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Who Manages Pension Fund Risk?

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Abstract

Using a unique panel dataset on pension funding and asset allocation for large U.S. corporations from 2000-2004, this paper documents that firms with weaker financial positions and worse credit ratings rely more heavily on safe pension fund investments, consistent with shareholder value maximizing theories of risk management. Furthermore, firms with large amounts of top-executive ownership of corporate stock take fewer risks in their pension funds, while firms with larger amounts of option compensation take greater risks, controlling for financial effects. Firms respond to deteriorating credit ratings by shifting asset allocations towards debt and cash, but this effect is much larger at firms with high levels of executive stock ownership. The results therefore provide new evidence of an interaction between the managerial and financial theories of corporate risk management.

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1. Introduction

Defined benefit (DB) pension plans have represented a substantial source of financial risk to U.S. corporations during the first half of the current decade. While the pension assets of publicly traded U.S. corporations exceeded the present value of projected pension benefits by \$366 billion as of the end of 1999, by the end of 2002 that position had deteriorated to a deficit of \$629 billion. Much of this deterioration has been the result of the poor performance of dedicated pension plan assets, particularly equity market investments. The resulting underfunded status of pension plans triggered federal rules that made contributions mandatory, at a time when many companies needed liquid assets for other purposes. During the 2002-2004 period, the largest 100 U.S. corporations with DB plans contributed over \$130 billion to these plans, compared to \$23 billion in 2000-2001, according to one study (Milliman (2005)). Pension-related burdens have played a role in many recent bankruptcies, notably those of airlines and steel companies. Aggregate statistics hide the fact that some firms had considerably more equity exposure in their pension funds than others.

This paper uses new panel data on pension funding and asset allocation, combined with traditional sources of financial and executive compensation data, to test whether the variation in the management of risk in DB pension plans is consistent with financial and managerial theories of risk management. Pension fund risk is useful for testing these theories because the degree of risk exposure and the changes in risk exposure over time can be quantified on a continuous scale by the percentage of the fund allocated to risky versus safe assets. Furthermore, this context allows the exposure to risk to be measured

in the relatively broad sample of firms that have defined benefit pension plans, and not confined to a specialized industry.

I find persistent evidence that firms in weaker financial condition as measured by lagged credit ratings tend to invest their pension assets in relatively safe securities (debt and cash). There is also evidence that firms with larger cash positions and lower probability of bankruptcy take more risk in the pension fund, contrary to moral-hazard hypotheses that emphasize the incentives created by the U.S. Pension Benefit Guaranty Corporation (PBGC) to invest in riskier securities as firms near bankruptcy. Pension fund risk does not appear correlated in the cross-section with the overall magnitude of cash flows to pension fund exposure, although the sample already consists of the U.S. firms with the largest pension plans. I also find that in the presence of financial control variables, firms in which top management owns a larger equity stake undertake more risk management (in the form of a larger pension fund allocation to debt and safe assets and larger voluntary contributions). Firms in which top management receives large option stakes tend to invest pension assets in riskier securities, however, a result that parallels the findings of Tufano (1996) in his study of commodities hedging in the gold mining industry.

An important innovation of the pension fund risk setting is that it allows for an examination of how risk exposure changes within firms over time and how the financial and managerial theories interact. I find that firms respond to credit rating downgrades by increasing allocations to safe assets. However, these responses manifest themselves only among the firms whose management owns substantial amounts of stock. The results

therefore provide new evidence of an interaction between the managerial and financial theories of corporate risk management.

The cross-sectional results are broadly consistent with aspects of other studies of risk management, such as Tufano (1996), Geczy, Minton and Schrand (1997) and Haushalter (2000).¹ However, these studies tend to find strong evidence of either financial or managerial theories of risk management but not both in the same context, and therefore do not observe interactions between managerial incentives and the effects of risk management on shareholder value. This paper also contributes to this literature in that it allows both non-discrete measures of risk exposure and analysis of panel data without a specific industry focus. Furthermore, the measurement of risk is not clouded by the need to quantify the effect of derivative securities on overall exposure, as firms do not use derivatives to hedge the risk of having to make cash contributions to underfunded pension plans.²

A recent relevant study is Faulkender (2005), who considers the overall interest rate exposure chosen by firms issuing debt and finds considerably more evidence of speculation than of hedging. He finds little evidence of a relationship between interest rate sensitivity and interest rate exposure but a strong positive relationship between the slope of the yield curve and interest rate exposure, suggesting that firms use derivatives primarily as speculation. My study finds that firms are not particularly sensitive in their choice of pension risk to the overall size of pension assets relative to operating assets. However, I also find that firms are quite sensitive to their financial condition and managerial incentives in their choice of pension fund risk. This suggests that variation in

¹ Other studies include Nance, Smith and Smithson (1983), Mian (1996), and Guay and Kothari (2003).

² To do so would probably be too expensive relative to the techniques analyzed here (investing in safe assets and voluntarily pre-funding the plan).

elected exposure to this particular risk is not purely driven by speculation, although the analysis certainly does not rule out variation in taste for speculation and market timing as additional explanatory factors.

This paper also relates to an empirical literature about pension fund asset allocation. This literature has generally focused either on the relationship between pension volatility and corporate capital structure (as in Friedman (1983) and Bodie et al. (1985)), the relationship between tax incentives and asset allocation decisions (as in Papke (1992) and Frank (1992)), and the relationship between pension accounting assumptions and pension fund asset allocation (Amir and Benartzi (1998) and Bergstresser, Desai and Rauh (2006)). This paper is distinct in considering pension fund allocation as fundamentally a problem of risk management.

The remainder of the paper proceeds as follows. Section 2 outlines the relevant institutional details about corporate pension plans in the U.S. and develops the conceptual framework. Section 3 provides descriptive statistics on the data. Section 4 considers the results of the main regression specifications. Section 5 concludes.

2. Pensions and Risk Management

In a DB pension plan, the firm pledges retirement benefits to employees according to a formula that is generally a function of each employee's age, tenure, and salary. A firm sponsoring a DB pension plan therefore has a financial liability equal to the present discounted value of the payments pledged to retirees. Firms are required to fund DB pension liabilities to US workers with dedicated pension assets, and the funding must meet certain standards stipulated by federal law. Although many U.S. corporate sponsors of DB plans are gradually phasing their plans out by freezing them to new

employees, publicly traded U.S. firms still held \$2.25 trillion in DB assets to back \$2.68 trillion in projected DB liabilities as of the end of 2004, leaving a \$423 billion or 15.8% aggregate funding deficit. Among the 1,814 publicly traded firms with pension liabilities in 2004, the median ratio of pension assets to operating assets was 6.0% and the mean ratio was 12.0%.³

If the market value of pension assets is greater than the discounted value of liabilities, the pension plan is *overfunded*. Firms with overfunded plans do not have to make contributions to their pension funds. They may choose to make contributions but only up to certain full funding limits, beyond which contributions lose their favorable tax treatment. If the market value of pension assets is less than the present discounted value of the pension liability, the pension plan is considered *underfunded*. The firm is then required by law to make contributions as given by a complex nonlinear function of the pension funding status. In general, the larger the difference between pension liabilities and pension assets (expressed as a percentage of pension liabilities), the larger the percentage of the dollar deficit that must be made up with contributions. Rauh (2006) discusses these rules in detail.

Contributions to pension plans are tax deductible and the investment earnings inside the pension are not taxed. Furthermore, before 1986, firms could withdraw surplus pension assets essentially without penalty (Petersen (1992)). Under this regime, the pension fund was an optimal place for storing financial slack. Firms could make voluntary contributions to the pension fund, take an immediate tax deduction for the contribution, and defer all taxes on the investment earnings of the assets in the pension

³ These calculations are based on Compustat data on pension assets (data287) and projected benefit pension liabilities (data286).

fund until the assets were withdrawn. Since 1986, firms have had to pay excise taxes on pension withdrawals, and since 1990 the excise tax rate has been a substantial 50% (see Ippolito (2002)). Since 1987, firms have been limited in their ability to make tax-qualified contributions to pension plans that have more than enough assets to meet accumulated pension liabilities (i.e. to overfunded plans).

