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The Effects of Financial Condition on Capital Investment and Financing: Evidence from Variation in Pension Fund Asset Performance

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This paper examines the effects of changes in a firm's financial condition on capital expenditures, as well as on the costs of raising external finance. Changes in pension fund asset values are largely reflected in the market value of the sponsor's equity, and can be fully incorporated into pension-adjusted measures of book equity. The condition of the firm's balance sheet, as measured by book and market leverage, has a statistically robust effect on capital investment, even when the variation in leverage is due strictly to pension fund asset performance. I provide evidence that variation in pension fund asset performance is unlikely to be correlated with the sponsor's investment opportunities, especially within industries and in the presence of nonlinear profitability controls. Credit rating agencies are more likely to upgrade firms when the pension assets perform well and downgrade them when the pension assets perform poorly. Overall the evidence highlights the impact of borrowers' net worth on the costs of external capital and is consistent with models of underinvestment in the presence of financial constraints. However, the magnitude of the effects is small relative to the within-firm standard deviation of capital expenditures.

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Most empirical studies examining the impact of an external finance premium on corporate investment have done so by measuring the response of capital expenditures to cash flow innovations. However, canonical theories of corporate finance and macroeconomics also predict that investment should decrease with leverage and increase with net worth. The seminal model of the leverage effect is Myers (1977), in which existing leverage restricts the extent to which firms can raise finance from new junior claimants, resulting in underinvestment. The agency cost literature (particularly Jensen (1986) and Stulz (1990)) has argued that debt payments reduce managerial incentives to overinvest and therefore also that higher leverage causes lower levels of investment, possibly with increased profitability. A class of macroeconomic business cycle models, of which Bernanke and Gertler (1989) is the leading example, derive conditions under which a greater level of net worth is associated with lower expected agency costs of external finance and higher capital investment.

The fact that the condition of a given firm's balance sheet in part reflects the profitability of its investment opportunities poses a challenge for the identification of a causal effect of financial condition on capital investment. If investment opportunities could be perfectly controlled for, properly specified regressions of investment on measures of leverage would capture this balance sheet effect. If controls for investment opportunities are imperfect, then regression coefficients on leverage will reflect a mixture of profitability and balance sheet effects.

This paper highlights a source of variation in the condition of corporate balance sheets that is arguably separate from the firm's investment opportunities, namely the performance of assets in defined benefit (DB) pension plans. A pension fund with assets less than the present value of pension liabilities represents an eventual financial claim on the cash flows of the firm's operating assets. If DB assets perform well, the claim that the pension fund has on cash flows from the firm's operating assets is lower, other things equal.

The paper first demonstrates the effects of variation in pension fund asset returns on the market value of the firm, and hence on market-based measures of leverage. A large part of pension fund returns are indeed reflected in the equity returns of the sponsoring company.[1] Due to pension accounting rules, firms do not represent an increase in unfunded liabilities immediately in book equity, but analysts and rating agencies often adjust book equity to reflect unfunded pensions. I show that pension-adjusted measures of book equity are indeed affected by variation in the funding status of corporate pension plans in general, and by the variation in pension fund asset returns in particular.

I then use an instrumental variables (IV) strategy to identify the effect of changes in the condition of the firm's balance sheet, as measured by market and book leverage, on capital expenditures. The sample of public firms that sponsored DB plans comprised about 25% of Compustat firms in 2004. However, these firms owned $15.3 trillion of the $22.0 trillion in book assets represented in Compustat that year, and they held $2.3 trillion in dedicated pension assets. The identifying assumption behind the empirical strategy is that firms experiencing better pension fund investment performance than other similar firms in the same year do not also experience a relative increase in the unobservable profitability of business opportunities. The paper also addresses the plausibility of this assumption.

The results of IV specifications suggest that a 10 percentage point increase in market leverage (roughly one within-firm standard deviation) decreases capital expenditures by 0.4 to 0.7 percent of operating assets. The result of a one within-firm standard deviation change in book leverage are similar. These IV estimates compare to an effect of approximately 1.0 percent of operating assets measured in OLS specifications. Relative to the standard deviation of the change in capital expenditures (which is 3.5 percentage points) these effects are small. Typical annual shocks would have to accumulate for several years before having quantitatively important effect on capital expenditures. These results are equally strong when the sample is limited to observations where there is no contemporaneous pension contribution requirement.

The IV specifications measure the effect of leverage on investment using only the variation in net worth caused by variation in pension fund asset returns, whereas an OLS specification relies on all

[1] This is not inconsistent with the conclusions of other literature such as Franzoni (2007) which points out that markets may under-appreciate the liquidity consequences of the mandatory pension contributions highlighted by Rauh (2006).

variation in leverage, not just the variation due to dispersion in pension fund performance. One drawback of the IV method is that the variation in financial condition due to pensions is typically of a much smaller magnitude than the overall variation in leverage, so that the effect is measured locally. The standard deviation of the first difference in market leverage is 9.6 percentage points, compared to 1.3 percentage points for the standard deviation of the first difference in market leverage caused by pensions only.[2] This is partly due to the fact that the sample for this paper includes essentially all publicly traded corporate sponsors of pension plans, not only those for which pension plans are large relative to operating assets. Indeed, for a company such as General Motors, the return on pension fund assets regularly affects the market leverage of the firm by around 5 percentage points per year.

The advantage of the IV method is that the effect is arguably exogenous to investment opportunities. The fact that the results are robust to the inclusion of industry-by-year controls at a fine level leaves two principal situations under which the identifying assumption would be violated: 1.) if a given firm's pension fund investments were structured to perform well when the firm's business investment opportunities improve relative to other firms in the same industry, and to perform poorly when the firm's investment opportunities deteriorate relative to other firms in the same industry; 2.) if better-than-average pension fund returns at year *t* for a given firm reflect better management skill, which drives or reflects greater investment opportunities.

I argue in the paper that these problems are unlikely to be driving the results, especially since the they are estimated in the presence of controls for current changes in operating profitability. Measures of market-to-book value for the firm's operating assets can also be incorporated as controls, and the results are robust to the inclusion of nonlinear terms in the control variables. Pension returns would have to reflect something about changing investment opportunities above and beyond the information contained in general functions of contemporaneous operating performance for this identification strategy to be invalid.

[2] The distributions underlying these statistics are winsorized at 1st and 99th percentiles.

I also find robust effects of pension returns on credit ratings, and hence on the cost of raising external finance for the firm. In IV specifications, a 10 percentage point increase in market leverage increases the probability of a credit rating downgrade by 4 percentage points and decreases the probability of an upgrade by 5 percentage points, compared to OLS estimates of around 2 percentage points. Increases in leverage should increase the cost of debt capital even in the absence of financing frictions, according to Proposition II of Modigliani and Miller, so this fact does not by itself add to evidence of financing frictions.

A key aspect of measuring investment and financing effects is ensuring that the financial variables when measured at book value are properly corrected for the effects of pension accounting. Until the implementation of FAS158 in 2006, book values of assets, liabilities, and shareholders equity were not required to reflect the full value of pension fund assets and liabilities. As a result, the financial strength of many companies may have been overstated. Merrill Lynch has estimated that of the projected $397 billion in aggregate 2006 underfunding among S&P 500 firms, $217 billion was unrecognized under the old system (see Latter and Haugh (2006)), and indeed some sponsors of large pension plans have stated substantially reduced levels of book equity in 2006 financial statements as a result of the new accounting.

Different models have different predictions for how reduced investment resulting from shocks to net worth should affect profitability. If firms typically overinvest then deterioration in financial condition that is unrelated to the business might help constrain managers and improve profitability. I find, however, that given a 10% deterioration in market leverage driven by a negative shock to net worth, near-term EBITDA profitability would decline by roughly 5% of assets in IV specifications. While there are certainly contexts in which increasing a given firm's leverage has been shown to increase discipline and improve profitability, the average increase in leverage in this sample reduces profitability and is therefore more indicative of models of underinvestment.

In terms of issuance behavior itself, there is a negative effect on the issuance of short term debt, but no statistically significant effect on total debt issuance. Firms may issue long-term nonpension debt to substitute it for pension debt as General Motors did with an $18 billion bond issue in 2003.

Why does a firm not always obtain debt financing and invest given a deterioration in balance sheet conditions if the result of not doing so is decreased profitability? This paper is not a test of any one specific theory. Debt overhang, generally construed, would explain why firms with underfunded pensions might have difficulty raising junior unsecured debt. However, given the variety of debt instruments available and the ability to renegotiate bank debt, debt overhang is unlikely to be binding, especially for large public companies. The results are consistent with a general class of asymmetric information and principal-agent models in which greater net worth leads to lower agency costs of borrowing. But again, the evidence suggests that the balance sheet shocks need to be quantitatively quite large in order to have an economically significant effect on investment.

This paper proceeds as follows. Section I reviews some prior literature on investment specifications and the role of net worth. Section II presents the data and ordinary least squares investment regressions. Section III describes the identification strategy in detail. Section IV discusses the main results. Section V concludes.

I. Background

A. Net Worth and Investment Specifications

Many empirical papers on corporate investment since Fazzari, Hubbard, and Petersen (1988) have examined the empirical relation between capital expenditures and components of cash flow, which are effectively changes in the level of net worth. The popularity of this empirical modeling choice likely traces back to the information models of Gertler and Hubbard (1988) and Gertler et al (1991), in which the level of net worth matters for the determination of the level of the capital stock (see footnote 26 to Hubbard and Kashyap (1992)). In those models, the change in the capital stock (i.e. investment) depends on the change in net worth.

In many other models, however, investment depends on the level of net worth. The most basic financial friction that generates this prediction is debt overhang (Myers (1977)). Hart and Moore (1995) formalize debt overhang as a state in which long-term debt constrains managers from overinvesting. Lamont (1995) shows how debt overhang can bind for large firms and impact macroeconomic dynamics. Hennessy (2004) derives a negative relation between the capital-scaled value of lender recoveries in default and investment, but argues that the debt overhang friction would be captured by true marginal q.

A large class of models of asymmetric information and principal-agent problems also generate predictions that the ability of firms to raise external finance depends on the strength of their balance sheets. Notably, Bernanke and Gertler (1989) develop a seminal real business cycle model with a costly state verification problem as in Townsend (1979), and demonstrate that in this context the agency costs associated with financing capital investments are inversely related to the borrower's net worth. In Kiyotaki and Moore (1997), the inability of lenders to force repayment on unsecured debt leads to a relation between borrowers' credit limits and the value of collateralized assets.[3] In DeMarzo and Fishman (2007), firms with less leverage invest more as a result of the evolution of the firm's debt levels under the presence of agency problems associated with inside equity holders.

A number of empirical studies have demonstrated a decisive negative empirical relation between leverage or financial condition and capital expenditures or firm growth more generally. Whited (1992) presents evidence that problems of asymmetric information in debt markets affect the ability of financially unhealthy firms to obtain outside finance. Lang, Ofek and Stulz (1996) document the firm-level and segment-level relation between leverage and asset growth. As Himmelberg (2000) points out, "the empirical relationship between investment and the market value of the firm's 'net worth' is particularly robust — at least as robust as the well-documented and better-known relationship between investment and cash flow."

