Pension Underfunding and the Expected Return on Pension Assets: The Impact of the 2008 Financial Crisis

Abstract

We use the 2008 crisis as an exogenous shock to the pension funding status of U.S. corporate defined benefit (DB) pension plans to examine its impact on the assumption of the expected return on pension assets (*ER*). Contrary to prior literature, we find that DB pension plans transitioning from funded to underfunded status make expense-reducing assumptions by increasing their *ER*. We also document that the *ER* manipulation is larger for plans whose funding after 2008 drops significantly. The funding deterioration conservatively generates a 28-79 basis points increase in *ER*, reducing the pension accounting expense by about 5.23% to 14.76% ($3.49 to $9.85 million). Our results are robust to controlling for the shock induced by the global financial crisis on corporate performance and other potential channels affecting *ER*.

JEL classification: G11, G23, G32.

Keywords:
Defined benefit pension plans, pension assumptions, EROA, PPROR, underfunded.

1. Introduction

Managerial discretion in setting pension accounting assumptions for corporate defined benefit (DB) pension plans has been used in favor of improving company earnings. Bergstresser et al. (2006) find that corporations manipulate the expected rate of return (*ER*) on pension assets assumption to manage their earnings, when for instance, they aim to meet decisive earnings levels. Alongside their main contribution, Bergstresser et al. (2006) reject the hypothesis that DB pension funding concerns also contribute to pension expense-reducing assumptions. While these results hold over their sample period (1991-2002), we show that this hypothesis cannot be rejected with more recent data.

Our contribution is to provide evidence that significant changes to the pension funding status of defined benefit (DB) pension plans lead to a manipulation of the expected rate of return on pension assets (*ER*). To do so, we use the 2008 crisis as an exogenous shock to pension funding ratios and empirically test whether corporate DB pension plan sponsors inflate the *ER* assumption, when their DB pension plans transition from a funded to an underfunded status. Moreover, we show that the level of pension funding is also linked to the degree of the *ER* manipulation. Our results are robust to the choice of threshold used to define underfunded status, the pension allocation to equity before 2008, board independence, survival bias and alternative definition of the expected return on assets and pension liabilities. Overall, the increase in *ER* amounts to a decrease of about $3.49 to $9.85 million in the pension accounting expense (an economically significant decrease in the pension expense ranging 5.23% to 14.76%).

At first sight, it might be surprising that the *ER* manipulation is linked to DB funding shortfalls, given that they fall under two separate institutional frameworks: one for “pension funding” and the other for “pension accounting”. Pension funding rules are set by U.S. Congress, to ensure

minimum funding levels, and reporting is done by DB pension plans through form 5500. Mandatory contributions are triggered when pension funding decreases, and, importantly, the *ER* assumption does not affect these payments. On the other hand, pension accounting rules are set by the U.S. Financial Accounting Standards Board (FASB) to develop accurate measurements of pension funding corporate plans status. The financial reporting is through 10-K forms. When pension funding decreases, reported net equity decreases, with no direct cash flow implications, unless the amortization of unrecognized actuarial gains/losses is triggered. Importantly, when the *ER* assumption increases, the pension expense decreases, and reported net income increases, even though there are no implications for cash flows or pension funding on the corporate balance sheet. Therefore, it is perhaps not accidental that the academic literature can be quite divided across these two institutional frameworks.

Given this discussion, why might the *ER* manipulation be linked to DB pension underfunding? We view the corporation as a unified entity that does not make decisions in separate compartments, ignoring the implications of a decision across different parts of the business. For instance, Webb (2007) provides a theoretical analysis of the interaction between a corporation's real and financial decisions with the financing of a corporate's DB pension plan. The *ER* assumption affects net equity and can also have cash flow implications if the amortization of unrecognized actuarial gains/losses is triggered and/or Pension Benefit Guaranty Corporation (PBGC) premiums need to be increased. In case of a pension funding shortfall, firms are likely facing the prospect of using cash or even having to raise new debt to increase pension funding. Such a prospect taking place in a period of elevated market volatility, creates incentives for managers to manipulate the pension *ER* assumption, as it will decrease the pension accounting expense and in turn improve corporate earnings. An et al., (2014) show that the market rewards firms in the short-run for elevated firm

earnings achieved through *ER* manipulation to meet or beat analysts' forecasts (even though in the long-run these firms underperform their peers).

Industry reports in late 2010 and early 2011 provide anecdotal evidence consistent with concerns about corporate income smoothing related to corporate DB plan underfunding. In November 2010, Honeywell International Inc. was the first corporation adopting mark-to-market pension accounting practices to replace the popular amortization methods that had been used until then. [1] The company defended its choice by citing increased transparency on operating performance and also citing the drag on future corporate income from the losses in pension assets experienced back in 2008 that would be carried over for several years after 2010. Moreover, the prevailing low interest rates in credit markets provided an opportunity for the firm to borrow funds and slowly close their DB pension funding gap by making DB pension contributions that were more than double the required contribution for the fiscal year.[2]

We use the Great Recession in 2008 as a particularly relevant period when earnings manipulation became more important, given the adverse impact on pension assets and liquidity. Focusing on pension accounting assumptions, a significant part of the pension accounting expense (subtracted from earnings) depends on the *ER* assumption. A higher *ER* can help reduce the sponsor's pension expense, therefore increasing current year's earnings, and presenting better than actual, current profitability. Moreover, the difference (loss) between expected and actual return on pension assets is amortized over the next several years' income statements, therefore reducing income volatility. In short, increasing earnings through an increase in *ER* in the current year,

[1] Soon after Honeywell (https://rb.gy/mmaiwy) AT&T and Verizon followed in early 2011 (https://rb.gy/ynknj8).
[2] Honeywell Corporation Inc. mentioned that they would also immediately make an additional pension contribution ($600 million) which was 1.5 times more than their required contribution ($400 million) for the current fiscal year. Their pension assets as December 31st of the previous fiscal year stood at $13.8 billion, while immediate loss they recognized on the 2010 financial statement stood at $5.5 billion in losses carried over from previous years.

potentially improves the borrowing conditions in the near future, as firms obtain the benefit from a higher *ER* assumption, while the cost of increased volatility is amortized over the next several years.

Our findings suggest that corporate DB pension plan sponsors make expense-reducing assumptions when their plans switch from a funded to an underfunded status. Our empirical findings show that plan sponsors purposely overstate *ER* to reduce the pension expense, especially in periods when DB plans experience a significant deterioration in pension funding. More importantly, we show that the degree of manipulation is higher when the level of pension funding is lower. Finally, we test for the economic impact of the *ER* manipulation on financial statements by documenting an expense-reducing outcome for these firms, as their pension expense decreases.

Our empirical analysis uses annual data from U.S. single-employer corporate DB pension plans. Using domestic, single-employer plans allows us to use COMPUSTAT data to determine funding shortfalls, rather than having to rely on form 5500, which would limit the number of observations in the sample.[3] We focus on the sample of non-financial firms over the period of 2003–2009, which covers several years before the 2008 crisis, and also the years that directly impacted the pension funding ratios (2008 and 2009).[4] We exclude the period after 2009, because they preceded the regulatory change introduced in 2012 by the "Moving Ahead for Progress in the 21st Century Act (MAP-21), that had a direct impact on corporate pension plans' risk-taking and contributions

[3] The COMPUSTAT funding ratio is the aggregate funding ratio of all pension plans offered by the company. Form 5500 has information on the funding ratio of individual pension plans. Two factors can explain why aggregating the individual pensions in Form 5500 might not give the COMPUSTAT funding ratio. First, a subsidiary company offering a pension may not be matched with the parent company. Second, the COMPUSTAT aggregate funding ratio includes foreign pensions, which are not included in Form 5500. We therefore focus on domestic, single-employer plans to address both concerns, while keeping the sample size reasonable.

[4] Sophisticated entities like financial institutions are more likely to make more accurate predictions about the expected return on assets, relative to non-financial institutions, that might have longer term negative impact on their firms (An et al., 2014). We thank a referee for this insightful comment.

(Ioannidou et al., 2022). We test for the relation between underfunding and the *ER* assumption using a difference-in-differences (*DID*) approach around 2008. Our treatment group comprises those firms that switch from funded to underfunded status.

We use two proxies for the *ER*. We construct the first proxy as the ratio of the dollar expected returns on pension assets (as reported by the firm) divided by the value of pension assets in the previous fiscal year. We refer to this measure as *EROA*. We also use the company's anticipated long-term rate of return on plan assets (as reported in Compustat, with code *PPROR*), as an alternative, potentially more conservative, measure of *ER.*

We conduct a difference-in-difference (*DID*) analysis around the exogenous 2008 crisis period, using *EROA* (*PPROR)* as dependent variable. Our *DID* models test whether the *EROA* (*PPROR)* assumed at the end of the plan's fiscal year (*t*) for the following fiscal year (*t*+1), when plan sponsors already have knowledge of the current year's (*t*) funding status, varies, depending on the pension funding status. Our main explanatory variable is a transition variable, which identifies plans that have transitioned from funded to underfunded in the current fiscal year *(t)*.

We find robust evidence that plans making the transition from funded to underfunded assume a higher *EROA* (*PPROR*) of about 79 bps (28 bps), in the following year, relative to plans that do not make this transition. This increase in *EROA* (*PPROR*) is consistent with the interpretation that pension plan sponsors make expense-reducing assumptions translates into an average annual decrease in the pension expense of about $9.85 ($3.49) million. Results are robust to a number of controls, such as firm size, firm age, pension asset allocations in equity (Addoum et. al., 2010; Amir et al., 2010; Chuk, 2013), actual past returns on pension assets, amortization amounts, exclusion of frozen pension plans, the presence of corporate financial constraints, and alternative

definitions of pension liabilities and *EROA*. We also posit that while funded plans do not experience a decrease in pension expense post-2008, underfunded plans do.

One potential criticism to our results is that the implementation of the Pension Protection Act (PPA) in 2008 might impact our results. The main change introduced by PPA related to our results was that firms were encouraged to fully fund their pension plans. However, the PPA was signed into law in August 2006 and became effective in 2008, thus firms likely focused on increasing their pension funding ratios in the period before 2008. To address concerns that our treatment sample might include some of these firms, we conduct a robustness test where we artificially raise the minimum required funding ratio by 15%. Our results remain robust.

Another potential objection to our findings is that the 2008 crisis might have shocked not only the DB pension funding status but also corporate performance. We address this possibility by re-running our analysis on the sub-sample of firms, for which the return on assets (ROA) was non-negative in the 2008 global financial crisis, and also for the sub-samples of firms with above and below median exposure in equities in 2007.[5] Our results remain robust to this specification in addition to a battery of other robustness tests we conduct.

The rest of the paper is structured as follows. Section 2 provides the institutional background and develops the hypotheses to be tested. Section 3 describes the identification process and provides descriptive statistics. Section 4 describes the empirical setup using *DID* models and discusses the results. Section 5 concludes.

[5] Results presented in Tables 8 and OA2 respectively.

2. Regulatory Framework and Hypothesis Development

2.1. Pension Funding Law

The Employee Retirement Income Security Act 1974 (ERISA) is a U.S. federal law that seeks to protect beneficiaries of corporate defined benefit pension plans. When originally introduced, it was seen as an attempt to safeguard the benefits employees accumulated over their working lives, and to guarantee promised benefits to retirees. In subsequent decades, and following the default of several sizable DB pension plans and the deteriorating financial condition of the PBGC,[6] additional pension funding reforms were implemented. Their main aim was to elevate the funding level of DB pension plans and enhance the financial condition of the PBGC. The most recent proposal, Pension Protection Act (PPA), is considered the most comprehensive reform of pension laws since the enactment of the ERISA.[7]

The PPA established new funding requirements for corporate DB pension plans and included reforms affecting cash balance pension plans, defined contribution plans, and deferred compensation plans for executives and highly compensated employees. Two major changes were introduced by the PPA to encourage firms to increase their pension funding ratios. First, after the implementation of PPA, they would have less time to cover any pension funding gaps relative to the period before the PPA implementation (7 vs. 30 years, respectively). Second, firms were provided with tax incentives to increase their funding ratios well above the 100% threshold. Another change introduced by the PPA was to reduce the flexibility of plan sponsors to choose the pension liability discount rates (*LDR*s), hence less discretion in calculating the present value of pension liabilities (the denominator of the funding ratio).

[6] PBGC is an independent U.S. government agency that takes over DB pension plans from bankrupt or insolvent firms and pays benefits to participants up to a stipulated maximum yearly amount.
[7] For more details visit, https://www.gpo.gov/fdsys/pkg/PLAW-109publ280/pdf/PLAW-109publ280.pdf

While the PPA was voted into law in August 2006, it became effective in 2008 (Campbell et al., 2010). It is possible that pension plan sponsors started preparing for the implementation of the PPA Act earlier than 2008 by aiming to increase their funding ratios above the minimum funding ratio in year 2008, thus avoiding regulatory scrutiny. To address this concern, we run several robustness tests related to the level, and the change of the percentage of pension assets invested in equity. In another robustness test, we artificially raise the pension funding threshold above the regulatory threshold to remove those observations from our treatment group that managed to increase their funding ratios slightly above the regulatory threshold.

2.2. Pension Accounting Expense and *ER*

We focus on investigating the *ER* assumption because it partly determines the pension expense. The four major components of the annual pension expense are the service cost, the interest cost, the expected change in value on pension assets, and amortization amounts:

$$\begin{aligned} Pension\ Expense &= Service\ Cost + Interest\ Cost \\ &- Expected\ Change\ in\ Value\ of\ Pension\ Assets + Amortization\ amounts. \end{aligned} \tag{1}$$

The first component in Equation (1) is the service cost, which is the value of additional pension benefits that employees have earned over the current year and increases the pension expense. The service cost is a function of a predetermined pension benefit formula that accounts for elements such as employees' salary and years of service, among other factors. The second component is the interest cost, which measures the impact of having employees age one year and thus being 1 year closer to receiving their retirement benefit, which has been accruing over the current year.

