The Dark Side of Hedge Fund Activism: Evidence from Employee Pension Plans

Anup Agrawal and Yuree Lim*

Current Draft: September 2017

Comments welcome

*Agrawal: University of Alabama, Culverhouse College of Commerce, Tuscaloosa, AL 35487-0224, aagrawal@cba.ua.edu, (205) 348-8970; Lim: University of Wisconsin-La Crosse, College of Business Administration, La Crosse, WI 54601, ylim@uwlax.edu, (608) 785-6679. We thank Ilona Babenko, Jonathan Berk, Philip Bond, Ben Branch, David Cicero, Doug Cook, Simon Gervais, Jack He, Joon Ho Kim, Andrew Koch, Luigi Pistaferri, Sugata Ray, Brian Song, and participants at the 2017 Stanford SITE Workshop on Labor and Finance, NFA-Halifax and AsianFA-Seoul meetings for useful comments. Special thanks are due to Alon Brav and Joshua Rauh for detailed comments and helpful suggestions. Agrawal acknowledges financial support from the William A. Powell, Jr. Chair in Finance and Banking, and Lim acknowledges a summer research grant from the University of Wisconsin – La Crosse.

The Dark Side of Hedge Fund Activism: Evidence from Employee Pension Plans

Abstract

We find that defined benefit employee pension plans of target firms experience greater underfunding after hedge fund activism. Targets reduce employer contributions, which they justify by increasing the assumed rates of return on plan investments. Despite tilting plan investment toward riskier assets, performance suffers. Moreover, the stock price reaction to activism announcement predicts future increases in pension underfunding. Our identification strategy uses a difference-in-differences method using matched non-targets, firm fixed effects, and tests of underlying mechanisms and alternative hypotheses. Shareholder gains from activism appear to partly come from raiding deferred compensation promised to workers, and from taxpayers via PBGC guarantees.

Keywords: wealth transfers, hedge fund activism, agency costs, corporate pensions
JEL: G34, G23, G30

The Dark Side of Hedge Fund Activism: Evidence from Employee Pension Plans

1. Introduction

This paper deals with two broad questions. First, does hedge fund (HF) activism enhance firm value? While prior studies find that stockholders of target firms earn positive returns, on average, upon announcement of HF activism, other stakeholders in these firms often experience adverse outcomes. Understanding the economic effects of HF activism is important because it is an important external governance mechanism (see, e.g., Brav, Jiang and Kim (2009, 2015b)). This topic is also of interest to policy makers because shareholder activism is highly regulated. Second, what are the factors that affect the financial stability of employee pension plans? This question is important for workers because underfunded pension plans put their promised pension benefits at risk. In addition, underfunded plans put a potential burden on taxpayers via the guarantees provided by the Pension Benefit Guarantee Corporation (PBGC) when the sponsoring employer defaults, and on workers whose promised pensions exceed the meager PBGC insurance limits (Cocco, 2014). This paper sheds light on both these questions by examining how employee pensions fare when firms become targets of HF activists.

Shareholder activism is an investment strategy whereby investors such as HFs attempt to use their shareholder rights to intervene in the management of a targeted firm to increase the value of their investment. Activists can nudge or push management to take shareholder-friendly actions such as increase dividends or share buybacks, do spinoffs, or be acquired. Prior studies find that HF activism is quite successful in increasing shareholder wealth of targeted firms (see

Brav, Jiang and Kim, 2009, 2015b for excellent reviews of this literature). However, there are two opposing views about the sources of these shareholder wealth gains. In the first view, activism increases the value of the target firm by enhancing firm productivity or promoting its takeover (see, e.g., Brav, Jiang and Kim, 2015a; Jiang, Li and Mei, 2016; and Boyson, Gantchev and Shivdasani, 2017). The second view is that shareholder gains from activism are due to wealth transfers from other stakeholders such as bondholders or employees (see, e.g., Klein and Zur, 2011; Coffee and Palia, 2016; and Brav, Jiang and Kim, 2015a). The two sources of shareholder gains have radically different implications about the value of activism for target firms and the broader society. If these gains arise, e.g., from operational efficiencies or facilitating a higher-valued takeover, HF activism is good for firm value and the overall society. On the other hand, if shareholder gains are merely the result of wealth transfers from other stakeholders, the value of such activism is less clear.

The purpose of this study is to uncover the role of HF activism on the welfare of a key stakeholder in the firm, namely employees. Brav, Jiang and Kim (2015a) find that HF activism decreases productivity-adjusted wages for workers. Except for this study, empirical evidence on the effect of activism on employees is quite limited.[1] More importantly, to our knowledge, no prior study has analyzed the effect of HF activism on employee pensions. This paper aims to fill this gap in the literature by examining the effect of HF activism on the welfare of employees, by focusing on employee pensions. Specifically, we study whether HF activism helps or hurts employee wealth as represented by the health of their defined benefit (DB) pension plans.

[1] Relatedly, Popadak (2014) finds that greater shareholder governance decreases employee cooperation and integrity due to a greater focus on results.

Anecdotal evidence suggests that HF activism hurts employee welfare. A story in the *New York Times* offers a vivid example of this phenomenon.[2] In 2012, Relational Investors, an activist fund, identified Timken Corporation, a steel and bearings maker in Ohio as a target of activism. In the summer and Fall of 2012, Relational started buying Timken stock. In November 2012, Relational publicly disclosed a 6% equity stake in Timken and launched an activist campaign against it. By September 2013, Timken was forced to replace its family CEO. In an investor presentation in November 2014, Timken reported that under the new CEO, the firm had almost eliminated its employee pension contributions (dropping from a third of cash flow to near zero), and planned a large buyback of shares by the end of 2016. *Wall Street Journal* quotes this example[3] in pointing out, "if we continue down this road, we won't have the long-term investments in workers and innovation that we need to sustain a higher rate of growth."

Consistent with this example, we find that employees of target firms that sponsor DB pension plans suffer from greater plan underfunding after HF activism. This finding is consistent with the view that HF activists expropriate wealth from employees. We then examine the mechanisms that lead to the underfunding of pension plans. We find that targeted firms reduce employer contributions to the pension fund, which they justify by increasing the assumed rates of returns on plan investments. They also tilt plan investments toward riskier assets, in a failed effort to boost plan returns.

---

[2] See Nelson D. Schwartz, How Wall Street bent steel: Timken bows to activist investors and splits in two, *New York Times*, December 6, 2014.

[3] William A. Galston, 'Shareholder Value' Is Hurting Workers: Financiers fixated on the short-term are forcing CEOs into decisions that are bad for the country. *Wall Street Journal*, December 9, 2014.

There are two potential interpretations of our findings. First, HF activists put pressure on managers to increase shareholder wealth and managers respond by raiding employee pension funds. Second, observable and unobservable characteristics of these firms that lead activist HFs to target them also lead the firms to underfund employee pensions. We address this identification concern in three ways. First, we match each target firm with a control firm, identified using a coarsened exact matching (CEM) procedure (described in section 6), which controls for observable firm characteristics. We then use a difference-in-differences (DiD) approach and draw inferences based on contemporaneous changes in treatment vs. control firms in years before vs. after HF activism. Moreover, within this framework, we use firm fixed effects regressions, which remove the effects of time-invariant firm characteristics, whether observable or not. Second, the stock price reaction to activism announcement predicts future increases in pension underfunding, which provides a direct test of the wealth transfer hypothesis. Finally, we conduct tests of several alternative hypotheses suggested by Brav, Jiang and Kim (2015a) to disentangle the effect of HF activism from mere stock picking. These tests confirm that our results are not driven by alternative hypotheses such as voluntary reforms by management, activists' stock-picking skills, mean-reversion, financial distress, or attrition bias.

We refer to the increase in underfunding of employee pension plans following HF activism as wealth transfers from employees for three reasons. First, these plans were already substantially underfunded, on average by 28% in the year before targeting (see Table 2). Under 9% of the firm-years in our sample have overfunded plans and dropping them does not change our main results. Second, while PBGC insures the plans in case the firm goes bankrupt, PBGC's coverage limits are modest, up to an annual pension of about $60,000 for a 65- year old retiree for a plan terminated in 2016. Finally, PBGC's own financial health is in question. GAO has

designated PBGC's single-employer program as 'high risk' since July 2003 and added this designation to multi-employer plans since January 2009 (see GAO (2017)). These facts do not support the idea that HF activism forces managers to eliminate overfunding of pension funds of 'fat cat' employees. Our finding of an increase in underfunding of employee pension plans following HF activism supports the Shleifer and Summers (1988) notion of a breach of trust with employees.