A. Benefits of Managing Pension Risk

Given that firms are required to make cash contributions to underfunded pension plans, the allocation of the firm's pension fund to risky assets creates a risk of having to make cash contributions if the pension fund assets perform poorly. Investing pension funds in equity therefore adds uncertainty to the firm's cash flows. In this paper I hypothesize that the firm views the pension fund as a source of potential financial risk. The firm can shield itself from the future cash flow risks of the pension by voluntarily pre-funding liabilities and investing the pension fund in safer securities such as debt and cash.

Financial theories of risk management predict that firms in better financial condition can afford to take more risks in the pension plan. There are several versions of financial theories of risk. Mayers and Smith (1982) and Smith and Stulz (1985) formalize the idea that if financial distress is costly then risk management can increase shareholder value by reducing the probability of financial distress.

The more sophisticated version of these arguments links the benefits of risk management to financial constraints, as well as to the covariances between the stochastic process underlying the risk and the firm's investment opportunities. As in Froot, Scharfstein and Stein (1993), firms that are financially constrained can create value by

minimizing the risks of ending up in the state of the world where they have profitable investment opportunities that need to be funded from internal funds which are depleted because of the risk outcome. Hedging this risk (by voluntarily funding the pension and investing in debt rather than equity) is more valuable if the firm's investment opportunities have low or negative covariance with the pension fund assets that underlie the risk of having to make large contributions.

There are also tax-based explanations for risk management due to Nance, Smith and Smithson (1993) and Smith and Stulz (1985). If the tax schedule is convex, then the present value of expected taxes are lower if firms can reduce the volatility of taxable earnings. The predictions from these theories are therefore about the relationship between the convexity of a given firm's tax schedule and the degree of risk management, not simply about the level of marginal tax rates. However, in the pension context there are further tax incentives for investing the pension fund in fixed income assets which will be discussed below.

Managerial theories of risk management, based largely on Smith and Stulz (1985), predict that firms whose managers hold more equity will engage in more risk management and firms whose managers hold more options will prefer less risk management. The positive correlation between stock holdings and desired risk management on the part of managers usually arises from managerial risk aversion in the presence of an assumption that the concavity of utility functions and the wealth held outside of company securities are homogeneous across managers. In practice, managers who hold more stock are likely to have less risk-averse preferences, either because they voluntarily own the stock or because the board wanted to reduce their tendency to take

excessive risks by compensating them with restricted stock. The relationship between options and greater risk taking derives from the convexity of the options contract and the positive relationship between volatility and option value. However, as noted by Hall (2002), when comparing option compensation to non-equity compensation, the predicted effect on managerial risk-taking is ambiguous.

B. Costs of Managing Pension Risk

These acts of risk management have costs. To voluntarily pre-fund pension plans, firms must contribute cash sooner, so this form of managing pension fund risk carries a clear cost. The costs of not being able to invest the pension fund in equity are somewhat harder to quantify, although several arguments have evolved in the literature.

The theoretical literature on pension fund asset allocation starts from the demonstration that under certain assumptions, the goal of shareholder maximization is accomplished by investing the pension fund entirely in bonds. The most well-known arguments in favor of this are due to Black (1980) and Tepper (1981). Since the returns to debt are more heavily taxed than the returns to equity, a firm with equity in its pension fund can increase its value by reallocating towards debt (and offsetting the leverage effects if necessary by repurchasing corporate equity outside the fund).⁴ As shown by Bodie (1990), however, even without these tax considerations, shareholders appear to have little to gain by investing the pension fund in risky assets because they own the entire downside of the asset performance but do not have a 100% claim to the upside. Furthermore, Rauh (2006) shows that financially constrained firms cut capital

⁴ Frank (2002) finds evidence of correlations between the tax benefits of investing the pension fund in debt and the share of the fund invested in fixed income securities.

expenditures in response to cash drains from required pension contributions. Despite these facts, equity investment in pension funds is pervasive.

The failure of firms to comply with the theoretical predictions of pension fund asset allocation suggests that there must be benefits or perceived benefits of investing pension funds in risky securities. There are three main hypotheses in the literature for the benefits of equity investment of pension funds to either shareholders or managers.

First, the firm may desire to manage the plan like a defined contribution plan on behalf of the employees (Bodie (1990)). If the plan has good returns the firm will have better bargaining power over other aspects of the employment contract.

Second, the U.S. federal government provides insurance for the pension beneficiaries of failed firms (Treyner (1977), Harrison and Sharpe (1983)). Firms in financial distress are generally able to renege on pension promises by unloading their pension assets and liabilities on to the US Pension Benefit Guaranty Corporation (PBGC), a government agency.⁵ Firms pay premiums to the PBGC in return for this insurance. The premiums are \$19 per employee per year plus \$9 per \$1,000 of unfunded vested benefits. The fact the premiums do not depend on the chosen volatility of the pension fund assets creates a moral hazard in the investment choice. Firms can increase the value of the PBGC put option by increasing the volatility of pension fund assets. However, the fact that this option is only valuable in bankruptcy puts a limit on its value.

Third, firms may wish to maximize the short-term earnings impact of selecting an equity investment strategy that allows for the assumption of a high rate of return on

⁵ The PBGC guarantees employee defined benefit pensions up to an annual ceiling which stood at \$44,386 per employee in 2004. When a firm terminates a pension plan and that plan is taken over by the PBGC, it is usually the case that the plan is underfunded and this contributes to the PBGC's deficit, for which the government is ultimately responsible. As of the end of 2004, the shortfall in the PBGC's single-employer program stood at \$23.3 billion.

pension assets (Bergstresser, Desai and Rauh (2006)). Reporting incentives surrounding defined benefit pension plans are subject to considerable managerial discretion. In particular, US firms can choose an assumed return on pension assets, as long as it is broadly justified by the asset allocation of their pension funds. Firms then book as income the assumed return times the level of pension assets as of the beginning of the fiscal year. The reconciliation between the assumed and actual rates of return happens over time, with potentially very long amortization periods. Bergstresser, Desai and Rauh (2006) analyze the use of this opportunity and find evidence that firms commonly raise return assumptions around times when they acquire other firms, when they issue equity, when they are near critical earnings thresholds and when their managers exercise stock options. Furthermore, they find evidence that suggests that firms raise the equity allocation of their pension funds to justify using higher rates of return. Firms that over the long run can achieve higher average rates of return will in the long run book more income from pension assets.

An additional argument often given for equity investment in pension funds is that firms can afford to take larger risks when the liabilities are of longer duration (*i.e.* are due in the far future). The prevailing theories of DB pension fund allocation have generally rejected this as a consideration that is secondary to the questions of who owns the pension surplus and the tax treatment of DB pensions. Nonetheless, managers may perceive the benefits of underfunding the pension fund and investing in equity as a strategy that becomes more viable as the duration of liabilities increases.

C. Hypotheses

The most basic financial risk management theories predict that financially weaker firms will invest their pension funds in safer assets. As a result, in the cross section one would expect firms with weaker credit ratings, smaller cash positions, lower profitability, and a higher probability of bankruptcy to make heavier use of safe assets. These findings would be expected to appear in first-difference specifications as well, since as a firm's financial condition deteriorates the optimal amount of hedging increases. However, for firms that have a very high probability of financial distress, investing in riskier assets may become more attractive as the probability that the government insurance will be relevant increases. These hypotheses are tested in this paper with pooled cross-sectional and first-difference regressions of pension fund asset allocation on financial variables, in the presence of year fixed effects.

The predictions for financial effects on the voluntary funding of pension plans are ambiguous. Financially weaker firms have less excess liquidity with which to fund their plans. However, they also have potentially more to lose by not securing themselves against the risks of future cash shocks. Similar pooled cross-sectional and first-difference regressions are estimated on voluntary contributions to test for these effects.

