

The Impact of Pension Assumptions on Firm Value

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Abstract

I examine the association between disclosed financial accounting data and firm value, while incorporating the effect of managerial discretion in reporting those data. I focus on the assumptions used to compute a firm's pension liability. I find that firm values are consistent with analysts being aware of the likely influence of reporting incentives on managers' choices of assumptions. Analysts appear to be aware of the incentives associated with contracting considerations and where they infer that such incentives have induced managers to choose obligation-reducing assumptions, they treat \$1 of reported obligation as if it were an obligation of more than \$1. These findings suggest that analysts recognize managers' use of assumptions that are not justified by the firm's operating environment and that they discount the effect of those assumptions on the disclosed accounting numbers.

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1. Introduction and overview of results

This study examines the extent to which analysts undo the effect of managers exercising their discretion in preparing financial reports. Preparation of financial statements necessarily involves subjectivity and giving discretion to managers to make subjective judgments enables them to reveal their private information about the firm through its financial reports. Thus, accrual-based earnings are superior to cash flows as a periodic performance measure (for example, Rayburn, 1986; Livnat and Zarowin, 1990; Dechow, 1994) and managers can use discretionary accruals to signal future performance (Subramanyam, 1996). However, managers can also exercise their discretion for potentially opportunistic purposes and prior studies have found evidence consistent with managers exercising discretion in response to reporting incentives.¹ The way in which analysts and other market participants interpret financial statements that are subject to managerial discretion is important because if they have access only to biased information and fail to remove the effect of the bias then the capital market is unlikely to allocate resources optimally. If, however, users do correct for the inherent bias, its presence should have no effect on the efficiency of the market in setting prices.

Note that managers face incentives to report opportunistically even if they believe that the equity market will be able to "see through" and reverse the effect of their incentive-induced choices. Other stakeholders – including creditors, employees and regulators – also rely on the financial statements. If managers believe that these users are less able or less willing to reverse

¹ For example, McNichols and Wilson (1988), Jones (1991) and Burgstahler and Dichev(1997), and with respect to pension obligations, Asthana (1999).

the effect of the incentive-induced reporting, those incentives will likely affect managers' accounting choices.

One area where managers can exercise their discretion in the financial reporting process is in the choice of assumptions used to compute the firm's defined-benefit pension obligation. Prior studies (including Feldstein and Morck, 1983 and Asthana, 1999) have shown that financial reporting incentives influence managers' choices of the discount rate and the assumed future compensation rate increases and hence the reported pension obligation. Therefore, this area of financial reporting is one where the analysis is necessarily based on biased figures. However, if analysts can, and do, undo the effect of managers' opportunistic exercise of accounting choice, the impact of the reported pension obligation on firm value will likely depend on the observed accounting choice. That is, analysts will value \$1 of reported pension liability as greater (less) than \$1 if they believe insufficiently conservative assumptions were used to compute the reported pension obligation. In this paper, I find that analysts' assessment of firm value implicitly adjust for the likely effect of the reporting incentives on the reported pension obligations – in effect, undoing the reporting bias induced by those incentives.

For several reasons, the reporting of pension obligations provides a particularly interesting context in which to examine the relation between firm value and financial reports that are affected by managerial discretion. First, the magnitude of pension-related liabilities can be large – in this study, the median (mean) pension obligation is 12% (24%) of equity value. In addition, the effect of changes in estimates compounds over many years; therefore, small changes in the underlying assumptions can generate material variations in the amounts of the pension-related liabilities. For example, an adjustment of 1% to either the discount rate or the assumed rate of compensation increases would typically change the reported pension obligation by 2% of the market value of equity.²

² As discussed below, the variation in assumptions used is of the order of $\pm 1.3\%$.

Second, the long-term nature of the pension assumptions makes it difficult for users of financial statements to identify errors – whether deliberate or accidental – in managerial accounting estimates. The accrual accounting process necessarily requires that managers make estimates about future events (for example, what proportion of gross accounts receivable will actually be received). However, in general, as accruals reverse, so do any associated errors and the effect on cumulative net income/stockholders' equity is zero. Managers, concerned about their reputations, are likely dissuaded from deliberately biasing estimates because the predictable future reversals of accruals within a relatively short time frame will potentially reveal any estimation error. However, the computations of the pension-related liabilities depend on long-term forecasts and the accuracy of managerial estimates is usually not revealed until many years later. If managers have only short- to medium-term time horizons, they will not expect to be called to account for their errors. In addition, when *ex post* outcomes reveal errors in *ex ante* estimates of pension obligations the financial statements typically do not recognize the correction of the past errors immediately but over many future accounting periods. In fact, under current Financial Reporting Standards (SFAS87), it may be that the error is never fully recognized because of on-going fluctuations in off-balance sheet assets and liabilities.

Third, compared with other aspects of financial reporting that are subject to managerial discretion, such as revenue recognition and the allowance for doubtful accounts, the technical reporting requirements for pensions are relatively complex. It is thus less likely that market participants can "unwind" reported pension data and restate them in alternative form for the purpose of equity valuation. The ability of analysts to cope in such a complex environment would suggest that they should be able to undo the effect of managerial discretion in less complex settings.

Finally, compared to other aspects of financial statements, pension obligations are more likely subject to bias because managers face incentives to report opportunistically even if equity investors and analysts can see through the opportunistic reporting. The Employment and

Retirement Income Security Act (ERISA) requires firms to fund their pension obligations adequately. If managers wish to minimize the resources that a firm is required to transfer to its pension fund, they have an incentive to make accounting choices that reduce the reported obligation.³

This paper contributes to our understanding of the interaction of managerial behavior and the market by showing that analysts are able to identify where managers have exercised their discretion opportunistically in the reporting of pension obligations and to undo the effect of incentive-based misrepresentation. To the extent that regulators (such as the SEC and FASB) are concerned that analysts are misled by misreporting, this paper offers evidence that such concerns are likely overstated.

The paper continues as follows: in Section 2, I develop the hypotheses in the context of prior research. In Section 3, I discuss the research design and Section 4 describes the data collection and descriptive statistics. I report and discuss the empirical results in Section 5 and Section 6 provides a brief conclusion.

2. Prior research and hypothesis development

Financial reports form part of the information set that analysts use to assess the intrinsic value of firms and market transactions based on analysis of those reports impound the information contained therein into prices. Investors analyze financial statements with a view to making their own investment decisions and security analysts analyze them with a view to making investment recommendations to others. Throughout this paper, I use the term analysts as shorthand for both groups.

³ Steven Kandarian, the executive director of the Pension Benefit Guarantee Corporation (PBGC), reported that the PBGC, on taking over Bethlehem Steel's pension fund, found the obligation was only funded by 45%, rather than the 84% that the PBGC was expecting, based on prior ERISA filings; the shortfall was \$4.3 billion (McKinnon, 2003).

However, when using financial statements to assess firm value, analysts typically observe not only the quantitative accounting information but also the accounting choices made by managers in preparing the financial reports and often the incentives faced by managers too. In this paper, I examine the link between financial reports and market values conditional on observable accounting choices and observable reporting incentives.

The way in which astute analysts incorporate accounting numbers that are subject to managerial discretion into an assessment of intrinsic value likely depends on the accounting choice of managers. For example, suppose analysts observe that particular choices made by managers have led to an increase in reported net assets, compared with other choices they might have made. Suppose too that the firm discloses sufficient information to enable analysts to quantify the effect of those choices on reported net assets. Then analysts could reverse managers' accounting choices, substitute their own accounting choice, and assess firm value based on what they consider to be a more appropriate measure of net assets. For example, analysts (and other users) may wish to adjust financial statements to reflect their choice of the accounting treatment of stock based compensation, amortization of goodwill and other intangibles, inventory valuation etc.

Whether it would be appropriate for analysts to substitute their own accounting choices for those of managers would depend on the reasons why managers made their particular choices. For example, it is likely appropriate for analysts to undo managers' accounting choices that are induced by managerial incentives to issue biased financial statements when assessing firm value. Undoing such choices may be easier when the opportunistic reporting was aimed at stakeholders other than shareholders who are unwilling or unable to undo the bias (for example Jones, 1991; DeAngelo and DeAngelo, 1991). In these cases, managers may disclose information that enables analysts to undo the effects of the incentive-induced choices but without facilitating the reversal of their choices by the other stakeholders.

It would likely be inappropriate for analysts to undo managers' accounting choices and substitute their own if the managers' choices were justified by the particular economic circumstances of the firm. For example, managers can signal their private information about the firm's future economic prospects and anticipated cashflows by appropriate choice of accruals (Subramanyam, 1996).

