Corporate Pension Plans' Return Chasing with Private Equity Investment

Abstract

We investigate corporate defined benefit (DB) plans' investment in private equity, which has replaced traditional corporate equity since 2008. For private equity investments, we test two hypotheses: return chasing and reduced monitoring. Using IRS 5500 data and 10-K filings for the period 2009–2014, we find evidence to support both hypotheses. A corporate DB plan's return chasing with increasing investment in private equity occurs when it faces a high level of required cash contributions or is at a low funding level. In addition, the return chasing is observed only when sponsoring firms have a leadership structure of CEO duality, which relates to boards' reduced monitoring. Our findings on private equity not only support corporate pension plans' risk shifting behavior addressed in the literature but also suggest that the risk shifting is closely related to a leadership structure of sponsoring firms.

Keywords: Corporate pension plan, private equity investment, return chasing, CEO duality
JEL classification: G23, G30, J32

1. Introduction

Since the financial crisis in 2008, corporate pension plans have shifted a significant portion of their investment portfolio from traditional corporate equity into private equity. For example, Figure 1 depicts that large defined benefit (DB) plans (single-employer DB plans with 100 or more participants) began to increase their allocation to private equity while decreasing their allocation to traditional corporate equity from the year 2008. Given the significant drop in equity values for the year 2007, the movement toward private equity, one of alternative assets, would be natural. With this market challenge, corporate pension plans would seek for higher returns than expected from traditional equities or diversify their portfolios from traditional equities. However, even if the stock market recovered, corporate pension plans have still allocated a significant portion of their assets to private equity, which includes partnership or joint venture interests. It seems that DB plans have replaced corporate equity with private equity in their portfolio. Thus, it is important to understand how corporate pension plans use private equity in their portfolio.

[Figure 1 here]

An increased allocation to private equity may be related to pension managers' attempt to generate higher risk-adjusted returns (Atanasova and Chemla, 2016) or to outperform benchmark returns (Del Guercio and Tkac, 2002) because pension fund flows are sensitive to whether or not a pension manager beats a benchmark (Del Guercio and Tkac, 2002). The tilt towards private equity may also be related to corporate governance of sponsoring firms. In particular, the role of the board of directors would be crucial in determining private equity investments because the board and its committees monitor pension investment policies (Phan and Hegde, 2013; Anantharaman and Lee, 2014; Vafeas and Vlittis, 2016). The monitoring role of board members,

however, becomes weakened when a CEO also works as a chair of the board of directors (Tuggle, Sirmon, Reutzel, and Bierman, 2010). Thus, this leadership structure (referred to as CEO duality) may divert the board from monitoring and enable pension trustees to adopt pension investment policies that are aligned with the CEO's interests such as his/her compensation (Anantharaman and Lee, 2014; Alderson, Betker, and Halford, 2017).

In this paper, we examine the determinants of DB plans' investment in private equity and how they interact on private equity investments. Drawing on return chasing and reduced monitoring hypotheses, we examine whether corporate pension plans' allocation to private equity is influenced by lagged pension returns, peer investment returns, or CEO duality. Since a pension plan's asset allocations is closely related to its funding status (see, e.g., Rauh, 2009), we also examine whether DB plans' investment in private equity depends on their funding status.

We analyze DB plans' asset allocations, using IRS 5500 data and 10-K filings disclosed under Accounting Standards Codification (ASC) 820 for the period 2009–2014. The IRS 5500 datasets enable us to analyze asset allocations at plan level but provide limited information on asset allocations. For pension asset allocations, the Form 5500 (Schedule H) includes opaque asset categories (such as collective trusts, pooled separate accounts, and registered investment companies) that many large-sized plans use (Rauh, 2009). Thus, plans that significantly use these investment vehicles are likely to be removed in an analysis because of their opaqueness on asset allocation (e.g., Rauh, 2009; Phan and Hegde, 2013). To circumvent this problem, we also use hand-collected data on pension asset allocation disclosed in 10-K filings for S&P 900 firms (mid- and large-cap firms). We focus on pension plans' asset allocations from the fiscal year 2009 because of ASC 820 (Fair Value Measurement). Under ASC 820 (formerly, SFAS 157), firms disclose the fair value of pension assets in more detail by three levels: Level 1 (quoted

prices), Level 2 (inputs other than quoted prices), and Level 3 (unobservable inputs) (FAS ASC 820-10-20). Under this new disclosure rule, firms provide the information on pension asset allocation to private equity (mainly at Level 3), if they hold.

We find that corporate pension plans' investments in private equity are negatively related to lagged pension returns. The negative relation is salient when a pension plan is at a low funding level (or a high level of required cash contributions) and/or when the sponsoring firm has a leadership structure of CEO duality, which reduces boards' attention to monitoring (Tuggle et al., 2010). This return chasing of pension plans with increasing private equity investments, however, is not observed when a pension plan is at a high funding level or when the sponsoring firm has no CEO duality. In addition, the return chasing of DB plans is not observed from their investment in corporate equity. Thus, our results suggest that a corporate pension plan tends to chase higher returns by investing its assets in private equity but not in corporate equity when its funding level is low and/or when the sponsoring firm has the CEO duality. Regarding a leadership structure of sponsoring firms, we find that the CEO duality is positively associated with the performance of private equity investments of pension plans. The positive association would relate to pension fund managers' timely investment decisions based on the private equity market performance. Pension plans' net purchases of private equity are positively correlated with private equity benchmark returns when their sponsoring firms have the CEO duality, which would lower information transmission and processing costs (Brickley et al., 1997; Yang and Zhao, 2014).

Our paper makes two contributions. First, there is little known on how private equity is used in corporate pension investments mainly because of a lack of detailed information on pension asset allocation to private equity. To fill this research gap, we use more detailed and

accurate information on pension asset allocation to private equity disclosed in 10-K filings under ASC 820. After fair value implementation, private equity fund managers are more likely to update their valuations and, as a result, the valuation error becomes smaller (Crain and Law, 2017). This improvement would also be reflected on the information on private equity allocation disclosed in 10-K filings. Using more accurate information on corporate pension asset investments, we find that a pension plan's return chasing with private equity investments is salient when it is at a low funding level. Thus, our finding provides evidence to support corporate pension plans' risk shifting behavior, which increases risky assets in their portfolio while underfunding, addressed in the literature (e.g., Sharpe, 1976; Treynor, 1977; Bodie, Light, Morck, and Taggart, 1985; Anantharaman and Lee, 2014).

Second, our finding that private equity investment is related to corporate leadership structure adds to the literature on corporate pension asset allocation. Most prior studies focused on whether pension asset allocations are related to risk shifting incentives in the presence of Pension Benefit Guaranty Corporation (PBGC) (e.g., Sharpe, 1976; Treynor, 1977; Bodie et al., 1985; Coronado and Liang, 2005) or risk management incentives limiting costly financial distress (e.g., Friedman, 1983; Amir and Benartzi, 1999; Rauh, 2006, 2009). Relatively recently, research on pension asset allocation has begun to recognize the importance of corporate governance, such as external corporate governance (Phan and Hegde, 2013), pension trustee composition (Cocco and Volpin, 2007), top management compensation (Anantharaman and Lee, 2014; Alderson et al., 2017), and board composition (Vafeas and Vlittis, 2016). Our finding that a pension plan's return chasing with private equity investments is salient when it is at a low funding level and when the sponsoring firm has CEO duality suggests that a pension plan's risk

shifting is closely related to a leadership structure of the sponsoring firms, which proxies for the effectiveness of boards' monitoring role (Tuggle et al., 2010).

The remainder of this paper is organized as follows. The next section discusses literature and hypotheses. This is followed by data and sample, the empirical model, and results. The last section provides concluding remarks, limitations, and future research.

2. Literature Review and Hypotheses

Corporate pension plans have recently begun to invest a significant portion of their portfolio in private equity. For example, Aguirre and McFarland (2016) show that corporate pension plans of 274 Fortune 1000 companies aggregately allocated 4.7–5.9% of their pension assets to private equity for the period 2009–2015. Yet few studies examine what determines corporate pension investments in private equity. In this section, we discuss potential hypotheses for explaining corporate pension investments in private equity.

2.1. Pension plans' return chasing with private equity investment

Facing significant drop in equity values during the financial crisis, corporate pension plans would seek higher returns than expected from traditional corporate equity. In particular, pension fund managers would attempt to outperform their benchmarks because the fund flows depend on whether or not they beat benchmarks (Del Guercio and Tkac, 2002). Among alternative assets, private equity would be attractive because private equity provides higher returns than other alternative assets, such as real estate, hedge funds, and commodities, despite larger volatility (see, e.g., Bilton, 2016; Aubry, Chen, and Munnell, 2017). In addition, investments in riskier assets can be used to justify higher expected rate of returns (Bergstresser, Desai, and Rauh, 2006). The higher expected rate of returns reduces periodic pension costs, the

reduction which can inflate a firm's reported earnings (Bergstresser, Desai, and Rauh, 2006). Thus, when a corporate pension plan experiences lower investment returns in the previous year, the pension plan would invest in private equity in an attempt to achieve higher returns. In this regard, we develop the following hypothesis:

H1: Lagged investment returns are negatively related to pension plans' investment in private equity.

2.2. Pension plans' return chasing, funding status, and CEO duality

A pension plan's return chasing behavior would be salient when the pension plan faces a high level of required cash contribution. Addoum, van Binsbergen, and Brandt (2010) show that in the face of mandatory contributions, pension plans increase risky asset allocation to avoid mandatory contributions, which lead to a higher cost of capital (Campbell, Dhaliwal, and Schwartz, 2012). The tilt towards risky assets may be related to pension fund managers' motive to minimize the sponsor's additional funding contributions (van Binsbergen and Brandt, 2016). Since a high level of required cash contribution mainly results from underfunding in prior years, a pension plan's return chasing would also occur when a pension plan is at a low funding level. A pension plan's return chasing at a high level of required contributions or at a low funding level would reflect its risk shifting behavior, which increases pension risk by investing its assets in risky assets while underfunding (Rauh 2009; Anantharaman and Lee, 2014). Drawing on risky shifting of pension plans addressed in the literature (e.g., Sharpe, 1976; Treynor, 1977, Rauh 2009; Anantharaman and Lee, 2014), we hypothesize the following:

H2a: A pension plan's return chasing occurs when a pension plan is at a high level of required cash contributions or at a low funding level.

Corporate pension investment policies may be related to a sponsoring firm's corporate governance structure. Even though corporate pension regulations require firms to establish a separate trust for pension investments, pension investment policies are under the direction and control of the sponsoring firms through the board of directors and relevant committees (Bergstresser et al., 2006; Cocco and Volpin, 2007; Rauh, 2009; Phan and Hegde, 2013; Anantharaman and Lee, 2014). After reviewing pension governance structure of a random sample of 100 firms, Anantharaman and Lee (2014) argue that pension investment policies are under the responsibility of a finance, compensation, or pension committee, which is oversighted by the board, and that trustees and internal committee members are likely to report eventually to the sponsor's top executives. The board plays a central role in a corporate governance mechanism and an effective board monitors a firm's risk management process and risk-taking behavior (e.g., Brick and Chidambaran, 2008; John, Litov, and Yeung, 2008; Pathan, 2009). Given that pension investment policies are reviewed by the board of directors or by relevant committees at the sub-board level, corporate pension funds would invest in private equity in an attempt to seek higher returns when the monitoring role of the board is reduced. Regarding the monitoring role of the board, Imhoff (2003) argues that board governance is severely weakened when the current or former CEO also serves as a chair of the board. Tuggle et al. (2010) also document that boards' allocation of attention to monitoring is negatively related to CEO duality even when independent directors and institutional ownership are controlled for. The findings suggest that CEO duality plays an important role in board members' monitoring on pension investment policies. CEO duality, which relates to reduced monitoring of the board of directors, may facilitate corporate pension funds to increase the pension asset allocation to private equity when pension funds experience low returns. Therefore, we develop the following hypothesis:

H2b: A pension plan's return chasing occurs when the sponsoring firm has CEO duality.