The more sophisticated financial risk management theories such as Froot, Scharfstein and Stein (1993) predict that the most relevant factors are the correlations among the firm's investment opportunities, its financial condition, and the stochastic process underlying the risk. These frameworks suggest, for example, that firms whose investment opportunities vary more with the risky assets in which they invest their pension funds have a natural hedge, since the states of the world in which they must make payments are those same states of the world in which their investment opportunities

are less profitable. To test for these effects, I examine whether long term correlations between proxies for the firm's investment opportunities and equity market returns are also correlated with the firm's pension fund allocation decisions. Proxies for the firm's investment opportunities are explained in the section 3 below and draw on the work of Acharya, Almeida and Campello (2004). Tax effects are tested and controlled for using net operating losses (from Compustat), which proxy for tax-function convexity (see Nance, Smith and Smithson (1993)). I also consider specifications which use the level of the firm's marginal tax rate and the effects of interest deductions on the marginal tax rate (based on Graham (1996a), Graham (1996b), and Graham (2000)), in order to account for the possibility of variable tax incentives to hold debt in the pension fund (see Frank (2002)).

To test the managerial hypotheses of risk management, I follow the literature (Tufano (1996), Geczy, Minton and Schrand (1997)) and consider the relationship between measures of stock or options held or received and the extent of risk exposure. The ideal variable to measure the incentive to take risk would account for the total value of all options, both in and out of the money. Unfortunately, such a variable is not offered in the available data sources. I therefore measure both the total value of in-the-money options owned (whose incentives may actually be more like those of equity) and the value of options granted (whose incentives may be closer to those reflected by the true convexity of the compensation function but which nonetheless represent only the flow of options in a particular year) and examine their correlation with pension risk exposure.

3. Data

The data for this study come from several sources. First, the 200 largest corporate pension fund sponsors in the U.S. were identified from the *Pensions and Investments* rankings in 2001. Data were then collected on U.S. pension fund asset allocation from the SEC 10-k filings of those firms. Since the FASB revision of SFAS 132 in 2003, firms have been required to present such information, so that for most firms an asset allocation breakdown was available from the 10-k filings for fiscal years ending 2002-2004. Years 2000-2002 were filled in using the *Pensions and Investments* survey-based data to create a panel for 2000-2004. Financial services firms (as identified by Compustat SIC codes between 6000 and 6500) were dropped from the sample, though their inclusion does not materially affect the results.

Combining asset allocation data from *Pensions and Investments* with asset allocation data from the SEC 10-k creates several potential sources of measurement error. Since *Pensions and Investments* collects its information from a survey, it is likely to be somewhat less accurate than what firms report to the SEC. Furthermore, the data from the 10-k filings are valid as of the end of the firm's fiscal year, whereas the data from *Pensions and Investments* are as of September 30th. Fortunately, the asset allocation categories into which firms could report are similar. On SEC 10-k filings firms usually break down the assets into equity, debt, real estate, cash, and other, although sometimes debt and cash are combined and sometimes additional categories such as private equity are explicitly reported. The *Pensions and Investments* survey offers a slightly more detailed breakdown, although firms do not always use all the categories.

To minimize any inconsistencies between these two sources, I focus on debt plus cash as the measure of assets allocated to safe investments. While this procedure does

not capture variation in volatility either within the “safe” or within the “risky” categories, Figure 1 shows that at least these allocations have the predicted slopes and effects on returns within years. When calculating first-differences, I always require that the beginning-of-year and end-of-year observations come from the same source.⁶

The SEC 10-k filings were also used to collect data on the funding status of the U.S. pension plans as well as total contributions to those plans. The 2003 revision SFAS 132 improved the disclosures about pension plans in corporate filings so that much of the information required for calculating the firm’s statutory contribution requirements is included. In particular, U.S. pension plans and foreign plans generally have to be separated in the disclosure, and the pension funding status must be given on both an accumulated and projected benefit obligation basis.

Using this information, I estimate the voluntary and mandatory components of pension contributions. Mandatory contributions are zero if the plan is not underfunded. For an underfunded plan, mandatory contributions are the maximum of two components: the deficit reduction contribution (DRC) and the minimum funding contribution (MFC). The DRC is a straightforward percentage of the underfunding that must be contributed if the firm is less than 90% funded; this percentage ranges from 30% to 60%. Airlines and steel companies were given exemptions from the DRCs in the Pension Funding Equity Act of 2004, so the DRC is automatically set to zero for firms in these industries. Following Zion and Carcache (2002), the MFC is approximated as the sum of the newly accrued pension benefits during the year (the service cost) and 10% of the underfunding.

⁶ This means for example that two sets of asset allocation numbers were generally collected for 2002, one set from *Pensions and Investments* and one set from the 10-k filings. When calculating first differences between 2001 and 2002, only *Pensions and Investments* data were used. When calculating first differences between 2002 and 2003, only 10-k data were used. The 2002 allocation from *Pensions and Investments* has a 0.85 correlation with the 2002 allocation from the SEC filings.

The mandatory contribution is taken as the maximum of these two components, and the voluntary contribution is the difference between the reported actual total contributions and the imputed mandatory contribution. See Rauh (2006) for further details of the mandatory contribution rules.

These firms were then matched to Compustat, and all firms for which the data exists to calculate the necessary financial variables (Tobin's Q, S&P credit ratings, Altman Z-scores, total debt, cash flow and balance sheet cash) were retained for the analysis. The data collection yielded 173 firms for which pension funding data was available and 172 for which asset allocation data was available. The sample was also linked to the Execucomp database to obtain the value of shares owned by top five executives, the value of in-the-money stock options owned by the top five executives, and the value of stock options owned by the top five executives.

Table 1, Panel A shows summary statistics in levels for the variables used in this study, and Table 1, Panel B shows summary statistics in first-differences. The mean sample observation held 29.7% of the pension fund assets in safe assets, and the standard deviation is 9.1%. At the 10th percentile the firm held 20% safe assets and at the 90th it owned 41% safe assets. At the median and the mean, the allocation to safe assets was roughly constant from one year to the next, suggesting that asset allocation was not simply moving inertially with actual returns. The standard deviation of the change in allocation to safe assets was 6.7%, and the distribution of the changes is relatively symmetric. In contrast, the distribution of voluntary contributions is very skew, with a median of 0.06% of assets and a mean of 0.38%. 10% of observations have voluntary contributions in excess of 1% of operating assets.

The credit rating is measured by two variables, the S&P credit rating variable and the discrete indicator for no credit rating. In analyzing the relationship between the credit rating and pension risk management, the beginning-of-year credit rating is always used. This addresses the possibility for reverse causality, at least in the first-difference specifications. If the firm has no credit rating then the no credit rating indicator equals 1 and the credit rating variable equals 0. If the firm has a AAA credit rating then the credit rating variable equals 0.929, if the firm has a D rating then the credit rating variable has a value of 0.036, and each of the 28 rating steps in between raises the credit rating variable by 0.036 (or $1/28$). The mean and median changes in the credit rating close to zero but the standard deviation of the change is 10%. The lagged change in the credit rating is nonzero for 162 of the 663 observations for which information is available (amounting to 24.4%). 131 of these, or 80.8% of nonzero observations, are downgrades. For this reason I generally interpret the relationship between the change in pension fund risk and the lagged change in the credit rating as the correlation between risk management and a credit rating downgrade.

The ratio of pension assets to operating assets for sample firms is 16.2% at the median and 23.3% and the mean. This highlights the fact that the sample is selected on the size of the pension fund. As stated above, the full sample of publicly traded firms with pension funds has a median ratio of 6% and a mean ratio of 12%. Firms in this sample also tend to have underfunded pension plans, though not dramatically so. The median and mean observations in the sample are underfunded by 1.4% and 2.0% of pension fund assets respectively.