Prior research (including, Feldstein and Morck, 1983; Landsman, 1986; Barth, 1991; Mittelstaedt and Regier, 1993; Choi, et al., 1997; and Amir, 1996) has established that firms' market values reflect the reported economic substance of the firm's post-retirement obligation. The studies have shown that analysts assess firm value based on the reported projected benefit obligation (PBO) and the fair value of pension plan assets. These two figures are typically only disclosed in footnotes but have been found to be more relevant for valuation than other measures of firms' pension obligations - particularly the net pension obligation that is recognized in the financial statements. To compute the PBO requires actuarial assumptions about life expectancy, future compensation rates, the tenure and promotion patterns of current and future employees and an appropriate discount rate to compute the present value of the anticipated eventual obligation. Managers can reduce the size of the reported PBO by choosing a higher discount rate or a lower assumed rate of increase in compensation and under SFAS 87, firms are required to disclose these two assumptions explicitly.

Previous studies (including Feldstein and Morck, 1983; Blankley and Swanson, 1995; Godwin, et al., 1996; Petersen, 1996; Asthana, 1999) have examined how reporting incentives affect managerial choice of the pension assumptions. The assumptions used to compute the pension obligation reported in the financial statements are chosen by managers in consultation with actuaries, who are appointed by managers and are subject to auditors' approval. The firm's external auditors will typically ensure that the pension assumptions used are similar (if not identical) to the assumptions made in the regulatory filings by each individual pension plan. (Under ERISA, each plan is required to report its funding status annually, on Form 5500, to the

Department of Labor.) Therefore, the choice of the assumptions disclosed in the financial statements is likely influenced by incentives and controls arising from the Form 5500 filing requirement as well as those arising with respect to the financial statements. The evidence in the studies is broadly consistent with theories of agency costs and political costs and with other research indicating that reporting incentives influence accounting choice.⁴ They find that, in general, firms with under-funded pension plans use less conservative assumptions - that is, a higher discount rate and/or a lower assumed rate of compensation increases.⁵

The fact that studies have found a strong association between the pension assumptions and reporting incentives suggests that managers believe that at least some users of the financial statements fail to fully recognize and reverse the effect of the incentives on the reported PBO. This belief by managers may arise because of the opacity of changes in the assumptions and the high leverage of such changes; relatively small changes in the pension assumptions can exert a substantial impact on the net reported pension obligation. For example, changing either the discount rate or the assumed rate of compensation increases by 1% (the inter-quartile range of the values in this study) typically alters the PBO by about 15%, but the precise amount cannot be easily determined from the financial statement disclosures.

Prior studies examining how analysts respond to accounting disclosures by management in the light of reporting incentives have found mixed results. In some cases, the findings suggest that analysts are "fooled" and do not seem to consider the accounting choices that managers have made (for example, Neill, et al., 1995). In other cases, the market seems to impound the

⁴ For a review of other research on the determinants of accounting choice, see Fields et al. (2001).

⁵ The net pension expense is clearly increasing in the assumed rate of compensation increases. The effect of changes in the discount rate on the interest element of the pension expense is a non-linear function of the average age of the beneficiaries and the discount rate. For parameter values typical of the sample period, the interest cost is non-decreasing with respect to the interest rate. Hence, the use of low discount rate and high rate of compensation increases is conservative with respect to the income statement as well as the balance sheet.

accounting numbers into values depending on the choice of the accounting procedures used to compute those numbers (for example, Harris and Ohlson, 1987; Rogers and Stocken, 2003).

In the area of accounting for post-retirement benefits, Feldstein and Morck (1983) find weak evidence that the explanatory power of a model relating market values to net pension obligations is increased if the pension obligations are crudely adjusted to reflect the use of an average discount rate rather than a firm-specific discount rate. This finding is consistent with analysts ignoring the managers' estimates of an appropriate discount rate and substituting a different rate. However, Coronado and Sharpe (2003) report evidence that the stock market failed to interpret the pension-related expense correctly throughout the late 1990's, leading to overvalued firms. Also, Amir and Gordon (1996) examine the association between firm value and Other Post Employment Benefits (OPEB) liabilities. Their study finds that firm values are consistent with analysts and the stock market accepting the reported figures at face value, notwithstanding that incentive effects likely influenced the assumptions. However, the authors do not distinguish between the types of factor that influenced managers' choice of assumptions. Some of the firm-specific choices may be justified by firm-specific circumstances, in which case it would be inappropriate for analysts to undo the effect of managers' choices. Ultimately, the issue of whether analysts implicitly adjust the disclosed post-retirement obligations to remove the effects of incentives on the chosen assumptions is unresolved.

I first test the hypothesis that analysts implicitly adjust the reported pension obligations depending on the assumptions used to compute them. That is, I test whether firm values are lower, conditional on the reported PBO, when less conservative assumptions are used – when the PBO is likely understated. In testing this hypothesis, I implicitly assume that when analysts observe managers choosing conservative assumptions, they infer that the managers have done so because of reporting incentives and not because firm-specific economic circumstances justify such choices. Stated in alternate form, I test:

H1a: Firm value is lower, conditional on the reported PBO, for firms that use higher

discount rates and lower assumed rates of compensation increases.

Although the firm reports the specific assumptions used to compute the PBO, it is not possible for analysts to determine unequivocally whether a particular firm observed to be using less conservative assumptions is doing so because of reporting incentives or because the firm's particular circumstances warrant their use. (For example, a firm may be justified in using a relatively low assumed rate of compensation increases because, compared to other firms, it plans to give lower pay raises to employees.) However, astute analysts will be aware of the strong connection between a plan's funding status and the assumptions managers choose. They would then recognize that, on average, in firms with under-funded plans managers have likely used relatively less conservative assumptions and that the PBO's in those firms are thereby understated. Hence, the valuation implications of \$1 of reported PBO for such firms should be greater than that of \$1 of reported PBO for firms that have computed the PBO using more conservative assumptions. I therefore test the following hypothesis, again stated in alternate form:

H2a: The valuation weighting on the PBO is greater for firms in which the pension plan is under-funded.

It is implicit to the testing of Hypothesis 1 that analysts assume firms using relatively less conservative assumptions do so because of opportunism and a desire to mask the real level of the PBO rather than because of *bona fide* firm-specific economic circumstances. Similarly, it is implicit to the testing of Hypothesis 2 that analysts assume firms with under-funded plans will have used assumptions that result in an understated PBO. Combining these two, I hypothesize that analysts would likely take into account the funding status of the plan when assessing the use of less conservative assumptions. That is, the use of less conservative assumptions by a firm with over-funded plans would more likely be perceived as resulting from managerial choice reflecting *bona fide* economic circumstances. In such cases, it would be appropriate for analysts to accept the reported PBO at face value, and the use of less conservative assumptions should not have an

impact on firm value. On the other hand, the use of less conservative assumptions by a firm with an under-funded pension obligation more likely results from reporting incentives. In these cases, the PBO is probably understated and it would be inappropriate for analysts to accept the reported PBO at face value. I test the following hypothesis, stated in alternate form:

H3a: The use of higher discount rates and lower assumed rates of compensation increases exerts a greater effect on firm value when the pension obligation is under-funded.

Based on the above discussion, I structure the study as follows. I first identify the determinants of the pension assumptions to ensure that the association between reporting incentives and the pension assumptions previously documented is present in my sample. I then assess how the assumptions are impounded into firm value conditional on the assumptions and reporting incentives. In the next section, I discuss the specifics of the research design and its implementation.

3. Research design

Before examining the impact of pension assumptions on valuation, I first confirm that managers' choices of the assumptions are associated with reporting incentives. (If, in my sample, managers' choices of pension assumptions are not opportunistic, there is no reason to believe that analysts would do anything other than accept the reported pension figures at face value.) The way the discount rate compounds over time resembles the way the assumed rate of compensation increases compounds (except that *higher* discount rates but *lower* assumed rates of compensation increases result in lower reported pension obligations). I therefore examine the two assumptions in combination. (Further details of this and other aspects of the pension computation are included as Appendix 1.) The variable *UNCON* is a measure of the extent to which the firm's assumptions deviates from benchmark, or average values. Positive (negative) levels of *UNCON* indicate that the firm's assumptions are less (more) conservative. I measure *UNCON* as follows:

$$UNCON_{it} = (DISCRATE_{it} - BASEDIS_t) - (COMPRATE_{it} - BASECOMP_{it}) \quad (1)$$

$DISCRATE_{it}$ is the discount rate used by firm i in period t , while $BASEDIS_t$ is the benchmark discount rate for that period. I set $BASEDIS_t$ equal to the 30 year TBOND rate.⁶ SFAS 87 dictates that the discount rate used to compute the pension obligation should equal the rate that would be used in valuing the obligation if it were to be transferred to an independent Life Assurance company, which should not vary between firms at a particular time. However, the firm is not obliged to use the rate at its fiscal year end, but can use a rate up to 3 months prior to that date (to facilitate completion of calculations prior to the year end). Hence, variations in discount rates do not necessarily result from reporting incentives. Nevertheless, the TBOND rate at year-end is arguably a more appropriate, if less convenient, rate to use when computing the liability. However, it can also be argued that the discount rate should be higher than the TBOND rate, reflecting the default risk premium inherent to long-term corporate bonds. If managers choose higher discount rates when the probability of default on firm obligations is high, then the default risk is a potentially omitted correlated variable, leading to potentially incorrect inferences about the effect of $UNCON$ on firm value. Therefore, in robustness tests, I control for this possibility.

