Familiarity Breeds Alternative Investment:

Evidence from Corporate Defined-Benefit Pension Plans[1]

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August 2013

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Abstract

We show that corporate sponsor R&D-intensity and land and buildings (L&B)-intensity increase defined-benefit pension plan investment in private equity and real estate and mortgages, respectively. The likelihood of investment in these two alternative asset classes is higher for large plans, well-funded plans, and plans with a low share of active plan participants. This is inconsistent with risk shifting, hedging or diversification motives. The performance of pension plans with portfolio tilts lags significantly the performance of the average plan in our sample, while there is no evidence that sponsor firms benefit from tilts in their pension portfolios. Hence, an informational advantage, specific expertise, or spillovers between pension funds and sponsor firms cannot explain portfolio tilts. Consistent with theories of familiarity based on ambiguity aversion, investment in PE and RE by funds with R&D-intensive and L&B-intensive sponsors increases significantly with the correlation of these asset classes with the S&P500. Further tests support the hypothesis that the portfolio tilts are due to a familiarity bias.

Key Words: pension plans, familiarity bias, sponsor, private equity, real estate.

JEL classification: G11, G23, G31, G32

Defined benefit (DB) pension plans manage assets worth trillions of dollars that are essential to many pension systems. According to the Investment Company Institute, at the end of September 2012 the total amount of US retirement assets in private DB plans alone were $2.6 trillion.[2] Since their corporate sponsors are ultimately responsible for any severe underfunding, these funds also represent potentially extremely important liabilities in corporate balance sheets. This is perhaps the reason why much of the literature on corporate defined-benefit pension plans has focused on the interactions between their asset allocation and the sponsor firm's liability structure.[3]

In this paper, we examine the impact of the sponsor firm asset-side characteristics on DB pension plan asset allocation decisions. There are a number of reasons why such a link may exist. First, it is well-established that many investors hold largely undiversified portfolios, and that these portfolios are largely invested in their employer's stock.[4] Hence, DB pension plans may choose their asset allocation so as to provide their future and present beneficiaries with portfolio diversification. Second, related factors, e.g. sponsor size and plan size, may be significant determinants of investment decisions. Third, employers may provide pension trustees and administrators with the information and support they need to perform their duty, and specific information, expertise and preferences at the corporate level may trickle down to the pension fund.

A number of examples illustrate a variety of links between the sponsoring firm's corporate focus and its pension fund's investment in alternative assets: From 1998 to 2007, the DB plan of Delta Airline had between 3% and 5% of its assets invested in Oil & Gas; Eastman

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[2] In a defined benefit (DB) pension scheme, the employer pledges retirement benefits to employees according to a formula that is generally a function of each employee's age, tenure and salary. DB pension plans are separate legal entities, set up in trusts, with the trustees being responsible for the management of pension assets and liabilities.

[3] Asset allocation is critical to understanding the problem of DB pension plan under-funding. A typical DB pension fund's annual investment return is much higher than its annual employer and employee contributions (Munnell and Soto (2007)). Furthermore, the fund's portfolio allocation across broad asset classes is a major determinant of its investment return (Brinson, Hood, and Beebower (1986) and Brinson, Singer, and Beebower (1991)). Thus, portfolio choice has first-order consequences on funding status.

[4] Blume and Friend (1975), Barber and Odean (2000), Goetzman and Kumar (2008, Calvet, Campbell, and Sodini (2007) show that investors hold poorly diversified portfolios., Kelly (1995) and Polkovnichenko (2005)) show that employer stock represent the bulk part of the portfolio of many stock investors.

Chemicals had between 6% and 24% invested in Mining & Natural Resources, Pfizer and Merck & co had more than 10% invested in Private Equity (PE) & Venture Capital (VC) and Macy's Department Stores pension plan had more than 12% invested in real estate.[5] These are much more than anecdotal observations.

Using three different pension plan and sponsor data sources from 1998 to 2007, we find strong evidence of a link between corporate asset characteristics and DB pension plan investment in alternative assets. Specifically, sponsoring firm's R&D-intensity and land and buildings (L&B)-intensity have a statistically significant and economically large effect on a DB pension plan's investment in private equity (PE) and real estate assets and mortgages (RE), respectively:[6]

i) Plans sponsored by firms with high R&D expenditures invest more in private equity. The effect is economically and statistically significant where one standard deviation increase in the ratio of R&D expenditures to capital increases plan's allocation to PE investment by more than 0.5%. This is large relative to the mean PE investment of 1.61% and the median of 0%.

ii) Plans sponsored by firms with large land and buildings (L&B) holdings invest more in real estate and mortgages. One standard deviation increase in the ratio of L&B to capital increases plan's allocation to RE investment by more than 0.7%. The effect is economically large and statistically significant.

We find that this investment tilt to alternative assets generated by the sponsoring firm characteristics results in private equity and real estate and mortgages being overweighed relative to the average and median pension mix. The positive relationship between the

[5] Traditional portfolio theory suggests that, all else equal, pension plans should optimally underweight assets correlated with their sponsor' corporate assets. To over-weight such assets is analogous to an individual investing in the stock of her own employer.

[6] Only 10 plans in our sample invest in commodities such as oil, gas and natural resources.

corporate focus of the sponsor and the allocation of the pension plan assets remains robust to a number of alternative specifications and when we address concerns of endogeneity.

We consider several explanations for the pension plan investment tilts we document. The effect of sponsor's characteristics on the investment policy of the pension plan appears to be inconsistent with risk shifting where plan managers maximize the value of the put option written on pension assets. We find that plans reduce the weight of risky assets such as private equity and real estate and mortgages as their pension liability funded status deteriorates. This evidence is consistent with the risk management rather than the risk-shifting hypothesis.

Another possible explanation is the existence of barriers to entry and the lack of financial sophistication. Large sponsors have large pension plans and at the same time they own more land and buildings and have higher R&D expenditures. If barriers to entry and the lack of financial sophistication are an important determinant of alternative asset allocation, these pension plans may invest more in PE and RE. Our empirical results show that even though, size is important, it cannot explain the investment tilts we document. The relation between corporate focus and plan's alternative asset allocation remains important even when we control for plan and sponsor's size.

We do not find support for the hedging or diversification motives. The share of active participants is not positively related to the investment in risky assets, which is inconsistent with the hypothesis that sponsors try to hedge wage growth risk. Similarly, plan's age, a proxy for plan's maturity, is not statistically significant.

It may also be the case that the links that we document arise because of specific information or expertise at the corporate level that spills over to the pension plan. However, we find that the pension plans that have the alternative investment tilts perform worse than the plans without tilts. The differences are large and economically significant. The results are robust to different measures of performance such as excess returns, Lo's decomposition and an active/passive (AP) decomposition. The worse performance of pension plans with stronger familiarity tilts is inconsistent with pension managers having value-relevant information or better forecasting abilities about familiar asset classes. Alternatively, it may be the case that

sponsor firms benefit from such biases at the expense of pension plan beneficiaries. For example, pension plans with R&D intensive sponsor firms may invest in R&D-intensive projects in order to "test" a new technology that will benefit the sponsor, or the sponsor firms may wish to develop good relationships with private equity firms through their pension plans in order to obtain better financing on their own projects financed with corporate venturing. Similarly, firms with large land holdings may wish to develop good ties with large real estate firms through their pension plans in order to obtain better deals at the corporate level. We do not find evidence to support this hypothesis. In particular, firms sponsoring pension plans characterized by the portfolio tilts that we document do not generate risk-adjused returns that are significantly different from firms sponsoring pension plans without such tilts.

Finally, our results may be consistent with earlier evidence that investors have a preference for familiar assets. It is now well-documented empirically that both individual stockholders and investment managers tend to tilt their investments toward stocks of firms that are close to them geographically, culturally, and professionally. However, little is known on whether such a familiarity bias exists in asset allocation decisions of large institutional investors such as corporate DB pension plans. If such institutions exhibit a familiarity bias, there are good reasons to expect that this will show in alternative assets. Indeed, performance in such asset classes is more difficult to measure than in traditional asset classes such as public equity and domestic bond markets that are subject to stringent reporting and transparency requirements. The lack of an active secondary market renders these alternative investments illiquid (especially private equity and venture capital investments) which means that reported fair values are often based on unobservable inputs rather than on quoted prices in active markets. A firm with an expertise in innovation may have a preference for PE pension investment. Private equity and venture capital tend to be particularly concentrated in high risk technology and R&D intensive industries (Gompers and Lerner, 2001). Similarly, corporate sponsor with large real estate holdings may influence pension plan investment in real estate and mortgages.[7]

[7] The collateral channel (see Chaney, Sraer and Thesmar, 2012) suggests that firms' real estate holdings have an important effect on its corporate investment.