The third component is our variable of interest: the expected change in the value of pension assets, an assumption made by pension actuaries.[8] Discretion is needed in setting this assumption, which takes into account the historical performance of asset classes, projections of future individual asset classes returns (e.g., equity), and other factors, such as macroeconomic developments, as described in the ASOP 27[9] and in the PPA.[10] Because the increase in pension assets will help pay future pension liabilities, the assumption of (a positive, overoptimistic) expected return on pension assets, will decrease the pension expense. This expected change in the value of pension assets is an input in both dependent variables we use (*EROA* and PPROR).

Finally, the fourth component relates to amortized amounts and consists of several items, such as the difference between the expected and actual return on pension assets, pension funding deficits (i.e., when the fair value of pension assets is smaller than the present value of pension liabilities) and other differences that might arise between assumptions and their realizations (e.g., on compensation, discount or mortality rates). When the net amount of these (potentially offsetting) differences is small, it does not affect net income, but is recorded in other comprehensive income. However, when these differences exceed a threshold (i.e. they exceed 10% of the fair value of plan assets or the projected benefit obligations), they have to be amortized over several years in the pension expense, therefore impacting net income.[11] We expect that such deviations between expected and actual returns on pension assets will be exacerbated in the 2008 crisis, hence we control for changes large changes in the amortization amounts in a robustness test.

[8] The literature has investigated different motives behind discretionary actuarial assumptions (e.g., Anantharaman, 2017; Kisser et al. 2017; Bartram, 2018; Anantharaman and Chuk, 2018).
[9] https://www.actuarialstandardsboard.org/wp-content/uploads/2014/02/asop027_172.pdf .
[10] https://www.govtrack.us/congress/bills/109/hr4/summary .
[11] Amortization amounts include, among other items, pension funding deficits (i.e., when the fair value of pension assets is smaller than the present value of pension liabilities). The pension plan sponsor is obliged by law to amortize these amounts over a number of years. For more details visit, https://www.actuary.org/pdf/pension/fundamentals_0704.pdf.

2.3. Hypothesis

The pension expense definition (Equation (1)) suggests a limited discretion associated with the service and interest costs, but a significant discretion associated with the expected change in pension asset value, and consequently the *ER* assumption. The last component (amortized amounts) is again not associated with any discretion as it reflects actuarial gains and losses realized from deviations between prior years' pension assumptions and their realizations. Hence, it is possible that a corporation uses its discretion on *ER* to manage earnings, by making expense-reducing assumptions (whose deviations from the realizations will appear in other comprehensive income). According to Bergstresser et al. (2006) one reason to make expense-reducing assumptions is to inflate earnings in periods associated with takeovers, the exercising of managerial option-based compensation, or when earnings are used to convey a good signal to markets. However, the arrival of a negative shock (e.g., the 2008 crisis) is likely to push deviations between actual and expected returns of pension assets outside the 10% corridor, therefore directly impacting net income in the following years through the amortization part of the pension expense.

Such an adverse shock to financial markets is expected to have a significant impact on the actual return on pension assets, therefore directly affecting the plan's funding ratio.[12] Even in the case that corporations did not previously manipulate *ER* to increase earnings, they might now be provided with an incentive to do so. Given the unprecedented shock from the 2008 crisis, it becomes likely that net income will be adversely affected, as the 10% corridor difference is more likely to be surpassed and trigger the amortization mechanism. Since most of our companies have a December fiscal year-end and given that the *ER* assumption can be set several months after the

[12] Funding ratio is calculated as the ratio of fair value of assets over the PBO. In robustness checks we also use the accumulated benefit obligation (ABO) instead of the PBO.

fiscal year end, pension assumptions can take place well into the following year. Focusing on the 2008 fiscal year, this means that pension assumptions are likely set at around the same time that the S&P 500 market experiences one of its worst declines in the previous several decades.

How might corporate plan sponsors react under the conditions described above? Before explicitly stating our hypothesis, it is useful to understand the reasons why a corporation would want to maintain a funded DB plan. First, regulatory scrutiny increases when a DB plan becomes underfunded, especially after the enforcement of the PPA in 2008 that increases funding requirements for DB pension plans.[13] Second, to emerge from underfunding, sponsors are required to make larger fund contributions to their pension plans (Campbell et al., 2010). The larger the gap separating the fair value of pension assets and projected benefit obligations (*PBO*), the larger the contributions needed to eradicate the deficit. Third, an underfunded plan pays insurance premiums to the PBGC, and premiums increase with respect to the DB plan's underfunded vested benefits.[14] If a DB plan is terminated, the PBGC is expected to pay (partial) retirement benefits to the employees covered by the plan. Put differently, the PBGC premium offers a larger benefit for employees than the employer, while premiums are non-refundable in the case that the plan becomes funded again.

Despite the incentives to stay funded, the onset of the financial crisis had an adverse impact on already financially challenged firms, especially those struggling to keep their funding ratios over the regulatory funded threshold. Therefore, we expect corporate plan sponsors transitioning from funded to an underfunded status, because of the 2008 crisis, to use the discretion offered by the pension *ER* assumption to decrease their pension expense. The plans making the transition are

[13] This is an indicator variable equal to 1 if the funding level is below 0.9 for the years preceding 2008, 0.92 for 2008, 0.94 for 2009, 0.96 for 2010, and 1 for 2011 or later.
[14] https://www.pbgc.gov/prac/prem/premium-rates.

presented with an opportunity to manipulate earnings, in the current year, in order to present a better picture on earnings. Firms transitioning to underfunded status have a stronger incentive to increase their *ER*, compared to firms not transitioning to underfunded status, as this can lead to higher earnings in the current year, whereas the realization of loss (expected minus actual return on assets) is amortized over future years. The scenario of increasing *ER* also includes the case where both types of plans decrease their *ER*, however, those who make the transition decrease their ER less than those not making the transition. We formally state this as our first hypothesis:

Hypothesis 1: Corporate defined benefit pension plan sponsors transitioning from funded to underfunded pension status are expected to assume a higher ER than those not making this transition.

3. Identification, Data, and Descriptive Statistics

We focus on U.S. corporate DB pension plans over the period 2003–2009. We choose this period to minimize contamination from unrelated regulatory changes and other events. We start in 2003 because this is the effective year of a new pension reporting standard (SFAS 132R), which required corporate pension plans to disclose their pension asset allocation (Chuk, 2013). In addition, and as a potential consequence of SFAS 132R, this was the year when most of the corporate DB pension plan data were reported in a consistent manner through Compustat.[15]

The key identification strategy in our analysis is the unexpected recession in 2008, which introduces an exogenous shock to the corporate DB pension plans.[16] The crisis generates a large decrease in pension asset values, thereby pushing many pension plans into an underfunded

[15] A revision, which was introduced in 2009, to SFAS132R enhanced the reporting of pension asset allocation from the 2003 requirement. Specifically, in 2003, pension plans had to report the percentage of pension assets invested in equity, fixed income, and "other assets." In 2009, pension plans had to refine the category of "other assets." This modification is of minor importance to our analysis, as the riskiest asset category in our analysis is the equity category.
[16] While the PPA was implemented at the same time, it is likely that the plan sponsors anticipated the impact of the new regulation on their pension plans, since it was voted in 2006 and it had been discussed for some time before that.

territory. We use a model of differences-in-differences, around 2008, to test how DB plans transitioning from funded to underfunded status, potentially manipulate their *ER* assumption, to generate expense-reducing outcomes for corporate DB pension plans.[17]

Our analysis ends in 2009, shortly after the official end of the 2008 crisis and before the significant regulatory change of MAP-21 was implemented in 2012. Moreover, several corporations (e.g., Honeywell Inc, AT&T and Verizon) opted to use mark-to-market accounting practices for the corporate DB pension plans in late 2010, therefore significantly altering the reporting requirements. We also restrict our sample to non-financial firms, since sophisticated entities like banks and other financial institutions are more likely to predict the *ER* and understand the potential consequences associated with missing inflated *ER* in the following years.[18]

Our sample combines data from three different databases. First, we consider DB single-employer pension plan data sponsored by US-based corporations. Specifically, we consider variables such as the fair value of pension assets, projected benefit obligations (*PBO*), and pension valuation assumptions. Second, we select sponsoring firm-related data from Compustat Fundamentals Annual. In this instance, we use variables that can affect pension valuation assumptions, such as the sponsoring firm's capital structure and creditworthiness. Finally, we use variables related to corporate governance from MSCI (formerly KLM and GMI Ratings). All three databases are provided by Wharton Research Data Services (WRDS) and combined they form the final dataset (panel) we use for the empirical analysis. After deleting duplicates and entries from non-defined benefit pension plans, we end up with a panel that consists of 9,659 firm-year

[17] Similar approaches have been employed in the context of public pensions, as highlighted by Novy-Marx and Rauh (2012), who document how state-level investment losses during the 2008 financial crisis exacerbated fiscal imbalances and borrowing costs.

[18] We thank an anonymous referee for this comment.

observations from 1,869 publicly traded U.S. firms, spanning 2003-2009. To remove the impact of outliers, we winsorize all variables at the 1% and the 99% levels. Table A1 provides a detailed description of our variables.

3.1. Dependent Variables

Our main dependent variable is the expected return on corporate DB pension plan assets, *ER*, which we construct in the following manner. At the end of fiscal year *t*, plan sponsors assume their pension assets will have a specific value by the end of the following fiscal year *t*+1. *EROA* is the ratio of the assumed change in value of pension assets over the fiscal year *t*+1 over the actual value of pension assets reported at the end of fiscal year *t*:

$$EROA_{t+1} = \frac{Expected\ Change\ in\ Value\ of\ Plan\ Assets_{t+1}}{Actual\ Value\ of\ Plan\ Assets_{t}}. \quad (2)$$

In addition to the constructed EROA variable, we also use the company's anticipated long-term rate of return on plan assets (Compustat variable *PPROR*), as in Comprix and Muller (2011). We do this to address the potential criticism that the variable in Equation (2) might be affected by issues such as acquisition or disposal of plan assets, and the pension plan measurement date, among others. Our results are robust to using *PPROR* as an alternative measure of *EROA*.

Since the expected change in the value of pension assets is one component of the Pension Expense, that shows the impact of ER manipulation on the firm's financial statements, we measure the impact of underfunding on *normalized pension expense*. To construct this variable, we use the pension accounting expense reported by the company and normalize it by dividing with the pension plan's *PBO*. We divide by the *PBO* instead of the pension asset value, because the *PBO* is more stable over time and is also not affected by the main driver of the underfunding ratio (the actual return on pension assets).

Table 1 reports aggregate descriptive statistics for the dependent variables over the period 2003–2009. We find that the average (median) *EROA* is 7.85% (7.89%), whereas the average (median) *PPROR* is 7.58% (8.00%). We note a difference in the standard deviation of the two measures, which appears to be driven by the longer tails of the *EROA* measure. Finally, focusing on the *normalized pension expense* we observe an average (median) value of 13.45% (6.36%).

3.2. Pension allocation to equity and *EROA (PPROR)* trajectory

Figure 1 provides some initial motivation for our analysis for both *EROA* (Panel A) and *PPROR* (Panel B). In Panel A, although we observe a generally downward-sloping curve for *EROA* until 2007, in 2008, plan sponsors increase their *EROA* assumption to levels as high as about 5 years earlier (2003) and it then drops significantly in 2009 but remains above the 2007 level. On the other hand, we observe a downward trend in *PPROR* that appears unrelated to the crisis, at first glance. Before formally testing the impact of the crisis on the *ER* assumptions, let us first try to understand the *EROA* trajectory.

Under what circumstances might *EROA* increase? Equities are the riskiest securities in which DB pension funds invest. Hence, the first potential explanation could be that *EROA* would increase from a high percentage of pension assets invested in equities. From Panel A, it is evident that the average percentage of pension plan assets invested in equities takes a sharp downturn in 2008 and subsequently increases by a small amount in 2009. This trend is inconsistent with the view that *EROA* increased in 2008 due to increased investment in equities.[19]

Historical increases in equity returns could provide another potential explanation for an increase in *EROA* in 2008. In general, actuarial assumptions are based on historical data (e.g., ASOP 27).

[19] We conduct a series of robustness checks using the pension asset allocation to equities and our results remain robust. Details are provided in and after section 4.4.5.

Since the stock market experienced one of its worst declines in that period, it is highly unlikely that *EROA* increased because actuaries suddenly became forward-looking and increased *EROA* after the 2008 crisis (Panel B).[20]

3.3. Main Explanatory Variables

Table 1 also reports descriptive statistics for the key explanatory variables in our analysis. We create the indicator variable called *Underfunded*, using the regulatory thresholds imposed on single-employer pension plans over the sample period (Table A1). On average, 76.79% of plans are classified as underfunded. For our analysis, it becomes especially important to identify those plans that have made a transition from a funded to an underfunded status, using an indicator variable. Therefore, we create a *transition* variable to identify those plans and find that 7.84% of our plan-years make this transition over our sample period.