Our study contributes to several strands of the literature. First, we provide empirical evidence on a source of shareholder gains from HF activism. Prior studies on HF activism find mixed evidence of wealth transfers from debtholders (see, e.g., Brav, Jiang, Partnoy and Thomas, 2008; Uchida and Xu, 2008; Aslan and Maraachilian, 2009; Huang, 2009; Jiang, Li and Wang, 2009; Brav, Jiang and Kim, 2009, Klein and Zur, 2011; Sunder, Sunder and Wongsunwai, 2015; and Feng, Xu and Zhu, 2016) and some evidence of wealth transfers from employees (see Brav, Jiang and Kim, 2015). Our paper complements this literature by showing that employee pensions suffer in HF activism events. Moreover, our finding that the stock price reaction to activism announcement predicts future increases in pension underfunding suggests a wealth transfer from employee pension funds to shareholders. Second, our study contributes to the literature that finds that as firms approach financial distress, they increase investment risk in employee pension plans (see, e.g., Bergstresser. Desai and Rauh, 2006; Cocco and Volpin, 2007; Phan and Hegde, 2013; Anantharaman and Lee, 2014; and Duan, Hotchkiss and Jiao, 2015). Third, and more broadly, we contribute to the literature on shareholder activism as well as the governance role of shareholders (see, e.g., the review articles by Gillan and Starks, 2007; Edmans and Holderness (2016); and Denes, Karpoff and McWilliams, 2017).

The paper proceeds as follows. Section 2 discusses the related literature. Section 3 details the data and sample. Section 4 presents our baseline results. Section 5 examines the underlying mechanisms. Section 6 presents identification tests and section 7 concludes.

2. Prior Literature and Main Hypothesis

This paper examines whether HF activism hurts the health of employee DB pension plans, which represent employees' post-retirement wealth. We measure pension plan health using funding levels. What is underfunding of DB plans and why does it matter? A DB pension plan is a deferred compensation arrangement, whereby an employer commits to making future benefit payments to employees for services they have provided during their employment with the firm (see, e.g., Kieso, Weygandt and Warfield, 2010). Plan liabilities are the pension promises that the firm has made to its employees, and plan assets fund these liabilities. Underfunding implies that a plan's liabilities exceed its assets, i.e., pension fund assets may be insufficient to keep its promises (see, e.g., Cocco, 2014). Thus, underfunding of a DB plan can hurt employee welfare after retirement.[4] Although most DB pension plans are insured by the PBGC under the Employee Retirement Income Security Act of 1974 (ERISA), underfunding creates problems for employees and for the society. This is because the PBGC guarantees benefits in private DB plans only up to a modest limit; this limit can change; not all pension plans are insured by PBGC; and any losses incurred by PBGC are ultimately borne by taxpayers. Moreover, the PBGC is itself

[4] See John Wasik, Is your pension plan underfunded? *Forbes*, September 3, 2014; and Floyd Norris, Private pension plans, even at big companies, may be underfunded, *New York Times* July 21, 2012.

severely underfunded, with a net worth of negative $62 billion as of the end of September 2014, so its guarantee is hardly solid.[5]

More specifically, pension plan funding is defined as follows:

$$Funding = Fair\ value\ (plan\ assets) - Present\ value\ (plan\ obligations) \quad (1)$$

The present value of plan obligations is the discounted value of expected future payments to retirees. To estimate plan obligations, the employer makes assumptions about employees' life expectancy, turnover, retirement date, and future salary levels. The fair value of plan assets is defined as follows:

$$Fair\ value\ (plan\ assets) = Contibutions\ \left(Minimum + \widetilde{discretionary}\right) + \widetilde{Return\ on\ plan\ assets} \quad (2)$$

The level of regulatory minimum contributions for a year is based on a complex formula that is a function of the plan's normal cost (i.e., additional pension obligations accrued from one additional year's service by employees) plus its deficit reduction contribution (Rauh, 2006). The employer can choose to contribute more than the statutory minimum, which accounts for the discretionary portion of contributions. Variations in discretionary employer contributions and returns on plan assets, determined by market conditions, can cause underfunding in a DB pension plan. If a plan is underfunded, pension legislation requires employers to make additional contributions to resolve the problem.

Does HF activism cause underfunding in DB pension plans for employees in target firms? Prior studies suggest that HF activism can transfer wealth from employees to

[5] See Alex J. Pollock, A Federal guarantee is sure to go broke, *Wall Street Journal*, November 30, 2014).

shareholders. Brav, Jiang and Kim (2015) find that the workers of target firms do not benefit from HF activism. Although labor productivity improves after HF activists target a firm, employees experience a reduction in work hours, and their wages do not keep pace with improved productivity. Using shareholder proposals on governance, Popadak (2015) finds that shareholders realize financial gains such as increases in sales, profitability, and payouts, while target firms suffer from deterioration in customer satisfaction and employee integrity. Coffee and Palia (2016) suggest that wealth transfers from target firms' employees to their shareholders could come from reductions in employees' promised pension payouts. Thus, our main testable hypothesis is that employees of target firms are more likely to experience underfunding of their DB pension plans.

Why can HF activism cause underfunding? First, the seminal theoretical work of Sharpe (1976) and Sharpe and Treynor (1977) shows that it is value-maximizing for stockholders to increase pension risk through underfunding and risky asset allocations, using the option pricing model. Firms can transfer their pension liabilities to the PBGC in return for pension fund assets plus 30% of the market value of the firm's net worth. Thus, PBGC insurance serves as a put option where pension liabilities are the underlying asset, while pension fund assets plus 30% of the firm's net worth is the exercise price. So if the exercise price is less than the pension liability, the firm has an incentive to exercise the put option.

Second, activists can cause underfunding by demanding more cash payouts from the firm. Bean and Bernardi (2000) find a significant positive correlation between the increase in pension liabilities and dividend payments. They argue that the underfunding of pension funds is a unilateral decision by management that effectively transfers risk from stockholders to employees and the society.

Third, HF activism can hurt employee pension health by increasing takeover pressure. Stein (1988) shows that takeover pressure leads managers to sacrifice the firm's long-term interests to boost current profits. Shleifer and Summers (1988) argue that hostile takeovers enable shareholders to transfer wealth from workers to themselves. Cocco and Volpin (2013) find that DB pensions act as takeover deterrents. Pontiff, Shleifer and Weisbach (1990) and Rosett (1990) find that pension plan terminations rise after hostile rather than friendly takeovers, suggesting that wealth transfers from employees are a source of shareholder gains in hostile takeovers. They also find that reversions following takeovers occur primarily in DB plans, where the potential for wealth transfers is the greatest (see also Harper and Treanor, 2014).

How can HF activism cause underfunding of employee pension plans? Under pressure from shareholder activists, managers can raid employee pension wealth in at least three ways. First, they can underfund pension plans by reducing employer contributions to the plans, effectively reneging on the firm's promises to employees (Anantharaman and Lee, 2014). Second, managers can increase the assumed rates of return on plan assets to justify making lower employer contributions. Third, they can freeze or terminate pension plans. Petersen (1992) examines a firm's decision to terminate their overfunded DB pension plans and finds that firms terminate their pension plans to relieve themselves of future benefits promised to workers. Similarly, firms can freeze underfunded DB plans to stop accumulating future benefit obligations (see Cocco (2014)).

3. Data and Methodology

3.1. Institutional background

3.1.1. Corporate pension plans

A pension plan can be either a DB plan or a defined contribution (DC) plan. A DB plan promises a specified monthly benefit at retirement.[6] The plan may state this promised benefit as an exact dollar amount, such as $1,000 per month after retirement. More commonly, it promises a benefit through a plan formula that considers such factors as salary and service (e.g., 2 percent of the average annual salary during the last 3 years of employment for every year of service with the employer).

A DC plan does not promise a specific amount of benefit at retirement. In these plans, the employee, the employer or both contribute to the employee's individual account under the plan, sometimes at a set rate, such as 5 percent of earnings annually. These contributions generally are invested on the employee's behalf. Employees ultimately receive the balance in their accounts, which equal contributions plus investment gains or losses. The value of the account fluctuates with changes in the value of the investments and contributions. Examples of defined contribution plans include 401(k) plans, 403(b) plans, employee stock ownership plans (ESOP), and profit-sharing plans.

[6] Detailed definitions of DB and DC plans are available at the DOL website: http://www.dol.gov/dol/topic/retirement/typesofplans.htm.

3.1.2. HF activism

When a person or group of shareholders acquires beneficial ownership of more than 5% of a voting class of a company's securities, they are required to file a Schedule 13D with the SEC in accordance with the Securities and Exchange Act of 1934. The initial 13D must be filed within 10 days of the shareholders taking their stake. In general shareholders who acquire greater than a 5% stake and intend to change or influence the control of the target must file a 13D, while those who do not intend to engage in any activism file a 13G instead. A beneficial owner having filed an initial 13D is required to file an amended 13D/A promptly if any material change occurs in the contents disclosed in the initial 13D. The purpose of the transactions is reported in item 4 of the 13D filing. A 13D filing can indicate multiple purposes.

3.2. Sample selection

3.2.1. Pension data

Our first pension dataset comes from Compustat Pension annual data files from 1998 to 2014. For tests of underfunding, our sample starts in 1998 because the Statement of Financial Accounting Standards (SFAS) 132 requires disclosure of actual returns starting that year.

