How do Private Equity Buyouts Affect Employee Pension Plans?

Wensong Zhong*

May 11th, 2023

Abstract

Using data from the Form 5500 filings, I analyze the impact of private equity (PE) buyouts on the defined benefit (DB) plans of target firms. I find that following a buyout, DB plans are more likely to be frozen or terminated. Regarding the actuarial assumption the pension characteristics, I find an increase in the pension liability discount rate and decreases in the projected benefit obligations (PBO), pension assets, and contributions, but I did not find significant effects on funding ratio. Additionally, I find that investment strategies for these plans become riskier, with a higher allocation to equities and lower allocations to cash, government securities, insurance accounts, and mutual funds. However, there is no significant effect on realized returns. These results suggest that private equity buyouts may negatively affect the retirement incomes of DB plan participants of target firms.

Keywords: Private equity, defined benefit plan, employee welfare

*Lundquist College of Business, University of Oregon. Email: wensongz@uoregon.edu.

1. Introduction

Private equity (PE) firms become an increasingly important investor in the economic landscape nowadays. According to the statistics from Pitchbook Data, Inc., PE firms have raised more than 2.5 trillion in capital from 2012 to 2022.[1] Despite the enormous volume of capital, PE firms deliver strong financial returns to their investors (e,g,. Harris, Jenkinson, and Kaplan (2014), Korteweg and Sorensen (2017)). Existing literature has found several sources of these returns. Researchers suggest that PE firms enhance the total factor productivity (Davis, Haltiwanger, Handley, Jarmin, Lerner, and Miranda (2014)), improve operations (Bernstein and Sheen (2016)), augment innovations (Lerner, Sorensen, and Strömberg (2011)), and reduce agency problems (Edgerton (2012)). It seems that PE firms benefit target companies by improving efficiencies, and benefit shareholders by providing attractive financial returns.

The impact of a PE buyout on employees, an important stakeholder group, is a topic of debate in existing literature. On the one hand, research has found that PE firms can improve operations, working conditions, and workplace safety, leading to job creation and overall positive outcomes (Bernstein and Sheen (2016), Cohn, Nestoriak, and Wardlaw (2021), Davis, Haltiwanger, Handley, Jarmin, Lerner, and Miranda (2014)). On the other hand, PE buyout can lead to layoffs, wage cuts, and reduced work-life balance, as labor cost optimization is a key strategy for these firms (Davis, Haltiwanger, Jarmin, Lerner, and Miranda (2011), Gornall, Gredil, Howell, Liu, and Sockin (2021)). However, little attention has been paid to the impact of a PE buyout on defined benefit (DB) plans, an important component of a company's compensation package in the U.S. DB plans require firms to contribute to the plans to ensure benefits are paid at retirement, and while there are restrictions, managers have discretion to manage these plans strategically. It is unclear whether PE firms, with their focus on profit maximization, might seek ways to reduce pension costs after a buyout, possibly through freezing the plans and making aggressive actuarial assumptions. Also, the

[1] Available at https://pitchbook.com/news/reports/2022-annual-us-pe-breakdown.

risk-shifting behavior in pension asset management may lead to the agency problem between shareholders and plan participants. To ensure timely distribution of benefits while minimizing contributions, employers may be tempted to take on more investment risk, hoping to offset the need for contributions with high investment returns. But this strategy can be risky as it does not guarantee better returns. Therefore, Investigating the impact of a PE buyout on a target firm's DB plan could yield valuable insights into the effects of these transactions on employees' long-term financial security.

This study explores the post-buyout impact on the target firms' DB plans to explain whether employees benefit from the PE buyout. More specifically, I utilize data from Bureau of Labor Statistics (BLS), Pitchbook, and S&P 500 CapitalIQ to conduct a difference-in-difference (DiD) analysis with the buyout as the treatment, and answer the following questions: (1) are firms more likely to freeze or terminate DB plans after the buyout, (2) do firms adopt more aggressive discount rates to compute the projected benefit obligations (PBO) after the buyout, and (3) do firms adjust the asset allocation of the plan assets after the buyout?

The sample consists of 25,596 firms with 30,774 DB plans spanning from 1999 to 2021. First, I use cross-sectional regression to test the relationship between PE buyouts and the probability of a plan being terminated or frozen, as well as the relationship between PE buyouts and the probability of a firm terminating or freezing at least one plan. In the context of DB plans, (hard) freeze means that no participant will receive any new benefit accrual as of the last day of the plan year, while termination means that the plan has been closed after paying all accrued benefits.[2] The analysis reveals that, after a buyout, plans backed by private equity are more likely to be terminated or frozen, and firms backed by private equity are more likely to terminate or freeze their defined benefit plans. Moreover, using the panel data, I interact the dummy variable of PE buyout with a set of event year dummies, and find that the differences of the probabilities of termination and freeze between

[2]Detailed definitions in the instruction for Form 5500 in 2021, available at https://www.dol.gov/sites/dolgov/files/EBSA/about-ebsa/our-activities/public-disclosure/foia/form-5500-2021-data-dictionary.zip

the PE-backed plans (firms) and the non-PE-backed plans (firms) are peaked in the third year after the buyout.

To examine the impact of PE buyouts on DB plan characteristics, several key metrics are investigated, including pension obligation discount rates, PBO, the number of plan participants, funding status, and firms' pension contributions.[3] To address the potential bias in the difference-in-difference framework when there are multiple treatments (Baker, Larcker, and Wang (2022), Goodman-Bacon (2021)), I adopt the approach suggested by Callaway and Sant'Anna (2021) and Gornall, Gredil, Howell, Liu, and Sockin (2021) and use a stacked difference-in-difference (DiD) framework to investigate whether PE buyouts result in the termination or freeze of corresponding DB plans at both the plan and firm levels. The time window is six years before and six years after the buyout. I find that after PE buyouts, PE-backed plans tend to use higher discount rates and have lower PBO. After adding the discount rate and a dummy variable indicating whether a plan is frozen in a given year, I find that the drop of PBO cannot be fully attributed to the higher discount rate and the freeze of the plan. While the PE buyout negatively affects the market value of pension assets or the number of participants, the funding ratio of PE-backed plans is not impacted. This could be attributed to the simultaneous decreases in the PBO and pension assets, which occur at similar magnitudes. Regarding the contribution, I find that following a buyout, PE-backed sponsors tend to contribute less to their pension plans, which may be the reason for the drop of pension assets.

As a firm can have multiple DB plans, the plan-level analysis is not able to capture the aggregate effect on the firm due to the termination. To gain further insights into the effect of PE buyouts on pension characteristics, I aggregated the sample to the firm level. The results are generally consistent to the plan-level findings. I find that after the buyout, the PE-backed firms use higher pension obligation discount rates, have lower PBOs, fewer

[3] Note that assumed rate of return on pension assets is another essential assumption within the reach of the firm, but this variable is not explicitly provided in the Form 5500 data set for each plan. Some firms disclose the value in the actuarial report attached to the filed forms, but the availability is rare.

DB plan participants, fewer pension assets, and less contributions, while the funding ratio remain unaffected. Overall, the findings suggest that PE firms cut labor costs for their target companies by modifying the DB plan and reduce contribution amounts, which potentially enables the firms to have more financial slack.

Although both plan-level and firm-level results show that after the buyout, PE-backed plans and firms have lower pension contributions from employers, it is not necessarily harmful for employees. If the plan is managed more efficiently and achieves higher returns, the drop of the contribution can be made up by investment returns. However, without changes in the investment returns, lower contributions may lead to an inability to pay out benefits at retirement. Therefore, it is crucial to investigate whether the PE buyout affects the realized return and asset allocation of the DB plan, as changes in asset allocation could shift risk. To understand this effect, I explore the post-buyout impact on asset allocation, using financial data from Form 5500 Schedule H and Schedule I for large and small plans, respectively. I find that PE-backed firms' DB plans reduce their allocation to mutual funds and safe assets, including cash, government securities, and insurance accounts, while increasing their allocation to corporate equities, and corporate preferred equities. However, I do not find significant changes in the allocation to trusts or risky debt, including corporate debt and other loans. Then, I examine whether the change of allocation is associated with an improvement in the realized return of DB plans after the buyout. I calculate the net-of-fee return following Jang and Wu (2021) and Munnell, Aubry, Crawford, et al. (2015) and I find no evidence of improved returns for PE-backed firms' DB plans, suggesting that sponsors are not managing the plan more profitably. The results of firm-level analysis are consistent with those at the plan level. These findings suggest that DB plans of PE-backed firms tend to take on more risks after a buyout without improving investment performance. Combined with the previous results, reduced contributions may lead to an inability to meet obligations, incentivizing firms to take on riskier investments for the DB plan. However, these investments may not be effective, as evidenced by the lack of improved realized returns. As a result, the reduction in contribution and change in discount rate may come at the expense of employees' post-retirement benefit security. It is crucial to monitor and assess the risk-taking behavior of PE-backed firms and ensure that employees' interests are protected.

For robustness check, I use entropy balancing proposed by Hainmueller (2012) and Hainmueller and Xu (2013), to make PE-backed firms similar to the control firms in terms of the covariates. More specifically, I use the data of all covariates in year $t-1$ which is one year before the buyout, and generate the entropy balancing weight by each cohort. Then, I repeat the test with the entropy balancing weight. The results are generally consistent to the main results. This suggests that my results are not driven by the selection bias.

This study contributes to the literature of post PE buyout effects on employees. Regarding this topic, researchers have found mixed evidence. On the positive side, several studies have found that PE buyouts can have beneficial effects on employees, including increased job availability, improved workplace safety, higher wages, and greater wage equality within the firm. For instance, using firm-level and establishment-level data, Davis, Haltiwanger, Handley, Jarmin, Lerner, and Miranda (2014) find that PE buyouts resulted in substantial increases in gross job creation and destruction, with only modest net job losses. Moreover, Gornall, Gredil, Howell, Liu, and Sockin (2021) observe that higher-skill workers and managers became more satisfied with their compensation and benefits after a PE buyout. Although Cohn, Nestoriak, and Wardlaw (2021) find that total employment decreases after the buyout, the occupational injury rates are lower for PE-backed firms after buyouts. On the other hand, some studies have reported negative impacts of private equity (PE) buyouts on employees, such as lower pay, reduced job stability, poor work-life balance, and higher turnover rates. For example, Davis, Haltiwanger, Jarmin, Lerner, and Miranda (2011) find that employment at PE target establishments declined by 3% over two years and 6% over five years after a buyout. As the literature on the effects of PE buyouts on employees continues to expand, it is becoming increasingly important to know how PE buyouts affect the interests of employees at target firms. One important aspect of this is examining the treatment of DB plans, which are often within the purview of these firms. Although no previous study has examined this topic, analyzing the post-buyout effects on DB plans can provide insights on how employee welfare is affected.

This study also contributes to the literature which investigates the impact of changes in firms' ownership structure on employees' post-retirement benefits. Previous studies suggest that manipulation of pension funds can contribute to gains from ownership changes. For example, Pontiff, Shleifer, and Weisbach (1990) shows that acquirers transfer the wealth from the DB plan participants to shareholders by reversing the target firms' DB plan after the acquisition. Similarly, Agrawal and Lim (2022) find that after the acquisition of hedge fund, the targets' DB plan experience under-funded, less contribution and riskier assets allocation, and these changes contribute to roughly 7% of the wealth gains to shareholders. This study extends this work to examine the effects of PE buyouts on pension plans. The findings indicate that PE buyouts are associated with a higher likelihood of terminating/freezing the DB plan and increasing the discount rate, funding ratio, and investment in risky assets for PE-backed plans and firms. These changes may optimize labor costs, provide financial slack for investments, and suggest risk shifting practices.

This study also joins the literature on firms strategically manipulating pension fund. Prior studies have found pension plan can be used as the source for financial slack. For example, As Bergstresser, Desai, and Rauh (2006) indicated, CEOs have incentive to increase the assumed returns to boost reported earnings when they exercises options, and decrease the rate to reduce the reported earnings when they are granted options. Chu, Goldstein, Li, and Yu (2020) provide both theoretical and empirical evidence that firms set the PBO discount rate higher when they face good investment opportunities. In this study, I provide evidence that PE buyout is also associated with strategic management of pension funds, in which the PE-backed firms may have more financial slacks by reducing the contribution.

The remainder of this paper is organized as follows. In section 2, I discussed the related literature. In Section 3, I discusses hypotheses related to PE buyout and DB plan management. Section 4 describes the data and the empirical methods. Section 6 shows the results, section 7 provide robustness check, and section 8 concludes.

2. Literature Review

I review sets of related literature in this section: first, I review previous works on the impact of PE buyout on employees. Second, I discuss the literature on firms strategically manipulating the pension plans.

2.1. PE buyout effect on the employees

Historically, PE firms have been portrayed by journalists as profit-seeking entities that exploit workers, but the actual impact of buyouts on employees is a complex issue that remains under debate.[4]

Prior research has documented various aspects of the impact of PE buyout on workers. Regarding the non-pecuniary interests of employees, researchers provide findings from both positive and negative side. For example, Bernstein and Sheen (2016) use the data on the restaurants industry in Florida and discover that the restaurants acquired by PE firms are cleaner, safer and better maintained, due to operational engineering, rather than hiring more employees. Meanwhile, Cohn, Nestoriak, and Wardlaw (2021) analyze the data on occupational injury and find that workers that remain employed appear to report less occupational injuries, indicating that buyouts can improve workplace safety. This improvement in safety is also found to benefit PE investors by increasing the likelihood of an IPO.

Agrawal and Tambe (2016) use the data from online job website and find that employees benefited from PE buyouts by acquiring transferable human capital, which improve their long-run employability and wages. This suggest that PE can benefit the employees who might

[4] For example, the artical states "... They frequently slash jobs and benefits for employees, cut services and hike prices for consumers, and sometimes even endanger lives and undermine the social fabric.". See at https://www.nytimes.com/2022/08/04/opinion/private-equity-lays-waste.html from New York Times.

be restricted by their exposure to outdated production methods. Gornall, Gredil, Howell, Liu, and Sockin (2021) observe that higher-skill workers and managers became more satisfied with their compensation and benefits after a PE buyout. Bloom, Sadun, and Van Reenen (2015) shows that the private equity-owned companies have better management practices than most other company types such as family-run, founder owned, or government owned firms, such as setting realistic target for the whole company.

Fang, Goldman, and Roulet (2022) analyzed data from French firms and find that expensive workers, typically older male, are more likely to be replaced by cheaper workers, who are typically younger ones. This replacement leads to a lower wage inequality within firms. Additionally, Bacon, Wright, Ball, and Meuleman (2013) develop a framework for analyzing the effects of PE buyouts on employment, finding that most buyouts did not prioritize short-term ownership and were less likely to have negative implications for employees' interests.

On the other hand, some studies suggest that employees may experience a decline in benefits following a buyout. For example, Gornall, Gredil, Howell, Liu, and Sockin (2021) analyze data from Glassdoor.com between 2008 and 2019 and find that PE buyouts lead to declines in job satisfaction, particularly in terms of compensation, for long-tenured, low-skill, and less-educated workers. Additionally, high-skill workers and managers report larger declines in work-life balance. Similarly, Lambert, Moreno, Phalippou, and Scivoletto (2021) also find that the employee satisfaction drops around leverage buyout transactions, and they attribute this decline to the ownership structure before the buyout. Their results show that the reduction in job satisfaction is more pronounced in public-to-private deals than in private-to-private ones.

In terms of the impact of PE buyouts on gross employment and wages, the evidence is mixed. On the one hand, some studies suggest that PE buyouts may lead to business expansion and job creation. For instance, Davis, Haltiwanger, Handley, Jarmin, Lerner, and Miranda (2014) use U.S. census data to track employment at 3200 portfolio companies ant their establishments that are acquired by PE firms. They find that PE buyouts result in substantial increases in gross job creation and destruction, with only modest net job losses. Their results suggest that PE owners actively reallocate the employment through exit of less productive establishments and greater entry of more productive ones, leading to a total factor of production gains at the target firms. Davis, Haltiwanger, Handley, Lipsius, Lerner, and Miranda (2019) expand this study and data coverage to a longer period. They find that the employment in firms previously under private ownership rises 13 percent, while employment in firms that were publicly listed shrinks by 13 percent. The authors attribute this discrepancy to the different goals of PE deals. For public-to-private deals, reducing the agency problem is the goal, while access to the capital markets is the goal for the private-to-private deals. Some industry-sponsored studies also claim positive employment effects of PE deals (e.g., Taylor and Bryant (2007) and a report by British Venture Capital Association).[5]

While some studies suggest that PE buyouts can create jobs and boost business expansion, other research indicates that they can also have negative consequences. In Davis, Haltiwanger, Jarmin, Lerner, and Miranda (2011), the authors document employment and job losses due to PE buyout amount to 3 percent in two-year period after the buyout and 6 percent over five years. In the follow-up study mentioned above, the author also find the employment reduction in the target establishment. Similarly, Antoni, Maug, and Obernberger (2019) study on 511 German PE buyouts and find that employment at PE-backed companies decreases by 8.96 percent, with a higher increase in the firing rate than the increase in the hiring rate (18.75 percent vs. 9.79 percent). They also find that the annual earnings per employee drop by 2.8 percent of the median earnings, which amounts to 980 euro dollar. More severely, Garcia-Gomez, Maug, and Obernberger (2020) use data on 274 PE buyouts in Netherlands involving 55,752 employees from 2007 to 2013, and find that employees with worse health status before the buyout face more losses of income and employment after the buyout. Olsson and Tåg (2017) find that workers performing automatable routine tasks and

[5]The report is available at https://www.bvca.co.uk/Research/BVCA-Publications/Details/Economic-contribution-of-UK-private-equity-and-venture-capital-in-2023

offshorable tasks at targets that is less productive than peers are more likely to lose their jobs. They also find that after leaving the portfolio company, they tend to have less income from their new jobs.

