, Goedhart, Wessels, et al. (2010) suggest that the working cash is about 2 percent of companies' annual sales. Accordingly, the non-working or excess cash can be estimated as the minimum of the difference between the total cash and the 2 percent of sales for each firm year and zero.[15] Opler, Pinkowitz, Stulz, and Williamson (1999) develop a model in determining a company's 'normal' cash holding position. The excess cash holding can then be defined as the difference between the company's total cash and 'normal' cash holdings. In other words, the residuals in their companies' cash holding determination model can be regarded as the excess cash holdings. Dittmar and Mahrt-Smith (2007) modify the 'normal' cash holding model by extending control variables including companies' investment opportunities. In this subsection, we estimate the excess cash holdings by using their cash holding determination model. Details can be found in the appendix.

After obtaining the estimates of excess cash holdings, we compare next year mandatory pension contributions with the level of excess cash holdings. If the excess cash holding amount is greater (smaller) than mandatory pension contribution for company i in year t, then we say that company

[15] Koller et al. (2010) admit that it is just an approximation and omits the significant industry effect in companies' cash holding level. Based on this approach to estimate companies' excess cash holdings, we find that our untabulated results are quantitatively similar.

i's excess cash holding is high (low). If a company's current excess cash holding is greater than the mandatory pension contribution next year, there may have no immediate pressure for managers to adjust their economic decision-making. In contrast, if a company's current excess cash holding is less than the predicted mandatory pension contribution, then managers may have to consider how to raise capital or even adjust current economic activities. We also consider two extreme excess cash holdings positions in each year after we calculate the historical average ($\overline{EC}$) and standard deviation (σ_{EC}) of excess cash holdings for each company. One is with extremely high excess cash holdings, in which excess cash holdings in year t are higher than its average plus one-standard-deviation; the other is with extremely low excess cash holdings, in which excess cash holdings in year t are lower than its mean minus one-standard-deviation.

The mandatory pension contribution is required by pension act and calculated based on current pension funding status. It is supposed to be reported in Form 5500. There is, however, a significant time delay to be available to the public (Campbell et al. (2010)). Since the estimates of excess cash holdings and our expected growth are based on 10-K disclosure and currently available market information, we follow method used by Moody (2006) and Campbell et al. (2010) to estimate the amount of one-year ahead mandatory pension contributions.[16] We expect that the degree of negative effects of DB pension deficits on companies' expected growth depends on relative magnitude of excess cash holdings and expected mandatory pension contributions. To describe two extreme excess cash holding positions, we introduce two dummy variables. DUM1 equals 1 if company i's excess cash holding is greater than ($\overline{EC}_i + \sigma_{EC_i}$), or zero otherwise. DUM2 equals 1 if company i's excess cash holding is less than ($\overline{EC}_i - \sigma_{EC_i}$), or zero otherwise. The excess cash holding position is viewed as normal if the excess cash holding is between ($\overline{EC}_i - \sigma_{EC_i}$) and ($\overline{EC}_i + \sigma_{EC_i}$). While we do not expect that there is a great effect of high excess cash holdings on the relation between DB pension deficits and companies' expected growth, we expected that a severe negative effects of low cash holdings, particularly extreme low cash holdings on the relation between pension deficits and future growth. The regression results are presented below.

[16]Specifically, if the accumulated benefit obligation (ABO) is greater than the fair value of pension plan assets (FVPA), then the mandatory pension contribution equals the service cost plus (ABO-FVPA/30). If (ABO¡FVPA), then the mandatory pension contribution equals zero. After adoption of Pension Protection Act 2006, the amortization period of pension deficits allow to be changed to 7 year. Thus, if pension deficits happen after 2006, the expected mandatory pension contribution will be adjusted into (ABO-FVPA/7).

[Insert Table VI here]

Panel A in Table 6 shows that if companies have sufficient internal excess cash holdings to cover the expected next period mandatory pension contributions, the pension deficits (and the lagged pension deficits) have no significant effects on companies' expected growth rate. This result holds even if a company's excess cash holding is extremely low relative to its historical average as long as the current excess cash holding is greater than the expected mandatory pension contributions. On the other hand, Panel B of Table 6 shows that if the current excess cash holdings cannot cover the expected next period mandatory pension contributions, the pension deficits have significant negative effects on companies' expected future growth. However, the negative effect is less severe if companies currently have extreme high excess cash holding ($> \overline{EC}_i + \sigma_{EC_i}$) relative to its historical average. This can be seen from a significant positive coefficient attached to the interaction term (DUM1×PD). If companies currently have extreme low excess cash holding ($< \overline{EC}_i - \sigma_{EC_i}$) relative to its historical average, the negative effect is captured by the interaction term defined as the product of DUM2 and pension deficits. All control variables also show the predictable signs.