The tax variables show that at the mean firms have NOL carryforwards of 2.1% of assets, but the distribution is very skew. The mean firm has an after-interest marginal tax rate (from John Graham) of 22.4% and an interest spread (difference between the before-interest and after-interest marginal tax rate) of 9.3 percentage points.

The executive ownership of stock variable is a log value of millions of dollars, whereas the value of option grants and in-the-money options owned are log values of thousands of dollars (as reported in Execucomp).⁷

4. Results

Tables 2 shows the results of univariate regressions between pension fund asset allocation and financial variables. The specifications are estimated one year at a time in the first four columns. Average coefficients are reported in the fifth column with standard errors in the style of Fama and MacBeth (1973). The final column shows the result of pooled specifications with year effects and standard errors clustered by firm.

Several statistically significant patterns emerge. Firms with a lower probability of bankruptcy (higher Z-score) invest a lower percentage of the pension fund assets in debt and cash securities, and therefore invest a higher percentage in risky securities such as equity and real estate. The coefficient -1.64 in the pooled specification implies that a one standard deviation lower probability of bankruptcy (higher Z-score) is correlated with an approximately 1.3 percentage point lower allocation to debt and cash. In the pooled specification, this effect appears largely driven by the earnings and retained earnings components of the Z-score calculation, although in the Fama-MacBeth (FM) specifications the other components also appear to play a role.

⁷ Note that this does not affect the interpretation of a one-unit change in log points.

Firms with higher cash flows relative to operating assets also take more risk in pension funds, according to the pooled coefficient. A one standard deviation increase in cash flows scaled by operating assets (0.076) is correlated with a 0.9 percentage point lower allocation to debt and cash, as implied by the -11.32 estimate in the pooled specifications. The level of balance sheet cash has coefficients of similar sign, but the effect is not statistically significant at standard confidence intervals in the univariate regressions. This evidence provides preliminary support for financial theories of risk management. Tax variables seem to have few correlations with pension fund risk in this setting.

Table 3 parallels Table 2 but considers another margin on which pension fund risk might be managed, namely the extent of voluntary pre-funding of investment opportunities. Clearly firms in better financial health have more means with which to fund pension plans, so that statistically significant coefficients on cash flow and balance sheet cash do not test theories of risk management. Furthermore, the higher a firm's marginal tax rate, the greater the tax benefit of contributing to pension plans. Table 3 does display evidence of a positive cross-sectional relationship between the amount of pension funding and the marginal tax burden as measured by the after-interest marginal tax rate. Similarly, firms with larger NOL carryforwards make smaller voluntary contributions to pension plans.

Using a similar format, Table 4 examines cross-sectional relationships between managerial variables and the amount of risk taken in pension plans, in terms of both asset allocation and voluntary funding activity. As discussed in section 2.C., the ideal variable to measure the incentive to take risk would account for the total value of all options, both

in and out of the money. Such a variable is not offered in the available data sources. I therefore examine both the total value of in-the-money options owned and the value of options granted, both of which are obtainable from the ExecuComp dataset.

Table 4 shows that the value of stock options granted to top five executives in a given year does seem to be negatively related to the share of the pension fund that is invested in safe assets, according to both the FM and the pooled specification with year fixed effects. It is important to emphasize that both of these specifications absorb any effects that are specific to a given year. A coefficient of -0.83 (as in the pooled specification) indicates that a one standard deviation change in the log value of options granted is correlated with an allocation to debt and cash securities that is approximately 1.2 percentage points lower. The value of in-the-money options owned by executives and the value of stock owned by executive does not appear to have an effect on pension fund asset allocation in these univariate specifications.

The value of stock owned by executives does appear to be positively related with voluntary pension funding, although the economic magnitude of this effect is not substantial. The coefficient of 0.057 suggests that a one standard deviation increase in share ownership is correlated with voluntary contributions that are 0.14% larger as a share of total assets. Compared to a standard deviation of voluntary contributions of 0.75%, this effect is very small. The sign would be consistent with the idea that managers who hold more stock are more likely to manage risk to the firm, either because of their own risk aversion or because their incentives are aligned with those of shareholders.

Table 5 examines the relationship between pension risk management and some proxies for hedging demand based on Acharya, Almeida and Campello (2004). There is some evidence that firms with a higher correlation between Tobin's Q and cash flow do appear to take greater risks in their pension fund asset allocation on the grounds that they have a larger natural hedge in place. The correlation between cash flow and industry-mean Tobin's Q, generally has the opposite sign, although this is not statistically significant in the pooled specification. Voluntary contributions in this sample do not appear related to these covariances that should determine hedging demand. Overall, therefore, the results on hedging demand and pension fund risk-taking are inconclusive.

Table 6 builds multivariate cross-sectional specifications that include variables with suggestive coefficients in the univariate regressions. When both the credit rating variable and the indicator for no credit rating are included, strong cross-sectional results emerge on the credit rating. Firms with better credit ratings invest a smaller percentage of the pension fund in debt and cash. Given that the standard deviation of the credit rating variable is around 0.2, the estimated magnitudes are substantial. The estimate of -10.38 in the first column is consistent with a two percentage point lower allocation to debt and cash for every one standard deviation increase in the credit rating. However, firms without credit ratings (6.6% of the sample) if anything take less risk in their pension funds. This may reflect the fact that credit rating agencies do consider pension fund asset allocation in setting ratings, so that firms with credit ratings are compelled to choose safer asset allocation. Note however that this would suggest that firms with better credit ratings would take less risk in the pension fund, whereas in fact the opposite result is found. Firms without credit ratings are also a heterogeneous group of firms, some of

which may lack a credit rating because they never issued debt and some of which may have lost their credit ratings because of poor financial performance. These results are overall consistent with the financial theories of risk management.

Columns (2) and (3) of Table 6 add financial controls to this specification. The results on the credit rating variables are robust to the inclusion of these controls. Furthermore, firms with more cash on their balance sheet and lower bankruptcy probabilities take more risk in their pension funds, also consistent with the financial theories of risk management. The coefficient on leverage, however, suggests that firms with more balance sheet leverage also take more risk in pension funds.

Columns (4) and (5) of Table 6 consider the cross-sectional relationship between managerial variables and the share of the pension fund allocated to debt and cash, in the presence of financial controls. A one log point increase in the value of equity owned by top executives is correlated with 0.33-0.35 percentage points greater allocation to safe assets. Increases in the log value of in the money options owned by top executives appear to have no statistically significant effect, but a one log point increase in the value of options granted to top five executives is correlated with 0.95-1.06 percentage points *smaller* allocations to safe assets. In terms of standard deviations, a one standard deviation increase in the log value of equity owned by top executives is correlated with approximately 0.80-0.85 percentage points more debt and cash as a share of total pension assets. A one standard deviation increase in the log value of options granted to top executive is correlated with 1.3-1.5 percentage points less of the safe assets.

Table 7 presents a parallel set of results on voluntary pension funding. As in Table 3, the positive correlation between many of the financial variables and voluntary

pension contributions reflects the fact that financially healthier firms have the means to fund pension plans voluntarily. Indeed, from a risk management standpoint, financially healthier firms should have less of a reason to manage risk in the plans.

The coefficients on managerial variables in Table 7 bear interesting parallels to those in Table 6, although the magnitudes are much smaller, and the option variable is not statistically significant. A one log point increase in the value of shares owned by top executives is correlated with voluntary contributions that are larger by 0.04% of book assets. Again, compared to a standard deviation of voluntary contributions of 0.73% of assets, this effect is quite small.

Table 8 shows the results of first difference specifications for the relationship between pension fund asset allocation and financial variables, both in the full sample and in samples cut along the dimensions of the managerial variables as of their 2001 values. The left panel shows that if a firm's credit ratings worsens, then percent of assets allocated to risky securities declines the next year, and vice-versa if the credit rating deteriorates. A coefficient of -9.05 in the full sample implies that a one notch deterioration in the credit rating is correlated with a one-third percentage point decline in the percentage of pension fund assets allocated to debt and cash. However, this result is at least three times as large in the large-stock and large-option samples as in their complements. Importantly, the difference between samples is not a reflection of radically different in-sample probabilities of credit-rating changes. 55% and 52% of observations with credit rating changes come respectively from the low-stock and low-options categories.