3. Research Design

3.1. Data and sample

Our main sources of DB plan data are IRS 5500 and 10-K filings. Regarding IRS 5500 data, we match unique DB plans with the main Form 5500, Schedule H, and Schedule SB over the period of 2009–2014. We restrict our sample to DB plans that have 100 or more participants. The full sample of plan-level data consists of 26,598 plan-year observations on 4,433 unique plans and 3,821 unique employers (identified by EINs) for the period 2009–2014. For our estimation, we include only plans that are consecutively observed for the period. In addition, our plan-level model includes lagged variables. As a result, our estimation is restricted to the period 2010–2014. Thus, our estimation sample consists of 20,655 plan-year observations (of 4,131 unique plans pertaining to 3,586 unique employers) over the period. Regarding 10-K data, we hand-collect DB plan information for S&P 900 firms (mid- and large-cap firms) that have DB plans as of 12/31/2012. We restrict the sample to firms that provide the information on U.S. DB plans over the period 2009–2014. That is, the sample does not include either firms that have only international plans or ones that provide the information on pension asset allocation by aggregating U.S. and international plans. The full sample of firm-level data consists of 1,992 firm-year observations on 333 firms over the period. Similar to the estimation sample of the IRS 5500, we include only firms that are consecutively observed for the period. Because our model includes lagged variables, we restrict our analysis to firm-year observations for the period 2010–2014. In addition, we match the hand-collected data from 10-K filings with accounting data from the Compustat annual data files, director data from Institutional Shareholder Services (ISS), and

institutional ownership data from the Thomson-Reuters Institutional Holdings (13F) database. After the matching process, we have an estimation sample that consists of 1,160 firm-year observations (of 232 unique firms) for the period 2010–2014.[1]

3.2. Empirical model

To reflect the possibility that the influences on a pension plan's decision to invest in private equity are not the same as those that affect its decision on how much of assets it allocates to private equity, we use the zero-inflated-beta (ZIB) regression model developed by Cook, Kieschnick, and McCullough (2008).[2] Since not many pension plans invest in private equity, our dependent variable, the proportion of pension assets allocated to private equity, has characteristics of the fractional data that possesses a cluster at zero. For this mixed discrete-continuous random variable, the ZIB model provides better estimates of the coefficients and their standard errors than the Tobit model or the quasi-likelihood model of Papke and Wooldridge (1996) (Cook, Kieschnick, and McCullough, 2008). Therefore, we estimate the following ZIB model:

$$f(y_{it} = 0: \mathbf{X}_{it}) = 1 - C(\alpha'\mathbf{X}_{it}) \text{ for } y_{it} = 0, \tag{1}$$

and

$$f(y_{it}: \mathbf{X}_{it}) = C(\alpha'\mathbf{X}_{it}) \left[\frac{\Gamma(p+q(\mathbf{X}_{it}))}{\Gamma(p)\Gamma(q(\mathbf{X}_{it}))} y_{it}^{p-1}(1-y_{it})^{q(\mathbf{X}_{it})-1}\right] \text{ for } 0 < y_{it} < 1, \tag{2}$$

where $q(\mathbf{X}_{it}) = p \exp(-\beta'\mathbf{X}_{it})$, p is a parameter of the beta distribution, and $C(\alpha'\mathbf{X}_{it})$ represents the probability of a pension plan choosing to invest in private equity. For the probability, the model uses the cumulative logistic function. We refer to equation (1) as the

[1] For the sample of S&P 900 firms, its selection procedure is presented in Panel A of Table 5.

[2] As a robustness check, the Heckman selection model with the maximum likelihood estimation and the Tobit model are estimated. Results are not materially different from those reported in the paper. Estimation results using the alternative models are available upon request.

selection equation having the coefficient vector α and equation (2) as the allocation equation having the coefficient vector β in this paper. The dependent variable (y_{it}) is the proportion of pension assets allocated to private equity. The selection and allocation equations do not include the same independent variables.[3] The selection equation includes beginning-of-year pension assets as an instrument to account for the barriers-to-entry hypothesis (Campbell and Viceira, 2006; Atanasova and Chemla, 2016). For an analysis of the sample of IRS 5500 filings, the allocation equation includes discount rates to account for a potential positive relationship between risky asset allocation and discount rates, which are excluded from the selection equation. A higher discount rate would be likely to be used for a pension plan that has a longer pension liability duration, which allows the pension plan to invest more in illiquid assets such as private equity (Campbell and Viceira, 2006; Anantharaman, 2011). For an analysis of the sample of S&P 900 firms, the allocation equation includes the expected long-term rate of return on plan assets to account for a potential positive relationship between risky asset allocations and assumed long-term rates of return, which are excluded from the selection equation. Aggressive return assumptions can be justified by increasing asset allocations to risky assets including private equity (Bergstresser, Desai, and Rauh, 2006).

4. Empirical Results

4.1. Sample of IRS 5500 filings

4.1.1. ***Descriptive statistics***. Table 1 presents summary statistics for the sample of IRS 5500 filings. Panel A shows the summary statistics for the full sample. For the period 2009–2014, the

[3] $\mathbf{X}_{it}$ in the selection equation is not the same as $\mathbf{X}_{it}$ in the allocation equation. This is to reflect our assumption that variables that influence a pension plan's choice on whether to invest in private equity would be different from those that influence its decision on how much the pension plan allocates its portfolio to private equity.

funding ratio is on average 92.5% and the required cash contributions, scaled by beginning-of-year pension current liabilities, is on average 3.4%. Pension investment returns, which are calculated as investment income divided by beginning-of-year assets, are on average 10.6%.[4] The pension plans allocate, on average, 8.7% of their total pension assets to corporate equity, 3.6% to corporate debt, and 5.5% to government debt and cash, 1.2% to partnership or joint venture interests (referred to as private equity), and 0.1% to real estate. About 10% of 4,433 pension plans invest in private equity on average for the period and they allocate, on average, 12.5% of their assets to private equity. Panel B shows the summary statistics when the sample is restricted to the observations that are used for the estimation over the period 2010–2014. The beginning-of-year funding ratio and required contribution ratio are on average 92.9% and 3.2%, respectively, which are similar to those of the full sample. The estimation and full samples also show similar allocations across the asset categories.

[Table 1 here]

4.1.2. ***Determinants of corporate pension investment in private equity***. Table 2 presents logistic regression results. The dependent variable is a dummy variable that takes a value of one when a corporate pension plan invests in private equity. Panel A shows logistic regression results when the regression uses lagged investment returns of pension plans. Results in columns (1)-(3) show that lagged investment returns are negatively related to a pension plan's decision on whether to invest in private equity. Since a pension plan's mandatory contributions influence its asset allocation (Addoum, van Binsbergen, and Brandt, 2010), we include in the regression a required cash contribution ratio (column (1)) and funding ratios (columns (2) and (3)), which are closely related to mandatory contributions. Column (2) uses a funding ratio measured by the

[4] This calculation method assumes that pension contributions are not made until the end of the plan year.

funding target attainment percentage (*FR1*), which is calculated by the actuarial value of beginning-of-year pension assets divided by beginning-of-year total funding target amounts, while column (3) uses a funding ratio (*FR2*) defined by a ratio of the market value of beginning-of-year pension assets to beginning-of-year total funding target amounts. The results show that when a pension plan has a high required contribution ratio or a low funding ratio, the pension plan is more likely to invest in private equity. In addition, consistent with Atanasova and Chemla (2016), we find that pension plan size (log of plan assets) is positively related to the probability of private equity investment, supporting the barriers-to-entry hypothesis that suggests the importance of pension plan size for private equity investment. The results in Panel A show that lagged pension investment returns, a required contribution ratio (or a funding ratio), and pension plan size are significantly related to a pension plan's decision on whether or not to invest in private equity.

[Table 2 here]

In Panel B, we further examine whether a pension plan's allocation to private equity is influenced by peer investment returns. We use, as a peer investment return, the median return of a sector, which is defined by two-digit North American Industry Classification System (NAICS) codes.[5] A relative pension investment return (*RelPensionRet*) is measured by subtracting the sector median return from a pension plan's investment return in a given year. Regarding a pension plan's relative investment return, the model considers not only a continuous variable (*RelPensionRet* in column (1)) but also two dummy variables (*Low1* in column (2) and *Low2* in column (3)). The variable *Low1* takes a value of one if a pension plan's investment return is lower than the sector median return in the previous year and zero otherwise. The variable *Low2*

[5] Following two-digit NAICS classifications, codes 31-33 are classified as a sector of manufacturing, codes 44-45 as a sector of retail trade, and codes 48-49 as a sector of transportation and warehousing.

takes a value of one if a pension plan's investment return is lower than the sector median return in the two previous plan years and zero otherwise. The result in column (1) shows that a pension plan's decision on whether to invest in private equity is affected by peer investment returns and that the influence is not much different from that of a pension plan's own investment return. However, when a pension plan has consecutively experienced lower returns relative to peers for the past two years (column (3)), the probability of investing in private equity in the following year is increased by 58.3% compared to when a pension plan has lower returns relative to peers for the last year (column (2)). Overall, the results presented in Table 2 support the return chasing hypothesis (**H1**).

4.1.3. ***Corporate pension asset allocation to private equity***. We find from the previous section that lagged pension investment returns affect a pension plan's decision on whether to invest in private equity. In this section, we examine the extent to which lagged investment returns influence a pension plan's asset allocation to private equity. To implement this, we use the ZIB regression model, which includes two equations: selection and allocation equations. In the selection equation, the dependent variable is a dummy variable that takes a value of one when a pension plan invests in *no* private equity and zero otherwise. The selection equation includes beginning-of-year pension assets as an instrument to account for the influence of plan size on a decision to invest in private equity (Campbell and Viceira, 2006; Atanasova and Chemla, 2016). In the allocation equation, the dependent variable is the percentage of pension assets allocated to private equity. The allocation equation includes discount rates to account for a potential positive relationship between a pension plan's risky asset allocation and discount rates, which are excluded from the selection equation.

Results in Table 3 show that lagged investment returns are significantly negatively related to private equity allocation. Conditional on selecting private equity, a one standard deviation decrease in lagged investment returns is associated with a 9.2% increase in private equity allocation (column (1)).[6] This magnitude of the effect is similar to those in other specifications that use relative investment returns instead of a plan's own investment returns (column (2)) or use funding ratios instead of required contribution ratios (columns (3) and (4)). The results in the selection equation are similar to those in Table 2 except for the coefficient signs. The coefficient signs have changed because the dependent variable in the selection equation is defined in an opposite way compared with the dependent variable in Table 2. In sum, the results in Table 3 show that lagged investment returns influence a pension plan's decision not only on whether to invest in private equity but also on how much it allocates its assets to private equity, supporting the return chasing hypothesis.