3.4. Plan Characteristics

We control for several plan characteristics in our analysis that might affect the *ER* assumption. The first one is plan size, which is determined by the present value of *PBO*. We use *PBO* (the promise made to employees about their future benefits) instead of pension assets because the *PBO* tends to be more stable from year to year (pension plan assets are volatile and depend on economic conditions). The average (median) defined benefit pension plan has *PBO* of $1,529 ($227) million with a standard deviation of $3,782 million. Similarly, the average (median) plan has an asset value of $1,247 ($170) million with a respective standard deviation of $3,174 million. The distribution of both variables suggests that the sample of pension plans includes a few very large plans

[20] In our sample 94% of the pension plans have a December 31st fiscal year-end date. Because firms have up to 7 months to file the accounts of each pension plan fiscal year, this means they can file until July 31st of the following calendar year. Therefore, plan sponsors have the benefit of grounding their *EROA* assumption after 7 months of the new fiscal year have passed. Even if we assume that plan sponsors exhausted the 7-month filing, the EROA assumption only increased once over our time period.

generating mean values several times over the median plan size. Hence, we control for the size of the plan (Plan Size), defined as the natural logarithm of the *PBO* (in millions). [21]

Pension asset allocation is a major determinant of the expected return on pension assets: more assets invested in equity could justify a higher *ER*, all else being equal. We control for the percentage of pension assets invested in equity and find that, on average, pension plans invest 57.7% of assets in equity and 35.2% in bonds.

Auditors are expected to act as an external, independent monitor for corporate DB pension plans and the respective assumptions set forth by actuaries. The literature finds that bigger audit offices provide higher-quality audits, because of less dependency from clients, and tend to avoid questionable practices (e.g., overlooking earnings manipulation) that might impact their good name (Francis and Yu, 2009). Hence, we expect that controlling for large versus small auditors will capture the potential negative relationship between auditor size (and quality) and expense-reducing assumptions. To control for the size (and indirectly quality) of auditing services, we create an indicator variable equal to 1 to identify auditing conducted by the Big 4 Auditors (PWC, Deloitte, KPMG, Ernst & Young) and 0 otherwise. On average, 91.7% of the plans in our sample are audited by the Big 4 auditors.

3.5. Corporate Characteristics

Current literature on corporate defined pension plan assumptions (Bergstresser et al., 2006; Bartram, 2018) discusses the likelihood that corporations might pierce the veil between the firm and the pension plan by adjusting their contributions to pension plans to serve corporate objectives, which are not necessarily aligned with the incentives of pension plan stakeholders. Hence, we also control for several corporate characteristics.

[21] Plan size and firm size are correlated, so we use only firm size.

First, we construct corporate leverage, defined as debt to assets. The average (median) leverage ratio is 28.9% (26.6%). Next, we calculate debt maturity, as a proxy of the repayment horizon that firms face on their debt. We expect that the shorter the debt maturity, the higher the need to refinance or repay the debt, hence the stronger the need to make expense-reducing assumptions. Then, we control for the firm's credit risk by including the firm's Z score, following Altman (1968). Firms in distress might have stronger incentives to inflate the *ER* assumption, by making expense-reducing assumptions to report improved profitability, which might in turn improve financing conditions. The amount of cash and short-term investments *(Cash and STI)* of a company could be a factor affecting *ER*. For example, cash shortage creates incentives to increase *ER*, therefore decreasing current pension expense and subsequently increasing current earnings. Presenting higher earnings than actual, potentially allows the firm to tap into debt markets in the near future. Next, we control for firm size and firm age; two demographic characteristics that are likely increased financial constraints (Hadlock and Pierce, 2010) on corporate pension plans, since both characteristics could correlate with the age of employees who are expected to have significant levels of accumulated benefits in their corporate DB plans.

Our final control variable relates to the alternative hypothesis of *ER* manipulation to present an optimistic snapshot of the firm. This might happen, for instance, in periods before potentially acquiring another firm, in periods when earnings are close to critical thresholds, or, even, in periods when executives are ready to exercise stock options on the firm's stock price granted to them as part of their compensation (Bergstresser et al., 2006). We construct the *Pension sensitivity* variable in Bergstresser et al. (2006) as another explanatory variable. *Pension sensitivity* is defined as the ratio of the fair value of pension assets to firm operating assets.

3.6. How Does 2008 Change Corporate DB Pension Plans?

We set up our *DID* model around year 2008, so we separately present descriptive statistics of all variables for the periods 2003–2007 and 2008–2009. Table 2, Panel A, shows results for the period 2003–2007, and Panel B shows results for the period 2008–2009. Focusing on the funding level, there is a dramatic decrease in pension funding levels in the latter period, which coincides with the crisis. This decrease is reflected in the mean difference of the *Funding* ratio, the *Underfunded* indicator, and the *Transition* variable. The Funding ratio decreases from 78.88% before 2008 to 71.41% after 2008. Moreover, the percentage of underfunded pension plans increases from 72.3% before 2008 to 88.8% after 2008, providing a signal that a mere 11.2% of plans remain in good funding status in the post-2008 era. Finally, the annual transition (from funded to underfunded) before 2008 is 2.56%, with this number increasing to 21.6% after 2008. This preliminary descriptive analysis illustrates that 2008 is associated with a major change in the funding status of pension plans, presumably arising from the financial crisis.

Table 3 provides further details of the comparison between firm characteristics between the control and treatment group. Firms that transition report higher EROA (8.45% vs 7.74%) and higher PPROR (7.74% vs 7.59%). The firm characteristics between the ones that transition and the ones that do not transition are broadly similar with some deviations that need to be controlled for in the analysis that follows. The main control that might affect our conclusions is the share of pension assets allocated to equity. We find that the ones that transition have 53% share in equities

versus 58% for the ones that do not transition. We will control for this variation in different ways in the analysis that follows.[22] [23]

4. Methodology and Results

In order to study the effect of pension plan funding deficiencies on assumed expected pension asset returns, a *DID* methodology is appropriate where the exogenous crisis in 2008 provides the first difference and then the variation between plans across different funding categories provides the second difference. The 2008 financial crisis provides an exogenous shock for examining the behavior of corporate pensions, as asset values fell dramatically during this period. This approach is consistent with prior studies, such as Novy-Marx and Rauh (2012), who also use the 2008 crisis to examine investment losses and borrowing costs for public pensions.

The *DID* research design is based on the assumption that two mutually exclusive groups of observations (treatment and control) have parallel trends before treatment (Angrist and Pischke, 2009).[24] Our *DID* regression model is set up as follows:

$$y_{t+1} = \alpha_0 + \alpha_1 * 2008onwards \ + \alpha_2 * Transition_t + \alpha_3 * 2008onwards * Transition_t + \ \alpha_4 * Funding_t + \beta * Plan\ Characteristics_t + \ \gamma * Firm\ Characteristics_t \ + \varepsilon_{t+1}. \quad (4)$$

EROA is the first dependent variable used to test our hypothesis. For robustness, we also use *PPROR*. *Transition* takes the value of 1 if a plan becomes underfunded in the current fiscal year (i.e., the plan is funded in year *t*-1 and underfunded on year *t*). To test for the impact of year 2008 onward, we create the *2008-onwards* indicator, which takes the value of 1 for the period 2008–

[22] We provide further details by year in the Online Appendix (Table OA1) and Figure OA1.
[23] In unreported results we compare the mean values of the control variables used in our models. Before 2008, underfunded plans generally have lower equity allocations, higher leverage, and they are typically smaller and younger than firms with funded plans. They also tend to have lower cash holdings and weaker Altman Z-scores, which may indicate greater financial constraints.
[24] Table 7 shows the parallel trends' test.

2009 and 0 otherwise. We interact this variable with the *Transition* variable, so that we can identify those firms that have switched funding status because of the crisis period. We also control for a series of pension plan characteristics and another set of corporate pension plan sponsor characteristics. We show the results next.

4.1. Evidence of Expense-Reducing Treatment of *EROA*

The main result from Table 4 is a strong positive coefficient on our identification variable, that is, the interaction term between the *2008-onwards* and the *Transition* variable. We interpret this positive coefficient as evidence supporting the argument that DB plan sponsors whose pension funding levels transitioned from funded to underfunded after 2008, choose to increase their *EROA* more than those sponsors whose funding ratios did not make this transition.

The size of this coefficient is economically significant amounts to about 79 bps, which represents about one-tenth of *EROA*'s average value. In absolute terms the increase in *EROA* for pension plans that transitioned from funded to underfunded corresponds to an increase in the value of pension plan assets of about 10 million USD.[25]

Next, we focus on the remaining control variables from the *DID* model. The *Equity* variable is positive and significant (p-value < 0.01), as expected, since a higher pension asset allocation in equity is expected to generate higher *EROA*. Next, we focus on the firm's *Cash and STI* (short-term investment) variable, which captures any potential liquidity issues that the plan sponsor might face. We observe that the coefficient of this variable is negative and significant (p-value < 0.01) implying an association between plan sponsors facing liquidity problems and their propensity to make expense-reducing assumptions through an elevated *EROA*.

[25] Calculated as follows: 0.0079*1,247 million, with the second number being the average pension asset value size.

4.1.1. Evidence using *PPROR*

One criticism to our analysis is that *EROA* is a calculated metric that might be sensitive to the reported value of pension assets, hence it might suffer from potential measurement errors. We address this concern, by repeating our analysis using *PPROR*, that is, the firm's reported long-term return on pension assets.

Results using *PPROR* of Table 4 (second column) show a similar story. Pension plans that switch from funded to underfunded, because of the crisis tend to increase *PPROR* relative to the rest of the pension plans. Specifically, we first note that variable *2008-onwards* shows that *PPROR* decreases for all plans after 2008, as the coefficient is -12 bps and statistically significant (p-value < 0.01). The interaction term *Transition*2008-onwards* however is positive and significant (p-value < 0.01) in all model specifications and amounts to 28 bps. We observe that while all plans tend to decrease *PPROR* by about 12 bps, plans that transition from funded to underfunded tend to increase *PPROR* by about 16 bps (28 bps – 12 bps).

4.2. Further evidence on the impact of funding on ER

We provide further evidence that the degree of manipulation of the *ER* return assumption is stronger the further a firm breaches the minimum funding ratio. Specifically, we expect that firms which became underfunded in 2008 but drop to a funding ratio relatively close to the minimum funding threshold, will likely manipulate *ER* to a smaller degree than those dropping significantly below the threshold. In this test, we focus on the pension funding ratio in year 2008 only, and split the entire sample at the median funding ratio of 2008 (median = 0.683622). We observe in Table 5 that the results are driven by the subsample of lower funding ratio (below median) for both *EROA* and *PPROR*. On the other hand, for the high funding subsample (above median funding) the

coefficient for *EROA* has a smaller coefficient than the Low Funding subsample, while the coefficient for *PPROR* is not statistically significant.

4.3. Effect on Pension Expense

Does the *ER* manipulation have an impact on corporate financial statements? Following Equation 1, we expect that if the *ER* manipulation is significant enough, it should impact the corporate pension expense, as the dollar value of the manipulation will is subtracted from the pension expense. The dependent variable in our DID model is the normalized pension expense, that is, reported pension accounting expense divided by *PBO*. Results are shown in Table 6.

We find that the *Transition*2008-onwards* variable is negative and statistically significant, therefore providing evidence that plans which have transitioned from funded to underfunded status, because of the 2008 crisis, have overall decreased their pension expense. This decrease in pension expense is surprising, given the exogenous shock to pension funding ratios, but it is also consistent with the results of our hypothesis, which show an increase in *ER*. The decrease is also economically significant as it amounts to 5.3%.

The evidence presented in Table 6, shows one channel of how a transition from a pension funded to an underfunded status due the 2008 shock, is linked to an inflation of the expected return on pensions assets, and in turn to a decrease in pension expense. This expense-reducing manipulation of the expected return assumption for pension assets provides evidence that company management engages in earnings management, when they face significant adverse effects on the funding status of corporate pension plans.

4.4. Robustness to Alternative Hypotheses

4.4.1. Parallel trends test

We run a parallel-trends test for our baseline model. Specifically, we add year indicators in our *DID* regressions and then interact these year indicators with the "*Transition*" variable, to observe whether the increase in *EROA* (*PPROR*) started happening before the 2008-2009 crisis. Results are reported in Table 7 for both *EROA* and *PPROR*. Focusing on the coefficient of "*Transition*Year 2008*" we note that it is positive and significant. On the contrary we do not observe any positive and statistically significant coefficients for the interaction terms involving the years before 2008 that would indicate that the *ER* manipulation started before the crisis.[26]

4.4.2. Crisis also affects corporate performance.

One main, alternative explanation of our results might be that the 2008 crisis does not only affect the pension funding ratios but also corporate performance. In other words, the results we observe might be because *ER* is manipulated to reduce corporate expenses, in an effort to soften the shock induced by the 2008 crisis on corporate performance. To address this criticism, we identify a sub-sample of firms that remained profitable (measured by the return on assets – *ROA*) in 2008 and re-run our main results using that sub-sample (about 65% of our original sample).

We re-run our *DID* analysis on this sub-sample for *EROA* and *PPROR* (Table 8). The *Transition * 2008-onwards* variable is still positive and significant for both variables. Specifically, we document an increase in *EROA* of 104 bps (p-value < 0.01). A similar result is obtained for *PPROR* where the coefficient of *Transition * 2008-onwards* of 28 bps (p-value < 0.01).

[26] We note the presence a weakly statistically significant (p-value < 10%) but negative (i.e., opposite to our main result) in "Transition*Year 2006", which goes against a potential criticism that ER manipulation started before year 2008.

4.4.3. Sensitivity to earnings manipulation

We next address the second potential alternative explanation that firms might be manipulating earnings, when their earnings are sensitive to such manipulation. Bergstresser et al. (2006) find that corporate pension plan sponsors tend to manipulate the *ER* assumption when the corporate plan sponsor needs to show elevated corporate earnings. As an example, they focus on firms getting ready to acquire potential investment targets, firms challenged by the level of their earnings, or firms whose executives intend to exercise their stock options on the firm's stock price. By using a dataset from 1991 to 2002, they create a measure of pension sensitivity to earnings that captures the *EROA* manipulation. We replicate this measure (*Sensitivity*) and include it as a control variable in our *DID* regressions (Table 9). The pension *sensitivity* variable has a positive and significant coefficient, consistent with Bergstresser et al. (2006). Nevertheless, the *Transition*2008-onwards* result remains robust.