2.2. Strategic usage of DB plans

As one crucial part of the compensation package, it is sponsor firms' responsibility to maintain the DB plan, so that the plan assets are able to cover all benefits owed to the participants, which is computed based on the assumptions. Otherwise, the sponsor must contribute to the plan to fill the gap between the plan assets and the projected benefit obligation, which may harm the companies' investment and reduce the earnings.

The liability of a DB plan is calculated based on various actuarial assumptions, such as the discount rate and assumed rate of returns However, regulations allow plan sponsors to adjust these assumptions to align with their strategic objectives. For instance, Bergstresser, Desai, and Rauh (2006) demonstrate that the assumed rate of return on pension assets can be used as a tool to manipulate earnings. They provide evidence that higher assumed rates of return lead to lower costs and higher earnings. Additionally, their results show that firms use higher assumed returns during critical events, such as acquiring other firms or when managers exercise stock options. Chu, Goldstein, Li, and Yu (2020) provide both theoretical and empirical evidence that firms set the PBO discount rate higher when they encounter good investment opportunities. This effect is more pronounced for firms with lower financial risks. Meanwhile, Bartram (2017) find that DB plan sponsors contribute less when they have low cash reserves and undertake real investments, indicating that DB plans can be utilized as a real option for sponsors. Kisser, Kiff, and Soto (2017) study a sample from 1999 to 2007 and find that underfunded plans utilize substantially higher discount rates to reduce the reported value of pension liabilities, which consequently reduces the cash contributions to the pension plan. In addition, Bartram (2018) finds that DB plan sponsors use more aggressive pension assumptions when they have less cash, especially during economy downturns. Regarding the asset allocation, Andonov, Bauer, and Cremers (2017) find that U.S. public pensions with a higher percentage of retired participants maintain higher liability discount rates and invest more in risky assets, especially when the pensions have fewer retirement obligations.

Besides the actuarial assumptions, the termination and freeze of a DB plan can also provide opportunities for firms to address their needs. For example, Pontiff, Shleifer, and Weisbach (1990) analyze 413 takeover deals between 1981 and 1988 and find that pension funds were reverted by 15.1% of acquirers following hostile takeovers, compared to 8.4% following friendly deals. This effect is more pronounced with overfunded plans. Their results suggest that acquirers transfer the wealth from the DB plan participants to shareholders by reversing the target firms' DB plan after the acquisition. Similarly, Harper and Treanor (2014) find that firms tend to convert the DB plans to defined contribution plan and cash balance plan, or simply terminate them, due to the related wealth transfer. This conversion contributes to the labor cost reduction in the sponsor firm, as discussed by Rauh, Stefanescu, and Zeldes (2013) They find that even starting a DC plan after the termination or freeze of a DB plan, the sponsoring firm save 2.7-3.6% payroll per year.

The ability to manipulate the DB plan may result in risk-shifting behavior and agency problems. According to Anantharaman and Lee (2014), managers' equity incentives affect a firm's pension policy, and when CFOs have high wealth-risk sensitivity (high vega) and low wealth-price sensitivity (low delta), they tend to engage in risk-shifting by underfunding the DB plan. But this effect is lower when CFO has larger personal stake in the pension plan. Despite this finding, Pedersen (2019) finds no evidence that managers shift risks to DB plan beneficiaries by underfunding the DB plan when firms have higher bankruptcy risk. The author attributes this finding to managers' concern to damage the reputations of employees. Furthermore, Rauh (2009) provides evidence against the risk-shifting in pension fund operation. They find that firms have less risky pension asset allocation when their financial condition is weaker. On the other hand, Phan and Hegde (2013) find that firms with higher external governance tend to take more risks by allocation higher proportion of the pension assets to equities, and they attribute this risk-taking behavior to firms seeking higher investment returns and better funding status. However, Cocco and Volpin (2005) find the opposite results, suggesting that indebted firms with poor governance (measured by the number of insider-trustees) tend to have a greater proportion of equity investments in their pension assets.

3. Hypothesis

This section will introduce the hypothesis that will be tested in the following sections.

3.1. PE buyout and the termination and freeze of the DB plan at the target firms

Why do PE firms want to terminate or freeze the DB plan for the target firms? The literature has shown that labor cost optimization is part of the reason why PE is able to provide shocking financial returns. Maintaining a DB plan requires the employer to manage funds closely, resulting in additional effort and expenses. By terminating or freezing the plan, the firms can reduce the plan related labor expenses not only for now (e.g., reducing service costs), but also for the future (e.g., reducing future payment at the retirement), resulting in positive impact on the returns for the shareholders (Pontiff, Shleifer, and Weisbach (1990) and Harper and Treanor (2014)). If maximizing the profit is the PE is purpose, removing the DB plan should be an possible option for the PE firms after the buyout. However, DB plan can be used as the reserve to fund the investment when the external financing methods are not available, according to Ballester, Fried, and Livnat (2002), Bartram (2017) and Bartram (2018). They find that although the contributions to the plan is required by law, the timing and amount can be decided based on firms' needs. They can use aggressive assumptions and contribute less to fund the real investment project, which is similar to borrowing from the employees. If the PE firms are focusing on the long-term goal (e.g., Bacon, Wright, Ball, and Meuleman (2013)), keeping the DB plan may provide additional financing source for the target firm, which may help maintain financial stability and contribute to long-term goals.

3.2. PE buyout and the actuarial assumptions

When a DB plan is underfunded, plan sponsors are required to make contributions. For the plans that remain active, their sponsors have the ability to adjust the discount rate to change the PBO, which in turn can impact the funding ratio and enable them to change the contribution. As indicated by Chu, Goldstein, Li, and Yu (2020), the discount rate is set higher for companies with good investment opportunities, especially for firms with lower financial slack, which prevents firms from making additional contributions. And similarly, Bartram (2018) illustrate that firms set higher assumed returns and make smaller contributions if they are in distress. Therefore, PE firms may seek to take advantage of the availability of this flexibility by making more aggressive assumptions to reduce contributions and increase the liquidity for investment in operational improvements. Alternatively, firms with a DB plan may opt to contribute more to the pension assets in order to maximize the tax benefit of the pension contribution, as the contribution is generally tax deductible within limits under IRC section 404.[6]

3.3. PE buyout and the asset allocations of the pension assets

PE buyout may lead to higher risk in the pension asset allocation due to risk shifting. The practice of risk shifting suggests that managers acting in the interests of shareholders may underfund the DB plan and to invest the pension funds in risky assets, which may earn higher pension investment return but put the employees' post-retirement benefits in danger. This creates a wealth transfer from the employees to the shareholder, which could be one consequence of the PE deals. The seminal theory work of Treynor (1977) shows that stockholder wealth can be increased by increasing pension risk through pension plan

[6] Avaiable at https://www.law.cornell.edu/uscode/text/26/404. Visited on 2023-03-31.

underfunding and risky asset allocation. Andonov, Bauer, and Cremers (2017) and Agrawal and Lim (2022) show that with higher discount rate and assumed rate of return, firms tend to invest more in equity to justify the change, which introduces higher risk into the pension funds. Furthermore, PE might seek ways to reduce the agency problem and improve the corporate governance in order to obtain the gains, as discussed in Edgerton (2012) and Nikoskelainen and Wright (2007). As shown by Phan and Hegde (2013), better corporate governance may lead to higher allocation in equities and lower in the safe assets, such as cash and insurance. On the contrary, firms may reduce the pension plan risk when the firms' bankruptcy risk is higher (e.g., Rauh (2009) and Anantharaman and Lee (2014)). Since the PE takeover generally is funded by debt, it introduces extra debt into target firms, which may increase the bankruptcy risk, even the PE firms selectively choose the firms with better financial health (e.g., Kaplan (1989), Kaplan and Stein (1993), and Tykvová and Borell (2012)). Therefore, it is also possible for PE firms to reduce the risky assets in the pension asset allocation due to the higher bankruptcy risk.

By using the PE data and DB plan data, I am able to test these three hypotheses at both plan level and firm level. And this can help understand how PE affects the employee treatment after the buyout.

4. Data

This section describe the dataset I construct to test the hypotheses. The dataset covers the U.S. firms filed Schdule SB of Form 5500 with all control variables available from 1999 to 2020.

4.1. DB plan data

The DB plan data are collected from Form 5500 database. The Form 5500, Annual Return/Report of Employee Benefit Plan, including all required schedules and attachments, is used to report information concerning employee benefit plans[7] The form is filed annually with the IRS and the Department of Labor's Employee Benefits Security Administration by corporate pension plan sponsors, and all firms with DB plans are required to file the schedule SB and corresponding Form 5500 or Form 5500-SF. Currently, the data from 1999 to 2021 are available from BLS.

I retrieve the fundamental data of the DB plan from Form 5500/Form 5500-SF and Schedule B/SB of Form 5500, and the financial data from Schedule H and Schedule I of Form 5500. According to the instruction, all sponsors of an employee benefit plans subject to Employee Retirement Income Security Act must file information about each plan every year.[8]

All firms covered by the dataset are identified by unique employer identification number (EIN), and the plans are identified by the plan number within the firm. However, one firm may have multiple EINs due to the geographical dispersion of the establishments and branches, meaning that two different EINs may represent the same firm. I manually check the duplicates within the dataset and assign them the earliest EIN as the unique identifier.[9] Also, there are cases where one EIN leads to multiple firm names (e.g., firm changes the name). After correcting the typo and expanding the abbreviations, I assign the earliest name as the correct name for the firm, which are used in the matching process.[10]. And I combine the EIN and the plan number as the identifier of an unique DB plan.

The dataset uses the acknowledgement ID (ACK ID) as a unique identifier to link schedules and main forms. Each form submission is treated as a distinct plan in the dataset and assigned a unique ACK ID. If the form of the same plan is submitted multiple times, each submission will have a different ACK ID. To remove duplicates, I rely on the receiving time

[7] Available at https://www.dol.gov/agencies/ebsa/about-ebsa/our-activities/public-disclosure/foia/form-5500-datasets. The data were downloaded in 2022

[8] Details at https://www.law.cornell.edu/uscode/text/26/6058

[9] For example, if A firm has two EINs in the dataset, xx-xxxxxx1 and xx-xxxxxx2, and xx-xxxxxx1 appears earlier, I will assign xx-xxxxxx1 as the EIN for the A firm.

[10] For example, if xx-xxxxxx1 has two names in the dataset, A and B, and A appears earlier, I will assign A as the true name for xx-xxxxxx1

recorded in the dataset and keep only the first record.[11]

4.2. Firms' fundamental information

As the majority of PE deals target private firms, fundamental information is often unavailable for many firms in the Form 5500 datasets. To address this, I gather industry classifications, total assets, and total sales for firms from the S&P 500 CapitalIQ dataset, using the firms' names as recorded in the Form 5500 dataset. The matching is performed using the CapitalIQ Excel plug-in, and I only keep exact matches in the sample and the fuzzy matches with abbreviations.[12]

In addition, as private firms are not required to disclose their financial information every year, I use the last available observation to impute missing financial variables for these firms.

4.3. PE-backed acquisition deal data

The PE-backed merger and acquisition events are collected from Pitchbook database. To be in the sample, the deal has to be completed between 1999 and 2020, the deal type has to be "Buyout/LBO", the deal class has to be "Private Equity", and the headquarter locations must be in the U.S., including the deals made by PE firms or PE-backed firms which are identified as "add-on" deals. The sample only includes the first deals of the same firm in the sample period.

To match the deals with the firms in my sample, I first fuzzy match the target firms' names in the Pitchbook database with firm names in Form 5500 dataset.[13] Then, I manually check the accuracy of the matches through similarity score filtering and internet searches. In total, I end up with 25,596 U.S. firms with 30,774 DB plans spanning from 1999 to 2021. Within this time frame, I identified 1,149 deals in the U.S. involving 1,622 DB plans.

[11] After the first submission, the record either does not contain any fundamental data or contain the exactly the same data as the first record.

[12] If the name contains abbreviations, such as LLC, L.L.C., P.C., Corp, and Inc, or if the matches only miss the abbreviations or sufix, I treat them as the same as the full words.

[13] Some deals have only the legal names of the target firms, so I will use them when the names are missing.

4.4. Return and performance measures

Following Munnell, Aubry, Crawford, et al. (2015) and Jang and Wu (2021), I define the realized return on pension asset as:

$$R_{i,t} = \frac{NetAssets_{i,t} - NetAssets_{i,t-1} - Contribution_{i,t} + Distribution_{i,t} + NetTransfer_{i,t}}{NetAssets_{i,t-1} + 0.5Contribution_{i,t} - 0.5Distribution_{i,t} - 0.5NetTransfer_{i,t}} \tag{1}$$

where $NetAssets_{i,t-1}$ and $NetAssets_{i,t}$ are the net assets of the plan i at the beginning and the end of the year t, respectively, $Contribution_{i,t}$ represents the amount contributed to the plan, $Distribution_{i,t}$ denotes the amount paid out to beneficiaries during the year t, and $NetTransfer_{i,t}$ is difference between the amount transferred out of the plan and the amount transferred into the plan, which occurs when a plan is merged or terminated. An underlying assumption of this definition is that the cash flows are made in the middle of the year. Alternatively, I compute the return using the incomes and expenses in Schedule H and I of Form 5500 as follows:

$$R'_{i,t} = \frac{InvestmentEarnings_{i,t} - InterestExpensei,t - AdministrativeExpenses_{i,t}}{TotalAssets_{i,t-1}} \tag{2}$$

where $InvestmentEarnings_{i,t}$ include the interest income, dividends, rents, realized and unrealized capital gains. Following Rauh (2009), I treat all the returns greater than 500% or less than -80% as errors and exclude all of them from the analysis,

4.5. Summary statistics

The summary statistics are shown in Table 1 and variable definitions are shown in Table A.1. All values are winsorized at 1st and 99th. Panel A describes the variables at the plan level, while Panel B summarizes these variables at the firm level. To be in the sample, the plans have to be active before the PE buyout year. Once the firm decides to terminate or freeze the plan, it has to file the Form 5500/Form 5500-SF with the specific code.[14] On average, there are roughly 4.9% of the DB plan file with termination or freeze, and the majority of them file freeze. Among all DB plans, the average age of the plan is 37 years, defined as the number of years since the starting year of the plan. Panel A also shows that plan size ("LogPA"), a natural logarithm of fair value of pension assets, is greater than the plan obligation ("LogPBO"), leading to the funding ratio is above 1.

I compute the weight on each asset category as the ratio of the value of an asset to the total market value of the pension assets at the end of each year. The observations with the weight greater than one or less than zero are treated as the error and are excluded from the analysis. on average, a plan invests 14% to equity, 11% to safe assets, 5% to risky debt, 33% to mutual fund and 48% to trust. Since the form does not require the sponsors to disclose the detailed asset allocations held by mutual fund and trust, I am not able to get this information from the database.[15] The last two categories in the Schedule H of Form 5500 are real estate and others. Since the values of these two classes are largely missing or 0, it is not used in the analysis.

The realized returns are computed as Equation 1 and Equation 2. The average return of the pension assets is approximately 7%. As schedule H and Schedule I are missing or the values in the form are 0 for some firms with DB plans, the total number of the plans in the asset allocation is smaller.

5. Empirical Methodologies

For the termination/freeze analysis, I employed a cross-sectional regression. To construct the sample, I used the PE buyout year as the basis. Each PE buyout year was treated as a cohort, consisting of observations from plans (and firms) that were bought by PE firms in

[14] According to the instruction, the code for termination is "1H" and the code for freeze is "1I".

[15] The searchable database contains the submissions of each plan after 2009, available at https://www.efast.dol.gov/5500search/, and some firms submit the actuarial reports covering the detailed holdings in trust and mutual funds. However, the submissions are scanned PDF and the reports are not standardized, which makes it too difficult to extract the information efficiently.

that year, plans (and firms) that were never bought by PE firms, and plans (and firms) that had not yet been bought by PE firms. I estimate the following equation for the analysis:

$$Y_{i,j,c} = \beta Treat_{j,c} + X^{'}_{i,j,c}\lambda_1 + X^{'}_{j,c}\lambda_2 + \gamma_{c,I} + \epsilon_{i,j,c}, \quad (3)$$

where $Y_{i,j,c}$ is the dummy variables equal to one when the plan i of firm j is terminated or frozen within one year, three years and five years after the buyout, $Treat_{j,c}$ is the dummy variable equal to one when the firm j is bought by a PE firm, and the subscript c represents the cohort. $X^{'}_{i,j,c}$ and $X^{'}_{j,c}$ are vectors of time-varying plan-related control variables and firm-related control variables in the year before the buyout year, respectively. $\gamma_{c,I}$ capture the cohort by industry fixed effects, where the industry is denoted by Fama-French 30 industry code. I cluster the standard errors by firm. To reflect the higher weights of large plans in the sample, I weight each observation by the actuarial pension asset value in the year before the buyout year for each cohort.