Table 9 shows specifications run in the full sample with interactions between the stock ownership category and option grant category and the credit rating. The results are similar. The first column shows that firms respond to deteriorating financial conditions by limiting risk exposure, but this effect is at least four times larger for firms with above-median executive stock holdings. Adding additional financial controls for changes in bankruptcy probabilities, pension funding, and the annual pension fund investment return do not alter this result, as shown in Column 2. Column 3 adds controls for interactions between firm size and lagged credit ratings, and the result is robust.

5. Conclusions

The findings in this paper imply that in the pension context, the risk-management incentives from executive stock ownership are related to both lower levels of risk taking and more risk-reducing responses to changes in the firm's financial condition. The results therefore provide new evidence of an interaction between the managerial and financial theories of corporate risk management. Executive stock options, in contrast, appear correlated with more risk taking in the cross section, consistent with Tufano (1996). This analysis raises the question whether the observed patterns are an intentional consequence of the compensation policies set by corporate boards in order to maximize shareholder value, or an accidental byproduct. Do boards that compensate managers with more options and less stock want managers to take greater risks with the firm? Do boards compensate managers with equity at firms where managing risk in response to deteriorating financial conditions are particularly important? Further research could aim to answer these questions, perhaps by identifying variation in managerial compensation that is plausibly unrelated to the relationship between risk and the value of the firm.

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Figure 1: Asset Allocation and Pension Fund Performance

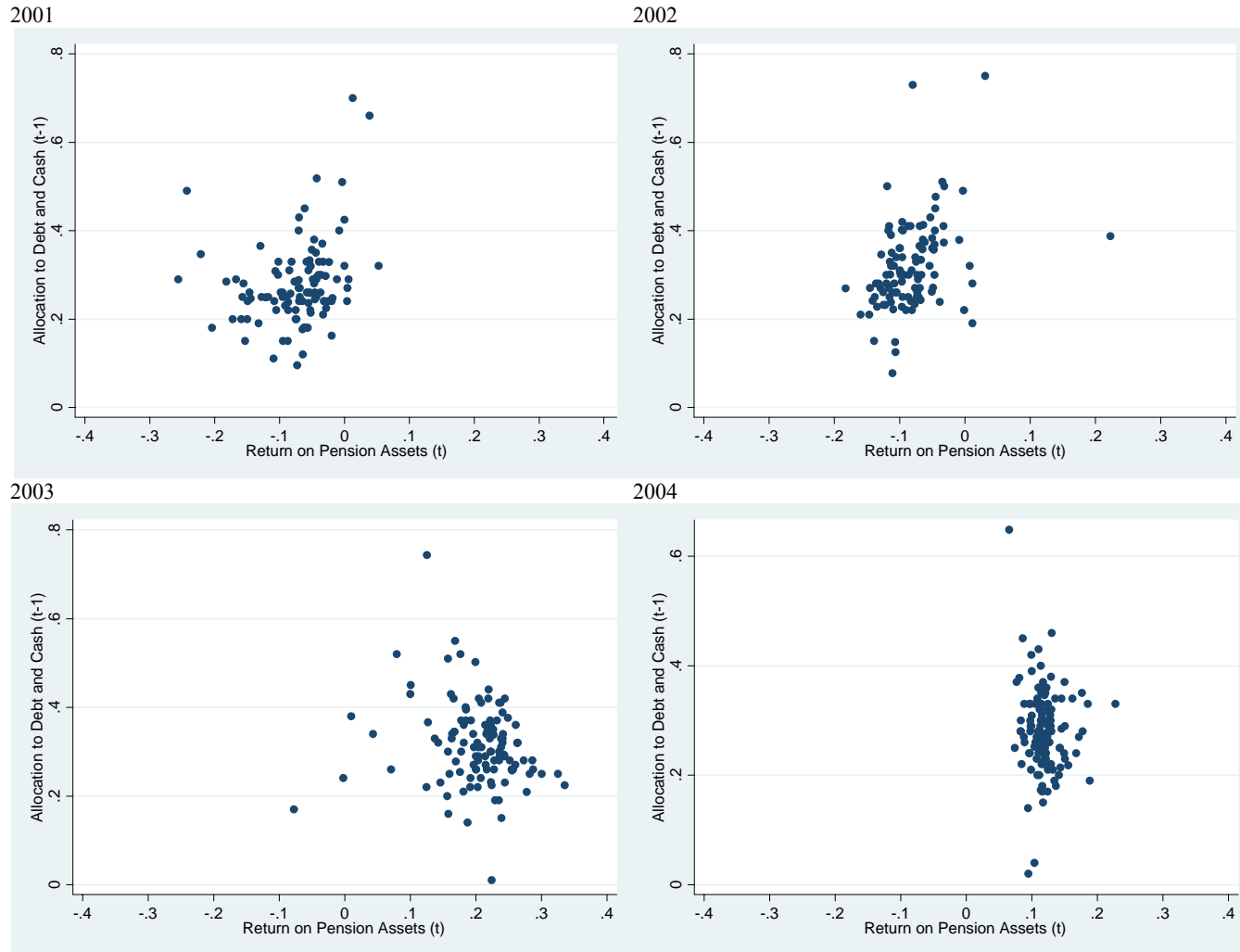


Table 1, Panel A: Summary Statistics in Levels (2000-2004)

This table shows summary statistics in levels for the sample of observations with available U.S. DB asset allocation data or voluntary contributions data. The Percent of U.S. DB assets in debt and cash is collected from the SEC 10-k filings for 2002-2004 and filled in with survey data from *Pensions and Investments* as necessary. The S&P credit rating is from Compustat and scaled from zero to one. Tobin's Q is from Compustat and is calculated as the market value of equity (data199*data25) plus book assets (data6) minus the book value of common equity including deferred taxes (data60 + data74) over assets. The Altman Z-Score equals $3.3*EBIT/Assets + Sales/Assets + 1.4*Retained\ Earnings/Assets + 1.2*Net\ Working\ Capital/Assets$. Debt is long term debt (data9) plus debt in current liabilities (data34). Pension assets are collected from the 10-k filings. Pension Funding Status is $(Pension\ Assets - Pension\ Liabilities)/(Pension\ Liabilities)$. NOL Carryforwards are from Compustat (data52). The After-Interest Marginal Tax Rate is as in Graham (1996a, 1996b, 2000), and the interest spread is the Graham Before-Interest rate minus the Graham After-Interest Rate. Executive ownership and option compensation variables are from Execucomp.