[Table 3 here]

4.1.4. ***Lagged pension returns, required contributions, and funding status for private equity investment***. We further examine whether a negative association of lagged pension returns with private equity investments depends on a pension plan's required contributions or funding status, drawing the risk shifting hypothesis in the literature. For doing this, we analyze interactions of pension plans' lagged returns and required contributions (or funding status) for their investment in private equity. We use two dummy variables based on the sample medians of required contribution and funding ratios, respectively.[7] For a required contribution ratio (*RatioReqCtrb*),

[6] A 9.2% increase is calculated relative to the unconditional mean of private equity investment [-0.143 (the marginal effect) times 0.074 (standard deviation of lagged pension investment return) divided by 0.093 (the mean of private equity investment).

[7] Results using a dummy variable based on the sample mean, instead of the sample median, are similar to those reported in Table 4. The sample means of the required contribution ratio and the funding ratio are 0.032 and 0.929, respectively.

the model uses a dummy variable indicating two levels: low (a base category) and high. The variable *HighReqCtrb* takes a value of one when a required contribution ratio is greater than the median ratio (0.026) and zero otherwise. Similarly, a funding ratio (*FR1*) is categorized into two levels: low and high (a base category). The variable *LowFR* takes a value of one when the funding ratio is less than the median ratio (0.907) and zero otherwise.

Table 4 shows that a pension plan's return chasing with private equity investment occurs when the pension plan is at a high level of required cash contributions or a low funding level. Panel A presents regression results when the model uses pension plans' lagged returns. Results in Panel A show that lagged pension returns and required contributions significantly interact for the likelihood of investing in private equity (column (2)), suggesting that a pension plan is more likely to invest in private equity when it experienced low returns and faced a high level of required contributions in the previous year. However, interactions of lagged pension returns and required contributions for private equity allocation are not statistically significant (column (1)). The results instead show that a negative association of a pension plan's lagged returns and private equity allocation is significant only when it is at a high level of required cash contributions, but not when it is at a low level (rows [A] and [A]+[B]). When the model uses funding levels instead of required contribution levels (columns (3) and (4)), we find similar results to those in columns (1) and (2): lagged pension returns and funding levels significantly interact for the likelihood of investing in private equity, while they do not significantly interact for private equity allocation (column (3)). Similar to column (1), results in column (3) also show that lagged investment returns are significantly negatively associated with a pension plan's private equity allocation when it is at a low funding level, but this negative association is not significant when a pension plan is at a high funding level. Overall, the results show that a

negative association of a pension plan's lagged returns with private equity allocation is salient only when a pension plan has a high level of required cash contribution or a low funding level, supporting the hypothesis **H2a**.

[Table 4 here]

Panel B presents regression results when the model uses lagged investment returns relative to peers. Similar to Panel A, results in Panel B show that a pension plan's return chasing measured with lagged relative returns occurs when a pension plan has a high level of required cash contribution or a low funding level. Thus, our findings on pension plans' return chasing at a low funding level are robust when we use lagged pension returns relative to peers.

4.2. Sample of S&P 900 firms

4.2.1. ***Descriptive statistics.*** In addition to the IRS 5500 sample, we use a sample of S&P 900 firms (mid- and large-cap firms) to circumvent the limitation of the pension asset allocation data reported in the IRS 5500, such as opaque categories used by many large-sized pension plans. Considering the importance of pension plan size for private equity investment addressed in the previous section, we should include large-sized pension plans and their asset allocation to examine corporate pension plans' investment in private equity.

Table 5 presents a sample selection procedure for S&P 900 firms (Panel A) and its summary statistics (Panel B). After several steps, we have a complete sample that can be used in the estimation. The estimation sample consists of 1,160 firm-year observations (of 232 unique firms) for the period 2010–2014. Panel B shows the summary statistics for the estimation sample. The lagged funding ratio, which is measured as the ratio of the fair value of pension assets to the projected benefit obligation at the end of the year, is on average 83.0%. Pension investment returns, which are measured as actual returns divided by beginning-of-year pension

assets, are on average 11.8%. The average rate of investment returns is slightly higher than that of the IRS 5500 sample, which is 11.4% (Panel B of Table 1). Regarding asset allocations, notably, the percentage of other investments is significantly reduced compared to the IRS 5500 sample because firms use opaque categories less when they disclose pension asset allocation in the 10-K. We also find that many mid- or large-cap firms invest their pension assets in private equity. Over 40% of 232 firms invest in private equity on average for the period 2010–2014 and they allocate, on average, 5.2% of their assets to private equity. Regarding a firm's leadership structure, 22.8% of the sample firms have no CEO duality for the period 2009–2014.

[Table 5 here]

4.2.2. ***Corporate pension asset allocation to private equity*.** Table 6 presents ZIB model regression results for the sample of S&P 900 firms. The dependent variable in the allocation equation (columns (1) and (3)) is the percentage of pension assets allocated to private equity while the dependent variable in the selection equation (columns (2) and (4)) is a dummy variable that takes a value of one when a pension plan invests in *no* private equity and zero otherwise. The model also considers pension plans' own investment returns (columns (1) and (2)) and pension investment returns relative to peers (columns (3) and (4)).

[Table 6 here]

Results in Table 6 show that lagged pension investment returns are significantly negatively associated with pension plans' private equity allocation. The negative association is also found when the model uses pension investment returns relative to peers. Thus, consistent with Table 3 (for the IRS 5500 sample), the results support the hypothesis **H1**. Results in the table 6 also show that private equity investments are positively related to the expected long-term rate of return on plan assets, which is used to determine net periodic pension cost. Consistent

with Bergstresser, Desai, and Rauh (2006), our results show that pension plans adopt aggressive return assumptions while increasing asset allocations to risky assets such as private equity.

To capture the potential influence of firm characteristics on private equity allocation, we include CEO duality as a proxy for a firm's leadership structure and firm-level control variables drawing on prior studies (Rauh, 2009; Phan and Hedgde, 2013; Anantharaman and Lee, 2014). For CEO duality, we use a dummy variable (*CEODuality*) that takes a value of one when a sponsoring firm has CEO duality at any time for the period 2009–2014 and zero when it has no CEO duality for the period. We find no direct effect of CEO duality on private equity allocation. For other firm characteristics, we find that a large-sized firm or a growing firm (having a high market-to-book ratio) tends to allocate more pension assets to private equity. The effect of the latter, however, is not economically significant.

4.2.3. ***Lagged pension returns, funding status, and CEO duality for private equity investment.*** We further investigate whether a negative association of a pension plan's lagged returns and private equity investment relies on its funding status and/or CEO duality. For doing this, we analyze two-way and three-way interaction effects on private equity allocation. Table 7, Panel A presents regression results when the model uses pension plans' lagged investment returns. First, we examine whether a negative association of a pension plan's lagged investment returns with private equity investment depends on its funding status. We use a dummy variable of funding ratios. The variable *LowFS* takes a value of one when the variable *FundingStatus* is less than the median ratio (0.812) and zero otherwise.[8] Results in column (1) show that while the coefficient of the variable *PensionRet* is not significant when a pension plan is at a high funding level (row [A]), the coefficient is significantly negatively related to private equity allocation when a pension

[8] Results using a dummy variable based on the sample mean (0.830), instead of the sample median, are similar to those reported in Table 7.

plan is at a low funding level (row [A]+[B]). The results, which are consistent with those for the IRS 5500 sample (see column (2) of Table 4), support the hypothesis **H2a**. Thus, our finding suggests that a pension plan's return chasing by increasing private equity allocation occurs when it is at a low funding level, but not when it is at a high funding level.

[Table 7 here]

Second, we examine whether a negative association of a pension plan's lagged returns with private equity investment depends on the sponsoring firm's CEO duality. Results in column (2) show that while the coefficient of the variable *PensionRet* is not significant when the sponsoring firm has no CEO duality (row [A]), the coefficient is significantly negatively related to private equity allocation when the sponsoring firm has CEO duality (row [A]+[C]). The results support the hypothesis **H2b**, suggesting that a pension plan's return chasing by increasing private equity allocation occurs when the sponsoring firm has CEO duality, but not when the sponsoring firm has no CEO duality.

Third, we examine whether a negative association of a pension plan's lagged returns with private equity investment depends on its funding status and the sponsoring firm's CEO duality. Results in column (3) show that the coefficient of the variable *PensionRet* is not significant when both the variables *LowFS* and *CEODuality* are equal to zero (row [A]) or when either one is equal to zero (row [A]+[B] or [A]+[C]), but that the coefficient is significantly negatively related to private equity allocation when both the variables *LowFS* and *CEODuality* are equal to one (row [A]+[B]+[C]+[D]). The results suggest that a pension plan's return chasing by increasing private equity allocation occurs only when the pension plan is at a low funding level and when the sponsoring firm has CEO duality.

Last, Panel B presents regression results when the model uses pension plans' lagged returns relative to peers. Similar to Panel A, results in Panel B show a pension plan's return chasing with increasing private equity allocation occurs when it is at a low funding level and when the sponsoring firm has CEO duality. Thus, our finding is robust to using lagged relative investment returns.

4.2.4. ***Corporate pension asset allocation to corporate equity*****.** Since corporate pension plans show return chasing with private equity investment when they are at a low funding level and when sponsoring firms have CEO duality, we examine whether corporate pension plans show similar return chasing with corporate equity investment. For the two samples, we run the same regressions except for the dependent variables. For the IRS 5500 sample, we use as the dependent variable the percentage of pension assets allocated to corporate equity, which is defined as the sum of corporate common and preferred stocks and employer securities. For the S&P 900 sample, we use as the dependent variable the percentage of pension assets allocated to corporate equity, which is defined as the sum of U.S. and international equities and equity funds.

Table 8 presents ZIB model regression results on pension plans' corporate equity investment. Panel A presents regression results for the IRS 5500 sample. Results in column (1) show that lagged pension returns are significantly positively associated with corporate equity allocation. The positive association is opposite to the negative association of private equity allocation. Results in columns (2) and (3) show that the positive association of lagged pension returns with corporate equity allocation is reduced when a pension plan is at a high level of required cash contributions or at a low funding level. Panel B presents regression results for the S&P 900 sample. Similar to Panel A, results show positive associations of a pension plan's lagged returns with corporate equity investment. The positive association of lagged investment

returns with corporate equity allocation becomes weak when a pension plan is at a low funding level and when the sponsoring firm has CEO duality. Overall, we find that pension plans' return chasing found from private equity investment is not observed from their investment in corporate equity.

[Table 8 here]

4.3. Corporate pension plans' return chasing with private equity investment

In the previous sections, we have examined how a pension plan's lagged investment returns are associated with private equity and corporate equity investments and found that the associations depend on a pension plan's required contributions (or funding level) and on whether the sponsoring firm has CEO duality, which is related to the reduced monitoring role of the board (Tuggle et al., 2010). This section quantifies the extent to which a pension plan's required contribution (or funding status) and the sponsoring firm's leadership structure influence the effects of a pension plan's lagged investment returns on its private equity and corporate equity allocations.