In the analysis of pension characteristics and asset allocation, I follow Callaway and Sant'Anna (2021) and Gornall, Gredil, Howell, Liu, and Sockin (2021) to use a difference-in-difference design with multiple treatment time. I split the sample into multiple cohorts based on the buyout year, and each cohort has five years before and after the treatment year. In each cohort, I use the later-treated and never-treated firms as the control group.[16] More specifically, I estimate the following equation for the plan-level analysis:

$$Y_{i,j,c,t} = \beta Treat_{j,c,t} \times Post_{c,t} + X^{'}_{i,j,c,t}\lambda_1 + X^{'}_{j,c,t}\lambda_2 + \quad (4)$$

$$\theta_{c,I,t} + \delta_{c,i} + \epsilon_{it}, \quad (5)$$

where the $Y_{i,j,c,t}$ is the dependent variable of plan i of firm j in year t within cohort c, $Post_t$ is a dummy variable that equals one from buyout year onward and zero for the earlier years.

[16]The later-treated firms represent firms that are bought by a PE firm in the years after the last year in the time period of a cohort. The never-treated firms are the ones that have never been acquired by a PE firm in the sample.

$X'_{i,j,c,t}$ and $X'_{j,c,t}$ are vectors of time-varying plan-related control variables and firm-related control variables, respectively, $\theta_{c,I,t}$ and $\delta_{c,i}$ capture the cohort by industry by year and cohort by plan fixed effects. The main interest is in the coefficient on the interaction term $\beta Treat_j \times Post_t$, which captures the effect of PE buyout on the dependent variable $Y_{i,j,c,t}$. For the firm-level analysis, I aggregate all plan-related variables to firm level, and include the cohort by firm fixed effects instead of cohort by plan fixed effects. I cluster the standard errors by cohort by firm. To reflect the higher weights of large plans in the sample, I weight each observation by the actuarial pension asset value at the beginning year of each cohort.

6. Results

I now present our main empirical results and show how PE buyout affects the post-buyout DB plan management at the plan and firm levels.

6.1. PE and termination and freeze of the DB plan

Since the accrued benefits increase with the working years of the employees, the liability of a pension is growing over time. To manage the growing liability, the plan sponsor may need to contribute more money to the plan or invest the existing assets more profitably, both of which can be costly for the sponsor. One way to minimize this cost is to freeze or terminate the DB plan, as discussed by Rauh, Stefanescu, and Zeldes (2013).

In the context of DB plan, there are mainly two types of freeze. Hard freeze means that the pension plan no longer accrues any benefits for additional working year, but the sponsor is still required to maintain the plan and pay out the existing benefits on time, while soft freeze means that existing participants can still add benefits to the plan by working longer, but there will not be new participants over time. Different from freeze, termination means that after paying out all the existing benefits, the pension no longer exists, and the excess pension assets are distributed to the sponsor. In the data, only hard freeze and termination of the plan are observable through the code in Form 5500 and Form 5500-SF.

Table 2 presents the results of cross-sectional analysis at both plan-level and firm-level. The sample only includes the plans that remain active in one year before the PE buyout year, and excludes the plan that are created after the PE buyout year. The dependent variable is represented by dummy variables, which are equal to one when the plan is terminated or frozen within one year, three years and five years after the buyout year for the plan-level analysis. Observations after the freeze are excluded from the sample. I include the cohort by industry fixed effects in all columns. Furthermore, standard errors are clustered at the cohort by firm level to control for potential correlation within the firm.

The plan-level results are presented in the first three columns of Table 2. The coefficient estimates of PE buyout dummy are significantly positive in first three columns, suggesting that compared to the control plans, the probability of PE-backed plans getting terminated or frozen is significantly higher after the buyout. More specifically, the coefficient estimates imply that the probability of termination or freeze for the PE-backed plans is 0.049 percentage point higher than the non-PE-backed plans within one year after the buyout. The difference is growing over time, reaching to 0.12 in column three, which suggests that within five years after the buyout, the difference of chances of getting terminate or frozen is 0.12 between PE-backed plans and non-PE-backed plans.

As a firm may have multiple DB plans, after the PE buyout, the firm may choose to terminate or freeze multiple plans all together or one at a time. Plan-level analysis is not able to capture this effect. I aggregate the plan-level data to firm level. The dependent variables become the dummy variable equals one when the firm terminates or freezes at least one plan within one year, three years and five years after the buyout year. Different from the plan-level sample, the observations of the firm will not be dropped after terminating or freezing one as long as the firm has other active plans. The regressions also consider the cohort by industry fixed effects, and the standard errors are clustered at firm level. In all three columns, I find that the coefficient estimates are significantly positive, meaning that the probability of PE-backed firms terminating or freezing at least one plan is higher than the non-PE-backed firms. The difference is 0.05 in the first year after the buyout and increases to 0.124 over the five years, which is similar to the plan level results. The comparison between the plan-level and firm-level results reveal that firms indeed terminate or freeze the plans with sequence, which may be the reason why the coefficients are different in column two and five. When the firm still has active plans, the observations of that firm will not be dropped from the sample, which inflates the denominator in the column five and results in a lower coefficient.

The control variables reveal that the probability of terminating or freezing the DB plan is positively correlated to the number of plan participants, plan age, and the expense ratio, while being negatively correlated to the market value of the pension assets. Interestingly, no significant results were found with the firm book value of assets or the total sales.

To explore the dynamics of the PE effect on DB plans termination or freeze, I replace the $PEtreat$ dummies with a set of year dummies (using year one year before the buyout as the base year) interacted with $PEtreat$ dummies The year-by-year coefficient plots are shown in Figure 1. The results suggest that the positive effect of PE buyout on the probability of termination or freeze for the PE-backed plans is mainly driven by the effect in the first year after the buyout. At the firm level, the results suggest that apart from the effect in the first year, the probability of terminating or freezing the DB plan is also higher in year $T + 3$.

To summarize, my analysis reveals that PE buyouts have a significant and positive impact on the likelihood of target firms terminating or freezing their DB plans. These plans often provide post-retirement benefits as a form of deferred compensation, but freezing or terminating the plan reduces the promised benefits and can result in lower labor costs for PE-backed firms, as noted by Rauh, Stefanescu, and Zeldes (2013). However, this can also increase risk and reduce wages for employees, representing a possible transfer of welfare from employees to shareholders.

6.2. PE and DB plan characteristics

While the termination/freeze analysis provides valuable insights into the impacts of PE buyout on DB plan management, it cannot capture the effects on firm managing the active DB plan (e.g., changing the actuarial assumptions, changing the wages, etc.). Therefore, I now examine the impacts of PE buyout on actuarial assumptions and plan characteristics. The Form 5500 data require sponsors of the DB plan disclose the disount rate for computing current PBO. Discount rates are recorded as "effective interest rates" in the Form 5500 Schedule B/SB. The effective interest rate is defined as the single rate that determines the present value of the benefits that would result in an amount equal to the plan's funding target determined for the plan year (Code section 430 (h)(2)(A)). In a DB plan, pledged benefits are estimated using a formula that considers employees' salary, tenure, age, and actuarial assumptions such as discount rates, mortality rates, and retirement age. The current PBO is calculated based on the segment rates determined by the Commissioner on the basis of the average of the monthly corporate bond yield curves for the 24-month period ending with the month preceding that month, considering the 5-year, 15-year, and 40-year benefits (Code section 430 (h)(2)(A)).[17] According to SFAS 158, the projected benefit obligations can be matched in timing and amount with a portfolio of high-quality zero-coupon bonds, but the files provide no specific requirements for the yield curve or high-quality zero-coupon bonds used, giving firms some discretion in choosing their discount rates for the PBO.

Table 3 presents the results for the discount rate at the plan level. I exclude the plans that are terminated or frozen before the buyout year. The first column shows a parsimonious model that includes only the DiD term $PEtreat \times Post$ as the explanatory variable, while the remaining columns include the full set of controls. In first three columns, I include cohort by plan fixed effects and cohort by year fixed effects. In the last two columns, I replace the cohort-by-year fixed effects with cohort-by-industry-by-year fixed effects to control for the industry time trend. The regressions are weighted by the value actuarial pension assets at

[17] Definitions are available at https://www.law.cornell.edu/cfr/text/26/1.430(h)(2)-1#d

the beginning of the cohort time window. the standard deviations are clustered at the firm level.

Across all specifications, the coefficient on the DiD term $PEtreat \times Post$ is significantly positive, indicating that plans sponsored by PE-backed firms tend to have higher discount rates after the buyout year. For example, in column four, the coefficient estimate suggests that if a DB plan is sponsored by a PE-backed firm ($PEtreat = 1$), the discount rate will increase by 0.108% after the buyout ($Post = 1$), which is 10% of the standard deviation of the discount rate in the sample.

In column five, I add a dummy variable that equals one when the plan is frozen in the year and zero otherwise. The coefficient of the dummy variable indicates that frozen plans tend to have higher discount rates compared to active plans, but the difference is not statistically significant. Additionally, I find that the discount rate is positively correlated with the expense ratio and the natural logarithm of the number of participants and the firm's book value of assets, while it is negatively correlated with the natural logarithm of the plan age, market value of pension assets, and total revenue.

Theoretically, higher discount rate should lead to lower PBO, whlie PBO can still increase each year due to employees' additional working years and higher salaries. The results of the effect of a PE buyout on PBO are shown in the Table 4. The sample is consistent with the on in Table 3. I control for cohort by plan fixed effects and cohort by industry by year fixed effects in all specifications. In the first column, I present the results on PBO, with the DiD term as the only independent variable. In subsequent columns, I add a full control set. I find negative and significant coefficients of the DiD term in all specifications, indicating that after the buyout, the DB plan sponsored by PE-backed firms tends to have a lower PBO. In column two, the coefficient estimate of the DiD term suggests that all else equal, when the DB plan is sponsored by a PE-backed firm, the PBO tends to drop by roughly 0.082 log points. I further add a dummy variable equal to one when the plan is frozen in a given year in column three, and the discount rate in column four, to control for the effects of these factors on PBO. Although the coefficient estimate is smaller in column four than the one in column two, it is statistically significant at the 5% level. This suggests that the drop in PBO cannot be fully explained by the higher discount rate or the frozen status of the plan. Because the PBO is a function of discount rate, the expected salary growth, retirement age and mortality rate of the employees, the results imply that apart from the actuarial assumptions and the status of the plan, the pension participants of DB plan may also experience layoffs, salary cut or slower salary growth after the buyout, which represents that employees' benefits are hurt by the PE buyout.

To see the dynamics of the PE effect on the discount rate and PBO, I replace the $PEtreat$ dummies with a set of event year dummies (using the starting year of each cohort as the base year) interacted with $PEtreat$ dummies. The year-by-year coefficient plots are shown in Figure 2. The panel A shows the coefficient plot of test on discount rate, while panel B shows the results on PBO. The results of panel A shows that the positive effect on the discount rate is driven by the effect in year one, three and six after the buyout, while the panel B shows that the negative effect on PBO is significant in year one, three and five after the buyout, which is consistent with the results from the discount rate. Besides, the negative effect is also significant in other years, meaning that the potential layoffs or salary cuts happen to the plan participants after the buyout. These graphs also indicate that there is no obvious pretrend before the buyout, which validate the parallel assumption of the DiD framework.

Table 5 presents the results on other plan characteristics, including the natural logarithm of the number of plan participants, market value of pension assets, and funding ratio. The empirical setups are similar to the ones in the previous tables. The frozen plan dummy variable, which indicates whether the plan is frozen or not in the given year, is included in even columns.

The results show that the PE buyout has a significant and negative effect on the the number of plan participants, as the coefficient estimate of the DiD term is statistically significant and negative in column one and two, with all control variables and fixed effects. The coefficient estimate implies that all else equal, the number of plan participants drop by 0.078 log points after the buyout. Since the plan sponsor cannot force some of the participants to quit the plan, this negative result suggests possible layoff after the buyout, which is consistent with Davis, Haltiwanger, Handley, Jarmin, Lerner, and Miranda (2014). In column three and four,the dependent variables are the natural logarithm of market value of pension assets. The coefficient of the DiD term is statistically significant and negative, indicating that the market value of pension assets decreases after the PE buyout. Take the column three as an example, the coefficient implies that after the buyout, the pension assets drop by 0.104 log points. The similar decreases in both PBO and pension assets lead to an unchanged funding ratio as shown in column five and six.

In Table 6, I present the results of PE buyout effect on the contributions made by PE-backed employers. In column one, I only include the DiD term, whereas in the subsequent columns, I add the full control set. I find that the contributions made by PE-backed employers are less in after the buyout. For example, the coefficient in column two implies that the contribution will drop by 0.152 log points after the buyout. In column three and four, I add the frozen dummy variable and the funding ratio in the last year. The results suggest that the lower contribution after the buyout may be can be partly explained by the freeze of the plan.

To explore the dynamics of the PE effect on the contribution received by plans, I replace the $PEtreat$ dummies with a set of year dummies (using the starting year of each cohort as the base year) interacted with $PEtreat$ dummies. The year-by-year coefficient plots are shown in Figure 3. The results suggest that the negative effect of PE buyout on the contribution is mainly driven by the effect in the third year and the fifth year after the buyout. The plot also shows that there is no obvious pre-trend before the buyout, which validates the parallel assumption for the DiD test.

In summary, the results suggest that the PE buyout does lead to the reduction in the contribution received by the plan, which may save the cash for the employer. The reduction of contributions may be part of the reasons for the decreases in pension assets. Meanwhile, the PE-backed plans also have a higher discount rate, less participants and lower PBO. The similar decreases in both pension assets and liabilities make the funding ratio unchanged.

Table 7 presents the firm-level analysis. The sample is constructed by aggregating plan-level data to the firm level. The results show that the PE buyout positively affects the firm-level average discount rate. Specifically, the coefficient estimate of the DiD term implies that the discount rate of the PE-backed firm will increase by 0.097% after the buyout, similar to the magnitude estimated at the plan level. Column two and three show that PE-backed firms have lower PBO after the buyout. I added discount rate as control variable in column three. Although the coefficient estimate of the DiD term is lower in column three, it remains significant, suggesting that higher discount rates are not the only reason for lower PBO. Moreover, I found that the natural logarithm of the number of participants is negatively affected by the PE buyout, which is consistent with the plan-level results.

The results of PE buyout effect on other pension characteristics are shown in the Table 8. I find that, consistent with the plan-level results, the funding ratio is unchanged after the buyout for PE-backed firms, primarily driven by similar decreases in both PBO and pension assets, as the PE buyout negatively and significantly affect the market value of pension assets shown in column one. In column three, I also find that PE-backed firms contribute less after the buyout.

In sum, these results indicate that after the buyout, the PE-backed firms and their DB plans will have higher discount rates, lower PBO, lower pension assets, less pension participants, and less contribution. The reduction of contribution saves the cash payment to the DB plan, but it also reduces the pension assets. To maintain the existing funding ratio, companies set a higher discount rate and/or fire the pension participants to cut the liability. The findings are consistent with the literature (e.g., Chu, Goldstein, Li, and Yu (2020) and Kisser, Kiff, and Soto (2017)) that firm set higher discount rate to report less

PBO and to contribute less to the pension plan. This behavior implies a potential welfare transfer from the employees to the shareholders. My results also suggest that the PE-backed firms' current treatment to employees (e.g., expected salary growth and salary) may also be negatively affected by the PE buyout, since the changing of discount rate cannot fully explain the drop of PBO.

6.3. PE and DB plan asset allocation

An assumption underlying concerns about post-retirement benefit security is that PE-backed firms may not manage pension plans effectively after a buyout. To investigate this assumption, I analyzed financial and asset allocation data from Form 5500 Schedule H and I to determine if asset allocation changed and if returns improved for DB plans sponsored by PE-backed firms after a buyout.

Table 9 presents the results of my analysis on asset management at the plan level. The dependent variables are the weights assigned to different asset categories, including safe assets, risky debt, equities, mutual funds, employer's securities and trust, and the rest of the assets, which mostly comprise real estate and other categories that have limited data availability. To account for potential confounding factors, I include cohort-by-plan and cohort-by-industry-by-year fixed effects in my analysis.

The results indicate that PE buyouts have negative and statistically significant effects on the weights assigned to safe assets and mutual funds, as shown in columns one and three. Conversely, the allocation to equities increases for DB plans sponsored by PE-backed firms, as demonstrated in column three. Specifically, the coefficient estimates of the DiD term in columns one and three indicate that DB plans sponsored by PE-backed firms reduce their weight on safe assets and mutual funds by 2.6% and 4.7%, respectively, while increasing their weight on equities by 3.2%. No significant effects are found in all other asset categories.