VI. Robustness Analysis

We have examined the impact of DB pension deficits on companies' expected growth rates, which are implied by companies' fundamentals, stock prices and the one-year ahead analysts' forecasts of earnings as well as industry-wide information. Bias in forecasts of one-year ahead earnings and deviation of the stock price from a company's intrinsic value may influence our analysis. Information asymmetry may lead to investors behavioral biases, such as under/over reaction to the effect of pension deficits on future corporate earnings (Coronado and Sharpe (2003); Franzoni and Marin (2006); An et al. (2014)). These may have impact on the input in estimating our expected growth rate. As a robustness test, we use two alternative measurements of future growth in this section. The first one is the consensus 5-year ahead long-term earnings growth rate collected from I/B/E/S database. The second one is the trailing price-to-earnings ratio (P/E), which is widely used as a proxy of a company's future growth. The higher the P/E, the high the expected growth. We regress these two growth proxies on DB pension deficits (and the lagged pension deficits) after controlling for other companies' fundamentals. The results are shown in the table below:

[Insert Table VII here]

Table 7 shows that DB pension deficits have significant negative effects on companies' future growth measured by analysts' forecasts of long-term growth in earnings and the trailing P/E ratio, if we do not consider historical pension funding status. However, if we include historical pension deficits in our regressions, the results show a significant negative relation between the historical pension deficits and the P/E ratio, while current pension deficits are negatively related to future growth but not significant. Somehow, the current DB pension deficits and lagged pension deficits are negatively related to analysts' forecasts of long-term earnings growth, but not significant.

In all above analysis, we treat companies' DB pension deficits as an exogenous variable. Note that pension deficits are defined as the difference between pension liabilities and pension assets. Since pension asset value is mainly determined by the return of pension asset allocation in the capital market, sponsors have limited control power on the performance of pension assets. Nevertheless, an endogeneity problem in reported pension deficits still cannot be ruled out if managers manipulate pension accounting and apply aggressive actuarial assumptions (Chuk (2012); Kisser, Kiff, and Soto (2017)). On the other hand, the pension deficits of other companies nearby may also affect the expectation of a company's future growth. To eliminate the potential bias, we use the method of instrumental variables (IV) to predict companies' pension deficits. Specifically, we use the average DB pension deficits for all companies located in same state with 2-digit ZIP code as the instrumental variable in the year.[17] We repeat our analysis by using the 2SLS method in our full sample and sub-sample (eliminating companies with pension surplus). The results are shown in the following table:

[Insert Table VIII here]

Our first-stage results show that companies' pension deficits are indeed significantly positively related to our instrumental variable. It indicates the efficiency of the applied instrumental variable and suggests that a company's pension policy is related to its geographical area. After adoption of the predicted value of companies' pension deficits in the second stage, the results show that

[17]Kedia and Rajgopal (2009) suggest that a company's interaction with nearby companies affects its employee benefit plans. Chen (2015) uses the average value of pension deficits of other local companies to predict pension deficits. Thus, companies' pension policy decisions are affected by geographical area.

companies' DB pension deficits have significant negative effects on the expected growth in both full sample and sub-sample with coefficients of -0.244 (with t-statistic of 2.55) and -0.437 (with t-statistic of 2.02) respectively.

VII. Conclusion

In this paper, we investigate how companies' current defined benefit pension deficits affect their expected future growth, one of the key drivers in corporate valuation. This is in contrast to existing literature that examines the impact of companies' pension funding status on their current investment, financing and operating activities. Our expected long-term growth rate is the implied growth rate from a company's accounting fundamentals, analysts' forecasts of future earnings, current stock prices and the industry-wide information. We also estimate a short-term future asset growth rate based on Fama and French (2006). Since companies' pension liabilities are debt equivalent long-term liabilities, and the projected DB pension deficits are based on the estimated present value of all future pension benefits, companies' pension deficits should have an important implication to their expected future growth. Future mandatory DB pension benefit contributions restrict companies' future financial flexibility. Our analysis shows that companies' pension deficits are significantly negatively associated with their expected long-term as well as short-term growth. The effect depends on a company's profitability, excess cash holding position, and financial constraints. Specifically, profitable companies have less severe negative impact of pension deficits on the expected short-term growth, but the impact of pension deficits on the long-term growth is less dependent on companies' profitability. We find that the effect of pension deficits on expected growth for companies with higher-level financial constraints is more severer than for companies with lower-level financial constraints. We also find that the negative effects of pension deficits on a company's expected growth rate are more severe if the company's current excess cash holdings are not sufficient to cover the mandatory pension contributions. Therefore, a company's pension policy is important for its future financing and investment decision-making and influencing capital market reaction to the company's future performance.

Appendix A. Estimating the short-term growth

Fama and French (2006) introduce a linear combination of determination factors for total asset growth. We use their methodology to forecast companies' growth of assets, $(A_{t+\tau} - A_t)/A_t$, one,two,three and five years ahead ($\tau = 1, 2, 3, 5$). We use the fitted asset growth rates to measure a company's future short-term growth condition. The company's accounting fundamentals used as explanatory variables include log value of book-to-market ratio B_t/M_t, log of market capitalization (stock price times the number of shares outstanding) at the end of fiscal year t, a dummy variable for negative earnings (Neg Y_t), profitability Y_t/B_t for companies with positive earnings, positive accruals relative to book value ratio $(+AC)_t/B_t$ and negative accruals relative to book value ratio $(-AC)_t/B_t$, investment dA_t/A_{t-1}, a dummy variable for companies that do not pay dividends (No D_t), the ratio of dividends to book equity D_t/B_t , the stock return for the year up to the end of fiscal year t, $1Yr_t$, the two-year return for the years up to the end of fiscal year t-1, $2 - 3Yr_t$, the I/B/E/S consensus forecast of earnings for the coming year, sampled at the end of fiscal year t scaled by book value I_t/B_t, the composite measure of firm strength used by Piotroski et al. (2000) and the probability of debt default ratio developed by Ohlson (1980).

