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HOW DOES THE MARKET VALUE UNFUNDED PENSION LIABILITIES?

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ABSTRACT

We lead off by discussing a number of theoretical reasons for expecting various relationships between a firm's unfunded pension liability and its market value. We then discuss our doubts about the methodology of earlier papers which studied the empirical relation between funding and market value using standard cross sectional techniques. A modified cross sectional approach which alleviates some of these doubts, and a variable effect event study methodology which alleviates most of them are both employed to investigate the issues raised in the first part of the paper. Our conclusion confirms those of earlier studies that unfunded pension liabilities are accurately reflected in lower share prices.

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The question of how the stock market values pension assets and liabilities is of central importance to corporate decision makers, financial economists and economists concerned with level of national savings. If investors treat pension debt differently from other forms of debt, in valuing firms, prudent value maximizing managers should recognize these differences and adjust their pension funding policies acordingly. A convincing demonstration that market valuations failed to take account of pension assets or liabilities would either challenge prevailing theories of market efficiency and rational valuation, or force a re-examination of conventional views about effective ownership of pension claims. Finally, if potential beneficiaries of pensions recognized the value of the pensions and adjusted their savings accordingly, but no comparable adjustment occurred because holders of pension liabilities did not recognize their liabilities, or were confident of their ability to shift them to some other source such as the PBGC, then pensions would reduce national savings. These effects might be quite significant. Contributions to private pensions represented 58 percent of personal savings in 1977.

A number of empirical studies including Oldfield (1977), Feldstein and Seligman (1981), Feldstein and Mφrck (1983), Gersovitz (1980) and Westerfield and Marshall (1983) have attempted to study the market's valuation of pension liabilities using cross-sectional valuation models. Other analysts have taken the position that the overwhelming empirical evidence in support of the hypothesis of market efficiency, makes studying the market valuation of pension assets and liabilities irrelevant. This position seems unwarranted. A great deal of controversy as reflected in Modigliani-Cohn (1977), Summers (1981) and French, Ruback and Schwert (1983) focuses on the effects of inflation on firms' nominal assets and liabilities. Furthermore, if the supposition of rational valuation is accepted, studies of the market valuation effect of changes in pension liabilities offer an ideal methodology for examining the true ownership of pension claims.

In adding to the already fairly extensive empirical literature on the valuation of pension assets and liabilities, this paper makes two significant innovations. First, we report results using a "variable effect" event study methodology, for studying the valuation of pension claims. This methodology is far superior to the traditional cross-sectional valuation model approach for examining the determinants of market valuations. Indeed, we suggest that identification is highly problematic using standard approaches. Second, following recent work by Bulow (1982), Lazear (1983), and others we recognize that pensions may only be one aspect of complicated contracts through which firms offer workers deferred compensation. If deferred compensation is an important aspect of the labor market, one would expect it to leave traces in the market valutions of otherwise equivalent firms with demographically different labor forces. We examine this issue using both the standard cross-section and the "variable effect" event study methodology. In addition to these innovations, the availability of a larger and more recent data set made it possible for us to replicate the estimates presented in earlier studies and examine their robustness.

The plan of the paper is as follows. Section 1 examines the theoretical relationships between pension assets and liabilities and the market valuation of firms. A number of possible reasons why unfunded pension liabilities may not reduce equity valuations dollar for dollar are considered. Section

II presents evidence on the relationship between pension obligations and market valuations using standard cross-sectional techniques. Other forms of deferred compensation are also considered. Our doubts about cross-sectional methodologies are also discussed. Section III presents estimates of the effect of pension obligations on market valuation using the variable effect event study methodology. We argue that this methodology provides a superior basis for testing market valuation issues than does the standard approach. While the available evidence is weak, it does tend to corroborate standard theories regarding the economic effects of pension obligations. Finally, Section IV presents our conclusions and suggests directions for future research.

1. VALUING A FIRM'S NET PENSION WEALTH

A number of empirical studies have attempted to examine the extent to which market valuations of firm equity accurately reflect firms pension positions. These studies have typically not discussed in any detail how rational investors should combine a firm's regular balance sheet and its pension position in valuing it. It turns out, however, that because of complexities engendered by the legal nature of the pension contract, the nature of the longterm implicit contracts between workers and firms, and the tax code; the valuation of pension assets and liabilities is quite a subtle issue. This section begins by sketching a naive benchmark model for evaluating firms' pension positions and then considers five qualifications to it. These qualifications provide the basis for much of the empirical discussion in the next two sections.

Perhaps the simplest model of a defined benefit plan is the "consolidated balance sheet" approach. In this approach, pension liabilities are defined on a "quit" basis-- what workers would receive if they individually quit the firm today, or their vested benefits--and those obligations are treated like a general corporate liability. Pension assets are similarly treated as a general corporate asset, so any difference between pension assets and liabilities is part of net shareholder wealth. On this view unfunded pension liabilities should reduce firms' market value dollar-for-dollar.

ERISA's Effect on the Pension Obligation

The first qualification to this simple model is that it does not take into account the special legal nature of the pension liability. Prior to ERISA employees' pension benefits were nonrecourse claims against corporate pension assets. Because of the workers' nonrecourse claim we could think of the firm's net pension wealth as being an option on the fund's assets, F, with an exercise price equal to V, vested benefits. If we think of the firm and its employees a constantly negotiating over the levels of F and V so that either side always had the ability to force immediate exercise of the option, then the firm's net pension wealth would be max $(0, F-V)$, and workers' net pension wealth would be $\min(F,V)$.

With the passage of ERISA firms are liable for varying sums depending on the level of guaranteed benefits G (which in terminations in the first few years of PBGC existence averaged .85 of vested benefits), accrued benefits A (which because they include nonvested benefits slightly exceed vested benefits), the amount of money in the pension fund F, and the market value of the firm's equity E.

Following Bulow (1982) we can make a table of the firm's total pension obligations and unfunded liability as a function of these four variables:

Table I.1

Level of Funding	Pension Liability	Net Firm Liability
(1) $F + .3E < G$	$F + .3E$	$.3E$
(2) $G < F + .3E < G + .3E$	G	$G-F$
(3) $G < F < A$	F	0
(4) $A < F$	A	$F-A$ (overfunded)

Note that in case (1), a severely underfunded plan, the firm's pension liability is less than the present value of worker's benefits. The difference is made up by the PBGC through its "insurance" program, and is often referred to as the pension put.