Table 10 presents the firm-level results of my analysis on the effect of PE buyouts on asset allocation. To aggregate the plan-level variables, I combine the data from all active and frozen plans to capture the overall impact of PE buyouts on the firms' asset allocation decisions. The dependent variables are the firm-level weights assigned to different asset categories, and I find that, consistent with the plan-level results, PE-backed firms increase their allocation to equities and decrease their allocation to mutual funds after the buyout. Specifically, the coefficients indicate that equity weight increases by 3.3 percentage points, while mutual funds weight decreases by 3.4 percentage points. This result suggests that PE-backed firms tend to replace mutual fund investment with equity investment following the buyout. However, I do not find any significant effects of PE buyout on the weights assigned to safe assets, risky debt, mutual funds, or employer's securities. Overall, my results suggest that DB plans sponsored by PE-backed firms tend to take on more risk by increasing their allocation to equities.

In Table 11, I present the results on realized returns at both plan level and firm level. The realized returns are computed as Equation 1 and Equation 2. Apart from the control variables in the previous tables, I further add the lagged weights on each asset as the control variables. The empirical setups are similar to the ones in the previous tables. In all specifications, I do not find significant coefficient of the DiD term. The results suggest that the return on pension assets of PE backed plans and firms are not improved after the buyout. The higher risk taken by these plans found in Table 9 and Table 10 does not translate to better investment performance.

The plan- and firm-level findings suggest that after a PE buyout, pension assets are managed more aggressively, but the returns are not significantly improved. This result implies that the shift towards more risky investments does not necessarily lead to higher returns, which may have negative implications for pension plan beneficiaries. Furthermore, the results also indicate that the reduction of contribution is not made up by better investment performance. The reason for unaffected funding ratio with less contribution is that PE-backed firms raise the discount rate to cut the PBO at the same time. However, since the pension asset is less, the ability to pay the benefits is deteriorating. This may cause managers to take more risks by increasing the allocation to equities in an attempt to reduce the concern, even though this approach does not appear to be effective in increasing realized returns. And when pension assets are invested in higher-risk assets, post-retirement benefits are exposed to greater risks, which can lead to not only bondholders but also employees shouldering the costs.

7. Robustness

In this section, I provide the robustness check.

7.1. Entropy balancing

Identifying the PE buyout effect is complicated by the endogenous selection of buyout targets by PE firms. The previous findings may be due to the fundamental difference between the PE-backed plans (and firms) and non-PE-backed plans (and firms). To address this concern, I use entropy balancing to mitigate observable differences across treatment and control groups. Entropy balancing is proposed by Hainmueller (2012) and Zhao and Percival (2016). This method uses the concept of information entropy to construct weights for each observation in the sample, such that the weighted distributions of covariates in the treatment and control groups become more similar. In other words, by reweighting the observations, the mean, the variance, and skewness become closer between the treatment and control group.

I repeat the tests in the previous sections with the entropy balancing weights computed using the software developed by Hainmueller and Xu (2013). I use only the data in year $t-1$ and generate the entropy balancing weight by cohort. I set the constraints based on mean and the variance of the sample. The results of the termination and freeze are presented in Table 12. The results with entropy balancing weight are consistent with the main findings that the PE buyout increases the probability of plan getting terminated or frozen and the probability of firm terminating or freezing its DB plan.

The plan-level results on the pension assumption and other characteristics are shown in Table 13, Table 14 and , Table 15. For the discount rate and PBO, the results are consistent with the findings in previous sections, that PE-backed plans tend to use higher discount rate, have lower PBO after the buyout, less participants, less pension assets, and receive less contribution from the employer. The negative coefficient of the DiD term in column one and two suggest that all else equal, the number of participants will drop by roughly 0.07 log points. The coefficient of DiD term in column three and four of Table 14 suggest that the pension assets drop by roughly 0.07 log points after the PE buyout. Combined with the results that there is no significant improvement in the investment return, this drop may come from the reduction of the contribution to the plan. Furthermore, I do not find the funding ratio is significantly improved with the entropy balanced sample in column five and six in Table 14. This may be resulted from the similar drop of PBO and pension assets after the buyout. The firm-level results on pension discount rate and characteristics are presented in Table 16. The results are generally consistent with the findings in previous discussion. It is worth noting that the coefficient estimates at firm level with entropy balancing sample are greater than the plan level results. This might be because at the firm level, the termination and freeze of the plans are considered, which may generate negative effect on pension characteristics.

The results on the asset allocation at plan level is shown in Table 17, while the results at the firm level are shown in Table 18. With entropy balanced samples, I do not find any significant results regarding the allocation on safe assets and risky debt at both plan level and firm level. However, consistent with the previous finding, I observe a significantly positive effect on the equity held by the pension. The coefficient estimates suggest that with the entropy balanced sample, the weight on equity increases for both PE-backed plan and firm by approximately 2.4 percentage point, which is roughly 18% of the sample mean. And this discovery imply that the risk taken by the pension fund is higher after the PE buyout. The result in column four imply that the weight on mutual fund is decreasing by 2.6 percentage point at the plan level, and 5.8 percentage point at the firm level. In column six of both

Table 17 and Table 18, I find that the fund allocated to employers' properties and stocks is increasing after the buyout at both plan and firm level. The coefficient estimates are small at both plan and firm level. The results regarding the net-of-fee return are shown in Table 19. Consistent with the previous findings, there is no significant evidence showing that the performance of the pension assets investment improves after the PE buyout.

In sum, the results with entropy balanced samples confirm the robustness of my findings in the previous section.

7.2. Time window

I repeat the test in the previous section with various time window, including four years and five years before and after the buyout year. The results are shown in Table A.5, Table **??**, Table **??**, Table **??** and Table A.6. In panel A, I show the results with five years before and after the buyout year, while in panel B, the time window is four years before and after the buyout. In all specifications, the results are consistent with the previous findings.

8. Conclusion

The literature on PE buyouts continues to debate on whether the PE buyout harms the employees or not. While buyouts can bring benefits such as new job opportunities, better working conditions, and safer working environments, they can also result in layoffs, reduced compensation, and worse work-life balance for employees. This paper helps answer this question by investigating whether employees suffer from PE buyouts. The study utilizes a stacked difference-in-difference framework and Form 5500 and Pitchbook data to investigate whether employees suffer from the PE buyout through looking at the DB plan, which is a deferred compensation for employees' human capital.

The empirical results of the study reveal that PE-backed firms are more likely to freeze their DB plans, and this effect is observed at both the plan and firm levels. Although the effect may not be immediate, it could lead to a reduction in the promised deferred compensation of employees. Furthermore, I find that after the buyout, PE-backed firms are more likely to have higher discount rates, lower PBO, lower pension assets, and lower contribution, but the funding ratio remain unchanged. Regarding asset allocation, the results show that PE-backed firms, at both the plan and firm levels, reduce their allocation to mutual funds but increase their weight on equity, but there is no evidence that the investment returns are improved accordingly.

In general, the results depict that PE firms may use their control over target firms to reduce cash flow to the pension and increase financial slack, benefiting shareholders. And to make the pension not in a worse shape, they change the pension actuarial assumptions and characteristics to hide the reduction. However, this behavior comes at the risk of employees' post-retirement benefits. The ability to pay benefits may be compromised, which may incentivize risk-increasing investment strategies for pension assets. The results also suggest that the PE premium is partly derived from the welfare transferred from employees, including post-retirement benefits. Therefore, it is essential to establish regulations and oversight mechanisms that safeguard the interests of employees involved in PE buyouts.

Table 1: **Summary statistics**

This table shows the summary statics (mean, standard deviation, the 25th, 50th, and 75th percentiles, and the number of observations) of variables at the plan-year level. It covers 30,774 DB plans in the U.S. Panel A presents the fundamental variables of the DB plans from the Form 5500/Form 5500-SF and Schedule B/SB, and Panel B describe the financial data. Variable definitions are provided in Table A.1. All dollar terms are expressed in the year 2000 dollars.

Panel A. Summary statistics at the plan level

	mean	sd	p25	p50	p75	count
p(T/F)	0.049	0.217	0.000	0.000	0.000	251,547
p(F)	0.045	0.207	0.000	0.000	0.000	251,547
p(T)	0.006	0.080	0.000	0.000	0.000	251,547
Dis.Rate	4.195	1.041	3.456	4.141	5.010	244,002
LogNPartcp	4.010	2.414	1.946	3.761	5.684	243,456
LogPA	14.785	2.135	13.275	14.366	16.055	243,850
LogPBO	14.724	2.151	13.195	14.297	16.035	243,226
LogPlanAge	37.632	18.104	25.000	38.000	50.000	90,051
LogTA	6.458	4.788	2.330	5.872	10.148	56,351
LogSales	5.896	4.721	1.957	5.024	9.122	50,305
FundRatio	1.119	0.377	0.903	1.051	1.239	243,216
ExpRatio	0.002	0.005	0.000	0.000	0.003	218,645
LogContri	12.417	1.922	11.230	12.144	13.394	224,324
SafeAssets	0.109	0.200	0.000	0.018	0.132	104,496
Equity	0.136	0.218	0.000	0.000	0.233	104,496
RiskyDebt	0.052	0.105	0.000	0.000	0.064	104,496
MutualFunds	0.327	0.382	0.000	0.112	0.701	104,496
Trust	0.476	0.443	0.000	0.406	0.971	104,496
R1	0.073	0.094	0.013	0.078	0.129	101,770
R2	0.070	0.085	0.012	0.076	0.126	103,786

Panel B. Summary statistics of the asset allocations

	mean	sd	p25	p50	p75	count
Pr(T/F)	0.050	0.218	0.000	0.000	0.000	185,367
Pr(F)	0.047	0.211	0.000	0.000	0.000	185,367
Pr(T)	0.005	0.073	0.000	0.000	0.000	185,367
Dis.Rate	4.180	1.037	3.435	4.131	4.998	218,930
LogPartcp	3.879	2.424	1.792	3.497	5.568	218,888
LogPA	14.712	2.144	13.211	14.261	15.933	218,938
LogPBO	14.644	2.160	13.124	14.181	15.909	218,620
LogPlanAge	23.574	20.266	6.000	15.000	41.000	154,823
LogTA	8.032	5.212	3.783	7.874	12.758	49,192
LogSales	7.615	5.351	3.158	7.213	12.890	42,938
FundRatio	1.125	0.374	0.908	1.057	1.247	218,620
ExpRatio	0.002	0.004	0.000	0.000	0.002	197,081
LogContri	12.424	1.856	11.274	12.147	13.328	168,224
SafeAssets	0.121	0.202	0.001	0.029	0.161	59,072
Equity	0.149	0.226	0.000	0.000	0.278	59,072
RiskyDebt	0.057	0.113	0.000	0.000	0.078	59,072
MutualFunds	0.319	0.371	0.000	0.120	0.657	59,072
Trust	0.417	0.433	0.000	0.215	0.940	59,072
R1	0.051	0.103	-0.008	0.055	0.109	59,072
R2	0.048	0.094	-0.011	0.052	0.106	59,072

Table 2: Cross-sectional results of PE buyout on termination or freeze of a DB plan

This table reports the results of cross-sectional regressions on the effects of PE buyout on termination and freeze decisions at the plan level and firm level. The dependent variables are the dummy variables that equal to one when the plan is terminated or frozen within one year, three years or five years after the buyout the year. Variable definitions are provided in Table A.1. The time period is from 2004 to 2020. The regression contains the cohort by industry fixed effects, and standard errors are clustered at firm level. *t*-statistics are reported in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	Plan level			Firm level		
	(1)	(2)	(3)	(4)	(5)	(6)
	T/F1Y	T/F3Y	T/F5Y	T/F1Y	T/F3Y	T/F5Y
PEtreat	0.049**	0.120***	0.120***	0.050*	0.099**	0.124**
	(2.22)	(3.42)	(2.95)	(1.77)	(2.35)	(2.45)
$LogNPartcp_{t-1}$	0.006***	0.013***	0.018**	0.004	0.015*	0.024**
	(2.88)	(2.83)	(2.40)	(1.42)	(1.95)	(2.04)
$LogPA_{t-1}$	-0.011***	-0.028***	-0.043***	-0.010***	-0.031***	-0.052***
	(-6.30)	(-6.63)	(-6.28)	(-3.70)	(-4.53)	(-4.77)
LogPlanAge	0.006***	0.019***	0.030***	0.004	0.014**	0.019*
	(3.01)	(4.25)	(4.22)	(1.37)	(2.13)	(1.73)
$ExpRatio_{t-1}$	1.015***	1.680***	1.982**	1.133***	2.117**	1.939
	(3.83)	(2.74)	(2.16)	(2.72)	(2.21)	(1.32)
$LogTA_{t-1}$	-0.000	0.000	0.000	-0.000	-0.000	-0.002
	(-0.20)	(0.11)	(0.14)	(-0.10)	(-0.01)	(-0.45)
$LogSales_{t-1}$	0.000	-0.001	0.001	0.002	0.002	0.006
	(0.21)	(-0.24)	(0.19)	(1.49)	(0.83)	(1.41)
LogNPlan				-0.005	-0.024**	-0.046***
				(-1.20)	(-2.49)	(-3.08)
Constant	0.173***	0.442***	0.678***	0.157***	0.468***	0.813***
	(8.41)	(8.91)	(8.82)	(5.04)	(6.17)	(6.82)
Observations	33589	30333	26742	13602	12388	11030
Within R^2	0.005	0.013	0.019	0.007	0.019	0.030
Cohort×Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: PE buyout and discount rate at the plan level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on discount rate for computing PBO at the plan level. The dependent variables are the discount rate in percentage point in the year t. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	Dis.Rate	Dis.Rate	Dis.Rate	Dis.Rate	Dis.Rate
Post×PEtreat	0.121**	0.127**	0.164***	0.108*	0.109**
	(2.32)	(2.56)	(3.02)	(1.96)	(2.01)
LogNPartcp_{t-1}		0.030	0.014	0.051**	0.054**
		(1.15)	(0.47)	(2.19)	(2.31)
LogPA_{t-1}		-0.032	-0.042**	-0.063***	-0.062***
		(-1.64)	(-2.19)	(-3.56)	(-3.53)
LogPlanAge		-0.076	-0.241*	-0.074*	-0.074*
		(-1.14)	(-1.92)	(-1.92)	(-1.91)
ExpRatio_{t-1}		-2.197	2.295	2.977	2.744
		(-1.02)	(0.80)	(1.25)	(1.16)
LogTA_{t-1}			0.006	0.005	0.005
			(1.24)	(1.01)	(1.00)
LogSales_{t-1}			-0.009*	-0.009*	-0.009*
			(-1.83)	(-1.91)	(-1.90)
D(Frozen)					0.050
					(1.62)
Constant	4.364***	5.124***	6.053***	5.493***	5.462***
	(14937.22)	(10.37)	(8.36)	(15.34)	(15.11)
Observations	1726949	1415109	226250	226151	226151
Within R^2	0.000	0.002	0.008	0.005	0.006
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Year FE	Yes	Yes	Yes	No	No
Cohort×Ind×Year FE	No	No	No	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes

Table 4: PE buyout and PBO at the plan level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on PBO at the plan level. The dependent variables are the PBO in the year *t*. The sample in the first four columns include the observations of the plan after the freeze, while the sample of the last column excludes these observations. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1) LogPBO	(2) LogPBO	(3) LogPBO	(4) LogPBO
Post×PEtreat	-0.055**	-0.082***	-0.083***	-0.074***
	(-2.10)	(-2.75)	(-2.69)	(-2.64)
LogPlanAge		0.024	0.024	0.017
		(0.80)	(0.81)	(0.60)
$ExpRatio_{t-1}$		-9.277***	-9.024***	-8.742***
		(-3.17)	(-3.05)	(-2.99)
$LogTA_{t-1}$		-0.001	-0.001	-0.001
		(-0.37)	(-0.36)	(-0.24)
$LogSales_{t-1}$		0.001	0.001	0.001
		(0.39)	(0.37)	(0.15)
D(Frozen)			-0.052**	-0.048**
			(-2.23)	(-2.13)
Dis.Rate				-0.081**
				(-2.52)
Constant	20.154***	20.317***	20.317***	20.698***
	(136719.91)	(178.05)	(177.13)	(101.59)
Observations	1721309	226170	226170	226008
Within R^2	0.000	0.003	0.004	0.011
Cohort×Plan FE	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Table 5: PE buyout and other pension characteristics at the plan level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension characteristics at the plan level. The dependent variables are the plan characteristics including the funding ratio, and natural logarithms of PA, and number of participants in the year *t*. The sample in the first four columns include the observations of the plan after the freeze, while the sample of the last column excludes these observations. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	LogNPartcp	LogNPartcp	LogPA	LogPA	FundRatio	FundRatio
Post×PEtreat	-0.078*	-0.081*	-0.104***	-0.105***	0.058	0.060
	(-1.80)	(-1.86)	(-2.82)	(-2.75)	(1.33)	(1.38)
LogPlanAge	-0.026	-0.025	0.036	0.036	0.061	0.061
	(-0.49)	(-0.47)	(0.99)	(1.00)	(1.62)	(1.61)
$\text{ExpRatio}_{\text{t-1}}$	-6.853*	-6.251*	-16.153***	-15.940***	-7.284***	-7.623***
	(-1.91)	(-1.76)	(-5.40)	(-5.29)	(-3.65)	(-3.96)
$\text{LogTA}_{\text{t-1}}$	0.011	0.011	-0.003	-0.003	0.000	0.000
	(1.50)	(1.51)	(-0.83)	(-0.82)	(0.11)	(0.10)
$\text{LogSales}_{\text{t-1}}$	-0.003	-0.003	-0.001	-0.001	-0.005*	-0.005*
	(-0.46)	(-0.47)	(-0.25)	(-0.25)	(-1.80)	(-1.81)
D(Frozen)		-0.123***		-0.043*		0.069**
		(-3.20)		(-1.84)		(2.32)
Constant	10.401***	10.404***	20.404***	20.404***	0.973***	0.972***
	(52.24)	(51.21)	(143.44)	(143.60)	(7.27)	(7.23)
Observations	226375	226375	226329	226329	226162	226162
Within R^2	0.001	0.003	0.008	0.009	0.010	0.016
cohort×Plan FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: PE buyout and contribution at the plan level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension characteristics at the plan level. The dependent variables are natural logarithms of the contributions made by employer in the year *t*. The sample in the first four columns include the observations of the plan after the freeze, while the sample of the last column excludes these observations. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
	LogContri	LogContri	LogContri
Post×PEtreat	-0.123*	-0.152*	-0.145*
	(-1.86)	(-1.88)	(-1.75)
LogPlanAge		-0.180	-0.182
		(-1.49)	(-1.51)
$ExpRatio_{t-1}$		16.020	17.037*
		(1.60)	(1.69)
$LogTA_{t-1}$		0.014	0.013
		(1.34)	(1.33)
$LogSales_{t-1}$		-0.002	-0.002
		(-0.20)	(-0.20)
D(Frozen)			-0.165
			(-0.91)
Constant	17.036***	17.833***	17.846***
	(37952.75)	(36.66)	(36.84)
Observations	1272051	162696	162696
Within R^2	0.000	0.002	0.003
cohort×Plan FE	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Table 7: PE buyout and pension discount rate and PBO at the firm level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension characteristics at the firm level. The dependent variables are the discount rate and natural logarithms of PBO and number of participants in the year t. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)
	Dis.Rate	LogPBO	LogPBO	LogNPartcp
Post×PEtreat	0.097*	-0.096**	-0.087**	-0.057*
	(1.66)	(-2.36)	(-2.33)	(-1.89)
$\text{LogNPartcp}_{\text{t-1}}$	0.097***			
	(3.27)			
$\text{ExpenseRatio}_{\text{t-1}}$	4.224*	-9.350***	-8.915***	-6.241***
	(1.91)	(-3.87)	(-3.76)	(-4.83)
LogPlanAge	-0.037	0.034	0.035	0.000
	(-1.37)	(1.38)	(1.40)	(0.02)
$\text{LogPA}_{\text{t-1}}$	-0.073***			
	(-4.06)			
$\text{LogTA}_{\text{t-1}}$	0.022***	0.003	0.005	0.002
	(3.49)	(0.45)	(0.73)	(0.74)
$\text{LogSales}_{\text{t-1}}$	-0.022***	-0.005	-0.007	0.000
	(-3.35)	(-1.06)	(-1.35)	(0.04)
Dis.Rate			-0.086**	
			(-2.54)	
Constant	5.065***	20.415***	20.789***	9.741***
	(16.85)	(201.51)	(135.72)	(97.93)
Observations	157881	157952	157881	157881
Within R^2	0.008	0.004	0.013	0.007
Cohort×Firm FE	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Table 8: PE buyout and pension characteristics at the firm level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension characteristics at the firm level. The dependent variables are the plan characteristics including the discount rate, funding ratio, and natural logarithms of PBO, PA, number os participants and contributions made by employer in the year *t*. The sample in the odd columns include the observations of the plan after the freeze, while the sample of the even column excludes these observations. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1) LogPA	(2) FundRatio	(3) LogContri
Post×PEtreat	-0.111**	0.059	-0.170*
	(-2.34)	(1.29)	(-1.78)
ExpRatio_{t-1}	-14.099***	-6.110***	6.428
	(-5.46)	(-3.63)	(0.63)
LogPlanAge	0.040	0.017	0.025
	(1.43)	(0.84)	(0.23)
LogTA_{t-1}	0.000	0.003	0.003
	(0.03)	(1.03)	(0.17)
LogSales_{t-1}	-0.004	-0.002	-0.009
	(-0.77)	(-0.56)	(-0.56)
Constant	20.535***	1.083***	17.319***
	(183.98)	(14.19)	(42.62)
Observations	158300	157952	125844
Within R^2	0.008	0.006	0.001
Cohort×Ind×Year FE	Yes	Yes	Yes
Cohort×Firm FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Table 9: PE buyout and pension asset allocation at the plan level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension asset allocation at the plan level. The dependent variables are the weights allocated to safe assets, risky debt, equities, mutual funds, and trust in the year t, respectively, together with realized returns. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	SafeAssets	RiskyDebt	Equity	MutualFunds	Trust
Post×PEtreat	-0.026**	-0.014	0.033*	-0.051*	0.074
	(-2.11)	(-1.22)	(1.85)	(-1.77)	(1.40)
$LogNPartcp_{t-1}$	0.001	0.005**	0.004*	0.059***	-0.045***
	(0.36)	(1.99)	(1.90)	(7.78)	(-6.40)
$ExpRatio_{t-1}$	0.291	-2.235***	0.512	-3.280***	-1.788**
	(1.11)	(-7.44)	(1.64)	(-8.13)	(-2.23)
$LogPA_{t-1}$	0.000	-0.005***	-0.002**	0.003***	0.006***
	(0.62)	(-7.49)	(-2.46)	(2.59)	(2.83)
LogPlanAge	-0.006	-0.029***	-0.000	-0.022***	0.058***
	(-1.31)	(-4.68)	(-0.06)	(-3.28)	(3.79)
$LogTA_{t-1}$	0.001***	-0.000	0.000	-0.004***	-0.003**
	(4.30)	(-0.02)	(0.54)	(-4.54)	(-2.35)
$LogSales_{t-1}$	-0.001**	0.001***	0.001	0.002**	-0.000
	(-2.23)	(3.24)	(1.27)	(2.37)	(-0.06)
Constant	0.068***	0.220***	0.130***	-0.372***	0.705***
	(2.73)	(6.28)	(3.66)	(-5.04)	(7.40)
Observations	252188	252188	252188	169353	252430
Within R^2	0.001	0.012	0.001	0.006	0.006
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table 10: PE buyout and pension asset allocation at the firm level

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on pension asset allocation at the firm level. The dependent variables are the weights allocated to safe assets, risky debt, equities, mutual funds, and trust in the year t, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1) SafeAssets	(2) RiskyDebt	(3) Equity	(4) MutualFunds	(5) Trust
Post×PEtreat	-0.019	-0.001	0.031*	-0.034**	0.079
	(-1.43)	(-0.08)	(1.79)	(-2.12)	(1.37)
LogNPartcp_{t-1}	-0.007***	0.008***	0.014***	-0.004**	-0.042***
	(-4.01)	(4.15)	(5.37)	(-2.26)	(-7.28)
ExpRatio_{t-1}	0.197	-1.193**	0.607	-1.298***	-2.631*
	(0.48)	(-2.10)	(1.51)	(-5.34)	(-1.95)
LogPlanAge	0.003	0.005	0.005	0.008*	-0.027**
	(0.93)	(1.20)	(1.25)	(1.95)	(-2.03)
LogPA_{t-1}	0.001	-0.003***	-0.005***	0.003***	0.009***
	(1.42)	(-3.68)	(-4.11)	(2.91)	(2.60)
LogTA_{t-1}	0.001***	-0.002***	-0.001	-0.004***	-0.002
	(3.58)	(-3.12)	(-1.29)	(-4.45)	(-0.82)
LogSales_{t-1}	0.000	0.004***	0.002***	0.003***	-0.005**
	(0.88)	(4.61)	(3.08)	(3.32)	(-2.26)
Constant	0.081***	0.018	0.055*	0.020	1.037***
	(3.24)	(0.72)	(1.85)	(0.82)	(12.70)
Observations	155717	155717	155717	155717	155717
Within R^2	0.003	0.005	0.003	0.002	0.008
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table 11: PE buyout and realized return on pension assets

This table reports the results of stacked difference-in-difference regressions on the effects of PE buyout on realized returns on pension assets The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	Plan level		Firm level	
	(1)	(2)	(3)	(4)
	R1	R2	R1	R2
Post×PEtreat	0.008	0.008	0.004	0.006
	(0.70)	(1.03)	(0.34)	(0.86)
$LogNPartcp_{t-1}$	-0.002	-0.002*	0.002	0.002
	(-1.22)	(-1.71)	(1.35)	(1.59)
$ExpRatio_{t-1}$	0.865***	0.819***	1.186***	1.196***
	(4.05)	(4.92)	(4.76)	(6.19)
LogPlanAge	0.004	-0.001	0.014***	0.007***
	(1.42)	(-0.65)	(5.95)	(3.43)
$LogPA_{t-1}$	0.008***	0.001**	0.001**	0.000
	(3.61)	(2.35)	(2.17)	(0.71)
$Equity_{t-1}$	-0.008	-0.001	-0.012***	0.003
	(-1.38)	(-0.23)	(-4.24)	(1.29)
$Trust_{t-1}$	-0.002	0.005	-0.008***	0.001
	(-0.62)	(1.58)	(-2.90)	(0.30)
$SafeAssets_{t-1}$	0.016*	0.007	0.041***	0.008
	(1.81)	(0.88)	(6.46)	(1.55)
$RiskyDebt_{t-1}$	0.011	0.006	0.008	-0.014**
	(1.35)	(0.86)	(0.90)	(-2.30)
$MutualFunds_{t-1}$	-0.010***	-0.001	-0.001	0.002
	(-2.80)	(-0.28)	(-0.48)	(0.99)
$Emplr_{t-1}$	-0.076	-0.043	-0.161***	-0.223***
	(-1.62)	(-1.51)	(-3.16)	(-5.56)
$LogTA_{t-1}$	-0.000	0.000	0.000	0.001
	(-0.21)	(0.92)	(0.61)	(1.60)
$LogSales_{t-1}$	-0.001*	-0.000*	-0.001**	-0.001*
	(-1.94)	(-1.89)	(-2.08)	(-1.88)
Constant	-0.076**	0.061***	-0.024	0.004
	(-2.20)	(4.31)	(-1.13)	(0.25)
Observations	252133	251964	155624	155624
Within R^2	0.004	0.001	0.008	0.009
Cohort×Plan FE	Yes	Yes	No	No
Cohort×Firm FE	No	No	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Table 12: Termination and freeze analysis with entropy balancing weights

This table repeat the tests in Table 2 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	Plan level			Firm level		
	(1)	(2)	(3)	(4)	(5)	(6)
	T/F1Y	T/F3Y	T/F5Y	T/F1Y	T/F3Y	T/F5Y
PEtreat	0.044**	0.138***	0.125***	0.026**	0.051**	0.083**
	(2.15)	(4.21)	(3.43)	(1.99)	(2.17)	(2.00)
$\text{LogNPartcp}_{t\text{-}1}$	0.001	-0.002	-0.002	0.015	0.011	-0.019
	(0.23)	(-0.13)	(-0.13)	(1.60)	(0.82)	(-1.04)
$\text{LogPA}_{t\text{-}1}$	-0.007	-0.012	-0.014	-0.023**	-0.033***	-0.019
	(-1.58)	(-1.13)	(-0.89)	(-2.23)	(-2.71)	(-1.20)
LogPlanAge	-0.002	-0.005	-0.021	0.018	0.025	0.015
	(-0.25)	(-0.36)	(-1.01)	(0.93)	(1.29)	(0.59)
$\text{ExpRatio}_{t\text{-}1}$	2.365	2.290	2.669	-2.502**	-2.175	0.382
	(1.63)	(1.27)	(1.28)	(-1.99)	(-1.40)	(0.18)
$\text{LogTA}_{t\text{-}1}$	-0.000	0.001	-0.002	0.006	0.008	0.003
	(-0.06)	(0.17)	(-0.27)	(1.56)	(1.22)	(0.44)
$\text{LogSales}_{t\text{-}1}$	-0.000	-0.002	0.003	-0.003	-0.007	-0.001
	(-0.10)	(-0.29)	(0.41)	(-0.97)	(-1.12)	(-0.12)
LogNPlan				-0.016	-0.019	-0.030
				(-0.94)	(-0.93)	(-1.26)
Constant	0.141***	0.331***	0.469***	0.258***	0.516***	0.561***
	(3.46)	(2.86)	(2.81)	(2.82)	(3.42)	(2.84)
Observations	32053	30360	26758	14354	13111	11712
Within R^2	0.014	0.029	0.023	0.022	0.030	0.039
Cohort×Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 13: Plan discount rate and PBO with entropy balancing weights

This table repeat the tests in Table 3 and Table 4 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	Dis.Rate	Dis.Rate	LogPBO	LogPBO	LogPBO
Post×PEtreat	0.067**	0.068**	-0.073***	-0.072***	-0.066***
	(2.36)	(2.36)	(-4.67)	(-4.62)	(-4.26)
LogNPartcp_{t-1}	0.047*	0.044*			
	(1.73)	(1.67)			
LogPA_{t-1}	0.034	0.034			
	(1.46)	(1.44)			
LogPlanAge	-0.019	-0.019	0.150***	0.150***	0.149***
	(-0.58)	(-0.58)	(3.44)	(3.42)	(3.32)
ExpRatio_{t-1}	0.009	0.054	-7.392***	-7.250***	-7.306***
	(0.01)	(0.05)	(-6.37)	(-6.23)	(-6.33)
LogTA_{t-1}	0.001	0.001	-0.002*	-0.002*	-0.002
	(0.20)	(0.20)	(-1.74)	(-1.72)	(-1.63)
LogSales_{t-1}	0.003	0.003	0.000	0.000	0.001
	(0.98)	(0.97)	(0.35)	(0.23)	(0.41)
D(Frozen)		-0.024		-0.067***	-0.070***
		(-1.06)		(-6.10)	(-6.14)
Dis.Rate					-0.091***
					(-13.16)
Constant	3.367***	3.388***	17.248***	17.254***	17.645***
	(9.82)	(9.79)	(113.60)	(112.81)	(113.32)
Observations	195672	195672	195690	195690	195548
Within R^2	0.003	0.004	0.025	0.029	0.053
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table 14: Other pension characteristics with entropy balancing weights

This table repeat the tests in Table 5 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	LogNPartcp	LogNPartcp	LogPA	LogPA	FundRatio	FundRatio
Post×PEtreat	-0.072***	-0.071***	-0.070***	-0.069***	0.009	0.009
	(-5.63)	(-5.57)	(-3.54)	(-3.47)	(0.68)	(0.68)
LogPlanAge	-0.020	-0.020	0.135***	0.135***	-0.002	-0.002
	(-0.71)	(-0.69)	(2.67)	(2.64)	(-0.13)	(-0.13)
$\text{ExpRatio}_{t\text{-}1}$	-4.163***	-3.981***	-14.513***	-14.341***	-5.664***	-5.664***
	(-3.97)	(-3.81)	(-10.21)	(-10.05)	(-8.63)	(-8.57)
$\text{LogTA}_{t\text{-}1}$	-0.003**	-0.003**	-0.003**	-0.003**	-0.001	-0.001
	(-2.09)	(-2.14)	(-2.21)	(-2.19)	(-1.07)	(-1.07)
$\text{LogSales}_{t\text{-}1}$	0.002*	0.002*	0.003*	0.003*	0.001	0.001
	(1.90)	(1.75)	(1.86)	(1.70)	(1.27)	(1.27)
D(Frozen)		-0.086***		-0.081***		-0.000
		(-8.00)		(-5.51)		(-0.06)
Constant	7.534***	7.541***	17.372***	17.379***	1.057***	1.057***
	(76.32)	(74.73)	(97.21)	(96.36)	(16.76)	(16.74)
Observations	195716	195716	195821	195821	190747	190747
Within R^2	0.014	0.023	0.037	0.041	0.016	0.016
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table 15: Contributions made by employer with entropy balancing weights

This table repeat the tests in Table 6 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
	LogContri	LogContri	LogContri
Post×PEtreat	-0.151***	-0.149***	-0.138***
	(-3.72)	(-3.67)	(-3.39)
LogPlanAge	-0.069	-0.064	-0.073
	(-1.00)	(-0.91)	(-1.02)
$ExpRatio_{t-1}$	7.223**	8.099***	7.895**
	(2.30)	(2.59)	(2.52)
$LogTA_{t-1}$	0.009	0.009	0.009
	(1.41)	(1.39)	(1.33)
$LogSales_{t-1}$	-0.013	-0.014*	-0.014*
	(-1.64)	(-1.71)	(-1.70)
D(Frozen)		-0.249***	-0.247***
		(-5.76)	(-5.71)
FR_{t-1}			-0.445***
			(-4.01)
Constant	15.167***	15.167***	15.644***
	(63.90)	(62.84)	(60.36)
Observations	159623	159623	159623
Within R^2	0.002	0.006	0.008
Cohort×Plan FE	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes
Controls	Yes	Yes	Yes