To compare the magnitudes of the effects of lagged pension returns, we measure a change in private equity and corporate equity allocations corresponding to a one standard deviation decrease in the lagged pension return, which is 7.4%. Table 9 summarizes the effects of lagged pension returns for the two samples. Results in Panel A (for the IRS 5500 sample) show that a pension plan's return chasing does not occur when it is at a low level of required cash contributions or when it is at a high funding level. However, when a pension plan is at a high level of required cash contributions or at a low funding level, it seeks higher returns by increasing its private equity allocation but decreasing its corporate equity allocation. In particular, when a pension plan is at a low funding level, it increases its private equity allocation

by 10.0% but decreases its corporate equity allocation by 9.9% relative to the mean allocations, respectively, corresponding to a one standard deviation decrease in lagged pension returns. Results in Panel B (for the S&P 900 sample) show that when a pension plan is at a low funding level and when the sponsoring firm has CEO duality, it increases its private equity allocation by 6.9% but decreases its corporate equity allocation by 2.7% relative to the mean allocations, respectively, corresponding to a one standard deviation decrease in lagged pension returns. Overall, the results show that a pension plan's return chasing by increasing private equity and decreasing corporate equity allocations is influenced by its funding level and the sponsoring firm's leadership structure.

[Table 9 here]

4.4. Performance of corporate pension plans' private equity investments

In this section, we examine the performance of private equity investments of corporate pension plans in the sample of S&P 900 firms for the period 2009–2014. We measure the performance with realized and unrealized gains reported under ASC 820. The accounting rule requires firms to report changes in the fair value of Level 3. Under this rule, firms disclose realized and unrealized gains, purchases, and sales of assets of Level 3 at which most private equity investments are reported.[9] The rate of returns on private equity investment is calculated by the sum of realized and unrealized gains divided by beginning-of-year private equity assets. When a corporate pension plan that holds private equity at the end of the year does not hold it at the beginning of the year, we calculate the rate of returns with an assumption that all transactions occur in the middle of a given year, as in Dietz (1986). In addition, when a firm does not report

[9] After fair value measurement rules were amended under Accounting Standards Update 2015-07, many firms do not report realized and unrealized gains, purchases, and sales of private equity because the amendment allows firms to report its net asset value, which should not be categorized in the fair value hierarchy. Thus, the information on private equity performance is mostly available only for fiscal years of 2009 to 2014.

realized or unrealized gains, the rate of returns on private equity investment is calculated by $R_{PE} = (FVE_{PE} - FVB_{PE} - NP_{PE})/(FVB_{PE} + 0.5 \times NP_{PE})$ where FVE_{PE} is the end-of-year fair value of private equity, FVB_{PE} the beginning-of-year fair value of private equity, and NP_{PE} a net purchase of private equity in a given year. A net purchase is calculated by subtracting sales from purchases in a given year.

Table 10 presents the performance of pension plans that invest in private equity. Panel A shows that pension plans investing in private equity report a higher return by 0.33 percentage points (pp), on average, than those not investing in private equity. The difference, however, is not statistically significant. When pension returns are compared to peer returns in the same sector based on two-digit NAICS codes, pension plans investing in private equity have a higher return by 0.42 pp, on average, than their peers. In contrast, pension plans that do not invest in private equity have a lower return by 0.04 pp, on average, than their peers. However, the difference is not statistically significant.

[Table 10 here]

We examine whether private equity investment returns are related to CEO duality of sponsoring firms. Panel B shows that private equity returns are lower by 2.26 pp, on average, when sponsoring firms have no CEO duality during the period than when they have CEO duality. The difference, however, is not statistically significant. Then we compare private equity returns focusing on two cases of CEO duality: (1) *no* CEO duality exists and (2) CEO duality exists all the time during the period. When sponsoring firms have no CEO duality, private equity returns are lower by 3.89 pp, on average, compared to when sponsoring firm have CEO duality all the time during the period. The difference is statistically significant at the 5% level.

We further examine relationships between private equity returns and CEO duality by using a continuous variable on CEO duality, instead of dummy variables in Panel B. The continuous variable *RatioCEODuality* is defined by the share of the years in which CEO duality exists during the period. The variable takes the minimum value of zero when *no* CEO duality exists during the period, a value of greater than zero or less than one when CEO duality exists at some time during the period, and the maximum value of one when CEO duality exists all the time during the period. Panel C presents OLS regression results on pension plans' private equity returns. Private equity returns are not significantly related to CEO duality when it is defined with the dummy variable *CEODuality*, which takes a value of one when CEO duality exists at any time for the period 2009–2014 and zero when no CEO duality exists for the period (column (1)). However, when CEO duality is defined with the continuous variable *RatioCEODuality*, private equity returns are significantly positively related to sponsoring firms' CEO duality (column (2)). Private equity returns are higher by 4.30 pp when sponsoring firms have CEO duality all the time during the period (i.e., when *RatioCEODuality* = 1) compared to when sponsoring firms have no CEO duality during the period (i.e., when *RatioCEODuality* = 0). This magnitude is similar to that of the effect of CEO duality reported in Panel B. The positive relationship between private equity returns and CEO duality and its magnitude are robust even when we include the allocation of pension assets to private equity (column (3)) and board characteristics (column (4)).

Regarding a positive association of private equity returns with CEO duality, we investigate how the positive association is related to pension plans' private equity investments. We examine covariances among benchmark returns, private equity returns, and net purchases of private equity for the period 2009–2014. We use as a benchmark return the internal rate of return (IRR) of the Cambridge Associates US Private Equity by vintage years. Net purchases of private

equity are scaled by the average of beginning-of-year and end-of-year fair values of private equity. To calculate a covariance, we drop firm-year observations that have the end-of-year value of private equity equal to zero because they indicate the settlement of private equity investments, which does not reflect a relationship between private equity returns and net investments in private equity. To calculate a covariance, we restrict our analysis to firms that report the private equity information for two or more years.

Panel D shows that the signs of the covariances are different depending on whether sponsoring firms have CEO duality or not. First, private equity returns of pension plans in which sponsoring firms have no CEO duality for the period are, on average, negatively correlated with the benchmark returns. In contrast, private equity returns of pension plans in which sponsoring firms have CEO duality all the time during the period are, on average, positively correlated with the benchmark returns. The difference in the covariances between the two groups is significant at the 10% level (p-value = 0.097). Second, pension plans' net purchases of private equity are, on average, negatively correlated with the benchmark returns when sponsoring firms have no CEO duality during the period. In contrast, net purchases of private equity are, on average, positively correlated with the benchmark returns when sponsoring firms have CEO duality all the time during the period. The difference in the covariances between the two groups is significant at the 10% level (p-value = 0.054). Third, pension plans' net purchases of private equity are, on average, negatively correlated with their private equity returns when sponsoring firms have no CEO duality during the period. In contrast, pension plans' net purchases of private equity are, on average, positively correlated with their private equity returns when sponsoring firms have CEO duality all the time during the period. The difference in the covariances between the two groups, however, is statistically significant at the 5% level (p-value = 0.037). Overall, the results show

that when sponsoring firms have CEO duality, pension plans' net investments in private equity are positively correlated with the benchmark returns and with their private equity returns. The findings would be related to boards' reduced monitoring under CEO duality. When sponsoring firms have CEO duality, pension fund managers may be able to make speedy decisions on private equity investments based on the market performance. Since CEO duality would lower information transmission and processing costs (Brickley et al., 1997; Yang and Zhao, 2014), it would lead to a positive association of pension plans' net investments in private equity and the benchmark returns and, as a result, a positive association of private equity returns with the benchmark returns.

5. Conclusion

We examine the determinants of corporate pension investment in private equity and the extent to which a pension plan's lagged returns influence its asset allocation to private equity. We also examine how the effects of a pension plan's lagged returns on private equity investments depend on its funding status or CEO duality. Using the IRS 5500 and S&P 900 samples, we test return chasing and reduced monitoring hypotheses on corporate pension plans' investment in private equity. We find evidence to support both hypotheses. First, a pension plan's investment in private equity is negatively related to its lagged investment returns and to lagged investment returns relative to peers. The results support the return chasing hypothesis. Second, a pension plan's return chasing occurs when it is at a low funding level and when the sponsoring firm has CEO duality. The latter result supports the reduced monitoring hypothesis. Third, we find that the CEO duality is positively associated with the performance of private equity investments of pension plans.

Few studies examine corporate pension investments in private equity mainly because of a lack of detailed information on corporate asset allocations. More detailed information on pension asset allocation disclosed in 10-K filings under ASC 820 enables us to examine corporate pension plans' investment in private equity. In addition, the accounting rule requires firms to disclose changes in the fair values (including net gains or losses, sales, and purchases) of Level 3 if their pension plans hold assets at Level 3. Firms report most private equity investments at Level 3. Thus, the information on changes in the fair values of private equity makes it possible to directly measure performance and net investments in private equity. However, the high cost of manual data collection restricts us to S&P 900 firms (mid- and large-cap firms) sponsoring DB plans for the period 2009–2014. Therefore, future research is called for to collect the pension data of small-cap firms from 10-K filings and to investigate whether pension plans' return chasing with private equity investments at a low funding level and under the CEO duality are observed among small-cap firms sponsoring DB plans.

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Table 1. Descriptive Statistics for A Sample from IRS 5500 Filings

This table provides descriptive statistics for the full sample (Panel A) and estimation sample (Panel B) from IRS 5500 filings. The full sample consists of 26,598 plan-year observations on 4,433 unique plans and 3,821 unique employers (identified by EINs) over the period of 2009–2014. The full sample is restricted to the observations that are used in the estimation. Since lagged variables are used in the estimation, the sample period is reduced to 2010–2014. The estimation sample consists of 20,655 plan-year observations (of 4,131 unique plans pertaining to 3,586 unique employers) that are consecutively observed over the period of 2010–2014. Pension assets are measured at the beginning of the plan year (Schedule H, Line 1f). Pension current liability is the total funding target amount at the beginning of the plan year (Schedule SB, Line 3d). Pension investment income is measured as the total income minus total contributions minus other noninvestment income (Schedule H, Line 2d – Line 2a(3) – Line 2c). Required cash contribution is a non-negative cash contribution amount required for the current plan year (Schedule SB, Line 36). A negative cash contribution (9 observations) is treated as a zero-cash contribution. A funding ratio is measured as the funding target attainment percentage (Schedule SB, Line 14). If it is missing, a funding ratio is calculated as the actuarial value of pension assets minus beginning-of-year carryover and prefunding balances (Schedule SB, Line 2b – Line 13) divided by beginning-of-year total funding target amounts (Schedule SB, Line 3d). A required contribution ratio is measured as beginning-of-year required cash contributions scaled by beginning-of-year total funding target amounts. Pension investment returns are measured as pension investment income divided by beginning-of-year pension assets (Schedule H, Line 1f). An active participant ratio is the ratio of active participants to total participants. Pension asset allocation is calculated by using Schedule H. Partnership or joint venture interests are referred to as private equity in the table. Corporate equity includes the employer stocks. Insurance company accounts indicate a plan's investment in insurance company general accounts. Corporate debt includes preferred and all other debt instruments. Real estate includes employer real property and other property used in plan operation. Other investments include investments in common or collective trusts, pooled separate accounts, master trusts, and mutual funds. Discount rate indicates the effective interest rate (Schedule SB, Line 5), the single rate of interest used to calculate funding target liabilities.

