by Martin Feldstein and Randall Morck

Pension Funds and the Value of Equities

The value of reported vested pension obligations depends critically on the interest rate a firm uses to discount future benefit obligations. Firms with substantial benefit obligations relative to existing pension assets tend to reduce the reported present value of their obligations by using a high interest rate assumption. Conversely, firms with substantial pension assets relative to benefit obligations tend to choose low interest rate assumptions in order to increase the present value of their pension obligations so that they may take advantage of the tax benefits of early funding.

The financial market appears to see through this manipulation of pension liabilities, using a common average rate to discount pension obligations. Market values correlate more closely with pension obligations when those obligations are valued at an average of the rates actually used by firms than when they are valued at those actual rates. This average rate is significantly below the long-term rate prevailing in the market. Pension liabilities are thus overemphasized by the market.

Furthermore, there is some indication that the market gives more weight to pension liabilities than to pension assets; that is, each dollar increase in pension liabilities tends to translate into a dollar decrease in market value, whereas the same increase in pension assets increases firm value by less than a dollar. This may be because the market views a substantial increase in pension assets as an indication that the firm expects a corresponding increase in future pension liabilities. In any event, the fact that the market overemphasizes pension liabilities and may underestimate pension assets suggests that the growth of the private pension system may increase savings by investors and firms.

THE RELATION of pension obligations to share prices offers a unique window on several key economic issues. Shares are claims on real corporate assets. Pension liabilities affect the real *net* value of those assets. How well share prices reflect the effects of pension liabilities is therefore a test of the market's efficiency. If share prices do not fully reflect unfunded obligations, the market will tend to overvalue equity owners' portfolios. Equity owners will then be induced to consume more and save less than they would if the market were efficient; total national savings will be reduced.[1]

To understand the link between national savings and the effect of pension obligations on share prices, consider the example of a firm that

1. Footnotes appear at end of article.

Martin Feldstein, on leave from Harvard University, is Chairman of the Council of Economic Advisers. Randall Morck is a doctoral student at Harvard.

This article is a non-technical revision of a 1982 study by Martin Feldstein and Randall Morck entitled "Pension Funding Decisions, Interest Rate Assumptions and Share Prices" (National Bureau of Economic Research Working Paper No. 938). The revision was supervised by Randall Morck.

obtains lower present wages in exchange for a promise of future pension benefits with the same present value, but that does not fund the resulting pension obligation. This firm will report higher earnings, adding the increment to its capital stock. Over time, the firm's capital stock will increase by an amount equal to its unfunded pension obligation. If shareholders correctly perceive the unfunded obligation, however, they will recognize that the change in the form of employee compensation has not made them any wealthier, and their consumption will remain unchanged. The net effect of the pension on national savings will therefore be the difference between the firm's additional retained earnings and the reduction in the employees' direct personal savings that is induced by the promise of retirement benefits.[2] If, however, the share price understates the unfunded pension obligation, shareholders will regard themselves as wealthier, increase their consumption, and thus reduce national savings by a corresponding amount.[3]

The effect of unfunded pension obligations has attracted attention not only because a significant fraction of the pension obligations of some firms is now unfunded, but also because alternative legal funding requirements could increase the extent to which pension obligations are not explicitly funded. Current ERISA (Employee Retirement Income Security Act) and tax rules require companies to fund their pension obligations over a period of years and permit a deduction in the calculation of taxable income only for the amount contributed to a fund. An alternative rule would be a "book reserving" system in which a firm would not be obliged to fund its pension obligation but could deduct for tax purposes the present value of a pension obligation that it assumes even if it does not fund that obligation as long as it reports the obligation on its "books" (i.e., balance sheet) and finds an appropriate organization, such as an insurance company or bank, to "guarantee" that pension obligation. The impact on national savings of unfunded pensions of this type would depend on how well share prices reflect the accumulating liability and thereby prevent shareholders from increasing their consumption in response to the apparent but artificial increase in the net assets of the firm.

In considering a firm's pension obligations, it is important to distinguish between vested benefits and other types of expected pension payments. The vested benefits are those that will be paid to existing retirees and that would have to be paid to current employees if they left the firm immediately. In addition to these vested benefits, there are two other types of benefits that a firm or its shareholders might take into account. First, "unvested accrued pension benefits" refer to the benefits that current employees have earned on the basis of their service with the firm but that have not yet become vested. Second, firms also look ahead and, on the basis of expected employee turnover and projected wages, estimate the pension benefits that current employees are likely to receive when they retire. Firms may use this very broad concept of benefits based on past and future employment for the purpose of determining the tax-deductible contributions they can make to their pension funds. Pension assets can therefore exceed both vested pension liabilities and total past service liabilities.