We test for a familiarity bias as understood by Boyle et al (2012) in their theory of portfolio choice based on ambiguity aversion. In their paper, investors exhibit different degrees of uncertainty, or ambiguity, about the distributions of asset returns and consider "familiar" assets with low degree of ambiguity. They show that when the optimal portfolio contains both familiar and unfamiliar assets, the optimal holding of familiar assets increases with the correlation across assets. The reason for this so-called "flight to familiarity" is that as correlations increase, the diversification benefit of holding unfamiliar assets decreases, which leads investors to increase their holding of the familiar asset. We test this by examining if investment in private equity (real estate) increases with an interaction term of an R&D (L&B) dummy that equals one if plans invest in PE (RE) and the correlation between the returns on our private equity (real estate) index and the S&P500. We find strong evidence that as this correlation increases, funds sponsored by R&D-intensive (L&B-intensive) firms increase their investment in private equity (real estate and mortgages). The result remains robust when we use the correlation between the return on our PE (RE) index and the return on a portfolio constructed from the other assets (excluding PE (RE)), where the portfolio weights are the pension plans asset allocations and the returns are the (n-1) index returns. Further tests support a familiarity bias hypothesis.

The remainder of this paper is organized as follows. In Section I, we briefly review the related literature and discuss our contribution. Section II discusses the data and provides some descriptive statistics. Section III presents our empirical tests and the estimation results for pension investment in private equity and real estate. Section IV offers further tests of familiarity bias as well as robustness checks. The final section concludes.

I. Related Literature

I.A. Asset Allocation by Corporate DB Pension Plans

Prior studies (Friedman 1983, Bodie, Light, Morck and Taggart 1985, Amir and Benartzi 1999, Coronado and Liang 2005 and Rauh 2008) have examined pension plans' incentives to

invest in risky assets. They have typically focused on pension plans allocation to equity versus fixed income investments. However, alternative assets represent an increasing proportion of corporate and public pension plan assets, and including alternative investments as part of the risky assets may affect the magnitude of existing results based only on equity versus fixed income asset classes. In addition, analyzing alternative investments may allow us to derive results that cannot be derived easily for equity investment. For example, is there a familiarity bias in equity investments by pension plans?[8]

I.A.1. Risk Management vs Risk Shifting

Corporate tax-based theories of pension asset allocation (see, e.g., Bodie (1991)) can explain neither why most plans are under-funded nor why a significant proportion of their funds are invested in risky asset classes. To explain actual pension portfolios, a number of authors have appealed to different incentives to increase pension investment risk. For example, risky assets may lower future contributions. In addition, potential incentives for risk shifting may be exacerbated when a government agency provides pension liability insurance in case of default.

The complexity of pension accounting and the reliance of pension expense calculations on an expected long term return of pension assets may also create an opportunistic behaviour from the sponsoring firm managers. First, managers tend to be more aggressive when changes to pension assumptions have a greater impact on reported earnings, when they exercise stock options, and before acquiring firms (Bergstresser, Desai, and Rauh, 2006). Second, pension plans of more indebted firms with a higher proportion of insider-trustees invest a higher proportion of the pension plan assets in risky equities (Coco and Volpin, 2007). This evidence suggests that such firms maximize the value of their put option and shift risk to the pension

[8] Our findings also contribute to the literature that examines the extent to which pension plans and their sponsoring firms are integrated. Existing studies have focused on the sponsor's choice of plan design and contribution policy (Petersen, 1994) and the effect of pension funding on corporate investment policy (Rauh, 2006a) or corporate capital structure (Shivdasani and Stefanesco, 2010). These studies show that firms incorporate the pension plan design and pension liability risk into their corporate policies.

plan beneficiaries. In addition, the presence of insider-trustees allows sponsoring firms to make lower contributions to the pension plan.

Conversely, several studies have tried to explain why plans seek to reduce their risk taking when the pension liability funded status deteriorates. Bader (1991) argues that firms attempt to minimize the volatility of their pension contributions. These contributions are often predictable for moderately underfunded or overfunded plans, but less predictable when funding levels become more extreme. Bader's argument suggests an inverted U-shape relationship between funding levels and equity investment where extremely over-funded and under-funded plans invest in fixed income securities and only moderately funded plans should increase their allocation to equity investment. Rauh (2009) shows that risk management incentives to avoid costly corporate financial distress dominate risk shifting. His empirical findings show that the better funded U.S. pension plans in his sample in fact invest more in risky equity.

Our results support Rauh's (2009) results and extend them to alternative investments. We find that as funding levels deteriorate, pension funds decrease their investment in private equity and real estate. Our results are both statistically significant and economically important. This is important to our understanding of pension plan de-risking strategies. More importantly, we also find a number of results that go well beyond risk management through the link between corporate sponsor characteristics and pension plan asset allocation decisions.

I.A.2. The Hedging Hypothesis

Alternatively, equity investing may hedge against increases in real wages if future earnings growth and the returns of risky assets are positively correlated (Black, 1989, Lucas & Zeldes, 2006). In the short-run the correlation between earnings growth and risky asset returns is negligible, economic theory and recent empirical evidence (see e.g. Benzoni, 2006) suggest that there is a positive long run correlation between labor earnings and asset returns.

We find that the share of active participants does not affect significantly pension plan investment in private equity and real estate. Similarly, the empirical results show that plan age, a proxy for pension liability duration, is not a significant determinant of alternative asset allocation. Hence, we do not find any support for the hedging hypothesis.

I.A.3. Barriers to Entry

DB plans tend to be large relative to almost any individual investor and they have fairly predictable inflows and outflows. These characteristics make them well suited to hold asset classes where large investments are required and liquidity is limited (Campbell and Viceira, 2005). Thus, these institutions are particularly well-suited to examine portfolio choice across a large number of asset classes, and in particular investments in real estate and private equity.

Recently several papers have documented the importance of pension plan size for its asset allocation and investment performance (see Dyck and Pomorski, 2011, Bauer et al, 2010). These studies document substantial positive scale economies in asset management of DB pension plans. For example, in Dyck and Pomorski (2011), the largest plans outperform the smaller ones in their sample by 43-50 basis points per year. Between a third and one half of these gains arise from cost savings related to internal management, where costs are at least three times lower than under external management. In addition, the ability to take advantages of scale depends on plan governance with better governed plans having higher scale economies. We also contribute to this strand of literature by showing that plan size has an effect on the investment biases that we document. We show that the asset allocation tilts are smaller for large DB plans than for small ones. Also the performance of large plan with tilted portfolios is better than the performance of small pension plans with the same investment tilt. This is consistent with large plans having superior performance that comes from greater returns in the alternative asset classes. Dyck and Pomorski (2011) show that in their private equity and real estate investments large plans have both lower costs and higher gross returns, yielding up to 6% per year improvement in returns.

Although our results are consistent with barriers to entry where size is an important determinant of pension fund investment in private equity and real estate, the familiarity bias remains statistically significant and economically important even when we control for size. Overall, size alone cannot explain the documented link between sponsoring firm corporate focus and its pension plan alternative investments.

I.B. The Informational Advantage Hypothesis versus the Familiarity Bias Hypothesis

Previous research on familiarity bias has documented the tendency of many investors to tilt their portfolio holdings toward familiar stocks. Further, studies have provided evidence that financial analysts and advisers make better stock picks or recommendations concerning firms that are either geographically, culturally or professionally close. In the US, Huberman (2001) shows that the shareholders of a Regional Bell Operating Company (RBOC) tend to live in the area which it serves, and an RBOC's customers tend to hold its shares rather than other RBOCs' equity. Investors' preference to invest in familiar stocks has been established in Norway (Døskeland and Hvide, 2010) and in Finland (Grinblatt and Keloharju, 2001). Individual investors also exhibit a strong familiarity bias both in their 401(k) pension plan through investments in employer stock (Benartzi, 2001) and through their direct stock holdings outside of their retirement plan (Ivkovich and Weisbenner, 2005). There is no evidence that such bias in portfolio holdings generate positive abnormal returns. Bernartzi's (2001) finds that companies with high ownership of employer stock in their 401(k) plan do not outperform companies with lower concentrations of ownership in employer stock and Døskeland and Hvide (2010) find that individuals who trade excessively in professionally close stocks generate negative abnormal returns.

Studies have also documented evidence that familiarity bias affect the holding of institutional investors. For example, the portfolios of U.S. mutual fund managers are characterized by a local bias (Coval and Moskowitz, 2001). There is evidence of a positive return to local information for institutional investors as they are able to generate excess returns on their local holdings. Equity analysts and corporate acquirers also seem to exploit a local

informational advantage. For example, geographically-proximate analysts issue more accurate forecasts and update their forecasts more frequently (Malloy, 2005). Bae, Stulz, and Tan (2008) document local analysts' information advantage in a non-U.S. setting. Kang and Kim (2008) find that local acquirers of a "block" of corporate shares engage in more monitoring than do more distant acquirers, with the more local target earning a higher return on the announcement of the acquisition and having better post-acquisition operating performance.