[3] The fundamental friction in that model is motivated by Hart and Moore (1994). Himmelberg (2000) also develops a model in which investment depends on balance sheet condition.

Given the likely negative relation between net worth and the profitability of investment opportunities, a negative correlation between investment and leverage is unsurprising. This paper aims to identify the extent to which this effect is another case of unobserved investment opportunities, or whether it truly reflects net worth effects on capital investment.

This research is related to a small but growing literature that has examined the effects of collateral shocks from real estate on corporate investment (Peek and Rosengren (2000), Gan (2006), and Chaney, Sraer, and Thesmar (2007)). Chaney, Sraer, and Thesmar (2007) in particular find that when real estate prices rise by one standard deviation, capital expenditures of real estate owning firms rise by about 2% of one standard deviation relative to those of firms that do not own real estate. Comparing the relative magnitudes of this study with that one is difficult in the absence of information on the distribution of real estate ownership as a fraction of firm-level net worth.

B. Leverage and Financial Health

The extent to which either market or book leverage is a meaningful measure of financial health is an important question. Lenders pay more attention to debt-to-cash flow ratios than any other measure of financial health, but debt-to-cash flow is a very volatile measure, often taking on negative values and presenting difficulties for empirical analysis. In a debt-to-total-capital ratio, innovations to cash flow are priced into the denominator but do not fully determine it from one year to the next.

The extent to which the variation in leverage is the result of a process of moving towards optimal leverage is a topic of substantial debate. One branch of the literature argues that variation in leverage is driven by attempts to time securities markets Baker and Wurlger (2002). A second, characterized by Welch (2004), views leverage as determined primarily by persistent shocks to security market values. A third argues that the apparent persistence of capital structure can be explained by adjustment towards an optimum in the presence of adjustment costs (Leary and Roberts (2006)), and that most variation in leverage is the result of time-invariant effects (Lemmon, Roberts, and Zender (2006)).

In this paper I show one way that book and market leverage are affected in the short-term by financial shocks. Short-term changes to book and market leverage measures resulting from financial shocks are viewed as summary measures of shocks to financial strength. To the extent that ability to repay is important, book measures might be more appropriate given the focus of lenders and credit rating agencies on book values. However, given that book values also depend heavily on accounting choices, and that costs of capital depend on market values, it is important to consider both measures.

C. The Effects of Pensions on Book and Market Values

An extensive literature has examined whether stock prices reflect pension funding. Papers such as Feldstein and Seligman (1981), Feldstein and Morck (1983), Bulow, Morck and Summers (1987), and Bodie and Papke (1992) have generally supported the idea that equity market valuations of the firm reflect net pension funding. Bodie, Jin and Merton (2006) demonstrate that the risk level of DB pension plans affects the beta risk of the firm as a whole. However, Franzoni and Marin (2006a, 2006b) and Franzoni (2007) have found evidence of a pension underfunding anomaly, whereby firms with underfunded pension plans display worse performance than comparable firms when controlling for the usual asset pricing factors. This latter line of research supports the idea that investors are surprised by the effect of mandatory pension contributions on corporate investment documented by Rauh (2006).[4]

In this paper, I establish that annual firm equity returns do respond to the annual returns of the firm's pension funds, with point estimates suggesting that 70-80% of the investment return is priced in. I am unable to reject the hypothesis that 100% of the return is priced in. If pension funding affects both net worth and the ability of firms to raise finance for positive NPV projects, then markets might rationally price an additional $1 of pension assets at more than $1. If lower pension funding requires cash to be disgorged from the control of managers who might otherwise overinvest, then an additional $1 of pension assets might rationally be valued at less than $1. Pension assets might also translate less than one-for-one into sponsor equity valuations if their payoffs will go to creditors in states of the world where debt is

[4] One possible reconciliation of these two strands of literature — the funding effects papers and the funding anomaly papers — is that pension footnotes and filings are transparent enough for investors to see the overall level of funding but that markets are taken by surprise when firms run up against pension funding rules that create liquidity problems.

underwater; if beneficiaries of DB pensions are able to bargain for benefit increases when pension assets perform well.

Another literature that is important for the present paper examines the effect of pension accounting on firms' book leverage. Hann, Heflin, and Subramanyam (2006) outline ways that firms' balance sheets can be corrected to recognize the true funding status of corporate pension plans. Importantly, pension fund returns are not immediately recognized in balance sheet book equity under US GAAP, and the smoothing mechanisms can lead to situations where even the existence of an underfunded pension plan increases the book value of equity. Credit rating agencies and analysts, however, will often adjust the book value of equity to reflect the true funding status of the pension plan. As described below, I follow such a procedure in this analysis.

II. Data

The data for this study come from two sources. Compustat is used for the usual financial information. The pension data come from a combination of Compustat and manual data collection from 10-K filings.

In order to make the requisite calculations about pension fund returns and their effects on financial condition and market leverage, which will be discussed in section IV, information is needed on the assets and liabilities of pension plans, pension fund investment returns, and the effects that pensions have on book balance sheet measures. Assets and projected benefit liabilities are available from Compustat for 1991-2005. Pension investment returns are also available from Compustat (data333) for years 1991-1997, but must be collected from the pension footnotes of 10-K filings for 1998-2005.[5] Similarly, the accounting effects of pensions on assets, liabilities, and accumulated other comprehensive income are available from Compustat for 1991-1997,[6] but must be collected from the footnotes of 10-K filings for the more recent years. The Compustat quantities aggregate domestic and foreign plans, and the same approach was taken in the manual data collection so as to obtain consistent series.

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[5] For years 1998-2005, Compustat data333 shows the *expected* return on plan assets, not the actual. See Bergstresser, Desai and Rauh (2006).

[6] The key items are data290, data300, and data298.

The main sample for the empirical analysis consists of all firms that sponsored DB pension plans during the sample period, that had more than \$100 million in operating assets, and for which information could be collected either from Compustat or from pension footnotes. It is worth bearing in mind that this includes firms whose pension assets are very small relative to operating assets and which effectively serve as control firms for the analysis, as well as firms whose pension assets are substantial. At the 10^{th} percentile, the ratio of pension assets to total book assets is 2.5%, and at the 90^{th} percentile it is 40.5%.

As of this draft, the data collection is still an ongoing process and hence there are more firms in the early years of the sample (where Compustat coverage is adequate) than the later years of the sample (where all data items need to be assembled manually). However, the results are robust to focusing on a more balanced sample. The data collection in the later years has covered the largest pension sponsors first, and contains fewer control firms for which pensions are a very small fraction of total assets.

Table 1a shows the constructions for the main variables in this study. Unadjusted measures of debt, equity, and book assets will partially reflect the effects of pensions according to US GAAP rules. I therefore calculate adjusted measures of debt, equity, and book assets that either fully reflect or fully exclude pension effects. For example, investment variables are normalized by *Assets Excluding Pensions* (*AXP*), which is simply book assets minus the effect that pension funding has on assets. *Nonpension debt* is defined as total debt from Compustat minus the effect that pensions have on liabilities. *Pension-adjusted equity book value* corrects the book value of equity so that it reflects the true value of unfunded pension liabilities, not the pension effect under US GAAP rules. *Book leverage* is then defined as nonpension debt scaled by the sum of non-pension debt and pension-adjusted equity book value. *Market leverage* is defined as nonpension debt scaled by the sum of nonpension debt and the market value of equity. This market leverage construction treats net pension funding as incorporated into the equity price of the firm, an assumption which is investigated further in the analysis later on.[7] One key variable in the

[7] The measure of market leverage is therefore a financial debt to capital ratio and in that sense follows the recommendation of Welch (2007). An initial draft of this paper defined market leverage variables following Fama and French (2002) so that the value of debt was estimated as the book value of total liabilities plus preferred stock

analysis is the return on investment pension fund assets scaled by the lagged market equity of the firm, *Pension Return*$_t$ / *Firm E*$_{t-1}$. I defer discussion of the other pension instruments (*Pension Δ Market Leverage*$_{t-1}$, and *Pension Δ Book Leverage*$_{t-1}$) until Section III.

Table 1b shows summary statistics for these data items in the main sample of analysis. All variables are winsorized at the 1st and 99th percentiles. The sample firms have mean and median market leverage of 30.7% and 27.9% respectively, and mean and median book leverage of 44.7% and 43.9% respectively. The standard deviations of market and book leverage are 22.1% and 29.8% respectively, and first differences in these variables have standard deviations of 9.6 percentage points and 15.1 percentage points respectively. Investment rates, scaled by assets excluding pensions, are 6.8% at the mean and 5.5% at the median. The first difference in the investment rate has a standard deviation of 3.5 percentage points.

The return on firms' pension assets at the mean amounts to 3.9% of the lagged equity market value of the firm, with a standard deviation of 8.7%. For roughly 10% of observations, the return on pension assets amounts to more than 10% of the lagged market value of the firm. This highlights the fact that pensions can have a critical impact on the financial condition of their sponsors. As a share of pension assets, firms earn mean and median returns of around 10.5%, with a standard deviation of approximately 9%.

Appendix Table 1 shows basic non-pension-adjusted summary statistics three samples: the full Compsutat sample, the Compustat sample with DB pension plans, and the sample for which we are able to obtain the pension data. Again, all variables are winsorized at the 1st and 99th percentiles.

Appendix Table 1 serves two purposes. First, comparing the three panels of Appendix Table 1 highlights the main differences between the pension firms and the Compustat universe. The sample firms have slightly higher mean and lower median capital investment rates than the full Compustat sample. They are larger and have higher levels of market leverage (28% at the median versus 16% in the full

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minus deferred taxes. The treatment of preferred stock, deferred taxes, and other non-debt components of liabilities does not appreciably affect the results, so for transparency I now use the measures based on the book value of debt.

Compustat sample), and book leverage (45% at the median versus 30% in the full Compustat sample) They have on average lower market-to-book ratios, 1.29 at the median compared to 1.46 at the median.

Second, a comparison of Panel C of Appendix Table 1 with Table 1b illustrates the effects of the pension adjustments. Unadjusted book leverage is 45.2% at the mean and 45.1% at the median, compared to 44.7% at the mean and 43.9% at the median when net pension funding is incorporated completely in book equity and excluded completely from book debt. Unadjusted market leverage is 31.4% at the mean and 28.7% at the median, compared to 30.7% and 27.9% when net pension funding is assumed to be incorporated fully in the market vale of equity and removed from the book value of debt.

There are several reasons that the pension adjustment on average lowers leverage slightly. First of all, note that the sample period was characterized by periods of overfunding as well as underfunding, so there is no a priori reason that the average correction would lead to higher leverage. Second, even for a firm with an underfunded pension, the pension adjustment lowers the book value of equity (and leaves the market value of equity unaffected) but it also lowers the book value of debt because I am including only nonpension debt in the debt measure. An alternative construction would be to include the unfunded pension liability positively in debt in addition to subtracting it from book equity. I elect not to do this as a modeling choice because unfunded pension debt is very junior in the capital structure priority in bankruptcy. The results are robust to this treatment, however. The critical aspect of including the pension in leverage is not whether it on average makes the firm more or less levered but how changes in the pension fund affect leverage. The General Motors example which follows illustrates this construction, and I discuss this issue further in that context.