This article focuses on the difference between vested pension liabilities and pension assets. The emphasis on vested benefits is appropriate for two reasons. First, vested benefits are the only legal obligation of the firm and have been the principal concern of financial analysts who discuss pension obligations. Moreover, the cost to the firm of any non-vested pension benefits can in principle be offset by corresponding reductions in wage payments as those benefits become vested.[4] It is not clear, however, to what extent such wage adjustments are actually made in practice or taken into account by financial analysts.[5] It is noteworthy that, whereas firms must report values for vested benefit obligations and may report values for other past service liabilities, they do not report the broader measure of total expected liabilities.

More than two-thirds of the firms in our sample reported a negative figure for "unfunded vested pension liability" (UVPL), implying that their pension fund assets exceeded their vested liabilities. Moreover, the aggregate value of their pension assets exceeded the aggregate value of their vested pension liabilities.[6]

Firms with negative unfunded liabilities have accumulated more in pension assets than the present value of the pension benefits they have promised to their employees. If these benefit promises constitute an upper limit on the extent to which the pensions depress private savings, then the "superfunded" pensions are potential net contributors to national savings.[7] By how much superfunded pensions increase national savings depends on the response of shareholders. If share prices ignore the value of these ex-

cess reserves, the extra corporate pension fund accumulations will not be offset by reduced shareholder savings.

Specification and Data

Our analysis utilizes the fact that there are two ways of valuing a corporation—(1) the firm's *market value* (V), or how much it would cost to buy the firm, given by the number of shares outstanding times the price per share, and (2) the *replacement cost* of the firm's underlying physical assets (A). In general, the marginal and average values of physical assets will differ. The marginal value of an additional unit of physical capital may also be distorted because of taxes or because the firm's capital stock is not in equilibrium. Differences between firms in the observed valuation ratio (q = V/A) will reflect perceived differences in the firms' abilities to provide above-average earnings and in the riskiness of their earnings and asset value. Our analytic framework relates the market value of the firm per dollar of its physical capital to several basic determinants of market value, including the firm's unfunded pension liability.

A firm's potential earning ability depends on such factors as market position, patents and know-how. We use three variables to represent future earnings:

(1) the current ratio of earnings to physical assets, E/A, where E includes interest payments as well as equity profits;
(2) the growth of earnings over the past decade, GROW; and
(3) expenditure on research and development as a fraction of the value of the firm's physical assets, RD/A.

The Capital Asset Pricing Model suggests that the risk of an equity investment can be measured by regressing the firm's share price returns against the returns on the total market portfolio. The value of the resulting beta coefficient will depend on how broadly the "total market portfolio" is defined (equities only; all financial assets; all investment assets including real assets such as land and gold) and on the frequency of the observations used for calculating the beta coefficient (e.g., daily, monthly, annual). We employ the widely available beta values based on monthly observations and an equity market portfolio that is calculated by Merrill Lynch, Pierce, Fenner and Smith.

In addition, we employ a second measure of risk—the ratio of a firm's net debt to its total capital, DEBT/A. A higher debt ratio increases the risk of bankruptcy and limits the firm's ability to undertake potentially profitable investment activities. On the other hand, the current tax system, which favors debt financing, may encourage investors to prefer high-debt firms that seem in little danger of bankruptcy.[8]

Because unfunded vested pension liabilities are a form of corporate debt, they should in principle be included with other debts in measuring the market value of the firm (V) and in calculating the net debt variable. If a firm's pension liability is accurately measured, the unfunded vested liability can be added directly to the market value of conventional debt or, equivalently, can be included on the right-hand side of the equation (divided by the replacement value of physical assets), where the expected value of its coefficient would be minus one. More generally, however, the coefficient of the observed unfunded vested pension liability variable (UVPL/A) reflects errors in the measurement of unfunded pension liabilities and the stock market's ability to perceive and reflect actual existing liabilities.

