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CHAPTER 4

Economic Funding Levels in Private Pension Plans in the United States

The theoretical and measurement principles presented in Chapter 3 lay the groundwork for determining funding policy in private pension plans in the United States. These principles will be applied to calculate liabilities in defined benefit plans, which in turn will be compared to plans' assets to determine funding status. In this chapter, funding policies across pension plans are analyzed, and overall funding trends for the system as a whole are estimated during the post–World War II period. Several principles are established: (1)defined benefit plans in the United States are underfunded; the underfunding appears to be deliberate, not a reflection of plan immaturity; (2) there is no discernible trend in "target" funding ratios over time; after accounting for market variation, desired funding levels appear to be in the range of 70 percent; and (3) most underfunding in the U.S. private pension system is attributable to union plans.

FUNDING RATIOS ACROSS PLANS

The Technical Relation between Liabilities and Assumed Interest Rate

The first task is to solve the technical problem of converting reported liabilities to economic liabilities. One approach is to recalculate all actuarial liabilities using new discount rates. But since the difference between economic and actuarial calculations has been expressed exclusively in terms of different interest rates, it is much more efficient simply to estimate the relationship between liability calculations and assumed interest rates, then to use this relation to convert all reported

liabilities (based on actuarial interest rates) to economic liabilities (based on economic interest rates).

In this section, the relationship between reported liabilities and assumed interest rates is estimated. Suppose all active workers are identical to the "typical" active participant who is $R-a$ years from retirement (recall that a denotes current age and service and R denotes age and service at retirement). All retirees are identical to the "typical" retired worker who has $D-J$ years left to collect a pension (i.e., D is the age the "typical" retiree dies and J is the average age of retirees). There are C active and N retired workers. Recalling notation used in Chapter 3, liabilities are therefore written as

$$L = C[abW_n](D - R)d_C + N(RbW_n)(D-J)d_N, \tag{4-1}$$

where the product in the first set of parentheses in each term represents the annual pension amount; the difference in the second set of parentheses in each term represents years to collect the pension for each group, and the terms d_C and d_N represent discounting factors. The effect of the interest rate should be somewhat heavier for the active worker group because the discount is made over more years; thus the impact of a higher interest rate is greater.

Letting P represent the full pension annuity based on R years of service ($P = RbW_n$), expression (4–1) reduces to

$$L/CP = [\,(a/R)(D - R)d_C + (N/C)(D - J)d_N\,];$$

or, in estimable form we have

$$L/CP = b_1 e^{-b_2 i} + b_3(N/C)\, e^{-b_4 i}, \tag{4-2}$$

where b_1 is a constant reflecting the pension liability for the typical active worker; that is, it reflects the full pension annuity based on R years service, P, which will be paid for $(D-R)$ years of expected retirement, scaled down by the ratio a/R to reflect the average service level of active workers, that is, $b_1 = (a/R)(D-R)$. The constant b_3 equals the number of years the typical current retiree will continue to collect his pension, that is, $b_3 = D-J$. Finally, each liability component is affected by the assumed interest rate i.

This liability relationship was estimated by nonlinear least squares using a cross-section sample of Form 5500 annual pension reports filed with the U. S. Department of Labor for the plan year 1978. The resulting equation is reported in Table 4–1. The results put the value of the constant b_1 at 10.24 years. Since the retirement period is approximately 17 years for pension recipients[1] then $D-R=17$. This estimate suggests that the typical active worker has completed 60 percent of his full

[1]This estimate is available from the Survey of Pension Benefit Amounts conducted by the U.S. Department of Labor, 1978.

TABLE 4–1 Relation between Liabilities and Assumed Interest Rates

Independent Variables	*Coefficient*
$b_1 = (A/R)(D - R)$	10.24
	(11.37)
$b_2 = D - J$	12.49
	(14.70)
b_3	−.077
	(5.13)
b_4	−.057
	(4.07)
Observations	4414

Dependent variable: Reported vested liabilities per active covered worker divided by the average annual pension (*L/CP*; see Equation 4–2). The estimate is made by nonlinear least squares. Numbers in parenthesis denote t-values.

SOURCE: Annual 5500 Pension Plan Reports, 1978.

service ($a/R = .6$). The estimate of b_2 suggests that the remaining years of annuity collection for the typical retiree is 12.49 years ($D - J = 12.49$).