Appendix B. Estimating the excess cash holdings

To estimate companies' excess cash holding positions, we follow Opler et al. (1999) and Dittmar and Mahrt-Smith (2007), who introduce a number of determination factors for companies' cash holding positions, and use the residuals in cash determination regressions as excess cash holdings. The accounting fundamentals used as explanatory variables in the determination formula of cash holding include the log value of net asset, which is calculated by the total asset (AT) minus the cash holding (CHE), ($AT - CHE$), non-cash liquid assets ($OIBDP - XINT - TXT$), working capital ($ACT - LCT - CHE$), standard deviation σ of non-cash liquid assets in last ten years within same industry (classified based on Fama and French-49 industry classification), research and development expense (XRD), capital expenditure ($CAPX$) divided by total asset (AT), market capitalization ($PRCC * CSHO + LT$), leverage ratio ($DLTT + DLC$) and dummy variable for dividend payment. For comparability, we scale all variables by dividing adjusted net assets, except the log value of net assets, industry σ and capital expenditure. We eliminate financial companies (SIC 6000-6999) and utilities (SIC 4900-4999). The industry and year fixed effect are applied and residuals are clustered at firm level. We de-log the calculated excess cash holding (in millions) for comparing it with predicted mandatory pension contributions.

REFERENCES

Aharoni, Gil, Bruce Grundy, and Qi Zeng, 2013, Stock returns and the miller modigliani valuation formula: Revisiting the fama french analysis, *Journal of Financial Economics* 110, 347–357.

Almeida, Heitor, and Murillo Campello, 2007, Financial constraints, asset tangibility, and corporate investment, *The Review of Financial Studies* 20, 1429–1460.

Amir, Eli, and Elizabeth A Gordon, 1996, Firms' choice of estimation parameters: Empirical evidence from sfas no. 106, *Journal of accounting, auditing & finance* 11, 427–448.

An, Heng, Yul W Lee, and Ting Zhang, 2014, Do corporations manage earnings to meet/exceed analyst forecasts? evidence from pension plan assumption changes, *Review of Accounting Studies* 19, 698–735.

Anantharaman, Divya, and Yong Gyu Lee, 2014, Managerial risk taking incentives and corporate pension policy, *Journal of Financial Economics* 111, 328–351.

Ashton, David, and Pengguo Wang, 2013, Terminal valuations, growth rates and the implied cost of capital, *Review of Accounting Studies* 18, 261–290.

Asthana, Sharad, 1999, Determinants of funding strategies and actuarial choices for defined-benefit pension plans, *Contemporary Accounting Research* 16, 39–74.

Bakke, Tor-Erik, and Toni M Whited, 2012, Threshold events and identification: A study of cash shortfalls, *The Journal of Finance* 67, 1083–1111.

Bartram, Söhnke M, 2016, Corporate postretirement benefit plans and real investment, *Management Science* 63, 355–383.

Bartram, Söhnke M, 2018, In good times and in bad: Defined-benefit pensions and corporate financial policy, *Journal of Corporate Finance* 48, 331–351.

Benmelech, Efraim, Nittai K Bergman, and Ricardo J Enriquez, 2012, Negotiating with labor under financial distress, *The Review of Corporate Finance Studies* 1, 28–67.

Bergstresser, Daniel, Mihir Desai, and Joshua Rauh, 2006, Earnings manipulation, pension assumptions, and managerial investment decisions, *The Quarterly Journal of Economics* 121, 157–195.

Campbell, John L, Dan S Dhaliwal, and William C Schwartz Jr, 2010, Equity valuation effects of the pension protection act of 2006, *Contemporary Accounting Research* 27, 469–536.

Campbell, John L, Dan S Dhaliwal, and William C Schwartz Jr, 2011, Financing constraints and the cost of capital: Evidence from the funding of corporate pension plans, *The Review of Financial Studies* 25, 868–912.

Chuk, Elizabeth C, 2012, Economic consequences of mandated accounting disclosures: Evidence from pension accounting standards, *The Accounting Review* 88, 395–427.

Cocco, João F, and Paolo F Volpin, 2013, Corporate pension plans as takeover deterrents, *Journal of Financial and Quantitative Analysis* 48, 1119–1144.

Coronado, Julia Lynn, and Steven Alan Sharpe, 2003, Did pension plan accounting contribute to a stock market bubble?, *Brookings Papers on Economic Activity* 2003, 323–371.

Dittmar, Amy, and Jan Mahrt-Smith, 2007, Corporate governance and the value of cash holdings, *Journal of financial economics* 83, 599–634.