In short, Bergstresser et al. (2006) show evidence of earnings management through *EROA* manipulation for firms whose earnings are sensitive to *EROA* manipulation. However, they reject the alternative hypothesis that pension funding ratios could be driving the *EROA* manipulation. Our study shows different results. We find that deterioration in pension funding ratios also impacts the *ER* (*EROA* & *PPROR*) assumption.

4.4.4. PPA impact on our results

While the PPA provided tax-incentives for firms to improve pension funding, it also reduced the flexibility that plan sponsors had in choosing the pension liability discount rate (Anantharaman, 2017; Kisser et al., 2017), and also decreased the amount of time that firms had to fully fund their pension plans from 30 years to 7 years. Campbell et al., (2010) document negative market reactions to significant PPA announcements in 2005 and 2006. According to Campbell et al. (2010) the

negative impact on shareholders is likely driven by the reduced time that would be imposed on firms with highly underfunded plans to fully fund their pension plans, when PPA would become effective in 2008. To avoid regulatory scrutiny from PPA in 2008, it might be the case that pension plan sponsors started preparing for the implementation of the PPA Act earlier than 2008, by aiming to increase their funding ratios just above the minimum required funding ratio (90%) in 2008.

To address this concern, we conduct the following test to reduce the number of firms in our "Transition" group, which might have managed to increase the corporate pension funding ratios slightly above this threshold at the end of 2007, thus potentially being part of our "Transition" sample. Hence, we artificially raise the threshold for full funding in 2008, from 90% (regulatory threshold), progressively by 3%, from 90% to 105% (Table 10). For example, the "Transition" variable in the 2nd column of Table 10 (1st column is the baseline model), comprises of firms that transitioned from 93% (in 2007) to below 90% (in 2008); for the third column from 96% (in 2007) to below 90% (in 2008), and respectively for the sixth column from 105% (2007) to below 90% (2008). We document robust results for all interaction variables with statistical significance of 5% or better for both *EROA* and *PPROR*.

4.4.5. Impact of Pension Asset allocation

An alternative explanation to our results could be that *ER* might be a function of the pension asset allocation (Chuk, 2013), hence *ER* might be increasing mechanically with an increase in the percentage of pension assets invested in high-risk investments.[27] To address this potential explanation, we run a series of robustness tests.

[27] Amir and Benartzi (1998) hypothesize that plan sponsors with a higher proportion of pension assets invested in equity should use a higher ER assumption.

First, in addition to the percentage of pension asset allocation in equity, we also add the change in this pension asset allocation from one year to another. Second, we add the actual return on pension assets from the previous period as an explanatory variable. This test internalizes the volatility in actual equity returns over time. Third, we also use the lagged *EROA (PPROR)* as control variables. Results remain robust as shown in columns 1-4 of Table 11.

Finally, we conduct an additional empirical test to address the concern that companies with high pension asset allocation to equity might have higher expected returns for their pension assets after the crisis. For instance, companies with high allocation to equity, would be expected to have higher expected returns after the transition to underfunded relative to companies with low allocation to equity, given the expectation that equities will recover in the future. Hence, we split our sample of firms based on the median pension asset allocation to equity in year 2007 and re-run the analysis. Results do not provide evidence that it is mostly firms with higher equity allocation that manipulate their expected return assumptions (Table OA2).

4.4.6. Impact of Amortization

Another concern is that the inflated *ER* might simply be the firm's response in an effort to smooth the pension expense, when the "amortization amount" (Equation 1) is triggered when unrecognized gains or losses exceed 10 percent. While our results for the pension expense (Table 6) partly address this concern, we re-run our baseline results by controlling for amortization. Specifically, in columns 5-6 of Table 11 we add an indicator variable for those companies which have a non-zero amortization amount. That is when the absolute difference between the expected and the actual rate of return of a pension plan exceeds 10%, the indicator variable is set to 1, and 0 otherwise. While this indicator variable is significant in our model, our results remain robust.

4.5. Additional Robustness checks

We confirm our results by conducting a series of additional robustness checks (reported in the online appendix). Our tests are done on the two main dependent variables (*EROA* and *PPROR*). As a first step, we control for the change in equity (*ΔEquity*), when pension plans allocate their pension assets (Table OA03), Board independence (Table OA04), the accumulated benefit obligation (ABO) instead of PBO in the estimation of pension liabilities (Table OA5). Then, we control for frozen pension plans using an indicator variable in our main *DID* model with robust results (Table OA6). Next, we re-do the analysis for the sub-sample of plans with a December fiscal year end, as reported through Compustat (Table OA7). Then, to address a concern regarding potential survivorship bias, we use a balanced panel for our analysis that includes firms that are present throughout the entire period of our analysis (Table OA8). Our next step is to also controlling for serial correlation of the standard errors (Table OA9). Finally, we use an alternative dependent variable *EROA2*, in which the value of pension assets in the *EROA* calculation is replaced with the book value of firm assets. We do this, as an alternative way to address the concern of the volatility in pension assets around the 2008 crisis (Table OA10).

5. Conclusions

We use the 2008 crisis as an exogenous shock on DB pension funding ratios to examine the impact on earnings management incentives through the manipulation of the expected return (*ER*) on pension assets. By inflating *ER*, DB plan sponsors decrease their current pension expense and improve corporate earnings. We also document that the *ER* manipulation is larger when pension plans suffer a larger drop in their pension funding ratios after the 2008 crisis.

Our results show evidence that plans transitioning from a funded to an underfunded status increase their *ER* by about 28-79 basis points, depending on the variation of the *ER* used (*PPROR*

and *EROA*, respectively). This increase in *ER* amounts to a decrease of about $3.49 to $9.85 million in the pension accounting expense (this is an economically significant decrease in the pension expense ranging 5.23% to 14.76%). Our results are robust to the alternative hypotheses in the literature (Bergstresser et al., 2006; Chuk, 2013; Anantharaman, 2017; Kisser et al., 2017). Importantly, our results also hold on the sub-sample of firms that have not suffered an adverse impact on their profitability because of the 2008 crisis. The economic significance of the results signals that regulators should be concerned about pension assumption manipulations, especially by corporate sponsors of underfunded DB pension plans that are more likely to terminate their plans and transfer the outstanding liabilities to the PBGC.

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Tables and Figures

Table 1. Descriptive Statistics (2003 – 2009)

This table presents descriptive statistics of US corporate pension plan and plan sponsor related variables from 2003 to 2009. Dependent variables are the expected return on pension assets (*EROA*, *PPROR* & *EROA2*) and the Pension Expense. Table A1 defines dependent and independent variables in further detail. All reported statistics are based on variables winsorized at the 1% and the 99% level. Descriptive statistics include the number of observations (Obs.), mean, standard deviation (SD), minimum (min), maximum (max), and several percentiles of the distribution (p5, p10, p25, p50, p75, p90, and p95).

Variable	Obs.	Mean	SD	Min	p5	p10	p25	p50	p75	p90	p95	Max
Dependent variables												
EROA	9659	0.0785	0.0354	0.0000	0.0268	0.0486	0.0688	0.0789	0.0860	0.0972	0.1099	0.3176
PPROR	9228	0.0758	0.0148	0.0210	0.0400	0.0560	0.0720	0.0800	0.0850	0.0875	0.0900	0.1000
EROA2	9659	0.0110	0.0137	0.0000	0.0002	0.0006	0.0021	0.0065	0.0144	0.0261	0.0389	0.0783
Pension Expense	9486	0.1345	0.2431	-0.0262	0.0043	0.0148	0.0344	0.0636	0.1237	0.2769	0.5038	1.6949
Independent variables												
Fair Value of Pension Assets ($Mil)	9659	1247.0	3174.2	0.2660	2.9900	7.1980	33.000	170.00	793.70	3058.0	6842.0	21407
Fair Value of Pension Liabilities ($Mil)	9659	1528.5	3782.0	0.9730	5.1120	11.674	47.865	227.26	990.1410	3693.0	8522.5	25027
Funding Ratio	9659	0.7685	0.2242	0.0944	0.3846	0.5180	0.6493	0.7707	0.8941	1.0165	1.1137	1.4868
Underfunded	9659	0.7679	0.4222	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Transition to Underfunded	9274	0.0784	0.2688	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000
Pension Assets in Equity	7944	0.5774	0.1677	0.0000	0.2300	0.3600	0.5100	0.6100	0.6800	0.7350	0.7800	0.9300
Firm Size	7746	7.7632	1.9834	2.5544	4.2849	5.2133	6.5052	7.7981	9.1635	10.267	10.997	12.010
Firm Age	9659	3.0755	0.8347	0.6931	1.6094	1.9459	2.4849	3.1781	3.8501	4.0431	4.0775	4.1109
Leverage (Debt / Assets)	9644	0.2892	0.2037	0.0000	0.0020	0.0381	0.1501	0.2656	0.3898	0.5438	0.6593	1.0750
Debt Maturity	8057	0.8753	0.1993	0.0000	0.4581	0.6633	0.8453	0.9550	0.9950	1.0000	1.0000	1.0000
Book-to-Market Ratio	7216	0.3360	1.7943	-15.6079	-0.0725	0.1251	0.2831	0.4766	0.7052	1.0335	1.3533	2.7858
Cash and Short-Term Investments	9586	-2.9586	1.5169	-7.3568	-5.8205	-5.0300	-3.8879	-2.7838	-1.8735	-1.1684	-0.7522	0.1188
Z-Score	7873	20.703	95.122	-1.3022	0.7245	1.1987	2.0676	3.6874	6.7839	15.488	40.611	818.73
Big 4 Auditor	9648	0.9170	0.2759	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2. Descriptive Statistics by period (2003 – 2007 vs. 2008 – 2009)

This table presents descriptive statistics of US corporate pension plan and plan sponsor related variables for the periods 2003–2007 and 2008–2009. Dependent variables are the normalized expected return on pension assets (*EROA, PPROR* & *EROA2*) and the Pension Expense. Table A1 defines dependent and independent variables in further detail. All reported statistics are based on variables winsorized at the 1% and the 99% level. Descriptive statistics include the number of observations (Obs.), mean, standard deviation (SD), minimum (min), maximum (max), and several percentiles of the distribution (p5, p10, p25, p50, p75, p90, and p95).

Panel A: 2003–2007 period												
Dependent Variables	**Obs.**	**Mean**	**SD**	**Min**	**p5**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**Max**
EROA	7032	0.0781	0.0358	0.0000	0.0262	0.0483	0.0695	0.0789	0.0853	0.0932	0.1036	0.3176
PPROR	6721	0.0766	0.0145	0.0210	0.0430	0.0580	0.0740	0.0800	0.0850	0.0879	0.0900	0.1000
EROA2	7032	0.0114	0.0139	0.0000	0.0002	0.0006	0.0022	0.0070	0.0148	0.0269	0.0398	0.0783
Pension Expense	6899	0.1316	0.2393	-0.0262	0.0019	0.0133	0.0328	0.0621	0.1225	0.2726	0.4921	1.6949
Independent Variables												
Funding Ratio	7032	0.7888	0.2279	0.0944	0.4010	0.5335	0.6687	0.7957	0.9153	1.0337	1.1393	1.4868
Underfunded	7032	0.7227	0.4477	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Transition to Underfunded	6709	0.0256	0.1581	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Pension assets in Equity	5607	0.6056	0.1548	0.0000	0.2960	0.4200	0.5600	0.6380	0.7000	0.7500	0.7900	0.9300
Panel B: 2008–2009 period												
Dependent Variables	**Obs.**	**Mean**	**SD**	**Min**	**p5**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**Max**
EROA	2627	0.0797	0.0343	0.0000	0.0289	0.0495	0.0670	0.0785	0.0905	0.1064	0.1181	0.3176
PPROR	2507	0.0734	0.0154	0.0210	0.0396	0.0515	0.0700	0.0796	0.0825	0.0850	0.0875	0.1000
EROA2	2627	0.0100	0.0132	0.0000	0.0002	0.0005	0.0018	0.0056	0.0133	0.0237	0.0347	0.0783
Pension Expense	2587	0.1421	0.2531	-0.0262	0.0092	0.0191	0.0387	0.0674	0.1266	0.2828	0.5758	1.6949
Independent Variables												
Funding Ratio	2627	0.7141	0.2044	0.0944	0.3711	0.4910	0.6113	0.7098	0.8246	0.9408	1.0297	1.4868
Underfunded	2627	0.8888	0.3144	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Transition to Underfunded	2565	0.2164	0.4119	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000
Pension assets in Equity	2337	0.5097	0.1779	0.0000	0.1130	0.2570	0.4300	0.5500	0.6300	0.6990	0.7300	0.9300

Table 3. Descriptive Statistics by Transition (Transition vs. Non-Transition)

This table presents descriptive statistics of US corporate pension plan and plan sponsor related variables for the periods 2003–2007 and 2008–2009. Dependent variables are the normalized expected return on pension assets (*EROA, PPROR* & *EROA2*) and the Pension Expense. Table A1 defines dependent and independent variables in further detail. All reported statistics are based on variables winsorized at the 1% and the 99% level. Descriptive statistics include the number of observations (Obs.), mean, standard deviation (SD), minimum (min), maximum (max), and several percentiles of the distribution (p5, p10, p25, p50, p75, p90, and p95).