The paper perhaps most closely related to ours is Hochberg and Rauh (2012). In this paper, the authors exhibit substantial home-state bias in venture capital and real estate investments by public pension funds. Our paper is complementary to theirs in that we focus on corporate pension plans and on a familiarity bias generated by corporate characteristics, rather than geographical proximity, and how this affects alternative investments by these corporate plans. In contrast to their analysis of which private equity investments public pension plans choose, our analysis focuses on investment in private equity and real estate as part of a DB plan asset allocation.

We contribute to this literature on familiarity bias by providing new evidence that asset allocation decisions made by the largest US corporate pension funds exhibit a familiarity bias related to the corporate focus of their sponsoring firm. We test a prediction by Boyle et al (2012) of a familiarity bias based on ambiguity aversion. Finally, our results imply that familiarity bias can have economically very large effects.

I.C. The Information Advantage and the Spillover Hypothesis

Another possible explanation for the documented bias may originate from an idea highlighted in the corporate venturing literature. Hellman (2002) and Bettignies and Chemla (2008) point out that one reason for the lower returns in projects financed through corporate venturing is that these projects may include a number of spillovers for their corporate VC. For examples, these projects may be financed to "test" new technologies that could benefit their corporate sponsors, or they could enable firms to attract, motivate and retain talented

managers. We call this the spillover hypothesis where sponsor firms may benefit from pension portfolio tilts in the plans that they sponsor. For example, pension plans may finance innovative projects that may benefit the firm or they may enable the firms to obtain investment opportunities in real estate or financing in innovative projects at better terms. We do not find any evidence supporting this hypothesis. In particular, firms sponsoring pension plans characterized by the familiarity bias that we document do not generate risk-adjusted returns that are significantly different from firms that sponsor plans without familiarity tilts.

II. Data and Descriptive Statistics

II.A. Data Sources

We have obtained pension fund asset allocation data from the Pensions and Investments magazine. We have merged these data with data from the IRS5500 forms to incorporate pension plan characteristics and with data from Compustat for sponsor firm financials.

Asset allocation data were obtained from the annual Pensions and Investments (P&I) survey for the period 1998 to 2007. Pensions & Investments (P&I) is a biweekly magazine aimed at pension, portfolio, and investment management executives. The magazine focuses its second issue of every calendar year on what has been dubbed the "P&I 1,000": the largest 1,000 pension plans as ranked by total assets under management. This special report details the investment practices of these plans. Data on pension funds' asset allocations, investment strategies, and investment managers are collected by sending questionnaires to over 1,200 plan sponsors.[9] The detail provided in the P&I asset allocation data is dichotomous between the periods 1992 to 1997 and 1998 to 2007, with much greater asset class detail reported during the latter period. Our estimation sample hence focuses on the period 1998 to 2007 so we could take advantage of this greater detail.

[9] Responses to these questionnaires are augmented with information from follow-up emails and phone calls, as well as with data from Money Market Directories Inc.

In this P&I dataset, we have eliminated observations with missing defined benefit asset allocation data, as well as those for which the plan sponsor is not incorporated in the United States. Since we aimed to focus on corporate defined-benefit pension plans, we have removed observations for which the plan sponsor is either a public (governmental) entity or a union. Next, we have hand-matched observations to Form 10Q filings, by sponsor name, using the SEC's EDGAR database to obtain plan sponsors' EINs. This resulted in 542 unique corporate plan sponsors (identified by unique EIN).

Sponsoring firm characteristics were obtained from the Compustat Annual Fundamentals database. We could match P&I and Compustat observations using EIN. After eliminating observations with missing Compustat accounting data, we we left with 451 plan sponsors.

Data on plan participants and plan financials were collected from the IRS 5500 forms for the period 1998-2007. US corporate pension plans covering 100 or more participants at the start of the plan year report annually summary balance sheet (assets and liabilities) and income statement (earnings and expenses) information on Form 5500. [10] After we have matched P&I, Compustat and IRS5500 data, we have winsorized the final sample at 1% and 99% for the pension plan funded status (pension assets over pension liabilities) and investment return (investment income over beginning of year pension assets). Our final sample consists of 366 plan sponsors.

In addition, we use monthly time series of asset returns in order to estimate portfolio benchmark returns and correlations using seven different asset classes. The following asset return series were chosen: S&P 500 for U.S. equities; MSCI EAFE for international equities; Barclay's US Aggregate Bond Index for U.S. bonds; Barclay's Global Bond Index for global bonds;

[10] Detailed asset allocation information, however, is typically unavailable from these forms. This is because plan assets are commonly invested in various collective investment vehicles, including common trust funds managed by banks, trust companies, or similar institutions, pooled separate accounts sponsored by insurance companies, and master trusts. Some of these collective investment vehicles are permitted or required to file their own annual reports with accompanying financial information (Form 5500 and Schedule H), and are referred to as direct filing entities (DFEs). A pension plan that invests through a DFE need only report its interest in the entity; the investor-plan is excused from providing detailed information about the underlying assets, liabilities, and transactions of the DFE.

Ryan ALM Cash Index for cash; NCREIF Property Index for real estate investment returns; Cambridge Associates LLC U.S. Private Equity Index for private equity; Barclay's Mortgage Index for mortgage investments. Finally, we have obtained sponsors' stock returns from the CRSP database for the period 1998-2007.

II.B. Descriptive Statistics

Table 1 reports summary statistics for the DB plan and sponsor characteristics for our sample for the period 1998-2007. Panel A presents summary statistics for the financials of the pension plans. The funding status is calculated as in the IRS 5500 data, i.e. as pension assets divided by pension liabilities. Plans had mean assets of $1.67 billion, and a mean funding status of 1.16. On average the share of active participants was 46.37%. The average DB plan had a ratio of contributions to assets of 1.57% and the average plan return was 7.75%.

Panel B reports summary statistics for the sponsoring firms. The average firm is our sample had assets worth more than $45 billion and just under 30% book leverage (total debt to total assets). On average R&D expenditures amounted to 18% of capital (PPE) while land and buildings represented 63% of capital.

Panel C shows asset allocation for the corporate defined-benefit pension funds in our sample. The variables are expressed as a percentage of total DB pension assets. The statistics show that on average equity investments amounted to 64.37% of holdings, debt investments represented 25.10%, while cash holdings represented 2.09%. The remaining 8.48% of mean asset holdings are held in alternative asset classes, including hedge funds, mortgages, private equity, and real estate investments. On average, pension plans with PE investment have $4,834.31 million in total assets and allocate 5.2% of their funds to PE. For real estate and mortgages, the average size is $4,175.01 million and the average portfolio weight for RE is 4.65%.

Table 2 provides summary statistics for the sample distribution across time and industry. Panel A gives the average plan's funded status and return for each year in the sample period.

The table shows negative mean returns in 2001 and 2002 and as a result a lower funded status in 2002 and 2003. Panel B presents the distribution of sponsors' R&D and real estate investments across industries. There are no utilities in our sample and only one financial company has non-missing R&D data. There are, however, 30 financial companies with non-missing land and buildings data. Our results remain the same if we exclude firms from the finance industry.

Table 3 highlights the link between plan and sponsor characteristics and plan's investment in alternative assets. It shows that there is no difference in the alternative asset allocation between underfunded and fully funded plans. On average, plans with a low share of active participants invest more in real estate, which is not consistent with a hedging motive. In addition, sponsoring firm characteristics such as z-scores and leverage do not affect the average plans' asset allocation in private equity and real estate. In contrast, pension plans sponsored by R&D-intensive firms invest more in private equity than others, while pension plans with sponsor firms with large land holdings invest more in real estate and mortgages than others. Plans of firms in the top 25% for R&D to capital invest almost twice as much in private equity than firms in the bottom 25%. Similarly, plans of firms in the top 25% for land and buildings to capital invest 85% more in real estate than firms in the bottom 25%. The means are significantly different at conventional levels. Section 4 contains the estimation results from our formal regression analysis.

III. Regression Analysis for Alternative Investment

III.A. Determinants of Pension Investment in Alternative Assets

Table 4 presents our estimation results from OLS and Logit regressions for the determinants of pension fund investment in private equity and real estate. Theories based on risk shifting incentives suggest that firms benefit when their pension assets are positively correlated with their own stock, and that incentives for risk shifting are stronger the more

underfunded the pension plan liabilities. To test for risk shifting versus risk management in pension investment we include the plan's funded status as an explanatory variable.

According to the theories based on hedging incentives, firms will invest in assets whose returns are correlated with the sponsor's industry returns in order to hedge future wage growth. This incentive for hedging is stronger for plans with larger share of active participants. To test for wage growth hedging motives in pension investment we include the ratio of plan's active participants to total participants as a control variable. We also include plan size (log of plan assets) to control for barriers to entry and plan age to control for pension liability structure.