We thus specify the market valuation equation as:

$$\frac{V}{A} = \alpha_0 + \alpha_1\frac{E}{A} + \alpha_2 GROW + \alpha_3\frac{RD}{A} + \alpha_4 BETA + \alpha_5\frac{DEBT}{A} + \alpha_6\frac{UVPL}{A} + \epsilon, \quad (1)$$

where ϵ represents a random error. The values of α_1, α_2 and α_3 are expected to be positive and the values of α_4 and α_6 are expected to be negative. The sign of α_5 (the coefficient of the debt variable) is uncertain.[9]

Data

Our analysis uses 1979 data for a sample of large manufacturing firms. We restricted the sample to firms for which all the data necessary to construct the variables used in Equation (1) were available. Also, because comparable information on earnings for the decade from 1970 through 1979 had to be available, we excluded firms engaged in significant merger activity. These requirements and the elimination of a few statistical outliers left us with 132 firms.

Economists have long recognized that accounting data for assets and earnings can be very misleading in inflationary periods such as the 1970s. Beginning in 1976, firms were required to provide information on the replacement value of their capital stock and on the effect of inflation

on the value of accounting depreciation and inventory costs. Given this information and an estimate of the inflation gain on net financial liabilities, it is possible to estimate an inflation-adjusted measure of accounting profits.[10]

Despite the accounting requirement to provide inflation-adjusted information and the widespread recognition of the great distortions created by inflation, most financial analysts have nevertheless continued to focus on the traditional accounting measures of assets and income. Standard & Poor's Corporation does not even include inflation-adjusted accounts in its Compustat file. Because we are concerned with market valuation and the perception of the financial community, our analysis uses these conventional accounting data as well as the inflation-adjusted data.

Effects of Unfunded Pension Liabilities

Column 1 of Table I reports the estimated coefficients of Equation (1) based on inflation-adjusted accounting measures of income and assets. The mean of the left-hand side variable—the ratio of the firm's market value to the current value of its physical assets—is 0.87.

An increase in the firm's capital income (i.e., its debt and equity earnings, E, per dollar of physical assets) increases the market value of its assets; an extra dollar of current earnings adds approximately two dollars to the market value of the firm. The coefficient of GROW suggests that a higher rate of increase in past earnings may lead to a higher market value, but the coefficient is smaller than its standard error. Companies that spend more on research and development have significantly greater market value, a relation that should be interpreted with care, because it presumably reflects the market's valuation of the general character of companies that spend more on research, rather than the direct effect of research on the firm's market value.

An increase in the firm's risk, as measured by beta, depresses the firm. The weak positive effect of leverage on the firm's total value is contrary to the findings of an earlier study.[11] The difference may be due to the sharp increase in inflation (the Consumer Price Index rose 4.8 and 6.8 per cent in 1976 and 1977, respectively, but 13.3 per cent in 1979), which may have raised the equity value of the firms with greater net debt.[12]

The coefficient of the unfunded vested liability variable (UVPL/A) is −1.43, with a standard error of 0.82. The effect is thus clearly negative and not significantly different from minus one.[13]

Table I Reported Pension Liabilities and the Market Value of the Firm

	(1) *Inflation-Adjusted*[a]	(2) *Unadjusted*[a]
Constant (C)	0.67 (0.10)	0.41 (0.13)
Earnings (E/A)	2.06 (0.38)	4.98 (0.41)
Growth (GROW)	0.15 (0.22)	0.33 (0.16)
Research (RD/A)	8.13 (1.02)	5.22 (0.88)
Beta (BETA)	−0.17 (0.08)	−0.19 (0.08)
Leverage (DEBT/A)	0.20 (0.17)	0.34 (0.14)
Unfunded Vested Liability[b] (UVPL/A)	−1.43 (0.82)	−1.70 (0.60)
$\bar{R}^2$	0.51	0.68
SSR[c]	13.35	16.05

a. Standard errors are shown in parentheses.
b. Pension liabilities are reported amounts.
c. Sum of the squared residuals.

It is consistent with the view that the financial market accepts the conventional measure of the net unfunded vested pension liability and reduces the market value of the firm by an equal amount.[14]

Column 2 of Table I reports the results of reestimating the basic equation using the conventional accounting figures. The estimate of the unfunded pension liability variable is essentially unchanged; it is slightly larger than the estimate for the inflation-adjusted data, but the difference is less than one standard error. Earnings, earnings growth and debt appear to have a larger effect on the value of the firm, whereas the level of research and development spending has a smaller effect.

Alternative Interest Rate Assumptions

Pension actuaries customarily assume a low rate of interest in calculating the present value of pension liabilities for annual reports. Thus, for the 132 firms in our sample, the average interest rate was only 7.3 per cent, far less than the 12.1 per cent rate on Baa bonds that prevailed at the end of 1979 or the 10.7 per cent average Baa rate for the year 1979 as a whole.[15] Using a low discount rate increases the present values of both vested

pension benefits and the unfunded pension liability.