Duygun, Meryem, Bihong Huang, Xiaolin Qian, and Lewis HK Tam, 2018, Corporate pension plans and investment choices: Bargaining or conforming?, *Journal of Corporate Finance* 50, 519–537.

Erickson, Timothy, and Toni M Whited, 2000, Measurement error and the relationship between investment and q, *Journal of political economy* 108, 1027–1057.

Fairfield, Patricia M, J Scott Whisenant, and Teri Lombardi Yohn, 2003, Accrued earnings and growth: Implications for future profitability and market mispricing, *The accounting review* 78, 353–371.

Fama, Eugene F, and Kenneth R French, 2006, Profitability, investment and average returns, *Journal of financial economics* 82, 491–518.

Franzoni, Francesco, and Jose M Marin, 2006, Pension plan funding and stock market efficiency, *the Journal of Finance* 61, 921–956.

Guan, Yanling, and Dragon Yongjun Tang, 2018, Employees' risk attitude and corporate risk taking: Evidence from pension asset allocations, *Journal of Corporate Finance* 48, 261–274.

Hadlock, Charles J, and Joshua R Pierce, 2010, New evidence on measuring financial constraints: Moving beyond the kz index, *The Review of Financial Studies* 23, 1909–1940.

Jin, Li, Robert C Merton, and Zvi Bodie, 2006, Do a firm's equity returns reflect the risk of its pension plan?, *Journal of Financial Economics* 81, 1–26.

Kaplan, Steven N, and Luigi Zingales, 1997, Do investment-cash flow sensitivities provide useful measures of financing constraints?, *The quarterly journal of economics* 112, 169–215.

Kedia, Simi, and Shiva Rajgopal, 2009, Neighborhood matters: The impact of location on broad based stock option plans, *Journal of Financial Economics* 92, 109–127.

Kisser, Michael, John Kiff, and Mauricio Soto, 2017, Do managers of us defined benefit pension plan sponsors use regulatory freedom strategically?, *Journal of Accounting Research* 55, 1213–1255.

Koller, Tim, Marc Goedhart, David Wessels, et al., 2010, *Valuation: measuring and managing the value of companies*, volume 499 (john Wiley and sons).

Lamont, Owen, Christopher Polk, and Jesús Saaá-Requejo, 2001, Financial constraints and stock returns, *The review of financial studies* 14, 529–554.

Liu, Weixi, and Ian Tonks, 2013, Pension funding constraints and corporate expenditures, *Oxford Bulletin of Economics and Statistics* 75, 235–258.

Modigliani, Franco, and Merton Miller, 1958, The cost of capital, corporation finance and the theory of finance, *American Economic Review* 48, 291–297.

Ohlson, James A, 1980, Financial ratios and the probabilistic prediction of bankruptcy, *Journal of accounting research* 109–131.

Opler, Tim, Lee Pinkowitz, René Stulz, and Rohan Williamson, 1999, The determinants and implications of corporate cash holdings, *Journal of financial economics* 52, 3–46.

Picconi, Marc, 2006, The perils of pensions: Does pension accounting lead investors and analysts astray?, *The Accounting Review* 81, 925–955.

Piotroski, Joseph D, et al., 2000, Value investing: The use of historical financial statement information to separate winners from losers, *Journal of Accounting Research* 38, 1–52.

Rauh, Joshua D, 2006, Investment and financing constraints: Evidence from the funding of corporate pension plans, *The Journal of Finance* 61, 33–71.

Shivdasani, Anil, and Irina Stefanescu, 2009, How do pensions affect corporate capital structure decisions?, *The Review of Financial Studies* 23, 1287–1323.

Table I Sample Statistics

Panel A presents the sample descriptive statistics in our analysis. The sample period is from 1988 to 2018. g is the firm level expected growth rate based on Ashton and Wang (2013). The pension deficits (PD) are calculated by the difference between the estimated present value of DB pension obligations and the fair value of pension assets scaled by total assets (AT). Q is the Tobin's Q, calculated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by the book value of firm (AT). Z is the Altman-Z score, calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat database. Accruals are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). The mean value, number of observations, quantile 1 and 3, median value and standard variance are reported. Panel B shows the Pearson correlation between variables. The p-value is in parentheses. All variables are winsorized at the 1% and 99% levels.

Panel A: Univariate statistics							
Variable	g	PD	Q	Z	Size	Age	Accruals
Mean	0.026	0.032	1.659	3.873	7.478	3.142	0.149
N	12280	12327	12327	12327	12327	12327	12327
Q1	-0.01	0.007	1.16	2.451	6.367	2.639	0.039
Median	0.028	0.019	1.438	3.401	7.469	3.332	0.104
Q3	0.063	0.042	1.92	4.721	8.568	3.784	0.193
Std	0.115	0.036	0.754	2.204	1.572	0.786	0.288
Panel B: Pearson correlation							
PD	-0.029						
	(-0.01)						
Q	0.054	-0.022					
	(-0.01)	(-0.01)					
Z	0.045	-0.124	0.696				
	(-0.01)	(-0.01)	(-0.01)				
Size	-0.04	0.026	0.001	-0.256			
	(-0.01)	(-0.01)	(-0.94)	(-0.01)			
Age	0.004	0.172	-0.009	-0.009	0.341		
	(-0.66)	(-0.01)	(-0.33)	(-0.3)	(-0.01)		
Accruals	-0.058	0.06	-0.084	-0.203	0.082	-0.011	
	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.01)	(-0.23)	