A. Full sample (2009–2014)

	N	Mean	Std Dev	1st pctl	Median	99th pctl
Levels (in millions of dollars)						
Pension assets	26,598	282.74	1,583.84	1.312	29.486	4,519.02
Pension current liabilities (A)	26,583	256.68	1,378.91	1.462	30.061	4,024.29
Pension investment income	26,598	29.80	173.71	-2.095	2.530	516.14
Required cash contribution (B)	25,935	3.64	18.25	0	0.415	60.17
Ratios						
Funding ratio	26,579	0.925	0.196	0.605	0.904	1.521
Required contribution ratio (B/A)	25,910	0.034	0.077	0	0.026	0.171
Pension investment return	26,575	0.106	0.072	-0.033	0.112	0.277
Active participant ratio	26,598	0.417	0.236	0	0.414	0.948
Asset allocation						
Corporate equity	26,598	0.087	0.179	0	0	0.698
Corporate debt	26,598	0.036	0.094	0	0	0.459
Government debt and cash	26,598	0.055	0.118	0	0.003	0.565
Insurance company accounts	26,598	0.024	0.117	0	0	0.758
Partnership or joint venture interests (private equity)	26,598	0.012	0.058	0	0	0.286
Real estate	26,598	0.001	0.012	0	0	0.032
Other investments	26,598	0.785	0.317	0.001	0.619	1
Private equity investment (yes=1)	26,598	0.098	0.297	0	0	1
Allocation to private equity	2,604	0.125	0.144	0.0001	0.080	0.750
Plan frozen (yes=1)	26,598	0.319	0.466	0	0	1
Discount rate	26,567	0.068	0.096	0.052	0.065	0.083
Plan-year observations: 26,598						
Number of unique plans: 4,433						
Number of unique employers identified by EIN: 3,821						

B. Estimation sample (2010–2014)

	Mean	Std Dev	1st pctl	Median	99th pctl
Levels (in millions of dollars)					
Beginning-of-year pension assets	300.98	1,654.62	1.48	30.84	4,876.92
Beginning-of-year pension current liabilities	271.97	1,449.87	1.61	30.79	4,272.96
Ratios					
Beginning-of-year funding ratio	0.929	0.200	0.619	0.907	1.524
Beginning-of-year required contribution ratio	0.032	0.036	0	0.026	0.145
Lagged pension investment return	0.114	0.074	-0.035	0.121	0.283
Lagged pension return relative to peers	-0.003	0.050	-0.156	0	0.116
Lagged active participant ratio	0.422	0.238	0	0.420	0.948
Asset allocation					
Corporate equity	0.085	0.177	0	0	0.701
Corporate debt	0.035	0.094	0	0	0.471
Government debt and cash	0.052	0.115	0	0.003	0.562
Insurance company accounts	0.023	0.114	0	0	0.719
Private equity	0.011	0.055	0	0	0.275
Real estate	0.001	0.012	0	0	0.033
Other investments	0.793	0.310	0.002	0.986	1
Private equity investment (yes=1)	0.093	0.291	0	0	1
Allocation to private equity (N=1,929)	0.117	0.143	0.0001	0.072	0.750
Lagged plan frozen (yes=1)	0.314	0.464	0	0	1
Beginning-of-year discount rate	0.065	0.060	0.052	0.065	0.072
Plan-year observations: 20,655					
Number of unique plans: 4,131					
Number of unique employers identified by EIN: 3,586					

Table 2. Determinants of Corporate Pension Investment in Private Equity

This table presents logistic regression results. The dependent variable is a dummy variable that takes a value of one if a pension plan invests in private equity and zero otherwise. The subscript *t*-1 indicates at the end of the previous plan year or at the beginning of the current plan year. A pension investment return is calculated by pension investment income divided by beginning-of-year pension assets. The variable RatioReqCtrb is a required contribution ratio, which is measured as beginning-of-year required cash contributions scaled by beginning-of-year total funding target amounts. The variable FR1 is a funding ratio measured by the funding target attainment percentage. The variable FR2 is a funding ratio defined by the market value of beginning-of-year pension assets (Schedule SB, Line 2a) divided by beginning-of-year total funding target amounts (Schedule SB, Line 3d). The variables PlanAsset and TotalParticipant takes a natural logarithm of plan assets and the number of total participants. All other variables' definitions are in Table 1. Panel A presents results when the model uses a pension plan's own lagged investment returns. Panel B presents results when the model uses a plan's lagged investment returns relative to peers. A relative pension investment return is calculated by subtracting the sector median return from a plan's investment return. The sector is defined by two-digit NAICS codes. Regarding a pension plan's relative investment return, the model considers not only a continuous variable (RelPensionRet) but also dummy variables (Low1 and Low2). The variable Low1 takes a value of one when a plan's relative investment return is negative in the previous plan year and zero otherwise. The variable Low2 takes a value of one when a plan's relative investment return is negative in the two previous plan years and zero otherwise. Marginal effects are evaluated at the means of independent variables. Robust standard errors clustered on employers are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

A. Pension plan investment returns

	(1)		(2)		(3)	
Private equity investment (yes=1)	Coef. (Std Error)	Marginal effects	Coef. (Std Error)	Marginal effects	Coef. (Std Error)	Marginal effects
$PensionRet_{t-1}$	-2.418***	-0.143	-2.406***	-0.141	-2.168***	-0.126
	(0.535)		(0.543)		(0.544)	
$RatioReqCtrb_{t-1}$	2.854**	0.168				
	(1.177)					
$FR1_{t-1}$			-1.081***	-0.063		
			(0.403)			
$FR2_{t-1}$					-1.010***	-0.059
					(0.332)	
$\ln(PlanAsset_{t-1})$	0.477***	0.028	0.483***	0.028	0.519***	0.030
	(0.082)		(0.081)		(0.083)	
$Frozen_{t-1}$ (yes=1)	0.038	0.002	-0.007	-0.000	-0.027	-0.002
	(0.124)		(0.122)		(0.122)	
$ActiveRatio_{t-1}$	-0.322	-0.019	-0.109	-0.006	-0.034	-0.002
	(0.266)		(0.266)		(0.269)	
$\ln(TotalParticipant_{t-1})$	0.066	0.004	0.054	0.003	0.025	0.001
	(0.088)		(0.089)		(0.090)	
Year fixed effects	Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes	
Plans	4,131		4,131		4,131	
Employers identified by EIN	3,586		3,586		3,586	
Observations	20,655		20,655		20,655	
Pseudo R^2	0.141		0.142		0.143	

Table 2 (Continued)

B. Pension plan investment returns relative to peers

	(1)		(2)		(3)	
Private equity investment (yes=1)	Coef. (Std Error)	Marginal effects	Coef. (Std Error)	Marginal effects	Coef. (Std Error)	Marginal effects
$RelPensionRet_{t-1}$	-2.434***	-0.144				
	(0.538)					
Low_{t-1} (Low1)			0.411***	0.024		
			(0.060)			
[Low_{t-2}, $Low1_{t-1}$] (Low2)					0.655***	0.038
					(0.082)	
$RatioReqCtrb_{t-1}$	2.843**	0.168	2.843**	0.166	4.085***	0.238
	(1.177)		(1.186)		(1.410)	
$ln(PlanAsset_{t-1})$	0.477***	0.028	0.479***	0.028	0.494***	0.029
	(0.082)		(0.082)		(0.082)	
$Frozen_{t-1}$ (yes=1)	0.037	0.002	0.029	0.002	0.032	0.002
	(0.124)		(0.124)		(0.128)	
$ActiveRatio_{t-1}$	-0.322	-0.019	-0.334	-0.020	-0.361	-0.021
	(0.266)		(0.266)		(0.269)	
$ln(TotalParticipants_{t-1})$	0.066	0.004	0.068	0.004	0.080	0.005
	(0.088)		(0.088)		(0.089)	
Year fixed effects	Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes	
Plans	4,131		4,131		4,131	
Employers identified by EIN	3,586		3,586		3,586	
Observations	20,655		20,655		16,524	
Pseudo R^2	0.141		0.144		0.153	

Table 3. Corporate Pension Plan Investments in Private Equity

This table presents zero-inflated beta (ZIB) model regression results. In the allocation equation, the dependent variable is the percentage of pension assets allocated to private equity. In the selection equation, the dependent variable is a dummy variable that takes a value of one when a pension plan invests in *no* private equity. All other variables' definitions are in Tables 1 and 2. The subscript *t*-1 indicates at the end of the previous plan year or at the beginning of the current plan year. A marginal effect in the allocation equation is evaluated conditional on the dependent variable greater than zero and less than one, indicating an allocation change corresponding to a one-unit change in an independent variable. A marginal effect in the selection equation indicates a change in the probability of the dependent variable being equal to zero corresponding to a one-unit change in an independent variable. Robust standard errors clustered on employers are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)		(2)		(3)		(4)	
	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect
Allocation equation: Pension asset allocation to private equity								
PensionRet$_{t-1}$	-1.105**	-0.115			-1.140**	-0.119		
	(0.495)				(0.488)			
RelPensionRet $_{t-1}$			-1.076**	-0.112			-1.110**	-0.116
			(0.497)				(0.490)	
RatioReqCtrb$_{t-1}$	-0.830	-0.086	-0.827	-0.086				
	(1.364)		(1.364)					
FR1$_{t-1}$					0.299	0.031	0.298	0.031
					(0.376)		(0.376)	
Discount rate$_{t-1}$	8.001	0.831	8.059	0.837	7.808	0.814	7.870	0.820
	(6.659)		(6.661)		(6.918)		(6.918)	
Frozen$_{t-1}$ (yes=1)	-0.134	-0.014	-0.134	-0.014	-0.119	-0.012	-0.119	-0.012
	(0.094)		(0.094)		(0.096)		(0.096)	
ActiveRatio$_{t-1}$	0.090	0.009	0.090	0.009	0.031	0.003	0.031	0.003
	(0.253)		(0.253)		(0.255)		(0.255)	
ln(TotalParticpant$_{t-1}$)	-0.033	-0.003	-0.033	-0.003	-0.033	-0.003	-0.033	-0.003
	(0.029)		(0.029)		(0.029)		(0.029)	

Table 3 (Continued)

	(1)		(2)		(3)		(4)	
	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect
Selection equation: Private equity investment (no=1):								
$PensionRet_{t-1}$	2.418***	0.143			2.406***	0.141		
	(0.535)				(0.543)			
$RelPensionRet_{t-1}$			2.434***	0.144			2.427***	0.142
			(0.538)				(0.546)	
$RatioReqCtrb_{t-1}$	-2.854**	-0.168	-2.843**	-0.168				
	(1.177)		(1.177)					
$FR1_{t-1}$					1.081***	0.063	1.081***	0.063
					(0.403)		(0.403)	
$\ln(PlanAsset_{t-1})$	-0.477***	-0.028	-0.477***	-0.028	-0.483***	-0.028	-0.483***	-0.028
	(0.082)		(0.082)		(0.081)		(0.081)	
$Frozen_{t-1}$ (yes=1)	-0.038	-0.002	-0.037	-0.002	0.007	0.000	0.007	0.000
	(0.124)		(0.124)		(0.122)		(0.122)	
$ActiveRatio_{t-1}$	0.322	0.019	0.322	0.019	0.109	0.006	0.109	0.006
	(0.266)		(0.266)		(0.266)		(0.266)	
$\ln(TotalParticipant_{t-1})$	-0.066	-0.004	-0.066	-0.004	-0.054	-0.003	-0.054	-0.003
	(0.088)		(0.088)		(0.089)		(0.089)	
Year fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Plans	4,131		4,131		4,131		4,131	
Firms identified by EIN	3,586		3,586		3,586		3,586	
Observations	20,655		20,655		20,655		20,655	