Table 2 provides an example of a firm for which such accounting corrections might be of critical importance. General Motors is the sponsor with the largest DB pension liabilities of any US firm, with almost $110 billion in projected benefit obligation pension liabilities in 2005, backed by $105 billion in assets. Its 2005 return on pension assets of $12.3 billion represented 54.4% of beginning-of-year market value.

Table 2 shows that General Motors recognized $38 billion in assets and $11 billion in liabilities in 2005. This therefore increased book equity by $27 billion over what it otherwise would have been. Removing this effect on book equity in 2005 reduces book equity from $14.6 billion to -$12.4 billion. Moreover, the table shows incorporating the true pension underfunding of $4.6 billion further reduces book equity to -$17.0 billion. FASB ruling 158 requires firms to recognize all pension underfunding directly on the balance sheet, and as a result General Motors did indeed state negative shareholders equity for 2006 of -$5.4 billion, which was largely the result of a $20 billion decline in the net recognition of pension assets and liabilities.[8]

Removing the effects of pensions on GM's market leverage only has a small effect on the market leverage ratio. Again, there are two reasons for this. First, the correction does not affect the market value of equity, which is taken directly from market data and was $11 billion at the end of 2005. Second, effects on the estimated market value of debt affect both the numerator and the denominator. The effects on book leverage ratios are larger: GM appears to have had a 95.2% book leverage ratio in 2005 using stated data, but correcting for the accounting raises this ratio to 106.6%.

The ex-pensions market leverage quantities I calculate in this paper assume that markets are efficient enough that the market value of equity reflects the market value of the unfunded pension liability. Since the unfunded part of the pension obligation is treated as junior debt in bankruptcy, investors in the firm should view it as a junior unsecured claim. If this debt is of similar priority to other junior unsecured claims, then of course it would affect the value of some of the firm's outstanding debt securities. There are several alternative possible treatments, including treating the unfunded pension liability as debt, rather than a charge to equity. Use of these alternatives does not have material effects on the results of the paper.

For regressions that contain a measure of Tobin's Q (market-to-book), the problem arises that the firm's market value will at least partly reflect net pension funding. This highlights the fact that market-to-book ratios as typically measured contain information that is not related strictly to business opportunities.

[8] See http://www.sec.gov/Archives/edgar/data/40730/000095012407001502/k11916e10vk.htm .

The variable *Pension-Adjusted Q* assumes that net pension funding is fully reflected in market values. It treats the denominator as book assets excluding pension accounting effects, and the numerator as the market value of the assets plus net pension funding. The assumption that net pension funding is incorporated into the equity price of the firm is investigated further in the analysis later on.

III. Identification

This paper uses standard instrumental variables estimation techniques. Results are presented using both IV with firm fixed effects and IV on first-differenced data. Part A of this section describes the instruments and Part B address possible objections.

A. Instrumental Variables

The first instrumental variable for the change in market leverage is simply the return on the firm's pension assets scaled by the book value of equity. So the first stage regression equation is:

$$\Delta Leverage_{i,t-1} = \alpha + \gamma_1 \frac{PensionReturn_{i,t-1}}{E_{i,t-2}} + \gamma_2 \Delta \frac{NonPensionCashFlow_{i,t-1}}{AXP_{i,t-1}} + \gamma_3 ' \boldsymbol{x} + \varepsilon_{it} ,$$

where the differences are taken with the first lag of the subscript, i.e. $\Delta Leverage_{t-1} = Leverage_{t-1} - Leverage_{t-2}$. The vector $\boldsymbol{x}$ contains additional control variables. This form of the first stage regression has the advantage that it makes the source of the identifying variation transparent. The return on pension assets scaled by the lagged value of pension equity has an effect on market leverage through its effect on equity market values. The identifying assumption when this specification is used as part of two-stage estimation of investment equations is that the pension return scaled by the lagged value of pension equity has an effect on capital expenditures only through its effect on the firm's market leverage or net worth.

While the specification above captures the idea that the return on pension assets affects net worth, it does not capture the fact that such an effect must be nonlinear since the equity market value appears in the denominator of the leverage ratio. This suggests the following as a more precise instrument:

$$Pension\ \Delta\ Leverage_{t-2} = \left[\frac{D_{t-2}}{D_{t-2} + E_{t-2} + PensionReturn} \right] - \left[\frac{D_{t-2}}{D_{t-2} + E_{t-2}} \right]$$

These variables represent the predicted change in the market leverage ratio that comes only from changes in the value of pension fund assets. When regressions are estimated with year fixed effects, the identifying variation comes from difference in pension fund asset returns among firms in the same year. When regressions are estimated with industry-by-year fixed effects, the identifying variation comes from difference in pension fund asset returns among firms in the same industry-year.

Given this discussion, I use three main instrumental variables specifications. In the first, I instrument for market leverage using the pension return scaled by the lagged market value of equity. In the second, I instrument for market leverage using *Pension Δ Market Leverage*. In the third, I instrument for book leverage using *Pension Δ Book Leverage*.

B. Possible Objections to the Instruments

One situation in which the exclusion restriction would not be satisfied is if a given firm's pension fund investments were intentionally structured to perform well when the firm's business investment opportunities improve relative to other firms in the same year, and to perform poorly when the firm's business investment opportunities deteriorate relative to other firms in the same year. This is never a stated goal of pension fund investment strategy, but firms could attempt to engage in a strategy whereby pensions are underfunded at times when cash needs and investment opportunities are low and well-funded at times when cash needs and investment opportunities are high (following Froot, Scharfstein and Stein (1993)). If firms invested in their own stock in their DB plans, that would generate this correlation, but such investment happens only in trace amounts due to statutory limitations on this practice. Nonetheless, it is conceivable that firms could assemble portfolios that were designed to mimic the performance of their own stock.

If firms were following this practice, one direct implication would be that pension fund asset returns for a given firm should positively correlated with the equity returns of other firms in its narrowly-defined industry. This turns out not to be true in the data, as I will demonstrate in section IV.

A second possible problem is that good investment performance in pension funds reflects investment opportunities because there is a correlation between investing skill and investment opportunities. This would have to be the case within industries, as the results presented in this paper are robust to the inclusion of industry-by-year fixed controls at the Fama-French 48 industry level (which over 14 years implies 672 control variables). Furthermore, the results are also robust to the inclusion of linear and nonlinear controls for both operating performance and a measure of market-to-book values for the firm's operating assets.[9] Finally, it is worth keeping in mind that most specifications here are estimated in terms of first differences. So conditions under which the instrument is invalid must be relevant for changes within industry-year cells and also even conditional on the industry and current profitability controls. Pension returns would have to reflect something about investment opportunities above and beyond the information contained in general functions of contemporaneous operating performance (and their rate of change) for this identification strategy to be invalid.

A third aspect of the identification strategy is that firms with larger pension liabilities relative to their operating assets and equity market values will be more exposed to shifts in the value of pension fund assets. This occurs both on the up-side and the down-side. Thus, for the effect to be driven by variation in investment opportunities that is correlated with relative pension fund size, it would have to be the case that firms with bigger pension funds have better investment opportunities when their pension assets perform well and worse investment opportunities when their pension funds perform poorly. This seems unlikely, but the specifications nonetheless all contain controls for the size of the pension liability relative to the size of operating assets or equity market values.

Another identification criticism is that shocks to pension fund asset values may have cash flow implications through their effect on mandatory pension contributions (see Rauh (2006)), and therefore that this paper may be measuring the exact same effect. In the 1990-1998 sample for Rauh (2006), approximately one-quarter of the firms had at least one annual episode such that required contributions were 10% of capital expenditures or greater, whereas the present paper is documenting a broader phenomenon. I demonstrate in a robustness test that the documented balance sheet effects are just as

[9] The same holds if firm market-to-book itself (Tobin's average Q) is used this measure, but this is not the preferred specification in this paper as unadjusted Tobin's average Q will contain information about the pension funding, not just about the firm's business opportunities.

strong in a sample of firms which are unlikely to have to make current-year mandatory pension contributions, so indeed the phenomenon is distinct.[10]

IV. Results

This section presents empirical results in four sub-sections. Section A establishes the first-stage relation between the instruments and market leverage, and demonstrates that pension fund returns of a given firm are not positively correlated with the firm equity returns of other firms in the same industry and year. Section B shows the effects of pension fund performance on credit ratings. Section C presents the results of the investment specifications, including robustness checks. Section D discusses the empirical results of similar IV specifications but with alternative outcome variables, i.e. asset growth, financing choices, debt maturity, and profitability.

A. Establishing the First-Stage Relation

Table 3 takes a coarse look at the effect of a firm's one-year pension fund returns on the one-year equity return of the sponsor's stock. In creating the sample, care is taken to match fiscal year ends to the appropriate calendar dates. I examine both raw unadjusted returns and returns net of the size, book-to-market, and momentum portfolios of Daniel, Grinblatt, Titman, and Wermers (1997), henceforth DGTW, and Wermers (2004).[11] In years for which the sample is complete, equity returns tend to increase monotonically across the portfolios. There is no year where such a relation could be statistically rejected. Firms in the highest category of pension return as a fraction of lagged market value outperform those in the lowest category.

Table 4 shows the relation between firm returns and the pension return scaled by lagged equity market assets in linear regressions. The first column reveals that for every dollar of pension fund returns scaled by the firm's lagged market value of equity, equity market value increases by $0.73. When the annual DGTW returns are netted out, this effect reduces to $0.52, as shown in the fourth column. One

[10] In the future I intend to include estimates of mandatory contributions in the IV specifications so that both can be considered in the same analysis. There are data limitations. It is difficult to estimate mandatory contributions from Compustat and 10-k filings.

[11] The DGTW benchmarks are available via http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm

potential concern with this analysis is that sponsors of large pension plans are somehow different than non-sponsors, and that this relation may simply reflect that fact. The second and fifth columns repeat the same exercise controlling for the pension liability of the firm scaled by firm assets and the results are unchanged or slightly stronger. The third and sixth columns repeat the same exercise controlling for the pension liability of the firm scaled by the market value of equity and the effects are slightly weaker but still significant at 95% confidence intervals. In all of the investment regressions I therefore control for the pension liability scaled by the market value of equity, in order to be conservative.

Figure 1 shows the separate effect of each of the three instrumental variables on the change in market leverage. The top graph shows the decreasing relation between the pension return scaled by the lagged market value of equity and the change in market leverage. The coefficient in this regression is -0.16, so that if the return on pension assets is 10% of lagged market equity, market leverage increases on average by 0.16 percentage points. The t-statistic (with standard errors clustered by firm) is -8.43 and the F-statistic is 71.08, so clearly this first instrument is sufficiently strong. When industry-by-year fixed effects are added, the coefficient magnitude falls to -0.12, and the t-statistic is -6.25.

The bottom two graphs show the relation between the predicted change in leverage based only on asset returns and the actual change in leverage, for market leverage and book leverage respectively. The coefficient in the market leverage regression is 1.46, the t-statistic is 13.29. When industry-by-year fixed effects are included the coefficient is 1.24 (t-statistic 11.89). The univariate F-statistics are over 100. In the book leverage regression, the coefficient is 0.72, the t-statistic if 5.26, and the univariate F-statistic is 27.67. Including industry-by-year effects in the book leverage first stage hardly changes these numbers. These instruments are therefore also sufficiently strong.