Panel A: Transition

Dependent Variables	**Obs.**	**Mean**	**SD**	**Min**	**p5**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**Max**
EROA	727	0.0845	0.0250	0.0000	0.0530	0.0621	0.0733	0.0811	0.0956	0.1119	0.1184	0.3176
PPROR	702	0.0774	0.0115	0.0210	0.0547	0.0620	0.0750	0.0800	0.0850	0.0875	0.0900	0.1000
EROA2	727	0.0124	0.0139	0.0000	0.0006	0.0012	0.0035	0.0076	0.0158	0.0276	0.0426	0.0783
Pension Expense	710	0.1100	0.2017	-0.025	0.0072	0.0176	0.0329	0.0565	0.1019	0.2149	0.3481	1.6949
Independent Variables												
Fair Value of Pension Assets ($Mil)	727	1538.8	3538.0	0.2660	5.5980	12.113	55.875	260	1105	3929	7614	21407
Fair Value of Pension Liabilities ($Mil)	727	1953.6	4359.3	0.9730	8.0250	15.666	71.813	327.20	1552	4917	9767	25027
Funding Ratio	727	0.7712	0.1096	0.0944	0.6039	0.6310	0.6888	0.7874	0.8654	0.8906	0.9027	0.9278
Underfunded	727	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Transition to Underfunded	727	1.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Pension assets in Equity	634	0.5344	0.1560	0.0000	0.2270	0.3300	0.4600	0.5600	0.6400	0.7000	0.7300	0.9300
Firm Size	564	7.7805	2.0452	2.5544	4.3102	5.0298	6.3478	7.8050	9.2237	10.536	11.067	12.010
Firm Age	727	3.2546	0.7750	1.0986	1.7918	2.0794	2.6391	3.4965	3.9318	4.0943	4.0943	4.1109
Leverage (Debt / Assets)	726	0.2955	0.1900	0.0000	0.0113	0.0528	0.1676	0.2731	0.3987	0.5527	0.6494	1.0750
Debt Maturity	577	0.8872	0.1880	0.0000	0.5081	0.7073	0.8579	0.9565	0.9963	1.0000	1.0000	1.0000
Book-to-Market Ratio	562	0.4246	1.8062	-15.61	-0.096	0.1187	0.2917	0.5537	0.8257	1.3195	1.8140	2.7858
Cash and Short-Term Investments	721	-3.066	1.5028	-7.357	-5.994	-5.112	-3.941	-2.918	-2.004	-1.299	-0.876	0.1188
Z-Score	592	10.396	45.467	-1.302	0.7023	1.1392	1.9521	3.3628	6.1018	12.142	22.888	818.73
Big 4 Auditor	727	0.9175	0.2754	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 3. Continued.

Panel B: Non-Transition

Dependent Variables	**Obs.**	**Mean**	**SD**	**Min**	**p5**	**p10**	**p25**	**p50**	**p75**	**p90**	**p95**	**Max**
EROA	8547	0.0774	0.0257	0.0000	0.0353	0.0537	0.0695	0.0789	0.0855	0.0945	0.1036	0.3176
PPROR	8211	0.0759	0.0149	0.0210	0.0400	0.0565	0.0725	0.0800	0.0850	0.0875	0.0900	0.1000
EROA2	8547	0.0110	0.0133	0.0000	0.0003	0.0006	0.0022	0.0067	0.0144	0.0259	0.0383	0.0783
Pension Expense	8396	0.1282	0.2259	-0.026	0.0035	0.0146	0.0342	0.0632	0.1217	0.2613	0.4825	1.6949
Independent Variables												
Fair Value of Pension Assets ($Mil)	8547	1255.7	3187.8	0.2660	3.6000	8.0250	34.791	174.14	804	3045.9	6934	21407
Fair Value of Pension Liabilities ($Mil)	8547	1532.4	3783.7	0.9730	5.8060	12.699	50.820	232.54	993.81	3688	8569.5	25027
Funding Ratio	8547	0.7740	0.2237	0.0944	0.4065	0.5192	0.6489	0.7707	0.9051	1.0263	1.1247	1.4868
Underfunded	8547	0.7465	0.4351	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Transition to Underfunded	8547	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pension assets in Equity	7082	0.5826	0.1664	0.0000	0.2400	0.3630	0.5200	0.6200	0.6900	0.7400	0.7800	0.9300
Firm Size	6950	7.7751	1.9765	2.5544	4.2899	5.2261	6.5313	7.8100	9.1704	10.247	11.011	12.010
Firm Age	8547	3.1106	0.7929	1.0986	1.7918	1.9459	2.4849	3.1781	3.8501	4.0431	4.0775	4.1109
Leverage (Debt / Assets)	8537	0.2873	0.2031	0.0000	0.0020	0.0386	0.1499	0.2629	0.3861	0.5379	0.6553	1.0750
Debt Maturity	7152	0.8748	0.1992	0.0000	0.4544	0.6610	0.8448	0.9549	0.9950	1.0000	1.0000	1.0000
Book-to-Market Ratio	6480	0.3227	1.8022	-15.61	-0.074	0.1246	0.2806	0.4710	0.6959	1.0034	1.3078	2.7858
Cash and Short-Term Investments	8489	-2.957	1.5155	-7.357	-5.796	-5.035	-3.892	-2.779	-1.868	-1.173	-0.758	0.1188
Z-Score	7059	21.583	98.271	-1.302	0.7252	1.2011	2.0904	3.7253	6.8348	15.684	42.943	818.73
Big 4 Auditor	8540	0.9176	0.2750	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 4. Difference in differences (2003–2009) – Baseline Model

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
2008-onwards	0.0040***	-0.0012***
	(0.0008)	(0.0003)
Transition	-0.0006	-0.0005
	(0.0016)	(0.0009)
Transition * 2008-onwards	0.0079***	0.0028***
	(0.0021)	(0.0011)
Equity	0.0325***	0.0271***
	(0.0027)	(0.0013)
Leverage	0.0034*	0.0004
	(0.0019)	(0.0008)
Firm Size	-0.0001	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0011***	0.0018***
	(0.0004)	(0.0002)
Debt Maturity	0.0018	0.0006
	(0.0018)	(0.0006)
Book to Market	-0.0001	-0.0001**
	(0.0003)	(0.0001)
Cash and STI	-0.0007***	-0.0007***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0039***	0.0022***
	(0.0012)	(0.0005)
Constant	0.0484***	0.0543***
	(0.0060)	(0.0020)
Observations	5303	5235
Adj. R-Square	.0846	.3151

Table 5. Difference in differences (2003–2009) – <u>Conditional on Pension Funding</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. *High (Low) Funding* is an indicator variable set to 1 if *Funding* is greater (less or equal) than its median value. *Funding* is the ratio of the fair value of pension assets over projected benefit obligations (pension liabilities). Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

For this estimation, we only consider observations of firms that are present in the sample for the entirety of the period of this study (2003 – 2009).

	Low Funding		**High Funding**	
	EROA	**PPROR**	**EROA**	**PPROR**
2008-onwards	0.0034***	-0.0017***	0.0023**	-0.0006
	(0.0010)	(0.0004)	(0.0010)	(0.0004)
Transition	-0.0011	-0.0006	-0.0004	-0.0013
	(0.0018)	(0.0011)	(0.0020)	(0.0013)
Transition * 2008-onwards	0.0118***	0.0028**	0.0078***	0.0020
	(0.0029)	(0.0013)	(0.0028)	(0.0014)
Equity	0.0241***	0.0242***	0.0249***	0.0201***
	(0.0054)	(0.0023)	(0.0031)	(0.0015)
Leverage	0.0030	0.0011	0.0058**	0.0003
	(0.0024)	(0.0011)	(0.0029)	(0.0012)
Firm Size	-0.0005*	-0.0007***	0.0004*	0.0002*
	(0.0003)	(0.0001)	(0.0002)	(0.0001)
Firm Age	0.0010*	0.0019***	0.0023***	0.0022***
	(0.0006)	(0.0003)	(0.0008)	(0.0003)
Debt Maturity	0.0062***	0.0027***	0.0019	0.0006
	(0.0019)	(0.0010)	(0.0020)	(0.0009)
Book to Market	-0.0002	-0.0002***	-0.0001	-0.0002
	(0.0003)	(0.0001)	(0.0002)	(0.0001)
Cash and STI	-0.0012***	-0.0006***	-0.0002	-0.0006***
	(0.0003)	(0.0001)	(0.0003)	(0.0001)
Z-Score	-0.0000	-0.0000***	0.0000**	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Big 4 Auditor	0.0017	0.0025***	0.0018	0.0022***
	(0.0013)	(0.0007)	(0.0023)	(0.0008)
Constant	0.0543***	0.0588***	0.0510***	0.0609***
	(0.0103)	(0.0033)	(0.0039)	(0.0017)
Observations	2101	2079	2032	2023
Adj. *R*-squared	.0778	.3244	.1024	.3664

Table 6. Difference in differences (2003–2009) – Dependent variable is Pension Expense

This table presents the results of the difference-in-differences regressions of the pension expense on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. In this table the proxy for the expected return on pension assets is *Pension Expense:* the pension and retirement expense of the sponsoring firm, normalized by projected benefit obligations at the end of the previous fiscal year. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	Pension Expense
2008-onwards	0.0158**
	(0.0075)
Transition	0.0195
	(0.0207)
Transition * 2008-onwards	-0.0531**
	(0.0232)
Equity	-0.1532***
	(0.0286)
Leverage	0.0245
	(0.0198)
Firm Size	0.0009
	(0.0017)
Firm Age	-0.0323***
	(0.0044)
Debt Maturity	-0.0100
	(0.0165)
Book to Market	0.0031**
	(0.0013)
Cash and STI	0.0010
	(0.0022)
Z-Score	0.0001***
	(0.0001)
Big 4 Auditor	0.0068
	(0.0128)
Constant	0.3289***
	(0.0361)
Observations	5213
Adj. R-Square	.1088

Table 7: Parallel Trends Test (2003–2009)

This table presents the results of the parallel trends test of the expected return on pension assets over the period 2003 – 2009, and also includes a number of firm- and plan-specific controls. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR,* which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *Year X* indicator (1 for X; 0 otherwise, X = 2003,2004, …, 2009) captures the effect on expected return imposed from the fiscal year X (unreported for brevity). The interaction term of the *Transition* and *Year X* indicators captures the effect on the expected return of pension assets, when a pension plan transitions to underfunded status in fiscal year X. Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
Transition * Year 2003	0.0154	0.0017
	(0.0112)	(0.0037)
Transition * Year 2004	-0.0020	0.0010
	(0.0022)	(0.0014)
Transition * Year 2005	-0.0021	-0.0012
	(0.0019)	(0.0016)
Transition * Year 2006	-0.0108	-0.0030*
	(0.0072)	(0.0016)
Transition * Year 2007	0.0032	-0.0016
	(0.0026)	(0.0026)
Transition * Year 2008	0.0047**	0.0018***
	(0.0018)	(0.0006)
Transition * Year 2009	0.0046*	0.0036**
	(0.0025)	(0.0014)
Equity	0.0316***	0.0268***
	(0.0027)	(0.0013)
Leverage	0.0028	0.0003
	(0.0018)	(0.0008)
Firm Size	0.0002	-0.0000
	(0.0002)	(0.0001)
Firm Age	0.0011**	0.0018***
	(0.0004)	(0.0002)
Debt Maturity	0.0016	0.0006
	(0.0018)	(0.0006)
Book to Market	-0.0001	-0.0001*
	(0.0003)	(0.0001)
Cash and STI	-0.0007***	-0.0007***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0025**	0.0017***
	(0.0012)	(0.0005)
Constant	0.0546***	0.0561***
	(0.0060)	(0.0020)
Observations	5303	5235
Adj. R-Square	.1069	.3221

Table 8. Difference in differences (2003–2009) – Excluding firms with negative ROA in 2008

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Table A1 defines the remaining variables. Heteroscedasticity-robust standard errors are used. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

For this estimation, we only use observations of firms with non-negative ROA in year 2008.

	EROA	**PPROR**
2008-onwards	0.0055***	-0.0009**
	(0.0008)	(0.0004)
Transition	-0.0021	-0.0006
	(0.0020)	(0.0011)
Transition * 2008-onwards	0.0104***	0.0028**
	(0.0026)	(0.0012)
Equity	0.0334***	0.0261***
	(0.0030)	(0.0015)
Leverage	0.0043**	0.0008
	(0.0020)	(0.0010)
Firm Size	-0.0002	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0013***	0.0014***
	(0.0005)	(0.0002)
Debt Maturity	-0.0005	-0.0006
	(0.0016)	(0.0008)
Book to Market	0.0001	-0.0004***
	(0.0002)	(0.0001)
Cash and STI	-0.0007***	-0.0007***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000**
	(0.0000)	(0.0000)
Big 4 Auditor	0.0026	0.0012**
	(0.0016)	(0.0006)
Constant	0.0502***	0.0553***
	(0.0046)	(0.0019)
Observations	3446	3408
Adj. R-Square	.1169	.3097

Table 9. Difference in differences (2003–2009) – Controlling for Sensitivity

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
2008-onwards	0.0045***	-0.0005
	(0.0010)	(0.0004)
Transition	-0.0009	-0.0002
	(0.0017)	(0.0010)
Transition * 2008-onwards	0.0073***	0.0025**
	(0.0024)	(0.0011)
Equity	0.0330***	0.0275***
	(0.0032)	(0.0014)
Sensitivity	0.0056***	0.0132***
	(0.0019)	(0.0008)
Leverage	0.0022	-0.0005
	(0.0021)	(0.0008)
Firm Size	-0.0000	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0010*	0.0010***
	(0.0005)	(0.0002)
Debt Maturity	0.0017	0.0009
	(0.0021)	(0.0007)
Book to Market	-0.0001	0.0000
	(0.0003)	(0.0001)
Cash and STI	-0.0011***	-0.0010***
	(0.0003)	(0.0001)
Z-Score	0.0000	-0.0000
	(0.0000)	(0.0000)
Big 4 Auditor	0.0045***	0.0029***
	(0.0012)	(0.0005)
Constant	0.0492***	0.0549***
	(0.0071)	(0.0024)
Observations	4039	3989
Adj. R-Square	.087	.3712

Table 10. Difference in differences (2003–2009) – <u>Robustness for PPA</u>

This table extends the results of Table 3. EROA is shown in Panel A and PPROR on Panel B. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition / Transition X* and *2008-onwards* indicators. *Transition X (X=1,2…5)* is an Indicator variable set to 1 if the plan is funded in the current fiscal year (over 90% for 2003 - 2007 and over (90 + 3X) % for 2008 & 2009) and underfunded in the previous fiscal year. Set to 0 otherwise. Table A1 defines the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * (p < 0.1); ** (p < 0.05); *** (p < 0.01).