Table 4. The Effects of Lagged Pension Return, Required Contribution, Funding Ratio on Pension Asset Allocation to Private Equity

This table presents zero-inflated beta (ZIB) model regression results on the effects of pension investment returns, required contributions, and a funding ratio on private equity investment. Panel A presents results of the regression that uses a pension plan's own lagged investment returns while Panel B presents results of the regression that uses a pension plan's lagged investment returns relative to peers. For a required contribution ratio (RatioReqCtrb), the model uses a dummy variable with two levels: low (a base category) and high. The variable HighReqCtrb takes a value of one when a required contribution ratio is greater than the median ratio (0.026) and zero otherwise. A funding ratio (FR1) is also categorized into two levels: low and high (a base category). The variable LowFR takes a value of one when the funding ratio is less than the median ratio (0.907) and zero otherwise. A marginal effect in the allocation equation is evaluated conditional on the dependent variable greater than zero and less than one, indicating an allocation change corresponding to a one-unit change in an independent variable. A change in marginal effects is calculated with respect to a base category. In the allocation equation, controls include discount rates, plan frozen, active participant ratios, and the number of total participants. In the selection equation, controls include all the variables in the allocation equation except for discount rate and beginning-of-year pension assets as an instrument. Robust standard errors clustered on employers are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

A. Pension plan investment returns

	(1)		(2)		(3)		(4)	
	Allocation equation: Private equity (%)		Selection equation: *No* private equity (=1)		Allocation equation: Private equity (%)		Selection equation: *No* private equity (=1)	
	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect
$PensionRet_{t-1}$ [A]	-1.026*	-0.108	1.783***	0.091	-0.769	-0.082	1.348**	0.068
	(0.584)		(0.607)		(0.557)		(0.621)	
$PensionRet_{t-1}$	-0.146		1.672**					
× $HighReqCtrb_{t-1}$ (yes=1) [B]	(0.604)		(0.702)					
$PensionRet_{t-1}$					-0.778		2.396***	
× $LowFR_{t-1}$ (yes=1) [C]					(0.607)		(0.745)	
Coefficients:								
[A]+[B]	-1.171**	-0.120	3.454***	0.232				
[A]+[C]					-1.547***	-0.158	3.745***	0.259
Controls	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Plans	4,131		4,131		4,131		4,131	
Employers identified by EIN	3,586		3,586		3,586		3,586	
Observations	20,655		20,655		20,655		20,655	

Table 4 (Continued)

B. Pension plan investment returns relative to peers

	(1)		(2)		(3)		(4)	
	Allocation equation: Private equity (%)		Selection equation: *No* private equity (=1)		Allocation equation: Private equity (%)		Selection equation: *No* private equity (=1)	
	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect
$RelPensionRet_{t-1}$ [D]	-0.424	-0.045	1.533**	0.078	-0.393	-0.042	0.931	0.046
	(0.629)		(0.664)		(0.653)		(0.701)	
$RelPensionRet_{t-1}$	-1.728*		2.618**					
× $HighReqCtrb_{t-1}$ (yes=1) [E]	(1.016)		(1.075)					
$RelPensionRet_{t-1}$					-1.682		3.460***	
× $LowFR_{t-1}$ (yes=1) [F]					(1.110)		(1.087)	
Coefficients:								
[D]+[E]	-2.152***	-0.219	4.152***	0.278				
[D]+[F]					-1.547***	-0.158	4.391***	0.301
Controls	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Plans	4,131		4,131		4,131		4,131	
Employers identified by EIN	3,586		3,586		3,586		3,586	
Observations	20,655		20,655		20,655		20,655	

Table 5. Sample Selection and Descriptive Statistics for A Sample from S&P 900 Firms

A. Sample selection

	Number of firms	Number of firm-year observations
S&P 900 firms (mid- and large-cap firms) that have defined benefit (DB) plans as of 12/31/2012	481	
Firms that have U.S. plans for 2009–2014 from 10-K filings: Excluding firms that have only international plans or provide pension asset allocation information by aggregating U.S. and international plans	333	1,992
Less: firm-year observations that have incomplete pension, financial, and corporate governance information for our analysis	101	600
Estimation sample: Since our model includes lagged variables, a regression analysis is conducted for a final sample of 232 firms that have complete information for 2010–2014	232	1,160

B. Descriptive statistics

The table below presents descriptive statistics for the estimation sample (2010–2014). Pension assets and liabilities are the fair value of pension assets and the projected benefit obligation, respectively, at the end of the year. Funding status is measured as the ratio of the fair value of pension assets to the projected benefit obligation at the end of the year. Pension liability duration is the ratio of annual pension service cost to the sum of service cost and interest cost. Pension investment returns are measured as actual returns divided by beginning-of-year pension assets. A relative pension investment return is calculated by subtracting the sector median return (using 1,992 firm-year observations) from a pension investment return in a given year. The sector is defined by two-digit North American Industry Classification System (NAICS) codes. The expected rate of return on pension assets is the expected long-term rate of return on plan assets used to determine net periodic pension cost. A pension asset allocation is calculated as the percentage of the total pension assets before reconciliation. Corporate equity includes U.S. and international equities and equity funds. Government debt includes U.S. and foreign government securities. Other fixed income includes U.S. corporate and foreign bonds, asset-backed securities, and other fixed income funds. All other investments include unclassified mutual funds, commingled trusts, collective trust funds, and insurance contracts. Total assets are a firm's total operating assets. Market-to-book is the ratio of the market value of equity to the book value of equity. Altman's Z-score, a measure of financial bankruptcy probability, is calculated as (3.3×EBIT/total assets) + (sales/total assets) + (1.4×retained earnings/total Assets) + (1.2×net working capital/total assets) + (0.6×maket value of equity/total liabilities). Leverage is calculated by a sum of long-term debt and debt in current liabilities divided by total assets at the end of the year. Operating cash flow ratio (OCF) is calculated by cash flows from operations before pension contributions divided by the beginning total assets. R&D intensity is defined as the ratio of R&D expenditure to sales. Credit rating is a dummy variable; it takes a value of one when a firm has a S&P credit rating in a given year and zero otherwise. CEO duality is a dummy variable that takes a value of one when the duality of CEO (indicating a CEO who is also the chair of the board of directors) exists at any time of the period of 2009–2014 and zero when no duality of CEO exists for the period. Board size is the total number of directors on the board. % independent directors is the percent of independent directors on the board. % financial experts is the percent of financial experts on the board. % institutional ownership is the percent of institutional ownership.

Table 5 (Continued)

Variable	Mean	Std Dev	1st pctl	Median	99th pctl
Pension characteristics					
Pension assets ($m)	3,132.63	6,919.06	33.39	709.47	42,395.00
Pension liabilities ($m)	3,696.93	8,051.36	47.09	904.35	48,816.00
Lagged funding status	0.830	0.171	0.496	0.812	1.465
Pension liability duration	0.261	0.180	0	0.281	0.689
Lagged pension investment returns	0.118	0.082	-0.063	0.123	0.293
Lagged pension return relative to peers	0.000	0.067	-0.211	0	0.149
Expected rate of return on plan assets	0.076	0.008	0.048	0.078	0.090
Pension asset allocation					
Corporate equity	0.409	0.216	0	0.443	0.838
Government debt and cash	0.101	0.115	0	0.079	0.458
Other fixed income	0.259	0.170	0	0.247	0.819
Private equity	0.021	0.038	0	0	0.179
Real estate	0.018	0.029	0	0	0.120
Hedge funds	0.023	0.065	0	0	0.305
Commodities	0.002	0.010	0	0	0.055
All other investments	0.167	0.274	0	0.020	1
Private equity investment (yes=1)	0.401	0.490	0	0	1
Allocation to private equity (N=465)	0.052	0.045	0.000	0.045	0.230
Firm characteristics					
Total assets ($m)	64,305.34	227,870.00	781.71	15,635.01	885,296.00
Market-to-book	3.903	29.687	-17.828	2.039	29.164
Altman's Z-score	2.398	1.940	0.155	1.948	8.542
Leverage	0.253	0.149	0	0.244	0.635
Operating cash flow ratio (OCF)	0.096	0.068	-0.004	0.091	0.291
Standard deviation of OCF	0.022	0.023	0.003	0.018	0.079
R&D intensity	0.011	0.023	0	0	0.117
Credit rating (yes=1)	0.836	0.370	0	1	1
CEO duality (yes=1)	0.772	0.420	0	1	1
Board size	11.056	2.440	7	11	17
% independent directors	0.839	0.085	0.556	0.875	0.933
% financial experts	0.220	0.131	0.067	0.200	0.571
% institutional ownership	0.773	0.153	0.336	0.792	1.082
Firm-year observations: 1,160					
Number of firms: 232					

Table 6. Corporate Pension Asset Allocation to Private Equity

This table presents zero-inflated beta (ZIB) model regression results. In the allocation equation, the dependent variable is the percentage of pension assets allocated to private equity. In the selection equation, the dependent variable is a dummy variable that takes a value of one when a corporate pension plan *does not invest* in private equity. The selection equation includes lagged pension assets as an instrument but not the expected long-term rate of return on plan assets. All other variables' definitions are in Table 5. The subscript *t*-1 indicates at the end of the previous fiscal year or at the beginning of the current fiscal year. A marginal effect in the allocation equation is evaluated conditional on the dependent variable greater than zero and less than one, indicating an allocation change corresponding to a one-unit change in an independent variable. A marginal effect in the selection equation indicates a change in the probability of the dependent variable being equal to zero corresponding to a one-unit change in an independent variable. Robust standard errors clustered on firms are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6 (Continued)

	(1)		(2)		(3)		(4)	
	Allocation equation		Selection equation		Allocation equation		Selection equation	
	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect
PensionRet$_{t-1}$	-1.101**	-0.042	0.588	0.130				
	(0.432)		(0.943)					
RelPensionRet $_{t-1}$					-1.159***	-0.044	0.634	0.140
					(0.445)		(0.966)	
FundingStatus$_{t-1}$	0.463	0.018	-0.691	-0.153	0.459	0.018	-0.692	-0.153
	(0.331)		(0.991)		(0.331)		(0.990)	
CEODuality (yes=1)	0.095	0.004	0.047	0.010	0.094	0.004	0.047	0.010
	(0.237)		(0.382)		(0.237)		(0.382)	
PLDuration$_t$	-0.750	-0.029	-0.877	-0.194	-0.748	-0.029	-0.877	-0.194
	(0.607)		(0.934)		(0.608)		(0.934)	
ExpectedRateReturn$_t$	25.340**	0.970			25.336**	0.970		
	(11.148)				(11.122)			
ln(pension assets$_{t-1}$)			-1.036***	-0.230			-1.037***	-0.230
			(0.233)				(0.233)	
Market-to-book$_t$	0.001**	0.000	0.002	0.000	0.001**	0.000	0.002	0.000
	(0.000)		(0.002)		(0.000)		(0.002)	
AltmanZ-score$_t$	0.004	0.000	0.014	0.003	0.005	0.000	0.013	0.003
	(0.105)		(0.136)		(0.105)		(0.136)	
Leverage$_t$	0.729	0.028	0.170	0.038	0.733	0.028	0.168	0.037
	(0.607)		(1.344)		(0.607)		(1.344)	
OCF$_t$	2.125	0.081	-0.214	-0.047	2.099	0.080	-0.203	-0.045
	(2.184)		(3.756)		(2.185)		(3.757)	
SD(OCF$_t$)	2.210	0.085	15.890	3.519	2.143	0.082	15.883	3.517
	(5.978)		(14.400)		(5.979)		(14.399)	
R&Dintensity$_t$	0.768	0.029	-4.915	-1.089	0.753	0.029	-4.913	-1.088
	(2.602)		(8.516)		(2.606)		(8.513)	
CreditRating$_t$ (yes=1)	-0.618*	-0.024	0.007	0.002	-0.614*	-0.023	0.006	0.001
	(0.358)		(0.555)		(0.359)		(0.556)	
ln(total firm assets$_t$)	0.178**	0.007	0.293	0.065	0.178**	0.007	0.294	0.065
	(0.083)		(0.234)		(0.083)		(0.234)	
BoardSize$_t$	0.062	0.002	-0.063	-0.014	0.062	0.002	-0.062	-0.014
	(0.039)		(0.056)		(0.039)		(0.056)	
(% independent directors)$_t$	0.216	0.008	0.352	0.078	0.226	0.009	0.352	0.078
	(0.946)		(1.752)		(0.949)		(1.753)	
(% financial experts)$_t$	0.917	0.035	-1.568	-0.347	0.916	0.035	-1.567	-0.347
	(0.723)		(1.217)		(0.723)		(1.217)	
(% institutional ownership)$_t$	0.274	0.010	-0.304	-0.067	0.264	0.010	-0.302	-0.067
	(0.470)		(1.070)		(0.473)		(1.069)	
Year fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Firms	232		232		232		232	
Observations	1,160		1,160		1,160		1,160	