If firms invested in portfolios that either intentionally or unintentionally correlate with changes in investment opportunities then the exclusion restriction in this identification strategy would be invalidated. Given the difficulty of observing investment opportunities, direct tests of this are not feasible. However, if this correlation exists then we should also observe that a given sponsoring firm's pension fund returns are positively correlated with the returns of other firms in the same industry as the sponsoring firm.

Table 5 examines the correlation of pension fund returns with equity returns of other firms in the same industry and year. The dependent variable is the average return of all firms in a the observation's industry-year excluding the observation itself. The explanatory variable is the dollar return on pension assets, scaled either by lagged pension assets or the lagged market value of equity. There is no evidence of a positive correlation. If anything there is a negative correlation. This suggests that firms do not intentionally structure pension assets to correlate positively with the market values of other firms in the same industry. This result holds regardless of whether industry-by-year controls are included or not.

B. Credit Ratings

Table 6 presents the results of linear probability models estimated by OLS and IV, for the impact of changes in net worth on the likelihood of credit rating changes. Panel A presents the results for the probability of an upgrade and Panel B presents the results for the probability of a downgrade. This table focuses on book leverage given the emphasis that credit rating agencies place on book quantities. In the OLS estimates, a 10% increase in book leverage decreases the probability of an upgrade by 1.8-2.0 percentage points. In the IV estimates, a similar increase in book leverage would decreases the probability of an upgrade by 4.4-4.7 percentage points. For downgrades the magnitude of the results are similar. A 10% increase in book leverage generates a 1.6-1.7 percentage point higher likelihood of a downgrade in OLS regressions and a 3.9-4.2 percentage point higher likelihood of a downgrade in IV specifications.

The fact that the IV magnitudes are larger can be explained by the fact that endogenous increases in book leverage through debt issues or increased borrowing must be taken with the consent of a borrower. The IV results focus on a deterioration in net worth that is exogenous to the active decision of whether to increase borrowing.

The fact that credit ratings deteriorate with increases in leverage that are not within the firm's control is unsurprising given Proposition II of Modigliani and Miller. The cost of debt will tend to rise as leverage increases even without any frictions. However, investment decisions should not be distorted in a frictionless system.

C. Investment Specifications

Appendix Table 1 shows baseline investment specifications that do not address the endogeneity of leverage or cash flow. These variables in OLS specifications reflect a mix of liquidity and investment opportunity effects. Market leverage appears highly statistically significant with a negative coefficient of -0.09 to -0.10 in both firm fixed effects and first differences specifications. This is very similar to the coefficients found by Lang, Ofek, and Stulz (1996).[12] If this effect were causal, it would imply that a 10 percentage point change in market leverage reduced investment by about 1 percentage point.

In what follows, the results of first difference specifications are presented and emphasized. First difference specifications net out any firm fixed effects in the differenced variables and so are used in place of firm fixed effects. The alternative, fixed-effects IV, requires sequential moment restrictions, in that the expectation of the error term for a given observation (*i,t*) in the investment equation must be independent of current and lagged values of the control variables. While this seems a plausible assumption, it is cleaner to work with first-difference specifications, in which the individual firm effect is differenced out.

In Table 7, IV regressions are shown in first difference specifications. Using the lagged pension return as an instrument and including year effects as opposed to industry-by-year effects, the effect of a change in lagged market leverage on the change in capital expenditures is -0.059 and statistically significant at the 1% level. This effect is somewhat smaller when *Pension Δ Market Leverage* is used as an instrumental variable, on the order of -0.041 significant at the 1% level. Based on a 10 percentage point increase in leverage (roughly one standard deviation of the change in market leverage), this translates into variation in capital expenditures of 0.4-0.6 percentage points of lagged nonpension assets. When book leverage is used and instrumented with *Pension Δ Market Leverage*, the effect is -0.030 and significant at the 5% level. However, one standard deviation of the change in book leverage is 15

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[12] They report a coefficient of book leverage on the investment ratio of -0.105 with an unclustered standard error of 0.001, and coefficients of market leverage on the investment ratio of -0.09 to -0.10 with an unclustered standard error of 0.001.

percentage points, so that the effect of a one percentage point change in book leverage appears similar to that of market leverage.

All specifications contain controls for the lagged ratio of the pension liability to the market value of firm equity, to control for possible heterogeneity in investment rates among firms with different levels of pension liability relative to the value of equity in the firm.

Panels B and C of Table 7 presents similar specifications but also including industry-by-year fixed effects, which over 14 years implies 672 control variables, as well as additional controls for potential correlations between pension fund returns and investment opportunities. Panel B includes controls for squared and cubed terms of the change in nonpension cash flow, and Panel C includes controls for the cash flow terms and for the change in pension-adjusted *Q*.[13]

Table 8 demonstrates that the documented balance sheet effects are just as strong and in fact slightly stronger in a sample of firms which are unlikely to have to make current-year mandatory pension contributions. It presents the same specifications as Table 7 but limits the sample to firms for which the pension assets are greater than the estimated accumulated benefit obligation (ABO). Firms typically only run up against mandatory contributions when pension assets are less than the ABO. This highlights the fact that firms are not simply cutting investment because of immediate cash demands of the pension fund (Rauh (2006)).

Since the sample is somewhat skewed towards the early part of the period, it is important to make sure that the result is still there when considering a more balanced panel. This is indeed the case in a table similar to that of Table 7 but limiting the sample to firms for which there is an observation manually collected for the later part of the sample (not shown here).

D. Other Outcome Variables

Tables 9 presents similar regression results for different outcome variables. All of the results are shown using market leverage as the main explanatory variable, instrumented with the first instrument ($Pension\ Return_{t-1} / MV\ Equity_{t-2}$). The first column shows the effect of leverage on net investment, where

[13] The results are in fact stronger when both nonlinear cash flow controls and pension-adjusted Q are both included.

net investment is defined as the change in property plant and equipment. This generates a slightly larger and slightly less precisely estimated coefficient than when gross CAPX is considered, resulting in a coefficient −0.11 with a standard error of 0.05. The second column examines profitability by considering nonpension cash flow scaled by operating assets as a dependent variable. Each 10 percentage points of leverage lowers nonpension cash flow by 0.5 percentage points, which is quite small compared to the standard deviation of the change in nonpension cash flow of roughly 5 percentage points.

The third column shows that a similar shock to net worth from pension fund performance would lower short term debt issuance by approximately 1 percentage point, compared to a standard deviation of the change in short term debt issuance equal to 4 percentage points. Long term debt issuance may increase in an offsetting way, although this is not a statistically significant effect, and neither overall equity issuance nor overall nonpension debt issuance appear to change, although both are estimated with large standard errors. Firms may issue long-term nonpension debt to substitute it for pension debt as General Motors did with its $18 billion issue in 2003.

V. Conclusion

This paper shows that even when firms do not have contemporaneous cash contribution requirements, shocks to net worth due to variation in pension fund asset performance raise borrowing costs and reduce capital expenditures. The paper provides evidence that variation in pension fund asset performance is unlikely to be correlated with the sponsor's investment opportunities, especially within industries and in the presence of nonlinear profitability controls. Capital expenditures rise as the condition of the balance sheet improves and declines as it deteriorates, even when the variation is limited to variation in balance sheet condition driven by intra-industry variation in pension fund asset performance.

The results are consistent with models in which the net worth of the firm affects output dynamics. Given the effects of these shocks on short-term debt issuance and future cash flow profitability, the findings are more suggestive of some underinvestment in the presence of financing constraints than they are of the idea that these shocks impose discipline on overinvesting managers. However, the magnitude of the effects is small relative to the within-firm standard deviation of capital expenditures. Substantial effects on investment would require multiple years of serially correlated shocks of the typical magnitude, or sudden shocks of large magnitude. Future research should aim to examine the mechanism through which net worth shocks to net worth from pensions affect investment by examining the ways that contractual provisions in debt contracts change in response to these shocks.

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Table 1a: Variable Descriptions

Basic Pension-Adjusted Variables Used in Constructions

Assets Excluding Pensions (AXP)	Book assets (data6) – pension effect on assets (data290 for 1991-1997, collected from 10-K for 1998-2005)
Nonpension Debt	Defined as debt (data9+data34) – pension effect on liabilities (data300*[-1] for 1991-1997, collected from 10-K for 1998-2005)
Pension funding	Pension assets (data287 + data296) – pension liabilities (data286 + data294), where projected liabilities are measured on a projected benefit obligation (PBO) basis
Pension-Adjusted BV Equity	Book value of equity (data60) corrected so that it reflects true pension funding status. Defined as book value of equity (data60) – pension effect on shareholders equity (data298 for 1991-1997, collected from 10-K for 1998-2005) + pension funding.

Variables Used in Analysis

$Investment_t/AXP_{t-1}$	capital expenditures (data128) scaled by lagged AXP
ΔNet $PPE_{t,t-1}/AXP_{t-1}$	change in Net PPE (data8) scaled by lagged AXP
Nonpension Cash $Flow_t$ / AXP_{t-1}	Net income excluding extraordinary items (data18) + depreciation and amortization (data14) + pension and retirement expense (data43), scaled by AXP
MV $Equity_t$	Market value of equity (data199*data25)
Market $Leverage_{t-1}$	Defined as [Nonpension Debt / (Nonpension Debt + MV equity)], assumes net pension funding is reflected in market value of equity.
Book $Leverage_{t-1}$	Adjusts book equity to reflect pension funding and calculates leverage as [Nonpension Debt / (Nonpension Debt + Pension-Adjusted BV equity)]
Pension-Adjusted Q_{t-1}	[AXP_{t-1} + (MV $Equity_{t-1}$ + net pension funding) – book value of equity (data60) – deferred taxes (data74)] / AXP_{t-1}. This measure assumes that market prices fully reflect any pension overfunding or underfunding and removes that effect from market values.
Pension $Return_t$ / Firm E_{t-1}	1991-1997: Compustat pension return (data333) / lagged equity market value (lagged data199*data25) 1998-2005: Manually collected pension return from 10-K filings / lagged equity market value
Pension $Return_t$ / Pension $Assets_{t-1}$	1991-1997: Compustat pension return (data333) / lagged pension assets (data287+data296) 1998-2005: Manually collected pension return from 10-K filings / lagged pension assets (data287+data296)
Pension Δ Market $Leverage_{t-1}$	Change in Market Leverage due only to pension return: $\left[\frac{\text{Nonpension } D_{t-1}}{\text{Nonpension } D_{t-1} + \text{MV Equity}_{t-1} + \text{Pension Return}_t}\right] - \left[\frac{\text{Nonpension } D_{t-1}}{\text{Nonpension } D_{t-1} + \text{MV Equity}_{t-1}}\right]$
Pension Δ Book $Leverage_{t-1}$	Change in Book Leverage due only to pension return: $\left[\frac{\text{Nonpension } D_{t-1}}{\text{Nonpension } D_{t-1} + \text{MV Equity}_{t-1} + \text{Pension Return}_t}\right] - \left[\frac{\text{Nonpension } D_{t-1}}{\text{Nonpension } D_{t-1} + \text{MV Equity}_{t-1}}\right]$

Unadjusted Quantities Used in Appendix

$Investment_t/A_{t-1}$	capital expenditures (data128) scaled by lagged book assets (data6)
$\Delta Net\ PPE_{t,t-1}/A_{t-1}$	change in Net PPE (data8) scaled by lagged book assets (data6)
$Cash\ Flow_t\ /\ A_{t-1}$	Net income excluding extraordinary items (data18) + depreciation and amortization (data14), scaled by book assets (data6)
$MV\ Equity_t$	Market value of equity (data199*data25)
Market Leverage $(Unadjusted)_{t-1}$	Defined as [Debt / (Debt + MV Equity)], where Debt = data9 + data34.
Book Leverage $(Unadjusted)_{t-1}$	Defined as[Debt / (Debt + BV equity)], where Debt = data9 + data34 and BV equity = data60.
Q_{t-1}	[Book $Assets_{t-1}$ + MV $Equity_{t-1}$ – book value of equity (data60) – deferred taxes (data74)] / Book $Assets_{t-1}$.