Panel A	**EROA**					
2008-onwards	0.0040***	0.0040***	0.0040***	0.0041***	0.0041***	0.0041***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Transition	-0.0006					
	(0.0016)					
Transition * 2008-onwards	0.0079***					
	(0.0021)					
Transition 1		-0.0006				
		(0.0016)				
Transition 1 * 2008-onwards		0.0080***				
		(0.0021)				
Transition 2			-0.0006			
			(0.0016)			
Transition 2 * 2008-onwards			0.0079***			
			(0.0021)			
Transition 3				-0.0006		
				(0.0016)		
Transition 3 * 2008-onwards				0.0075***		
				(0.0021)		
Transition 4					-0.0006	
					(0.0016)	
Transition 4 * 2008-onwards					0.0075***	
					(0.0021)	
Transition 5						-0.0006
						(0.0016)
Transition 5 * 2008-onwards						0.0074***
						(0.0021)
Equity	0.0325***	0.0325***	0.0325***	0.0327***	0.0327***	0.0326***
	(0.0027)	(0.0027)	(0.0027)	(0.0027)	(0.0027)	(0.0027)
Leverage	0.0034*	0.0034*	0.0034*	0.0033*	0.0033*	0.0033*
	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)	(0.0019)
Firm Size	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Firm Age	0.0011***	0.0011***	0.0011***	0.0011***	0.0011***	0.0011***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Debt Maturity	0.0018	0.0018	0.0018	0.0018	0.0018	0.0018
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Book to Market	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Cash and STI	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Z-Score	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Big 4 Auditor	0.0039***	0.0039***	0.0040***	0.0040***	0.0040***	0.0040***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)
Constant	0.0484***	0.0484***	0.0484***	0.0483***	0.0484***	0.0484***
	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)	(0.0060)
Observations	5303	5303	5303	5303	5303	5303
Adj. R-Square	.0846	.0849	.0847	.0843	.0843	.0842

Table 10. Continued.

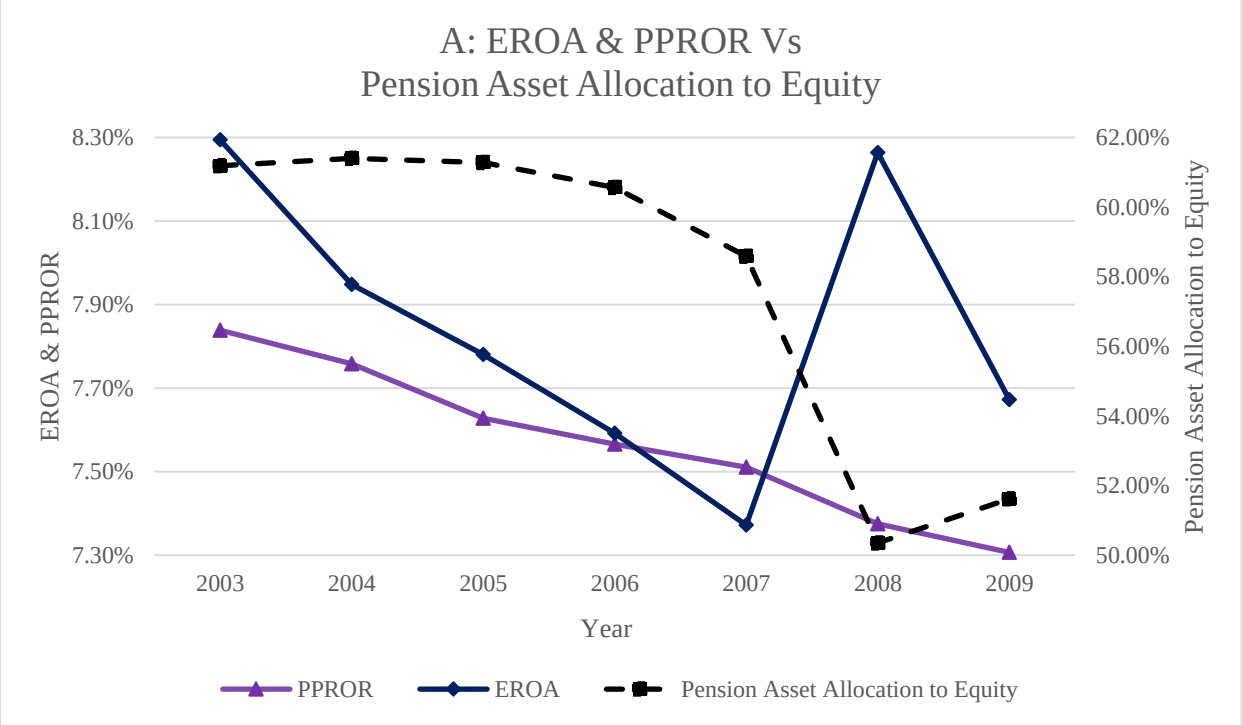
Panel B	**PPROR**					
2008-onwards	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***	-0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Transition	-0.0005					
	(0.0009)					
Transition * 2008-onwards	0.0028***					
	(0.0011)					
Transition 1		-0.0005				
		(0.0009)				
Transition 1 * 2008-onwards		0.0028***				
		(0.0011)				
Transition 2			-0.0005			
			(0.0009)			
Transition 2 * 2008-onwards			0.0029***			
			(0.0011)			
Transition 3				-0.0005		
				(0.0009)		
Transition 3 * 2008-onwards				0.0029***		
				(0.0011)		
Transition 4					-0.0005	
					(0.0009)	
Transition 4 * 2008-onwards					0.0028***	
					(0.0010)	
Transition 5						-0.0005
						(0.0009)
Transition 5 * 2008-onwards						0.0028***
						(0.0010)
Equity	0.0271***	0.0271***	0.0271***	0.0271***	0.0271***	0.0271***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Leverage	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Firm Size	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Firm Age	0.0018***	0.0018***	0.0018***	0.0018***	0.0018***	0.0018***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Debt Maturity	0.0006	0.0006	0.0007	0.0006	0.0006	0.0006
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Book to Market	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**	-0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cash and STI	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***	-0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Z-Score	-0.0000*	-0.0000*	-0.0000*	-0.0000*	-0.0000*	-0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Big 4 Auditor	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***	0.0022***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Constant	0.0543***	0.0543***	0.0543***	0.0543***	0.0544***	0.0543***
	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)	(0.0020)
Observations	5235	5235	5235	5235	5235	5235
Adj. R-Square	.3151	.3151	.3152	.3154	.315	.3151

Table 11. Difference in differences (2003–2009) – Additional Control Variables

We run a series of robustness checks of Table 3, using additional firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. *Actual Return (on Pension Assets)* is estimated by normalizing the actual annual dollar change in pension assets value (Compustat item PBARAT) with the total value of pension assets (Compustat Item PPLAO) at the end of the previous fiscal year. Amortization is an indicator variable set to 1 if the absolute difference between the EROA and the actual rate of return on pension assets is bigger than 10%. Set to 0 otherwise. Table A1 defines the remaining variables. Heteroscedasticity-robust standard errors are used. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**	**EROA**	**PPROR**	**EROA**	**PPROR**
2008-onwards	0.0036***	-0.0009***	0.0038***	-0.0002	0.0026**	-0.0013***
	(0.0008)	(0.0003)	(0.0008)	(0.0002)	(0.0010)	(0.0004)
Transition	-0.0008	-0.0004	-0.0016	-0.0012**	-0.0006	-0.0005
	(0.0016)	(0.0009)	(0.0017)	(0.0006)	(0.0016)	(0.0009)
Transition * 2008-onwards	0.0071***	0.0034***	0.0094***	0.0015**	0.0073***	0.0028***
	(0.0022)	(0.0011)	(0.0022)	(0.0006)	(0.0021)	(0.0011)
Equity	0.0324***	0.0266***	0.0287***	0.0052***	0.0317***	0.0270***
	(0.0028)	(0.0013)	(0.0029)	(0.0008)	(0.0028)	(0.0013)
Leverage	0.0034*	0.0004	0.0030	0.0000	0.0032*	0.0004
	(0.0019)	(0.0008)	(0.0018)	(0.0005)	(0.0019)	(0.0008)
Firm Size	-0.0001	-0.0001*	-0.0002	0.0000	-0.0001	-0.0001
	(0.0002)	(0.0001)	(0.0002)	(0.0000)	(0.0002)	(0.0001)
Firm Age	0.0011**	0.0019***	0.0013***	0.0002**	0.0012***	0.0018***
	(0.0004)	(0.0002)	(0.0004)	(0.0001)	(0.0004)	(0.0002)
Debt Maturity	0.0020	0.0007	0.0020	0.0007**	0.0017	0.0006
	(0.0018)	(0.0006)	(0.0018)	(0.0003)	(0.0018)	(0.0006)
Book to Market	-0.0001	-0.0001*	-0.0001	0.0000	-0.0001	-0.0001**
	(0.0003)	(0.0001)	(0.0003)	(0.0000)	(0.0003)	(0.0001)
Cash and STI	-0.0007***	-0.0007***	-0.0006***	-0.0002***	-0.0007***	-0.0007***
	(0.0002)	(0.0001)	(0.0002)	(0.0000)	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000	0.0000	-0.0000	0.0000	-0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Big 4 Auditor	0.0040***	0.0021***	0.0036***	0.0002	0.0039***	0.0022***
	(0.0012)	(0.0005)	(0.0012)	(0.0002)	(0.0012)	(0.0005)
Actual Return	-0.0047	0.0029***				
	(0.0036)	(0.0011)				
Lagged EROA			0.1184***			
			(0.0229)			
Lagged PPROR				0.0087***		
				(0.0001)		
Amortization					0.0023**	0.0002
					(0.0009)	(0.0004)
Constant	0.0488***	0.0544***	0.0428***	0.0053***	0.0488***	0.0544***
	(0.0060)	(0.0020)	(0.0059)	(0.0012)	(0.0060)	(0.0020)
Observations	5256	5189	5272	5212	5303	5235
Adj. R-Square	.0816	.3135	.1076	.8284	.0859	.315

Figure 1. Expected Return on Pension Assets Vs Pension Asset Allocation to Equity and S&P500
Panel A shows the annual average (across all pension plans) expected return on pension assets (*EROA* & *PPROR*) and pension asset allocation to equity from 2003 to 2009. Panel B shows the annual average (across all pension plans) expected return on pension assets (*EROA* & *PPROR*) and the annual level of the S&P 500 index from 2003 to 2009. *EROA* is the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. *PPROR* represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The pension asset allocation in equity is the proportion of pension assets invested in equity. All variables are winsorized at the 1% and the 99% levels.





Appendix: Table A1. Variable definitions and sources of data

Variable description	Short name	Definition and source
Dependent Variables		
Expected Return on Pension Assets	*EROA*	Estimated by normalizing the expected annual dollar change in pension assets value (Compustat item PPRPA) with the total value of pension assets (Compustat Item PPLAO) at the end of the previous fiscal year.
Expected Return on Pension Assets #2	*EROA2*	Estimated by normalizing the expected annual dollar change in pension assets value (Compustat item PPRPA) with the total book value of the sponsoring firm's assets (Compustat Item AT) at the end of the previous fiscal year.
Anticipated long-term return on Pension Assets	*PPROR*	Defined as the anticipated long-term rate of return (in %) on pension assets (Compustat item PPROR).
Pension Expense	*Pension Expense*	Estimated by normalizing the pension and retirement expense included as an expense on the sponsoring firm's income statement (Compustat item XPR) with projected benefit obligations (Compustat Item PBPRO) at the end of the previous fiscal year.
Independent Variables (Plan-Related)		
Funding Ratio	*Funding*	The funding level of pension plans is estimated from the ratio of pension plan assets (Compustat item PPLAO) over projected benefit obligations (Compustat item PBPRO)
Underfunding Status	*Underfunded*	Indicator variable set to 1 if funding level is below 0.9 for years preceding 2008, 0.92 for 2008 and 0.94 for 2009. Set to 0 otherwise.
Transition	*Transition*	Indicator variable set to 1 if Underfunded = 1 in the current fiscal year and Underfunded = 0 in the previous fiscal year. Set to 0 otherwise.
Pension Assets in Equity	*Equity*	The proportion of pension assets invested in equity (Compustat item PNATE, divided by 100).

Ratio of Pension Assets to Operating Assets	Sensitivity	The ratio of pension plan assets (Compustat item PPLAO) by firm operating assets (Compustat item AT – Compustat item CHE – Compustat item IVAO – Compustat item IVAEQ).
Independent Variables (Firm Related)		
Ratio of Leverage	*Leverage*	Long-term debt (Compustat item DLTT) + Debt in current liabilities (Compustat item DLC) / Total Firm Assets (Compustat item AT).
Size of Firm	*Firm Size*	The natural logarithm of size of market value ([Compustat item (CSHO) × Compustat item (PRCC_F) + Compustat item (DT) + Compustat item (PSTK)]).
Age of Firm	*Firm Age*	The natural logarithm of unity added to the total number of years a firm is listed with Compustat, until the year of observation.
Debt Maturity	*Debt Maturity*	The ratio of long-term debt (Compustat item DLTT) over total debt (Compustat item DT).
Book to Market	*Book to Market*	The ratio of total book value of equity (given by Compustat item (CSHO) × Compustat item (BKVLPS)) over the total market value of equity (Compustat item MKVALT) of a firm.
Cash and Short-Term Investments	*Cash and STI*	The natural logarithm of the ratio of Cash and Short-Term Investments (Compustat item CHE) divided by (Total Firm Assets (Compustat item AT) − Cash and Short-Term Investments (Compustat item CHE)).
Altman Z-Score	*Z-score*	Estimated by 1.2 × [Current Firm Assets (Compustat item ACT) - Current Firm Liabilities (Compustat item LCT)] / Total Firms Assets (Compustat item AT) + 1.4 × Retained Earnings (Compustat item RE) / Total Firm Assets (Compustat item AT) + 3.3 × Operating Income After Depreciation (Compustat item OIADP) / Total Firm Assets (Compustat item AT) + 0.6 × [Firm Stock Price (Compustat item PRCC_F) × Number of Shares Outstanding (Compustat item CSHO)] / [Debt in Current Liabilities (Compustat item DLC) + Long-Term Debt (Compustat item DLTT)] + 0.99 × Total Sales (Compustat item SALE) / Total Firm Assets (Compustat item AT).
Big 4 Auditor Indicator	*Big 4 Auditor*	Indicator variable set to 1 if the plan sponsor is audited by one of the Big 4 audit firms (Deloitte, KPMG, PWC, Ernst & Young, given by Compustat item AU). Set to 0 otherwise.