Our second dataset on corporate pension plans is from the IRS Form 5500 Private Pension Plan Research Files, available from the Department of Labor (DOL). Under ERISA and the Internal Revenue Code, most private-sector employer sponsored employee benefit plans are required to provide annual reports on the plan's financial condition, investments, and operations with the DOL, Internal Revenue Service (IRS), and the PBGC. Form 5500 contains pension asset and liability values, and must be filed annually by pension plan sponsors for plans with greater than 100 participants.

3.2.2. HF activism data

HF activism data come from the Audit Analytics Shareholder Activism database. Recent research on shareholder activism focuses on HF activism and uses limited, proprietary data. Our data is from a comprehensive database of all initial and amended Schedule 13D filings by all types of investors from 2001 to 2014. We focus on large outside shareholders who are not affiliated with the target. To identify the type of shareholder activist, we use Form D filings, Bloomberg Terminal, Internet sources, and news searches. Pooled investment funds, such as hedge funds, have to file a Form D with the SEC within 15 days of an exempt offering of securities. Item 4 of the Form D filing contains a box that identifies the fund as either a hedge fund, private equity, venture capital, or other investment fund. But the availability of Form D filings in the SEC Edgar database is very limited before 2009. When a Form D is unavailable or fund classification cannot be determined from it, Bloomberg is another reliable source of data on the type of the investment fund. Bloomberg does not suffer from a self-reporting bias because most institutional investors such as HFs are customers of Bloomberg and maintain business relationships with it (see, e.g., Bae, Baik and Kim, 2011). After deleting targets whose corporate pension plan data is not available on Compustat Pension annual data files, our final sample consists of 594 HF activism events.

3.2.3. Other data

Financial accounting and stock return information come from Compustat annual files and CRSP daily files, respectively. Data on other firm characteristics are from Thomson Financial, IBES, and RiskMetrics.

Table 1 reports the annual number of HF activism events and the industry distribution of target firms. The number of activism events was at a minimum of 13 in 2002 and reached a maximum of 80 in 2008 over our sample period. Business equipment manufacturers and financial firms are the most frequent targets of HF activism.

3.3. Matching

To address potential selection bias and control for firm heterogeneity, we match our sample of firms targeted by HF activists (henceforth, target firms) with a control sample constructed using the coarsened exact matching (CEM) method (Iacus, King and Porro, 2011; Duygan-Bump, et al., 2013).[7] We match each target firm in year t with a non-target firm from the same year. Sampling is with replacement to ensure better matches, so there are fewer control firms than target firms. Matching is based on lag 1 of the following variables: 4-digit SIC industry-adjusted Tobin's Q, leverage, ROA, an indicator of negative ROA, log of market value, log of total assets; and lag 3 of industry-adjusted Tobin's Q.

We report summary statistics comparing the characteristics of the target firms with control firms one year prior to the year of targeting. Panel A of Table 2 presents the mean value for each group, t-statistics for differences between them, followed by median values and the p-

[7] The CEM method creates a grid from the coarsened support of each variable in observable characteristics of firms, and then exactly matches target firms with non-target firms in the same cells. Iacus, King and Porro (2011) show that the CEM method has several advantages over common matching methods such as propensity score matching (PSM). CEM reduces the imbalance between comparison groups, is independent from the assumption of functional form of the matching system (e.g., the logit score in PSM), avoids extreme counterfactual comparisons for targets without close matches, and considers higher moments of the distribution of observable variables to match treatment and control firms.

value of the Wilcoxon test for differences between the two distributions for variables used in subsequent regressions. The two samples are generally quite similar in terms of firm and plan characteristics.

Panel B presents tests of the parallel trends assumption. Given our later finding in Table 3 that underfunding of pension plans in target firms increases over the five years following the year of HF activism, we want to make sure that the growth rate of underfunding before activism was not higher in target firms than in control firms. There is no evidence of higher growth rates for target firms relative to control firms based on either mean or median values of the one-year or two-year growth rates in *Underfund* as of year -1.

3.4. Methodology

To test the underfunding hypothesis, we examine the relation between HF activism and corporate pension funding status. The pension sample consists of firm-year level observations from 1998 to 2014, where firms are limited to HF targets and their matched firms over 2001-2014. Following Brav, Jiang, Ma and Tian (2016), our main regression adopts the difference-in-differences (DiD) approach:

$$y_{i,t} = \alpha_0 + \alpha_1 Post_{i,t} + \alpha_2 Target_i \times Post_{i,t} + \underline{\alpha_3} Control_{i,t} + \underline{\alpha_4} Year_t + \underline{\alpha_5} Firm_i + \varepsilon_{i,t} \quad (3)$$

where the dependent variable $Y_{i,t}$ is *Underfund* of firm i at time t. *Target*$_i$ equals one if firm i is a target of activism over the sample period; it equals zero otherwise. *Post*$_{it}$ equals one if the firm-year (i,t) observation falls within [$t+1$, $t+5$] years of an activism event or a pseudo-event; it equals zero otherwise. $Control$ is a vector of firm i's controls. Appendix A defines all the variables. We also include year and firm fixed effects to eliminate macroeconomic and firm-

specific effects. The regressions do not control for $Target_i$ because its effect is subsumed in the firm fixed effect. We report t-statistics based on standard errors clustered at the firm level or firm and year level.

3.5. Dependent variables

We test our main hypothesis with *Underfund* as the dependent variable. These analyses are at the firm-year level. We define *Underfund* as pension liabilities minus fair value of pension assets, all divided by pension liabilities. So a high *Underfund* indicates a poorly funded pension plan (Anantharaman and Lee, 2014). We also examine asset allocation, asset returns, and employer contribution measures. Specifically, *%Equity* is pension asset allocation in equity. *Return* is actual return on plan assets. *Contribution* measures employer contributions. We supplement Compustat Pension data with the IRS research file. IRS datasets contain information on pension participants and the freezing (termination) status of a plan. Using the IRS data, we measure employer contribution per participant and a frozen (terminated) indicator that equals one for a firm that freezes (terminates) its DB plans.

3.6. Key independent variables

We test our main hypothesis using a difference-in-differences framework as in equation (3). Our main interest is in coefficient α_2, which compares the change in the level of underfunding in target firms post-activism to that in matched firms.

3.7. Control variables

We control for various plan characteristics such as plan size, the chosen discount rate, and pension duration, and tax rate as these may affect plan funding status (see, e.g., Rauh, 2009; Amir and Gordon, 1996; Asthana, 1999; Sundaresan and Zapatero, 1997). Specifically, high marginal tax rate indicates strong incentives to fund pension plans and invest in highly taxed assets (Black, 1980; Thomas, 1988; Frank, 2002). We control for the chosen discount rate as distressed firms manipulate the assumed discount rate to reduce pension liabilities (Amir and Gordon, 1996; Asthana, 1999). We also control for pension duration as younger participants may prefer more asset allocation in risky assets (Sundaresan and Zapatero, 1997; Rauh, 2009).

We also control for firm characteristics that can affect funding status and the probability of being targeted by HF activists. Specifically, we control for firm size, book-to-market ratio as a proxy for investment opportunities, sales growth, leverage, profitability, firm value, and firm age. Finally, we control for cash flow from operations and its standard deviation because underfunded firms are more likely to be cash-constrained (see, e.g., Coronado and Liang, 2005).

4. Baseline Results

Table 3 reports our regression results on the level of pension underfunding. They support our main hypothesis that employees of target firms experience underfunding of DB pension plans over the five years after activism events. The standard errors are not clustered in column (1); in columns (2) and (3), they are clustered at the firm level, and firm and year level, respectively. The coefficient of $Target_i$ x $Post_{it}$ is positive and statistically significant in all three columns. This result indicates that pension plans of firms targeted by HF activists experience an

increase in underfunding relative to their normal levels, compared to increases experienced by otherwise similar control firms. The last three rows of the table show that the marginal effect of the DiD term Target*Post is 0.014, which implies that relative to control firms, DB pension plans of target firms experience a greater increase in underfunding of 1.4% of projected benefit obligations per year over the years [t+1, t+5], where t is the year of targeting.[8] This represents a non-trivial increase of about 5.5% relative to the mean underfunding level of 26.5%. This finding suggests that shareholder activism results in an increased risk for employee pensions.

5. Underlying Mechanisms

Having shown deterioration in employee pension funding following HF activism, we next try to identify the mechanisms underlying this effect. How does a pension plan of a target company become underfunded? One possible explanation is that funding levels go down over time because sponsors' contributions to the plans do not keep up with additional benefit accruals year-after-year. This hypothesis is consistent with the opening example of Timken Corporation. To test whether underfunding results from reduced employer contributions, we re-estimate the DiD regressions in Table 3 after replacing the dependent variable with three measures of employer contributions to the plans. Specifically, we use the following measures of contribution: *Contribution1* (natural logarithm of employer contribution in $ millions), *Contribution2* (Employer contribution $ / Number of participants), and *Contribution3* (Unexpected contribution

[8] The marginal effect of D_1*D_2 is computed as in Agrawal and Cooper (2015). It equals [E(y | X; D_1=1, D_2=1) - E(y | X; D_1=1, D_2=0)] - [E(y | X; D_1=0, D_2=1) - E(y | X; D_1=0, D_2=0)], where y is the dependent variable, D_1= Target, D_2= Post, and X = x_1 to x_n are the explanatory variables. The expectations are evaluated at the sample means of the x's.