$COMPRATE_{it}$ is the firm's assumed rate of compensation increases. Anticipated rates of compensation increases might reasonably differ between firms – both within and between industries – because employees' skill sets are often not fully transferable. Competitive forces do not fully eliminate differences in wage rates and anticipated increases in compensation. Increases in anticipated wage rates in mature or declining firms and industries may reasonably be lower than those anticipated in newer, growing firms and industries. I therefore define $BASECOMP_{it}$ as

⁶ As an alternate specification in the empirical tests, I set $BASEDIS_{it}$ equal to the median discount rate used by firms in the same industry and time period. The conclusions with respect to each of hypotheses are unaltered.

the median assumed rate of compensation increases used by firms in the same industry and time period.

To examine the effect of reporting incentives on *UNCON*, I run the following regression model:

$$UNCON = \lambda_0 + \lambda_1 HIINC + \lambda_2 SIZE + \lambda_3 LEVERAGE + \lambda_4 UNDFUND + \lambda_5 (HIDUR * UNDFUND) + \sum \lambda_j INDUM_j + \sum \lambda_k YEARDUM_k + \varepsilon_2 \quad (2)$$

Equation (2) includes proxies for all factors that prior studies have found to be associated with managers' choices of the assumptions (including Feldstein and Morck, 1983; Petersen, 1996; Asthana, 1999). I report details of their measurement in the next section. In brief, they are: *HIINC* (a measure of profitability), *SIZE*, *LEVERAGE*, and *UNDFUND* (a measure of the level of underfunding of the firms' pension plans).

In addition to the incentive factors identified and examined in prior studies, I hypothesize that the duration of the pension obligation also affects managers' choices. Because of compounding, the pension obligation is more sensitive to changes in the assumptions when there are many years until the pension obligation falls due – that is, when the average beneficiary is young. The weighted average length of time until the payments under the plan fall due (where the weighting for each payment is its present value) is called the duration of the obligation.⁷ For an employee presently aged 35, who expects to receive their pension between the ages of 65 and 82, this period is approximately 37 years. For a recently retired (former) male employee aged 65 with normal life expectancy of approximately 16 years, this period is approximately 7 years.⁸ In

⁷ The duration of the an income stream is the weighted average of the length of time until the cashflows arise, and for a PBO is computed as: $D = \frac{1}{PBO} \sum \frac{t * CF_t}{(1+DISCRATE)^t}$ where CF_t is the periodic payment due to the beneficiaries at time t (Copeland and Weston, 1983, pp432-433).

⁸ According to Life Tables at <http://www.ssa.gov/OACT/STATS/table4c6.html> life expectancy for male (female) aged 65 years is 15.9 (18.9) years.

firms where the ratio of retirees to current employees is high (e.g. manufacturing firms in the rust-belt), the average duration is relatively short.

To a first order approximation, increasing the discount rate (or decreasing the compensation assumption) by $x\%$ reduces the PBO by $Dx\%$, where D is the duration. Thus, to affect the reported PBO by a given percentage requires a smaller adjustment to the assumptions when the duration is high. I expect that although *UNDFUND* induces managers to choose less conservative assumptions, the effect of underfunding on the assumptions is lower when the duration of the obligation is high. To test for this effect, I include an interaction variable in my model of determinants of the pension assumptions. Finally, I also include eight industry indicator variables based on the classification used by Thomas (1989) and indicator variables for each Compustat year⁹.

To test Hypothesis 1, I model firm value as the net sum of the reported balance sheet components (e.g., as in Barth, 1991) adjusted to take account of intangibles and other elements of firm value not reflected in net book assets. Thus:

$$MKTCAP = \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO + \beta \mathbf{CONTROL} + \beta_5 UNCON + \epsilon_3 \quad (3)$$

NPA = non-pension assets; *NPL* = non-pension liabilities; *PLNA* = pension plan assets and *PBO* = reported PBO. *CONTROL* is a vector of factors other than balance sheet components that likely affect firm value. These include the following: long-term interest rates (*TBOND*) since the capitalized value of income streams inherent to equity values generally declines as interest rates rise; profitability (*HIINC*) as a proxy for future anticipated economic rents not recorded on the

⁹ The following four-digit SIC codes are assigned to each group: (1) basic industries — 1000–1299, 1400–1499, 2600–2699, 2800–2829, 2870–2899, and 3300–3399; (2) capital goods — 3400–3419, 3440–3599, 3670–3699, 3800–3849, 5080–5089, 5100–5129 and 7300–7399; (3) construction — 1500–1599, 2400–2499, 3220–3299, 3430–3439, and 5160–5219; (4) consumer goods — 0000–0999, 2000–2399, 2500–2599, 2700–2799, 2830–2869, 3000–3219, 3420–3429, 3600–3669, 3700–3719, 3850–3879, 3880–3999, 4830–4899, 5000–5079, 5090–5099, 5130–5159, 5220–5999, 7000–7299, and 7400–9999; (5) energy — 1300–1399, and 2900–2999; (6) finance — 6000–6999; (7) transportation — 3720–3799 and 4000–4799; and (8) utilities — 4800–4829 and 4900–4999. I also ran the regression models without industry indicator variables; the conclusions of my hypothesis tests are unaltered.

balance sheet; recent growth in sales (*SALGRO*) as a proxy for growth opportunities that are not yet reflected in accounting numbers; firm size (*SIZE*) since large firms likely have higher values (conditional on scale-free accounting numbers) because their operating cashflows are less risky than those of smaller firms. Financial leverage increases the risk of equity capital, and therefore it is likely that the mapping of accounting numbers to market value of equity is negatively associated with leverage. To control for this effect, I include a measure of leverage (*LEVERAGE*) within *CONTROL*. In addition, as in equation (2) above, I include industry and year indicator variables.

UNCON measures the lack of conservatism in the firm's assumptions. If analysts accept the managers' choices of assumptions at face value then they will not perceive the PBO to be understated. If that were the case, I would expect to find $\beta_5 = 0$. However, if analysts believe that the use of less conservative assumptions occurred because of reporting incentives, then analysts will implicitly adjust their assessment of firm value to reflect the understated PBO and to reverse the effect of reporting incentives on managers' choices of the assumptions. In this case, I expect to find $\beta_5 < 0$.

To test Hypothesis 2, I model firm value as above but exclude the term for *UNCON* and test analysts' assessment of the PBO in firms with net over-funded and under-funded plans.¹⁰ I therefore model firm value as:

$$\begin{aligned}
 MKTCAP = & \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO + \beta_5 (PBO * UNFD) \\
 & + \beta \text{ CONTROL} + \varepsilon_4
 \end{aligned}
 \tag{4}$$

UNFD is set equal to 1 for firms with under-funded pension plans and zero otherwise. If, as hypothesized, analysts believe that managers use less conservative assumptions when the plan is

¹⁰ Under SFAS 87, firms reported separately the PBO and plan assets for over- and under-funded plans. However, the assumptions for categories of plans are not reported, and the detailed reporting requirement was withdrawn with SFAS 132. Therefore, I use only firm level data.

under-funded, the valuation weighting on under-funded plans will be greater than on over-funded plans. That is, β_5 will be negative.

To test the hypothesis that analysts believe that managers' use of less conservative assumptions is more likely the result of reporting incentives rather than *bona fide* economic factors when the pension obligation is under-funded I model firm value as:

$$\begin{aligned}
 MKTCAP = & \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO + \beta \mathbf{CONTROL} + \beta_5 UNCON \\
 & + \beta_6 (UNFD*UNCON) + \epsilon_5
 \end{aligned}
 \tag{5}$$

If analysts believe that a firm more likely uses less conservative assumptions when its pension plan is under-funded, this belief will be reflected in a lower assessment of value for such firms, conditional on the reported accounting numbers. Hence, I expect to find that β_6 is negative. If the firm's pension plans are over-funded, then I hypothesize that analysts more likely trust that there are *bona-fide* reasons for any use of less conservative assumptions. Thus, analysts more likely accept those assumptions and the reported PBO at face value because there is no apparent need to mask underfunding. Therefore, I expect to find that β_5 is not significantly different from zero.

4. Data description and descriptive statistics

The sample consists of all US firms listed in the 2002 Compustat and CRSP database for which data are available. To minimize the scale-induced bias (Barth and Kallapur, 1996; Brown, et al., 1999), I deflate firm level variables by number of shares issued. I exclude observations that meet any of the following criteria: i) stock prices less than \$1 (418 observations) or more than \$100 (143 observations);¹¹ ii) recorded discount rate is less than 1%; iii) rate of growth of total assets or growth of market value is greater than 8 (35 observations); iv) decline in total assets or market value by a factor of more than 8 (21 observations). Before the elimination of outliers

¹¹ This limitation ensures that the coefficients on the control variables can be more sensibly interpreted. Results are not qualitatively different if these limits are removed.