To test for a link between the sponsor's corporate focus and the pension plan investment in alternative assets we include R&D to capital in the private equity regressions and land and buildings (L&B) to capital in the real estate regressions. Our hypotheses are that stronger corporate involvement in innovation is associated with a higher pension plan investment in private equity and large corporate land holdings are associated with a higher pension plan investment in real estate and mortgages.

Our set of control variables also includes sponsor characteristics. Profitability is defined as the ratio of operating income before depreciation to total assets. Frank (2002) and Rauh (2009) provide evidence that sponsors offset their (non-pension) business risk by reducing the investment risk of the pension plan assets. We include the sponsor's z-score (Altman's unlevered Z score) as a measure of sponsor's credit risk to capture this incentive.[11] Finally, we include the sponsor's size, market-to-book (MTB) ratio and leverage as additional controls.

The results in Table 4 can be interpreted as tests of several of the hypotheses about the relationship between the investment behavior of the pension plan and the corporate characteristics of its sponsor outlined above. The table reports linear OLS estimates and the maximum likelihood estimates of a logistic discrete choice model with fixed effects. Panel A show that R&D/PPE has a positive and statistically significant effect on private equity

[11] Results remain the same if we use credit rating as in Rauh (2009).

investment in all regressions. Similarly, in Panel B, the coefficient of L&B/PPE in the real estate regression is positive and statistically significant. These effects are also economically significant. One standard deviation increase in the ratio of R&D expenditures to capital increases plan's private equity investment by more than 0.5%. This is large relative to the mean PE investment of 1.61% and the median of 0%. Relatedly, one standard deviation increase in the ratio of L&B holdings to capital increases plan's private equity investment by more than 0.7%. This is large relative to the mean real estate investment of 1.64% and the median of 0%.

Our results are not consistent with theories based on risk shifting according to which firms have an incentive to invest in i) risky assets and ii) assets that are positively correlated with their own stock. These risk shifting incentives are stronger the more underfunded the pension plan. In contrast, we find that the effect of pension funded status on the probability of investing in private equity and real estate is either significantly positive or not significantly different from zero at conventional significance level. Our findings are consistent with Rauh (2009) who provides evidence that the better funded U.S. pension plans in his sample invest more in equity.

We do not find evidence that pension plans invest in assets that are correlated with the sponsor's industry growth in order to hedge against increases in real wages. Such an incentive for hedging will be stronger for pension plans with a large share of active participants. However, Table 4 shows that the share of active participants has either insignificant or a negative effect on the probability of investing in private equity and real estate. The results for funded status and share of active participants are consistent with the univariate statistics in Table 3.

Our results also indicate that plan size is an important determinant of pension plans' asset allocation with larger pension funds being significantly more likely to invest in private equity and real estate. This finding supports that there important barrier to entry and substantial positive scale economies in asset management. The finding is also consistent with Dyck and Pomorski (2011) who find that largest plans outperform smaller ones by 43-50 basis points per year where most of the superior returns come from large plans' increased allocation

to alternative investments. In their private equity and real estate investments large plans have both lower costs and higher gross returns, yielding up to 6% per year improvement in returns.

The signs of the other control variables are as expected. Age, our proxy for maturity of the pension plan, too is either positive or does not seem to affect the plan allocation to alternative assets. Sponsor's size and MTB are either positive or not statically significant. Sponsor's profitability, leverage and credit risk do not have a significant or an economically strong effect on the pension plan investment choice for private equity and real estate.[12]

Overall, our results provide strong evidence for the fact that pension plans tilt their portfolio towards alternative assets related to the sponsoring firm's corporate focus. The likelihood of investment in private equity and real estate is higher for large plans, well-funded plans, and plans with a low share of active plan participants. This is inconsistent with risk shifting, hedging or diversification motives.

III.B. Pension Plan Performance

Our next set of results compares the investment performance of pension plans' portfolios sorted by corporate focus and pension investment in alternative assets. If pension plan managers have value relevant information related to the corporate focus of the sponsoring firm we expect that pension portfolios in the top quartile for private equity and R&D/PPE and for real estate and L&B/PPE will outperform the portfolios in the bottom quartile. Alternatively if the portfolios with corporate focus tilt (top 25%) underperform pension portfolios without the tilt (bottom 25%), our results will be consistent with a familiarity bias. Table 5 presents the

[12] We also include the one year lagged asset class investment return (instead of time dummies) as a robustness check and find that higher returns lead to a higher probability of investing in that asset class. This is consistent both with risk management (as in Rauh, 2009) and a number of other frictions including the transactions costs of rebalancing, behavioral biases such as investor inertia or an excessive focus by managers on the short-term lagged return. The relationship between pension asset allocation and sponsor's corporate characteristics is robust to controlling for lagged investment returns, which suggests that the allocation bias is not explained by the tendency of short-term asset allocation to be affected by lagged performance.

results on the effect of sponsoring firm corporate focus on its pension plan investment performance.

Our first performance measure uses excess returns calculated as the actual pension plan returns over the returns for portfolios of benchmarks where the portfolio weights are the pension plans asset allocations. Our second measure uses the return decomposition of Lo (2007).[13] Lo splits the expected return of a portfolio into two components. The first depends only on the average values of portfolio weights and asset returns. The second depends on the correlation between portfolio weights and returns. The portfolio allocation of a successful manager tends to be positively correlated with returns. Therefore, the correlation between portfolio weights and returns at date *t* is a measure of the predictive power of the information used by the manager to select her date-*t* portfolio weights. If weights have no forecasting power, the only source of expected return is risk premia, which can usually be generated by a buy-and-hold portfolio. The performance measure has an added advantage that it does not depend on a choice of a benchmark.

Panel A of Table 5 reports the plans' abnormal returns calculated as the excess of the actual pension return over the benchmark return. The plans' abnormal returns are sorted in quartiles by private equity and R&D/PPE or sorted by real estate and mortgages and L&B/PPE. The table also shows that the overall effect of investing in private equity and real estate is positive. The average abnormal return for plans that do not invest in alternative assets is -1% whereas the average abnormal return for plans that invest in private equity or real estate is 0.38%. The means are significantly different at conventional levels. Pension plan performance does not improve with size. Plans in the top 25% for plan assets have an average abnormal return of -0.44% whereas for plans in the bottom 25% the average return is -0.56%. The means are not significantly different at conventional levels.

[13] Lo's active component of portfolio returns may be computed solely from the average weights and average returns of the portfolio. Under some very general assumptions, the active component of any portfolio may be estimated consistently from the sample moments where the estimator is asymptotically normal with variance that may be estimated consistently using GMM.

Our results concerning the effect of the corporate focus, however, suggest that there is a negative effect of the asset allocation bias on the plan performance. The positive average abnormal return of plans with alternative investments suggests that the worse performance for these plans is not just due to bad luck for investing in alternative assets during our sample period.

Panel B of Table 5 shows the effect of the familiarity bias on pension performance using the excess of the actual pension plans' returns over a benchmark return. The benchmark return is the return on a portfolio invested in benchmark indexes with portfolio weights identical to those of the pension plan. For both private equity and R&D/PPE and real estate investment and L&B/PPE, the abnormal returns of the plans in the top quartile are significantly lower than the returns of the plans in the bottom quartile at conventional levels. Panel C of Table 5 shows the effect of the familiarity bias on pension performance using Lo's (2007) decomposition. The results suggest that pension managers do not add value by actively managing their pension portfolio as on average the active component of pension returns for plans with large investment tilts in these asset classes is significantly worse and the gap for real estate tilt is economically important.

A possible explanation for the worse performance of biased plans that is consistent with the information advantage hypothesis is that managers can successfully time investments in alternative asset classes but underperform when actively managing investments in traditional asset classes. Panels D and E present the active components for private equity and real estate, respectively. Our results confirm our previous findings that there is a negative effect of the asset allocation bias on the plan's performance. For both private equity and real estate, the active component of returns of plans in the top quartile is significantly lower than the active component of plans in the bottom quartile at conventional levels. Overall, our results show that the impact of familiarity biases on pension plan investment policy is negative. This is consistent with managerial overconfidence about the performance of familiar assets.

Finally, we also investigate whether sponsoring firms' shareholders benefit from the tilts in pension plan asset allocation decisions[14] and suggested by the spillover hypothesis. In Table 6, we run monthly Fama-Macbeth regressions for sponsors' stock returns on firm level characteristics for sample firms sorted by their pension plan alternative assets bias. At the end of each year in the sample period, we double-sort sponsors in quartiles by private equity to total pension assets and sponsor R&D expenditures (Panel A) or real estate to total pension assets and sponsor L&B holdings (Panel B). The results do not support the spillover hypothesis as only B/M and to a lesser extent size are significant.