= (Employer contribution $ at time t - Expected next year employer contribution at time t-1)/ Total Assets at time t-1. Table 4 reports the results. Consistent with our conjecture, target firms reduce their cash contributions to employee pension plans after being targeted by HF activists. Employer contributions per employee drops by about a third and unexpected contributions drop even more substantially. Both these effects are statistically significant. This evidence confirms that employee pension plans suffer from underfunding due to reduced employer contributions to the plans. More importantly, we find that targets reduce the discretionary employer contributions post activism.

We next examine whether firms start making more optimistic assumptions about the anticipated rates of returns on pension plan assets in order to justify reducing employer contributions to the plans. So we re-estimate the DiD regression in Table 3 after replacing the dependent variable with PPROR, the anticipated long-term rate of return on plan assets. Row 1 of Table 5 shows that the coefficient of the interaction variable Target*Post is statistically significant under varying approaches to clustering of standard errors. The last three rows of the table show that the magnitude of this effect is about 0.1% or about 1.3% of the mean assumed return of 7.7%.[9]

Next, we examine whether HF activism affects asset allocation decisions of pension plans because pension funding and asset allocation are closely intertwined. First, funding decisions often determine asset allocation decisions. For example, underfunded plans may be more inclined to invest in risky assets to earn their way out of underfunding. Second, asset allocation

[9] The assumed rates of return for a firm do not change significantly over time (see, e.g., Bergstresser, Desai, and Rauh, 2006). Both the statistical and economic significance of the results increases when we use industry, instead of firm, fixed effects. We tabulate the results with firm fixed effects to be consistent with our basic specification throughout the paper.

decisions can affect funding levels. For example, a good year for the stock market can reduce the level of future contributions needed to maintain plan health for some time. Third, stockholders are inclined to tilt pension portfolios towards high-risk, high-return assets, so as to provide pension benefits more efficiently and cheaply. Whether such a tilt happens and whether it leads to improved asset performance in terms of actual returns (not alpha) are both empirical questions. We use the DiD approach, replacing the dependent variables in Table 3 regressions with asset allocation to equity, *%Equity*, which measures the percentage of pension assets allocated to equity. Table 6 reports the results. There is some evidence that targeted firms tend to invest more in risky assets such as equity. The coefficient of the DiD term, Target*Post, is positive and statistically significant under one specification. The last three rows in the table show that the magnitude of this effect is about 2.3% of plan assets or about 3.9% relative to the mean equity allocation of 57.4%. This result provides modest support to the view that shareholders prefer riskier investment of pension plan assets. After being targeted by HF activists, target firms tend to take somewhat more risk in pension plans.[10]

The next obvious question is that whether this risky investment results in higher performance of plan assets. Although sponsors' contributions to plans do not keep up with additional benefit accruals year-after-year, if pension plans perform better due to risky investment, pension plan funding levels would not be compromised. We use the DiD approach, replacing the dependent variables with pension asset return, *Return*, which measures the actual return on plan assets. Table 7 shows that after being targeted by activists, the firm does not experience superior performance in pension plans. The coefficient of the interaction term,

[10] The t-statistics are small in this test possibly due to limited availability of data. Compustat data on asset allocations became available starting in 2003, when SFAS 132(R) became effective.

Target*Post, is negative and statistically significant when we cluster the standard errors by firm and year. In the last three rows, the size of the marginal effect is -0.85% or about -20.2% of the mean return of 4.2%.

Next, we examine how much managers manipulate the assumed returns on plan assets. We shed additional light on this issue by examining the difference between the assumed and actual returns on pension plan assets. The DiD regression in Table 8 shows that the assumed return exceeds the actual return by an average of 1.4% or as much as 16.4% of the mean difference of 8.6% between the two returns. The coefficient of the DiD term, Target*Post, is positive and statistically significant when we cluster the standard errors by firm and year.

We next examine whether firms targeted by HF activists increase the discount rates to reduce the present values of pension plan liabilities, as Andonov, Bauer and Cremers (2016) find for more underfunded U.S. public pension funds. On the other hand, Stefanescu, Wang, Xie and Yang (2017) find that large U.S. companies *lower* pension plan discount rates for top executives before they retire with a lump-sum benefit distribution. We use the DiD approach, replacing the dependent variables with an assumed *Discountrate*. Table 9 shows that after being targeted by activists, firms increase the pension discount rate used to compute the present value of pension liabilities, though the coefficient estimate of this increase is statistically insignificant.

Finally, as Cocco (2014) argues, firms are more likely to freeze underfunded plans and terminate overfunded plans. After a freeze, employees no longer accrue pension benefits from their future service, which results in a loss of wealth to employees (see, e.g., Comprix and Muller, 2011; Choy, Lin and Officer, 2014; Rauh, Stefanescu and Zeldes, 2016). On the other hand, firms terminate overfunded plans to avoid having to make future contributions to them. Given that plan underfunding increases following HF activism, we examine whether plan

freezing becomes more likely and plan termination becomes less likely. We obtain freezing and termination status for our sample from the IRS database. We use the DiD approach and replace the dependent variable in Table 3 with an indicator variable for frozen (terminated) DB plans.[11] While Table 10 shows some evidence of lower plan terminations, we find no evidence of greater freezes of pension plans after HF activists target firms.

6. Identification

Sections 4 and 5 show clear evidence of deterioration in the health of employee pension funds after firms are targeted HF activists. These results support our main hypothesis that firms targeted by HF activists transfer wealth from employees to shareholders. However, these findings are also consistent with two other possibilities. First, instead of activism causing pension underfunding, both activism and underfunding may be related via some other, omitted variables, which may be observable or unobservable. Second, the selection of target firms by HF activists is obviously not random. Our baseline tests address these concerns by using matching method to control for observable attributes of target firms that may attract HF activists. Accordingly, we match each target firm with a control firm, and then draw inferences using a DiD approach. Moreover, we control for time-invariant firm characteristics, both observable and unobservable, by including firm fixed effects in our baseline regressions. Nonetheless, there is a residual concern that some time-varying unobservable factors drive reductions in employee pension funding after activism episodes.

[11] We use the linear probability model instead of the logit model, which does not converge because the regression includes firm fixed effects.

We address this concern in three additional ways. First, in section 5, we examine several mechanisms underlying our underfunding results. We find that target firms reduce employer contributions to the pension plans (Table 4), increase the assumed rates of return on plan assets (Table 5), and tilt the allocation of plan assets toward riskier investments (Table 6), in a failed attempt at boosting plan performance (Table 7). Second, in section 6.1 below, we present some direct evidence of wealth transfers from employees to shareholders. Finally, we test five alternate interpretations of our findings. As discussed in section 6.2 below, none of these alternative explanations hold up to empirical scrutiny, leaving our interpretation as the most likely one.

6.1 Do abnormal returns to activism announcements predict pension underfunding?

Finally, we provide a direct test of the wealth transfer hypothesis that underfunding of pension plans represents a wealth transfer from employees to shareholders. In efficient markets, the stock price reaction to the announcement of HF activism represents investors' best estimate of the effect of activism on stockholders' wealth. So the question we ask is whether the stock price reaction to HF activism announcement predict the levels of future underfunding of employee pensions. If it does, then assuming market efficiency, that would be direct evidence of wealth transfers from employees to shareholders.

We start by computing the abnormal return on day t as $AR_{it} = r_{it} - r_{\mathrm{m}t}$, where r_{it} and r_{mt} are the day t returns on stock i and the CRSP value-weighted market index. We then compute *CAR(-1,+1)*, the cumulative abnormal return over days (-1, +1) surrounding the activism announcement date as the sum of AR_{it} over days -1, 0 and +1. We next estimate panel regressions of pension underfunding only on the sample of firms targeted by HF activists. We use the specification in Table 3, and replace *Target* with *CAR(-1,+1)*. The main explanatory

variable of interest is Post**CAR(-1,+1)*. A positive coefficient on this variable will be evidence of wealth transfer from employees to shareholders. In Table 11, the coefficient estimate of this variable is positive and statistically significant at the 1% level or better. In other words, the magnitude of the stock price reaction to activism announcement is partly in anticipation of future reductions in employee pension funding levels. This result provides additional support for our interpretation of the increase in pension underfunding after HF targeting as being partly due to wealth transfer from employees to shareholders.