An empirical implication of the valuation model implied in Table 1 is the that firms with overfunded pensions (where F > A) are the residual claimants in their plans and should benefit from increases in F (through plan asset growth) and decreases in A (caused by interest rate increases that decrease the present value of accrued benefits). Again in the case where G < F + .3E < G + .3E the firm is the residual claimant. However, in cases (1) and (3), for vastly underfunded plans and for those with G < A < F the firm is not the residual claimant and should be unaffected by changes in pension asset and liability values. Of course, if we realistically assume that pension policy cannot be instantaneously revised then the firm may be a partial gainer or loser from changes in pension asset and liability valuation. For example, following Sharpe (1977) one might view the firm as having a call option on the assets of the fund F at an exercise price A, so changes in F and A change the value of that option but not dollar for dollar with A-F. On average, though, we would expect firms with overfunded pension plans to have valuations that are more sensitive to pension asset and liability values than firms with less well funded plans. We test this hypothesis in the next two sections.

Implicit Contracting

A second qualification to the benchmark analysis of pension obligations is that one may be reluctant to take literally all the aspects of the employment contract. For example, firms often raise the benefits of already retired workers and workers may find their pension benefits much higher if they leave a firm just after qualifying for early retirement rather than just before. A literal view of individuals' pension wealth would say that increasing benefits to retired workers is a gift of the firm and that a worker accumulates a large amount of wealth the day he becomes eligible for early retirement. Neither assumption seems very satisfying.

Bulow and Scholes (1983) make the argument that in fact compensation is negotiated cross-sectionally between a firm and its employees, either explicitly through a union or implicitly. Workers bargain for part of the quasi-rents earned by firms and have some leeway as to how to split those rents among themselves. Their model allows for the possibility that sometimes a worker will be paid much more than marginal product, such as when retirement benefits are raised or early retirement eligibility is attained. Their measure of worker compensation in a period is the salary, pension and other benefits legally accrued during the period (the workers' extra compensation if they all left at the end of the period rather than at its beginning) plus any increment in the present value of the quasi-rents that the workers expect to be able to negotiate with the firm. In particular, it is widely believed that workers benefit from their firm's reinvestment in their industry. Bulow and Scholes argue the reason is that even if such investment did not change the marginal product of the last worker employed in the firm, average product would be greater and the workers would be in a position as a group to negotiate greater compensation. Similarly, increases in pension assets may affect the workers' bargaining ability with their employers. A company with extra cash in its pension fund may find its workers are able to bargain for a better deal, implying that part of any gain on the pension portfolio will find its way to the workers.

The Bulow-Scholes model has the empirical implication that workers share in the gain or loss on the pension portfolio and, therefore, pension gains and losses should only partially be reflected in stock prices. It most clearly differs from the first qualification in its prediction of the treatment of changes in net pension assets for vastly overfunded plans ($F >> A$) where the first qualification would predict that all incremental gains would go to stockholders.

Pensions and Other Aspects of Compensation Arrangements

Third, it is extremely difficult to isolate pensions from the rest of the compensation contract. For example, a firm may have more generous severance arrangements for workers who leave before the early retirement date. If so, the extra pay for staying until early retirement is much less than implied by the pension plan because the gain in pension benefits is mitigated by a loss in severance pay. Other benefits such as health benefits and (in universities especially) college tuition may also be spread unevenly accross an employee's career. Thus looking at pension wealth in isolation may be an error if pension wealth is correlated with other nonbalance sheet compensation.

Most importantly, pension contributions are less than 10 percent of salary for most firms and have been decreasing for the past two years. Clearly small percentage changes in salary can cancel much larger percentage changes in pensions.

The implication of all this is that we know little about how the pension obligation correlates with other elements of the compensation package. If there is a correlation between firms with large gross pension liabilities and firms with older workers, say, and older workers get overpaid regardless of the nature of the firm's pension plan, then a relation between large pension liabilities and low firm valuation may be due to the correlation of those liabilities with the age composition of the firm's labor force. In Section 2 we make preliminary tests of whether steep wage/age profiles and older labor forces are correlated with firms' stock market value.

Tax Effects

The fourth issue which causes significant conceptual difficulty in valuing a firm's net claim on its pension fund is taxes. For simplicity we will confine our analysis here primarily to the case of an overfunded plan, making the assumption that the firm can use any excess assets to reduce future pension costs and thus bear the entire risk of changes in pension asset and liability values. Therefore, we will be placing an upper bound on the value of an increment in pension assets to a firm.

We limit our discussions to three tax issues that have not received wide attention among pension researchers. The first is an explicit calculation of the value of being overfunded. The second is the implications of that calculation for changes in pension asset and liability valuation. The third is simply that overfunding a pension fund can serve many of the same purposes as a stock repurchase, with better tax implications. We use as an arbitrary benchmark a plan which is always funded at the level of accrued benefits. (Defined contribution plans are generally like this.) We compare such a plan with one where the plan is funded at some level $F(s)$ at time s where $F(s)$ may differ from the level of accrued benefits. Then it is easy to show that the tax advantage to having a defined benefit plan is equal to the present value of interest earned on pension assets in excess of pension liabilities, times the tax rate on pension contributions.

To illustrate this point we introduce the following notation: Let r = pre-tax market interest rate

τ_1 = marginal tax rate of the firm

τ_2 = implicit tax rate the firm pays on investment income; that is its after-tax discount rate is $r(1-\tau_2)$

$F(s)$ = amount of money in pension fund at time s

$B(s)$ = benefits paid at time s.

We compare the tax benefits of beginning a plan at time t, making an initial contribution $F(t)$, and subsequently operating with funding at level $F(s)$ versus making an initial contribution of $A(t)$ and subsequently remaining fully funded at level $A(s)$.