In considering the effect of the interest rate assumption, it is important to distinguish between vested pension liabilities and the total future pension benefits that a firm expects to pay its current employees; the firm may legally determine its funding contributions on the basis of the latter. In estimating total future pension benefits, the firm must project employees' future wage growth (as well as the probabilities of death and of employment separation). The typical pension benefit formula relates an individual's retirement benefits to his wage during the year or the few years immediately before retirement.

At any time in an employee's career, the present value of the benefits he will be paid during his first year of retirement depends on the difference between the discount rate and the projected rate of growth of wages. Since pension actuaries generally assume a low rate of wage growth, their use of a low discount rate may not produce as substantial a bias in their estimates of total future pension liabilities as might at first appear. The value of benefits to be paid after retirement, however, depends only on the discount rate, implying that the present value of total future pension benefits is typically overstated.

Vested pension benefits depend only on an employee's previous experience with the firm. Although that experience will entitle the employee to greater future benefits if he stays with the firm, the future annual value of his benefit is fixed if he leaves the firm immediately.[16] In calculating the present value of vested benefits, then, the likely future growth of wages is irrelevant. An artificially low interest rate assumption thus unambiguously raises the value of vested pension liabilities.[17]

The assumed interest rates for our sample firms ranged from 5 to 10.5 per cent. For all but 13 companies, the rate was between 6 and 9 per cent. The rates thus varied significantly and differed from the actual rate of return available on pension fund assets. Because the firms' pension assets and vested liabilities were approximately equal in value, a change in the interest rate could have a significant effect on the estimate of unfunded liabilities and, therefore, on the estimated regression coefficient of this variable in the market value equation.[18]

The effect of changes in the interest rate assumption on the present value of vested pension benefits depends on the current distribution of vested benefits among employees and retirees of different ages. The closer an employee is to retirement, the nearer in time his benefits are and the less sensitive their present value is to the interest rate assumption. For example, increasing the discount rate from 6 to 8 per cent reduces the value of the pension benefit by 14 per cent at age 65, but by 21 per cent at age 60.

Unfortunately, each firm did not supply data on the distribution of vested pension benefits by employee and retiree age. In the aggregate, however, most of the "weight" of the typical vested pension distribution will fall on retirees and older employees who are close to retirement. This concentration reflects three things. First and foremost, the benefits of retirees and older workers are closer in time, hence subject to less mortality risk and less interest rate discounting than the benefits of younger employees. Second, older workers and retirees have generally accumulated more years of service with a firm, and vested benefits are generally proportional to the number of years of service after an initial period. Finally, older workers generally have higher earnings, and vested benefits are also proportional to earnings.

Professional actuaries often assume, as a rule of thumb, that the age distribution of vested benefits is such that the overall present value of vested benefits is inversely proportional to the rate of interest.[19] In fact, this rule of thumb is a rough estimate of a complicated mathematic relation. Our analysis uses the inverse proportionality assumption because data for developing a better weighting are not available. While we believe that the resulting estimates of vested pension liabilities are an improvement over those based on the reported values using varying interest rate assumptions, we caution that the adjustment procedure is only an approximation.[20]

We made two different types of interest rate adjustments in recalculating pension benefits. First, we standardized all pension liabilities to the Baa bond rate of 12.1 per cent prevailing at the end of 1979. Because no firm used an interest rate even remotely as high as this, it seems unlikely that the financial market implicitly used such a high rate in evaluating the unfunded pension liabilities. This was confirmed in our study by the fact that use of such a high discount rate reduced the explanatory power of the market valuation equation and resulted in small and insignificant coefficients of the pension liability variables.

Table II Estimated Effect of Pension Liabilities with Alternative Interest Assumptions

Interest Rate	*Vested Liability Coefficient*[a]	*SSR*[b]	
Actual	−1.43 (0.82)	13.35	*Inflation-Adjusted*
Baa	−0.31 (0.43)	13.62	
Average	−0.90 (0.33)	12.89	
Actual	−1.70 (0.60)	16.05	*Unadjusted*
Baa	0.04 (0.35)	17.09	
Average	−0.64 (0.25)	16.26	

a. Standard errors are shown in parentheses.
b. Sum of the squared residuals.