Table II Expected growth and DB pension deficits

Table 2 reports the relationship between the expected growth rate and pension deficits. Results on full sample and sub-sample by excluding companies with pension surplus are reported. The sample period is from 1988 to 2018. The firm-level expected growth rate is calculated based on Ashton and Wang (2013). Pension deficit (PD) is calculated by the difference between the estimated present value of pension obligations and the fair value of pension assets scaled by total asset (AT). Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided total asset (AT). Altman Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat database. Accruals are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). $\widehat{PD}_3$ is the average pension deficits in the prior three years. The modified expected growth rate is the expected growth rate winsorized by industry and year. The heteroscedasticity-consistent t-statistics are shown in the second line.

	Panel A: Expected growth rate (g_t)		Panel B: Modified expected growth rate (g_t)			
	Full sample	Sub-sample	Full sample	Sub-sample		
PD	-0.096	-0.203	-0.032	-0.088	-0.099	-1.076
	-1.62	-2.56	-1.32	-2.73	-2.37	-64.74
Q	0.013	0.014	0.009	0.010	0.008	0.047
	3.51	3.00	5.78	5.31	3.13	78.62
Z	-0.003	-0.003	-0.002	-0.001	-0.001	-0.024
	-2.23	-1.65	-2.49	-1.99	-0.29	-43.92
Size	-0.004	-0.004	-0.003	-0.003	-0.004	0.007
	-2.20	-2.05	-3.53	-3.70	-4.12	6.72
Age	0.003	0.005	0.003	0.004	0.007	-0.228
	0.90	1.61	2.17	2.89	3.49	-68.63
Accrual	-0.024	-0.023	-0.023	-0.022	-0.019	-0.136
	-3.34	-3.01	-6.00	-5.33	-3.55	-37.60
g_{t-1}						-0.080
						-50.47
$\widehat{PD}_3$					-0.077	
					-1.88	
Fixed-effect	Y	Y	Y	Y	Y	
N	16681	12327	16681	12327	8268	
Adj-R	0.02	0.02	0.08	0.09	0.09	

Table III When a company's profitability is high

Table 3 reports how the short-term and long-term growth rates are affected by pension deficits when companies have different profitability. The sample period is from 1988 to 2016. The expected long-term growth rate (g) is estimated based on Ashton and Wang (2013), and 1- to 5-year ahead short-term growth rates (AG-AG5) are based on Fama and French (2006). Profitability is measured by return on asset (ROA=IBCOM/AT), return on equity (ROE=IBCOM/CEQ) and return on investment (ROI=IBCOM/ICAPT). Pension deficit (PD) is calculated by the difference between the estimated present value of pension obligations and the fair value of pension assets scaled by total asset (AT). Dummy variable equals 1 if each of the measures is greater than its median value, zero otherwise. The interaction term is the product of pension deficits and the dummy variable. Q is the Tobin's Q, calculated by total assets: (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by the book value of firm (AT). Z is the Altman-Z score, calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat database. Accruals (Accr) are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). The heteroscedasticity-consistent t-statistics are shown in the second line. All variables are winsorized at 1% and 99%.