With funding maintained at level $F(s)$ the present value of after-tax future pension contributions needed to supply a benefit stream $B(s)$ is

$$(1.1)\quad (1-\tau_1)F(t) + (1-\tau_1)\int_t^{\infty} (\dot{F}(s) + B(s) - rF(s))\, e^{-r(1-t_2)(s-t)}\, ds$$

The present value of contributions to a plan that is always fully funded is

$$(1.2)\quad (1-\tau_1)A(t) + (1-\tau_1)\int_t^{\infty} (\dot{A}(s) + B(s) - rA(s))\, e^{-r(1-t_2)(s-t)}\, ds$$

The tax saving from funding at level F is simply (3) minus (2) or

(1.3) $$\text{Tax Saving} = r\tau_2(1-\tau_1)\int_t^{\infty} F(s)-A(s) \quad e^{-r(1-\tau_2)(s-t)}ds$$

It should be clear that the way to maximize (1.3) is to set F(s) as high as possible at each moment. In such a simple model, then, firms will always be up against their IRS funding limitation.

What is the implication for firm valuation of a shock to the value of F(s) or A(s)? First, consider a rise in F(s). With increased excess funding the firm would get larger tax benefits. It would amortize its "experience gain" on asset performance as slowly as possible. If amortization occurs over T years annual pension contributions will drop by $r\Delta F/(1-e^{-rT})$ where ΔF is the gain in the value of fund assets. The present value to the firm of its savings is

(1.4) $$\frac{\Delta F(1-\tau_1)\ (1-e^{-r(1-\tau_2)T})}{(1-\tau_2)\ (1-e^{-rT})} \text{.}$$

This formula is most understandable by considering some extreme cases. First, asume $\tau_2 = 0$: there is no tax paid on investment income earned outside the pension fund. Then there is no advantage to funding per se and an increase in F of one dollar will raise firm value by $1-\tau_1$, the amount of money the firm would get if it were able to immediately withdraw the extra dollar from the plan. Second, consider the oft-considered case where $\tau_2 = \tau_1 = \tau$: the implicit tax rate on corporate non-pension investment income is the same as the corporate marginal rate of τ_1 (generally considered 46 percent). This view is consistent with that of Miller's (1977) model of corporate finance. Furthermore, assume that $T = \infty$;

the increment in pension assets does not have to be amortized and the firm may be overfunded by an extra dollar forever. Then the increment in firm value is ΔF. Of this gain of ΔF, then, $\Delta F(1-\tau)$ is created because the value of assets in the pension fund (which holds pre-tax assets) has risen by ΔF. Also, because those ΔF dollars will earn returns of $r\Delta F$ each year forever instead of $r(1-\tau)\Delta F$ as non-pension assets would earn, there is an annual saving in pension costs of $r\tau\Delta F$ because of the tax-sheltered nature of the pension returns. The after-tax value of this saving is $r\tau\Delta F(1-\tau)$. If we discount this saving at the after-tax rate of $r(1-\tau)$, we find that the present value of the tax saving from being able to remain overfunded forever is

$$\frac{r\tau\Delta F(1-\tau)}{r(1-\tau)} = \tau\Delta F. \tag{1.5}$$

If in fact we assume 15 years amortization of excess funding, that $\tau_1 = \tau_2 = .46$, and that pre-tax interest rates are 10 percent, then (1.4) implies that a firm's value should rise by approximately 72 cents for each dollar its pension assets rise in value. There is an asymmetry on the loss side in that while excess assets will be defunded as slowly as possible asset shortfalls will be made up as quickly as allowed. Of course, if a funding deficiency could be made up instantly then the cost to a firm of a decline in the value of its pension assets would be 54 cents. Because of the asymmetry firms have a mitigated incentive to establish "dedicated" bond portfolios which preclude gains or losses on a fraction of their pension obligations.

Changes in the value of pension liabilities are a bit more complicated. The reason is that funding limitations are based on the book value of liabilities rather than market value. If interest rates rise, causing the value of liabilities to fall, in the short run the firm will be more overfunded than before. This overfunding will only be recognized for funding limitation purposes through the channel of the firm's pension assets earning a return greater than the plan's actuarial rate. As these greater returns are earned each year they must then be amortized as experience gains. Thus changes in liability values will end up being effectively amortized more slowly than changes in asset values and a slightly higher coefficient would be expected in the sensitivity of firm value to changes in pension liabilities than to changes in pension assets.

Finally, we note the large amount of corporate stock and other assets held in private pension plans. Numerous firms hold pension assets in excess of the market value of firm equity. Because pension contributions are tax-deductible, except for the fact that transfer of assets to a pension fund may involve a transfer of corporate wealth from stockholders to employees pension overfunding seems to dominate corporate share repurchases on two grounds. First is the deductibility of contributions, and second the fund can use money to hold a wider variety of assets than just the firm's own stock. As such, we might expect excess pension fund contributions to provide a signalling role much like that of dividends and repurchases. However, we leave this last point for future research.

Investor Rationality

A fifth reason that changes in firms' pension assets and liabilities may not be reflected dollar-for-dollar in stock prices is that the market may be inefficient in valuing pension liabilities. While this reason may seem implausible, concern over the effect of large pension contributions on reported earnings may be one of the reasons that managements often contribute much less to their pension funds than they are permitted by IRS regulations.

Other studies such as French, Ruback, and Schwert (1983) have indicated that it is difficult to find the effect of the change in the market value of conventional debt on stock prices. Pension debt, which does not appear on corporate balance sheets and has only recently appeared in any form in the footnotes, may thus be discounted by the market because of its complexity.

In this section we have discussed a number of reasons why a naive model of changes in a firm's net pension wealth being reflected dollar-for-dollar in stock market valuation may fail. In particular, we have discussed the details of ERISA, implicit contracting issues, the correlation between pension and nonpension compensation, tax effects, and investor rationality in valuing pension claims. In the subsequent sections of the paper we attempt to estimate what in fact is the relation between a firm's pension assets and liabilities and the market value of its equity.

2. CROSS-SECTIONAL VALUATION MODELS

The extent to which share prices reflect unfunded pension obligations is a key issue in considering the effect of private pensions on national savings. It has been argued (Feldstein 1978) that if unfunded pension liabilities are not fully reflected in stock prices, equity owners will save less and consume more than they would in a world where perceptions were correct. National savings might thus be reduced by the introduction of private pensions.