Second, we standardized all pension liabilities to a discount rate of 7.2 per cent, the average rate used by the 132 firms in the sample. This eliminated the *relative* overstatements and understatements of pension liabilities that resulted from the variety of interest rate assumptions while changing very little the estimated liability for firms that used a rate close to the average for the group. It is equivalent to assuming that financial markets adjust stated pension liabilities for deviations from common practice, rather than for deviations from a Baa rate.

Table II summarizes the effects of different interest rate assumptions on the estimated impact of pension liabilities on the market value of the firm. The estimates are based on the specifications presented in Table I for Equation (1). For each basic variant of the equation, Table II presents only the estimated pension liability coefficient and the sum of squared residuals for that specification.

Table I showed that use of inflation-adjusted data and the reported value for the unfunded vested liability yields a regression coefficient of −1.43 with a standard error of 0.82; this figure is repeated in the first row of Table II. We approximated the present value of vested benefits discounted at the Baa rate by multiplying each firm's reported liability by the ratio of its actual interest rate to the 1979 year-end Baa rate of 12.1 per cent. With this adjustment, almost all firms had negative unfunded vested liabilities; pension assets exceeded the recalculated vested liabilities by amounts that averaged 8.7 per cent of the replacement value of the firm's physical assets. With these adjusted unfunded vested liabilities, the estimated regression coefficient is only −0.31, with a standard deviation of 0.43. The corresponding sum of squared residuals (13.65) is, however, greater than the sum of squared residuals with the actual interest rate (13.35), implying that the Baa rate is a less likely specification of the market valuation model.

By contrast, adjusting the vested pension liabilities to the common average interest rate of 7.2 per cent provides a substantially better explanation of the data (the sum of squared residuals is only 12.89) and implies a regression coefficient of −0.90 with a standard error of 0.33. This evidence is consistent with the view that the financial markets disregard the differences in unfunded pension liabilities and evaluate pension liabilities in terms of a common average discount rate. It is clear that the assumed average rate of 7.2 per cent is substantially more likely than either the Baa rate or the actual rates used by the individual companies. The regression coefficient and its standard error strongly support the view that unfunded vested pension obligations, when correctly valued, depress the value of the firm by approximately one dollar for every dollar of unfunded obligation or, equivalently, raise the market value of the firm by one dollar for every dollar of pension assets in excess of the vested pension liability.

When the conventional accounting data are used without inflation adjustment, the estimated coefficients are less stable. The evidence indicates that the best specification uses the actual interest rate. The coefficient of the pension liability variable is −1.70 with a standard error of 0.60. The Baa rate has a substantially higher residual sum of squares. With the common average interest rate, the coefficient is −0.64 with a standard error of 0.25.

In these equations, the unfunded pension liabilities evaluated at a common average interest rate generally have a better explanatory power than the corresponding reported pension liabilities.[21] We therefore reestimated the specifications of Table I using these more appropriately measured pension variables. Table III presents the results. The coefficients of the pension variables have already been discussed in conjunction with Table II. The coefficients of the other variables are similar to their values in Table I.

Although we have included five variables that

Table III Adjusted Pension Liabilities and the Market Value of the Firm

	(1) *Inflation-Adjusted*[a]	(2) *Unadjusted*[a]
Constant (C)	0.66 (0.10)	0.42 (0.13)
Earnings (E/A)	1.97 (0.38)	4.88 (0.41)
Growth (GROW)	0.06 (0.21)	0.24 (0.16)
Research (RD/A)	7.75 (1.02)	5.35 (0.89)
Beta (BETA)	−0.20 (0.08)	−0.23 (0.08)
Leverage (DEBT/A)	0.22 (0.17)	0.37 (0.15)
Unfunded Vested Liability[b] (UVPL/A)	−0.90 (0.33)	−0.64 (0.25)
$\bar{R}^2$	0.52	0.67
SSR[c]	12.89	16.26

a. Standard errors are shown in parentheses.
b. Pension liabilities are adjusted to the average rate of 7.2 per cent.
c. Sum of the squared residuals.

can influence the market value of the firm, it is of course still possible that the unfunded pension liability is correlated with some other omitted variable and that the apparent effect of the unfunded pension liability is really only a reflection of this omitted variable. In particular, it might be argued that "strong" companies fully fund or overfund their accumulated liabilities, whereas "weaker" companies have large unfunded liabilities. If this is true, and if corporate strength and weakness are not reflected in the other included variables, then the negative coefficient of the unfunded liability really reflects the corporation's generally weak financial position. Although it is clearly impossible to rule out this argument completely, we tried to test for its importance by reestimating our inflation-adjusted equations using the company's bond rating as an additional variable. The bond rating represents an expert judgment about the long-term financial strength of the company; we used Moody's bond rating for the longest maturity bond issued by each firm in 1979 and scaled the ratings from a nine for an Aaa-rated bond to a four for a B-rated bond.