Online Appendix

Table OA1. Descriptive Statistics of Expected Return by Year and Transition (2003 – 2009)
This table presents the yearly average expected return on pension assets across different classifications of pension plans (*All plans, Transition* and *No Transition*). The mean differences in expected return on pension assets, between *Transition* and *No Transition* plans are also reported. The p-values test for significant differences between the mean values (H_0: mean values are the same). In Panel A the proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. In Panel B the proxy for the expected return on pension assets is *PPROR,* which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. *Transition* is an indicator variable set to 1 if *Underfunded = 1* in the current fiscal year and *Underfunded = 0* in the previous fiscal year. *Underfunded* refers to plans with a funding level below 90% for years 2003–2007, a funding level below 92% for 2008 and a funding level below 94% for 2009.

Panel A – EROA

Fiscal year	All plans		No Transition		Transition		Transition – No Transition	
	Number	Mean	Number	Mean	Number	Mean	(T-NT)	*p* Value
2003	1470	8.29%	1346	8.28%	41	9.57%	1.29%	0.1172
2004	1438	7.95%	1325	7.89%	43	7.68%	-0.21%	0.3601
2005	1410	7.78%	1296	7.77%	55	7.49%	-0.28%	0.2045
2006	1362	7.59%	1283	7.50%	17	6.87%	-0.63%	0.0728
2007	1352	7.37%	1287	7.23%	16	6.67%	-0.56%	0.3540
2008	1335	8.26%	819	7.94%	476	8.76%	0.82%	0.0000
2009	1292	7.67%	1191	7.57%	79	7.80%	0.23%	0.2795

Panel B – PPROR

Fiscal year	All plans		No Transition		Transition		Transition – No Transition	
	Number	Mean	Number	Mean	Number	Mean	(T-NT)	*p* Value
2003	1407	7.84%	1300	7.88%	40	7.90%	0.02%	0.9014
2004	1376	7.76%	1278	7.78%	42	8.05%	0.27%	0.0716
2005	1354	7.63%	1252	7.65%	54	7.75%	0.10%	0.6156
2006	1302	7.57%	1235	7.61%	16	7.11%	-0.50%	0.1324
2007	1282	7.51%	1225	7.53%	16	7.08%	-0.45%	0.3215
2008	1273	7.38%	780	7.19%	458	7.77%	0.58%	0.0000
2009	1234	7.31%	1141	7.28%	76	7.61%	0.33%	0.0129

Table OA2. Difference in differences (2003–2009) – Baseline conditional on Equity Allocation in 2007

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The difference with the baseline model is that we conduct subsample analysis conditional on the level of pension allocation to equity. Panel A (B) shows that subsample with below (above) median allocation in equity in 2007. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR,* which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

Panel A: subsample with pension allocation in equity, below the 2007 median value in equity.

Panel A	**EROA**	**PPROR**
2008-onwards	0.0024**	-0.0013**
	(0.0012)	(0.0005)
Transition	0.0008	-0.0002
	(0.0022)	(0.0017)
Transition * *2008-onwards*	0.0080***	0.0036**
	(0.0028)	(0.0018)
Equity	0.0361***	0.0328***
	(0.0040)	(0.0020)
Leverage	0.0065*	0.0003
	(0.0034)	(0.0013)
Firm Size	-0.0003	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0021***	0.0025***
	(0.0007)	(0.0003)
Debt Maturity	0.0024	0.0008
	(0.0034)	(0.0011)
Book to Market	-0.0005	-0.0000
	(0.0006)	(0.0001)
Cash and STI	-0.0005	-0.0010***
	(0.0003)	(0.0002)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0033*	0.0018***
	(0.0017)	(0.0007)
Constant	0.0437***	0.0463***
	(0.0056)	(0.0027)
Observations	2277	2241
Adj. R-Square	.1273	.4134

Panel B: subsample with pension allocation in equity, above the 2007 median value in equity.

	EROA	PPROR
2008-onwards	0.0051***	-0.0015***
	(0.0010)	(0.0004)
Transition	-0.0045**	-0.0010
	(0.0023)	(0.0009)
Transition * *2008-onwards*	0.0101***	0.0018*
	(0.0030)	(0.0010)
Equity	0.0198***	0.0117***
	(0.0048)	(0.0024)
Leverage	0.0031	-0.0013
	(0.0023)	(0.0011)
Firm Size	-0.0002	-0.0003***
	(0.0002)	(0.0001)
Firm Age	0.0014**	0.0017***
	(0.0006)	(0.0002)
Debt Maturity	0.0014	0.0001
	(0.0017)	(0.0008)
Book to Market	0.0001	-0.0002***
	(0.0002)	(0.0001)
Cash and STI	-0.0008***	-0.0005***
	(0.0003)	(0.0001)
Z-Score	0.0000	-0.0000
	(0.0000)	(0.0000)
Big 4 Auditor	0.0050***	0.0030***
	(0.0019)	(0.0008)
Constant	0.0497***	0.0644***
	(0.0064)	(0.0024)
Observations	2506	2487
Adj. R-Square	.0485	.1763

Table OA3. Difference in differences (2003–2009) – <u>Controlling for ΔEquity</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR,* which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. *ΔEquity* is the change in the proportion of pension assets invested in equity from the previous year. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * (p < 0.1); ** (p < 0.05); *** (p < 0.01).

	EROA	**PPROR**
2008-onwards	0.0055***	-0.0007**
	(0.0009)	(0.0003)
Transition	-0.0008	-0.0008
	(0.0013)	(0.0010)
Transition * 2008-onwards	0.0072***	0.0022**
	(0.0020)	(0.0011)
Equity	0.0350***	0.0309***
	(0.0033)	(0.0015)
ΔEquity	-0.0149***	-0.0146***
	(0.0046)	(0.0022)
Leverage	0.0038*	0.0002
	(0.0020)	(0.0008)
Firm Size	0.0000	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0012**	0.0018***
	(0.0005)	(0.0002)
Debt Maturity	0.0018	0.0011*
	(0.0018)	(0.0007)
Book to Market	-0.0002	-0.0001*
	(0.0003)	(0.0001)
Cash and STI	-0.0008***	-0.0007***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0027**	0.0017***
	(0.0013)	(0.0005)
Constant	0.0442***	0.0518***
	(0.0075)	(0.0024)
Observations	4430	4376
Adj. R-Square	.0947	.3323

Table OA4. Difference in differences (2003–2009) – <u>Controlling for Board Independence</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
2008-onwards	0.0050***	-0.0006
	(0.0009)	(0.0004)
Transition	-0.0019	-0.0009
	(0.0018)	(0.0013)
Transition * 2008-onwards	0.0086***	0.0028**
	(0.0023)	(0.0014)
Equity	0.0339***	0.0266***
	(0.0039)	(0.0018)
Leverage	0.0014	0.0008
	(0.0022)	(0.0011)
Firm Size	0.0007***	0.0003***
	(0.0003)	(0.0001)
Firm Age	0.0010*	0.0014***
	(0.0006)	(0.0002)
Debt Maturity	0.0037**	0.0017*
	(0.0019)	(0.0009)
Book to Market	0.0002	-0.0002
	(0.0003)	(0.0001)
Cash and STI	-0.0011***	-0.0009***
	(0.0003)	(0.0001)
Z-Score	-0.0000	-0.0000**
	(0.0000)	(0.0000)
Big 4 Auditor	0.0006	0.0023***
	(0.0021)	(0.0009)
Board Independence	-0.0038	-0.0001
	(0.0027)	(0.0012)
Constant	0.0445***	0.0543***
	(0.0120)	(0.0033)
Observations	2986	2952
Adj. R-Square	.1015	.33

Table OA5. Difference in differences (2003–2009) – <u>A different proxy for pension liabilities (ABO)</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition ABO* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * (p < 0.1); ** (p < 0.05); *** (p < 0.01).

	EROA	**PPROR**
2008-onwards	0.0041***	-0.0006*
	(0.0008)	(0.0004)
Transition ABO	0.0025	-0.0004
	(0.0029)	(0.0008)
Transition ABO * 2008-onwards	0.0066**	0.0025***
	(0.0032)	(0.0009)
Equity	0.0313***	0.0276***
	(0.0034)	(0.0016)
Leverage	0.0009	-0.0003
	(0.0019)	(0.0009)
Firm Size	-0.0000	-0.0000
	(0.0002)	(0.0001)
Firm Age	0.0012**	0.0021***
	(0.0005)	(0.0002)
Debt Maturity	0.0029*	0.0013*
	(0.0016)	(0.0008)
Book to Market	0.0001	-0.0001*
	(0.0002)	(0.0001)
Cash and STI	-0.0008***	-0.0007***
	(0.0003)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0020	0.0010*
	(0.0014)	(0.0006)
Constant	0.0509***	0.0528***
	(0.0103)	(0.0031)
Observations	3831	3782
Adj. R-Square	.1059	.3294

Table OA6. Difference in differences (2003–2009) – <u>Controlling for Frozen Plans</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets (*EROA* - dependent variable) on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. The *Frozen* indicator variable is a proxy for corporate pension plans that were frozen by their sponsors. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
2008-onwards	0.0041***	-0.0011***
	(0.0008)	(0.0003)
Transition	-0.0006	-0.0005
	(0.0016)	(0.0009)
Transition * 2008-onwards	0.0080***	0.0029***
	(0.0021)	(0.0010)
Equity	0.0323***	0.0270***
	(0.0027)	(0.0013)
Frozen	-0.0033***	-0.0012**
	(0.0010)	(0.0005)
Leverage	0.0035*	0.0006
	(0.0019)	(0.0008)
Firm Size	-0.0001	-0.0001*
	(0.0002)	(0.0001)
Firm Age	0.0010**	0.0018***
	(0.0004)	(0.0002)
Debt Maturity	0.0019	0.0007
	(0.0018)	(0.0006)
Book to Market	-0.0001	-0.0001**
	(0.0003)	(0.0001)
Cash and STI	-0.0007***	-0.0007***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0032***	0.0019***
	(0.0012)	(0.0005)
Constant	0.0503***	0.0550***
	(0.0061)	(0.0020)
Observations	5295	5227
Adj. R-Square	.0863	.3166

Table OA7. Difference in differences (2003–2009) – <u>December Fiscal Year End</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

<u>For this estimation, we only use observations corresponding to firms with a 31st of December fiscal year end.</u>

	EROA	**PPROR**
2008-onwards	0.0040***	-0.0014***
	(0.0010)	(0.0004)
Transition	-0.0010	-0.0015
	(0.0018)	(0.0011)
Transition * 2008-onwards	0.0104***	0.0037***
	(0.0025)	(0.0013)
Equity	0.0326***	0.0263***
	(0.0035)	(0.0015)
Leverage	0.0036	-0.0000
	(0.0022)	(0.0008)
Firm Size	-0.0001	-0.0001
	(0.0002)	(0.0001)
Firm Age	0.0009	0.0021***
	(0.0005)	(0.0002)
Debt Maturity	0.0026	0.0018***
	(0.0022)	(0.0007)
Book to Market	0.0001	-0.0001
	(0.0002)	(0.0001)
Cash and STI	-0.0009***	-0.0006***
	(0.0003)	(0.0001)
Z-Score	0.0000	-0.0000**
	(0.0000)	(0.0000)
Big 4 Auditor	0.0045***	0.0014***
	(0.0012)	(0.0006)
Constant	0.0465***	0.0535***
	(0.0071)	(0.0023)
Observations	3880	3829
Adj. R-Square	.0834	.3319

Table OA8. Difference in differences (2003–2009) – Balanced Panel

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR,* which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

For this estimation, we only consider observations of firms that are present in the sample for the entirety of the period of this study (2003 – 2009).