The results also show that the assumed interest rate plays an important role in determining reported liabilities. Both interest rate coefficients are significant. The importance of the interest rate for retirees is somewhat smaller, as expected, but its size is not substantially different from the interest rate coefficient for active participants; the difference between b_3 and b_4 is not statistically significant. Knowing this equation, we can convert reported liabilities based on an assumed interest rate to calculations based on any other interest rates we choose to use.

The results suggest that reported liabilities can be converted to a common interest rate basis by the following formulas:

$$\text{For active participants: } L_e/L_n = \exp(-.077(i^* - i)) \qquad (4\text{–}3)$$

$$\text{For retirees: } L_e/L_n = \exp[-.057\ (i^* - i)],$$

where L_e are economic liabilities, L_n are reported liabilities, i^* is the common interest rate upon which economic liabilities are based, and i is the reported interest rate. This conversion formula represents an approximation—it is a shortcut to recalculating liabilities in every plan using a new assumed interest rate—but as a first order of magnitude, it will reveal true economic pension liabilities for the U.S. pension system. The results suggest that liabilities calculated for active workers on the basis of a 10 percent interest rate will yield liabilities that are only 54 percent of what they would be if a 2 percent assumption is used.

TABLE 4–2 Economic Funding Ratios: 1978 and 1981

	1978		1981	
Funding Ratio	*Number of Plans*	*Percent Total Liabilities*	*Number of Plans*	*Percent Total Liabilities*
Less than 25%	216	.08	60	.01
25%–49%	960	.23	544	.18
50%–74%	1,012	.43	1,102	.29
75%–99%	634	.23	1,202	.35
100% or more	342	.03	1,115	.17
Total	3,164	1.00	4,023	1.00
Average Funding ratio[a]	.655		.768	
Funding ratios using alternative assumptions				
Reported basis[b]	.799		1.008	
PBGC termination basis[c]	.884		1.188	
Long-term interest rate basis[d]	1.000		1.586	

[a]Overall funding ratios are weighted by pension liabilities in the plan. Active vested liabilities are discounted at 1 percent; current retiree liabilities, at 1.5 percent plus 50 percent of expected inflation (see text).

[b]The average reported discount rate used for annual 5500 pension reports purposes in 1978 was 5.6 percent; in 1981 it was 7.1 percent.

[c]PBGC termination interest rates are taken from the June 1st quotation in 1978 and 1981.

[d]The long-term interest rate was approximated by Moody's new issue rate (8.73 percent in 1978; 14.17 percent in 1981).

SOURCE: Data is from a random sample of pension plan annual reports submitted to the Department of Labor in 1978 and 1981. Reported liabilities are converted to a common interest rate equivalent. Funding ratios reported in the table exclude any consideration of unvested pension liabilities.

Distribution of Economic Funding Ratios, 1978, 1981

This conversion procedure was applied to representative pension plan samples for the years 1978 and 1981 using data from Form 5500 annual pension plan reports. In addition to reporting market value of trust assets and accrued benefit liabilities (schedule B, question 6), Form 5500 pension plan reports in these years included interest rate assumptions for a large cross section of pension plans. The economic interest rates were set equal to 1 percent for active workers, and 1.5 percent plus 50 percent of the expected inflation rate (long-term interest rate minus 1.5 percent) for current retirees (see Chapter 3). The resulting funding calculations are presented in Table 4–2.

The results in the table show that in 1978, pension plan assets were approximately 65.5 percent of economic pension liabilities; in 1981 the overall funding ratio was 76.8 percent. If a zero interest rate is used across the board, the funding ratio in 1978 falls from 65.5 percent to approximately 40 percent; if a 3 percent assumption is used for active workers (instead of 1 percent), the funding ratio for 1978 increases to

73 percent. Similar results are found for 1981. The results suggest that unless these years are atypical, firms do not set aside assets in trust that are sufficient to cover true economic pension liabilities. Moreover, economic funding levels are much lower than those reported for financial and regulatory disclosure purposes.

In 1978, the average assumed interest rate used by actuaries for public disclosure was 5.6 percent. By 1981, the average increased to 7.1 percent. After applying these common interest rates to the sample of plans considered in Table 4–2, the average funding ratio turns out to be 79.9 percent in 1978 and 100.8 percent in 1981. Thus, on average, actuarial funding ratios in 1978 overstated economic funding ratios by over 20 percent; by 1981 the average overstatement was over 30 percent.