	Mean	Median	Stdev	Count	Firms	Percentile			
						10th	25th	75th	90th
Percent of U.S. DB Assets in Debt and Cash (%)	29.7	29.0	9.1	741	172	20.0	24.0	35.0	41.0
Voluntary Contributions (% of Operating Assets)	0.375	0.061	0.753	625	164	0.000	0.000	0.384	1.044
S&P Credit Rating (1 = AAA)	0.612	0.643	0.207	804	173	0.429	0.571	0.714	0.786
No Credit Rating Indicator	0.070	0.000	0.255	804	173	0.000	0.000	0.000	0.000
Tobin's Q	1.610	1.312	0.910	804	173	0.975	1.081	1.790	2.594
Altman Z-Score	1.396	1.289	0.781	804	173	0.596	0.827	1.902	2.444
EBIT / Operating Assets	0.083	0.077	0.036	804	173	0.048	0.062	0.099	0.128
Sales / Operating Assets	0.818	0.723	0.455	804	173	0.340	0.496	1.029	1.327
Net Working Capital / Operating Assets	0.049	0.026	0.114	804	173	-0.064	-0.018	0.114	0.186
Retained Earnings / Operating Assets	0.175	0.168	0.328	804	173	-0.072	0.055	0.322	0.531
Debt / Operating Assets	0.315	0.323	0.141	804	173	0.132	0.222	0.402	0.487
Cash Flow / Operating Assets (t-1)	0.085	0.079	0.076	804	173	0.024	0.051	0.123	0.173
Cash / Operating Assets	0.051	0.028	0.060	804	173	0.006	0.012	0.065	0.132
Pension Assets / Operating Assets	0.233	0.162	0.232	804	173	0.052	0.093	0.294	0.467
Pension Funding Status (PBO)	-0.020	-0.014	0.083	804	173	-0.093	-0.041	0.008	0.045
NOL Carryforwards / Operating Assets	0.021	0.000	0.062	804	173	0.000	0.000	0.007	0.058
After-Interest Marginal Tax Rate	0.224	0.282	0.135	698	170	0.023	0.074	0.350	0.351
Interest Spread	0.093	0.032	0.131	654	161	-0.002	0.000	0.207	0.312
ln[Value of Shares Owned by Top 5]	2.561	2.808	2.414	670	164	0.866	2.006	3.701	4.421
ln[Value of Stock Options Granted to Top]	8.906	9.062	1.395	672	165	7.337	8.159	9.721	10.394
ln[Value of In-Money Options Owned by Top 5]	8.460	9.254	3.037	672	165	4.683	7.717	10.415	11.232

Table 1, Panel B: Summary Statistics in Changes

See Table 1, Panel A for variable descriptions. The change in allocations to safe assets is nonzero in 83.7% of observations, and the change in the credit rating is nonzero in 27.8% of observations. Data from the 10-k filings, *Pensions and Investments*, Compustat, Execucomp, and Graham (1996a, 1996b, 2000).

	Mean	Median	Stdev	Count	Firms	Percentile			
						10th	25th	75th	90th
Percent of U.S. DB Assets in Debt and Cash (%)	-0.115	0.000	6.719	574	171	-6.000	-3.000	2.200	7.550
Voluntary Contributions (% of Operating Assets)	0.099	0.005	0.864	613	164	-0.348	-0.006	0.193	0.748
S&P Credit Rating (1 = AAA)	-0.010	0.000	0.100	663	173	-0.071	0.000	0.000	0.000
No Credit Rating Indicator	-0.008	0.000	0.140	663	173	0.000	0.000	0.000	0.000
Tobin's Q	-0.070	0.012	0.480	801	172	-0.440	-0.122	0.115	0.232
Altman Z-Score	-0.034	-0.008	0.291	804	173	-0.290	-0.116	0.103	0.231
EBIT / Operating Assets	-0.004	-0.003	0.034	804	173	-0.027	-0.013	0.006	0.021
Sales / Operating Assets	-0.008	0.000	0.171	804	173	-0.143	-0.054	0.052	0.128
Net Working Capital / Operating Assets	0.007	0.004	0.063	804	173	-0.051	-0.018	0.034	0.070
Retained Earnings / Operating Assets	-0.016	0.001	0.111	804	173	-0.093	-0.031	0.027	0.053
Debt / Operating Assets	-0.006	-0.008	0.064	804	173	-0.065	-0.038	0.023	0.064
Cash Flow / Operating Assets (t-1)	-0.005	0.000	0.067	801	173	-0.058	-0.020	0.017	0.043
Cash / Operating Assets	0.005	0.002	0.038	804	173	-0.023	-0.006	0.015	0.040
Pension Assets / Operating Assets	0.002	0.004	0.062	495	171	-0.037	-0.012	0.017	0.045
Pension Funding Status (PBO)	-0.021	-0.009	0.067	653	173	-0.072	-0.035	0.003	0.015
NOL Carryforwards / Operating Assets	0.005	0.000	0.040	804	173	-0.001	0.000	0.000	0.015
After-Interest Marginal Tax Rate (Graham)	-0.017	0.000	0.104	682	168	-0.108	-0.034	0.006	0.057
Interest Spread (Graham Before - After)	0.010	0.000	0.114	636	160	-0.097	-0.019	0.032	0.154
ln[Value of Shares Owned by Top 5]	0.013	0.050	2.746	637	161	-1.277	-0.402	0.441	1.031
ln[Value of Stock Options Granted to Top 5]	-0.090	-0.016	1.329	639	162	-1.082	-0.515	0.354	0.897
ln[Value of In-Money Options Owned by Top 5]	0.037	0.034	3.268	639	162	-3.172	-0.997	1.042	3.328

Table 2: Univariate Regression Coefficients Between Pension Asset Allocation and Financial Variables

Each cell in the columns 2001, 2002, 2003, 2004, and Pooled represents one regression. The FM column contains Fama-MacBeth (1973) estimates based on the four annual regressions for each row.

	Percent of U.S. DB Pension Assets Allocated to Debt and Cash					
	2001	2002	2003	2004	FM	Pooled
S&P Credit Rating (lag)	-2.01 (4.02)	0.48 (3.28)	-3.67 (2.71)	-2.81 (2.60)	-2.00 (1.55)	-2.63 (2.01)
Q	-1.67 * (0.93)	-2.30 ** (1.14)	-1.41 (0.99)	-1.90 * (1.07)	-1.82 *** (0.33)	-1.19 ** (0.54)
Z-Score	-0.92 (1.25)	-2.31 ** (1.03)	-1.82 ** (0.89)	-2.23 *** (0.80)	-1.82 *** (0.55)	-1.64 ** (0.80)
EBIT / Assets	-12.10 (24.25)	-84.13 *** (25.78)	-19.32 (20.92)	-14.93 (19.98)	-32.62 (29.85)	-31.45 ** (14.80)
Sales / Assets	-0.87 (1.99)	-2.77 (1.78)	-1.83 (1.59)	-2.42 * (1.46)	-1.97 *** (0.72)	-1.47 (1.25)
Net Working Capital / Assets	-5.70 (7.44)	-6.67 (7.22)	-2.81 (6.74)	-5.35 (5.62)	-5.13 *** (1.42)	-3.82 (5.76)
Retained Earnings / Assets	-1.29 (3.16)	-2.90 (2.38)	-4.44 ** (2.14)	-4.96 *** (1.88)	-3.40 ** (1.44)	-3.50 ** (1.44)
Debt / Assets	-6.09 (6.31)	-7.54 (5.89)	-3.07 (4.83)	-2.40 (4.93)	-4.77 ** (2.12)	-5.08 (4.24)
Cash Flow / Assets(t-1)	-5.22 (8.80)	-25.05 ** (10.81)	-8.29 (10.16)	-17.01 * (9.43)	-13.89 * (7.76)	-11.32 ** (5.31)
Cash / Assets	-50.58 *** (18.72)	-9.29 (15.48)	-11.49 (11.43)	-8.33 (9.63)	-19.92 (17.74)	-15.17 (10.12)
Funding Gap / Assets	20.42 (12.47)	1.49 (9.60)	-1.88 (10.77)	-0.07 (10.76)	4.99 (8.99)	3.88 (6.35)
Pension Assets / Assets	3.64 (4.15)	1.46 (4.85)	-1.82 (3.96)	-2.14 (3.05)	0.29 (2.39)	0.20 (2.88)
NOL Carryforwards / Assets	4.22 (29.99)	-0.61 (16.28)	15.66 (10.64)	14.44 * (7.49)	8.43 (6.85)	9.19 (8.38)
After-Interest Marginal Tax Rate	1.13 (6.10)	-7.16 (6.09)	-3.76 (5.24)	.	-3.26 (3.40)	-3.52 (4.19)
Interest Spread	-5.03 (6.40)	10.70 (6.95)	-0.91 (5.44)	.	1.58 (6.66)	2.30 (4.42)

Standard errors are heteroskedasticity-robust, and clustered by firm in the pooled specification. FM = Fama-MacBeth. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 3: Univariate Regression Coefficients Between Voluntary Pension Funding and Financial Variables

Each cell in the columns 2001, 2002, 2003, 2004, and Pooled represents one regression. The FM column contains Fama-MacBeth (1973) estimates based on the four annual regressions for each row. The Pooled specifications all contain year fixed effects.