Table 7. The Effects of Pension Investment Return, Funding Status, and CEO Duality on Pension Asset Allocation to Private Equity

This table presents zero-inflated beta (ZIB) model regression results on the effects of pension investment returns, required contributions, and a funding ratio on private equity investment. Columns (1) and (2) present two-way interaction effects while column (3) presents three-way interaction effects. Panel A presents results of the regression that uses a pension plan's own lagged investment returns while Panel B presents results of the regression that uses a pension plan's lagged investment returns relative to peers. Regarding pension funding status (FundingStatus), the model uses a dummy variable with two levels: low and high (a base category). The variable LowFS takes a value of one when the variable FundingStatus is less than the median ratio (0.812) and zero otherwise. CEO duality is a dummy variable that takes a value of one when a sponsoring firm has CEO duality at any time for the period 2009–2014 and zero when it has no CEO duality for the period. A marginal effect in the allocation equation is evaluated conditional on the dependent variable greater than zero and less than one, indicating an allocation change corresponding to a one-unit change in an independent variable. A marginal effect in the selection equation indicates a change in the probability of the dependent variable being equal to zero corresponding to a one-unit change in an independent variable. A change in marginal effects is calculated with respect to a base category. In the level equation, controls include pension liability duration, expected rate of returns on pension assets, market-to-book, Altman's Z-score, leverage, operating cash flow ratio (OCF), its standard deviation, R&D intensity, credit ratings dummy, firm size, board size, % independent directors on the board, % financial experts on the board, and % institutional ownership. In the selection equation, controls include all the variables in the level equation except for the expected rate of returns and beginning-of-year pension assets as an instrument. Robust standard errors clustered on firms are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7 (Continued)

A. Pension plan investment returns

	(1)		(2)		(3)	
	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect
Allocation equation: Pension asset allocation to private equity						
$PensionRet_{t-1}$ [A]	0.350	0.014	0.608	0.022	1.439	0.044
	(0.715)		(1.092)		(1.359)	
$PensionRet_{t-1}$	-1.657**				0.146	
× $LowFS_{t-1}$ (yes=1) [B]	(0.796)				(2.317)	
$PensionRet_{t-1}$			-1.832*		-1.141	
× CEODuality (yes=1) [C]			(1.078)		(1.448)	
$PensionRet_{t-1}$ × $LowFS_{t-1}$					-1.844	
× CEODuality [D]					(2.466)	
Coefficients:						
[A]+[B]	-1.307***	-0.047			1.585	
[A]+[C]			-1.224***	-0.048	0.297	
[A]+[B]+[C]+[D]					-1.401***	-0.048
Controls	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes	
Firms	232		232		232	
Observations	1,160		1,160		1,160	

B. Pension plan investment returns relative to peers

	(1)		(2)		(3)	
	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect
Allocation equation: Pension asset allocation to private equity						
$RelPensionRet_{t-1}$ [E]	-0.375	-0.015	0.253	0.009	1.490	0.046
	(0.767)		(1.198)		(2.198)	
$RelPensionRet_{t-1}$	-0.881				-0.882	
× $LowFS_{t-1}$ (yes=1) [F]	(0.809)				(2.990)	
$RelPensionRet_{t-1}$			-1.535		-1.965	
× CEODuality (yes=1) [G]			(1.226)		(2.389)	
$RelPensionRet_{t-1}$ × $LowFS_{t-1}$					0.029	
× CEODuality [H]					(3.127)	
Coefficients:						
[E]+[F]	-1.256***	-0.045			0.609	
[E]+[G]			-1.282***	-0.050	-0.474	
[E]+[F]+[G]+[H]					-1.327***	-0.046
Controls	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes	
Firms	232		232		232	
Observations	1,160		1,160		1,160	

Table 8. Corporate Pension Asset Allocation to Corporate Equity

This table presents zero-inflated beta (ZIB) model regression results on pension plans' corporate equity investment. Panel A presents regression results for the sample of IRS 5500 filings. Corporate equity is defined as a sum of corporate common and preferred stocks and employer securities. The variable HighReqCtrb takes a value of one when a required contribution ratio is greater than the median ratio and zero otherwise. A funding ratio (FR1) is also categorized into two levels: low and high (a base category). The variable LowFR takes a value of one when the funding ratio is less than the median ratio (0.907) and zero otherwise. All other variables in the allocation and selection equations are the same as those in Tables 3 and 4. A marginal effect in the allocation equation is evaluated conditional on the dependent variable greater than zero and less than one, indicating an allocation change corresponding to a one-unit change in an independent variable. Panel B presents regression results for the sample of S&P 900 firms. Corporate equity is defined as a sum of U.S. and international equities and equity funds. The variable LowFS takes a value of one when the variable FundingStatus is less than the median ratio (0.812) and zero otherwise. CEO duality is a dummy variable that takes a value of one when the duality of CEO (indicating a CEO who is also the chair of the board of directors) exists at any time of the period of 2009–2014 and zero when no duality of CEO exists for the period. All other variables in the allocation and selection equations are the same as those in Tables 6 and 7. Robust standard errors clustered on firms are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

A. Sample of IRS 5500 filings

	(1)		(2)		(3)	
	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect	Coef (Std Error)	Marginal effect
Allocation equation: Pension asset allocation to corporate equity						
$PensionRet_{t-1}$ [A]	2.600***	0.530	3.052***	0.612	3.376***	0.671
	(0.438)		(0.504)		(0.522)	
$PensionRet_{t-1}$			-0.861**			
× $HighReqCtrb_{t-1}$ (yes=1) [B]			(0.424)			
$PensionRet_{t-1}$					-1.455***	
× $LowFR_{t-1}$ (yes=1) [C]					(0.496)	
Coefficients:						
[A]+[B]			2.190***	0.452		
[A]+[C]					1.922***	0.401
Controls	Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes	
Plans	4,131		4,131		4,131	
Employers identified by EIN	3,586		3,586		3,586	
Observations	20,655		20,655		20,655	

Table 8 (Continued)

B. Sample of S&P 900 firms

	(1)		(2)		(3)		(4)	
	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect	Coef (Std Err)	Marginal effect
Allocation equation: Pension asset allocation to corporate equity								
$PensionRet_{t-1}$ [D]	1.423***	0.345	2.387***	0.569	1.956***	0.471	2.832***	0.661
	(0.452)		(0.651)		(0.372)		(0.988)	
$PensionRet_{t-1}$			-1.510**				-1.078	
× $LowFS_{t-1}$ (yes=1) [E]			(0.674)				(1.162)	
$PensionRet_{t-1}$					-0.701		-0.536	
× CEODuality (yes=1) [F]					(0.499)		(1.229)	
$PensionRet_{t-1}$ × $LowFS_{t-1}$							-0.572	
× CEODuality [G]							(1.467)	
Coefficients:								
[D]+[E]			0.877**	0.216			1.755***	
[D]+[F]					1.255***	0.306	2.297***	
[D]+[E]+[G]+[G]							0.647**	0.159
Controls	Yes		Yes		Yes		Yes	
Year fixed effects	Yes		Yes		Yes		Yes	
Industry fixed effects	Yes		Yes		Yes		Yes	
Firms	232		232		232		232	
Observations	1,160		1,160		1,160		1,160	

Table 9. Summary of the Effects on Pension Asset Allocation to Private Equity and Corporate Equity

This table presents the summary of the effects on pension asset allocation to private equity and corporate equity corresponding to a one standard deviation decrease in lagged pension investment returns (7.4%). Panel A summarizes the interaction effects presented in Table 4 (private equity allocation) and Panel A of Table 8 (corporate equity allocation) for the sample of IRS 5500 filings. The mean private equity allocation is 11.7% conditional on holding the asset. The mean corporate equity allocation is 30.0% for pension plans that hold the asset. Panel B summaries the interaction effects presented in Table 7 (private equity allocation) and Panel B of Table 8 (corporate equity allocation) for the sample of S&P 900 firms. The mean private equity allocation is 5.2% conditional on holding the asset. The mean corporate equity allocation is 43.4% for pension plans that hold the asset. A change in asset allocation is expressed as the percentage point (pp) variation. A change relative to the mean is measured conditional on holding an asset.

A. Sample of IRS 5500 filings

		Change in lagged investment returns	Private equity		Corporate equity	
			Change in asset allocation (pp)	Change relative to the mean (%)	Change in asset allocation (pp)	Change relative to the mean (%)
Required contribution ratio	Low	1 std dev decrease	Not sig at the 5% level		-4.53 pp	-15.1%
	High	1 std dev decrease	+0.89 pp	+7.6%	-3.34 pp	-11.1%
Funding ratio	High	1 std dev decrease	Not sig at the 10% level		-4.97 pp	-16.5%
	Low	1 std dev decrease	+1.17 pp	+10.0%	-2.97 pp	-9.9%

B. Sample of S&P 900 firms

		Change in lagged investment returns	Private equity		Corporate equity	
			Change in asset allocation (pp)	Change relative to the mean (%)	Change in asset allocation (pp)	Change relative to the mean (%)
Funding ratio	High	1 std dev decrease	Not sig at the 10% level		-4.21 pp	-9.7%
	Low	1 std dev decrease	+0.35 pp	+6.7%	-1.60 pp	-3.7%
CEO duality	No	1 std dev decrease	Not sig at the 10% level		-3.49 pp	-8.0%
	Yes	1 std dev decrease	+0.35 pp	+6.8%	-2.26 pp	-5.2%
(Funding ratio, CEO duality)	(High, No)	1 std dev decrease	Not sig at the 10% level		-4.89 pp	-11.3%
	(Low, No)	1 std dev decrease	Not sig at the 10% level		-3.19 pp	-7.3%
	(High, Yes)	1 std dev decrease	Not sig at the 10% level		-4.07 pp	-9.4%
	(Low, Yes)	1 std dev decrease	+0.36 pp	+6.9%	-1.18 pp	-2.7%