In Table 7, we report average excess returns against the riskfree rate and DGTW-adjusted returns (following Daniel et al, 1997) for portfolios of sponsoring firms sorted by their pension plan alternative assets bias. At each year end we sort sponsors in quartiles by sponsor R&D expenditures and plan private equity to total pension assets (Panel A) or sponsor L&B holdings and plan real estate to total pension assets (Panel B). We use the sorting to calculate value and equally weighted portfolio returns. The abnormal returns are not significantly different across portfolios so we do not find any evidence that would support the spillover hypothesis.

In Table 8, we report the percentage of pension assets allocated to private equity and in real estate for OLS regressions using our not only our usual control variables, but also the interaction between an R&D (resp L&B) dummy and the correlation between private equity (resp real estate) and the S&P500. This variable is significant, which is consistent with the theory of familiarity developed by Boyle et al (2012).

IV. Further Tests

In this section we address the effect of two estimation problems on our results: (1) returns to R&D investment and local real estate prices may be correlated with the investment

[14] Previous literature has identified other links between pension plan's asset allocation and shareholders' wealth. For example, Rauh (2006b) shows that employee ownership in defined contribution plans lowers takeover probabilities.

opportunities of pension plans and (2) the decision to invest in R&D projects and to own land and buildings may be correlated with pension plan's investment opportunities. We provide two robustness checks to gauge the severity of the problem they may cause which also provide further tests of a familiarity bias.

We control for the two most important determinants in the R&D investment and L&B ownership decision, size and financial constraints. Table 9 presents our main results for the sample of small and large firms. We use the median firm to split the sample but the results remain robust to using size quartiles. Table 10 presents the results when we use the WW Index estimated as in Whited and Wu (2006) to control for the effect of financial constraints. The index is the Lagrange multiplier on a dividend non-negativity constraint in an investment Euler equation. The estimation results remain unchanged and the familiarity bias remains significant.

Second in the spirit of Chaney et al (2012), we estimate the sensitivity of PE investment to industry R&D returns for firms that invest in R&D before and after they do so and the sensitivity of RE to local MSA real estate prices for firms that acquire real estate before and after they do so. The results are presented in Table 11. Panel A shows that before their sponsoring firm invests in R&D, future plan investors in private equity are statistically indistinguishable from the pension plans sponsored by firms that never invest in R&D. Similarly, before acquiring real estate, future purchasers are statistically indistinguishable from firms that never own real estate. The sensitivity of their pension investment in private equity to R&D returns becomes large, positive and significant only after they invest in R&D projects. Panel B shows that before sponsors invest in L&B, future plan investors in real estate and mortgages are statistically indistinguishable from the pension plans of firms that never invest in L&B. The sensitivity of their pension investment in real estate and mortgages to state real estate prices becomes large, positive and significant only after they acquire real estate. Overall this robustness check confirms our main results and they provide another support for a familiarity bias.

Several other robustness tests provide further insight. We account for the fact that asset allocation weights are censored below zero and above one and use a two-limit Tobit model to

estimate the regressions in Table 4. Also, we control for the effects of persistence in asset allocation than may be caused by regular rebalancing towards a strategic asset allocation and include a one period lag of the dependent variable to the regressions in Table 4. We use GMM to estimate the specification. The results remain the same.[15]

V. Conclusions

This paper considers the asset allocation decisions of the large US defined benefit pension plans. We estimate reduced form models of the determinants of pension fund asset allocation decisions and examine the effect of sponsoring firm's corporate focus on the investment strategy of the pension funds' investment in foreign assets, private equity, and real estate and mortgages. We show that pension plans whose sponsors have a higher proportion of foreign to total sales are more likely to invest in international assets, plans sponsored by firms that spend more on research and development are more likely to invest in private equity, and plans whose sponsors have more fixed assets are more likely to invest in real estate and mortgages. Our results are not consistent with risk shifting motives as we find that plans de-risk their asset allocation as their funded status deteriorates. Similarly, our findings do not support theories based on hedging or diversification motives. We show that pension plans that align their investment policy with the sponsor's corporate focus do not have higher share of active participants and their returns exhibits higher correlation with the sponsor's equity returns. Overall, our results suggest that familiarity bias is an important determinant of pension investment. The worse performance of pension plans with such allocation bias is consistent with pension managers being subject to familiar assets thus taking excess risks for which they do not get compensated. Further, we provide direct tests that support the familiarity bias hypothesis.

Many questions await future research. For example, examining pension plans' trading and rebalancing activities can help distinguish between different sources of familiarity bias, e.g.

[15] Results of these robustness tests are available upon request.

theories based on a fear of change, e.g. Cao et al (2012). Finally, the importance of pension trustees and of their relationship with their sponsoring firm remains largely unknown due to data limitations. They play a central role in pension governance, asset allocation, and in the magnitude of familiarity bias such as those we documented. This will certainly be the subject of

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Table 1: Descriptive Statistics for US Defined Benefit Pension Plans and their Sponsors

The final sample consists of 366 P&I 1000 corporate plans for which we were able to obtain sponsor's EIN data, match P&I, Compustat and IRS 5500 files for the period 1998-2007. The sample is also winsorized at 1% and 99% for funded status (pension assets over pension liabilities) and investment return (investment income over beginning of year pension assets). Panel A presents summary statistics for the sample pension plans. Panel B presents summary statistics for the sponsoring firms and Panel C presents summary statistics for the pension plans' asset allocation. The weights are expressed as a percentage of total DB pension assets.

Panel A: Descriptive Statistics for DB Pension Plans (IRS5500 1998-2007)					
	(1)	(2)	(3)	(4)	(5)
Variables	Mean	Std. dev	10%	50%	90%
Plan Size (Million USD)	1667.19	4525.50	43.69	641.91	3280.01
Plan age (years)	41.67	27.0105	12.00	46.00	63.00
Plan return	7.75%	0.1094	-7.89%	9.29%	20.16%
Funded Status	1.16	0.4749	0.80	1.07	1.55
Share of active participants	0.46	0.19	0.21	0.47	0.70
Contributions	0.02	0.05	0.00	0.00	0.06
Panel B: Descriptive Statistics for DB Plan Sponsors (COMPUSTAT, 1998-2007)					
Size (Billion USD)	45.38	156.6536	1.94	10.19	79.72
Market-to-Book	1.45	1.1596	0.59	1.10	2.71
Leverage	0.29	0.1686	0.08	0.28	0.48
Profitability	0.13	0.0759	0.04	0.12	0.22
Z score	1.59	1.0312	0.52	1.53	2.78
R&D/PPE	0.18	0.3167	0.01	0.08	0.43
Land and Buildings/PPE	0.63	0.3522	0.27	0.60	0.93

Panel C: Asset Allocation for DB Pension Plans (P&I SURVEY, 1998-2007)					
	(1)		(2)		(3)
	Plans with PE		Plans with RE		All Plans
US equity	45.34%	(0.1161)	47.26%	(0.1173)	49.45% (0.1521)
US fixed income	22.84%	(0.0874)	22.81%	(0.0895)	24.03% (0.1349)
Foreign equity	17.06%	(0.0853)	16.28%	(0.0833)	14.93% (0.1096)
Foreign fixed income	1.28%	(0.0343)	1.51%	(0.0362)	1.07% (0.0344)
Cash	2.08%	(0.0425)	1.44%	(0.0267)	2.09% (0.0587)
Private equity	5.20%	(0.0399)	2.77%	(0.0377)	1.61% (0.0329)
Real estate	2.51%	(0.0299)	4.65%	(0.0311)	1.64% (0.0281)
Mortgages	0.14%	(0.0087)	0.15%	(0.0089)	0.01% (0.0096)
Other	3.64%	(0.0878)	3.19%	(0.0626)	5.14% (0.1536)

Table 2: Sample Distribution across Time and Industry

Panel A presents the average and median plan's funded status and return for each year in the sample period. Panel B presents the distribution of sponsors R&D and real estate investments across industries. The panel shows the average and median R&D/PPE and Land & Buildings/PPE.