(defined as those observations for which the absolute value of the studentized residual is greater than 2.5) in the specific regression models, the sample consists of 10,891 observations.

Data are from the Compustat fiscal years 1991 to 2002, and the number of observations in any year varies between 785 (in 2001) and 998 (in 1995). The total value of pension-plan assets for the sample firms was \$401 (\$866) billion in 1992 (2000), which represents approximately 40% of the U.S. corporate defined-benefit pension assets (Greenwich Associates, 1995).

To compute *UNCON*, I use the discount rate used to compute the PBO, and the assumed rate of compensation increases are taken from Compustat (Data items 246 and 335, respectively). I measure firm size (*SIZE*) by the natural logarithm of prior-year sales, leverage (*LEVERAGE*) as the ratio of book value of non-pension liabilities to the sum of book value of non-pension assets and non-pension liabilities and profitability (*HIINC*) as income before extraordinary items per share. I then transform these three variables to a decile ranking, rescaled to [0,1], as in Abarbanell and Bushee (1998). That is, I group the raw measure into deciles, and assign values of 0, 1/9, 2/9...8/9, 1 to the deciles. Rescaling variables in this way allows a convenient interpretation of the resulting regression coefficient — the coefficient measures the extent to which the regressor is affected by the independent variable falling into the top decile, rather than the bottom decile.¹² The rescaling also eliminates outlier problems common with ratio-based variables. *MKTCAP* is the market value of equity per share at fiscal year end.¹³

Prior studies (including Feldstein and Morck, 1983; Petersen, 1996; Asthana, 1999) have found that less conservative assumptions are used by firms with under-funded pension

¹² In the reported figures, decile measures were based on the whole sample. Results are robust to alternate specifications, e.g. computing the decile metric within year or within industry-year groupings of the variables.

¹³ I also ran all tests using the market value of equity three months after the fiscal year-end, adjusted for equity issues etc. in the period since fiscal year end. As in Collins et al. (1997), the three-month delay is used to ensure that the financial statements, including pension disclosures, are available to investors. All results are similar to those reported in the text.

obligations. The observed underfunding is the difference between the *reported* PBO (PBO_{REP}) and the fair value of plan assets; therefore, the association between the assumptions and underfunding is mitigated as the less conservative assumptions are used. In fact, if managers were able to wholly mask any under-funding of the firm's pension obligations by judicious choice of the assumptions, there would be no association between the reported level of underfunding and the assumptions used. To counter this effect, I estimate the level of underfunding that would have been apparent had the underfunding itself not affected managers' choices of the discount rate and compensation rate increase used to compute the PBO. That is, I estimate the PBO that would have been reported using $BASEDIS_t$ and $BASECOMP_{it}$. Using a standard linear approximation, I compute the adjusted PBO (PBO_{ADJ}) as follows:

$$PBO_{ADJ} = PBO_{REP} + UNCON * \frac{\partial PBO_{REP}}{\partial UNCON}$$

$$\approx PBO_{REP} + UNCON * (DURATION * PBO_{REP})$$

To reduce measurement error, I assume that the duration of all plans is 15 years, and hence

$$PBO_{ADJ} \approx PBO_{REP} + UNCON * (15 * PBO_{REP})^{14}$$

I then compute the level of underfunding based on this adjusted PBO. For observations where the adjusted pension PBO is less than the fair value of plan assets, this variable is set equal to 0.¹⁵

To reduce the likely effect of the measurement error induced by this estimation process and also to ease interpretation of the coefficients, I use the decile value of the resulting measure of underfunding, rescaled to [0,1].

Figure 1 shows the extent of underfunding of pension plans throughout the sample period. Panel A shows the median underfunding (\$ per share) and the 5th and 95th percentiles.

¹⁴ I use a constant assumed duration to minimize measurement error. In untabulated tests I use a firm specific estimate for duration; conclusions of hypothesis tests are unaltered. Further details of the adjustment are given in Appendix 1.

¹⁵ Results using a measure of under-funding based on the unadjusted PBO and also those using a measure of net under-funding (which distinguishes the degree of over-funding) are qualitatively similar to those reported below except where explicitly stated.

While the median level of underfunding (on a both reported and adjusted basis) is in the range $-\$1$ to $+\$2$, there are many firms with substantial underfunding – particularly in the later years. Panel B reports the proportion of firms with under-funded plans; based on the adjusted figures, in each year more than 50% of firms are under-funded. Accordingly, since under-funding has been found to induce the use of less conservative assumptions, it is likely that the use of less conservative assumptions is an issue in the present sample.

To estimate PBO_{ADJ} , I do not attempt to quantify firm-specific measures of duration. However, to examine the effect of duration on managerial choice of the pension assumptions, I do need a firm-specific estimate. I estimate the duration of the PBO based on the following characterization of pension costs. For firms with a relatively young workforce, for whom the duration of the PBO is high, the PBO is relatively small. The interest cost, which is based on the beginning-of-period PBO and thus on accumulated prior service, is small relative to the current service cost. By contrast, a short duration of the PBO arises when the workforce is relatively mature, the PBO relatively large and hence the interest cost is large relative to the service cost. Using this relation between service cost (Compustat data item 331) and interest cost (Compustat data item 332), I define the variable $HIDUR$ as the decile rank of the ratio of service cost to the sum of interest cost and service cost rescaled to $[0,1]$.

Table 1, Panel A reports univariate descriptive statistics and Figure 2, Panel A shows the assumptions used and $TBOND$ graphically. The mean $DISCRATE$ (at 7.5%) is 1.2% higher than $TBOND$ while the mean $COMPRATE$ (at 5.0%) is 1.3% lower than $TBOND$. Thus, the average rate of real assumed increases in compensation is lower than the real interest rate. While this level of assumed compensation increase is lower than might be expected for the US economy as a whole, the figures are reasonable given that defined benefit pension plans are more common in more mature (and often declining) industries. The variation in $COMPRATE$ (standard deviation of 0.8%) is greater than that of $DISCRATE$. This difference likely reflects the greater variation in firm-specific circumstances that would justify the use of different assumptions, as well as the

absence of a clear benchmark for setting that assumption. The standard deviation of *UNCON* is also 0.8%, and is fairly constant over the period in spite of the variation in its component parts. That the variance of *UNCON* is less than the sum of the variances of its component parts is consistent with the high positive correlation between *DISCRATE* and *COMPRATE*, which relation is induced in the whole sample because both variables are related to the anticipated rate of inflation. The time series relation between these variables is shown in more detail in Figure 2, Panel B. Typical discount rates and assumed rates of increases in compensation fell over the period, in line with *TBOND* and inflation. Untabulated results show that the correlation is also positive in each annual sub-sample (approximately 0.2) suggesting that managers choose assumptions that partially offset one another; a less conservative choice of discount rate is matched with a conservative choice of assumed increase in rate of compensation.

The *SIZE* variable indicates that the average sample firm is larger than the average Compustat firm; median value of *SIZE* in the sample (Compustat population) is 6.78 (4.70), corresponding to annual sales of \$880m (\$110m). This difference may arise because firms that have no material defined-benefit pension obligations are effectively excluded from my sample — their pension assumptions are missing. Such excluded firms are typically smaller than firms with material defined-benefit schemes. *LEVERAGE* indicates that the average sample firm has similar leverage as the average firm in the Compustat population for the period – which was 40%, prior to scaled-decile transformation. The summary statistics for reported *PBO* and the fair value of plan assets (*PLNA*) indicate that on average, throughout the sample period, the pension plans are neither over- nor under-funded based on the reported figures. Median values for both variables are equal to \$3.1 per share and the 5th and 95th percentiles are similar to one another.

Table 2 reports the Spearman rank correlations between the variables. (Unreported Pearson product moment correlation coefficients are similar.) As expected, strong positive correlation exists between *DISCRATE*, *COMPRATE*, and *TBOND* (ρ is between 0.4 and 0.7) since all are related through the level of anticipated inflation.

Also as expected, high positive correlation exists between *SIZE* and *LEVERAGE* ($\rho = 0.22$), consistent with large firms being more highly levered (Myers, 1977). The high negative correlation between *PBO* and duration (*HIDUR*) ($\rho = -0.56$) arises because the PBO grows with the maturity of the workforce, that is, as the *DURATION* declines. The hypothesized bivariate relation between *UNCON* and *UNDFUND* is apparent. The absence of a relation between *DISCRATE* and *UNDFUND* and the strong relation between *COMPRATE* and *UNDFUND* are not reliable however, since the level of underfunding increased in 2000 to 2002 when interest rates, and assumed rates of increases in compensation increases generally fell.