Table 10. Performance of Corporate Pension Plans Investing in Private Equity

This table presents the performance of corporate pension plans in the sample of S&P 900 firms for the period 2009−2014. Panel A shows pension portfolio returns depending on whether pension plans invest in private equity or not. Pension investment returns are measured as actual returns divided by beginning-of-year pension assets. A relative pension return is calculated by subtracting the sector median return from a pension plan's portfolio return in a given year. Panel B shows private equity returns of corporate pension plans depending on whether sponsoring firms have CEO duality or not. CEO duality is defined with three cases: (A) no CEO duality exists all the time during the period 2009−2014; (B) CEO duality exists at any time during the period; and (C) CEO duality exists all the time during the period. Panel C presents OLS regression results on pension plans' private equity returns. The dependent variable is the rate of returns on private equity investment. The rate of return is calculated by a sum of realized and unrealized gains divided by beginning-of-year fair value of private equity. The variable *CEODuality* is a dummy variable that takes a value of one when CEO duality exists at any time for the period 2009–2014 and zero when no CEO duality exists for the period. The variable *RatioCEODuality* is the share of the years in which CEO duality exists during the period. Allocation to private equity is the percentage of pension assets allocated to private equity. Market-to-book is the ratio of the market value of equity to the book value of equity. Board size is the total number of directors on the board. The variable *%IndependentDirectors* is the percent of independent directors on the board. The variable *%FinancialExperts* is the percent of financial experts on the board. Panel D shows the covariances of private equity benchmark returns and corporate pension plans' private equity returns and net purchases. To calculate a covariance, the sample is restricted to firms that report the information on changes in the fair value of private equity for two or more years. We use as a benchmark return the internal rate of return (IRR) of the Cambridge Associates US Private Equity by vintage years. Net purchases of private equity are scaled by the average of beginning-of-year and end-of-year fair values of private equity. ** and * indicate statistical significance at the 5% and 10% levels, respectively.

A. Portfolio returns of pension plans: whether they invest in private equity or not

	Pension plans *not* investing in private equity (A)	Pension plans investing in private equity (B)	Difference between A and B
Pension portfolio returns (mean)	11.22%	11.55%	0.33%
Pension portfolio returns relative to peers (mean)	-0.04%	0.42%	0.46%
Firms	159	105	
Observations	847	545	

B. Private equity returns: whether sponsoring firms have CEO duality or not

	CEO duality *no* existing all the time during the period (A)	CEO duality existing at any time during the period (B)	CEO duality existing all the time during the period (C)	Difference between: A and B	A and C
Private equity returns (mean)	7.08%	9.34%		2.26%	
	7.08%		10.97%		3.89%**
Firms	13	64	29		
Observations	74	334	157		

Table 10 (Continued)

C. Regression results on private equity returns

	(1)	(2)	(3)	(4)
CEODuality (yes=1)	0.029			
	(0.019)			
RatioCEODuality		0.043**	0.044**	0.044**
		(0.020)	(0.020)	(0.022)
Allocation to private equity			-0.059	-0.064
			(0.172)	(0.169)
ln(private equity asset)	0.004	0.003	0.005	0.006
	(0.008)	(0.008)	(0.011)	(0.011)
ln(total pension assets)	-0.007	-0.007	-0.008	-0.008
	(0.009)	(0.009)	(0.011)	(0.011)
R&D intensity	-0.101	-0.113	-0.118	-0.082
	(0.336)	(0.318)	(0.317)	(0.343)
Market-to-book	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
ln(total firm assets)	0.004	0.004	0.004	0.004
	(0.007)	(0.008)	(0.007)	(0.008)
Board size				-0.001
				(0.005)
%IndependentDirectors				-0.080
				(0.097)
%FinancialExperts				0.016
				(0.069)
Year fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Firms	77	77	77	77
Observations	408	408	408	408
Adjusted R^2	0.047	0.053	0.051	0.045

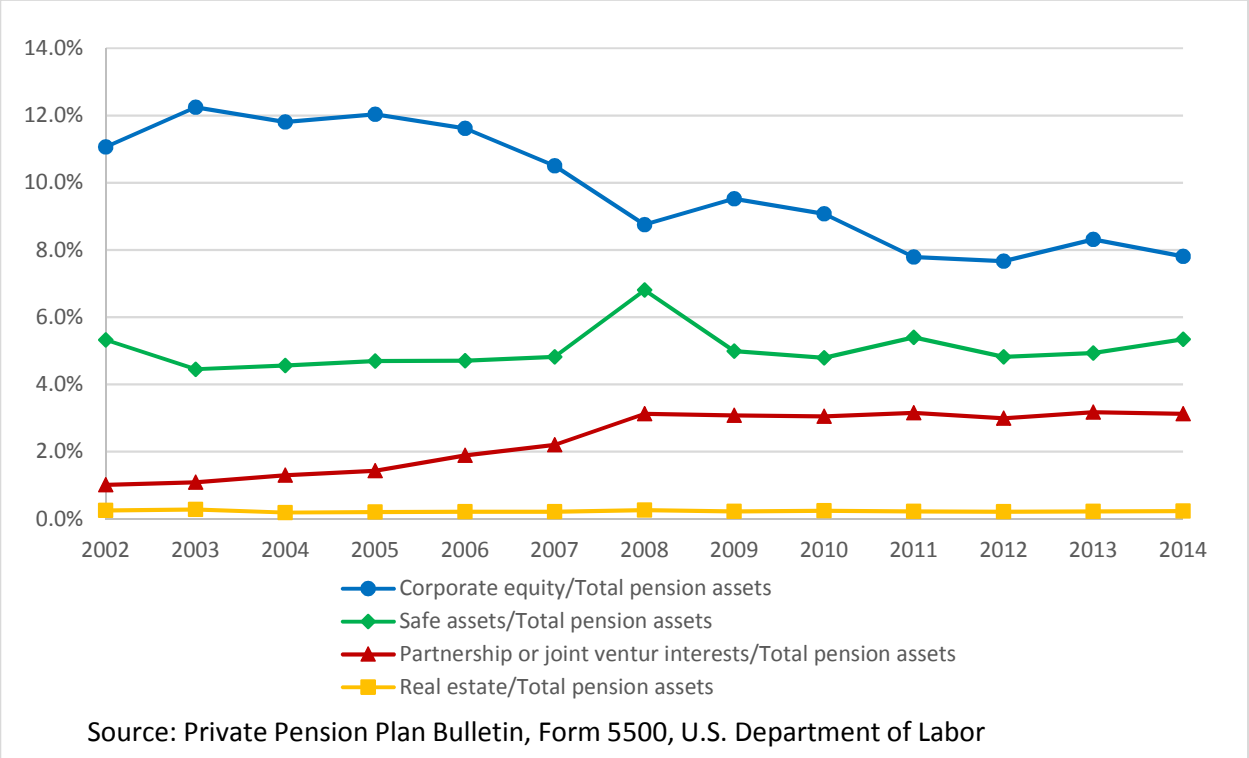
D. Covariances of private equity benchmark returns and corporate pension plans' private equity returns and net purchases of private equity

	CEO duality *no* existing all the time during the period (A)	CEO duality existing all the time during the period (B)	Difference between A and B
Covariance of the benchmark IRR and private equity returns (mean)	-0.0009	0.0002	0.0011*
Covariance of the benchmark IRR and net purchases of private equity (mean)	-0.0001	0.0017	0.0018*
Covariance of private equity returns and net purchases of private equity (mean)	-0.0090	0.0119	0.0209**
Firms	13	27	

Figure 1. Corporate Pension Plan Investment in Risky, Safe, and Alternative Assets

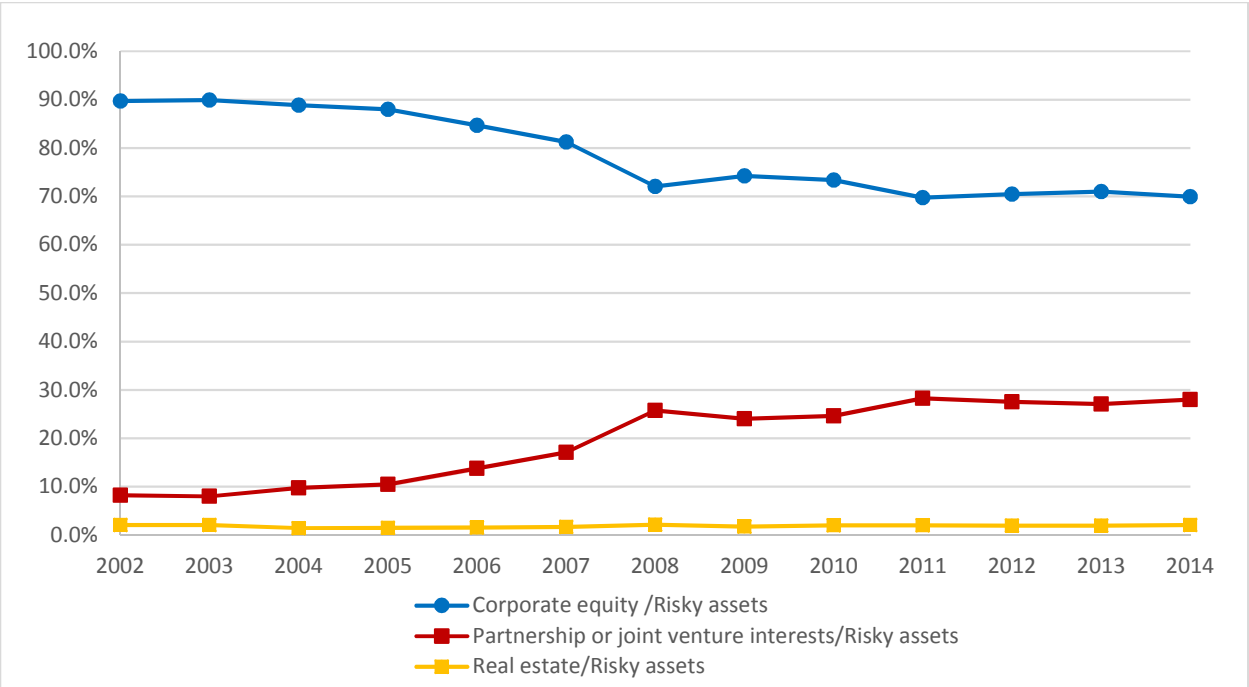
This figure presents corporate pension plan investment in risky, safe, and alternative assets by using Private Pension Plan Bulletins issued by U.S. Department of Labor for 2002–2014 Form 5500. Risky assets include corporate equity (including employer securities), partnership or joint venture interests, real estate, and employer or other real property used in plan operation. Safe assets include government debt and cash. As alternative assets, the figure includes partnership or joint venture interests and real estate (including employer real property and other property used in plan operation). Pension asset allocations are depicted for single-employer pension plans with 100 or more participants. Panel A presents the percentage of pension total assets invested in corporate equity, safe assets, partnership or joint venture interests, and real estate. Panel B presents the percentage of risky assets invested in corporate equities, partnership or joint venture interests, and real estate.

A. Percentage of pension total assets invested in corporate equity, safe assets, partnership or joint venture interests, and real estate



Source: Private Pension Plan Bulletin, Form 5500, U.S. Department of Labor

B. Percentage of risky assets invested in corporate equity, partnership or joint venture interests, and real estate



Source: Private Pension Plan Bulletin, Form 5500, U.S. Department of Labor