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Year		Funded Status			Plan return	
	N	Mean	Median	N	Mean	Median
1998	210	1.35	1.22	215	13.20%	13.45%
1999	166	1.28	1.17	175	15.90%	15.23%
2000	159	1.37	1.19	163	1.84%	0.40%
2001	170	1.19	1.08	177	-4.55%	-4.50%
2002	190	1.06	0.97	198	-9.25%	-9.40%
2003	194	0.96	0.82	199	21.28%	21.45%
2004	149	1.13	1.03	151	10.95%	11.00%
2005	147	1.08	1.03	151	7.40%	7.24%
2006	202	1.08	1.02	205	12.59%	12.78%
2007	152	1.11	1.07	211	6.73%	7.52%

Panel B: Fama-French Industries		R&D/PPE			L&B/PPE	
Consumer NonDurables	74	0.06	0.04	188	0.68	0.64
Consumer Durables	49	0.12	0.10	43	0.45	0.44
Manufacturing	370	0.11	0.09	320	0.60	0.57
Oil, Gas, and Coal Extraction	52	0.05	0.01	20	0.44	0.40
Chemicals and Allied Products	139	0.07	0.07	125	0.75	0.57
Business Equipment	111	0.50	0.39	114	0.69	0.67
Telephone and Television	1	0.00	0.00	7	0.41	0.39
Utilities	0	.	.	0	.	.
Wholesale, Retail, Services	65	0.04	0.00	93	0.79	0.74
Healthcare, Medical Equipment	63	0.41	0.42	64	0.69	0.73
Finance	1	0.00	0.00	30	0.35	0.23
Other	24	0.73	0.04	62	0.40	0.34

Table 3: Alternative Investment and Plan and Sponsor Characteristics

The final sample consists of 366 P&I 1000 corporate plans for which we were able to obtain sponsor's EIN data, match P&I, Compustat and IRS 5500 files for the period 1998-2007. The sample is also winsorized at 1% and 99% for funded status (pension assets over pension liabilities) and investment return (investment income over beginning of year pension assets). The p values are from for t-tests for differences in means.

Variables	Obs.	Mean	Std. dev	Obs.	Mean	Std. dev	p value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Funded Status		Funded Plans			Underfunded Plans		
Private Equity	1160	1.72%	0.0327	694	1.88%	0.0360	0.3560
Real Estate	1160	1.76%	0.0276	694	1.74%	0.0315	0.8899
Mortgages	1160	0.12%	0.0105	694	0.07%	0.0076	0.2788
Others	1160	4.66%	0.1428	694	5.49%	0.1620	0.2672
Panel B: Plan Participants		Share Active Participants 75%			Share Active Participants 25%		
Private Equity	454	1.73%	0.0373	454	2.01%	0.0317	0.2274
Real Estate	454	1.21%	0.0249	454	2.24%	0.0291	0.0000***
Mortgages	454	0.08%	0.0103	454	0.16%	0.0097	0.2750
Others	454	6.86%	0.1882	454	4.22%	0.1168	0.0113***
Panel C: Credit Risk		Z score 75%			Z score 25%		
Private Equity	393	1.94%	0.0347	393	1.36%	0.0311	0.0138***
Real Estate	393	1.88%	0.0292	393	1.58%	0.0279	0.1311
Mortgages	393	0.09%	0.0088	393	0.12%	0.0132	0.7500
Others	393	3.51%	0.1008	393	4.97%	0.1582	0.1239

Table 3 (continued)

Panel D: Leverage		Leverage 75%			Leverage 25%		
Private Equity	460	1.61%	0.0324	460	1.92%	0.0341	0.1630
\zReal Estate	460	1.62%	0.0306	460	1.90%	0.0311	0.1621
Mortgages	460	0.07%	0.0096	460	0.09%	0.0077	0.7336
Others	460	6.07%	0.1808	460	5.13%	0.1426	0.3852

Panel E: R&D/PPE		R&D 75%			R&D 25%		
Private Equity	237	3.24%	0.0433	237	1.19%	0.0236	0.0000***
Real Estate	237	1.85%	0.0296	237	1.81%	0.0335	0.4768
Mortgages	237	0.05%	0.0034	237	0.05%	0.0045	0.9076
Others	237	5.56%	0.1656	237	3.79%	0.1281	0.1943

Panel F: L&B/PPE		L&B 75%			L&B 25%		
Private Equity	267	1.56%	0.0323	267	1.71%	0.0328	0.6046
Real Estate	267	2.03%	0.0249	267	1.62%	0.0229	0.0461**
Mortgages	267	0.21%	0.0166	267	0.02%	0.0026	0.0695*
Others	267	5.05%	0.1562	267	4.55%	0.1319	0.6929

Table 4: Determinants of Pension Investment in Alternative Assets

Panel A: the dependent variable is: (1), (2) and (3) the percentage of pension assets allocated to private equity for OLS regressions or (4) a dummy variable equal to one if the pension plan invests in private equity in Logit regression. Panel B: the dependent variable is (1), (2) and (3) the percentage of pension assets allocated to real estate in OLS regressions or (4) a dummy variable equal to one if the pension plan invests in real estate in Logit regression. All regressions contain time dummies. Robust standard errors clustered at state level are presented in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: PE	(1)		(2)		(3)		(4)		
	coeff	std error	coeff	std error	coeff	std error	coeff	std error	marg eff
Plan size	0.0029	(0.0005)***	0.0026	(0.0009)***	0.0015	(0.0007)**	0.0134	(0.0513)	0.0029
Plan age	0.0031	(0.0012)***	0.0024	(0.0021)	0.0039	(0.0014)***	0.3567	(0.1216)***	0.0770
Funded status	-0.0009	(0.0017)	0.0081	(0.0028)***	0.0015	(0.0022)	-0.0259	(0.1797)	-0.0056
Share active participants	0.0072	(0.0049)	0.0043	(0.0078)	-0.0014	(0.0062)	-2.1629	(0.5167)***	-0.4671
Spon size			0.0033	(0.0014)**	0.0064	(0.0011)***	0.7441	(0.0898)***	0.1600
MB			0.0048	(0.0017)***	0.0032	(0.0014)**	0.0120	(0.1056)	0.0000
Z score			0.0016	(0.0019)	0.0029	(0.0015)*	0.5071	(0.1557)***	0.1100
Leverage			-0.0138	(0.0113)	0.0097	(0.0086)	1.5564	(0.7464)**	0.3400
Profitability			-0.0460	(0.0307)	-0.0624	(0.0233)***	-1.4331	(2.0397)	-0.3100
R&D/PPE			0.0186	(0.0069)***	0.0287	(0.0060)***	2.1585	(0.5951)***	0.4700
Firm fixed effects	Yes		Yes		IND dummies		Yes		
R^2	14.49%		20.69%		24.60%		17.46%		
Obs	1711		949		949		949		

Table 4 (continued)

Panel B: RE	(1)		(2)		(3)		(4)		
	coeff	std error	coeff	std error	coeff	std error	coeff	std error	marg eff
Plan size	0.0233	(0.0007)***	0.0062	(0.0012)***	0.02065	(0.0018)***	0.0503	(0.0158)***	0.1227
Plan age	0.0006	(0.0011)	0.00024	(0.0013)	-0.00175	(0.0020)	-0.0288	(0.1628)	-0.0070
Funded status	0.0037	(0.0016)**	-0.00338	(0.0021)	0.000627	(0.0027)	-0.3913	(0.2714)	-0.0954
Share active participants	-0.0141	(0.0045)***	-0.02211	(0.0060)***	-0.01104	(0.0082)	-0.8338	(0.6369)	-0.2033
Spon size			0.0030	(0.0012)***	0.001793	(0.0018)	-0.1400	(0.1412)	-0.0341
MB			-0.0017	(0.0013)	-0.00269	(0.0017)	0.1872	(0.1324)	0.0457
Z score			0.00125	(0.0014)	0.00285	(0.0019)	0.4347	(0.1749)**	0.1060
Leverage			0.01239	(0.0081)	0.014308	(0.0112)	-0.2360	(0.8848)	-0.0576
Profitability			-0.00222	(0.0219)	-0.0029	(0.0305)	0.5633	(0.4179)	0.1396
L&B/PPE			0.0190	(0.0056)***	0.022602	(0.0068)***	1.0255	(0.5267)**	0.2500
Firm fixed effects	Yes		Yes		IND dummies		Yes		
R^2	14.81%		20.11%		22.27%		19.64%		
Obs	1711		1066		1066		1066		

Table 5: Pension Plan Performance

Panel A and Panel B report the excess of the actual pension plans' returns over a benchmark return. The benchmark return is the return on a portfolio invested in benchmark indexes with portfolio weights identical to those of the pension plan. Panel C reports the active component of pension returns, the sum of the covariances between asset class returns and pension portfolio weights. Panel D reports the active component of PE returns, the covariances between PE returns and pension portfolio weights. Panel E reports the active component of RE returns, the covariances between RE returns and pension portfolio weights. The p values are from a t-test for differences in mean between the top and bottom quartiles. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: Pension Plans Abnormal Returns (1998-2007)					
Plans with PE or RE	0.38%	(0.0031)	Plan size bottom 25%	-0.56%	(0.0029)
Plans without PE & RE	-1.00%	(0.0020)	Plan size top 25%	-0.44%	(0.0025)
p value	0.0002	***	p value	0.7561	
Panel B: Abnormal Returns					
PE>0 and R&D/PPE			RE>0 and L&B/PPE		
Bottom 25%	-0.35%	(0.0026)	Bottom 25%	-0.38%	(0.0027)
Inter-quartile 25%-75%	-0.63%	(0.0579)	Inter-quartile 25%-75%	-0.42%	(0.0584)
Top 25%	-0.96%	(0.0028)	Top 25%	-1.58%	(0.0034)
p value	0.0508	**	p value	0.0086	***
Panel C: Active Component					
PE>0 and R&D/PPE			RE>0 and L&B/PPE		
Bottom 25%	0.14%	(0.0014)	Bottom 25%	-0.03%	(0.0058)
Inter-quartile 25%-75%	-0.11%	(0.0104)	Inter-quartile 25%-75%	-0.13%	(0.0302)
Top 25%	-0.51%	(0.0026)	Top 25%	-0.69%	(0.0094)
p value	0.0374	**	p value	0.0648	*
Panel D: Active Component for PE					
PE>0 and R&D/PPE					
Bottom 25%	-0.10%	(0.0038)			
Inter-quartile 25%-75%	-0.09%	(0.0203)			
Top 25%	-0.41%	(0.0017)			
p value	0.1038*				
Panel E: Active Component for RE					
RE>0 and L&B/PPE					
Bottom 25%	-0.03%	(0.0027)			
Inter-quartile 25%-75%	-0.04%	(0.0301)			
Top 25%	-0.39%	(0.0015)			
p value	0.0422**				