Other calculations are also shown in the table. For example, the results show that reported liabilities, while based in principle on the termination concept, are considerably higher than actual Pension Benefit Guaranty Corporation (PBGC) termination calculations. After applying the PBGC method to calculate liabilities, it turns out that PBGC-termination funding ratios are 35 percent (1978) to 55 percent (1981) higher than economic funding ratios. If legal liabilities are based on actual long-term interest rates—which some economists have suggested is appropriate in a pure legal model[2]—funding ratios are over 50 percent greater than true economic ratios in 1978, and 100 percent greater in 1981. Thus, while reported funding ratios are significantly higher than true economic funding ratios, they are less distorted on average than those implied by other methods also based on legal liability concepts.

While overall averages for pension plans are useful for evaluating the aggregate level of corporate pension liabilities, the variation in funding ratios among plans is also of considerable importance. For example, proper stock valuations require adjustments to each particular plan to accommodate the unfunded pension obligations. The data in Table 4–2 show a wide range of funding policies across firms; for example, in 1981, while 27.7 percent of firms were fully funded or overfunded, 15 percent of firms were less than 50 percent funded on an economic basis.

Moreover, it is important to notice that just because, say in 1981, economic liabilities *on average* are 76.1 percent of reported funding ratios, it is not possible to convert reported liabilities for each firm to true economic liabilities by multiplying reported liabilities by .761. This is true in large part because different firms use different actuarial interest rates to calculate reported liabilities. To illustrate, the absolute difference between economic funding levels and reported funding lev-

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[2]See Martin Feldstein and Randall Morck, "Pension Funding Decisions, Interest Rate Assumptions and Share Prices", National Bureau of Economic Research, Working Paper No. 938, 1982.

TABLE 4–3 Difference between Economic and Reported Funding Ratios

	1978		1981	
Economic Minus Reported Funding Ratio	*Firms*	*Liabilities ($ billions)*	*Firms*	*Liabilities ($ billions)*
Less Than 25%	2,324	$26.3	2,062	$77.6
25–49%	736	2.6	2,088	62.5
50–74%	86	.2	651	10.9
75% or more	13	.0	219	1.4
Total	3,159	$29.1	5,020	$152.4
Average[a]	.202		.327	

[a]This number is the simple average of economic minus reported funding ratios.

els was calculated for the samples in 1978 and 1981. The results are presented in Table 4–3.

The results show that in 1978, over 73 percent of the firms holding approximately 90 percent of true economic liabilities reported funding ratios that overstate true economic funding ratios by less than 25 percent; most of the remaining firms had reporting distortions in the range of 25–50 percent. By 1981, the range of reporting distortions increased considerably. In 1981, 41 percent of the firms holding approximately 50 percent of the liabilities exaggerated their funding ratios by less than 25 percent; but 42 percent of the firms holding 41 percent of the liabilities had reporting distortions in the range 25–50 percent; and 17 percent of firms holding approximately 8 percent of the liabilities had reporting distortions in excess of 50 percent.

The data reported in Table 4–2 and 4–3 dramatically illustrate the need to convert reported liabilities to true economic liabilities. The conversion makes more difference in changing the liability picture for some firms than others, and the levels of underfunding across firms are markedly different. Ignoring these conversions or using a rule-of-thumb algorithm to convert all reported liabilities to economic liabilities (e.g., increase all reported funding ratios by 20 percent) can lead to large errors in calculating corporate stock valuations. An illustration in Table 4–4 depicts the difference between economic liabilities and legal and reported liabilities in relation to firm equity for a small sample of firms (106) available for the year 1981. The range is very wide. For the majority of firms, the impact of different pension concepts on equity value is less than 10 percent. But for 20 percent of firms, the substitution of economic pension liabilities for reported liabilities amounts to at least 20 percent of equity; for 10 percent of firms, at least 30 percent. The equity impact is higher when economic and legal liabilities are compared. On average, economic liabilities minus reported liabilities

TABLE 4–4 Impact of Pension Liability Concept on Firm Valuation

	Economic Minus Reported Liabilities Divided by Equity		*Economic Minus Legal Liabilities Divided by Equity*	
Category (Ratio)	*Firms (Percent)*	*Equity (Percent)*	*Firms (Percent)*	*Equity (Percent)*
Less than 10%	66%	54%	47%	42%
10–19%	14	13	23	13
20–29%	10	22	10	12
30–49%	7	8	10	19
50% or more	3	3	10	14
Total	100%	100%	100%	100%
Average (unweighted)	.110		.213	

SOURCE: Results are based on a sample of 106 firms drawn from the Compustat files, 1981.

amounts to 11.0 percent of firm equity value, 21.3 percent comparing economic and legal liabilities. Moreover, because equity values and reported and legal liabilities exhibit substantial variation over time, the range of potential error evinced in Table 4–4 from miscalculating pension liabilities can change markedly from year to year.