For this reason and because of intrinsic interest as an aspect of financial behavior a series of pioneering papers including Oldfield (1977), Feldstein and Seligman (1981), Gersovitz (1980), and Feldstein and Mϕrck (1983) have endeavored to explore this issue. These efforts have focused on listing variables likely to be determinants of a firms market value. If an effect of unfunded pension liabilities on market value can be detected after these other likely factors are controlled for, the studies conclude that unfunded pension obligations influence share prices.

Feldstein and Mϕrck (1983), for example, model a firm's market value (V) per dollar of net assets (A) as depending on the firms future earnings potential, its riskiness, its leverage, and (perhaps) its pension obligations.

$$(2.1) \qquad \frac{V}{A} = F\text{ (future earnings potential, risk, leverage, unfunded pension liability)}$$

As proxies for future earnings potential, they use the firm's current earnings (E), its historical growth rate in earnings (GROW) and its research and development spending (RD). They employ the firm's beta as a measure of risk, and the market value of its debt as a fraction of net assets as a leverage indicator.

The firm's unfunded vested pension liability (UVPL) per dollar of net assets is used to measure its pension obligations. Thus Feldstein and Mφrck ended up estimating

$$(2.2) \qquad \frac{V}{A} = \beta_0 + \beta_1\frac{E}{A} + \beta_2 GROW + \beta_3\frac{RD}{A} + \beta_4 BETA + \beta_5\frac{DEBT}{A} + \beta_6\frac{UVPL}{A} + \varepsilon$$

They found a coefficient of about minus one on unfunded vested pension liabilities, and concluded that an added dollar of net pension obligations depresses the firm's market value by about one dollar. Their study was plagued by fairly difficult data problems -- primarily by the use of only very coarse inflation adjustments and by the very small size of their sample.

Preliminary to this study, we replicated the Feldstein/Mφrck regressions using a much larger body of more recent data. Although their result could be reproduced, it was quite unstable. Seemingly innocuous changes in the sample made it come or go. The estimated coefficients on the proxies for future earnings potential -- especially on GROW -- were also disturbingly unstable.

In this section, we shall point out severe problems inherent in the cross-sectional valuation methodology used by these previous authors. We then suggest alternative more satisfactory cross-sectional estimating equations. Estimation of these equations yields results consistent with Feldstein and Mφrck's conclusion that pension liabilities are largely reflected in a firms market valuation.

Problems with the Cross-Sectional Valuation

The lack of robustness of the Felstein-Mφrck equations when replicated for a larger sample using more recent data calls into question the validity of the cross-sectional valuation methodology used by them and other authors. This inference is supported by the conflicting evidence found in previous cross-sectional valuation studies. Feldstein and Seligman (1981), for example, obtain results similar to those of Feldstein and Mørck; while Oldfield (1977) found no such relation.

It should not be surprising that such cross-sectional studies lead to conflicting inferences about the valuation of pension liabilities. It is not at all clear in what sense these equations can be said to identify structural parameters of any interest. Standard financial theory postulates that the value of a firm (V) may be expressed either as the sum of assets (A_i) and liabilities (L_j) or as the present value of future cash flows (CF_t) discounted at some rate s. These two alternatives may be written as:

$$(2.3) \qquad V = \sum_{i=1}^{n} A_i - \sum_{j=1}^{m} L_j$$

$$(2.4) \qquad V = \sum_{t=1}^{\infty} \frac{CF_t}{(1+\rho)^t}$$

Note that neither of these equations includes an error term. The standard procedure in estimating a cross-sectional valuation equation seems to be to deflate both sides of (2.3) by an estimate of the replacement value of the firm's capital stock, insert proxies for whatever assets and liabilities are easily measured in the equation, and then try to adhere to the spirit of equation (2.4) in adding to the equation measures of earnings and earnings growth to cover for assets and liabilities which are hard to measure. Reasoning of this sort appears to guide the specification of Feldstein-Mørck and the earlier work of Tobin and Brainard (1977) upon which they rely.

It is difficult to know how to interpret the error term in such a mongrel equation. Presumably it reflects unmeasured assets or liabilities. But since the opportunity cost of purchasing these assets (incurring these liabilities) is not being able to purchase measured assets (not incurring measured liabilities), it is hard to believe that the error is orthogonal to the included balance sheet variables. Furthermore, since earnings depend on the assets and liabilities held by a firm it is difficult to see how they could be orthogonal to the error term in the cross-section. As a consequence it seems very difficult to interpret the coefficients of equations such as those reported by the authors who have previously examined the market valuation of pension obligations. Since almost every right-hand side variable in standard valuation equations is endogenous, adequate instruments do not seem to be available for estimating the parameters of the standard hedonic equation consistently. Given these problems, instability in the estimated coefficients is not surprising. Even if the parameters of standard hedonic market valuation equations could be estimated consistently serious problems of interpretation would remain. The standard procedure for using these equations to answer questions about pension obligations involves focusing on the coefficient on the pension variables in the equation. For example, a coefficient of -1 on the UVPL variable was to be interpreted as meaning that if a firm gets an extra dollar in its pension fund, its value will rise by one dollar.

This conclusion is unwarranted. If the firm contributes a dollar to its pension fund, current earnings are reduced by one dollar. Taken literally the Feldstein-Mφrck equation implies that this decrement would reduce market value by almost two dollars. The presence of the growth variable makes the situation even more complex. It is clear, however, that simply looking at the pension variable will not be satisfactory. A similar problem of inference holds with respect to the R&D and debt variables in hedonic valuation equations.

We conclude that the standard hedonic equation approach is not a useful instrument for studying the market valuation of pension liabilities. In the remainder of this section, we modify the standard cross-sectional approach by using only balance sheet variables to explain firm valuations. The next section uses an alternative variable effect event study methodology to study the questions at hand.