Table 1b: Summary Statistics

All variables are winsorized at the 1st and 99th percentiles. AXP stands for Book Assets Excluding Pensions, and can be construed as operating assets. See Table 1a for detailed variable descriptions. The sample period is 1991-2005. The sample for 1991-1997 consists of all firms with DB plans in Compustat and with at least $100 million in book assets. The sample for 1998-2005 is all firms with at least $100 million in book assets for which data on pension returns has been collected from 10-K filings. Leverage quantities are constructed as described in Table 1a and so include the pension adjustments.

	Mean	Median	Standard Deviation	Count	10th Percentile	25th Percentile	75th Percentile	90th Percentile
Levels								
$\text{Investment}_t/\text{AXP}_{t-1}$	0.0680	0.0555	0.0502	10885	0.0216	0.0347	0.0859	0.1261
$\Delta\text{AXP}_{t,t-1}/\text{AXP}_{t-1}$	0.0831	0.0463	0.2150	9735	-0.0817	-0.0137	0.1254	0.2617
$\Delta\text{Net PPE}_{t,t-1}/\text{AXP}_{t-1}$	0.0255	0.0114	0.0815	10996	-0.0340	-0.0081	0.0418	0.0989
$\text{Nonpension Cash Flow}_t/\text{AXP}_{t-1}$	0.1013	0.0973	0.0731	10738	0.0301	0.0650	0.1416	0.1858
$\text{Market Leverage}_{t-1}$	0.3068	0.2791	0.2211	10977	0.0386	0.1263	0.4497	0.6094
$\text{Book Leverage}_{t-1}$	0.4473	0.4388	0.2976	9986	0.0947	0.2638	0.5762	0.7385
$\text{Pension-Adusted Q}_{t-1}$	1.5428	1.2861	0.8355	10977	0.9378	1.0646	1.7330	2.4059
$\text{Short Term Debt}_{t-1}/\text{AXP}_{t-1}$	0.0196	0.0091	0.0313	10752	0.0000	0.0014	0.0253	0.0494
$\text{Long Nonpension Debt}_{t-1}/\text{AXP}_{t-1}$	0.2549	0.2417	0.1898	9733	0.0239	0.1239	0.3472	0.4621
$\text{Total Nonpension Debt}_{t-1}/\text{AXP}_{t-1}$	0.3082	0.2964	0.2020	9732	0.0627	0.1742	0.4048	0.5336
$\text{Short Term Debt Issuance}_t/\text{AXP}_{t-1}$	0.0014	0.0000	0.0291	10693	-0.0192	-0.0038	0.0054	0.0236
$\text{Long Nonpension Debt Issuance}_t/\text{AXP}_{t-1}$	0.0179	-0.0006	0.1115	9732	-0.0654	-0.0245	0.0381	0.1128
$\text{Total Nonpension Debt Issuance}_t/\text{AXP}_{t-1}$	0.0210	0.0001	0.1197	9729	-0.0726	-0.0279	0.0449	0.1228
First Differences								
$\Delta\text{Investment}_t/\text{AXP}_{t-1}$	-0.0005	0.0000	0.0345	10467	-0.0335	-0.0121	0.0120	0.0313
$\Delta[\Delta\text{AXP}_{t,t-1}/\text{AXP}_{t-1}]$	0.0032	0.0036	0.2716	9376	-0.2261	-0.0779	0.0866	0.2313
$\Delta[\Delta\text{Net PPE}_{t,t-1}/\text{AXP}_{t-1}]$	-0.0008	0.0007	0.1045	10593	-0.0886	-0.0265	0.0269	0.0858
$\Delta\text{Nonpension Cash Flow}_t/\text{AXP}_{t-1}$	-0.0005	0.0017	0.0583	10329	-0.0571	-0.0186	0.0198	0.0511
$\Delta\text{Market Leverage}_{t-1}$	-0.0083	-0.0078	0.0962	10572	-0.1110	-0.0518	0.0314	0.0942
$\Delta\text{Book Leverage}_{t-1}$	0.0030	-0.0045	0.1511	9828	-0.1008	-0.0422	0.0378	0.1174
$\Delta\text{Pension Adusted Q}_{t-1}$	0.0364	0.0315	0.3259	10574	-0.2689	-0.0832	0.1569	0.3462
$\Delta\text{Short Term Debt Issuance}_t/\text{AXP}_{t-1}$	0.0012	0.0001	0.0486	10249	-0.0358	-0.0070	0.0122	0.0383
$\Delta\text{Long Nonpension Debt Issuance}_t/\text{AXP}_{t-1}$	0.0003	0.0000	0.1603	9373	-0.1360	-0.0484	0.0458	0.1432
$\Delta\text{Total Nonpension Debt Issuance}_t/\text{AXP}_{t-1}$	0.0014	0.0006	0.1681	9369	-0.1435	-0.0497	0.0545	0.1513

Instruments								
Pension $Return_t$ / Pension $Assets_{t-1}$	0.1042	0.1069	0.0933	9648	-0.0204	0.0556	0.1629	0.2208
Pension $Return_t$ / MV $Equity_{t-1}$	0.0389	0.0150	0.0869	9651	-0.0030	0.0030	0.0421	0.0995
Pension Δ Market $Leverage_{t-1}$	-0.0063	-0.0021	0.0130	10612	-0.0189	-0.0078	-0.0002	0.0004
Pension Δ Book $Leverage_{t-1}$	-0.0135	-0.0056	0.0310	9856	-0.0325	-0.0152	-0.0009	0.0007

Table 2: General Motors Corporation Example of Variable Construction

	Book Assets	Equity Market Value	Pension Assets	Pension Liability	Pension Return	Pension Return / E_{t-1}
	(1)	(2)	(3)	(4)	(5)	$(5)_t/(2)_{t-1}$
1992	191013	22795	42831	56841	2919	16.3%
1993	188201	39516	51026	73289	7935	34.8%
1994	198599	31777	54624	67192	1266	3.2%
1995	217123	39815	73720	80291	12832	40.4%
1996	222142	42182	77210	82027	8964	22.5%
1997	228888	42127	78355	83394	11638	27.6%
1998	257389	46874	80983	87246	6766	16.1%
1999	274730	45024	87524	82997	14547	31.0%
2000	303100	27923	85263	86042	1455	3.2%
2001	323969	27170	73662	86333	(4835)	-17.3%
2002	370782	20658	66803	92243	(5262)	-19.4%
2003	448507	30011	93729	102373	14155	68.5%
2004	479603	22639	99909	107440	11860	39.5%
2005	476078	10982	105175	109774	12306	54.4%

	Pension Amounts Recognized in Balance Sheet					
	Assets	Liabilities	AOCI*	Retained Earnings	Net	Actual Funding
	(6)	(7)	(8)	(9)	(6)+(7) =(9)-(8)	(3)-(4)
1992	3859	(13627)	9331	(437)	(9768)	(14010)
1993	6588	(22277)	17105	1417	(15689)	(22264)
1994	6829	(13894)	13093	6028	(7065)	(12568)
1995	7770	(6706)	14128	15192	1064	(6570)
1996	7741	(7581)	14567	14727	160	(4817)
1997	14743	(7058)	6513	14198	7685	(5039)
1998	13811	(8175)	8161	13797	5636	(6263)
1999	16789	(3427)	191	13553	13362	4527
2000	21917	(3604)	73	18386	18313	(779)
2001	13758	(10839)	15393	18312	2919	(12671)
2002	6911	(22762)	37164	21313	(15851)	(25440)
2003	40888	(8024)	3714	36578	32864	(8644)
2004	39684	(9455)	4588	34817	30229	(7531)
2005	38319	(11304)	5908	32923	27015	(4599)

				Book Equity		
	Book Assets Ex Pension	Book Liabilities	Liabilities Ex Pension	Unadjusted Implied	Ex Pensions	Pension-Adjusted
	(11)	(12)	(13)	(1)-(12)	(13)-(11)	(13)-(11)+(3)-(4)
1992	187154	184022	170396	6991	16758	1744
1993	181613	182153	159877	6048	21736	(982)
1994	191770	185325	171431	13274	20339	7319
1995	209353	193778	187072	23346	22282	15711
1996	214401	198724	191143	23418	23258	18441
1997	214145	211382	204324	17506	9821	4782
1998	243578	242405	234230	14984	9348	3085
1999	257941	254086	250659	20644	7282	11809
2000	281183	272925	269321	30175	11862	11083
2001	310211	304262	293423	19707	16788	4117
2002	363871	363968	341206	6814	22665	(2775)
2003	407619	423239	415215	25268	(7596)	(16240)
2004	439919	451877	442422	27726	(2503)	(10034)
2005	437759	461481	450177	14597	(12418)	(17017)

	Unadjusted Market Leverage	Market Leverage (Adjusted)	ΔUnadjusted Market Leverage	ΔMarket Leverage (Adjusted)	IV: Pension Δ Market Leverage
1992	78.4%	75.2%	-5.6%	-7.2%	-2.3%
1993	64.3%	55.2%	-14.1%	-19.9%	-6.0%
1994	70.1%	65.6%	5.8%	10.3%	-0.8%
1995	67.8%	66.0%	-2.2%	0.4%	-8.0%
1996	67.1%	65.0%	-0.8%	-1.0%	-4.7%
1997	69.0%	67.3%	1.9%	2.3%	-5.7%
1998	70.9%	69.4%	1.9%	2.1%	-3.4%
1999	74.6%	74.1%	3.6%	4.7%	-6.0%
2000	83.8%	83.5%	9.3%	9.4%	-0.6%
2001	86.0%	85.1%	2.1%	1.6%	2.5%
2002	90.7%	89.7%	4.8%	4.5%	2.5%
2003	90.1%	89.8%	-0.7%	0.1%	-5.9%
2004	93.0%	92.8%	2.9%	3.0%	-3.5%
2005	96.3%	96.2%	3.3%	3.4%	-3.5%