The Underfundedness of Plans

The level of underfunding evinced in Table 4–2 raises several questions. First, a question that will be addressed later in this chapter, what explains the wide variation in funding ratios across plans? Second, a question that will be addressed immediately, are funding results for 1978 and 1981 typical of funding policies over longer periods? Indeed, the marked differences in funding ratios for these two years alone suggests that conclusions about funding ratios could be sensitive to the particular year in which calculations are made. More particularly, perhaps unanticipated stock market performance reduced the funding ratios in 1978 below long-term target levels; perhaps funding ratios were higher than anticipated in 1981. Additionally, perhaps funding ratios, while still relatively low, are growing, reflecting a gradual amortization of past pension liabilities.

Since 1978 and 1981 are unique years in which abundant data are available, it is not possible to replicate the funding calculations for a large cross section of pension plans over several years. But as long as the liability relation estimated above (see Table 4–1) is stable, sufficient data is available to approximate funding ratios for pension plans in the aggregate over a 30-year period.

AGGREGATE FUNDING RATIOS: 1950–1981

Actual Funding Ratios

The issues addressed by using long-run aggregate data can be described as follows. Are 1978 and 1981 "fluke" years? Are there any discernible trends in the data to suggest that funding ratios in the United States are increasing? Put another way, notwithstanding particular observations that are influenced by extraneous factors, is the long-run "target" funding ratio significantly less than unity?

The market value of assets held by pension plans in the United States is available annually throughout the post-war period through 1981.[3] Annual data series are also available that describe the number of vested employees and pension beneficiaries in the United States, as well as the average benefit amount paid and the average retirement age of pension recipients.[4] By substituting these variables into the liability equation estimated in Table 4–1, economic funding levels for pension plans can be recreated on an annual basis for the United States as a whole from 1950 to 1981.[5] For the purpose of this exercise, the same interest rate assumptions described above were used.[6]

The results listed in Table 4–5 reveal that underfunding has been a persistent characteristic of defined benefit plans over the period 1950–1981. Considerable variation is exhibited in the level of funding, rang-

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[3]Market values of pension plan holdings is found in the Federal Reserve Board, *Flow of Funds*. Beginning in 1980, the SEC encountered difficulties in their estimation; their results were markedly different from any reasonable expectation. For this reason and others, the SEC abandoned the project in 1981. Numbers appearing in the *Flow of Funds* after 1981 are based on different data, and may be inconsistent with long term data developed by the SEC.

[4]Number of vested employees, pension beneficiaries, and average benefit levels are based on data found in A. M. Skolnik, "Private Pension Plans, 1950–1974," *Social Security Bulletin* 39 (June 1976), pp. 3–17; and the American Council on Life Insurance, *Pension Facts* (Washington, D. D.; 1982). Retirement age and proportion of female worker pension recipients (which indirectly affects the length of the average annuity period) are available from a Department of Labor, Survey of Pension Benefit Amounts.

[5]To perform this exercise, it is necessary to exclude assets and liabilities that are related to defined contribution pension plans. Since the funding levels in these plans equal unity by definition, their relative growth over time will bias the true measure of funding in defined benefit plans. Because defined contribution plans are typically secondary plans for workers, the pension coverage data is virtually unaffected by this consideration. But asset data does include assets held by some types of defined contribution plans. Since the starting date of all plans is known, it is possible to purge the data of the defined contribution plan influence under the assumption that relative sizes of pension plans in 1978 are reflective of their relative sizes throughout the period of their existence. The exercise was carried out based on this assumption using data from the Department of Labor Annual Pension Reports. See also Chapter 6.

[6]That is, liabilities for active pension participants were discounted at a 1 percent rate of interest; those for retirees, at 1.5 percent (real rate) plus 50 percent of the expected inflation rate (long-term interest rate minus 1.5 percent).