Modified Cross-Sectional Equations

In the remainder of this section we estimate equations relating to market valuation of firms only to items that can be thought of as elements in their balance sheet. This avoids the problems of interpretation discussed in the previous section although the possibility of inconsistent parameter estimates remains. In particular the equation we estimate is of the form:

$$(2.5) \quad \frac{V}{A} = \beta_0 + \beta_1 \frac{UVPL}{A} + \beta_2 \frac{DEBT}{A} + \beta_3 \frac{RD}{A} + \beta_4 \, BETA + \sum \gamma_i D_i$$

where

V = market value of firm

A = replacement cost of firm

RD = research and development spending

BETA = beta

DEBT = market value of firm's debt

UVPL = unfunded vested pension liabilities

D_i = two digit SIC industry code dummies

Our data for 1980 and 1981 is constructed exactly as described by Feldstein and Mϕrck's (1984) numbers with a few exceptions which are explained below. The reader is referred to the earlier paper for a detailed account of the data. Following Myers (1983) comments, an unlevered rather than a standard BETA is used here. We also make use of inflation adjusted figures that have recently become available. In this study we use inflation adjusted asset figures from the Financial Accounting Standards Board's statement 33 (FASB 33). Our replacement cost number A is the inflation-adjusted value of property plan and equipment plus the inflation-adjusted value of inventories. Our pension numbers were taken from the Financial Accounting Standards Board's statement 36 (FASB 36). Pension liabilities are adjusted to reflect a common discount rate of seven percent.

Dummies for two digit industries are included in the equation to capture the notion that different types of physical capital are valued differently in the marketplace. The estimation results for 1979, 1980 and 1981 are shown in Table 2.1. Like the Feldstein Mϕrck conclusion the results for all three years suggest that firms' market values do reflect their pension obligations. In each case the parameter estimates imply that firms' market values are reduced more than dollar-for-dollar with unfunded pension liabilities though the hypothesis that $\beta_1 = -1$ can never be rejected.

One possible objection to these questions is the "weak firm" problem raised by Myers (1983) in his comments on the Feldstein-Mϕrck paper and confirmed by Bodie, Light, Mϕrck and Taggart (1984) as an important effect. Firms with low value assets will tend to have low market values and because of financial pressure will tend to underfund their pension funds. As a result a spurious negative association between firm value and unfunded pension liabilities may be observed. This is addressed in Table 2.2 by using two different techniques.

First, in the equations in the left half of the table a variable RATING is included reflecting the firm's Standard & Poor's bond rating is added to the specification. The RATING variable takes values ranging from 1 for firms rated D by S&P to 10 for firms ranked AAA. It should be at least a partial control for weak firm effects.

Second, in the second half of the table UVPL is treated as an endogenous variable and is instrumented using the firm's total pension liabilities. The justification is that the total size of the firm's liabilities is independent of its funding policy, and so should be a satisfactory instrument. It obviously should also be correlated with the firm's level of unfunded liabilities and so should provide reasonably efficient estimates.

The results unambiguosly and robustly point to a negative relationship between a firm's unfunded vested pension liabilities and its market value.

Using either of our two procedures for controlling for weak firm effects, the absolute value of the UVPL coefficient actually increases. While the standard errors are large, we are able to find no evidence that weak firm problems account for these results, suggesting that the market penalizes firms with unfunded pension liabiities.

The discussion in the previous section suggested that the marginal effect of reduced pension liabilities may be different for underfunded than for overfunded plans. The analysis of section 1 implies that generally stockholders will gain more from a reduction in an already overfunded plan, because unfunded liabilities will be put in part to the PBGC and in part to employees. We address this issue by adding a variable PUT to the specification of equation (2.5). The variable PUT is defined as Max (0, UVPL). Results are shows in Table 2.3.

Unfortunately, the data do not appear to be powerful enough to reject any interesting hypothesis concerning this issue. In the more reliable 1980 and 1981 equations, there is very weak evidence that the availability of the pension put influences the marginal valuation of liabilities for troubled firms.

A final major issue suggested by the discussion in Section 1 is the role of other deferred compensation arrangements which may be correlated with our included pension variables. Firms may have implicit contracts with their workers which require them to pay older workers in excess of their marginal products. If so the capitalized value of these obligations represents a liability of the firm. This liability is of interest in its own right. In addition, it is likely to be correlated with pension liabilities.

Unfortunately, there is no apparent way to construct an estimate of firm's deferred compensation liability. As a crude approximation, we added three variables to equation 2.3; AGE, SLOPE, and AGExSLOPE where AGE is an estimate of the average age of a firm's workforce, SLOPE is an estimate of the slope of its age-wage profile and AGExSLOPE should enter the equation negatively. Firms with steep age-wage profiles and old work forces should have the largest deferred compensation liability. The other variables cannot be signed on an *a priori* basis.

Our estimates of AGE and SLOPE were obtained from a merge of the January and March 1978 Current Population Survey tapes. This collection of data included the ages, wages, tenures and three digit employer industry codes for over forty thousand individuals. Parameters of an age distribution and an age vs. log(wage) profile were estimated for each three digit industry code. These codes were matched to the SIC codes on the compustat tape. In general a three digit CPS industry code corresponded to a 3 digit or in a few cases a four digit SIC code. Each firm in our sample was thus assigned a wage-age profile corresponding to its SIC industry code.

The results of estimating equation (2.5) with the additional variables AGE, SLOPE and AGExSLOPE are displayed in Table 2.4. They are disappointing. The 1980 estimates are consistent with the hypothesis advanced above. The age-slope interaction variable is both satistically and substantively significant. However, its sign is reversed with equal statistical significance in the 1981 equation. As a consequence, we cannot reach any judgement about the role of deferred compensation in affecting firm valuations. However, our results suggest tha taking account of several deferred compensation liabilities does not alter the estimates of the influence of unfunded pension liabilities.

3. INTEREST RATE CHANGES AND THE VALUATION OF PENSION LIABILITIES

This section uses an alternative methodology to circumvent some of the problems in the standard cross-sectional approach discussed in the preceding section. The essential insight underlying our tests may be illustrated as follows. Consider two otherwise equivalent firms one of which has more pension liabilities than the other. Now suppose the nominal long-term interest rate rises unexpectedly. The firm with more pension liabilities should do relatively better than the firm with less liabilities because of the greater capital gain it experiences as the higher interest rate unexpectedly erodes the value of long-term obligations. By examining the response of firms with different pension obligations to interest rate changes, it should be possible to determine the extent to which the market values changes in the status of a firm's pension fund.

Because the approach taken here looks at the effect of an exogenous event, a change in the interest rate on the valuation of different firms, it does not depend on any assumption about how firms decide how much to fund their pension plan. Thus the variable effect event study method used here is not subject to the weak firm problem described in the previous section.