5. Empirical results

To assess the extent that the pension assumptions are attributable to economic factors or incentive factors, I report the results of estimating Equation (2) in Table 3. The regression model reported in this table and others is based on the entire sample of firms. Huber-White standard errors are computed using the number of firms (as opposed to the number of observations) in the sample. Each firm can appear in the sample multiple times (on average, 5.7), and it is therefore likely that error terms are not independent. Basing standard errors on the number of firms in the sample implicitly assumes that firm specific errors are perfectly correlated, and this practice is therefore very conservative with respect to the computation of *t*-statistics.

By far, the most important factor associated with the use of less conservative assumptions is the level of underfunding. The coefficient on *UNDFUND* indicates that the assumptions used by firms in the most under-funded decile are 0.73% (p-val < 0.001) less conservative than those in the least under-funded decile. For a pension plan with typical duration of 15 years, a 0.7% change in the assumptions alters the obligation by more than 10%. As hypothesized, a given level of underfunding induces a lower shift in the assumptions when the duration of the plan is high. The coefficient on the interaction variable *HIDUR* * *UNDFUND* is significantly negative as hypothesized. The value of -0.31 (p-val < 0.001) indicates that within the decile of firms with

the highest level of underfunding, the change in assumptions for firms with pension plans of the highest decile of duration is only half the increase of those firms with short duration plans. This finding is consistent with managers manipulating the pension assumptions less when the effect of such manipulation on the PBO is magnified, because the obligation has a high duration. The coefficient on *UNDFUND* (*HIDUR* * *UNDFUND*) is also significantly positive (negative) in all (all but one) of the 12 untabulated separate annual regressions.

LEVERAGE is a significant determinant of choice of assumptions in the overall sample indicating that firms in the highest decile of leverage choose assumptions that are 0.16% ($p < 0.01$) less conservative compared with the least levered firms. The coefficient is also positive in 11 out of 12 annual regressions (significantly so in 8). I find the coefficient on *HIINC* negative overall ($p < 0.01$) and in 9 out of 12 annual regressions. The coefficients on the overall sample indicate that firms in the lowest decile of profitability choose assumptions that are 0.15% lower than their peers at the other end of the spectrum. These results are generally consistent with those found in earlier studies.¹⁶

According to the political cost hypothesis, larger firms are expected to use more conservative assumptions – to reduce apparent profitability. Consistent with the generally weak evidence in earlier studies (Christie, 1990), I do not find evidence in support of the hypothesis. Untabulated results indicate that the correlation between the assumed rate of compensation increases and firm size is negative in every year, which suggests that larger firms expect to give smaller pay raises to their employees. This finding may result from my intra-industry measure of *UNCON* failing to control for industry effects completely and from the fact that larger firms within an industry (based on sales, not market value) tend to be older-economy firms.

¹⁶ Asthana (1999) and Godwin et al. (1996), find a positive association between leverage and the use of liberal pension assumptions, while Feldstein and Morck (1983) find no relation between leverage and the discount rate.

The tests of the main hypotheses are reported in Table 4. In Column A, I report the results of testing the valuation model developed above in equation (3). The R^2 of the model is high at around 55%, which is comparable to prior studies (e.g. Barth, 1991; Choi, et al., 1997) and is to be expected since the control variables include pension and non-pension assets and liabilities. The coefficients on the control variables are as hypothesized and are similar for *all* the other market value regressions. Firms with recent high growth in sales, larger firms, and more profitable firms have higher stock prices – conditional on book values of reported assets and liabilities. The p-value of all these coefficients is less than 0.001. Interestingly, while past sales growth is clearly an imperfect proxy for future growth of profits, this variable has great economic significance. Firms in the top decile of growth have stock prices that are, on average, \$8 higher than those in the lowest decile. This figure is not particularly sensitive to the sample of firms considered – for example, results are similar when firms in the top and bottom quartile of net book value are excluded. As expected, equity values are lower when interest rates are high – even though the bulk of the variation in this variable is subsumed into the annual indicator variables.

This first table offers support for the hypothesis that analysts do not accept the assumptions at face value – firms using less conservative assumptions *do* have lower stock prices. The coefficient of -0.95 indicates that firms that use assumptions that are 1% less conservative than their industry peers have stock prices that are \$0.95 lower. In non-tabulated annual regressions the coefficient on *UNCON* is negative in 10 out of 12 years and significantly so ($p < .05$) in 6 of the 12. While *UNCON* itself adds little explanatory power to the regression model (the R^2 increases from 55.84% to 55.97%), note that this change reflects only that part of *UNCON* that is orthogonal to the other variables.

As noted earlier, it is possible that firms' use of higher discount rates is perceived as justified by analysts when risk of default is higher and thus, any negative coefficient on *UNCON* reflects the default risk rather than an understated PBO. To examine this possibility, in

untabulated regressions, I include a measure of Standard & Poor's credit rating in the model (Compustat item data280). The credit rating variable is not a significant factor in the *UNCON* model itself. However, the variable adds significant explanatory power to the market valuation model (R^2 increases by approximately 6%). The coefficient on *UNCON* is reduced in magnitude (to -54) but remains significant ($p < 0.02$).

In Column B, I investigate whether the market value is lower when firms have under-funded pension plans; analysts might reasonably believe that that managers have responded to incentives to reduce the size of the reported obligation. Analysts' differential weighting of over and under-funded PBO's is reflected in the coefficients on *UNFD * PBO*. If analysts implicitly believe that firms with under-funded plans have attempted to mask the level of underfunding by understating the PBO, \$1 of reported PBO for firms with under-funded PBO's will have a greater impact on firm value than will \$1 of PBO for a firm with an over-funded plan. The coefficient of -0.08 on *UNFD * PBO* indicates that the markets' weight on the PBO for firms that have under-funded plans is more negative than on the PBO for firms with net over-funded plans, though to a marginal degree – the one-sided p-value on this coefficient is 7%. In untabulated annual regressions, the coefficient on *UNFD * PBO* is negative in just 8 out of the 12 years, although significantly so in 3 of those years. In summary, I find only weak evidence that the market values the PBO of over- and under-funded plans differently.

I find evidence that analysts' assessment of the funding-status is more likely based on the *adjusted* PBO rather than the *reported* PBO. In untabulated regression models I set *UNFD* equal to 1 for firms that have under-funded plans based on the level of *reported* PBO and zero otherwise. I am unable to reject the hypothesis that the coefficients on *UNFD * PBO* is other than zero ($p\text{-val} = 0.51$). In annual regressions, the coefficient on *UNFD * PBO* is negative six times (twice significantly so) and positive six times (twice significantly so). Hence, no evidence emerges that analysts differentially value the PBO of firms with over- and under-funded plans if they do not also implicitly adjust the reported PBO in determining the funding status of the plan.

In Column C of Table 4, I investigate how the funding status of the plan affects the analysts' interpretation of a firm's use of less conservative assumptions. The differential impact of *UNCON* for firms with over- and under-funded pension obligations is reflected in the coefficients on *UNFD * UNCON*. For firms with under-funded plans, a combination of increase in the discount rate and decrease in the assumed rate of compensation increases that total 1%, leads to a reduction in the stock price of \$1.16, on average (-0.12 – 1.04). In untabulated annual regressions, the coefficient on *UNFD * UNCON* is negative in 10 out of 12 years and 4 times significantly so. However, for firms with over-funded plans, the stock price is not significantly affected when the managers choose less conservative assumptions. (The coefficient on *UNCON* is -0.12; p-val is not significant.) Hence, I am unable to reject the hypothesis that analysts accept managers' pension assumptions at face value when there is little or no apparent incentive for managers to mask the level of funding. Overall, I find strong evidence that analysts do not accept the managers' choice of assumptions at face value if the firm's pension plans are under-funded.

The tests above indicate that analysts take into account a firm's use of less conservative assumptions – when less conservative assumptions are used the assessed value of the firm is as if the PBO were higher than figure reported in the financial statements. The tests do not, however, address the issue of whether the size of analysts' adjustment is appropriate; the weighting that analysts apply to the reported PBO when there is evidence that the assumptions may have been chosen opportunistically may be too great or too small. For analysts to weight the reported PBO appropriately, it needs to know what the PBO would have been in the absence of opportunistically induced discretion. To accurately reverse the impact of opportunistic managerial choice of the pension assumptions requires knowledge of the following: first, the extent to which the firm's use of less conservative assumptions is attributable to opportunism and how much is justified by firm specific economic circumstances; second, the sensitivity of the reported PBO to changes in the assumptions, i.e. the duration of the liability. I hypothesize that analysts do make reasonable estimates of the impact of managerial opportunism, the duration of

the PBO and that they adjust the PBO accordingly. The test of this hypothesis, reported below, is a joint test of the accuracy of my characterization of analysts' estimate of the parameters and the market's valuation of the resulting PBO.