TABLE 4–5 Funding Ratios in Defined Benefit Plans in the United States: 1950–1981[a]

Year	*Economic Funding Ratio*	*Legal Ratio Minus Economic Ratio*	Year	*Economic Funding Ratio*	*Legal Ratio Minus Economic Ratio*
1950	.40	.07	1967	.77	.27
1951	.41	.07	1968	.82	.36
1952	.48	.08	1969	.71	.37
1953	.48	.10	1970	.76	.51
1954	.53	.09	1971	.82	.45
1955	.58	.10	1972	.86	.44
1956	.56	.10	1973	.68	.36
1957	.56	.16	1974	.53	.33
1958	.66	.15	1975	.64	.44
1959	.68	.21	1976	.75	.50
1960	.73	.25	1977	.73	.42
1961	.76	.24	1978	.65	.44
1962	.70	.21	1979	.70	.51
1963	.76	.20	1980	.84	.86
1964	.80	.23	1981	.77	.99
1965	.80	.22	Average	.68	.31
1966	.75	.23			

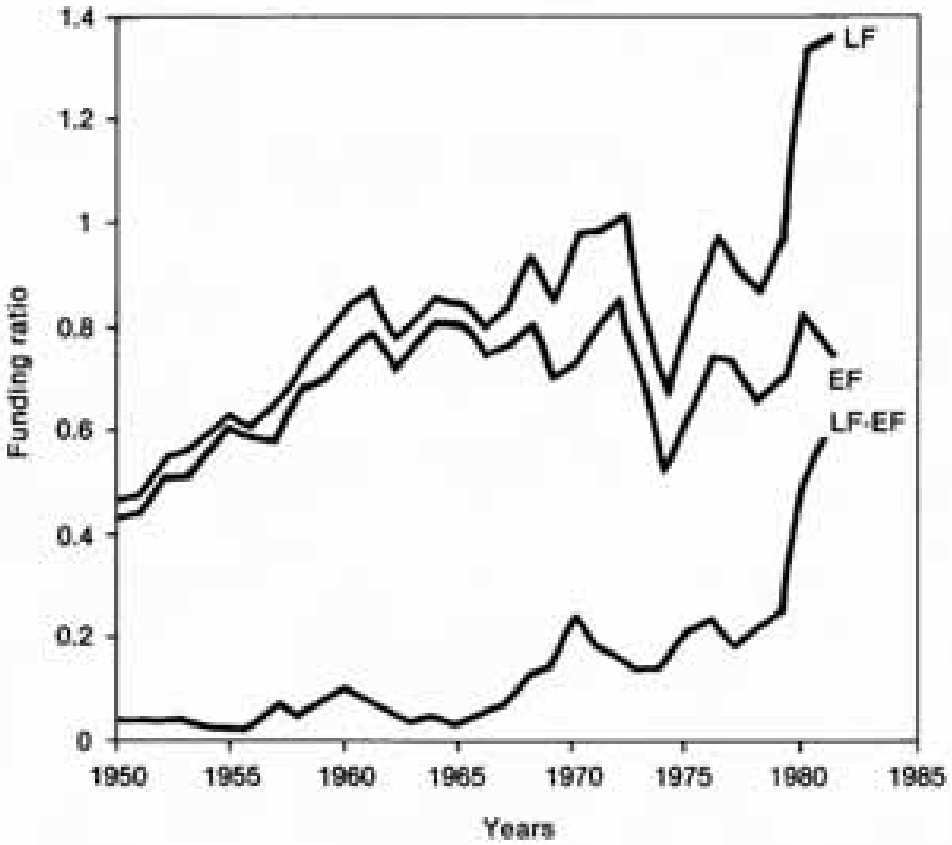
[a]The economic and legal funding ratios are calculated using data reported in the text. The economic ratios depend on use of a 1 percent discount rate for active workers and 1.5 percent plus one half the inflation rate for retirees. The legal ratios are calculated using the long-term interest rate for all actives and retirees. The role of the interest rate in the liability calculation is given in Table 4–1.

ing from 40 to 86 percent; the average funding ratio for the period as a whole was approximately 68 percent. Thus, while the 1978 funding ratios are somewhat below the 30-year average experience reported in the table and the 1981 experience was somewhat higher, the overall inference about the underfunded nature of pension plans is the same.

The table also reports the difference between legal and economic funding ratios. The differences have never been trivial—the average for the period as a whole is 31 percent—but the wedge between these funding concepts has been growing, reflecting higher nominal interest rates. In 1965, the difference between the two funding ratios was 22 percentage points; in 1975, 44 percentage points; and in 1981, 99 percentage points. These trends are shown graphically in Figure 4–1.