More formally our approach is as follows. We postulate that the return on firm i, in month t, can be expressed as:

$$(3.1) \quad \rho_{it} = \alpha_i + \beta_{it}\Delta R_t + u_{it}$$

where α_i is the normal required expected return on firm i, and β_{it} reflects its sensitivity to interest rate news, here proxied by the change in the long-term interest rate, and u_{it} is a random error term. We initially specify that

β_{it} depends on the firm's characteristics at time t according to:

$$(3.2) \qquad \beta_{it} = \gamma_0 + \gamma_1 \frac{UVPL_{it}}{V_{it}} + \gamma_2 \frac{LTD}{V_{it}} + Z_{it}\gamma_4 + \varepsilon_{it}$$

where UVPL represents unfunded vested pension liabilities. LTD represents long-term debt, Z refers to control variables discussed in more detail below, and V is the equity value of the firm. Combining equations (3.1) and (3.2) yields the cross-section time series equation which provides the basis for an empirical work:

$$(3.3) \qquad \rho_{it} = \alpha_i + [\gamma_0 + \gamma_1 \frac{UVPL}{V_{it}} + \gamma_2 \frac{LTD}{2V_{it}} + Z_{it}\gamma_4] \ \Delta R_t + u_{it} + \Delta R_t \varepsilon_{it}$$

Equation (3.3) can be estimated given cross-section time series data using ordinary least squares, to yield unbiased estimates of the parameters. However, the error term does not satisfy the requirements for consistency of the standard errors. In the results reported below we allow for the inclusion of firm and/or period effects in (3.3). This should make it possible to compute approximately accurate standard errors.

Our procedure is entirely consistent in spirit with the event study methodology that is widely used in financial economics. The approach involves looking at the response of securities prices to unexpected developments or "news" in an effort to gauge the effects of the variables being studied on firms market value. Our "variable effect-event study methodology" represents an improvement over the techniques normally used in finance in two ways.

First, the events we look at are developments that are exogenous from the viewpoint of the firm. A standard event study approach to the problem of studying how the market values firms pension liabilities would involve looking at how firms' market value responded to news about their pension funding decision. The difficulty is that firm's decisions are themselves responses to news, or to privately held information. It is not really possible to sort out the effects of policy changes from the independent effects of their causes. Our indirect procedure of looking at the differential effects of interest rate changes on firms entirely avoids these problems. Second, our econometric procedure is superior to the grouping techniques normally used in event studies. One could, as many financial economists would, group as firms by pension funding status, and then look at how different portfolios responded to news about interest rate developments. Such a procedure simply discards information about within-group differences in pension funding status and therefore is inefficient.

Before turning to a description of our data, it is useful to discuss the expected signs of the coefficient in (3.3) and possible biases arising from omitted variables. We expect γ_1 and γ_2 to be positive reflecting the capital gains firms earn on their nominal liabilities as interest rates reduce the value of outstanding liabilities. The principal problem in estimating (3.3) is that some long-term nominal assets or liabilities which might be correlated with the included variables are excluded. These might include the value of depreciation in tax shields or of prospective lease obligations. If these variables have a systematic impact on firms' pension funding decisions, our results will be biased. However, we know of no previous arguments suggesting a role for these variables in pension funding decisions. They might, however, be related to the amount of long term debt a firm decides to carry.

In estimating equation (3.3) we use data for the 36-month period from January, 1979 to December 1981. We assume that pension assets and liabilities are constant within each year[1]. Data on pension assets and liabilities are drawn from a tape provided by the FASB. Liabilities are adjusted to current interest rates using the rule of thumb described in Feldstein and Mørck (1983). Essentially, this procedure involves multiplying reported liabilities by the ratio of the actuarially assumed interest rate to the actual market interest rate. This is done on a monthly basis. The market value of long-term debt is calculated from information available on the Compustat tape. It is assumed that all debt reported as long-term by Compustat has a 10-year maturity and a 10 percent coupon rate. This debt is then valued using the monthly BAA interest rate. Monthly stock returns are drawn from the CRSP tapes. To insure robustness extreme values of the right-hand side variables were eliminated from the sample. All necessary data were available for about 200 firms in 1979, about 470 firms in 1980 and about 400 firms in 1981 giving us a total of 12,715 observations in a 36-month sample period.

The results of estimating (3.3) omitting any Z variables are reported in Table 3.1 for various specifications of the error term. In some cases α_i is treated as a constant, in others it is allowed to vary across firms, and in others to vary from month to month.

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[1]An alternative which we intend to explore would involve interpolating net assets and liabilities within years.

The results are broadly consistent with the hypothesis that the market values pension obligations rationally. In each case the unfunded liability variable is both substantively and statistically significant. The estimates in column (1) for example imply that for a firm with unfunded liabilities equal to 10 percent of equity value, a one percent increase in the interest rate would raise market value by about .3 percent. While this is only about half the value that would be predicted by a naive model in which firms "owned" all unfunded liabilities and none of the other complicating factors discussed in the first section arose, it seems very reasonable especially in light of tax considerations.

In all the equations the debt variable has the wrong sign and it is highly statistically significant in equations (1) and (2). This finding confirms the results of French Ruback and Schwert (1983) who were unable to find any evidence in support of the nominal credit hypothesis. It also supports the Modigliani-Cohn inflation illusion hypothesis. These surprising results may alternatively be a consequence of our short sample period or of our failure to accurately measure all the firms' nominal assets and liabilities. In any event, they stand as a major puzzle. We recognize that it is implausible to assert as our results seem to suggest that market participants recognize the effects of increases in interest rates on pension debt but not on regular balance sheet debt. But we do not at this point have any resolution to offer.

Our results are somewhat less unsatisfactory for equation (3) where month dummies are included in the specification. The unfunded pension liabilities variable remains statistically significant in (3), although its substantive significance is much less than that suggested by equations (1) and (2). The debt variable, thought it continues to have the wrong sign, becomes insignificant in equation (3).