To test the hypothesis, I write: $PBO_{ADJ} = PBO_{REP} + PBO_{HID}$, where PBO_{REP} is the PBO as reported in the financial statements (the measure used in the earlier regressions), and PBO_{ADJ} is the adjusted PBO – that which would have been reported if the firm had used *BASEDIS* and *BASECOMP* assumptions. The difference between the PBO that would have been reported using base level assumptions and that which was reported is PBO_{HID} . By using assumptions different from the base level, the firm has effectively "hidden" PBO_{HID} . Hence, I then model firm value as:

$$\begin{aligned}
 MKTCAP = & \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO_{REP} + \beta_5 PBO_{HID} + \beta_6 PBO_{HID} * UNFD \\
 & + \beta \text{ CONTROL} + \varepsilon_6
 \end{aligned}
 \tag{6}$$

If 15 years is a reasonable approximation of the duration of the obligation and if analysts value the PBO as if all deviations from industry median assumptions are opportunistic, then analysts would not distinguish between the part of PBO_{ADJ} that is reported and the part of PBO_{ADJ} that is "hidden". Therefore, I expect to find that the coefficient β_5 is not significantly different from β_4 . A finding that $\beta_5 = 0$ would be consistent with analysts accepting the reported PBO at face value. However, if analysts accept that managers of firms with over-funded plans have no incentive to hide part of the PBO and that any PBO attributable to the use of other than base assumptions is valid, then I expect to find $\beta_5 = 0$ and that β_6 is not significantly different from β_4 .

In Table 5, I report the results of the above regression model. The estimated coefficient on PBO_{HID} (β_5) is significantly different from zero (p-val < 0.01) but is not significantly different from that on PBO_{REP} (β_4). Hence we are unable to reject the hypothesis that the *hidden* amount of the PBO has the same effect on firm value as does the reported PBO. This conclusion is borne out also by the 12 non-tabulated annual regressions. The coefficients on PBO_{HID} and PBO_{REP} are not significantly different from one another in any year; and in 9 (12) years, the coefficient on PBO_{HID} (PBO_{REP}) is negative – 3 times (10 times) significantly so.

Consistent with the results in Table 4, column B, and in contrast to those in column C, the coefficient on $PBO_{HID} * UNFD$ is not significantly different from zero. In effect, analysts do not distinguish between pension plans that are over-funded and those that are not. In none of the 12 non-tabulated annual regressions can we reject the hypothesis that the weighting on PBO_{REP} is equal to the weighting on $(PBO_{HID} + PBO_{HID} * UNFD)$.

These results are robust to different estimates of duration; the results are not materially different if duration is estimated as follows: a) a constant anywhere between 10 and 25 years or b) based on the ratio of service cost to total cost (service + interest) standardized to a mean of 15 years and standard deviation of 3 years. (The coefficients on PBO_{HID} and PBO_{REP} for the whole sample are closest when the duration is estimated as 20 years for all firms.) These results are consistent with the analysts completely undoing the effect of firm-specific pension assumptions and instead valuing the firm as if the PBO were computed using base level assumptions irrespective of whether the firm's pension plans are over or under-funded. Together with the results in Table 4, the evidence that analysts treat assumptions differently depending on whether the pension plans are under-funded or not is mixed. However, the evidence is consistently strong that they do not accept the reported PBO at face value.

6. Conclusions

In this study, and consistent with prior evidence, I find strong evidence that obligation-reducing assumptions are made by firms with under-funded pension plans and other reporting incentives. I add to prior literature by showing that managers' manipulation of the assumptions in response to a given level of underfunding is lower when the duration of the liability is high because the reported PBO is more sensitive to such manipulation.

However, I find that the way that the reported PBO is impounded into firm value is consistent with analysts seeing through managers' opportunistic choices of obligation reducing assumptions. Where managers have chosen obligation-reducing assumptions relative to their

industry peers – and particularly where those choices appear to result from reporting incentives due to the funding status of the plan – analysts, and hence the stock market, place a lower value on the firm. These findings are consistent with the hypothesis that incentives to misreport influence managers' choices of the assumptions and that equity analysts, aware of these influences, discount the resulting obligation accordingly. I find that the apparent adjustment to the reported pension obligation is consistent with analysts completely undoing the effect of managerial choice. That managers continue to manipulate the assumptions in response to reporting incentives even though analysts, and hence the stock market too, undo the effect of managerial choice suggests that the managerial behavior may be designed to mislead parties other than shareholders.

The paper contributes to our understanding of analysts' ability to identify the effect of managers' accounting choices on financial statements. I find that the analysts are able to identify the effect of misreporting incentives factors on accounting choices in this complicated area — the computation of pension liabilities. It is therefore likely that the analysts also recognize the effect of misreporting incentives in simpler settings. To the extent that analysts are able to recognize such incentives and to invert their effect on the firm's financial reports, concern about the stock market being misled by misreporting is unwarranted. As for concerns that managers respond to incentives to misreport *per se*, this study offers additional evidence that such concerns are well founded.

Appendix 1 - Sensitivity of PBO to Assumptions

For ease of exposition, suppose that an employee's accumulated pension benefit consists of a single payment, equal to a proportion x of their final salary that is to be paid in n years' time. Then the Accumulated Benefit Obligation is the present value of this amount, $\frac{xT}{(1+r)^n}$, where annual r is the discount rate and T is their anticipated final salary. If the employee's current salary is S and future changes in annual compensation at a rate c , are anticipated such that the anticipated final salary of the employee is $T = S(1+c)^n$, then the PBO can be expressed as: $\frac{xS(1+c)^n}{(1+r)^n}$.

To a first order approximation, we can write this as: $\frac{xS}{(1+[r-c])^n}$. Hence, in evaluating the effect of changes in the assumptions, we need only be concerned with the changes in the net difference between r and c , i.e. $[r-c]$ and need not consider their separate effects.

The effect of changes in the assumptions on the PBO is given by:

$$\begin{aligned} \frac{\partial \text{PBO}}{\partial [r-c]} &= \frac{n}{(1+[r-c])} \frac{xS}{(1+[r-c])^n} \\ &= \frac{n}{(1+[r-c])} * \text{PBO} \\ &\approx n * \text{PBO}, \text{ since } [r-c] \approx 0. \end{aligned}$$

For a PBO made up of many payments due at various times, the effect of changing the assumptions on the PBO is given by $\frac{\partial \text{PBO}}{\partial [r-c]} \approx \text{DURATION} * \text{PBO}$, where DURATION is the average length of time until the payment is due. (And in computing this average, each payment is weighted by its present value.)

Using a linear approximation [$f(x+h) = f(x) + h * f'(x)$] and defining *UNCON*, my measure of low conservatism in the pension assumptions, as deviations from industry median assumptions I compute the adjusted PBO that would have been reported if industry median assumptions had been used as:

$$\text{PBO}_{\text{ADJ}} = \text{PBO}_{\text{REPORTED}} + \text{UNCON} * \frac{\partial \text{PBO}_{\text{REPORTED}}}{\partial \text{UNCON}}$$

$$= PBO_{\text{REPORTED}} + UNCON * DURATION * PBO_{\text{REPORTED}}$$

To compute the adjusted PBO, I initially estimate DURATION as 15 years for all firms. (In robustness tests, discussed in the text, I use alternate values.)

Figure 1 – Panel A

Average underfunding per share of pension plans – based on reported and adjusted PBO

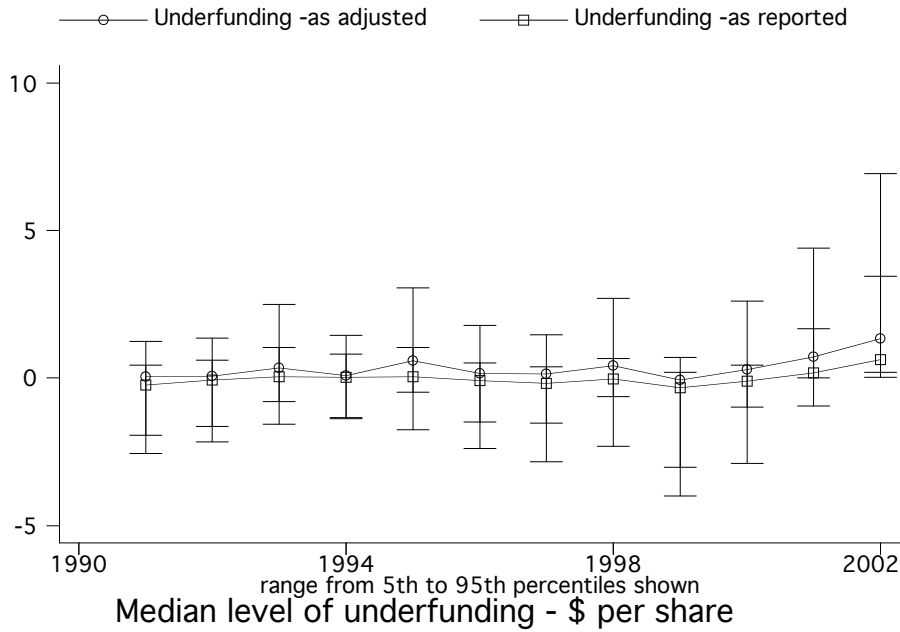


Figure 1 – Panel B

Percentage of firms with under-funded pension plans based on reported and adjusted PBO