Dependent	Intercept	PD	Dummy	PD×Dummy	Q	Z	Size	Age	Accr	N	R
					Panel A: ROA						
AG	0.171	-0.329	0.006	0.098	0.023	-0.003	-0.011	0	-0.005	9176	0.12
	32.11	-12.83	3.04	2.67	15.91	-5.36	-17.56	0.3	-1.61		
AG2	-0.277	-0.321	0.007	0.104	0.018	-0.004	-0.014	-0.002	0.003	8052	0.14
	-50.31	-11.66	3.09	2.68	12.56	-6.91	-22.68	-1.48	0.92		
AG3	-0.406	-0.383	0.003	0.104	0.015	-0.004	-0.016	-0.003	0.006	7072	0.16
	-71.34	-11.9	1.3	2.39	10.46	-7.5	-24.91	-2.61	1.49		
AG5	-0.464	-0.51	0.008	-0.071	0.013	-0.006	-0.023	-0.002	0.023	5365	0.18
	-59.3	-10.53	2.46	-1.09	6.6	-8	-24.8	-0.99	3.68		
g	0.037	-0.141	-0.01	0.081	0.012	-0.001	-0.004	0.005	-0.018	10399	0.01
	4.77	-2.98	-3.35	1.37	5.38	-1.3	-4.45	2.99	-4.05		
					Panel B: ROE						
AG	0.174	-0.333	0.009	0.084	0.024	-0.003	-0.011	0.001	-0.01	9192	0.13
	32.43	-11.83	4.67	2.3	15.92	-5.35	-18.52	0.34	-2.28		
AG2	-0.275	-0.334	0.008	0.108	0.019	-0.003	-0.015	-0.002	0.004	8072	0.15
	-49.62	-11.24	3.94	2.76	12.75	-6.53	-23.57	-1.47	1.01		
AG3	-0.403	-0.405	0.005	0.124	0.016	-0.004	-0.017	-0.003	0.009	7084	0.17
	-70.42	-11.53	2.48	2.81	10.62	-7.43	-25.74	-2.77	2.07		
AG5	-0.462	-0.557	0.009	-0.004	0.012	-0.006	-0.023	-0.002	0.022	5369	0.18
	-58.87	-10.48	2.99	-0.06	6.02	-7.77	-25.13	-1.28	3.31		
g	0.033	-0.097	-0.016	0.014	0.013	-0.001	-0.003	0.005	-0.018	10399	0.01
	4.21	-1.89	-5.3	0.24	6.14	-1.91	-3.66	2.98	-2.94		
					Panel C: ROI						
AG	0.173	-0.343	0.008	0.104	0.024	-0.003	-0.011	0.001	-0.004	9178	0.12
	32.46	-12.85	3.99	2.85	16.06	-5.91	-17.99	0.31	-1.45		
AG2	-0.274	-0.343	0.008	0.12	0.018	-0.004	-0.015	-0.002	0.005	8049	0.14
	-49.78	-12.09	3.96	3.1	12.48	-7.33	-23.17	-1.5	1.38		
AG3	-0.403	-0.419	0.005	0.149	0.015	-0.004	-0.017	-0.003	0.009	7062	0.17
	-70.92	-12.45	2.17	3.44	10.16	-7.86	-25.5	-2.7	2.35		
AG5	-0.462	-0.544	0.009	-0.008	0.013	-0.006	-0.023	-0.002	0.023	5351	0.18
	-59.1	-11.04	2.89	-0.13	6.42	-8.26	-25.19	-1.06	3.46		
g	0.035	-0.133	-0.013	0.079	0.012	-0.001	-0.004	0.005	-0.017	10399	0.01
	4.58	-2.59	-4.24	1.3	5.48	-1.11	-4.2	2.95	-3.86		

Table IV When a company has financial constraints

Table 4 reports how the expected growth rate is affected by pension deficits when companies have different financial constraints. The sample period is from 1988 to 2016. We apply KZ index, SA index, dividend ratio, and S&P credit rating to measure the degree of financial constraints. The KZ index is introduced in the Kaplan and Zingales (1997) and Lamont, Polk, and Saaá-Requejo (2001), KZ = -1.001909×(IB+DP)/LAG1(PPENT) + 0.2826389×(AT+(CSHO×PRCC_F) - CEQ - TXDB)/AT + 3.139193×(DLTT+DLC)/(DLTT+LC+SEQ) - 39.3678×(DVC+DVP)/LAG1(PPENT) - 1.314759×CHE/LAG1(PPENT). The SA index is introduced in Hadlock and Pierce (2010) and calculated as (-0.737×Size) + (0.043×$Size^2$) − (0.040×Age), where size equals the log of inflation-adjusted book assets and age is years a firm is listed with a non-missing stock price on Compustat database. We adjust the value of total asset for inflation based on the CPI index in 1988 (The first year in our sample). The dividend ratio is calculated by the total dividends (DVC+DVP) scaled by total asset. If a company's S&P rating is equal or above BBB, the company is viewed as financially unconstrained. We categorize all companies into financially constrained (CN) or unconstrained (UCN). The pension deficit (PD) is calculated by the difference between the estimated present value of pension obligations and the fair value of pension assets scaled by total assets (AT). Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by total assets. The Altman-Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat. Accruals are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). The heteroscedasticity-consistent t-statistics are reported in the second line. All variables are winsorized at 1% and 99%.

	PD	Q	Z	Size	Age	Accrual	N	Adj_R
				Panel A: KZ Index				
CN	-0.116	0.023	-0.005	-0.003	0.008	-0.021	5676	0.08
	-2.05	6.01	-3.71	-1.76	3.67	-4.15		
UCN	-0.039	0.006	-0.001	-0.003	0.002	-0.020	5664	0.11
	-1.04	2.04	0.20	-2.69	1.00	-2.55		
				Panel B: SA Index				
CN	-0.100	0.008	-0.001	-0.002	0.005	-0.027	6162	0.09
	-2.16	2.73	-0.67	-1.19	2.38	-4.13		
UCN	-0.070	0.011	-0.002	-0.005	0.005	-0.019	6118	0.10
	-1.48	3.75	-1.56	-3.25	1.79	-3.73		
				Panel C: Dividend Payout Ratio				
CN	-0.120	0.013	-0.001	-0.003	0.008	-0.025	5404	0.09
	-2.12	3.26	-0.98	-2.11	3.25	-4.26		
UCN	-0.054	0.007	-0.001	-0.005	0.002	-0.018	5403	0.11
	-1.37	2.93	-0.8	-3.92	1.05	-2.04		
				Panel D: S&P Rating				
CN	-0.111	0.011	-0.001	-0.002	0.004	-0.022	8129	0.08
	-2.65	3.82	-1.23	-1.83	2.14	-4.57		
UCN	-0.016	0.008	-0.001	-0.005	0.006	-0.021	3334	0.12
	-0.34	2.56	-0.67	-2.88	2.25	-2.42		