When this bond rating variable was tacked onto Equation (1), its coefficient was small (0.04) and barely larger than its standard error. Including it in the equation actually raised the absolute value of the coefficient of the pension liability variable. Thus including a general measure of the financial strength of the company does not alter the estimated effect of unfunded pensions.

Extensions

Our model assumes that there is a linear relation between the market value of the firm and its unfunded vested pension liabilities. The specification implies that a one dollar increase in a firm's pension liability has the same effect on the firm's value as a one dollar decrease in the value of the firm's pension assets. The linear specification also implies that the market responds in the same way to unfunded liabilities that are positive as it does to unfunded liabilities that are negative. What happens if these constraints are relaxed?

Separating Assets and Liabilities

Using inflation-adjusted data, we reran Equation (1) including the value of pension assets per dollar of the firms' physical assets (PA/A) as an explanatory variable. The estimated parameter values for the non-pension variables are very similar to the corresponding figures in Column 1 of Table I, which are for the basic specification of Equation (1). The respecification, however, resulted in a slightly lower coefficient of unfunded vested pension liabilities (−1.14, with a standard error of 0.82) and in a coefficient of the pension assets variable of −0.55 with a standard error of 0.28.

Tacking on the pension assets variable allows us to calculate separate coefficients for vested pension liabilities and pension assets. The coefficient of UVPL/A measures the effect of increases in vested pension liabilities (−1.14 dollars of market value per dollar of vested pension liability), while the difference between the coefficients of PA/A and of UVPL/A measures the effect of increases in pension assets (i.e., −0.55 + 1.14 = 0.59 dollars of market value per dollar of pension assets). This coefficient of pension assets has a larger standard error (0.91), implying that when pension assets and pension liabilities are included as separate variables neither can be estimated very well.[22]

Adjusting pension liabilities so they are based on a common average interest rate gives us much more precise estimates. The implied coefficient of vested pension liabilities is −0.91 with a standard error of 0.32, while the implied coefficient

of pension assets is 0.29 with a standard error of 0.42. This suggests that liabilities have a substantial negative effect on the market value of the firm, whereas assets have a much smaller effect that may not differ from zero. Such asymmetry may result if the financial market regards large pension assets as an indication that the firm expects large pension liabilities to become vested in the future.[23]

These results suggest that each dollar increase in a firm's pension liabilities reduces the firm's market value by about one dollar, whereas each dollar increase in pension assets increases firm value by less than a dollar. If this is correct, it provides at least a short-run reason for firms not to fully fund or overfund their pensions. It also implies that, to the extent that firms make pension promises that reduce employee savings, the market perceives the extra liability and therefore has the information to adjust other personal savings. At the same time, the lower coefficient of the pension assets variable implies that the market does not accurately reflect the extent of asset accumulation in the pension fund. The net effect of this is that an increase in a funded vested liability reduces the market value of the firm and induces additional savings.

Positive and Negative Net Liabilities

A different but related issue is raised by the fact that pension assets exceed liabilities for the majority of the firms in our sample. Does the market respond differently to unfunded pension liabilities that are positive than to the unfunded liabilities that are negative and therefore represent an additional net asset of the firm? To answer this question, we reestimated Equation (1), dividing the unfunded pension liability variable into two variables—i.e., PUVPL/A is UVPL/A if this is a positive amount (implying that liabilities exceed assets) and zero otherwise, whereas NUVPL/A is UVPL/A if the latter is a negative amount (implying that assets exceed liabilities) and is zero otherwise.

Given the same basic specification used in Tables I and III, and using the common average discount rate for pension liabilities and inflation-adjusted data, the coefficient of PUVPL/A is −2.25 with a standard error of 0.093 and that of NUVPL is −0.052 with a standard error of 0.40. The parameter estimates show a much larger negative coefficient for the firms with actual unfunded liabilities (the "positive" liability coefficients) than for the firms whose assets exceed their liabilities. The pension coefficient for the latter firms is approximately −0.5 with a standard error of about 0.4; it is not significantly different from either zero or minus one. In contrast, the pension coefficient for those firms whose liabilities exceed their assets is approximately minus two with a standard error of about 0.8. This coefficient is significantly different from zero and, again, not significantly different from minus one.[24]

How should these estimates be interpreted? We could conclude that, because of the large standard errors, there is no need to distinguish between the two types of firms or to revise the prior conclusion that an extra dollar of unfunded vested liability reduces the market value of the firm by approximately one dollar. An alternative "statistical" explanation is that the equation is misspecified and omits additional variables that are observed by participants in the financial markets and correlated with the size of pension liabilities. Thus, although the financial market may correctly reduce or increase a company's market value by a dollar for each dollar of positive or negative unfunded vested pension liability, our estimated coefficient instead reflects the impact of the additional omitted variables.