Table 6: Sponsors Stock Returns and Pension Fund Alternative Assets Bias

The table reports monthly Fama-Macbeth regressions for sponsors' stock returns on firm level characteristics for sample firms sorted by their pension plan alternative assets bias. At the end of each year in the sample period, we double-sort sponsors in quartiles by private equity to total pension assets and sponsor R&D expenditures (Panel A) or real estate to total pension assets and sponsor L&B holdings (Panel B). Size is the log of market capitalization. B/M is the end of year book to market equity value and Mom2-12 is the cumulative return from months t-12 to t-2. All variables are winsorized at the 1% and 99%. Stock returns are from the CRSP Merged database. Standard errors are Newey-West adjusted with four lags. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: Pension Plan Private Equity and Sponsor R&D Expenditures								
	Low		(2)		(3)		High	
PE/TA	-0.0285	(0.0233)	-0.0256	(0.0475)	-0.0104	(0.0120)	-0.0310	(0.0283)
Size	-0.0018	(0.0010)*	-0.0020	(0.0012)*	-0.0023	(0.0015)	-0.0028	(0.0021)
B/M	0.0029	(0.0011)***	0.0019	(0.0010)*	0.0048	(0.0016)***	0.0048	(0.0015)***
Mom2-12	0.0041	(0.0045)	0.0051	(0.0048)	0.0013	(0.0044)	0.0042	(0.0043)
Avg R^2	0.0282		0.0212		0.0475		0.0487	

Panel B: Pension Plan Real Estate and Sponsor L&B Holdings								
	Low		(2)		(3)		High	
RE/TA	-0.0191	(0.0231)	-0.0549	(0.0696)	-0.0097	(0.0352)	-0.0137	(0.0374)
Size	-0.0017	(0.0078)	-0.0016	(0.0019)	-0.0020	(0.0021)	-0.0016	(0.0010)*
MB	0.0031	(0.0014)**	0.0089	(0.0053)*	0.0208	(0.0081)***	0.0029	(0.0011)***
Mom2-12	0.0016	(0.0047)	0.0015	(0.0012)	0.0018	(0.0027)	0.0018	(0.0045)
Avg R^2	0.0497		0.0402		0.0673		0.0681	

Table 7: Average Returns for Portfolios Sorted by Pension Fund Alternative Assets Bias

The table reports average excess returns against the riskfree rate and DGTW-adjusted returns (following Daniel et al (1997) for portfolios of sponsoring firms sorted by their pension plan alternative assets bias. At each year end we sort sponsors in quartiles by sponsor R&D expenditures and plan private equity to total pension assets (Panel A) or sponsor L&B holdings and plan real estate to total pension assets (Panel B). We use the sorting to calculate value and equally weighted portfolio returns. All variables are winsorized at the 1% and 99%. Stock returns are from the CRSP Merged database. Standard errors are Newey-West adjusted with four lags. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: Plan Private Equity and Sponsor R&D Expenditures						
	Excess Returns		DGTW-adj. Returns			
	VW	EW	VW	EW	Avg. ME (mil)	BE/ME
High	0.8604	0.5011	0.7354	0.5424	26.9545	0.8759
(2)	0.2458	0.4554	0.5615	0.5829	22.5405	0.8388
(3)	0.5438	0.4968	0.7053	0.5903	16.4170	0.8797
Low	0.7516	0.6719	0.7024	0.6110	39.3175	0.5932
High-Low	0.1088	-0.1708	0.0331	-0.0686		
t-stat	(1.3571)	(1.5201)	(0.9565)	(0.7608)		

Panel B: Plan Real Estate and Sponsor L&B Holdings						
	Excess Returns		DGTW Returns			
	VW	EW	VW	EW	Avg. ME (mil)	BE/ME
High	0.7512	0.6116	0.6947	0.5698	9.4438	0.9000
(2)	0.6703	0.4627	0.7275	0.4925	8.8684	0.8759
(3)	0.4981	0.4317	0.8585	0.6277	22.7462	0.7110
Low	0.8165	0.5655	0.9198	0.6568	40.9836	0.8108
High-Low	-0.0654	0.0461	-0.2252	-0.0870		
t-stat	(0.7091)	(0.5260)	(1.4602)	(0.7908)		

Table 8: Determinants of Pension Investment in Alternative Assets

The dependent variable for (1) and (2) is the percentage of pension assets allocated to private equity for OLS regressions. The dependent variable for (3) and (4) is the percentage of pension assets allocated to real estate in OLS regressions. All regressions contain time dummies. Robust standard errors clustered at state level are presented in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

	(1)		(2)		(3)		(4)	
Plan size	0.0060	(0.0015)***	0.0058	(0.0035)*	0.0043	(0.0019)***	0.0033	(0.0016)**
Plan age	0.0031	(0.0019)*	0.0057	(0.0038)	-0.0014	(0.0016)	-0.0038	(0.0026)
Funded status	0.0060	(0.0027)**	0.0072	(0.0026)***	-0.0047	(0.0023)	0.0007	(0.0019)
Share active participants	0.0179	(0.0076)**	0.0083	(0.0109)	-0.0126	(0.0071)	0.0091	(0.0085)
Spon size	0.0032	(0.0013)***	0.0038	(0.0019)**	0.0018	(0.0013)	0.0015	(0.0029)
MB	0.0051	(0.0016)***	0.0017	(0.0018)	0.0010	(0.0014)	0.0008	(0.0012)
Z score	-0.0177	(0.0101)	-0.015	(0.0147)	0.0156	(0.0086)	-0.0056	(0.0108)
Leverage	-0.0211	(0.0283)	-0.016	(0.0349)	-0.0086	(0.0281)	0.0749	(0.0257)
Profitability	0.0003	(0.0016)	-0.006	(0.0033)	0.0003	(0.0014)	-0.0038	(0.0023)
R&D/PPE	0.0168	(0.0056)***	0.0124	(0.0048)***				
L&B/PPE					0.0100	(0.0030)***	0.0178	(0.0081)**
Corr(S&P500, PE Index)*Dummy R&D	0.0216	(0.0081)***	0.0088	(0.0012)***				
Corr(S&P500, RE Index)*Dummy L&B					0.0120	(0.0061)***	0.0136	(0.0016)***
Firm fixed effects	Industry effects		Yes		Industry effects		Yes	
R^2	14.26%		11.66%		24.83%		19.28%	
Obs	949		949		1066		1066	

Table 9: Robustness Tests for Alternative Investment: Size

Panel A: the dependent variable is the percentage of pension assets allocated to private equity. Panel B: the dependent variable is the percentage of pension assets allocated to real estate. All regressions contain time dummies. Robust standard errors clustered at state level are in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: PE	Small firms (bottom 50%)		Large firms (top 50%)		Interaction	
	coeff	std error	coeff	std error	coeff	std error
Plan size	0.0020	(0.0014)	0.0028	(0.0014)**	0.0026	(0.0009)***
Plan age	0.0007	(0.0024)	0.0031	(0.0042)	0.0030	(0.0021)
Funded status	0.0102	(0.0034)***	0.0034	(0.0077)	0.0078	(0.0027)***
Share active participants	-0.0314	(0.0106)***	0.0419	(0.0179)**	0.0077	(0.0079)
Spon size					0.0057	(0.0017)***
MB	-0.0009	(0.0025)	0.0066	(0.0044)	0.0051	(0.0017)***
Z score	0.0066	(0.0019)***	0.0044	(0.0056)	0.0022	(0.0019)
Leverage	0.0147	(0.0134)	0.0802	(0.0345)**	-0.0176	(0.0113)
Profitability	-0.0331	(0.0368)	-0.0884	(0.0728)	-0.0594	(0.0309)*
R&D/PPE	0.0368	(0.0083)***	0.0179	(0.0151)	0.1106	(0.0332)***
Spon size * R&D/PPE					-0.0107	(0.0038)***
Adj. R^2	17.59%		24.66%		19.75%	
Obs	569		380		949	