Table 16: Firm-level pension characteristics with entropy balancing weights

This table repeats the tests of discount rate, PBO, pension assets, participants, funding ratio and contribution at the firm level with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1) Dis.Rate	(2) LogPBO	(3) LogPBO	(4) LogNPartcp	(5) LogPA	(6) FundRatio	(7) LogContri
Post×PEtreat	0.072*	-0.192***	-0.190***	-0.173***	-0.233***	0.004	-0.230***
	(1.88)	(-2.71)	(-2.67)	(-2.83)	(-2.95)	(0.23)	(-3.47)
LogNPartcp_{t-1}	-0.018						
	(-0.47)						
ExpRatio_{t-1}	0.326	-11.285***	-10.799***	-8.579***	-18.680***	-6.511***	16.484***
	(0.15)	(-6.18)	(-6.00)	(-5.78)	(-8.70)	(-7.35)	(3.63)
LogPlanAge	-0.008	0.230***	0.210***	0.121**	0.166**	-0.004	-0.032
	(-0.23)	(3.88)	(3.51)	(2.18)	(2.24)	(-0.23)	(-0.40)
LogPA_{t-1}	0.031						
	(0.97)						
LogTA_{t-1}	0.007	-0.007*	-0.006	-0.005	-0.009*	-0.004	-0.009
	(1.05)	(-1.73)	(-1.60)	(-1.56)	(-1.94)	(-1.38)	(-0.88)
LogSales_{t-1}	-0.005	0.003	0.003	0.004	0.009**	0.005*	0.008
	(-0.92)	(0.81)	(0.76)	(1.17)	(2.09)	(1.78)	(0.81)
Dis.Rate			-0.076***				
			(-6.62)				
Constant	3.884***	17.735***	18.128***	7.690***	18.095***	1.092***	15.567***
	(10.30)	(90.32)	(86.43)	(42.38)	(74.04)	(15.78)	(55.78)
Observations	137658	137715	137658	137658	138159	125656	109777
Within R^2	0.002	0.038	0.045	0.037	0.035	0.013	0.006
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 17: Plan-level asset allocation with entropy balancing weights

This table repeats the tests in Table 9 with entropy balancing weights. The dependent variables are the realized returns in the year *t*, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	SafeAssets	RiskyDebt	Equity	MutualFunds	Trust
Post×PEtreat	0.006	0.001	0.024***	-0.026*	0.017
	(1.08)	(0.19)	(2.69)	(-1.76)	(0.96)
$\text{LogNPartcp}_{t\text{-}1}$	-0.003	0.004	-0.006	0.032***	-0.011
	(-0.70)	(0.98)	(-0.77)	(2.90)	(-1.20)
$\text{ExpRatio}_{t\text{-}1}$	0.005	-0.065	1.222***	-2.042***	-0.205
	(0.02)	(-0.42)	(3.48)	(-3.52)	(-0.32)
$\text{LogPA}_{t\text{-}1}$	-0.001	0.002	0.011*	-0.004	0.005
	(-0.35)	(1.18)	(1.66)	(-0.45)	(0.57)
LogPlanAge	0.009	-0.011*	0.004	-0.043*	0.051**
	(1.16)	(-1.78)	(0.40)	(-1.96)	(2.15)
$\text{LogTA}_{t\text{-}1}$	-0.000	-0.000	-0.001*	0.004**	-0.000
	(-0.99)	(-0.46)	(-1.69)	(2.21)	(-0.07)
$\text{LogSales}_{t\text{-}1}$	0.000	0.000	0.000	-0.002	-0.000
	(0.35)	(1.49)	(0.10)	(-1.07)	(-0.12)
Constant	0.096	0.014	-0.044	0.196	0.361**
	(1.62)	(0.37)	(-0.40)	(1.21)	(2.44)
Observations	171634	171084	171152	170787	172089
Within R^2	0.001	0.002	0.006	0.004	0.002
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table 18: Firm-level asset allocation with entropy balancing weights

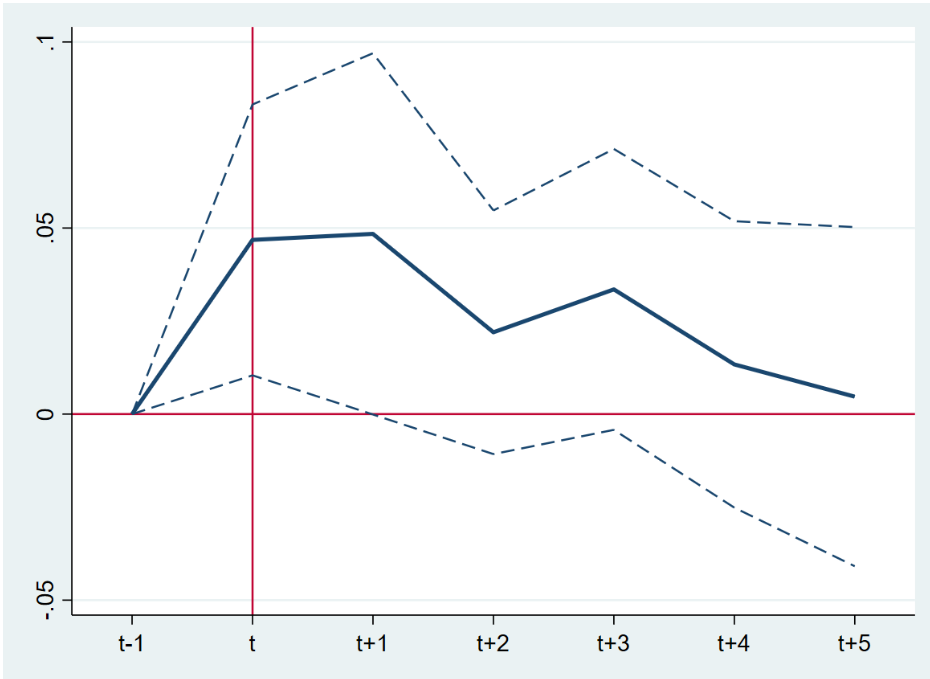
This table repeats the tests in Table 9 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)	(4)	(5)
	SafeAssets	RiskyDebt	Equity	MutualFunds	Trust
PEtreat×PEtreat	0.013	-0.004	0.030***	-0.058***	0.036
	(1.57)	(-0.60)	(2.78)	(-3.17)	(1.53)
LogNPartcp_{t-1}	-0.011	0.002	0.011	-0.035**	-0.046**
	(-0.76)	(0.71)	(1.48)	(-2.11)	(-2.18)
ExpRatio_{t-1}	1.622***	0.372	1.697***	-1.039	-4.311***
	(2.80)	(1.44)	(3.31)	(-0.76)	(-3.97)
LogPA_{t-1}	0.004	0.000	-0.000	0.014	0.031**
	(0.50)	(0.16)	(-0.03)	(1.17)	(1.98)
LogPlanAge	0.014	0.002	0.067***	-0.003	-0.067*
	(1.22)	(0.13)	(3.44)	(-0.13)	(-1.69)
LogTA_{t-1}	-0.001	0.000	-0.002	-0.000	0.001
	(-1.25)	(0.40)	(-1.51)	(-0.00)	(0.55)
LogSales_{t-1}	0.002	0.001	0.001	-0.001	-0.002
	(1.16)	(1.31)	(0.76)	(-0.25)	(-0.60)
Constant	0.054	0.015	-0.131	0.316*	0.432**
	(0.81)	(0.36)	(-1.19)	(1.69)	(2.30)
Observations	109184	109189	109076	108928	109104
Within R^2	0.005	0.003	0.018	0.005	0.012
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

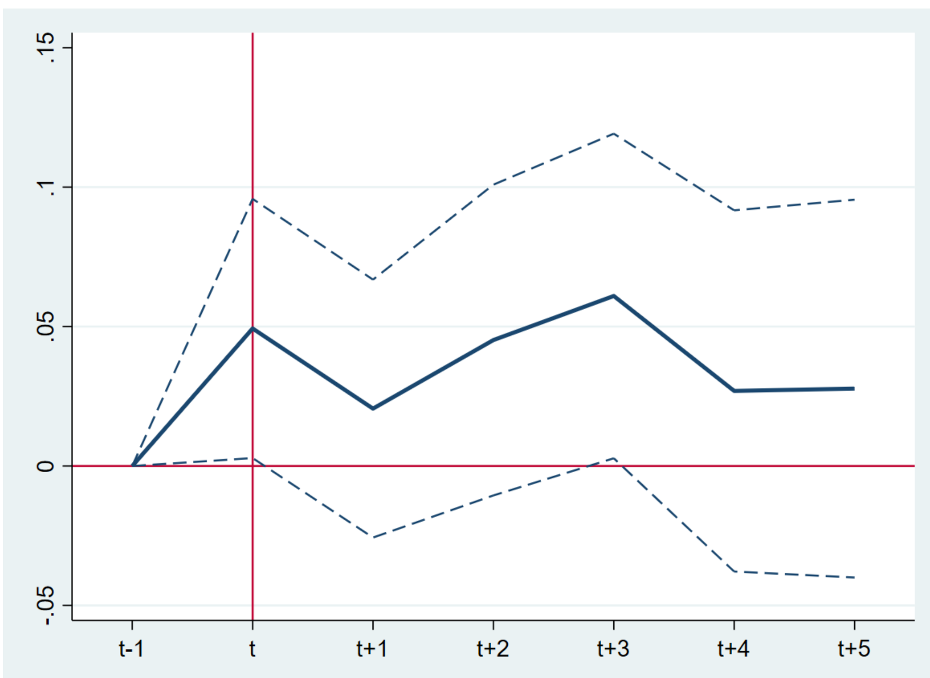
Table 19: Net-of-fee return on pension assets with entropy balancing weights

This table repeats the tests in Table 11 with entropy balancing weights. The dependent variables are the realized returns in the year t, defined as Equations 1 and 2, respectively. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. In each cohort, there are six years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	Plan level		Firm level	
	(1)	(2)	(3)	(4)
	R1	R2	R1	R2
Post×PEtreat	0.001	0.003	0.003	0.004
	(0.45)	(1.34)	(1.03)	(1.64)
$\text{LogNPartcp}_{\text{t-1}}$	0.007	0.009***	0.006*	0.005*
	(1.24)	(3.19)	(1.85)	(1.82)
$\text{ExpRatio}_{\text{t-1}}$	0.484	-0.032	-0.067	-0.142
	(0.93)	(-0.25)	(-0.28)	(-0.73)
$\text{LogPA}_{\text{t-1}}$	-0.016***	-0.013***	-0.007**	-0.006***
	(-3.68)	(-4.73)	(-2.56)	(-2.58)
LogPlanAge	0.009*	0.012***	0.001	0.001
	(1.88)	(3.41)	(0.26)	(0.29)
$\text{Equity}_{\text{t-1}}$	-0.012*	0.001	-0.009	-0.006
	(-1.77)	(0.11)	(-1.53)	(-0.93)
$\text{Trust}_{\text{t-1}}$	-0.009*	0.001	-0.006	0.001
	(-1.69)	(0.16)	(-1.42)	(0.34)
$\text{SafeAssets}_{\text{t-1}}$	-0.008	-0.008	-0.017**	-0.018**
	(-1.22)	(-1.43)	(-2.04)	(-2.17)
$\text{RiskyDebt}_{\text{t-1}}$	0.002	-0.004	0.017	-0.006
	(0.13)	(-0.45)	(1.31)	(-0.57)
$\text{MutualFunds}_{\text{t-1}}$	-0.001	0.002	-0.002	-0.001
	(-0.28)	(0.61)	(-0.51)	(-0.34)
$\text{Emplr}_{\text{t-1}}$	0.095***	0.045**	5.524	0.524
	(3.13)	(2.45)	(1.00)	(0.13)
$\text{LogTA}_{\text{t-1}}$	-0.000	-0.001*	-0.000	-0.001
	(-0.77)	(-1.87)	(-0.29)	(-1.31)
$\text{LogSales}_{\text{t-1}}$	0.000	0.000	0.000	0.000
	(0.62)	(0.86)	(0.00)	(0.74)
Constant	0.254***	0.163***	0.163***	0.140***
	(4.22)	(4.51)	(4.53)	(4.97)
Observations	230490	230234	129377	129377
Within R^2	0.004	0.004	0.002	0.002
Controls	Yes	Yes	Yes	Yes
Observations	230490	230234	129377	129377
Within R^2	0.004	0.004	0.002	0.002
Cohort×Plan FE	Yes	Yes	No	No
Cohort×Firm FE	No	No	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

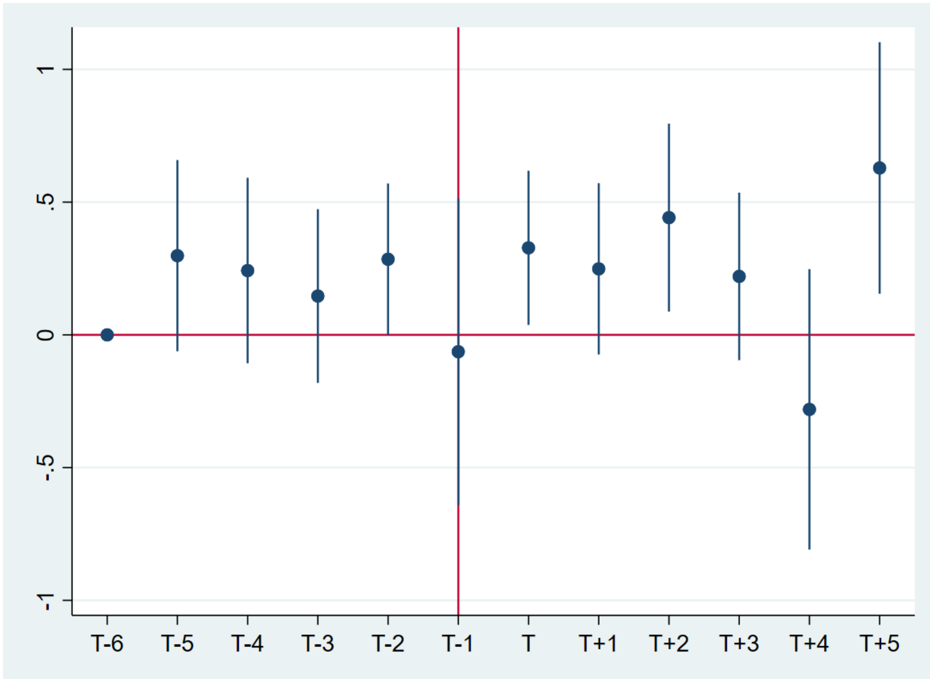


(a) Coefficient plot for the plan level termination/freeze

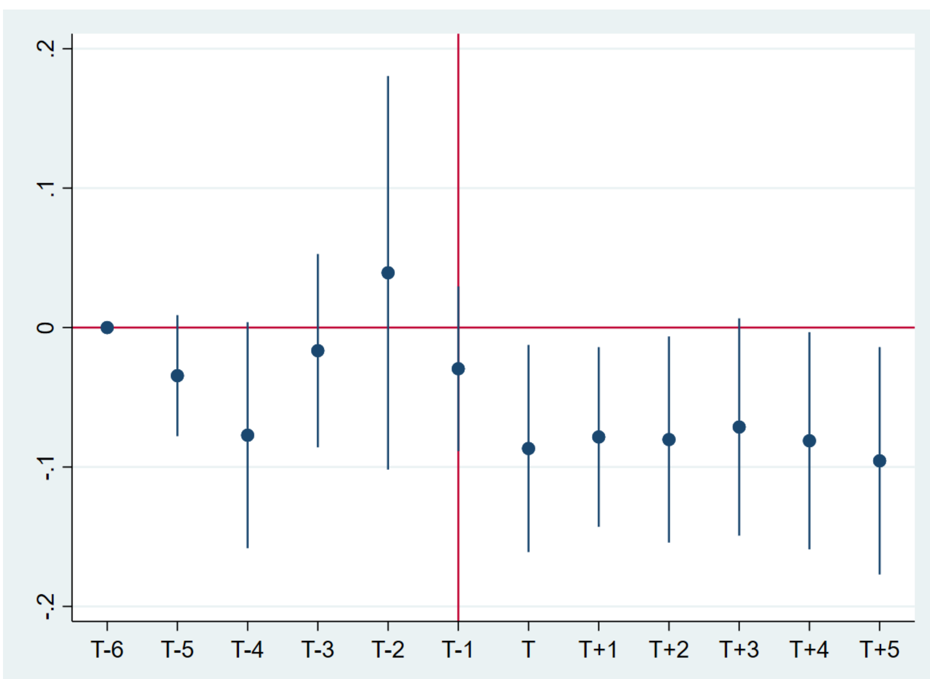


(b) Coefficient plot for the firm level termination/freeze

Figure 1: **Coefficient plot of termination/freeze analysis** Panel (a) shows the coefficient plot at the plan level. Panel (b) shows the coefficient plot at the firm level. The base year for both plots is year $T-1$, which is one year before the buyout



(a) Coefficient plot for the plan level discount rate



(b) Coefficient plot for the plan level PBO

Figure 2: **Coefficient plot of test on discount rate and PBO** Panel (a) shows the coefficient plot of test on discount rate at the plan level. Panel (b) shows the coefficient plot of PBO. The base year for both plots is the starting year of each cohort.