It is not entirely logical, however, to conclude that because observed funding ratios over even a lengthy period of time are substantially less than unity, that the "target" ratio is also less than unity. Funding ratios are affected by rates of return and capital losses and gains that are not under the control of the firm. Moreover, adjustments to differences in desired and actual funding ratios presumably do not occur instantaneously. In the context of a stock-adjustment model, the observed funding ratio could be systematically lower or higher than the true "target" funding ratio for long periods of time.

FIGURE 4–1 Economic versus Legal Funding Ratios: 1950–1981



Target Funding Ratio

To test if the "target" funding ratio is also less than unity, a simple model which characterizes the funding process is used. Consider the definition of the funding ratio itself:

$$F = A/L$$

where A denotes pension assets and L, true economic pension liabilities. Totally differentiating this relation, the following expression is obtained:

$$\Delta F = (1/L)\,\Delta A - (A/L^2)\,\Delta L. \qquad (4\text{–}4)$$

This relationship describes the components of a change in the funding ratio: it increases as the pension asset base is augmented (first term) and decreases as pension liabilities grow (second term).

The relation in equation (4–4) is the definition of the funding ratio albeit in a somewhat different form. To complete the model, a behavioral equation is introduced to describe how the pension asset base is augmented in any given period. The following simple model is used:

$$\Delta A = rA + \sigma F \Delta L + \gamma(F^* - F)L, \tag{4–5}$$

where r is the rate of return in the pension fund, F is the actual funding ratio in the plan, and F^* is the target funding ratio. The expression in equation (4–5) says that the pension asset base is increased by a positive rate of return in the fund during the period (first term). The firm will also increase its contributions to the plan by some portion σ of the usually positive increase in pension liabilities (second term), and some portion γ of the difference between the target and actual funding ratios, times liabilities (third term). The lower the actual funding ratio compared to the desired funding ratio, the higher the rate of contributions.

Substituting the expression in equation (4–5) into equation (4–4) and adding period subscripts, the following funding relation is posited:

$$F_t = F_{t-1}[1 + r_t + (\sigma - 1)(\Delta L/L)] + \gamma (F^* - F_{t-1}). \tag{4–6}$$

This expression has an intuitive interpretation. The funding level in the current period F_t equals the funding ratio in the last period F_{t-1}, adjusted for the rate of return in the fund and changes in pension liabilities, plus some *additional* increase (or decrease) due to the firm's attempt to narrow the wedge between the target F^* and actual F_{t-1} funding ratio. The extra "kick" in the funding ratio (last term) is attributable to increased contributions by the firm in an attempt to get closer to the target funding level it is trying to attain.

The central idea behind equation (4–6) is that pension plan sponsors will "tip off" their long-run intentions by adjusting their rate of contributions: if funding levels creep too high (higher than desired levels), other things constant (including growth in participation), firms will reduce the rate of contributions; if they are too low, they will increase the rate of contributions. By observing these reactions over a 30-year period, it is possible in principle to discern which particular funding ratio F^* pension plans as a whole are trying to attain.

Equation (4–6) was estimated using aggregate pension plan data over the period 1951–1981. Funding ratios and liabilities have been calculated above; rates of return are readily available.[7] The results are reported in Table 4–6. The estimated coefficients on the parameters in the model are of the anticipated signs, are reasonable in their magni-

[7] It was assumed that pension rates of return reflected overall rates of return in the economy. Pension portfolio shares are found in the Federal Reserve Board, Flow of Funds data. Securities' rates of return were taken from standard series; in particular, the S&P 500 Equity, 90-day Treasury, and Solomon Bond indexes.

TABLE 4–6 Estimates of the Target Funding Ratio

Parameter	*Coefficient*
Adjustment parameters:	
σ	.304
	(3.45)
γ	.152
	(2.65)
Estimated target funding level (F^*)	.695
	(9.84)
Log of likelihood	55.9
D.W. statistic	2.12
Observations	31

Dependent Variable: F_t (see equation 4–6). Numbers in parentheses are asymptotic t-statistics. Estimates are made by nonlinear least squares.

tudes, and are significant at least at the 95 percent confidence intervals. The results yield an estimate of the target funding ratio of 69.5 percent which is very close to the simple average funding ratio (68 percent) observed over the period 1950–1981 (see Table 4–5); it is significantly less than unity.[8] Taken together, the overall evidence supports the notion that actual and intended economic funding ratios in defined benefit plans are substantially less than unity. Despite the tax advantages afforded full funding, the data suggest that firms are resolute in holding economic funding ratios below 100 percent.