6.2 Alternative explanations

6.2.1 Stock picking skill of hedge funds

Our first test is designed to address the stock picking skill of HFs. Activists are skilled at picking stocks with improving prospects even if they remain passive shareholders. Following Kim, Kim and Kwon (2009), Brav, Jiang and Kim (2015a), and Aslan and Kumar (2016), we examine the effect of HF activism on underfunding when the HF switches from being a passive, 13G filer, to being an active, 13D filer. If our results are merely driven by the activist's stock picking skill, this switch should have no effect on pension underfunding because both 13G and 13D filings indicate the same stock picking skill that led to the purchase of a 5% stake in the firm. We find 221 cases in our sample where the filer switched from a 13G to a 13D. We then re-estimate our baseline regression in column (1) of Table 3 after adding a triple interaction variable, GD*Target*Post, where GD equals 1 for target firms where the activist switches from 13G to 13D, and equals zero otherwise. The *Post* indicator equals 1 for years [t+1,t+3] , and equals zero otherwise. Column (1) of Table 12 shows the result. We find a significant positive effect on underfunding of target firms in the three years after an activist switches its filing from

13G to 13D. This finding does not support the idea that the impact of HF activism on pension underfunding is merely due to the activist's stock picking skill.

6.2.2 Mean-reversion in pension funding

Our second test examines the possibility that our results merely pick up mean-reversion in pension funding by target firms. Pension funding may decrease after intervention simply due to mean-reversion because it increased before the intervention. We set up a placebo test wherein we define a pseudo-event year and examine the targets' response to this pseudo-event. The pseudo-event is defined as three years before the true activism event year, following Aslan and Kumar (2015). We examine the effect of HF activism on underfunding when target firms experience this pseudo-event. We expect a significantly positive effect after the pseudo-event if our results are merely picking some existing trends. Column (2) of Table 12, however, shows an insignificant coefficient on the DiD term. This result does not support the idea that the changes in pension underfunding that we observe after activism are simply an artifact of mean-reversion.

6.2.3 Voluntary reforms by target managements

Our third test investigates the possibility of voluntary reform by the management of the target firm. This alternative hypothesis suggests that target firms voluntarily reduce their funding of employee pension plans without any pressure from a HF. Hard activism involves disputes between shareholder activists and target management due to management's resistance to the activist's agenda. So for hostile events, it is difficult to attribute any changes to voluntary reforms by management because we know that management in these cases resisted the actions demanded by activists (see Brav, Jiang and Kim, 2015a). Therefore, hard activism rules out the

possibility of voluntary reforms by management. If we find underfunding of pension plans after hard activism, we can safely conclude that the change was not voluntary.

To examine this possibility, we classify activists' approaches based on their stated tactics in 13D filings. While our full sample includes a range of tactics employed by activists, here we focus on just two, hard activism and soft activism by excluding multiple purposes in a 13D filing, which reduces the sample size in this test. Hard activism consists of cases when an activist publicly criticizes the targets or publicly announces a dispute with target management, while in soft activism, an activist adopts a softer approach by communicating privately with management. We define an indicator variable Hard, which equals 1 for hard activism and zero for soft activism, and interact it with Target*Post. The voluntary reforms story implies that the coefficient of this interaction term should be zero. But column (3) of Table 12 shows a significantly positive coefficient on this triple interaction term, Hard*Target*Post, implying that targets are more likely to experience underfunding when the pressure from activist shareholders is strong. This finding supports the hypothesis that the underfunding of target firms is due to pressure from HF activists rather than voluntary reforms by target firms.

6.2.4 Financial distress

Our fourth test addresses the possibility that firms targeted by activists are more likely to be financially distressed and reduce pension funding in response (see, e.g., Duan, Hotchkiss and Jiao, 2015). To examine this possibility, we compute Altman's Z score for each of our sample firms and interact it with our DiD variable, Target*Post. Altman's Z score measures a firm's financial strength; it is an inverse measure of the probability of bankruptcy of a firm. Column (4) of Table 12 shows that the effect of activism on underfunding is actually stronger when firms are

financially healthier. This finding does not support the idea that pension underfunding is target firms' response to financial distress.

6.2.5 Attrition bias

Our final test addresses a potential attrition bias that can affect firms targeted by HF activists. Specifically, targets that delist after activism may drive our results. Boyson, Gantchev and Shivdasani (2017) find that target firms are more likely to be sold after HF activism. Pension underfunding also appears to be firms' response to financial distress (see Duan, Hotchkiss and Jiao, 2015), which can lead to delisting. To address this concern about our main hypothesis, we re-estimate the DiD regression in Table 3 after eliminating firms that delist within three years of the onset of activism. In column (5) of Table 12, our results continue to hold, negating the idea that pension underfunding can be explained by the delisting of target firms after activism.

7. Conclusion

Shareholder gains from activism can come from wealth transfers from workers. Existing empirical evidence in support of this hypothesis is quite limited. Specifically, there is no prior evidence that employee pensions suffer from HF activism. In this paper, we fill this gap by comparing the funding levels of pension plans before and after HF activism. We find that on average, DB employee pension plans of target firms suffer from greater underfunding after the activism episode. This effect is caused by reduced employer contributions to the pension plans, which firms justify by increasing the assumed rate of return on plan investments. While targeted firms take more risk when investing pension plan assets, the plans show no corresponding

increases in their realized returns. In addition, the stock price reaction to the announcement of HF activism predicts future increases in pension underfunding, which provides further support to the wealth transfer hypothesis. We find no empirical support for several alternative hypotheses such as activists' stock-picking skills, voluntary changes adopted by management, mean-reversion, financial distress, and attrition bias, which leaves wealth transfer from employees as the most likely explanation.

Overall, the paper extends the literature showing that HF activism transfers wealth from other stakeholders to shareholders (see, e.g., Klein and Zur, 2011; Brav, Jiang and Kim, 2015; and Feng, Xu and Zhu, 2016). Our empirical results point to a negative effect of HF activism on workers' welfare. Finally, our findings have important implications for public guarantees and regulation of private pension plans.

References

Agrawal, A. K. (2012). Corporate governance objectives of labor union shareholders: Evidence from proxy voting. *Review of Financial Studies*, 25(1), 187-226.

Agrawal, A. and Cooper, T. (2015). Insider trading before accounting scandals. *Journal of Corporate Finance*, 34, 169-190.

Amir, E., & Gordon, E. A. (1996). Firms' choice of estimation parameters: Empirical evidence from SFAS No. 106. *Journal of Accounting, Auditing and Finance*, 11(3), 427-448.

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

Andonov, A., Bauer, R., & Cremers, M. (2016). Pension fund asset allocation and liability discount rates. *Review of Financial Studies* Forthcoming

Aslan, H., & Kumar, P. (2016). The product market effects of hedge fund activism. *Journal of Financial Economics*, 119(1), 226-248

Aslan, H., & Maraachlian, H. (2009). Wealth effects of hedge fund activism. Working Paper.

Asthana, S. (1999). Determinants of funding strategies and actuarial choices for defined-benefit pension plans. *Contemporary Accounting Research*, 16(1), 39-74.

Bae, K. H., Baik, B., & Kim, J. M. (2011). Do hedge funds have information advantages? Evidence from hedge fund stock holdings. Working Paper.

Bakke, T. E., & Whited, T. M. (2012). Threshold events and identification: A study of cash shortfalls. *Journal of Finance*, 67(3), 1083-1111.

Barney, J. B. (1988). Returns to bidding firms in mergers and acquisitions: Reconsidering the relatedness hypothesis. *Strategic Management Journal*, 9(S1), 71-78.

Bean, D. F., & Bernardi, R. A. (2000). Underfunding pension obligations while paying dividends: Evidence of risk transfers. *Critical Perspectives on Accounting*, 11(5), 515-530.

Bebchuk, L. A., Brav, A., & Jiang, W. (2014). The long-term effects of hedge fund activism. Forthcoming, *Columbia Law Review*, 114, 13-66.

Benmelech, E., Bergman, N. K., & Enriquez, R. J. (2012). Negotiating with labor under financial distress. *Review of Corporate Finance Studies*, 1(1), 28-67.

Bergstresser, D., Desai, M., & Rauh, J. (2006). Earnings manipulation, pension assumptions, and managerial investment decisions. *Quarterly Journal of Economics*, 157-195.

Black, F. (1980). The tax consequences of long-run pension policy. *Financial Analysts Journal*, 36(4), 21-28.

Boyson, N., Gantchev N., & Shivdasani, A. (2017). Activism mergers. *Journal of Financial Economics*, forthcoming.

Brav, A., Jiang, W., & Kim, H. (2009). Hedge fund activism: A review. *Foundations and Trends in Finance*, 4(3), 185-246.

Brav, A., Jiang, W., & Kim, H. (2015a). The real effects of hedge fund activism: Productivity, asset allocation, and labor outcomes. *Review of Financial Studies*.