It is also possible that the observed difference between the "positive" and "negative" coefficients is more than a statistical artifact and does reflect a difference in the way the financial market responds to the two types of firms. Because a firm that fails to fund fully its vested or past service liability incurs a higher corporate tax than would otherwise be necessary, the financial market may view such a firm as financially weak or not well managed. This could account for coefficients of the unfunded liability variables being absolutely greater than one. This argument would, however, suggest that firms with negative unfunded liabilities would have an equally large negative coefficient. One reason we do not observe this may be that, as noted, the financial market regards large pension assets as an indication that the firm has correspondingly large future pension benefits that are not yet vested but that can be reasonably anticipated.

Why Firms Choose Different Interest Assumptions

The choice of the discount rate, as noted, has a very powerful effect on the value of vested and other accrued pension liabilities. Because these benefits are based only on employees' past ser-

vice, future wage rates and turnover rates are irrelevant to their calculation. As a rough approximation, the value of unfunded pension liabilities varies in inverse proportion to the assumed interest rate.

Tax law provides a strong reason for companies to assume a low interest rate. By increasing the amount of its pension liability, a firm can justify accumulating more pension assets. For any given stream of anticipated benefits, the accumulation of more pension assets is equivalent to reducing the real cost of those pensions. The reduction reflects the fact that the earnings in the pension fund are untaxed, whereas earnings on assets held by the corporation are taxed, and the interest rate that the corporation pays on its own debt is deductible from taxable income. Thus the firm gains by using a low rate for tax purposes. Were it then to use a much higher rate in calculating its liabilities for disclosure purposes, its pension fund would look overly healthy and employees might be led to demand higher benefits.

If the tax benefits of early funding were the only influence on the choice of an interest rate assumption, firms would choose the lowest permissible interest rate. But other considerations may favor a higher rate. For example, firms may wish to avoid making the large annual funding payments that would result from a low interest assumption, or they may simply not wish to report large unfunded pension liabilities.

A large unfunded liability requires a firm to increase its annual contribution to the pension fund. This directly reduces the firm's reported earnings. A firm may fear that this in turn will have an adverse effect on the market price of its stock because portfolio investors may not correctly perceive the reason for the lower reported earnings. Moreover, a firm that has limited access to credit, or that faces a rising marginal cost of funds, may prefer to postpone funding. Corporate management may also regard a large unfunded liability as undesirable in itself. They may reasonably fear that such a liability would depress the equity value of the firm and increase its cost of debt. Thus, if a firm can fund as much as it wants at a moderate or high interest rate, it will have no incentive to use a lower interest rate.

If investors do not take the firm's choice of interest rate into account in interpreting the reported liability, the firm may be able to raise its value by selecting a high interest rate. Firms that have large vested pension liabilities when calculated at some standard rate will have an incentive to reduce their apparent liability by selecting a high interest rate. Firms that have large unfunded liabilities (when valued at a standard interest rate) will have even greater incentive to choose a high interest rate and virtually nothing to gain by choosing a low rate. Conversely, firms whose pension assets exceed their liabilities (when valued at a standard rate) will have no reason to disguise the size of their promised liability and every reason to increase the size of that liability in order to increase the rate of tax-deductible funding.

Table IV presents some estimates of the way in which the choice of interest rate is influenced by the firm's pension liability (adjusted to the common average discount rate to permit comparability) and by other variables that measure the firm's financial condition. Column 1 shows that firms with large vested pension liabilities tend to choose high interest rate assumptions. The assumed interest rate is related even more strongly to the firm's unfunded vested pension liability, a fact shown in Column 2. Firms with higher ratios of net debt to assets may be more reluctant to increase the size of their pension fund, hence may prefer a higher assumed interest rate. The coefficient of DEBT/A in Column 3 is positive but just barely larger than its standard error.