Table V When pension benefit discount rate is manipulated

Table 5 shows how expected growth rates are affected by pension deficits when companies manipulate DB pension benefit discount rates. The sample period is from 1988 to 2018. The dependent variable is the firm level expected growth rate (g) estimated based on Ashton and Wang (2013). We apply three different measures to define benchmark discount rates by assuming: (i) companies in the same state with similar funding status should apply the same actuary pension assumptions in the same year; (ii) companies in the same state in the same industry should apply the same actuary pension assumptions in the same year; (iii) a company applies a consistent discount rate and considers the company own distribution of historical discount rates applied in estimating DB pension liabilities. If company's applied pension obligation discount rate is higher than the benchmark, the company is said to apply aggressive pension assumptions. Dummy variable equals 1, if a company applies aggressive accounting, zero otherwise. Interaction term is calculated by pension deficit (PD) times the dummy variable. We add the average value of last-three years' pension deficit ($\widehat{PD}_3$) to measure their historical plan's performance.The pension deficit (PD) is calculated by the difference between the estimated present value of pension obligations and the fair value of pension assets scaled by total assets (AT). Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by total assets (AT). The Altman-Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat. Accruals are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). Year and industry fixed effect are considered. Fame and French-49 industry classification is applied. The heteroscedasticity-consistent t-statistics are reported in the second row. All variables are winsorized at 1% and 99%.

	PD	Dummy	PD×Dummy	$\widehat{PD}_3$	Q	Z	Size	Age	Accrual	N	Adj_R
Method 1	-0.035	0.005	-0.122	-0.077	0.008	-0.001	-0.006	0.008	-0.018	7764	0.09
	-0.59	1.4	-1.74	-1.82	2.85	-0.54	-5	3.61	-3.37		
Method 2	-0.040	0.002	-0.118	-0.077	0.008	-0.001	-0.006	0.008	-0.018	7764	0.09
	-0.73	0.5	-1.72	-1.85	2.84	-0.56	-4.98	3.68	-3.4		
Method 3	-0.085	0.019	-0.426	-0.084	0.008	-0.001	-0.006	0.008	-0.018	7764	0.09
	-1.93	2.52	-2.77	-2.02	2.82	-0.53	-4.99	3.75	-3.30		

Table VI When a company has excess cash holdings

Table 6 reports how the expected growth rate is affected by pension deficits when companies have different excess cash holding positions. The sample period is from 1988 to 2018. We compare the current excess cash holdings with the predicted next year mandatory pension contributions and then split total sample into two. We also define two extreme excess cash holding positions for company i: outside of average value ± one standard deviation. Dummy variable $Dum_1 = 1$ if the current excess cash holding is greater than the average value plus one standard deviation, otherwise zero. $Dum_2 = 1$ if the current excess cash holding is less than the average value minus one standard deviation, otherwise zero. Pension deficit (PD) is the difference between the estimated value of pension obligations and the fair value of pension assets scaled by total asset (AT). $\widehat{PD}_3$ is the average pension deficits in last three years. Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by total assets (AT). The Altman-Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat. Accruals (Accr) are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). Year and industry fixed effect with French-49 industry classification are considered in all regressions. The heteroscedasticity-consistent t-statistics are shown in the second line. All the variables are winsorized at 1% and 99% separately.

Panel A: Excess cash >= Contribution

PD	$\widehat{PD}_3$	Dum_1	$Dum_1 \times PD$	Q	Z	Size	Age	Accr	N	R
-0.058				0.009	-0.001	-0.002	0.004	-0.025	9296	0.09
-1.15				4.13	-1.45	-2.43	2.33	-4.72		
-0.028		0.010	-0.226	0.008	-0.001	-0.003	0.004	-0.026	8206	0.10
-0.49		2.1	-1.62	3.59	-1.26	-2.77	1.95	-4.69		
-0.037	-0.068	0.015	-0.250	0.005	0.000	-0.003	0.005	-0.026	5490	0.10
-0.49	-1.22	2.84	-1.53	1.76	0.34	-2.45	2.05	-3.01		
PD	$\widehat{PD}_3$	Dum_2	$Dum_2 \times PD$	Q	Z	Size	Age	Accr	N	R
-0.079		-0.012	0.089	0.008	-0.001	-0.003	0.003	-0.026	8206	0.10
-1.41		-2.41	0.59	3.64	-1.28	-2.73	1.76	-4.67		
-0.099	-0.072	-0.021	0.177	0.005	0.000	-0.003	0.005	-0.026	5490	0.10
-1.34	-1.32	-2.56	0.68	1.84	0.36	-2.43	1.88	-3		