Brav, A., Jiang, W., & Kim, H. (2015b). Recent advances in research on hedge fund activism: Value creation and identification. *Annual Review of Financial Economics*, Vol. 7, pp. 579-595

Brav, A., Jiang, W., Ma, S. & Tian, X. (2015). How does hedge fund activism reshape corporate innovation? Working Paper

Brav, A., Jiang, W., Partnoy, F., & Thomas, R. (2008). Hedge fund activism, corporate governance, and firm performance. *Journal of Finance*, 63(4), 1729-1775.

Cai, J., & Walkling, R. A. (2011). Shareholders' say on pay: Does it create value? *Journal of Financial and Quantitative Analysis*, 46(02), 299-339.

Chaplinsky, S., & Niehaus, G. (1994). The role of ESOPs in takeover contests. *Journal of Finance*, 49(4), 1451-1470.

Choy, H., Lin, J., & Officer, M. S. (2014). Does freezing a defined benefit pension plan affect firm risk? *Journal of Accounting and Economics*, 57(1), 1-21.

Cocco, J. F., & Volpin, P. F. (2007). Corporate governance of pension plans: the UK Evidence. *Financial Analysts Journal*, 63(1), 70-83.

Cocco, J. F., & Volpin, P. F. (2013). Corporate pension plans as takeover deterrents. *Journal of Financial and Quantitative Analysis*, 48(04), 1119-1144.

Cocco, Joao F. (2014). Corporate Pension Plans. *Annual Review of Financial Economics*, Vol. 6, pp. 163-184.

Coffee, J. C., & Palia, D. (2016). The wolf at the door: The impact of hedge fund activism on corporate governance. *Annals of Corporate Governance*, 1(1), 1-94.

Coles, J. L., Daniel, N. D., & Naveen, L. (2006). Managerial incentives and risk-taking. *Journal of Financial Economics*, 79(2), 431-468.

Coles, J. L., Daniel, N. D., & Naveen, L. (2013). Calculation of compensation incentives and firm-related wealth using Execucomp: Data, program, and explanation. Program, and Explanation. Working Paper.

Comprix, J., & Muller, K. (2011). Pension plan accounting estimates and the freezing of defined benefit pension plans. *Journal of Accounting and Economics*, 51 (1-2), 115-133.

Core, J., & Guay, W. (2002). Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research*, 613-630.

Coronado, J., & Liang, N. (2005). The influence of PBGC insurance on pension fund finances. *Restructuring Retirement Risks*, 88-108.

Cronqvist, H., Heyman, F., Nilsson, M., Svaleryd, H., & Vlachos, J. (2009). Do entrenched managers pay their workers more? *Journal of Finance*, 64(1), 309-339.

Denes, M. Karpoff, J. and McWilliams, V. (2017). Thirty years of shareholder activism: A survey of empirical research. *Journal of Corporate Finance*, forthcoming.

Duan, Y., Hotchkiss, E. S., & Jiao, Y. (2015). Corporate pensions and financial distress. Working Paper.

Duygan-Bump, B., Parkinson, P., Rosengren, E., Suarez, G. A., & Willen, P. (2013). How effective were the Federal Reserve emergency liquidity facilities? Evidence from the asset-backed commercial paper money market mutual fund liquidity facility. *Journal of Finance*, 68(2), 715-737.

Eaton, T. V., Nofsinger, J. R., & Varma, A. (2014). Institutional investor ownership and corporate pension transparency. *Financial Management*, 43(3), 603-630.

Edmans, A. (2014). Blockholders and Corporate Governance. *Annual Review of Financial Economics*, 6(1), 23-50.

Edmans, A., & Holderness, C. G. (2016). Blockholders: A survey of theory and evidence. In B. Hermalin and M. Weisbach, eds., *Handbook of Corporate Governance*.

Feng, F. Z., Q. Xu, and H. Zhu. (2016) Caught in the Cross-fire: How the threat of hedge fund activism affects creditors. Working Paper, University of Oklahoma.

Frank, M. M. (2002). The impact of taxes on corporate defined benefit plan asset allocation. *Journal of Accounting Research*, 40(4), 1163-1190.

Gillan, Stuart L. and Laura T. Starks, 2007, The evolution of shareholder activism in the United States. *Journal of Applied Corporate Finance* 19, 55–73.

Government Accountability Office, United States. (2017). High risk: PBGC insurance programs, GAO report # 17-317.

Graham, J. R., & Mills, L. F. (2008). Using tax return data to simulate corporate marginal tax rates. *Journal of Accounting and Economics*, 46(2), 366-388.

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

Huang, J. (2009). Hedge funds and shareholder wealth gains in leveraged buyouts. Working Paper.

Iacus, S. M., King, G., & Porro, G. (2011). Causal inference without balance checking: Coarsened exact matching. *Political Analysis*, mpr013.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, 3(4), 305-360.

Jiang, W., Li, K., & Wang, W. (2012). Hedge funds and Chapter 11. *Journal of Finance*, 67(2), 513-560.

Jiang, W., Li, T., & Mei, D. (2016). Influencing control: Jawboning in risk arbitrage. Working Paper, SSRN.

Kieso, D. E., Weygandt, J. J., & Warfield, T. D. (2010). Intermediate accounting: IFRS edition (Vol. 2). John Wiley & Sons.

Kim, E., & Ouimet, P. (2014). Broad-based employee stock ownership: Motives and outcomes. *Journal of Finance*, 69(3), 1273-1319.

Kim, W., Kim, W., & Kwon, K. S. (2009). Value of outside blockholder activism: Evidence from the switchers. *Journal of Corporate Finance*, 15(4), 505-522.

Kisser, M., Kiff, J., & Soto, M. (2016). Do pension plans exploit regulatory leeway to manage pension liabilities? Working Paper.

Klein, A., & Zur, E. (2011). The impact of hedge fund activism on the target firm's existing bondholders. *Review of Financial Studies*, 24(5).

Pagano, M., & Volpin, P. F. (2005). Managers, workers, and corporate control. *Journal of Finance*, 60(2), 841-868.

Petersen, M. A. (1992). Pension reversions and worker-stockholder wealth transfers. *Quarterly Journal of Economics*, 1033-1056.

Peterson, M. A. (1994). Cash flow variability and firm's pension choice: A role for operating leverage. *Journal of Financial Economics*, 36(3), 361-383.

Phan, H. V., & Hegde, S. P. (2013). Pension contributions and firm performance: Evidence from frozen defined benefit plans. *Financial Management*, 42(2), 373-411.

Pontiff, J., Shleifer, A., & Weisbach, M. S. (1990). Reversions of excess pension assets after takeovers. *Rand Journal of Economics*, 600-613.

Popadak, J. A. (2014). A corporate culture channel: How increased shareholder governance reduces firm value. Working Paper, SSRN.

Rauh, J. D. (2006). Investment and financing constraints: Evidence from the funding of corporate pension plans. *Journal of Finance*, 61(1), 33-71.

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

Rauh, J. D., Stefanescu, I., & Zeldes, S. P. (2016). Cost saving and the freezing of corporate pension plans. Working Paper.

Rosett, J. G. (1990). Do union wealth concessions explain takeover premiums? The evidence on contract wages. *Journal of Financial Economics*, 27(1), 263-282.

Sharpe, W. F. (1976). Corporate pension funding policy. *Journal of Financial Economics*, 3(3), 183-193.

Sharpe, W. F., & Treynor, J. L. (1977). The principles of corporate pension finance. *Journal of Finance*, 32(2), 627-638.

Shleifer, A., & Summers, L. H. (1988). Breach of trust in hostile takeovers. In *Corporate Takeovers: Causes and consequences*, University of Chicago Press, 33-68.

Stefanescu, I., Wang, Y., Xie, K., & Yang, J. (2017). Pay me now (and later): Pension benefit manipulation before plan freezes and executive retirement. *Journal of Financial Economics*, forthcoming.

Stulz, R. (1988). Managerial control of voting rights: Financing policies and the market for corporate control. *Journal of Financial Economics*, 20, 25-54.

Sundaresan, S., & Zapatero, F. (1997). Valuation, optimal asset allocation and retirement incentives of pension plans. *Review of Financial Studies*, 10(3), 631-660.

Sunder, J., Sunder, S. V., & Wongsunwai, W. (2014). Debtholder responses to shareholder activism: Evidence from hedge fund interventions. *Review of Financial Studies*, 27(11), 3318-3342.

Thomas, J. K. (1988). Corporate taxes and defined benefit pension plans. *Journal of Accounting and Economics*, 10(3), 199-237.

Uchida, K., & Xu, P. (2008). US barbarians at the Japan gate: Cross-border hedge fund activism. Working Paper.

Table 1

Hedge fund activism

The table shows the number of HF activism events by year and by Fama-French 12 industry. An HF activism event represents a 13D filing by a hedge fund. When a person or investor group acquires beneficial ownership of 5% or more of a voting class of a company's securities and intends to change or influence control of the firm, they are required to file a 13D with the SEC within 10 days of acquiring the stake. The sample consists of 594 activism events during 2001-2014 for which data on funding levels of defined benefit pension plans of target firms is available on Compustat Pension annual data files.