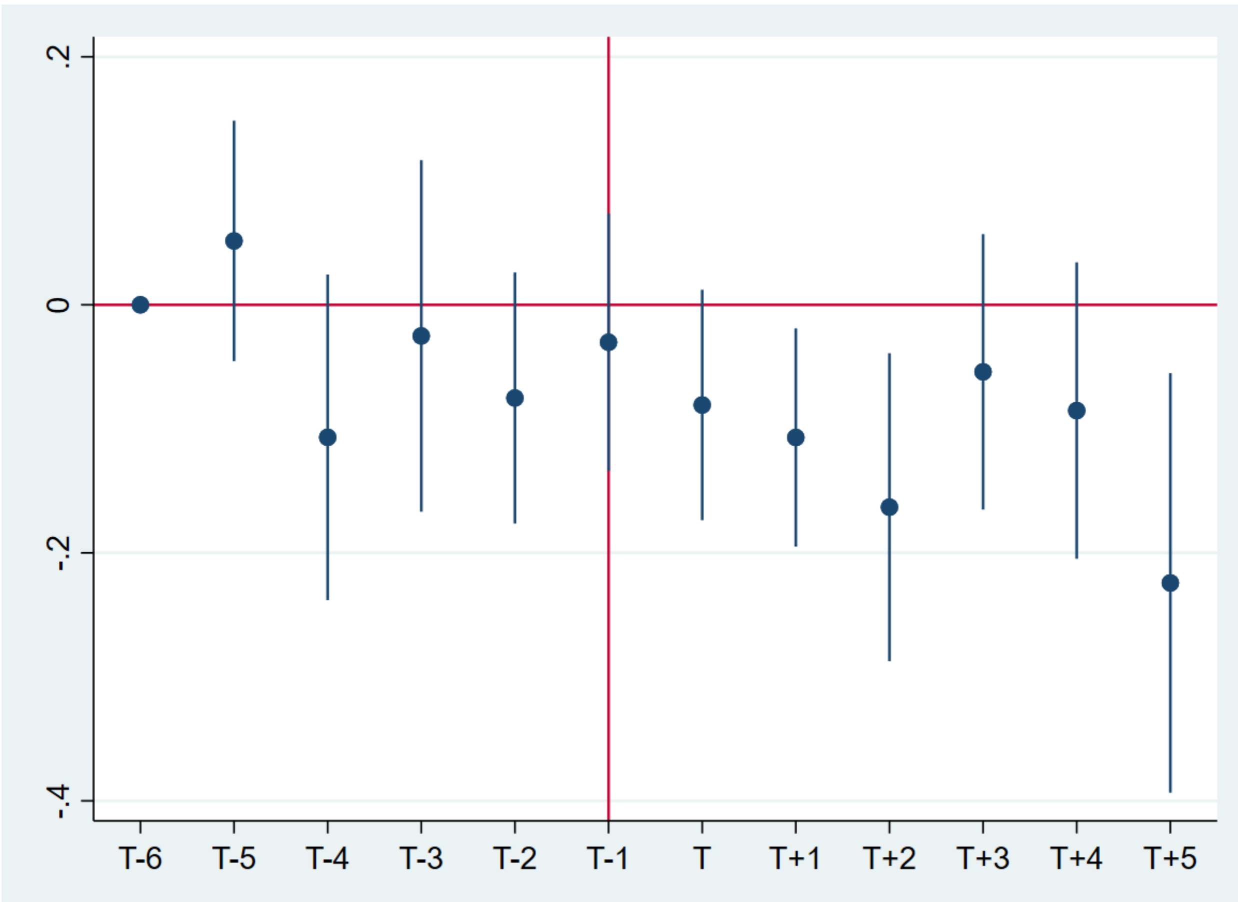


Figure 3: **Coefficient plot of test on contribution at the plan-level** This figure shows Coefficient plot of the test in Table 6. The independent variables of interests are the interaction of year dummies with the PE treat dummy. The base year is one year before the PE buyout.

References

Agrawal, A., and Y. Lim, 2022, "Where do shareholder gains in hedge fund activism come from? Evidence from employee pension plans," Journal of Financial and Quantitative Analysis, 57(6), 2140–2176.

Agrawal, A., and P. Tambe, 2016, "Private equity and workers' career paths: The role of technological change," The Review of Financial Studies, 29(9), 2455–2489.

Anantharaman, D., and Y. G. Lee, 2014, "Managerial risk taking incentives and corporate pension policy," Journal of Financial Economics, 111(2), 328–351.

Andonov, A., R. M. Bauer, and K. M. Cremers, 2017, "Pension fund asset allocation and liability discount rates," The Review of Financial Studies, 30(8), 2555–2595.

Antoni, M., E. Maug, and S. Obernberger, 2019, "Private equity and human capital risk," Journal of Financial Economics, 133(3), 634–657.

Bacon, N., M. Wright, R. Ball, and M. Meuleman, 2013, "Private equity, HRM, and employment," Academy of Management Perspectives, 27(1), 7–21.

Baker, A. C., D. F. Larcker, and C. C. Wang, 2022, "How much should we trust staggered difference-in-differences estimates?," Journal of Financial Economics, 144(2), 370–395.

Ballester, M., D. Fried, and J. Livnat, 2002, "Pension plan contributions, free cash flows and financial slack," Unpublished working paper, New York University.

Bartram, S. M., 2017, "Corporate postretirement benefit plans and real investment," Management Science, 63(2), 355–383.

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

Bergstresser, D., M. Desai, and J. Rauh, 2006, "Earnings manipulation, pension assumptions, and managerial investment decisions," The Quarterly Journal of Economics, 121(1), 157–195.

Bernstein, S., and A. Sheen, 2016, "The operational consequences of private equity buyouts: Evidence from the restaurant industry," The Review of Financial Studies, 29(9), 2387–2418.

Bloom, N., R. Sadun, and J. Van Reenen, 2015, "Do private equity owned firms have better management practices?," American Economic Review, 105(5), 442–446.

Callaway, B., and P. H. Sant'Anna, 2021, "Difference-in-differences with multiple time periods," Journal of Econometrics, 225(2), 200–230.

Chu, L., M. A. Goldstein, X. Li, and T. Yu, 2020, "Do Firms Set Pension Discount Rates Strategically?," https://papers.ssrn.com/sol3/Papers.cfm?abstract_id=3627965 (visited: 2022-12-21).

Cocco, J. F., and P. F. Volpin, 2005, "The corporate governance of defined benefit pension plans: Evidence from the United Kingdom," ECGI-Finance Working Paper, (76).

Cohn, J., N. Nestoriak, and M. Wardlaw, 2021, "Private equity buyouts and workplace safety," The Review of Financial Studies, 34(10), 4832–4875.

Davis, S. J., J. Haltiwanger, K. Handley, R. Jarmin, J. Lerner, and J. Miranda, 2014, "Private equity, jobs, and productivity," American Economic Review, 104(12), 3956–3990.

Davis, S. J., J. C. Haltiwanger, K. Handley, B. Lipsius, J. Lerner, and J. Miranda, 2019, "The (heterogenous) economic effects of private equity buyouts," working paper, National Bureau of Economic Research.

Davis, S. J., J. C. Haltiwanger, R. S. Jarmin, J. Lerner, and J. Miranda, 2011, "Private equity and employment," working paper, National Bureau of Economic Research.

Edgerton, J., 2012, "Agency problems in public firms: Evidence from corporate jets in leveraged buyouts," the Journal of Finance, 67(6), 2187–2213.

Fang, L. H., J. Goldman, and A. Roulet, 2022, "Private equity and pay gaps inside the firm," https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4306840 (visited: 2023-03-26).

Garcia-Gomez, P., E. G. Maug, and S. Obernberger, 2020, "Private equity buyouts and employee health," https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3601813 (visited: 2023-05-10).

Goodman-Bacon, A., 2021, "Difference-in-differences with variation in treatment timing," Journal of Econometrics, 225(2), 254–277.

Gornall, W., O. Gredil, S. T. Howell, X. Liu, and J. Sockin, 2021, "Do employees cheer for private equity? the heterogeneous effects of buyouts on job quality," https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3912230 (visited: 2023-03-21).

Hainmueller, J., 2012, "Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies," Political analysis, 20(1), 25–46.

Hainmueller, J., and Y. Xu, 2013, "Ebalance: A Stata package for entropy balancing," Journal of Statistical Software, 54(7).

Harper, J. T., and S. D. Treanor, 2014, "Pension conversion, termination, and wealth transfers," Journal of Risk and Insurance, 81(1), 177–198.

Harris, R. S., T. Jenkinson, and S. N. Kaplan, 2014, "Private equity performance: What do we know?," The Journal of Finance, 69(5), 1851–1882.

Jang, D., and Y. Wu, 2021, "Size and Investment Performance: Defined Benefit vs. Defined Contribution Pension Plans," https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3697711 (visited: 2023-03-21).

Kaplan, S., 1989, "The effects of management buyouts on operating performance and value," Journal of financial economics, 24(2), 217–254.

Kaplan, S. N., and J. C. Stein, 1993, "The evolution of buyout pricing and financial structure in the 1980s," The quarterly journal of economics, 108(2), 313–357.

Kisser, M., J. Kiff, and M. Soto, 2017, "Do managers of US defined benefit pension plan sponsors use regulatory freedom strategically?," Journal of Accounting Research, 55(5), 1213–1255.

Korteweg, A., and M. Sorensen, 2017, "Skill and luck in private equity performance," Journal of Financial Economics, 124(3), 535–562.

Lambert, M., N. Moreno, L. Phalippou, and A. Scivoletto, 2021, "Employee views of leveraged buy-out transactions," https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3926300 (visited: 2023-05-10).

Lerner, J., M. Sorensen, and P. Strömberg, 2011, "Private equity and long-run investment: The case of innovation," The Journal of Finance, 66(2), 445–477.

Munnell, A. H., J.-P. Aubry, C. V. Crawford, et al., 2015, "Investment returns: Defined benefit vs. defined contribution plans," Issue in Brief, (15-21).

Nikoskelainen, E., and M. Wright, 2007, "The impact of corporate governance mechanisms on value increase in leveraged buyouts," Journal of Corporate Finance, 13(4), 511–537.

Olsson, M., and J. Tåg, 2017, "Private equity, layoffs, and job polarization," Journal of Labor Economics, 35(3), 697–754.

Pedersen, D. J., 2019, "Risk shifting and corporate pension plans: Evidence from a natural experiment," Journal of Financial and Quantitative Analysis, 54(2), 907–923.

Phan, H. V., and S. P. Hegde, 2013, "Corporate governance and risk taking in pension plans: Evidence from defined benefit asset allocations," Journal of Financial and Quantitative Analysis, 48(3), 919–946.

Pontiff, J., A. Shleifer, and M. S. Weisbach, 1990, "Reversions of excess pension assets after takeovers," The RAND Journal of Economics, pp. 600–613.

Rauh, J. D., 2009, "Risk shifting versus risk management: Investment policy in corporate pension plans," The Review of Financial Studies, 22(7), 2687–2733.

Rauh, J. D., I. Stefanescu, and S. P. Zeldes, 2013, "Cost shifting and the freezing of corporate pension plans," .

Taylor, A., and C. Bryant, 2007, "Private equity buyouts and employee health," Financial Times, https://www.ft.com/content/757b1c6c-e096-11db-8b48-000b5df10621 (visited: 2023-05-10).

Treynor, J. L., 1977, “The principles of corporate pension finance,” The Journal of Finance, 32(2), 627–638.

Tykvová, T., and M. Borell, 2012, “Do private equity owners increase risk of financial distress and bankruptcy?,” Journal of Corporate Finance, 18(1), 138–150.

Zhao, Q., and D. Percival, 2016, “Entropy balancing is doubly robust,” .

Table A.1: Variable descriptions

Variable	Description
PEtreat	A dummy variable equal to 1 if the plan or firm is acquired by a PE firm within the time window
Matreat	A dummy variable equal to 1 if the plan or firm is acquired by a PE firm within the time window
Post	A dummy variable equal to 1 if the plan year is after the deal year
p(T/F)	Probability of a plan got terminated or frozen in the given year. *Source: Form 5500 line 8a.*
p(F)	Probability of a plan got frozen in the given year.
p(T)	Probability of a plan got terminated in the given year.
PBODis.Rate	Discount rate for computing the projected benefit obligation (PBO). *Source: Form 5500 Schedule SB line 5 and Form 5500 Schedule B line 6a.*
LogPartcp	Natural logarithm of the total number of participants. *Source: Form 5500 Schedule SB line 3d(1) and Form 5500 Schedule B line 2b(1)(4).*
LogMkt.PA	Natural logarithm of the market value of the pension assets. *Source: Form 5500 Schedule SB line 2a and Form 5500 Schedule B line 1b.*
LogPBO	Natural logarithm of the market value of the PBO. *Source: Form 5500 Schedule SB line 3d(3) and Form 5500 Schedule B line 2b(3)(4).*
PlanAge	The number of years since the plan inception. *Source: (1) plan year: Form 5500 Schedule SB line 1 and Form 5500 Schedule B line 1a; (2) starting year: Form 5500 line 1c.*
LogContri	Natural logarithm of the total contribution made by the employer. *Source: Form 5500 Schedule SB line 18b and Form 5500 Schedule B line 3b.*
LogTA	Natural logarithm of the book value of assets. *Source: S&P 500 CapitalIQ.*
LogSales	Natural logarithm of the revenue. Source: *S&P 500 CapitalIQ.*
FundingRatio	A ratio of market value of pension assets to PBO
ExpenseRatio	A ratio of total administrative expenses divided by the average of the total assets at the beginning and end of the year.
Contribution/PBO	A ratio of total total contribution made by employer divided by the PBO
SafeAssets	The fraction of plan assets investments in cash, government bonds, and funds held in insurance company general accounts. *Source: Form 5500 Schedule H line a, c(2) and c(14)*
Equity	The fraction of plan assets invested in preferred and common stocks, including sponsor's stocks. *Source: Form 5500 Schedule H line 1c(4) and 1d and Form 5500 Schedule I line 3d.*

Variable	Description
RiskyDebt	The fraction of plan assets invested in all corporate debt, loans, and loans to the participants. *Source: Form 5500 Schedule H line 1c(3), 1c(7) and 1c(8) and Form 5500 Schedule I line 1e and 1f.*
MutualFunds	The fraction of plan assets invested in mutual funds. *Source: Form 5500 Schedule H c(13).*
Trust	The fraction of plan assets invested in common/collective trusts, pooled separate accounts, master trust investment accounts, and 103-12 investment entities. *Source: Form 5500 Schedule H line c(9), c(10), c(11), and c(12)*
Emplr	The fraction of plan assets invested in employer's properties and securities. *Source:Form 5500 Schedule H 1d(1) and 1d(2)*
R1	Realized return defined as Equation 1
R2	Realized return defined as Equation 2

Table A.2: PE buyout effect on pension actuarial assumptions and characteristics at the plan level with various time window

This table repeats the tests on pension liability discount rate and characteristics with various time window. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. Panel A shows the results with five years before and after the buyout year, wile panel B provides the results with four years before and after the buyout year. Standard errors are clustered at firm level, and t-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A. Five years before and after the buyout year

	(1) Dis.Rate	(2) LogPBO	(3) LogNPartcp	(4) LogPA	(5) FundRatio	(6) LogContri
Post×PEtreat	0.156*	-0.074***	-0.076**	-0.093***	0.029	-0.153**
	(1.71)	(-2.60)	(-2.14)	(-2.62)	(1.02)	(-2.01)
$LogPA_{t-1}$	-0.066***					
	(-3.43)					
$LogNPartcp_{t-1}$	0.062***					
	(2.60)					
LogPlanAge	-0.006	0.016	-0.013	0.024	0.057	-0.123
	(-0.13)	(0.58)	(-0.23)	(0.71)	(1.53)	(-1.32)
$ExpRatio_{t-1}$	3.448	-9.153***	-6.180	-15.706***	-7.050***	15.288*
	(1.64)	(-2.99)	(-1.59)	(-5.02)	(-4.24)	(1.95)
$LogTA_{t-1}$	0.004	0.001	0.010	-0.001	-0.000	0.004
	(0.98)	(0.15)	(1.21)	(-0.22)	(-0.07)	(0.52)
$LogSales_{t-1}$	-0.008**	-0.000	-0.003	-0.002	-0.005*	0.003
	(-2.15)	(-0.06)	(-0.38)	(-0.55)	(-1.88)	(0.37)
Constant	5.071***	20.341***	10.354***	20.437***	0.993***	17.074***
	(12.94)	(183.48)	(50.41)	(150.23)	(7.66)	(45.64)
Observations	185621	192116	192297	192255	192109	156652
Within R^2	0.008	0.002	0.001	0.006	0.010	0.002
cohort×Plan FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Four years before and after the buyout year