	EROA	**PPROR**
2008-onwards	0.0032***	-0.0012***
	(0.0007)	(0.0003)
Transition	-0.0010	-0.0009
	(0.0014)	(0.0010)
Transition * 2008-onwards	0.0085***	0.0025**
	(0.0020)	(0.0011)
Equity	0.0247***	0.0221***
	(0.0029)	(0.0014)
Leverage	0.0038**	0.0006
	(0.0018)	(0.0009)
Firm Size	0.0000	-0.0003***
	(0.0002)	(0.0001)
Firm Age	0.0011**	0.0018***
	(0.0004)	(0.0002)
Debt Maturity	0.0038***	0.0018***
	(0.0014)	(0.0007)
Book to Market	-0.0001	-0.0002***
	(0.0002)	(0.0001)
Cash and STI	-0.0008***	-0.0006***
	(0.0002)	(0.0001)
Z-Score	0.0000	-0.0000*
	(0.0000)	(0.0000)
Big 4 Auditor	0.0019	0.0023***
	(0.0012)	(0.0005)
Constant	0.0522***	0.0568***
	(0.0078)	(0.0024)
Observations	4133	4102
Adj. R-Square	.0762	.288

Table OA9. Difference in differences (2003–2009) – <u>Controlling for Serial Correlation</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. The first proxy for the expected return on pension assets is *EROA:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. The second proxy for the expected return on pension assets is *PPROR*, which represents the sponsoring firm's actual assumption (in %) of the long-term return on pension assets. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Firm (sponsor) and industry fixed effects are used. Standard errors are clustered at the firm level and are heteroscedasticity-robust. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

	EROA	**PPROR**
2008-onwards	0.0061***	-0.0011***
	(0.0010)	(0.0002)
Transition	-0.0033*	-0.0009*
	(0.0018)	(0.0005)
Transition * 2008-onwards	0.0095***	0.0016**
	(0.0020)	(0.0006)
Equity	0.0204***	0.0098***
	(0.0039)	(0.0021)
Leverage	0.0104**	0.0011
	(0.0040)	(0.0013)
Firm Size	-0.0031***	-0.0008***
	(0.0008)	(0.0003)
Firm Age	-0.0195***	-0.0053***
	(0.0041)	(0.0011)
Debt Maturity	0.0025	0.0005
	(0.0022)	(0.0005)
Book to Market	0.0003	0.0001
	(0.0003)	(0.0001)
Cash and STI	0.0006	-0.0001
	(0.0004)	(0.0001)
Z-Score	0.0000	-0.0000
	(0.0000)	(0.0000)
Big 4 Auditor	0.0059***	0.0015***
	(0.0022)	(0.0005)
Constant	0.1439***	0.0941***
	(0.0139)	(0.0035)
Observations	5303	5235
Adj. R-Square	.0452	.1571

OA10. Difference in differences (2003–2009) – <u>Dependent variable is EROA2</u>

This table presents the results of the difference-in-differences regressions of the expected return on pension assets on the transition (from funded to underfunded status) variable in the period before 2008 and the period of 2008 onward as well as several firm- and plan-specific control variables. In this table the proxy for the expected return on pension assets is *EROA2:* the expected dollar change in the value of plan assets over a fiscal year, normalized by the total value of the sponsoring firm's assets at the end of the previous fiscal year. The *2008-onwards* indicator (1 for 2008–2009; 0 otherwise) captures the exogenous change imposed from the 2008 crisis. The impact of the difference-in-differences model is captured through the interaction term of the *Transition* and *2008-onwards* indicators. Tables A1 (main paper) and OA11 (OA) define the remaining variables. All variables are winsorized at the 1% and the 99% levels. Industry fixed effects and heteroscedasticity-robust standard errors are used. Standard errors are provided in parentheses. * ($p < 0.1$); ** ($p < 0.05$); *** ($p < 0.01$).

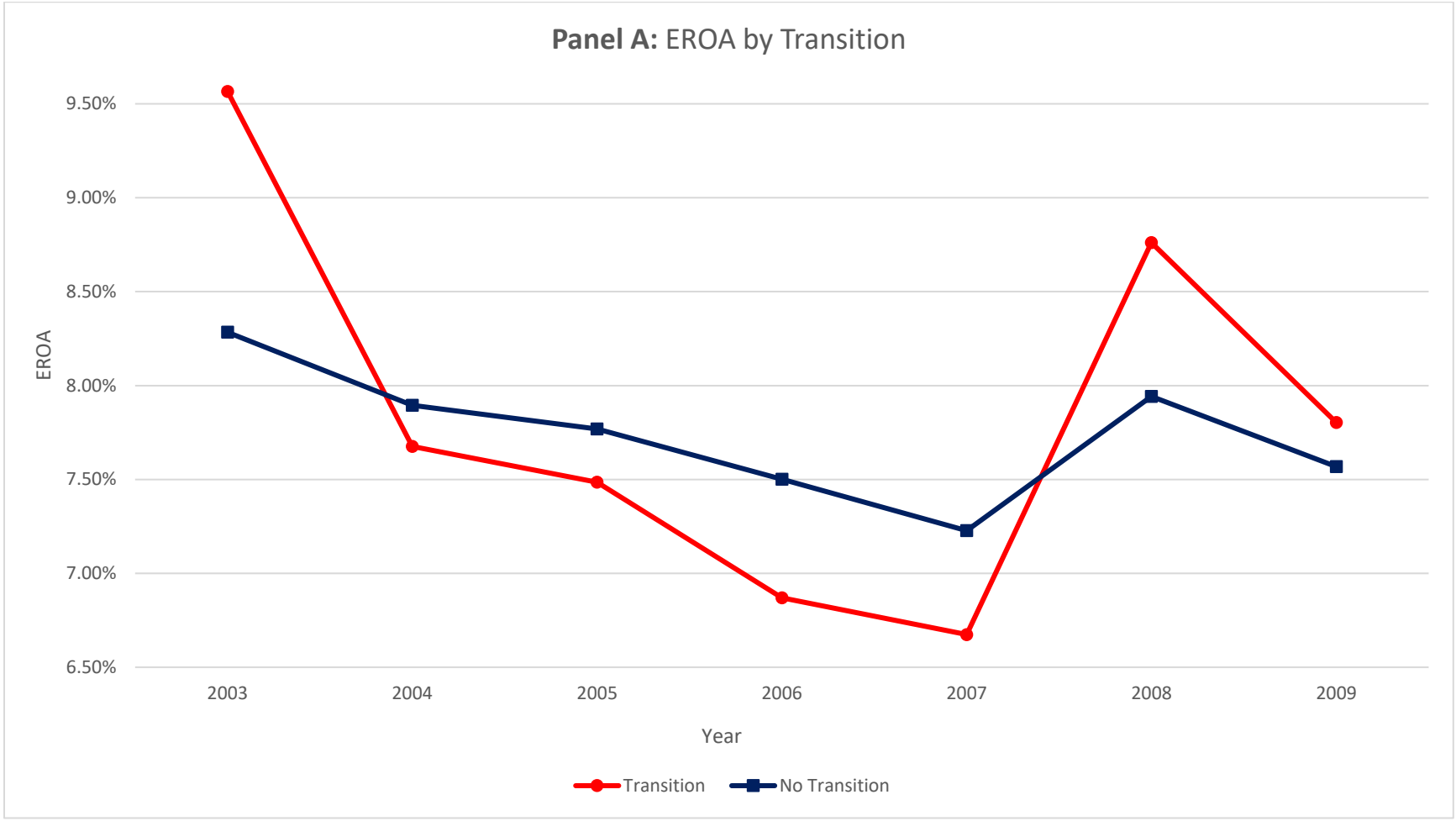
	EROA2
2008-onwards	-0.0028***
	(0.0004)
Transition	-0.0028**
	(0.0012)
Transition * 2008-onwards	0.0066***
	(0.0015)
Equity	0.0049***
	(0.0013)
Leverage	0.0015
	(0.0015)
Firm Size	-0.0007***
	(0.0001)
Firm Age	0.0050***
	(0.0003)
Debt Maturity	-0.0008
	(0.0012)
Book to Market	-0.0007***
	(0.0001)
Cash and STI	0.0001
	(0.0002)
Z-Score	-0.0000
	(0.0000)
Big 4 Auditor	-0.0019**
	(0.0009)
Constant	-0.0056***
	(0.0019)
Observations	5303
Adj. R-Square	.205

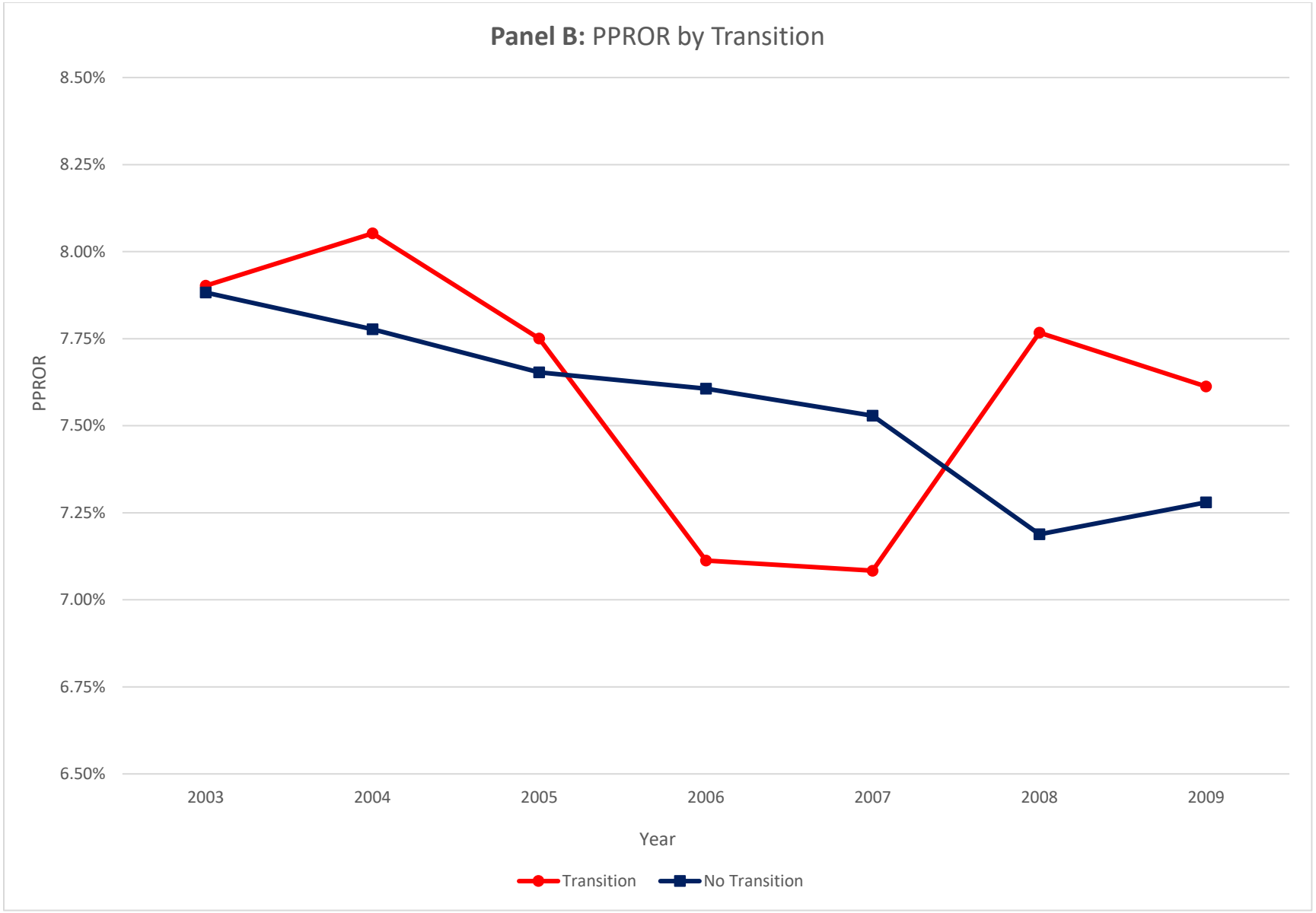
Table OA11. Variable definitions and sources of data
This table contains the additional variables we used for the regression results presented in the Online Appendix. The remaining variables' definitions are given in the Appendix of the main paper.

Variable	Symbol	Definition and source
Expected Return on Pension Assets #2	*EROA2*	Estimated by normalizing the expected annual dollar change in pension assets value (Compustat item PPRPA) with the total book value of the sponsoring firm's assets (Compustat Item AT) at the end of the previous fiscal year.
Funding level ABO	Funding ABO	The funding level of pension plans is estimated from the ratio of pension plan assets (Compustat item PPLAO) over accumulated benefit obligations (Compustat item PBACO).
Underfunding Status ABO	Underfunded ABO	Indicator variable set to 1 if funding level ABO is below 0.9 for years preceding 2008, 0.92 for 2008 and 0.94 for 2009.
Transition ABO	Transition ABO	Transition ABO is an indicator variable set to 1 when Underfunded ABO = 1 in the current fiscal year and Underfunded ABO = 0 in the previous fiscal year. Set to 0 otherwise.
Change in Pension Assets in Equity	ΔEquity	The difference of the proportion of pension assets invested in equity for 2 consecutive years *(i.e.* $\Delta PNATE_t = PNATE_t - PNATE_{t-1}$*).*
Frozen Plan	Frozen	Indicator variable set to 1 if the pension service cost (Compustat item PPSC) is zero. Set to 0 otherwise.
Board Independence	Board Independence	Number of Board of Directors that are not firm employees (MSCI item DIRECTORSOUTSIDE) / Total Number of members in Board of Directors (MSCI item DIRECTORSTOTAL).

Figure OA1: Expected Return on Pension Assets *by* Transition

This figure shows the annual average (across all pension plans) expected return on pension assets (*EROA*), from 2003 to 2011, by pension funding status. *EROA* is the expected dollar change in the value of plan assets over a fiscal year, normalized by the fair value of pension assets at the end of the previous fiscal year. *EROA* is winsorized at the 1% and the 99% levels and, in this graph, is given in percentage terms. Pension plans are classified to *Transition* and *No Transition*. *Transition refers to plans that are Underfunded* in the current fiscal year and *Fully Funded* in the previous fiscal year. *Underfunded* refers to plans with a funding level below 90% for years 2003–2007 and a funding level below 92%, 94%, 96%, and 100% for years 2008, 2009, 2010, and 2011 or later, respectively. Plans that are not *Underfunded* are considered *Fully funded.*




Panel B: PPROR by Transition
8.50%
8.25%
8.00%
7.75%
7.50%
7.25%
7.00%
6.75%
6.50%
PPROR
2003
2004
2005
2006
2007
2008
2009
Year
Transition
No Transition