DETERMINANTS OF FUNDING STATUS

As a final undertaking in the funding evaluation, it is useful to compare the differences in funding ratios across plans. There are three reasons to conduct this exercise. First, and foremost, the aggregate results suggest that target funding ratios are in the vicinity of 70 percent, substantially below full funding. It is highly tax advantageous for firms to fully (or to over-) fund their plans: since the pension plan's earnings are tax exempt, the firm reduces its tax burden markedly by accumulating funds in its pension account; otherwise it must pay corporate income tax on earnings from assets held outside the pension plan.[9] The tax advantages are precisely those shown in Chapter 2 illustrating the

[8]The standard error on the estimated target ratio is 7.1; thus, the estimated target ratio is less than unity even at the 1 percent significance level.

[9]Irwin Tepper and A. Affleck, "Pension Plan Liabilities and Corporate Financial Strategies," *Journal of Finance* 29 (December 1974), pp. 1549–64; Irwin Tepper, "Taxation and Corporate Pension Policy," *Journal of Finance* 36 (March 1981), pp. 1–14; also see Fisher Black, "The Tax Consequences of Long-Run Pension Policy," *Financial Analysts Journal* 36 (July–August 1980), pp. 3–10.

nature of the tax-exempt status benefits of pension plans. The underfunding characteristics of pension plans can perhaps partially be explained by examining which types of plans are responsible for the overall underfunding position.

Second, cross-sectional evaluation of funding ratios provides information about the maturity of the pension system. The aggregate results suggest that actual and target funding ratios are less than 100 percent, implying that continued maturity of the system will not result in higher funding levels. Comparison of funding ratios by maturity characteristics on the cross-sectional basis can provide additional evidence on this point.

Third, and finally, suppose that funding characteristics differ markedly across pension plans and plan sponsor characteristics. To the extent that the compositions of types of plans and sponsors change over time, expected funding levels could change due to compositional shifts in the industry.

Sufficient information for the year 1978 was available to compute funding ratios for a cross section of 5,300 defined benefit plans. All liabilities were converted to a common 2 percent interest rate assumption. These funding ratios were compared across the sample by type of plan and type of plan sponsor. The results of the regression making these comparisons are shown in Table 4–7. The dependent variable (funding ratio) was run in log form; all other variables are expressed in natural units. Thus, each coefficient reported in the table is the *percentage* change in funding ratio caused by an increase in the dependent variable by one unit. Numbers in parenthesis are t-values—values in excess of two signify that the estimated coefficient, which is subject to error, is significantly different from zero (at the 95 percent level of confidence).

The first result worth noting is that the regression explains only approximately 15 percent of the variation in funding ratios found across plans. The bulk of such variation is explained by factors not included in the analysis. Nevertheless, many of the coefficients are related to funding level status in a statistically meaningful way. This bears on the third point made above: funding ratios indeed do systematically vary by type of plan and type of plan sponsor.

For example, firms that are in high-growth industries either over the period 1958–1972 or 1972–1981, and/or are high-growth firms (measured by growth in pension plan participation levels between 1978 and 1981) generally have higher funding ratios. For example, for a firm in an industry with 100 percent higher growth from 1972 to 1981, its predicted funding ratio is 10.5 percent higher. Industry effects are also correlated to funding status. Compared to the manufacturing sector (the intercept term), plans in the construction industry exhibit significantly

TABLE 4–7 Determinants of Funding Ratios, 1978

Independent Variables	*Coefficient*
Intercept	−.127
	(.68)
Year plan created	−.0027
	(4.40)
Firm size; employees (000)	−.0001
	(1.23)
Plan size; vesteds (000)	−.0002
	(.70)
Unionized participants (0,1)	−.241
	(16.32)
Multiemployer plan (0,1)	.098
	(1.06)
Growth characteristics:	
Plan growth; vesteds, 1981/1978	.147
	(4.10)
Industry growth 1958–1972 (4-digit)	.066
	(4.33)
Industry growth 1972–1981 (4-digit)	.105
	(3.12)
Industry characteristics: (0,1)	
Manufacturing (omitted)	
Mining	.0006
	(.01)
Construction	.252
	(3.49)
Transportation	−.009
	(.18)
Communication and utilities	.227
	(5.81)
Wholesale trade	.044
	(1.25)
Retail trade	.047
	(1.22)
Finance, insurance,	.167
real estate	(6.54)
Other	−.004
	(.10)
Pension type: (0,1)	
Trustee plan (omitted)	
Flat benefit formula	−.072
	(3.85)
Partially insured	−.063
	(3.44)
Fully insured	−.101
	(5.41)
Custodial	.145
	(1.51)
Other	−.064
	(1.72)
R-squared	.156
Number of Observations	5,300

Dependent variable: log of funding ratio. Funding ratio is equal to the ratio of pension trust assets divided by real pension liabilities incurred by the firm. Numbers in parenthesis are t-statistics.