Columns 4 and 5 indicate that firms with better bond ratings choose higher interest rates.[25] Again, the coefficient of this variable is only slightly larger than its standard error and may be due to chance. If it is not due to chance, the positive relation between bond rating and the choice of interest rate suggests that the causation actually flows from the interest rate assumption to the bond rating. Thus a firm with a given "true" value of UVPL/A that chooses a high interest rate assumption will appear to have a smaller pension liability. This in turn makes the firm appear financially sound if the rating agency does not take its interest rate assumption into account.

It is clear from the estimates presented in Table IV that firms do engage in strategic attempts to reduce their reported unfunded vested pension liabilities when the benefits from doing so may outweigh the tax advantages of early funding.

Pension Liabilities and National Savings

Although the measurement of pension liabilities and the specification of an appropriate framework for estimating their effect on market values in-

Table IV Factors Affecting the Choice of Interest Rate Used to Calculate Reported Pension Liabilities[a]

Equation[b]	1[c]	2[c]	3[c]	4[d]	5[d]
Constant (C)	6.95 (0.14)	7.20 (0.08)	7.10 (0.12)	6.62 (0.12)	6.42 (10.74)
Vested Liabilities[e] (VPL/A)	1.88 (0.70)				
Unfunded Vested Liabilities[e] (UVPL/A)		11.58 (1.73)	10.99 (1.81)	10.63 (1.99)	10.56 (2.06)
Debt (DEBT/A)			0.48 (0.44)		0.28 (0.68)
Bond Rating (Bond)				0.09 (0.07)	0.11 (0.09)
$\bar{R}^2$	0.05	0.25	0.25	0.22	0.21
SSR[f]	128.32	100.61	99.70	100.69	75.34

a. All data adjusted for inflation.
b. The dependent variable in all equations is the interest chosen by the firm for calculating the pension liability it reports.
c. Based on 132 firms.
d. Based on 98 firms.
e. The pension liability variables are all based on common average rate.
f. Sum of the squared residuals.

volves substantial problems, our results can be said to be generally consistent with the view that firms' market values reflect a conventional measure of unfunded pension obligations or net pension assets. The market appears to see through the variety of interest rate assumptions used by firms in reporting their net pension liabilities and to evaluate pension obligations at a common average rate. On the other hand, this rate is far below the market rate of interest.

If pension liabilities are indeed evaluated at an interest rate that is too low, then the present value of those liabilities is overstated. Thus share prices are depressed by larger pension obligations and shareholders have increased incentive to save. Furthermore, if the market tends to attach less significance to changes in pension assets than to changes in pension liabilities, as our evidence suggests, then an increase in pension assets will not reduce shareholders' private savings by an offsetting amount. The overstatement of pension liabilities and the possible understatement of pension assets thus suggests that the expanding size of the private pension system may increase total savings by companies and their shareholders.[26] ■

Footnotes

1. This problem is addressed in more technical terms by Martin Feldstein and Randall Morck in "Pension Funding Decisions, Interest Rate Assumptions and Share Prices" (National Bureau of Economic Research Working Paper No. 938, 1982). That study was motivated by an earlier investigation by Martin Feldstein and Stephanie Seligman, "Pension Funding, Share Prices and National Savings," *The Journal of Finance*, September 1981, pp. 801-824.
2. In the extreme case in which employees reduce direct personal savings by a dollar for every dollar of present value of promised pension benefits, the introduction of the pension would have no effect on total savings.
3. In the special case referred to in footnote 2, the provision of a private pension could actually reduce national savings.
4. See Jeremy Bulow, "Analysis of Pension Funding Under ERISA" (National Bureau of Economic Research Working Paper No. 402, 1979) and "The Effect of Inflation on the Private Pension System," in R. Hall, ed., *Inflation*, forthcoming.
5. This is noted in Feldstein and Seligman, "Pension Funding, Share Prices and National Savings," *op cit.*
6. We repeated all our calculations using a broader measure of future liabilities—total unfunded accrued pension liabilities. The reader is referred to Feldstein and Morck, "Pension Funding Decisions," *op cit.* For this broader variable, 62 per cent of the sample firms reported a negative value. When the pension liabilities are reevaluated using the market interest rate instead of the lower values assumed by the companies in their calculations, significantly higher fractions of the companies had assets that exceeded their liabilities. Using the Baa bond rate prevailing at the end of the sample year suggests that virtually all the firms in the sample had pension assets in excess of both vested and accrued liabilities.
7. This need not be true if employees reduce their own savings to offset the benefits they anticipate