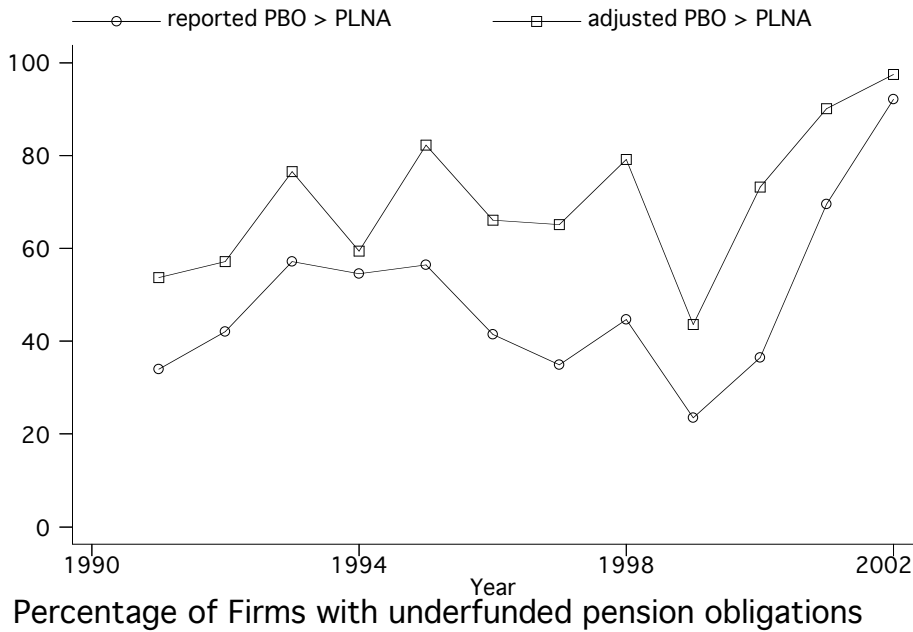


Figure 2 – Panel A

Assumptions used by firms in computation of pension obligations

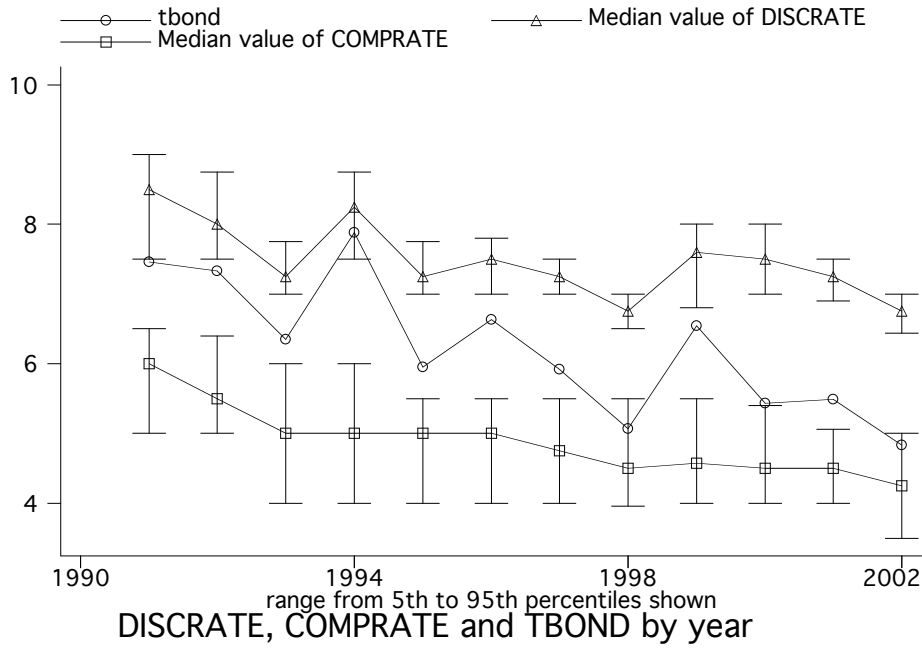


Figure 2 – Panel B

Assumptions used by firms in computation of pension obligations

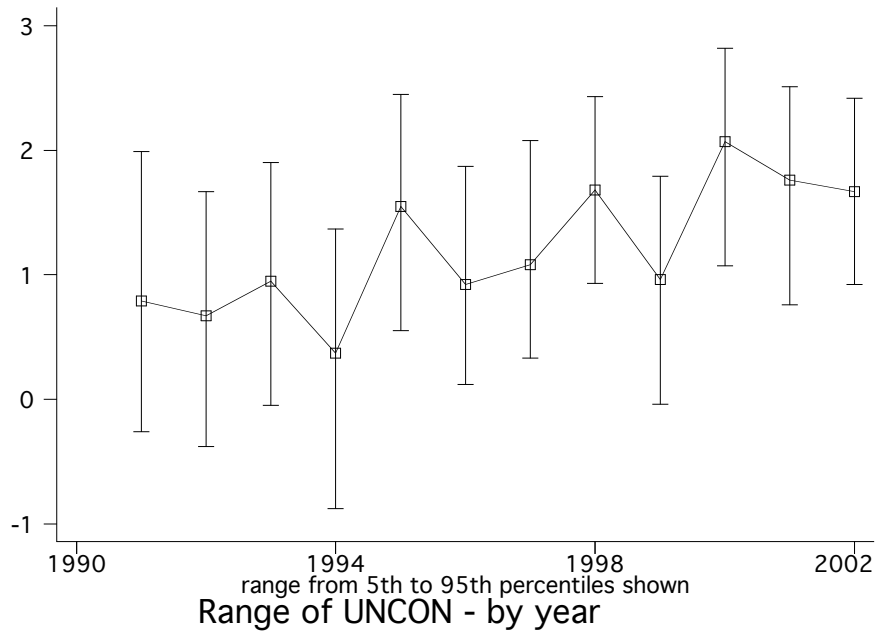


TABLE 1**Panel A: Descriptive Statistics**

Variable	Mean	Standard Deviation	Median	5th percentile	95th percentile
<i>MKTCAP</i>	28.4	17.9	25.1	4.9	64.3
<i>DISCRATE</i> (%)	7.5	0.6	7.5	6.5	8.5
<i>COMPRATE</i> (%)	4.9	0.8	5.0	3.7	6.0
<i>UNCON</i> (%)	1.1	0.9	1.2	-0.4	2.6
<i>TBOND</i> (%)	6.3	0.9	6.3	4.8	7.9
<i>PBO</i>	5.7	9.5	3.1	0.3	19.8
<i>PLNA</i>	6.1	10.2	3.1	0.2	21.4
<i>(PBO-PLNA)</i>	0.6	3.3	0.3	-2.4	4.2
<i>SALGRO</i> (Raw)	1.1	0.2	1.1	0.8	1.4
<i>IBX</i> (Raw)	0.2	0.3	0.05	-0.0	0.6
<i>BOOKLEV</i> (Raw)	0.4	0.1	0.4	0.2	0.5
<i>DURATION</i> (Raw)	15.0	1.9	14.9	12.2	18.5
<i>SIZE</i> (Raw)	6.7	1.7	6.7	3.9	9.5

Variables are defined as follows: *MKTCAP* is the market value of equity per share; *DISCRATE* is the discount rate used to compute pension obligations; *COMPRATE* is the assumed rate of compensation increases; *UNCON* is the difference between the firm level assumptions of discount rate and *TBOND* less the difference between the firm level assumed rate of compensation increases and industry median levels for the fiscal year; *TBOND* is the interest rate on 30-year treasury bonds at the end of the fiscal year; *SIZE* is log of total prior year sales; *PBO* is the reported projected benefit obligation per share; and *PLNA* is fair value of pension-plan assets per share. (Univariate descriptive statistics are not reported for variables that are transformed to decile ranks.)