Year	Freq.	Percent		Fama-French 12 industries	Freq.	Percent
2001	15	2.53				
2002	13	2.19	1	Consumer NonDurables	37	6.23
2003	24	4.04	2	Consumer Durables	35	5.89
2004	30	5.05	3	Other Manufacturing	113	19.02
2005	56	9.43	4	Energy	22	3.7
2006	74	12.46	5	Chemicals and Allied Products	28	4.71
2007	70	11.78	6	Business Equipment	70	11.78
2008	80	13.47	7	Telephone and Television Transmission	21	3.54
2009	28	4.71	8	Utilities	22	3.7
2010	42	7.07	9	Wholesale, Retail, and Some Services	61	10.27
2011	54	9.09	10	Healthcare, Medical Equipment, and Drug	24	4.04
2012	39	6.57	11	Finance	81	13.64
2013	30	5.05	12	Others	80	13.47
2014	39	6.57				
Total	594	100		Total	594	100

Table 2

Mean values for target and control samples in year -1

The table shows characteristics of target and control firms one year prior to the year of the activism event. We match each target firm to a non-target firm on Compustat from the same year using the coarsened exact matching method. Matching is based on lag 1 of the following variables: 4-digit SIC industry-adjusted Tobin's Q, leverage, ROA, an indicator of negative ROA, log of market value, log of total assets; and lag 3 of industry-adjusted Tobin's Q. Sampling is with replacement to ensure better matches, so there are fewer control firms than target firms. For each variable, we report the mean (median) values for the target and control samples, and t-statistics (p-value of the Wilcoxon test) of the differences between them. The n-year growth rate in Underfund is defined as $[(\text{Underfund}_{-1}/\ \text{Underfund}_{-1\text{-}n}) - 1]$. Appendix A defines the variables.

Panel A

Variable	Mean			Median			Sample size	
	Target	Control	t-stat for difference	Target	Control	Wilcoxon test p-value	T	C
Dependent variables:								
Underfund	0.28	0.28	0.26	0.26	0.24	0.53	534	492
Contribution1	1.40	1.18	1.56	1.39	1.19	0.10	437	414
Contribution2	0.00	0.00	-1.73	0.00	0.00	0.11	394	342
Contribution3	0.00	0.00	1.74	0.00	0.00	0.10	300	288
PPROR	7.57	7.46	1.08	8.00	8.00	0.27	472	443
%Equity	58.53	55.45	2.35	62.00	60.00	0.03	387	358
Return	3.21	6.01	-1.06	8.27	8.03	0.84	468	442
DIFF	8.70	6.13	0.97	3.43	3.24	0.69	455	431
Discountrate	5.64	5.57	1.20	5.75	5.75	0.25	511	473
Frozen	0.16	0.16	-0.04	0.00	0.00	0.97	405	364
Terminated	0.00	0.01	-0.67	0.00	0.00	0.50	400	359
Independent variables:								
lnFVPA	3.90	3.81	0.65	3.93	3.79	0.54	537	493
OCF	0.07	0.07	-1.08	0.07	0.07	0.33	547	507
Std_OCF	0.04	0.04	2.15	0.03	0.03	0.07	547	507
Duration	0.30	0.31	-1.08	0.30	0.31	0.33	514	479
Taxrate	0.26	0.27	-2.18	0.31	0.32	0.04	465	401
SIZE	7.03	7.10	-0.75	6.96	7.00	0.49	551	513
ROA	0.10	0.10	-0.47	0.10	0.10	0.76	549	510
TDA	0.25	0.23	1.84	0.23	0.21	0.06	551	513

SaleG	0.09	0.09	-0.28	0.04	0.05	0.06	529	501
lnMV	6.40	6.48	-0.74	6.38	6.54	0.47	551	512
MB	1.45	1.44	0.27	1.26	1.23	0.71	551	512
lnAge	2.31	2.25	0.76	2.48	2.48	0.59	187	205
Panel B: Tests of parallel trends assumption								
Underfund								
1-year growth rate	-0.45	0.21	-1.79	-0.06	-0.05	0.44	496	469
2-year growth rate	1.07	-0.38	1.05	-0.14	-0.11	0.59	467	444

Table 3

Underfunding of defined benefit pension plans after hedge fund activism

The table presents estimates from panel regressions of pension underfunding. The sample includes firms targeted by HF activists and control firms as described in Table 2. We use the following difference-in-differences specification:

$$y_{i,t} = \alpha_0 + \alpha_1 Post_{i,t} + \alpha_2 Target_i \times Post_{i,t} + \underline{\alpha_3} Control_{i,t} + \underline{\alpha_4} Year_t + \underline{\alpha_5} Firm_i + \varepsilon_{i,t}$$

where the dependent variable measures underfunding of firm i in year t. The dependent variable is Underfund = (Projected Benefit Obligation - Pension Plan Assets)/ Projected Benefit Obligation. *Target* is a dummy variable equal to one if firm i is a target of activism at year t. *Post* is a dummy variable equal to one if the firm-year (*i*,*t*) observation is within [*t+1*, *t+5*] years of an activism event or a pseudo-event, zero otherwise. *Control* is a vector of firm i's controls. The regressions include year and firm fixed effects. Appendix A defines the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Underfund	(2) Underfund	(3) Underfund
Target*Post	0.046***	0.046**	0.046**
	(3.14)	(2.19)	(2.35)
Post	-0.008	-0.008	-0.008
	(-0.73)	(-0.61)	(-0.67)
lnFVPA	-0.177***	-0.177***	-0.177***
	(-22.13)	(-6.03)	(-6.22)
OCF	0.075	0.075	0.075*
	(1.10)	(1.13)	(1.73)
Std_OCF	-0.510***	-0.510***	-0.510***
	(-4.67)	(-2.69)	(-2.59)
Discountrate	-0.032***	-0.032***	-0.032***
	(-4.25)	(-2.90)	(-2.86)
Duration	0.169***	0.169**	0.169**
	(6.16)	(2.32)	(2.41)
Taxrate	0.048	0.048	0.048
	(1.06)	(0.63)	(0.70)
SIZE	0.048***	0.048**	0.048**
	(3.84)	(2.05)	(2.07)
ROA	0.009	0.009	0.009
	(0.11)	(0.09)	(0.11)
TDA	-0.029	-0.029	-0.029
	(-0.81)	(-0.44)	(-0.47)
SaleG	-0.007	-0.007	-0.007
	(-0.56)	(-0.42)	(-0.43)
lnMV	-0.031***	-0.031**	-0.031**
	(-3.84)	(-2.06)	(-2.07)

MB	-0.008	-0.008	-0.008
	(-1.07)	(-0.42)	(-0.45)
lnAge	0.086***	0.086***	0.086***
	(6.47)	(3.24)	(3.28)
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	2436	2436	2409
R^2	0.461	0.461	0.461
Marginal effect of Target*Post[1]		0.014	
Mean of the dependent variable		0.265	
% Marginal effect of Target*Post[2]		5.469	

[1] Marginal effect of D_1*D_2 = [E(y | X; D_1=1, D_2=1) - E(y | X; D_1=1, D_2=0)] - [E(y | X; D_1=0, D_2=1) - E(y | X; D_1=0, D_2=0)], where y is the dependent variable, D_1= Target, D_2= Post, and X = x_1 to x_n are the explanatory variables. The expectations are evaluated at the sample means of the x's.

[2] % Marginal effect = 100*(Marginal effect / Mean of dependent variable).

Table 4

Employer contributions to pension plans after hedge fund activism

The table presents estimates from panel regressions of employer contributions to defined benefit pension plans. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with a measure of employer contributions. Contribution1 = ln(Employer contribution in $ millions); Contribution2 = Employer contribution / Number of plan participants; and Contribution3 = Unexpected contribution = (Employer contribution in year t - Expected next year employer contribution in year t-1)/ Total assets at the end of year t-1. Sample sizes for the regressions in columns (2) and (3) are smaller than column (1) because of missing data on the denominator of the dependent variables. Data on the number of plan participants is from the IRS database. Control variables are as in Table 3. Standard errors are clustered at the firm level. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) Contribution1	(2) Contribution2	(3) Contribution3
Target*Post	-0.143	-0.001*	-0.002**
	(-0.95)	(-1.80)	(-1.99)
Post	0.158	0.001**	0.002**
	(1.53)	(2.17)	(2.17)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
N	1944	1540	1209
R^2	0.270	0.103	0.051
ME	-0.197	-0.001	-0.001
Mean	1.106	0.003	0.001
%ME	-17.812	-33.333	-100.000

Table 5

Assumed rates of return on plan assets after hedge fund activism

The table presents estimates from panel regressions of assumed rates of return on pension plan assets. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with PPROR, the anticipated long-term rate of return on plan assets. Control variables are as in Table 3. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) PPROR	(2) PPROR	(3) PPROR
Target*Post	0.169***	0.169*	0.169*
	(2.93)	(1.77)	(1.74)
Post	-0.111**	-0.111	-0.111
	(-2.46)	(-1.64)	(-1.37)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	2238	2238	2213
R^2	0.474	0.474	0.474
ME		0.097	
Mean		7.659	
%ME		1.266	