	Unadjusted Book Leverage	Book Leverage (Adjusted)	ΔUnadjusted Book Leverage	ΔBook Leverage (Adjusted)	IV: Pension Δ Book Leverage
1992	93.2%	97.5%	15.6%	20.7%	-1.7%
1993	92.7%	102.1%	-0.5%	4.5%	-7.0%
1994	85.3%	89.2%	-7.4%	-12.9%	-1.2%
1995	78.2%	83.1%	-7.1%	-6.1%	-10.4%
1996	78.6%	80.9%	0.3%	-2.2%	-6.4%
1997	84.3%	94.8%	5.7%	13.8%	-7.9%
1998	88.4%	97.2%	4.1%	2.4%	-5.9%
1999	86.5%	91.6%	-1.9%	-5.6%	-10.3%
2000	82.8%	92.7%	-3.7%	1.1%	-1.0%
2001	89.4%	97.4%	6.7%	4.7%	3.0%
2002	96.7%	101.6%	7.3%	4.2%	2.8%
2003	91.5%	106.6%	-5.2%	5.0%	-5.8%
2004	91.5%	103.6%	0.1%	-3.0%	-4.6%
2005	95.2%	106.6%	3.6%	3.0%	-4.1%

Table 3: Firm-Level Equity Returns Sorted by Pension Returns

Each panel presents the mean and standard deviation of equity returns for three groups of firms sorted annually into three groups based on the value of *Pension Return*$_t$ / *Firm E*$_{t-1}$. This is the dollar return on pension assets scaled by lagged firm equity market value. 1 = low, 2 = medium, and 3 = high. The symbol † indicates a provisional observation count, as the sample in the later years is still under construction. The top panel shows unadjusted returns and the bottom panel shows returns adjusted by the size, book-to-market, and momentum portfolios of Daniel, Grinblatt, Titman, Wermers (1997) and Wermers (2004).

Panel A: Unadjusted Returns

	1		2		3		Total Count
1992	0.093	(0.017)	0.143	(0.017)	0.226	(0.025)	1257
1993	0.185	(0.028)	0.174	(0.019)	0.286	(0.030)	1282
1994	-0.012	(0.017)	-0.008	(0.012)	0.090	(0.020)	1313
1995	0.180	(0.025)	0.229	(0.019)	0.236	(0.021)	1322
1996	0.154	(0.020)	0.224	(0.026)	0.204	(0.021)	1317
1997	0.225	(0.021)	0.290	(0.022)	0.334	(0.021)	1279
1998	0.128	(0.038)	0.078	(0.037)	0.073	(0.036)	252†
1999	-0.003	(0.038)	0.004	(0.040)	0.011	(0.045)	257†
2000	0.100	(0.044)	0.090	(0.047)	0.038	(0.049)	260†
2001	0.068	(0.047)	0.015	(0.028)	0.007	(0.036)	269†
2002	-0.088	(0.033)	-0.091	(0.019)	-0.094	(0.025)	502†
2003	0.223	(0.026)	0.360	(0.027)	0.586	(0.069)	508†
2004	0.150	(0.018)	0.273	(0.025)	0.383	(0.060)	500†
2005	0.113	(0.034)	0.080	(0.023)	0.068	(0.038)	262†

Panel B: DGTW Benchmark Adjusted Returns

	1		2		3		Total Count
1992	-0.065	(0.020)	-0.024	(0.018)	0.027	(0.029)	1131
1993	-0.041	(0.023)	-0.001	(0.020)	0.069	(0.033)	1153
1994	-0.016	(0.016)	-0.009	(0.012)	0.054	(0.021)	1170
1995	-0.103	(0.028)	-0.076	(0.019)	-0.090	(0.021)	1158
1996	-0.041	(0.022)	0.019	(0.028)	-0.003	(0.021)	1176
1997	-0.043	(0.021)	-0.004	(0.023)	0.011	(0.021)	1132
1998	-0.028	(0.038)	-0.036	(0.039)	-0.041	(0.035)	239†
1999	-0.112	(0.034)	-0.112	(0.047)	-0.083	(0.044)	240†
2000	-0.025	(0.053)	-0.048	(0.059)	-0.097	(0.051)	244†
2001	-0.079	(0.051)	0.003	(0.034)	0.012	(0.041)	254†
2002	0.016	(0.033)	0.046	(0.019)	0.042	(0.023)	472†
2003	-0.138	(0.030)	-0.066	(0.028)	-0.004	(0.076)	476†
2004	-0.003	(0.017)	0.095	(0.025)	0.124	(0.044)	471†
2005	0.002	(0.025)	-0.022	(0.023)	-0.007	(0.040)	240†

Table 4: Effect of Pension Returns on Firm-Level Equity Returns

This table shows results of regressing annual unadjusted and annual DGTW excess returns on the value of (*Pension Return$_t$ / Firm E$_{t-1}$*), to test the extent to which pension returns are priced into the returns of the sponsoring company stock. All specifications contain year fixed effects. Standard errors are clustered by year.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Dependent Variable	Annual Unadjusted Return			Annual DGTW Excess Return		
Pension Return$_t$ / MV Equity$_{t-1}$	0.727 ***	0.864 ***	0.550 **	0.517 ***	0.654 ***	0.497 **
	(0.232)	(0.277)	(0.232)	(0.185)	(0.232)	(0.222)
Pension Liability$_{t-1}$ / A$_{t-1}$		-0.126			-0.118	
		(0.080)			(0.075)	
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$			0.026			0.003
			(0.019)			(0.023)
Constant	0.129 ***	0.143 ***	0.124 ***	-0.038 ***	-0.025 ***	-0.038 ***
	(0.008)	(0.009)	(0.019)	(0.006)	(0.008)	(0.007)
Observations	10580	10580	10580	9556	9556	9556
R-Squared	0.07	0.07	0.07	0.02	0.02	0.02

Table 5: Correlation of Pension Fund Returns with Equity Returns of Other Firms in the Same Industry and Year

The dependent variable is the mean annual return of all firms in the same industry-year cell as a given observation, excluding the firm itself. Standard errors are clustered by year.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

	Dependent Variable: Average Return of Industry-Year Excluding Firm i			
Pension $Return_{it}$ / Pension $Assets_{i,t-1}$	-0.019		-0.044***	
	(0.037)		(0.013)	
Pension $Return_{it}$ / MV $Equity_{i,t-1}$		0.047		-0.023
		(0.040)		(0.023)
Constant	0.151***	0.149***	-0.036***	-0.039***
	(0.003)	(0.001)	(0.001)	(0.000)
Fixed Effects	Year	Year	Ind*Yr	Ind*Yr
Observations	10964	10997	10964	10997
R-squared	0.35	0.35	0.96	0.96

Table 6: Credit Ratings, Book Leverage, and Pension Fund Performance

The dependent variable is the mean annual return of all firms in the same industry as a given observation. In the instrumental variables specification, the change in book leverage is instrumented with *Pension Δ Book Leverage*. In the first stage regression, *Pension Δ Book Leverage* has a coefficient of 0.92 and a firm-clustered t-statistic of 5.41. Regressions are linear probability models, but marginal effects for the key coefficient in a probit specification are also shown.
Standard errors are clustered by firm.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Panel A: Probability of Upgrade

	Dependent Variable: Credit Rating Upgrade (Binary)					
	Ordinary Least Squares			IV with *Pension Δ Book Leverage*		
Δ Book Leverage$_{t-1}$	-0.179 ***	-0.174 ***	-0.181 ***	-0.476 **	-0.470 **	-0.449 **
	(0.036)	(0.035)	(0.036)	(0.230)	(0.227)	(0.221)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	0.673 ***	0.636 ***	0.819 ***	0.505 ***	0.471 ***	0.674 ***
	(0.101)	(0.100)	(0.143)	(0.161)	(0.157)	(0.192)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	0.014 **	0.014 **	0.010 *	0.018 ***	0.019 ***	0.015 **
	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.006)
ΔPension-Adjusted Q$_{t-1}$		0.067 ***			0.063 ***	
		(0.016)			(0.017)	
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^2			2.804 ***			2.838 ***
			(0.852)			(0.831)
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^3			-5.572			-5.886
			(5.275)			(5.413)
Constant	0.143 ***	0.133 ***	0.140 ***	0.137 ***	0.128 ***	0.134 ***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
Observations	4361	4361	4361	4361	4361	4361
R-squared	0.03	0.04	0.04	0.02	0.02	0.03
Note: Marginal Effect in Analogous Probit Specification						
ΔBook Leverage$_{t-1}$	-0.159 ***	-0.148 ***	-0.155 ***	–	–	–
	(0.034)	(0.032)	(0.033)	–	–	

Panel B: Probability of Downgrade

	Credit Rating Downgrade (Binary)					
	Ordinary Least Squares			IV with *Pension Δ Book Leverage*		
ΔBook Leverage$_{t-1}$	0.168***	0.159***	0.168***	0.400**	0.391**	0.421***
	(0.044)	(0.045)	(0.044)	(0.159)	(0.157)	(0.158)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	-0.719***	-0.661***	-0.952***	-0.587***	-0.531***	-0.816***
	(0.127)	(0.123)	(0.161)	(0.162)	(0.157)	(0.189)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	0.051***	0.050***	0.047***	0.047***	0.046***	0.043***
	(0.010)	(0.010)	(0.010)	(0.008)	(0.008)	(0.008)
ΔPension-Adjusted Q$_{t-1}$		-0.105***			-0.101***	
		(0.018)			(0.018)	
$[\Delta(\text{Nonpension Cash Flow}_{t-1}/\text{AXP}_{t-2})]^2$			2.337***			2.306***
			(0.880)			(0.867)
$[\Delta(\text{Nonpension Cash Flow}_{t-1}/\text{AXP}_{t-2})]^3$			11.432*			11.728*
			(6.181)			(6.036)
Constant	0.098***	0.112***	0.092***	0.102***	0.116***	0.097***
	(0.016)	(0.016)	(0.015)	(0.015)	(0.016)	(0.015)
Observations	4361	4361	4361	4361	4361	4361
R-squared	0.05	0.06	0.06	0.05	0.06	0.05
Note: Marginal Effect in Analogous Probit Equation						
ΔBook Leverage$_{t-1}$	0.142***	0.132***	0.138***	–	–	–
	(0.037)	(0.038)	(0.037)	–	–	–

Table 7: Effect of Pension-Induced Leverage Changes on Changes in Capital Expenditures

IV coefficient estimates are presented for the specification

$$\Delta \frac{I_{it}}{AXP_{i,t-1}} = \alpha + \beta_1 \Delta Leverage_{i,t-1} + \beta_2 \Delta \frac{CashFlow_{it}}{A_{i,t-1}} + \beta_3 ' \mathbf{x} + \varepsilon_{it},$$

with the change in leverage instrumented with one of the pension leverage instruments. All specifications contain year fixed effects. Standard errors clustered by firm are in parentheses. *** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