	Voluntary Pension Contributions as a Percentage of Operating Assets					
	2001	2002	2003	2004	FM	Pooled
Credit Rating (lag)	0.34 (0.17)	6.44 (2.21)	2.02 (1.70)	1.91 (1.79)	2.67 (2.27)	1.88 (1.28)
Q (lag)	0.13 *** (0.02)	0.44 *** (0.09)	0.33 *** (0.07)	0.17 * (0.09)	0.27 ** (0.12)	0.24 *** (0.04)
Z-Score	0.07 (0.05)	0.43 (0.78)	0.71 (0.57)	0.81 (0.52)	0.51 * (0.29)	0.88 *** (0.30)
EBIT / Assets	0.07 (0.89)	0.68 (0.25)	0.26 (0.17)	0.38 (0.17)	0.35 (0.22)	0.44 (0.12)
Sales / Assets	0.03 (0.08)	4.45 *** (0.94)	2.64 *** (0.89)	2.38 ** (0.98)	2.38 (1.57)	2.60 *** (0.54)
Net Working Capital / Assets	0.40 (0.31)	-3.02 (2.15)	-0.74 (0.85)	-0.87 (0.68)	-1.06 (1.24)	-0.84 ** (0.34)
Retained Earnings / Assets	0.22 * (0.12)	0.28 (1.76)	0.95 (0.98)	1.25 (0.87)	0.67 (0.44)	1.53 ** (0.68)
Debt / Assets	-0.21 (0.25)	-1.29 ** (0.59)	-0.31 (0.41)	-0.74 (0.45)	-0.64 (0.43)	-0.65 ** (0.32)
Cash Flow / Assets(t-1)	0.83 ** (0.37)	4.84 *** (0.94)	2.31 *** (0.86)	3.41 *** (0.90)	2.85 * (1.47)	2.60 *** (0.54)
Cash(t-1) / Assets(t-1)	1.90 *** (0.68)	2.08 (1.54)	0.95 (0.94)	1.44 (0.89)	1.59 *** (0.44)	1.53 ** (0.68)
Funding Gap(t-1) / Assets(t-1)	-0.78 ** (0.39)	-1.90 (1.27)	-0.49 (0.81)	0.03 (0.30)	-0.78 (0.70)	-0.27 (0.31)
Pension Assets(t-1) / Assets (t-1)	0.15 (0.14)	0.37 (0.41)	0.02 (0.29)	0.28 (0.29)	0.20 (0.13)	0.20 (0.18)
NOL(t-1)/Assets(t-1)	0.49 (1.29)	-2.58 (2.12)	-0.20 (0.83)	-1.00 (0.70)	-0.82 (1.14)	-0.84 ** (0.34)
After-Interest Marginal Tax Rate	0.49 ** (0.23)	1.25 * (0.72)	0.56 (0.42)	.	0.77 ** (0.34)	0.76 *** (0.25)
Interest Spread	-0.28 (0.24)	-0.90 (0.78)	-0.44 (0.42)	.	-0.54 (0.26)	-0.52 (0.23)

Standard errors are heteroskedasticity-robust, and clustered by firm in the pooled specification.

FM = Fama-MacBeth. *** significant at 1%; ** significant at 5%; * significant at 10%.

Table 4: Univariate Regression Coefficients with Managerial Variables

Each cell in the columns 2001, 2002, 2003, 2004, and Pooled represents one regression. The FM column contains Fama-MacBeth (1973) estimates based on the four annual regressions for each row. The Pooled specifications all contain year fixed effects.

	<i>Dependent Variable: Percent of DB Pension Assets Allocated to Debt and Cash</i>					
	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>FM</u>	<u>Pooled</u>
ln[Value of Shares Owned by Top 5 Executives]	0.13 (0.41)	-0.43 (0.61)	-0.35 (0.48)	-1.21 * (0.63)	-0.47 (0.48)	-0.02 (0.17)
ln[Value of Stock Options Granted to Top 5 Executives]	-0.53 (0.68)	-1.54 *** (0.58)	-0.55 (0.65)	-1.59 ** (0.74)	-1.05 ** (0.51)	-0.83 * (0.46)
ln[Value of In-Money Stock Options Owned by Top 5 Executives]	-0.05 (0.30)	-0.14 (0.26)	-0.41 (0.33)	-0.69 (0.55)	-0.32 (0.25)	-0.15 (0.23)
	<i>Dependent Variable: Voluntary Pension Contributions as a Percentage of Operating Assets</i>					
	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>FM</u>	<u>Pooled</u>
ln[Value of Shares Owned by Top 5 Executives]	0.034 ** (0.015)	0.201 *** (0.054)	0.023 (0.029)	0.032 (0.038)	0.072 (0.074)	0.057 *** (0.019)
ln[Value of Stock Options Granted to Top 5 Executives]	0.048 (0.031)	0.049 (0.059)	0.066 (0.051)	0.044 (0.074)	0.052 *** (0.009)	0.052 (0.049)
ln[Value of In-Money Stock Options Owned by Top 5 Executives]	0.030 ** (0.012)	0.077 *** (0.026)	0.049 * (0.026)	0.001 (0.055)	0.039 (0.028)	0.054 *** (0.016)

Table 5: Test for Correlations Between Cash Flow and Investment-Opportunity Proxies As Predictors of Hedging Demand

	<i>Dependent Variable: Percent of DB Pension Assets Allocated to Debt and Cash</i>					
	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>FM</u>	<u>Pooled</u>
Correlation Between Cash Flow and Q	-0.61 (2.38)	-1.32 (2.22)	-3.91 ** (1.79)	-3.78 ** (1.87)	-2.40 (1.46)	-1.99 (1.53)
Correlation Between Cash Flow and Industry-Median Q	2.65 (2.77)	3.19 (2.54)	3.48 * (2.09)	3.40 (2.08)	3.18 *** (0.32)	3.00 (1.90)
Correlation Between Cash Flow and Industry-Median R&D/Sales	1.77 (3.36)	-2.91 (3.12)	-0.22 (2.20)	-0.77 (2.12)	-0.53 (1.67)	-0.11 (1.77)
	<i>Dependent Variable: Voluntary Pension Contributions as a Percentage of Operating Assets</i>					
	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2004</u>	<u>FM</u>	<u>Pooled</u>
Correlation Between Cash Flow and Q	0.022 (0.090)	0.260 (0.231)	0.178 (0.139)	-0.265 (0.180)	0.049 (0.200)	0.062 (0.124)
Correlation Between Cash Flow and Industry-Median Q	-0.158 (0.109)	-0.320 (0.270)	-0.062 (0.179)	0.105 (0.198)	-0.109 (0.154)	-0.112 (0.129)
Correlation Between Cash Flow and Industry-Median R&D/Sales	-0.080 (0.128)	0.533 * (0.310)	-0.064 (0.218)	0.124 (0.241)	0.128 (0.247)	0.132 (0.145)

Table 6: Pension Fund Asset Allocation, Financial Condition and Managerial Incentives in the Cross-Section (2000-2004)

This table consists of pooled regressions of the percent of U.S. DB pension fund assets allocated to debt and cash on financial, managerial, and tax variables. All specifications contain year fixed effects.