SOURCE: 1978 Annual Form 5500 Pension Plan Reports.

higher funding ratios, more than 25 percent higher; those in finance, insurance, and real estate, 16.7 percent higher.

Type of plan also affects funding status. Flat benefit formula plans exhibit funding ratios that are 7.2 percent lower than compensation-based plans (the intercept). Fully or partially insured plans are also less well funded on average. In short, the results suggest that funding ratios are indeed partially related to industry, firm, and plan characteristics, suggesting that the average funding ratio for pensions as a whole could shift somewhat if the composition of pension plans and sponsors change. The coefficients are generally sufficiently small, however, to suggest that even rather dramatic shifts in plan composition would not radically alter overall pension funding status.

The coefficient on age of plan is worthy of special consideration. The coefficient tells us that a plan begun in 1960 versus 1970 would on average have a funding ratio in 1978 that was 2.7 percent higher; compared to one begun in 1950, 5.4 percent higher. Thus, while the results suggest that the funding ratio of plans improves with maturity, the effect is quite small. The result does not support an expectation that funding ratios will significantly improve in the future as a result of a "maturing" process. Firms appear to attain their desired funding levels quite early in the plan's history. Thus, the underfunding characteristic in the aggregate results is at least not largely explained by plans of different maturity status.

The most dramatic result in the table—and the primary candidate to explain the underfunding characteristic in private pension plans—is union status of the plan's participants. The coefficient on union status tells us that holding other factors constant—plan growth, industry growth, firm and plan size, industry characteristics, plan characteristics, including flat benefit formula—funding ratios are approximately 24.1 percent lower than comparable nonunion plans. This coefficient is one of the largest (and by far, the most significant) in the table.

In fact, the result explains virtually all underfunding in the aggregate data. That is, if the *average* target funding ratio among pensions is 70 percent (see above), the union results in the table suggest that nonunion plans have target ratios of 90 percent; union plans, 60 percent.[10] Numerous theories can be formulated to explain this result. One theory is discussed in Chapter 11.[11] But potentially if the percentage

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[10]The overall funding ratio is defined as $F = (A_u + A_n)/(L_u + L_n)$ where $A_u(A_n)$ are assets held by union (nonunion) plans and $L_u(L_n)$ are liabilities held by union (nonunion) plans. Using the relations, $F_u = A_u/L_u$ and $F_n = dF_u$ where d is estimated in Table 4–7, it is straightforward using known asset weights to solve for F_u and F_n.

[11]This discussion explores the possibility that firms use underfunding as a way to offset union power; if the union acquires "too much" from the firm, so that the firm's viability is threatened, union members stand to lose substantial portions of their pensions. In this model, the tax disadvantages of underfunding are offset by a reduction of union power in the firm.

of union plans in the pension population significantly changes, the overall funding ratio could change significantly.

CONCLUSION

This chapter summarizes the funding status and the funding policies of private pension plans in the United States. The results show that the variation in funding ratios across pension plans is quite wide, and further, funding levels themselves are highly dependent on the interest rate assumption. Using the most liberal definition of legal liability, funding ratios are twice as high as those calculated on an economic basis. Without properly converting reported liabilities to a common economic basis, it is difficult to see how a firm's funding condition can be analyzed in a meaningful way.

Once union status of plans is accounted for, the results show that pension plans are relatively well funded, virtually fully funded in fact in a target sense. The results also show that, accounting for market swings, funding ratios have been quite high and persistent over the entire post–World War II period. This is a rather astounding result because contrary to most published reports, this analysis was conducted on the basis of *real* pension liabilities, not *terminated* liabilities. Perhaps just as important, however, the results contradict the myth that pension plans are overfunded, a myth based on a termination-based calculation of liabilities.

The private pension industry enjoys a healthy funding status and has done so for many years. Recalling the caveats presented in the tax policy discussion in Chapter 2, the results provide little if any basis to believe that this overall pattern will change in the foreseeable future.