	Dependent Variable: $\Delta Investment_t/AXP_{t-1}$		
Instrumental Variable	Pension Return$_{t-1}$ / MV Equity$_{t-2}$	[Pension Δ Market Leverage]$_{t-1}$	[Pension Δ Book Leverage]$_{t-1}$
Leverage Measure	Market	Market	Book
Observations	9796	9796	9296
Panel A: Baseline Specification			
Δ Leverage$_{t-1}$	-0.0591 ***	-0.0407 ***	-0.0297 **
	(0.0148)	(0.0113)	(0.0119)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	0.0003	0.0001	0.0004
	(0.0003)	(0.0003)	(0.0004)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	0.0313 ***	0.0380 ***	0.0412 ***
	(0.0096)	(0.0088)	(0.0101)
Constant	-0.0039 ***	-0.0032 ***	-0.0022 **
	(0.0012)	(0.0012)	(0.0011)
R-squared	0.07	0.06	0.03
*Panel B: With Industry48*Year Fixed Effects and Nonlinear Profitability Controls*			
Δ Leverage$_{t-1}$	-0.0688 ***	-0.0390 ***	-0.0299 **
	(0.0150)	(0.0120)	(0.0124)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	0.0007 *	0.0003	0.0005
	(0.0004)	(0.0004)	(0.0004)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	0.0351 **	0.0487 ***	0.0534 ***
	(0.0138)	(0.0131)	(0.0140)
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^2	-0.0607	-0.0578	-0.0464
	(0.0469)	(0.0464)	(0.0518)
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^3	-0.6078 *	-0.7333 **	-0.8539 **
	(0.3448)	(0.3418)	(0.3630)
Constant	-0.0119	-0.0134	-0.0135
	(0.0169)	(0.0171)	(0.0170)
R-squared	0.14	0.13	0.10
*Panel C: With Industry48*Year Fixed Effects, Nonlinear Profitability, and Pension-Adjusted Q Controls*			
Δ Leverage$_{t-1}$	-0.0666 ***	-0.0349 ***	-0.0234 **
	(0.0154)	(0.0122)	(0.0110)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	0.0006 *	0.0002	0.0004
	(0.0004)	(0.0003)	(0.0004)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	0.0103	0.0188 **	0.0193 *
	(0.0092)	(0.0086)	(0.0099)
ΔPension-Adjusted Q$_{t-1}$	0.0145 ***	0.0179 ***	0.0214 ***
	(0.0023)	(0.0021)	(0.0018)
Constant	-0.0128	-0.0146	-0.0151
	(0.0167)	(0.0168)	(0.0168)
R-squared	0.15	0.14	0.13

Nonlinear profitability terms included, but not shown in Panel C due to space considerations.

Table 8: IV Regression Models of Capital Expenditures, Sample Without Mandatory Contributions

This table presents the same specifications as in Table 7 but only for the sample for which the firm has zero expected mandatory pension contributions in year *t* (i.e. are overfunded on an accumulated benefit obligation (ABO) basis). All specifications contain year fixed effects. Standard errors clustered by firm are in parentheses.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

	Dependent Variable: $\Delta Investment_t/AXP_{t-1}$		
Instrumental Variable	Pension $Return_{t-1}$ / MV $Equity_{t-2}$	[Pension Δ Market $Leverage]_{t-1}$	[Pension Δ Book $Leverage]_{t-1}$
Leverage Measure	Market	Market	Book
Observations	5523	5523	5343
Panel A: Baseline Specification			
Δ $Leverage_{t-1,t-2}$	-0.0648 ***	-0.0481 ***	-0.0471 **
	(0.0175)	(0.0156)	(0.0207)
Pension $Liability_{t-1}$ / MV $Equity_{t-1}$	0.0003	0.0001	0.0003
	(0.0004)	(0.0004)	(0.0007)
Δ(Nonpension Cash $Flow_{t-1}/AXP_{t-2}$)	0.0374 ***	0.0437 ***	0.0407 **
	(0.0130)	(0.0126)	(0.0163)
Constant	-0.0028 **	-0.0023	-0.0012
	(0.0014)	(0.0014)	(0.0013)
R-squared	0.07	0.06	0.03
*Panel B: With Industry48*Year Fixed Effects and Nonlinear Profitability Controls*			
Δ $Leverage_{t-1,t-2}$	-0.0774 ***	-0.0517 ***	-0.0504 ***
	(0.0199)	(0.0171)	(0.0194)
Pension $Liability_{t-1}$ / MV $Equity_{t-1}$	0.0010 *	0.0006	0.0004
	(0.0006)	(0.0005)	(0.0006)
Δ(Nonpension Cash $Flow_{t-1}/AXP_{t-2}$)	0.0365 **	0.0491 ***	0.0491 **
	(0.0184)	(0.0175)	(0.0200)
$[\Delta(\text{Nonpension Cash } Flow_{t-1}/AXP_{t-2})]^2$	-0.0371	-0.0274	0.0368
	(0.0663)	(0.0646)	(0.0770)
$[\Delta(\text{Nonpension Cash } Flow_{t-1}/AXP_{t-2})]^3$	-0.5810	-0.7245	-0.8721
	(0.5271)	(0.5129)	(0.5537)
Constant	0.0186 ***	0.0179 ***	0.0184 ***
	(0.0031)	(0.0021)	(0.0022)
R-squared	0.14	0.13	0.1
*Panel C: With Industry48*Year Fixed Effects, Nonlinear Profitability, and Pension-Adjusted Q Controls*			
Δ $Leverage_{t-1,t-2}$	-0.0711 ***	-0.0440 **	-0.0445 **
	(0.0211)	(0.0178)	(0.0179)
Pension $Liability_{t-1}$ / MV $Equity_{t-1}$	0.0011 **	0.0008 *	0.0009
	(0.0005)	(0.0005)	(0.0006)
Δ(Nonpension Cash $Flow_{t-1}/AXP_{t-2}$)	0.0161	0.0241 *	0.0179
	(0.0128)	(0.0124)	(0.0153)
ΔPension-Adjusted Q_{t-1}	0.0131 ***	0.0158 ***	0.0199 ***
	(0.0030)	(0.0028)	(0.0023)
Constant	0.0172 ***	0.0162 ***	0.0162 ***
	(0.0041)	(0.0032)	(0.0036)
R-squared	0.19	0.18	0.17

Nonlinear profitability terms included, but not shown in Panel C due to space considerations.

Table 9: Effect of Pension-Induced Leverage Changes on Changes in Net Investment, Profitability and Financing Variables

Pension Return$_{t-1}$ */ MV Equity*$_{t-2}$ is used as an instrument for *Δ Market Leverage*$_{t-1}$ in all specifications in this table. The first dependent variable, *Δ[Net Investment/AXP*$_{t-1}$*]*, is equal to *Δ[ΔNetPPE*$_{t,t-1}$*/AXP*$_{t-1}$*]* or the change in net investment scaled by lagged nonpension assets. The issuance variables are defined as the change in the level of the variable in question. For example, *Short Term Debt Issuance*$_t$ = *Short Term Debt*$_t$ - *Short Term Debt*$_{t-1}$. All specifications include industry-by-year fixed effects. Standard errors are clustered by firm.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Dependent Variable:	Δ[Net Investment/ AXP$_{t-1}$]	Δ(Nonpension Cash Flow$_t$ /AXP$_{t-1}$)	Δ(Short Term Debt Issuance$_t$ /AXP$_{t-1}$)	Δ(Long Term Nonpension Debt Issuance$_t$ /AXP$_{t-1}$)	Δ(Total Nonpension Debt Issuance$_t$ /AXP$_{t-1}$)	Δ(Equity Issuance$_t$ /AXP$_{t-1}$)
Δ Market Leverage$_{t-1}$	-0.1059 **	-0.0537 **	-0.0999 **	0.1893	0.0168	-0.0252
	(0.0529)	(0.0250)	(0.0419)	(0.1300)	(0.1293)	(0.0328)
Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)	-0.1476 ***	-0.0946 ***	0.0021	0.1334	0.2229 **	-0.1042 ***
	(0.0427)	(0.0209)	(0.0263)	(0.0902)	(0.0897)	(0.0278)
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^2	0.0603	0.1380	-0.0564	-0.8339 ***	-0.8813 ***	-0.0940
	(0.1390)	(0.0853)	(0.0839)	(0.2887)	(0.2872)	(0.0981)
[Δ(Nonpension Cash Flow$_{t-1}$/AXP$_{t-2}$)]^3	2.5978 ***	-0.1936	-0.1307	0.3380	-1.1031	1.4291 *
	(1.0050)	(0.5839)	(0.6611)	(2.4165)	(2.2588)	(0.7308)
Pension Liability$_{t-1}$ / MV Equity$_{t-1}$	-0.0002	0.0032 ***	0.0016 *	-0.0004	0.0003	0.0014 *
	(0.0011)	(0.0007)	(0.0010)	(0.0025)	(0.0022)	(0.0008)
Constant	-0.0020	-0.0378	0.0110 **	09.1254 ***	-0.0883	0.0027
	(0.0143)	(0.0288)	(0.0049)	(0.0471)	(0.0585)	(0.0307)
Observations	9911	9841	9594	8458	8458	9928
R-squared	0.11	0.19	0.08	0.01	0.09	0.08

Appendix Table 1: Basic Summary Statistics for Full Compustat Sample versus Pension Firms Only

Panel A: Full Compustat Sample

	Mean	Median	Standard Deviation	Count	10th Percentile	25th Percentile	75th Percentile	90th Percentile
$Investment_t/A_{t-1}$	0.0894	0.0468	0.1436	116424	0.0065	0.0202	0.0954	0.1924
$\Delta A_{t,t-1}/A_{t-1}$	0.3672	0.0569	1.3961	118745	-0.2504	-0.0610	0.2531	0.8687
ΔNet $PPE_{t,t-1}/A_{t-1}$	0.0550	0.0078	0.2177	118385	-0.0545	-0.0145	0.0551	0.1758
Q_{t-1}	2.8390	1.4630	5.1222	97024	0.8602	1.0589	2.4749	4.8629
Cash $Flow_t/A_{t-1}$	-0.1538	0.0657	0.9540	117706	-0.4769	-0.0663	0.1311	0.2107
Operating Cash $Flow_t$ / A_{t-1}	-0.0702	0.0582	0.5676	116215	-0.3497	-0.0492	0.1277	0.2107
Market Leverage $(Unadjusted)_t$	0.2432	0.1582	0.2563	110508	0.0000	0.0164	0.4007	0.6418
Book Leverage $(Unadjusted)_t$	0.3641	0.3050	0.6848	134092	0.0000	0.0264	0.5692	0.8664
$\Delta Investment_t/A_{t-1}$	-0.0133	-0.0014	0.1158	100770	-0.0761	-0.0220	0.0133	0.0494
$\Delta[\Delta A_{t,t-1}/A_{t-1}]$	-0.1619	-0.0114	1.4906	103484	-0.7451	-0.2059	0.1410	0.4840
$\Delta[\Delta$Net $PPE_{t,t-1}/A_{t-1}]$	-0.0192	-0.0016	0.2360	103115	-0.1585	-0.0436	0.0299	0.1160
ΔQ_{t-1}	-0.0718	-0.0057	2.6053	83521	-1.1854	-0.3004	0.2483	0.9882
ΔCash $Flow_t/A_{t-1}$	0.0237	-0.0005	0.5724	102227	-0.2129	-0.0578	0.0459	0.2028
ΔOperating Cash $Flow_t$ / A_{t-1}	0.0234	0.0006	0.3906	100754	-0.1762	-0.0602	0.0638	0.1954
ΔMarket Leverage $(Unadjusted)_t$	0.0113	0.0000	0.1341	95842	-0.1207	-0.0346	0.0547	0.1640
ΔBook Leverage $(Unadjusted)_t$	0.0041	0.0000	0.7889	117955	-0.1987	-0.0482	0.0582	0.2367