	(1) Dis.Rate	(2) LogPBO	(3) LogNPartcp	(4) LogPA	(5) FundRatio	(6) LogContri
Post×PEtreat	0.182*	-0.076***	-0.068**	-0.090***	0.029	-0.125*
	(1.94)	(-2.61)	(-2.15)	(-2.59)	(1.08)	(-1.68)
LogPA_{t-1}	-0.073***					
	(-3.93)					
LogNPartcp_{t-1}	0.073***					
	(3.08)					
LogPlanAge	-0.017	0.019	0.010	0.026	0.052	-0.141
	(-0.36)	(0.75)	(0.19)	(0.81)	(1.43)	(-1.35)
ExpRatio_{t-1}	1.506	-7.434***	-3.527	-13.456***	-6.812***	15.719**
	(0.71)	(-2.73)	(-0.89)	(-4.79)	(-5.17)	(2.00)
LogTA_{t-1}	0.002	0.001	0.009	0.000	-0.001	0.002
	(0.42)	(0.27)	(0.99)	(0.03)	(-0.30)	(0.28)
LogSales_{t-1}	-0.008**	-0.001	-0.003	-0.002	-0.004*	0.001
	(-2.21)	(-0.16)	(-0.28)	(-0.58)	(-1.86)	(0.17)
Constant	5.163***	20.326***	10.264***	20.415***	1.006***	17.177***
	(12.84)	(201.88)	(50.24)	(157.07)	(7.86)	(40.94)
Observations	152145	157192	157345	157306	157186	127940
Within R^2	0.012	0.002	0.001	0.005	0.010	0.001
cohort×Plan FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A.3: PE buyout effect on pension actuarial assumptions and characteristics at the firm level with various time window

This table repeats the tests on pension liability discount rate and characteristics with various time window. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. Panel A shows the results with five years before and after the buyout year, wile panel B provides the results with four years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A. Five years before and after the buyout year

	(1) Dis.Rate	(2) LogPBO	(3) LogNPartcp	(4) LogPA	(5) FundRatio	(6) LogContri
Post×PEtreat	0.092**	-0.088**	-0.056*	-0.107**	0.026	-0.260**
	(2.04)	(-2.20)	(-1.88)	(-2.29)	(0.86)	(-2.01)
$LogNPartcp_{t-1}$	0.066*					
	(1.67)					
$ExpRatio_{t-1}$	5.136**	-9.246***	-6.358***	-13.574***	-5.703***	18.909**
	(2.01)	(-3.51)	(-5.14)	(-4.95)	(-4.09)	(2.23)
LogPlanAge	-0.009	0.043*	0.009	0.043	0.017	-0.064
	(-0.21)	(1.72)	(0.33)	(1.48)	(0.83)	(-0.35)
$LogPA_{t-1}$	-0.034					
	(-0.96)					
$LogTA_{t-1}$	0.012**	0.004	0.001	0.002	0.004	-0.010
	(2.34)	(0.60)	(0.61)	(0.31)	(1.17)	(-0.50)
$LogSales_{t-1}$	-0.008	-0.006	0.000	-0.004	-0.003	0.015
	(-1.48)	(-1.09)	(0.11)	(-0.72)	(-0.69)	(0.80)
Constant	4.426***	20.374***	9.713***	20.496***	1.083***	15.948***
	(8.45)	(204.72)	(96.84)	(176.40)	(14.10)	(24.21)
Observations	106342	140433	140433	140306	140433	102693
Within R^2	0.003	0.003	0.007	0.006	0.005	0.002
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Four years before and after the buyout year

	(1) Dis.Rate	(2) LogPBO	(3) LogNPartcp	(4) LogPA	(5) FundRatio	(6) LogContri
Post×PEtreat	0.110**	-0.084*	-0.038*	-0.106**	0.023	-0.235*
	(2.37)	(-1.77)	(-1.78)	(-2.00)	(0.76)	(-1.69)
$\text{LogNPartcp}_{\text{t-1}}$	0.058	0.272***	0.301***	0.238***	-0.040	0.938***
	(1.40)	(6.62)	(5.73)	(5.07)	(-1.08)	(5.97)
$\text{ExpRatio}_{\text{t-1}}$	4.721*	-9.291***	-6.198***	-13.087***	-5.261***	8.094
	(1.76)	(-3.38)	(-5.95)	(-4.51)	(-4.40)	(0.90)
LogPlanAge	-0.017	0.054**	0.032	0.052*	0.019	-0.078
	(-0.36)	(2.24)	(1.36)	(1.84)	(0.93)	(-0.39)
$\text{LogPA}_{\text{t-1}}$	-0.035	-0.086***	-0.026	-0.069**	0.011	-0.879***
	(-0.92)	(-5.28)	(-1.47)	(-2.16)	(0.52)	(-5.72)
$\text{LogTA}_{\text{t-1}}$	0.014**	0.003	-0.000	0.002	0.003	-0.008
	(2.56)	(0.49)	(-0.00)	(0.25)	(1.17)	(-0.37)
$\text{LogSales}_{\text{t-1}}$	-0.008	-0.006	0.001	-0.004	-0.003	0.014
	(-1.39)	(-0.97)	(0.48)	(-0.59)	(-0.71)	(0.70)
Constant	4.504***	19.443***	7.219***	19.563***	1.246***	24.977***
	(8.15)	(42.10)	(13.12)	(34.44)	(4.60)	(11.85)
Observations	86552	114415	114415	114305	114415	83568
Within R^2	0.003	0.026	0.165	0.022	0.007	0.015
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes

Table A.4: PE buyout effect on pension asset allocation at the plan level with various time window

This table repeats the tests on pension asset allocation with various time window. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. Panel A shows the results with five years before and after the buyout year, wile panel B provides the results with four years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A. Five years before and after the buyout year

	(1) SafeAssets	(2) RiskyDebt	(3) Equity	(4) MutualFunds	(5) Trust
Post×PEtreat	-0.023*	-0.015	0.031*	-0.054*	0.071
	(-1.74)	(-1.16)	(1.67)	(-1.95)	(1.39)
$LogNPartcp_{t-1}$	0.001	0.005	0.003	0.057***	-0.041**
	(0.22)	(0.81)	(0.63)	(3.26)	(-2.36)
$ExpRatio_{t-1}$	0.329	-2.308***	0.378	-3.047***	-1.489
	(0.51)	(-2.80)	(0.43)	(-3.08)	(-0.77)
$LogPA_{t-1}$	0.000	-0.004***	-0.002	0.002	0.005
	(0.41)	(-3.80)	(-1.22)	(1.16)	(1.25)
LogPlanAge	-0.006	-0.031*	-0.003	-0.022	0.061
	(-0.58)	(-1.91)	(-0.18)	(-1.40)	(1.59)
$LogTA_{t-1}$	0.001**	0.000	0.000	-0.004**	-0.003
	(1.99)	(0.01)	(0.24)	(-2.22)	(-0.91)
$LogSales_{t-1}$	-0.001	0.001	0.001	0.002	0.000
	(-1.19)	(1.21)	(0.65)	(1.31)	(0.02)
Constant	0.069	0.206**	0.139	-0.347**	0.679***
	(1.24)	(2.38)	(1.61)	(-2.05)	(2.88)
Observations	225125	225125	216862	151296	225323
Within R^2	0.001	0.012	0.001	0.005	0.005
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Panel B. Four years before and after the buyout year

	(1) SafeAssets	(2) RiskyDebt	(3) Equity	(4) MutualFunds	(5) Trust
Post×PEtreat	-0.017	-0.016	0.031*	-0.056*	0.064
	(-1.36)	(-1.33)	(1.65)	(-1.95)	(1.36)
$LogNPartcp_{t-1}$	0.001	0.005	0.002	0.056***	-0.037**
	(0.19)	(0.88)	(0.42)	(3.25)	(-2.21)
$ExpRatio_{t-1}$	0.354	-2.326***	0.359	-2.744***	-1.307
	(0.57)	(-2.91)	(0.41)	(-2.79)	(-0.70)
$LogPA_{t-1}$	0.000	-0.003***	-0.001	0.002	0.004
	(0.42)	(-3.83)	(-0.99)	(0.92)	(1.11)
LogPlanAge	-0.005	-0.034**	-0.004	-0.023	0.068*
	(-0.50)	(-2.07)	(-0.22)	(-1.50)	(1.73)
$LogTA_{t-1}$	0.001**	0.000	0.000	-0.004**	-0.003
	(2.01)	(0.04)	(0.09)	(-2.40)	(-0.91)
$LogSales_{t-1}$	-0.001	0.001	0.001	0.003*	0.000
	(-1.35)	(1.11)	(0.82)	(1.70)	(0.01)
Constant	0.068	0.203**	0.146*	-0.323*	0.640***
	(1.26)	(2.41)	(1.74)	(-1.93)	(2.78)
Observations	197151	197151	189765	132682	197305
Within R^2	0.001	0.012	0.001	0.005	0.005
Cohort×Plan FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table A.5: PE buyout effect on pension asset allocation at the firm level with various time window

This table repeats the tests on pension asset allocation with various time window. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. Panel A shows the results with five years before and after the buyout year, wile panel B provides the results with four years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A. Five years before and after the buyout year

	(1) SafeAssets	(2) RiskyDebt	(3) Equity	(4) MutualFunds	(5) Trust
Post×PeEtreat	-0.020	-0.002	0.035*	-0.047**	0.083
	(-1.37)	(-0.14)	(1.75)	(-1.99)	(1.35)
$LogNPartcp_{t-1}$	-0.006	0.010	0.018**	-0.013*	-0.033***
	(-1.06)	(1.52)	(2.36)	(-1.79)	(-2.67)
$ExpRatio_{t-1}$	0.499	-1.943	1.526	-0.694	-5.531**
	(0.64)	(-1.63)	(1.08)	(-0.70)	(-2.51)
$LogPA_{t-1}$	0.001	-0.003	-0.005**	0.004	0.007
	(0.49)	(-1.54)	(-2.15)	(1.47)	(1.06)
LogPlanAge	-0.002	0.011	0.005	0.017	-0.036
	(-0.17)	(0.92)	(0.41)	(0.92)	(-0.88)
$LogTA_{t-1}$	0.001	-0.002	-0.002	-0.004	-0.000
	(1.14)	(-1.62)	(-1.41)	(-1.16)	(-0.08)
$LogSales_{t-1}$	0.000	0.004*	0.003	0.003	-0.006
	(0.08)	(1.93)	(1.52)	(0.98)	(-0.89)
Constant	0.127	0.013	0.065	0.104	0.866***
	(1.59)	(0.15)	(0.73)	(1.17)	(3.97)
Observations	117711	117711	117711	97586	117711
Within R	0.002	0.008	0.005	0.002	0.011
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Panel B. Four years before and after the buyout year

	(1) SafeAssets	(2) RiskyDebt	(3) Equity	(4) MutualFunds	(5) Trust
Post×PEtreat	-0.016	-0.002	0.036*	-0.048*	0.069
	(-1.19)	(-0.22)	(1.72)	(-1.95)	(1.25)
$LogNPartcp_{t-1}$	-0.006	0.009	0.018**	-0.013*	-0.031***
	(-0.95)	(1.55)	(2.54)	(-1.89)	(-2.70)
$ExpRatio_{t-1}$	0.421	-1.829	1.647	-0.239	-5.707***
	(0.55)	(-1.59)	(1.22)	(-0.25)	(-2.67)
$LogPA_{t-1}$	0.001	-0.003	-0.004**	0.004	0.006
	(0.43)	(-1.45)	(-2.18)	(1.32)	(1.02)
LogPlanAge	-0.001	0.010	0.007	0.017	-0.040
	(-0.10)	(0.86)	(0.60)	(0.90)	(-0.92)
$LogTA_{t-1}$	0.001	-0.002	-0.003	-0.004	-0.001
	(1.21)	(-1.50)	(-1.50)	(-1.20)	(-0.10)
$LogSales_{t-1}$	-0.000	0.004*	0.003	0.003	-0.005
	(-0.05)	(1.80)	(1.49)	(1.01)	(-0.84)
Constant	0.123	0.014	0.048	0.122	0.881***
	(1.53)	(0.17)	(0.57)	(1.36)	(4.14)
Observations	104834	104834	104834	87104	104834
Within R^2	0.002	0.007	0.006	0.002	0.011
Cohort×Firm FE	Yes	Yes	Yes	Yes	Yes
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes

Table A.6: PE buyout effect on realized returns at the plan level with various time window

This table repeats the tests on realized returns at both plan and firm level with various time window. Variable definitions are provided in Table A.1. The time period is from 1999 to 2020. Panel A shows the results with five years before and after the buyout year, wile panel B provides the results with four years before and after the buyout year. Standard errors are clustered at firm level, and *t*-statistics are reported in parentheses. The regressions are weighted by the actuarial pension assets in the beginning year of each cohort. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

Panel A. Five years before and after the buyout year

	Plan level		Firm level	
	(1)	(2)	(3)	(4)
	R1	R2	R1	R2
Post×PEtreat	0.003	0.005	0.003	0.006
	(0.24)	(0.67)	(0.24)	(0.66)
LogNPartcp_{t-1}	-0.002	-0.002	-0.002	0.001
	(-0.44)	(-0.89)	(-0.62)	(0.24)
ExpRatio_{t-1}	0.687	0.635*	1.798**	1.644***
	(1.34)	(1.66)	(2.33)	(3.13)
LogPA_{t-1}	0.008	0.001	0.002	0.001
	(1.45)	(1.12)	(1.51)	(0.39)
LogPlanAge	0.006	0.002	0.012*	0.007
	(1.12)	(0.48)	(1.82)	(1.38)
Equity_{t-1}	-0.005	-0.000	-0.011	0.003
	(-0.32)	(-0.04)	(-1.50)	(0.78)
Trust_{t-1}	0.000	0.005	-0.008	0.003
	(0.00)	(0.73)	(-1.27)	(0.56)
SafeAssets_{t-1}	-0.000	-0.005	0.041**	0.007
	(-0.02)	(-0.25)	(2.39)	(0.68)
RiskyDebt_{t-1}	0.009	0.003	-0.004	-0.029**
	(0.53)	(0.25)	(-0.18)	(-2.33)
MutualFunds_{t-1}	-0.014	-0.005	-0.003	0.002
	(-1.60)	(-0.80)	(-0.40)	(0.39)
LogTA_{t-1}	-0.000	0.000	0.001	0.001
	(-0.13)	(0.42)	(0.79)	(1.38)
LogSales_{t-1}	-0.000	-0.000	-0.001	-0.001
	(-0.57)	(-0.54)	(-0.68)	(-1.02)
Constant	-0.100	0.050	0.017	0.020
	(-1.14)	(1.59)	(0.34)	(0.49)
Observations	282702	282530	117649	117649
Within R^2	0.003	0.001	0.011	0.015
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Cohort×Plan FE	Yes	Yes	No	No
Cohort×Firm FE	No	No	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Panel B. Four years before and after the buyout year

	Plan level		Firm level	
	(1)	(2)	(3)	(4)
	R1	R2	R1	R2
Post×PEtreat	0.001	0.003	0.004	0.006
	(0.10)	(0.40)	(0.28)	(0.65)
$LogNPartcp_{t-1}$	-0.001	-0.002	-0.002	0.002
	(-0.37)	(-0.97)	(-0.50)	(0.41)
$ExpRatio_{t-1}$	0.737	0.678*	1.904**	1.768***
	(1.38)	(1.68)	(2.40)	(3.26)
$LogPA_{t-1}$	0.008	0.001	0.002	0.000
	(1.40)	(0.77)	(1.42)	(0.25)
LogPlanAge	0.006	0.002	0.013*	0.008
	(0.98)	(0.37)	(1.88)	(1.44)
$Equity_{t-1}$	-0.007	-0.002	-0.012	0.003
	(-0.43)	(-0.20)	(-1.56)	(0.65)
$Trust_{t-1}$	0.000	0.004	-0.009	0.001
	(0.01)	(0.61)	(-1.38)	(0.17)
$SafeAssets_{t-1}$	0.003	-0.000	0.042**	0.008
	(0.13)	(-0.01)	(2.46)	(0.76)
$RiskyDebt_{t-1}$	0.012	0.004	-0.005	-0.030**
	(0.64)	(0.32)	(-0.24)	(-2.28)
$MutualFunds_{t-1}$	-0.014	-0.005	-0.003	0.001
	(-1.59)	(-0.82)	(-0.40)	(0.19)
$LogTA_{t-1}$	-0.000	0.000	0.001	0.001
	(-0.07)	(0.37)	(1.05)	(1.40)
$LogSales_{t-1}$	-0.000	-0.000	-0.001	-0.001
	(-0.51)	(-0.36)	(-0.57)	(-0.97)
Constant	-0.099	0.056*	0.005	0.012
	(-1.10)	(1.81)	(0.11)	(0.29)
Observations	250840	250682	104779	104779
Within R^2	0.003	0.001	0.012	0.015
Cohort×Ind×Year FE	Yes	Yes	Yes	Yes
Cohort×Plan FE	Yes	Yes	No	No
Cohort×Firm FE	No	No	Yes	Yes
Controls	Yes	Yes	Yes	Yes