Panel B: Spearman Rank Correlations

	<i>MKTCAP</i>	<i>PBO</i>	<i>PLNA</i>	<i>SIZE</i>	<i>LEVERAGE</i>	<i>UNDFUND</i>	<i>HIDUR</i>	<i>HIINC</i>	<i>SALGRO</i>	<i>TBOND</i>	<i>DISCRATE</i>	<i>COMPRATE</i>
<i>PBO</i>	0.28											
<i>PLNA</i>	0.30	0.98										
<i>SIZE</i>	0.48	0.36	0.36									
<i>LEVERAGE</i>	0.07	0.10	0.12	0.22								
<i>UNDFUND</i>	-0.01	0.27	-0.10	0.13	-0.01							
<i>HIDUR</i>	-0.06	-0.56	-0.56	-0.21	-0.04	-0.11						
<i>HIINC</i>	-0.12	-0.18	0.17	0.46	-0.10	0.02	0.03					
<i>SALGRO</i>	0.17	-0.17	-0.15	-0.05	-0.02	-0.08	0.14	-0.10				
<i>TBOND</i>	-0.05	0.01	0.04	-0.11	-0.09	-0.30	0.06	-0.13	0.01			
<i>DISCRATE</i>	-0.06	0.03	0.06	-0.03	-0.03	-0.14	-0.01	-0.08	0.02	0.71		
<i>COMPRATE</i>	0.02	-0.05	-0.03	-0.09	-0.06	-0.34	0.13	-0.11	0.02	0.43	0.40	
<i>UNCON</i>	-0.01	0.08	0.06	0.11	0.07	0.43	-0.17	-0.11	-0.02	0.13	-0.13	-0.78

Variables are defined as follows: *MKTCAP* is the market value of equity per share; *PBO* is the reported projected benefit obligation per share; *PLNA* is fair value of pension-plan assets per share; *SIZE* is log of total prior year sales; *LEVERAGE* is the scaled decile rank of the ratio of non-pension liabilities to non-pension assets; *UNDFUND* is the scaled decile rank of the underfunding of the plan, computed as the PBO (adjusted to average discount rates and average rates of compensation increase) less the fair value of pension-plan assets; *HIDUR* is the scaled decile rank of the estimated duration of the pension obligation, based on the ratio of service cost to interest cost; *HIINC* is the scaled decile rank of the ratio of -income before extraordinary items per share; *SALGRO* is the scaled decile rank of rate of growth of annual sales; *TBOND* is the interest rate on 30-year treasury bonds; *DISCRATE* is the discount rate; *COMPRATE* is the assumed rate of compensation increases; *UNCON* is the difference between the firm level assumptions of discount rate and *TBOND* less the difference between the firm level assumed rate of compensation increases and industry median levels for the fiscal year. Spearman rank correlations with an absolute value of greater than 0.028 are statistically significant at the 0.01 level.

TABLE 3: Economic factors, incentive factors, and pension-related assumptions

$$UNCON = \lambda_0 + \lambda_1 HIINC + \lambda_2 SIZE + \lambda_3 LEVERAGE + \lambda_4 UNDFUND + \lambda_5 (HIDUR * UNDFUND) + \sum \lambda_j INDUM_j + \sum \lambda_k YEARDUM_k + \varepsilon$$

	Expected sign	Coefficient	t- value
<i>HIINC</i>	–	-0.15**	-3.8
<i>SIZE</i>	–	-0.03	-0.6
<i>LEVERAGE</i>	+	0.16**	3.2
<i>UNDFUND</i>	+	0.88**	19.6
<i>HIDUR*UNDFUND</i>	–	-0.26**	-4.1
R ²		0.42	
R ² using just year and industry indicators		0.33	
Number of observations		10,667	
Number of firms (clusters)		1,835	

All *t*-statistics are based on heteroskedastic-consistent standard errors (White, 1980) where degrees-of-freedom allow for non-independence of multiple observations for a single firm. * and ** indicate significance at the 5% and 1% level respectively.

UNCON is the difference between the firm specific (discount rate - assumed rate of compensation increases) and (TBOND - industry median assumed rate of compensation increases for the fiscal year). *HIINC* is the scaled decile rank of the ratio of -income before extraordinary items per share; *SIZE* is log of prior year sales; *LEVERAGE* is the ratio of total book liabilities to total assets; *UNDFUND* is the scaled decile rank of the underfunding of the plan, computed as the PBO (adjusted to average discount rates and average rates of compensation increase) less the fair value of pension-plan assets; *HIDUR* is the decile rank of the estimated duration of the pension obligation, based on the ratio of service cost to interest cost; *INDUM_i* is one of 8 indicator variables for industry membership and *YEARDUM_k* is an indicator variable based on the Compustat year (June – May) – estimated coefficients not tabulated.

TABLE 4: Firm value and the use of less conservative pension assumptions

$$MKTCAP = \beta \text{CONTROL} + \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO + \beta_5 (PBO * UNFD) + \beta_6 UNCON + \beta_7 (UNFD * UNCON) + \varepsilon$$

	Predicted Sign	Col. A		Col. B		Col. C	
		Coefficient	t- value	Coefficient	t- value	Coefficient	t- value
<i>Constant</i>		15.81**	4.9	10.79**	3.6	15.91**	4.5
<i>NPA</i>	+	0.47**	14.6	0.47**	14.9	0.47**	14.8
<i>NPL</i>	-	-0.47**	-13.7	-0.47**	-13.8	-0.47**	-13.9
<i>PLNA</i>	+	0.56**	6.1	0.56**	5.4	0.56**	5.4
<i>PBO</i>	-	-0.49**	-5.5	-0.41**	-3.2	-0.49**	-4.8
<i>SIZE</i>	+	26.91*	30.1	26.75**	30.0	26.81**	30.1
<i>LEVERAGE</i>	-	-5.13**	-5.5	-5.13**	-5.5	-5.17**	-5.6
<i>HIINC</i>	+	10.74**	15.9	10.77**	15.8	10.69**	15.8
<i>SALGRO</i>	+	8.03**	19.4	8.10**	19.5	8.03**	19.4
<i>TBOND</i>	-	-2.76**	-4.8	-2.08**	-3.8	-2.72**	-4.8
<i>UNCON</i>	-	-0.95**	-3.9			-0.12**	-0.4
<i>PBO * UNFD</i>	-			-0.08	-1.5		
<i>UNCON * UNFD</i>	-					-1.04	-3.4
R ²		0.55		0.56		0.56	
Number of observations		10,646		10,638		10,644	
Number of firms (clusters)		1,843		1,841		1,843	

All *t*-statistics are based on heteroskedastic-consistent standard errors (White, 1980) where degrees-of-freedom allow for non-independence of multiple observations for a single firm. * and ** indicate significance at the 5% and 1% level respectively.

Variables are defined as follows: *MKTCAP* is the market value of equity per share; *PLNA* is fair value of pension-plan assets per share; *PBO* is the reported projected benefit obligation per share; *SIZE* is log of total prior year sales; *LEVERAGE* is the scaled decile rank of the ratio of non-pension liabilities to non-pension assets; *HIINC* is the scaled decile rank of the ratio of -income before extraordinary items per share; *SALGRO* is the scaled decile rank of rate of growth of annual sales; *TBOND* is the interest rate on 30-year treasury bonds; *UNCON* is the difference between the firm specific (discount rate - assumed rate of compensation increases) and (TBOND - industry median assumed rate of compensation increases for the fiscal year). *CONTROL* also includes indicator variables for industry membership and Compustat year (June – May) – estimated coefficients not tabulated.

TABLE 5: Differential value of reported PBO and adjustment to PBO

$$MKTCAP = \beta_0 + \beta_1 NPA + \beta_2 NPL + \beta_3 PLNA + \beta_4 PBO_B + \beta_5 PBO_{HID} + \beta_6 PBO_{HID} * UNFD + \beta CONTROL + \varepsilon$$

	Predicted Sign	Coefficient	t- value
<i>NPA</i>	+	0.48**	15.1
<i>NPL</i>	-	-0.47**	-14.2
<i>PLNA</i>	+	0.61**	6.5
<i>SIZE</i>	+	26.79**	30.2
<i>LEVERAGE</i>	-	-5.13**	-5.6
<i>HIINC</i>	+	10.70**	15.8
<i>SALGRO</i>	+	8.13**	19.6
<i>TBOND</i>	-	-2.43*	-4.4
<i>PBO_{REP}</i>	-	-0.40**	-3.8
<i>PBO_{HID}</i>	-	-0.72**	-2.6
<i>PBO_{HID} * UNFD</i>		-0.05	-0.2
R ²		0.56	
Number of observations		10,635	
Number of firms (clusters)		1,841	
p-val of F-test that <i>PBO_{REP} = PBO_{HID}</i>		0.28	
p-val of F-test that <i>PBO_{REP} = PBO_{HID} + PBO_{HID} * UNFD</i>		0.14	

All *t*-statistics are based on heteroskedastic-consistent standard errors (White, 1980) where degrees-of-freedom allow for non-independence of multiple observations for a single firm. * and ** indicate significance at the 5% and 1% level respectively.

Variables are defined as follows: *MKTCAP* is the market value of equity per share; *PLNA* is fair value of pension-plan assets per share; *SIZE* is log of total prior year sales; *LEVERAGE* is the scaled decile rank of the ratio of non-pension liabilities to non-pension assets; *HIINC* is the scaled decile rank of the ratio of -income before extraordinary items per share; *SALGRO* is the scaled decile rank of rate of growth of annual sales; *TBOND* is the interest rate on 30-year treasury bonds; *PBO_{REP}* is the reported projected benefit obligation per share; *PBO_{HID}* is the difference between the reported PBO and that which would have been reported if industry median value of the assumptions had been used. *CONTROL* also includes indicator variables for industry membership and Compustat year (June – May) – estimated coefficients not tabulated.

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