Further Tests

A major problem with the cross-sectional valuation tests presented in the previous section was the "weak firm" problem. Firms with capital that cannot earn a high rate of return tend to find themselves in financial trouble and try to underfund their pension plans. A negative relationship between firm value and unfunded pension liabilities is observed but may well be spurious. Both low firm value and underfunding of the pension liability are consequences of the firm's ownership of the unprofitable assets. There is no reason to expect a similar problem here. Weak firms should not be differentially affected by changes in the nominal interest rate. However, as a further check we added a variable ΔR•RATING to equation (2) in Table 3.1, where RATING is a categorical variable which ranges from 1 for firms whose debt is rated D to 10 for firms whose debt is rated AAA. The estimated equation was:

$$(3.4) \qquad \rho_{it} = \alpha_i + \Delta R \cdot [(\underset{(14.0)}{25.7}\ (UVPL) - \underset{(6.2)}{22.6}\ LTD - \underset{(1.6)}{3.4}\ RATING + \underset{(14.2)}{20.3}]$$

While the RATING interaction variable enters significantly, it does not have an important influence on the pension variable's coefficient, which rises slightly. The introduction of RATING has little effect on the anomalous debt coefficient.

A concern in previous pension research has been whether the market responds to pension liabilities as measured at market or actuarial interest rates. The equations reported so far in this section assume that liabilities are valued at market interest rates. To test this assumption we add an additional variable to equation (2) in Table 3.1 equal to $\Delta R(PL^A - PL^M)$ where PL^M is the pension liability valued at market-interest rates and PL^A is the pension liability valued at actuarial interest rates. If the market responds to actuarial interest rates rather than market rates, one would expect that this variable would have a positive sign. The estimated equation was:

$$(3.5) \qquad \rho_{it} = \alpha_i + \Delta R[\underset{(12.3)}{23.6}\ (UVPL) + \underset{(12.7)}{29.9}(PL^A - PL^M) - \underset{(2.1)}{12.5}\ \underset{(2.1)}{-12.5}]$$

This equation provides very weak evidence that actuarial interest rates influence market valuations. It appears that firms who overstate their pension liabilities by more gain more when interest rates rise. These results are in accord with the results obtained in the preceding section using a different methodological approach. They do also support the claim of Feldstein and Morck (1983) that market participants appear to use below market interest rates in valuing pension liabilities.

The results in the previous section provided evidence that the pension put and the possibility of bankruptcy influenced the market's valuation of pension liabilities. This issue can be examined by investigating whether interest rate changes have smaller effects for firms with large relative pension liabilities. This issue can be examined by investigating whether interest rate changes have smaller effects for firms with large relative pension liabilities. We examine this issue by adding a variable $\Delta R \cdot PUT$ to our basic equation where PUT =

MAX(0, UVPL). Our hypothesis is that the coefficient on this variable will be negative but smaller in absolute value than the coefficient on (UVPL). This reflects the attenuated impact of interest rate changes on badly underfunded firms discussed in Section 1. The estimation result was:

$$(3.6)\quad \rho_{it} = \alpha_i + \Delta R[\underset{(10.7)}{33.7}\ (PL-PA) - \underset{(99)}{165}\ PUT - \underset{(3.5)}{6.9} - \underset{(2.1)}{12.8}]$$

Although the coefficient on the put variable is statistically insignificant because it cannot be estimated with any accuracy, its magnitude is consistent with our hypothesis. This evidence thus dovetails with the evidence in the preceding section on potential importance of the level of unfunded benefits.

A final issue to be considered is the relationship between a firm's pension arrangements and other parts of its compensation scheme. In the previous section we presented some crude tests of the idea that firms with steep age earnings profiles and aging work forces were valued by the market as if they had a formal debt liability to their work force. While the results were inconclusive, taking acount of this liability did not have a large impact on the estimated effect of pension obligations on firms' market valuations.

It would be desirable to examine these questions using the methodology of this section. However, a serious problem presents itself. Any long-term implicit contract between workers and firms is likely to be formulated in real terms. The changes in interest rates which provide the basis for our tests largely reflect changing inflationary expectations. Separating out real interest rate changes in monthly data is probably not feasible. Hence we cannot in this section shed much light on the existence of nonpension-deferred compensation. On the possibility that interest rate changes over our 1979-81 sample period might reflect real interest rate variations, or that nonpension long-term contracts might be nominally denominated, we re-estimated equation (3.3) with various wage growth and age structure variables included. In no case did they enter significantly or affect the magnitude of the pension coefficients. Therefore, no results are displayed here. We reluctantly conclude that this section's method cannot be used to examine the important deferred compensation issue.

4. CONCLUSIONS

The results in this paper confirms earlier analyses suggesting that the stock market valuation of firms reasonably accurately reflects their pension funding situations. This conclusion is reached using alternative methodological approaches and data from several different years and so is reasonably robust. In particular we demonstrate that it is not simply a consequence of weak firm effects. Our results also suggest that the availability of the termination and the pension put influences the market valuation of pension liabilities. Finally, we provide some evidence suggesting that market valuations of firms reflect implicit contractual liabilities to pay older workers amounts in excess of their marginal products. These contractual liabilities appear to be denominated in real rather than nominal terms.

Our results provide no support for the notion that investors ignore pension liabilities in valuing firms. As a consequence, they suggest that corporate managers will benefit if they fund their plans as fully as possible. Furthermore, they suggest that the private pension may not have a large effect on aggregate saving since both the asset and liability side of pension balance sheets influence private savings decisions.

Perhpas the most promising area suggested for future research is the market's valuation of implicit contractual liabilities to older workers. It would be desirable to extend the tests reportd here in order to get an estimate of the value of this liability. If it were to be significant, strong evidence would be provided for incentive contracting models of the labor market.

REFERENCES

Bulow, J. 1982. What are Corporate Pension Liabilities? Quarterly Journal of Economics 97 (August): 435-52.

Bulow, J. and M. Scholes. 1983. Who Owns the Assets in a Defined-Benefit Pension Plan? In Financial Aspects of the U.S. Pension System. Zvi Bodie and John B. Shoven eds. University of Chicago Press.

Bodie, Z., J. Light, R. Mφrck and R. Taggart. 1984. Funding and Asset Allocation in Corporate Pension Plans: An Empirical Investigation. In this volume.

Feldstein, M.S. and R. Mφrck. 1983. Pension Funding Decisions, Interest Rate Assumptions, and Share Prices. In Financial Aspects of the U.S. Pension System. Zvi Bodie and John B. Shoven eds. University of Chicago Press.