Table 6

Pension asset allocation after hedge fund activism

The table presents estimates from panel regressions of asset allocation in pension plans. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with %Equity, defined as the percentage of pension assets allocated to equity. Control variables are as in Table 3. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) %Equity	(2) %Equity	(3) %Equity
Target*Post	2.579*	2.579	2.579
	(1.80)	(1.31)	(1.43)
Post	-2.029*	-2.029	-2.029
	(-1.92)	(-1.33)	(-1.31)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	1523	1523	1504
R^2	0.161	0.161	0.161
ME		2.260	
Mean		57.425	
%ME		3.936	

Table 7

Pension plan performance after hedge fund activism

The table presents estimates from panel regressions of the return on pension plan assets. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with Return (=Actual return on pension plan assets / Pension plan assets)×100. Control variables are as in Table 3. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) Return	(2) Return	(3) Return
Target*Post	-0.780	-0.780	-0.780***
	(-0.71)	(-1.07)	(-8.83)
Post	-0.396	-0.396	-0.396
	(-0.47)	(-0.74)	(.)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	2127	2127	2103
R^2	0.532	0.532	0.532
ME		-0.846	
Mean		4.196	
%ME		-20.162	

Table 8

The difference between assumed and actual returns after hedge fund activism

The table presents estimates from panel regressions of the difference between assumed and actual returns on pension plan assets. We use the difference-in-differences specification as shown in Table 3, and replace the dependent variable with DIFF (= the absolute value of the difference between the assumed rate of return minus actual return). Control variables are as in Table 3. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) DIFF	(2) DIFF	(3) DIFF
Target*Post	1.038	1.038	1.038***
	(1.34)	(1.49)	(5.65)
Post	0.711	0.711	0.711*
	(1.15)	(1.38)	(1.93)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	2087	2087	2063
R^2	0.540	0.540	0.540
ME		1.408	
Mean		8.603	
%ME		16.366	

Table 9

Assumed pension discount rates after hedge fund activism

The table presents estimates from panel regressions of the discount rate assumed by pension plans to compute the present value of plan liabilities. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with *Discountrate*. Control variables are as in Table 3, except they omit *Discountrate*. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) Discountrate	(2) Discountrate	(3) Discountrate
Target*Post	0.040	0.040	0.040
	(0.63)	(0.63)	(0.73)
Post	0.016	0.016	0.016
	(0.32)	(0.32)	(0.39)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	2447	2447	2420
R^2	0.835	0.835	0.835
ME		-0.014	
Mean		5.765	
%ME		-0.243	

Table 10

Pension plan freezes and terminations after hedge fund activism

The table presents estimates from panel regressions of the freezing and termination of employee pension plans. We use the difference-in-differences specification as in Table 3, and replace the dependent variable with Frozen (Terminated), which is an indicator variable that equals one for firms that freeze (terminate) their defined benefit pension plans in a given year, and equals zero otherwise. Data on freezing and termination of pension plans are from the IRS database. Control variables are as in Table 3. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. In the last three rows of the table, ME is the marginal effect of Target*Post, Mean is the mean of the dependent variable, and %ME is the % marginal effect of Target*Post, as defined in the footnotes to Table 3.

	(1) Frozen	(2) Frozen	(3) Frozen	(3) Terminated	(3) Terminated	(3) Terminated
Target*Post	-0.046*	-0.046	-0.046	-0.018**	-0.018	-0.018
	(-1.70)	(-0.92)	(-0.98)	(-2.38)	(-1.38)	(-1.46)
Post	-0.006	-0.006	-0.006	0.010*	0.010	0.010
	(-0.29)	(-0.18)	(-0.19)	(1.88)	(1.29)	(1.35)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year	No	Firm	Firm and Year
N	1616	1616	1596	1616	1616	1596
R^2	0.247	0.247	0.247	0.023	0.023	0.023
ME		-0.014			-0.018	
Mean		0.131			0.004	
%ME		-10.687			-450.000	

Table 11

Does the stock price reaction to HF activism announcement predict underfunding of employee pensions?

The table presents estimates from panel regressions of pension underfunding. The sample consists of firms targeted by HF activists. We use the specification in Table 3, and replace Target with *CAR(-1,+1)*. The main explanatory variable of interest is Post**CAR(-1,+1)*. *CAR(-1,+1)* is the cumulative abnormal return over days (-1, +1) surrounding the activism announcement date. The abnormal return on day t is computed as $AR_{it} = r_{it} - r_{mt,}$ where r_{it} and r_{mt} are the day t returns on stock i and the CRSP value-weighted market index. The *t*-statistics are in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1)	(2)	(3)
	Underfund	Underfund	Underfund
Post*CAR(-1,+1)	0.443***	0.443**	0.409**
	(3.19)	(2.72)	(2.87)
Post	0.009	0.009	0.009
	(0.77)	(0.58)	(0.63)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Cluster	No	Firm	Firm and Year
N	1578	1578	1557
R^2	0.437	0.437	0.437

Table 12

Tests of alternative explanations

Each column in the table reports the result of a variant of the regression in column (3) of Table 3. Our main interest in columns (1) to (4) is in the interaction of *Target*Post* with a third variable. In column (1), this third variable is *G→D Switcher*, *which* is an indicator for a firm that switches its SEC filing status from Schedule 13G (passive ownership) to Schedule 13D (active ownership). There are 221 cases of such switches in our sample. Column (2) conducts a falsification test by creating a dummy variable, *Placebo*, which equals 1 for a placebo event and 0 for a control firm. The placebo event year is three years before the actual event date. In column (3), we use a dummy variable *Hard*, which equals one if a HF targets a firm with hard activism and equals zero for soft activism. We estimate this regression on the subsample of hard and soft activism events only, and exclude 13D filings that list multiple purposes. In column (4), we interact Altman's Z-score, which measures the financial strength of a firm, with our DiD variable, *Target*Post*. *Target* equals one for a target firm and zero for a control firm. *Post* equals one if a firm is within $[t+1, t+3]$ years after an activism or a pseudo-activism event. Control variables are as in Table 3. In column (5), we redo our DiD regression after excluding firms that are delisted within three years of activism. We also include year and firm fixed effects. We report t-statistics based on standard errors clustered at the firm and year level. Appendix A defines the variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var.: Underfunding/ Liabilities	(1) G to D Switcher	(2) Placebo tests	(3) Hard vs. Soft	(4) AltmanZ	(5) Attrition
{G→D Switcher (1), Placebo (2), Hard (3), or AltmanZ (4)} × Target × Post	0.075**	-0.016	0.148**	0.012***	0.029*
	(2.44)	(-0.95)	(2.13)	(3.93)	(1.84)
Post	0.013	0.016	0.039*	0.002	0.003
	(1.39)	(1.51)	(1.83)	(0.19)	(0.25)
AltmanZ				-0.008	
				(-1.57)	
Target×Post				-0.002	
				(-0.13)	
Controls	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
N	2409	2409	705	2074	2358
R^2	0.460	0.458	0.590	0.476	0.456

Appendix A
Variable definitions

This table defines the variables used in the analysis. L*ag* indicates that a variable is lagged by a year. Names in block capitals are Compustat variable names.

Variable	Definition
Pension	**Data Source: Compustat Pension**
Underfund	{Pension liabilities (PBPRO) – fair value of pension assets (PPLAO, millions)} / PBPRO
lnFVPA	= ln(1+PPLAO)
Discountrate	Discount rate actuarial assumption (PBARR)
Return	Actual returns from plan assets (PBARAT/PPLAO)×100
%Equity	Pension Asset Allocation in Equity (PNATE)
Contribution1	=ln(Pension Employer Contribution (PBEC) in $ millions)
Taxrate	Marginal tax rate after interest deductions (BCG_MTRINT). Missing values are replaced with simulated marginal tax rate from Graham and Mills (2008)
Duration	= Service Cost (PPSC) / (PPSC + Interest Cost (PPIC))
PPROR	Anticipated Long-Term Rate of Return on Plan Assets
Firm	**Data Source: Compustat**
SIZE	Ln(AT in $ millions)
ROA	Earnings before interest, taxes, depreciation, and amortization (OIBDP) / AT
TDA	(DLC+DLTT)/AT
lnMV	Ln(Market value of equity (PRCC_F× CSHO))
SaleG	(SALE-lag_SALE) / lag_SALE
lnAge	Ln(Fiscal year – IPO year)
AltmanZ	1.2*(ACT-LCT)/AT + 1.4*RE/AT + 3.3*(NI+XINT+TXT)/AT+0.6*CSHO*PRCC_F/LT + 0.999*SALE/AT)
OCF	Cash flows from operations (OANCF) / AT
Std_OCF	Standard deviation of OCF for the current and previous four years.