Panel B: All Compustat Observations with DB Pension Plans

	Mean	Median	Standard Deviation	Count	10th Percentile	25th Percentile	75th Percentile	90th Percentile
$Investment_t/A_{t-1}$	0.0679	0.0520	0.0661	29530	0.0170	0.0304	0.0846	0.1297
$\Delta A_{t,t-1}/A_{t-1}$	0.1058	0.0421	0.4556	29863	-0.1087	-0.0241	0.1278	0.2878
ΔNet $PPE_{t,t-1}/A_{t-1}$	0.0308	0.0099	0.1294	29829	-0.0386	-0.0107	0.0426	0.1035
Q_{t-1}	1.5237	1.2395	1.1224	24656	0.8903	1.0265	1.6662	2.3637
Cash $Flow_t/A_{t-1}$	0.0818	0.0846	0.1426	29808	0.0007	0.0497	0.1283	0.1769
Operating Cash $Flow_t$ / A_{t-1}	0.0874	0.0858	0.1078	29446	-0.0002	0.0450	0.1308	0.1846

Market Leverage (Unadjusted)$_t$	0.3271	0.2943	0.2384	27062	0.0340	0.1311	0.4818	0.6694
Book Leverage (Unadjusted)$_t$	0.4905	0.4610	0.4781	32635	0.0738	0.2697	0.6220	0.8661
ΔInvestment$_t$/A$_{t-1}$	-0.0028	-0.0008	0.0518	26630	-0.0383	-0.0141	0.0111	0.0318
Δ[ΔA$_{t,t-1}$/A$_{t-1}$]	-0.0168	-0.0012	0.5609	27016	-0.2773	-0.0966	0.0898	0.2521
Δ[ΔNet PPE$_{t,t-1}$/A$_{t-1}$]	-0.0053	-0.0004	0.1583	26976	-0.0994	-0.0304	0.0266	0.0877
ΔQ$_{t-1}$	-0.0114	0.0098	0.6766	22200	-0.3614	-0.1243	0.1414	0.3514
ΔCash Flow$_t$/A$_{t-1}$	-0.0021	0.0002	0.1343	26930	-0.0700	-0.0239	0.0205	0.0595
ΔOperating Cash Flow$_t$ / A$_{t-1}$	-0.0004	-0.0004	0.1020	26565	-0.0787	-0.0334	0.0322	0.0782
ΔMarket Leverage (Unadjusted)$_t$	0.0033	-0.0009	0.1132	24505	-0.1112	-0.0467	0.0477	0.1283
ΔBook Leverage (Unadjusted)$_t$	0.0062	-0.0021	0.4461	29687	-0.1105	-0.0424	0.0410	0.1343

Panel C: Collected Pension Sample

	Mean	Median	Standard Deviation	Count	10th Percentile	25th Percentile	75th Percentile	90th Percentile
Investment$_t$/A$_{t-1}$	0.0688	0.0548	0.0590	10885	0.0213	0.0342	0.0851	0.1251
ΔA$_{t,t-1}$/A$_{t-1}$	0.0963	0.0490	0.3023	11002	-0.0806	-0.0118	0.1294	0.2710
ΔNet PPE$_{t,t-1}$/A$_{t-1}$	0.0286	0.0113	0.1095	10996	-0.0335	-0.0080	0.0415	0.0978
Q$_{t-1}$	1.5428	1.2861	0.8355	10977	0.9378	1.0646	1.7330	2.4059
Cash Flow$_t$/A$_{t-1}$	0.0926	0.0901	0.0853	10979	0.0228	0.0594	0.1319	0.1734
Operating Cash Flow$_t$ / A$_{t-1}$	0.0951	0.0913	0.0733	10941	0.0177	0.0559	0.1330	0.1794
Market Leverage$_t$	0.3137	0.2871	0.2194	10977	0.0447	0.1343	0.4551	0.6174
Book Leverage$_t$	0.4515	0.4509	0.3445	11007	0.1081	0.2784	0.5813	0.7360
ΔInvestment$_t$/A$_{t-1}$	-0.0012	-0.0001	0.0449	10867	-0.0341	-0.0123	0.0115	0.0308
Δ[ΔA$_{t,t-1}$/A$_{t-1}$]	-0.0055	0.0035	0.4250	11002	-0.2432	-0.0804	0.0876	0.2379
Δ[ΔNet PPE$_{t,t-1}$/A$_{t-1}$]	-0.0026	0.0007	0.1394	10996	-0.0895	-0.0267	0.0265	0.0849
ΔQ$_{t-1}$	0.0286	0.0298	0.4386	10976	-0.2759	-0.0848	0.1508	0.3401
ΔCash Flow$_t$/A$_{t-1}$	-0.0007	0.0014	0.0851	10977	-0.0564	-0.0184	0.0189	0.0503
ΔOperating Cash Flow$_t$ / A$_{t-1}$	-0.0012	-0.0005	0.0763	10934	-0.0691	-0.0289	0.0276	0.0636
ΔMarket Leverage (Unadjusted)$_t$	-0.0079	-0.0073	0.0975	10975	-0.1082	-0.0509	0.0319	0.0930
ΔBook Leverage (Unadjusted)$_t$	-0.0013	-0.0048	0.2714	11004	-0.0952	-0.0407	0.0341	0.1104

Appendix Table 2: Ordinary Least Squares Investment Specifications

Coefficient estimates are presented for the specifications:

$$\frac{Y_{it}}{A_{i,t-1}} = \alpha_i + \alpha_t + \beta_1 Q_{i,t-1} + \beta_2 \frac{CashFlow_{i,t-1}}{A_{i,t-1}} + \beta_3 MarketLeverage_{i,t-1} + \varepsilon_{it} \text{ , and}$$

$$\Delta \frac{Y_{it}}{A_{i,t-1}} = \alpha + \beta_1 \Delta Q_{i,t-1} + \beta_2 \Delta \frac{CashFlow_{i,t-1}}{A_{i,t-1}} + \beta_3 \Delta MarketLeverage_{i,t-1} + \varepsilon_{it} \text{ ,}$$

where Y_{it} is capital expenditures (I_{it}) in the upper sub-panel and asset growth ($\Delta A_{t,t-1} = A_t – A_{t-1}$) in the lower sub-panel. Panels A and B show the regressions for the full Compustat sample excluding financial services and the collected pension sample respectively. All specifications contain year effects (α_t).
Standard errors clustered by firm are in parentheses.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Panel A: Full Compustat Sample Excluding Financial Services

	Dependent Variable: I_t/A_{t-1}			
Estimation	Firm Fixed Effects		First Differences	
Q_{t-1}	0.0049***	0.0048***	0.0063***	0.0061***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Cash $Flow_{t-1}/A_{t-2}$	0.0008		0.0059***	
	(0.0014)		(0.0016)	
Operating Cash $Flow_{t-1}/A_{t-2}$		0.0035*		0.0086***
		(0.0021)		(0.0021)
Market Leverage $(Unadjusted)_{t-1}$	-0.0999***	-0.1002***	-0.0888***	-0.0905***
	(0.0034)	(0.0034)	(0.0041)	(0.0040)
Constant	0.1134***	0.0821***	-0.0078***	-0.0084***
	(0.0021)	(0.0022)	(0.0013)	(0.0013)
Observations	88384	87587	75307	74603
Firms	12163	12098		
[Within] R-squared	[0.09]	[0.09]	0.06	0.06

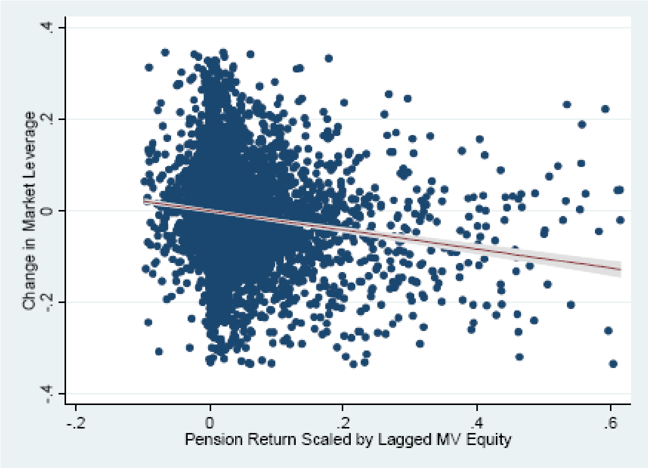
Panel B: Collected Pension Sample

	Dependent Variable: I_t/A_{t-1}			
Estimation	Firm Fixed Effects		First Differences	
Q_{t-1}	0.0053***	0.0051**	0.0061***	0.0083**
	(0.0019)	(0.0020)	(0.0019)	(0.0034)
Cash $Flow_{t-1}/A_{t-2}$	0.0504***		0.0146**	
	(0.0134)		(0.0070)	
Operating Cash $Flow_{t-1}/A_{t-2}$		0.0799***		0.0218*
		(0.0218)		(0.0114)
Market Leverage $(Unadjusted)_{t-1}$	-0.1045***	-0.1081***	-0.1098***	-0.1096***
	(0.0080)	(0.0082)	(0.0079)	(0.0086)
Constant	0.1050***	0.1032***	-0.0043	-0.0049
	(0.0067)	(0.0077)	(0.0034)	(0.0035)
Observations	12529	12443	10581	10506
Firms	2097	2085		
[Within] R-squared	[0.12]	[0.12]	0.07	0.07

Standard errors clustered by firm are in parentheses.
*** = significant at 1% level, ** = significant at 5% level, * = significant at 10% level.

Figure 1: First Stage Regressions

This figure shows first-stage relations between the three pension variables used as instruments and the leverage variables. Standard errors are clustered by firm.



Instrument #1: Pension Return$_{i,t}$ / MV Equity$_{i,t-1}$

N = 9796

Fixed Effects Removed	Coeff	Standard Error	T-Statistic	Univariate F-statistic
None	-0.162	0.019	-8.43	71.08
Year	-0.121	0.019	-6.32	39.91
Ind*Year	-0.120	0.019	-6.25	39.07

Instrument #2: Pension Δ Market Leverage

N = 9796

Fixed Effects Removed	Coeff	Standard Error	T-Statistic	Univariate F-statistic
None	1.457	0.110	13.29	176.57
Year	1.242	0.114	10.94	119.62
Ind*Year	1.244	0.119	10.45	109.19

Instrument #3: Pension Δ Book Leverage

N = 9296

Fixed Effects Removed	Coeff	Standard Error	T-Statistic	Univariate F-statistic
None	0.721	0.137	5.26	27.67
Year	0.701	0.150	4.68	21.91
Ind*Year	0.746	0.145	5.13	26.35