	<i>Percent of DB Pension Fund Allocated to Debt and Cash</i>				
	(1)	(2)	(3)	(4)	(5)
S&P Credit Rating (t-1)	-10.38 ** (4.10)	-9.40 * (4.89)	-10.25 * (5.90)	-14.21 ** (6.32)	-16.94 *** (6.39)
Binary for No S&P Credit Rating (t-1)	-4.47 (3.64)	-3.50 (3.86)	-5.16 (4.35)	-8.42 * (4.66)	-10.41 ** (4.58)
Tobin's Q(t)		-0.66 (0.59)	0.07 (0.70)	0.12 (0.65)	0.60 (0.74)
ln[Operating Assets]		0.37 (0.66)	0.23 (0.65)	0.47 (0.56)	0.65 (0.61)
ln[Value of Shares Owned by Top 5 Executives]				0.35 ** (0.17)	0.33 * (0.17)
ln[Value of Stock Options Granted to Top 5]				-1.06 *** (0.38)	-0.95 ** (0.38)
ln[Value of In-Money Options Owned by Top 5]				0.01 (0.18)	-0.06 (0.18)
Cash(t) / Assets(t)			-22.03 * (11.32)		-16.56 (11.44)
Z-Score			-1.56 * (0.91)		-0.60 (0.85)
Pension Assets(t) / Assets(t)			-1.38 (2.89)		0.22 (2.90)
Funding Gap(t) / Assets(t)			4.29 (6.29)		1.50 (7.51)
NOL(t) / Assets(t)			6.17 (8.94)		-1.86 (11.23)
Debt (t) / Assets (t)			-11.49 ** (5.59)		-8.38 ** (4.15)
Constant	35.58 *** (3.05)	32.55 *** (5.76)	40.23 *** (6.05)	42.20 *** (5.57)	45.01 *** (6.64)
Observations	755	755	755	619	607
R-squared	0.05	0.05	0.09	0.08	0.1

Standard errors are heteroskedasticity-robust and clustered by firm.

*** significant at 1%; ** significant at 5%; * significant at 10%.

Table 7: Voluntary Pension Contributions, Financial Condition and Managerial Incentives in the Cross-Section (2001-2004)

This table consists of pooled regressions of voluntary pension contributions on financial, managerial, and tax variables. All specifications contain year fixed effects.

	<i>Voluntary Pension Contributions (% of Operating Assets)</i>				
	(1)	(2)	(3)	(4)	(5)
S&P Credit Rating (t-1)	1.29 *** (0.29)	0.67 ** (0.27)	0.60 (0.37)	0.76 * (0.41)	0.79 * (0.46)
Binary for No S&P Credit Rating (t-1)	0.92 *** (0.27)	0.41 * (0.22)	0.41 (0.26)	0.48 (0.33)	0.53 (0.34)
Tobin's Q(t-1)		0.20 *** (0.04)	0.15 *** (0.05)	0.19 *** (0.05)	0.16 *** (0.05)
ln[Operating Assets]		-0.07 * (0.04)	-0.02 (0.05)	-0.07 (0.05)	(0.03) (0.06)
ln[Value of Shares Owned by Top 5 Executives]				0.04 ** (0.02)	0.04 ** (0.02)
ln[Value of Stock Options Granted to Top 5 Executives]				-0.06 (0.05)	-0.07 (0.05)
ln[Value of In-Money Options Owned by Top 5 Executives]				0.02 (0.01)	0.02 (0.01)
Cash(t-1) / Assets(t-1)			0.63 (0.74)		0.74 (0.79)
Z-Score (lag)			0.12 * (0.06)		0.12 * (0.06)
Pension Assets (t-1) / Assets(t-1)			0.34 * (0.18)		0.26 (0.18)
Funding Gap (t-1) / Assets (t-1)			-0.47 (0.36)		-0.22 (0.27)
NOL Carryforwards (t) / Assets(t)			-0.83 (0.56)		-0.50 (0.70)
Debt (t) / Assets (t)			0.00 (0.30)		0.30 (0.34)
Constant	-0.41 ** (0.18)	0.34 (0.36)	-0.49 ** (0.24)	0.48 (0.35)	0.14 (0.43)
Observations	634	634	574	476	476
R-squared	0.06	0.12	0.14	0.16	0.18

Standard errors are heteroskedasticity-robust and clustered by firm.

*** significant at 1%; ** significant at 5%; * significant at 10%.

Table 8: Response to Changes in Credit Ratings by Managerial Compensation Categories

Each column represents one first-difference regression. All specifications contain year fixed effects. The low stock and high stock categories represent firms with below-median and above-median managerial stock ownership (in dollars) at the end of 2001. The low option and high option categories represent firms with below-median and above-median managerial option grants (in dollars) during 2001.

	<i>Dependent Variable: ΔPercent of DB Pension Fund Allocated to Debt and Cash</i>				
	All	Low Stock	High Stock	Low Option	High Option
Δ S&P Credit Rating (t-1)	-9.05 *** (3.42)	-7.53 ** (2.94)	-22.26 * (13.24)	-7.03 ** (3.03)	-25.22 ** (10.56)
Δ Binary for No S&P Credit Rating (t-1)	-3.80 (2.45)	-0.05 (2.19)	-13.64 (8.41)	-2.47 (2.01)	0.00 (0.00)
Δ Tobin's Q(t-1)	0.30 (0.81)	4.72 (3.49)	-0.36 (0.99)	1.97 (1.41)	-0.45 (1.18)
$\Delta \ln$ [Operating Assets]	-1.98 (2.23)	-0.22 (4.48)	-4.12 (3.06)	2.65 (2.96)	-6.82 (3.99)
Δ Z-Score	-0.72 (1.18)	0.19 (1.48)	-3.08 (3.34)	-0.16 (1.76)	-2.86 (2.83)
Δ Funding Gap(t-1) / Assets(t)	-0.33 (1.35)	10.58 (9.87)	-1.90 *** (0.48)	-1.70 (0.45)	18.35 (17.08)
Constant	-3.39 *** (0.45)	0.58 (0.99)	-1.34 (1.37)	-0.55 (0.85)	-0.11 (0.47)
Observations	442	201	200	199	197
R-squared	0.08	0.12	0.11	0.11	0.12

Standard errors are heteroskedasticity-robust and clustered by firm.

*** significant at 1%; ** significant at 5%; * significant at 10%.

Table 9: Responses to Changes in Credit Ratings and Managerial Compensation

Each column represents one first-difference regression. All specifications contain year fixed effects. The low stock and high stock categories represent firms with below-median and above-median managerial stock ownership (in dollars) at the end of 2001. The low option and high option categories represent firms with below-median and above-median managerial option grants (in dollars) during 2001.

	<i>ΔPercent of DB Pension Fund Allocated to Debt and Cash</i>		
ΔS&P Credit Rating (t-1)	-7.10** (2.95)	-6.33* (3.49)	-6.78** (3.27)
ΔBinary for No S&P Credit Rating (t-1)	-0.51 (2.27)	-0.01 (2.48)	-1.29 (2.48)
High Stock	-0.65 (0.74)	-0.69 (0.76)	-0.74 (0.77)
High Stock * ΔS&P Credit Rating	-27.00** (12.03)	-29.98** (11.67)	-30.24*** (11.23)
High Option	0.33 (0.72)	0.39 (0.74)	0.39 (0.76)
High Option * ΔS&P Credit Rating	5.18 (4.70)	6.91 (4.84)	5.17 (4.70)
ΔTobin's Q(t-1)	0.20 (0.92)	0.37 (0.89)	0.31 (0.90)
Δln[Operating Assets]	-2.00 (2.34)	-2.44 (2.52)	-2.72 (2.62)
ΔZ-Score		-1.87 (1.64)	-1.94 (1.65)
ΔFunding Gap(t-1) / Assets(t)		-0.91 (0.97)	-0.90 (0.97)
Pension Investment Return (%)		-14.40 (8.94)	-13.83 (9.21)
ln[Assets]*ΔS&P Credit Rating (t-1)			1.54 (1.84)
Δln[Assets]*ΔS&P Credit Rating (t-1)			-8.76 (9.56)
Constant	-0.20 (0.74)	-0.02 (0.48)	-1.57 (1.14)
Observations	396	396	396
R-squared	0.10	0.11	0.11

Standard errors are heteroskedasticity-robust and clustered by firm.

*** significant at 1%; ** significant at 5%; * significant at 10%.