Panel B: Excess cash <Contribution

PD	$\widehat{PD}_3$	Dum_1	$Dum_1 \times PD$	Q	Z	Size	Age	Accr	N	R
-0.119				0.014	-0.002	-0.006	0.007	-0.017	2984	0.09
-2.2				2.37	-0.8	-3.04	2.34	-2.76		
-0.145		-0.025	0.199	0.017	-0.002	-0.007	0.011	-0.015	2375	0.09
-2.19		-2.46	1.59	2.49	-0.81	-2.91	3.13	-2.49		
-0.174	-0.085	-0.021	0.243	0.019	-0.002	-0.008	0.014	-0.015	2030	0.10
-2.23	-1.18	-1.96	1.81	2.46	-0.66	-3.15	3.22	-2.42		
PD	$\widehat{PD}_3$	Dum_2	$Dum_2 \times PD$	Q	Z	Size	Age	Accr	N	R
-0.080		0.012	-0.218	0.017	-0.002	-0.007	0.012	-0.015	2375	0.09
-1.23		1.22	-1.58	2.46	-0.91	-3.01	3.32	-2.41		
-0.100	-0.078	0.013	-0.324	0.019	-0.002	-0.008	0.014	-0.015	2030	0.10
-1.32	-1.08	1.16	-2.29	2.49	-0.81	-3.34	3.14	-2.39		

Table VII Robustness Text

Table 7 reports the relationship between two alternative measures of growth and pension deficits. The sample period is from 1988 to 2018. The first is analysts' long-term forecasts of future earnings collected from I/B/E/S database. The second is the P/E ratio, defined as the market value of equity (CSHOPRCC_C) divided by net income (NI). Pension deficit (PD) is calculated by the difference between the estimated present value of pension obligations and the fair value of pension assets scaled by total asset (AT). Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by total assets (AT). The Altman-Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat. Accruals (Accr) are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). $\widehat{PD}_3$ is the average pension deficits in last three years. We consider year and industry fixed effect based on Fame and French-49 industry classification. The heteroscedasticity-consistent t-statistics are shown in the second line. All the variables are winsorized at 1% and 99% separately.

Dependent variables	PD	$\widehat{PD}_3$	Q	Z	Size	Age	Accr	N	Adj_R
Analysts' long-term forecast	-0.052		0.015	-0.001	-0.007	-0.008	-0.014	10919	0.84
	-2.570		11.850	-2.920	-13.350	-9.550	-3.570		
	-0.034	-0.016	0.010	-0.001	-0.006	-0.008	-0.008	7187	0.83
	-1.310	-0.610	6.730	-1.230	-9.310	-6.670	-1.720		
P/E ratio	-32.879		7.109	-2.792	-2.553	-0.099	11.940	9531	0.42
	-2.610		9.010	-9.720	-7.630	-0.200	3.470		
	-15.112	-36.446	6.283	-2.660	-2.841	-0.016	10.943	6372	0.45
	-1.010	-2.660	7.650	-8.300	-7.710	-0.020	2.470		

Table VIII Using 2SLS to deal with endogeneity

Table 8 shows the regression results based on the 2SLS. In the first-stage regression, the potential endogenous variable, a company's specific pension deficit (PD) is the dependent variable. We regress it against average value of all companies' pension deficits ($\overline{PD}$) located in same state (defined by the 2-digit ZIP codes). The predicted pension deficits are used as the instrumental variable in the second stage regression. In the second stage regressions, we regress the expected company's growth against the predicted value of pension deficit (Pre_PD). Tobin Q is estimated by the market value of firm (AT+PRCC_C×CSHO-SEQ-TXDB-ITCB+PREF) divided by total assets (AT). The Altman-Z score is calculated by the (3.3×(EBIT/AT) +0.99×(SALE/AT) +0.6×(ME/LT) +1.2×(ACT/AT) +1.4×(RE/AT)). Size is the log value of companies' total asset (Log(AT)). Age is calculated as the present year minus the year when a company's data is firstly available in Compustat. Accruals (Accr) are calculated based on the balance sheet method: (ΔACT-ΔCHE-ΔLCT+ΔDLC+ΔTXP-DP), divided by the book value of equity (CEQ). NPCF is the non-pension cash flow calculated by the sum of earnings (IB), depreciation and amortization (DP), and pension and retirement expense (XPR) scaled by total asset (AT) (Rauh (2006)). Industry and year fixed effects are considered. 2SLS is applied in full-sample and sub-sample (eliminating companies with pension surplus) separately. The sample period is from 1988 to 2018. All the variables are winsorized at 1% and 99% separately.

First-stage	Intercept	$\overline{PD}$	Q	NPCF	Age	Size	N	Adj-R
Full-sample	-0.002	0.534	-0.001	0.011	0.002	0.001	16681	0.11
	-1.06	40.79	-0.25	1.6	4.78	1.77		
Sub-sample	0.012	0.27	-0.001	0.016	0.008	-0.002	12327	0.07
	6.31	19.47	-2.8	2.37	18.91	-7.13		
Second-stage	**Pre_PD**	**Q**	**Z**	**Size**	**Age**	**Accr**	**N**	**Adj-R**
Full-sample	-0.244	0.011	-0.001	-0.003	0.003	-0.021	16681	0.08
	-2.55	5.44	-2.08	-3.9	2.62	-5.68		
Sub-sample	-0.437	0.009	-0.001	-0.004	0.007	-0.02	12327	0.09
	-2.02	4.18	-1.11	-4.36	3.06	-4.98		