Panel B: RE	Small firms (bottom 50%)		Large firms (top 50%)		Interaction	
Plan size	0.0142	(0.0035)***	0.0050	(0.0022)**	0.0021	(0.0017)
Plan age	-0.0018	(0.0028)	-0.0021	(0.0079)	-0.0001	(0.0019)
Funded status	0.0115	(0.0034)***	-0.0217	(0.0172)	0.0048	(0.0025)**
Share active participants	0.0073	(0.0115)	0.0222	(0.0343)	-0.0027	(0.0077)
Spon size					0.0047	(0.0018)***
MB	-0.0040	(0.0039)	-0.0025	(0.0062)	-0.0013	(0.0015)
Z score	0.0075	(0.0021)***	-0.0041	(0.0136)	0.0034	(0.0017)**
Leverage	0.0030	(0.0141)	0.0555	(0.0583)	0.0106	(0.0104)
Profitability	-0.0300	(0.0414)	0.0256	(0.1495)	-0.0254	(0.0286)
L&B/PPE	0.0574	(0.0078)***	0.0092	(0.0166)	0.1755	(0.0304)***
Spon size * L&B/PPE					-0.0179	(0.0035)***
Adj. R^2	31.59%		30.70%		21.52%	
Obs	655		411		1066	

Table 10: Robustness Tests for Alternative Investment: Financial Constraints

Panel A: the dependent variable is the percentage of pension assets allocated to private equity. Panel B: the dependent variable is the percentage of pension assets allocated to real estate. WW Index is estimated as in Whited and Wu (2006) and is the Lagrange multiplier on a dividend nonnegativity constraint in an investment Euler equation. All regressions contain time dummies. Robust standard errors clustered at state level are in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

Panel A: PE	Constrained firms (top 50% WW Index)		Unconstrained firms (bottom 50% WW Index)		Interaction	
	coeff	std error	coeff	std error	coeff	std error
Plan size	0.0098	(0.0025)***	0.0018	(0.0028)	0.0076	(0.0019)***
Plan age	0.0073	(0.0029)***	0.0008	(0.0027)	0.0037	(0.0021)
Funded status	0.0003	(0.0037)	0.0194	(0.0039)***	0.0070	(0.0028)***
Share active participants	0.0131	(0.0119)	0.0325	(0.0112)***	0.0159	(0.0083)**
Spon size	-0.0023	(0.0025)	0.0053	(0.0025)**	-0.0002	(0.0018)
MB	0.0066	(0.0021)***	0.0050	(0.0035)	0.0053	(0.0017)***
Leverage	-0.0130	(0.0182)	-0.0275	(0.0142)**	-0.0136	(0.0113)
Profitability	-0.0713	(0.0481)	-0.0842	(0.0399)**	-0.0610	(0.0321)*
Z-score	0.0037	(0.0041)	0.0023	(0.0026)	0.0023	(0.0026)
R&D/PPE	0.0218	(0.0019)***	0.0195	(0.0032)***	0.0217	(0.0083)***
WWIndex*R&D/PPE					0.0009	(0.0034)
Adj. R^2	17.64%		19.35%		18.68%	
Obs	446		503		949	

Panel B: RE	coeff	std error	coeff	std error	coeff	std error
Plan size	0.0033	(0.0012)***	0.0032	(0.0013)***	0.0045	(0.0017)***
Plan age	0.0009	(0.0022)	0.0043	(0.0025)*	-0.0011	(0.0019)
Funded status	0.0063	(0.0029)**	0.0061	(0.0035)*	0.0043	(0.0026)*
Share active participants	-0.0214	(0.0091)**	-0.0004	(0.0116)	-0.0092	(0.0077)
Spon size	-0.0003	(0.0021)	0.0018	(0.0027)	0.0011	(0.0017)
MB	0.0018	(0.0016)	0.0008	(0.0037)	0.0019	(0.0016)
Leverage	0.0304	(0.0136)**	0.0164	(0.0147)	0.0166	(0.0106)
Profitability	0.0269	(0.0408)	-0.0552	(0.0447)	-0.0003	(0.0299)
Z score	0.0021	(0.0033)	0.0003	(0.0024)	0.0019	(0.0024)
L&B/PPE	0.0169	(0.0055)***	0.0070	(0.0042)*	0.0214	(0.0077)***
WWIndex*L&B/PPE					0.0006	(0.0032)
Adj. R^2	18.96%		21.31%		18.23%	
Obs	516		550		1066	

Table 11: Pension Investment Behavior for R&D and non-R&D Investors and L&B Purchasers and non-Purchasers

Panel A: the dependent variable is: (1), (2) and (3) the percentage of pension assets allocated to private equity for OLS regressions. Panel B: the dependent variable is (1), (2) and (3) the percentage of pension assets allocated to real estate in OLS regressions. Panel A: Column (1) looks at the sensitivity of pension plan PE investment to Industry R&D returns for firms that never invest in R&D projects; Column (2) looks at the same sensitivities for sponsoring firms that will invest in R&D but before they invest; Column (3) estimates the same sensitivities for R&D firms but after they have invested in the R&D projects. Test "R&D before=R&D after" presents the p-value from a t-test of equality of the Industry R&D returns coefficients between the R&D investors before and after the investment. Robust standard errors clustered at state level are in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

	Non R&D firms		R&D firms before R&D investing		R&D firms after R&D investing		Test "R&D before=R&D after"
	coeff	std error	coeff	std error	coeff	std error	p value
Panel A:		(1)		(2)		(3)	
Plan size	0.0152	(0.0054)***	0.0174	(0.0019)***	0.0053	(0.0015)***	
Plan age	-0.0261	(0.0135)*	0.0039	(0.0021)	0.0027	(0.0020)	
Funded status	0.0415	(0.0183)**	0.0071	(0.0028)***	0.0060	(0.0028)**	
Share active participants	0.0007	(0.0218)	0.0155	(0.0185)	0.0155	(0.0077)**	
Spon size	0.0029	(0.0075)	0.0020	(0.0018)	0.0034	(0.0013)***	
MB	0.0063	(0.0091)	0.0054	(0.0071)	0.0050	(0.0017)***	
Z score	-0.0014	(0.0021)	-0.0019	(0.0019)	0.0006	(0.0017)	
Leverage	0.0121	(0.0237)	0.0140	(0.0116)	-0.0172	(0.0106)	
Profitability	0.1152	(0.1009)	0.0164	(0.0315)	-0.0743	(0.0288)***	
Ind R&D returns	0.0168	(0.0129)	0.0138	(0.0260)	0.0585	(0.0159)***	0.0071***
Adj. R^2	17.93%		17.26%		18.06%		
Obs	249		265		435		

Table 11 (continued)

Panel B: Column (1) looks at the sensitivity of pension plan RE investment to MSA real estate prices for firms that never own real estate assets in our sample; Column (2) looks at the same sensitivities for sponsoring firms that will acquire real estate but before they acquire it; Column (3) estimates the same sensitivities for real estate purchasers but after they have purchased their real estate assets. Test "L&B before=L&B after" presents the p-value from a t-test of equality of the MSA real estate prices coefficients between the purchasers before and after the purchase. All regressions contain time dummies. Robust standard errors clustered at state level are in parenthesis. *,**,*** represents 1%, 5% and 10% significance level.

Panel B: RE	(1)		(2)		(3)		
	Non L&B firms		L&B firms before L&B purchase		L&B firms after L&B purchase		Test "L&B before=L&B after"
Plan size	0.0036	(0.0013)***	0.0050	(0.0017)***	0.0030	(0.0022)	
Plan age	-0.0026	(0.0029)	-0.0010	(0.0019)	-0.0006	(0.0021)	
Funded status	0.0077	(0.0018)***	0.0058	(0.0022)***	0.0058	(0.0027)**	
Share active participants	-0.0307	(0.0137)***	-0.0272	(0.0086)***	-0.0037	(0.0092)	
Spon size	0.0063	(0.0029)**	-0.0013	(0.0016)	0.0016	(0.0019)	
MB	0.0033	(0.0028)	0.0006	(0.0015)	-0.0021	(0.0016)	
Z score	-0.0046	(0.0026)*	0.0033	(0.0017)**	0.0004	(0.0018)	
Leverage	-0.0268	(0.0158)	-0.0300	(0.0101)***	0.0162	(0.0107)	
Profitability	-0.0870	(0.0582)	-0.0200	(0.0312)	-0.0048	(0.0332)	
MSA real estate prices	0.0296	(0.0368)	0.0216	(0.0281)	0.1255	(0.0526)**	0.0034***
Adj. R^2	15.41%		15.23%		16.11%		
Obs	111		342		613		