Feldstein, M.S. and S. Seligman. 1981. Pension Funding, Share Prices and National Savings. Journal of Finance 36: 801-24.

French, K.R., R. S. Ruback and G. W. Schwert. 1983. Effects of Nominal Contracting on Stock Returns. Journal of Political Economy 91:1 70-96.

Gersovitz, M. 1980. Economic Consequences of Unfunded Vested Pension Benefits. NBER Working Paper No. 480.

Lazear, E. P. 1979. Why is There Mandatory Retirement? Journal of Political Economy 87 (December): 1261-64.

Miller, M. Debt and Taxes. Journal of Finance 32 (May): 261-75.

Modigliani, F. and R. A. Cohn. 1979. Inflation, National Valuation and the Market. Financial Analysts Journal 35: 24-44.

Meyers, S.C. 1983. Comment on Feldstein and Mφrck. In Financial Aspects of the U.S. Pension System. Zvi Bodie and John B. Shoven eds. University of Chicago Press. 207-9.

Oldfeld, G.S. 1977. Financial Aspects of the Private Pension System. Journal of Money, Credit and Banking 9: 48-93.

Sharpe, W. 1976. Corporate Pension Funding Policy. Journal of Financial Economics 3 (June): 183-93.

Tobin, J. and W. Brainard. 1977. Asset Markets and the Cost of Capital. In Economic Progress, Private Values and Public Policy: Essays in Honor of William Fellner. R. Nelson and B. Balassa eds. Amsterdam: North Holland.

Westerfield, R. and W. Marshall. 1983. Pension Plan Funding Decisions and Corporate Shareholder Value: A New Model and Some Empirical Results. Unpublished paper: University of Pennsylvania.

TABLE 2.1

Balance Sheet Approach to Measuring the Impact of Unfunded Vested Pension Liabilities on Firm Valuation

Dependent Variable: Market VAlue Over Replacement Cost V/A

Year		1979	1980	1981
Unfunded vested liabilities	UVPL/A	-1.42 (1.17)	-1.54 (0.70)	-1.16 (0.50)
Leverage	DEBT/A	1.06 (0.31)	-0.16 (0.33)	-0.32 (0.21)
Research	RD/A	6.94 (2.18)	10.75 (1.54)	7.58 (1.12)
Beta	BETA	0.18 (0.15)	0.08 (0.13)	0.06 (0.04)
Constant	C	0.18 (0.21)	0.56 (0.30)	0.68 (0.15)
Sample	N	70	266	256
R^2		0.48	0.39	.53

TABLE 2.2

Balance Sheet Approach to Measuring the Impact of Unfunded Vested Pension Liabilities on Firm Valuation and the Weak Firm Problem

Dependent Variable: Market Value Over Replacement Cost V/A

Year		1980	1981	1980	1981
Unfunded Vested Liabilities	UVPL/A	-1.92 (0.93)	-1.45 (0.69)	-3.15 (1.63)	-2.38 (1.15)
Rating	RATING	0.05 (0.06)	0.04 (0.04)	-- --	-- --
Leverage	DEBT/A	-0.06 (0.54)	-0.24 (0.30)	0.052 (0.39)	0.30 (0.24)
Research	RD/A	10.66 (1.84)	7.43 (1.37)	12.27 (1.76)	8.15 (1.22)
Beta	BETA	0.03 (0.20)	0.08 (0.05)	-0.10 (0.15)	0.05 (0.04)
Constant	C	0.16 (0.80)	0.48 (0.33)	0.74 (0.32)	0.65 (0.17)
Sample	N	153	147	256	257
R^2		0.45	0.46	0.41	0.52

TABLE 2.3

Balance Sheet Approach to Measuring the Impact of Unfunded Vested Pension Liabilities on Firm Valuation and the PBGC Put

Dependent Variable: Market Value Over Replacement Cost V/A

Year		1979	1980	1981
Unfunded Vested Liabilities	UVPL/A	0.75 (3.64)	-2.63 (1.80)	-1.59 (1.44)
PBGC Put Indicator	PUT	-2.65 (4.21)	1.43 (2.16)	0.61 (1.44)
Leverage	DEBT/A	1.03 (0.31)	-0.16 (0.33)	-0.32 (0.21)
Research	RD/A	7.02 (2.20)	10.65 (1.55)	7.49 (1.14)
Beta	BETA	0.16 (0.16)	0.07 (0.13)	0.06 (0.04)
Constant	C	0.23 (0.23)	0.55 (0.30)	0.66 (0.16)
Sample	N	70	266	256
R^2		0.48	0.39	0.53

TABLE 2.4

Balance Sheet Approach to the Impact of Pensions and Labor Force Structure on Firm Valuation

Dependent Variable: Market Value Over Replacement Cost V/A

Year		1980	1981
Mean age	AGE	0.05 (0.04)	-0.03 (0.03)
Slope of age wage profile	SLOPE	144.44 (67.09)	-67.88 (62.52)
Age and slope interaction term	AGExSLOPE	-3.78 (1.74)	1.66 (1.62)
Unfunded vested liabilities	UVPL/A	-1.99 (0.90)	-1.81 (0.61)
Leverage	DEBT/A	-0.39 (0.39)	-0.27 (0.22)
Research	RD/A	11.06 (1.87)	7.90 (1.25)
Beta	BETA	0.08 (0.15)	0.07 (0.04)
Constant	C	-1.38 (1.49)	1.82 (1.30)
Sample	N	233	234
R^2		0.40	0.55

TABLE 3.1

The effect of interest rate changes on monthly stock returns reflected through pension assets and liabilities as well as from loss term debt.

Equation	(1)	(2)	(3)
Unfunded vested pension liabilities x ΔR	30.6 (10.4)	29.2 (10.4)	29.1 (9.10)
Long term debt x ΔR	-8.05 (3.42)	-7.97 (3.43)	-3.41 (2.95)
ΔR	-13.0 (2.10)	13.2 (2.09)	86.1 (6.84)
Constant	0.012 (0.000707)		
Firm Effects	no	yes	no
Month Effects	no	no	yes
Sample	12,563	12,563	12,563
R^2	1.93%	1.97%	29.9%