Measuring Pension Liabilities: An Examination of the Funding Levels of Defined Benefit Pension Plans

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Abstract

We examine pension funding measures and interest rate disclosures for 223 firms from the Fortune 500. Three different liability measures are used to develop funding ratios, which indicate sample firms' funding condition. We then examine firms' discount rate estimates and compare these estimates with their funding levels. Using chi-square tests to examine dependence between rates and funding, we determine whether over (under) funding is simply an artifact of the choice of discount rates or the result of authentic economic conditions surrounding the pension plan.

Introduction

Over the past year or two, a great many articles have appeared in the popular financial press concerning the safety and viability of employers' defined benefit pension plans. The *Wall Street Journal* alone has carried at least seven pension articles over the past twelve months, many of them on the front page. While some articles have been careful to mention that most pension plans face no serious problems, the overall impression created by these articles is one of alarm. A glance at the titles illustrates: "Risk to Retirees Rises as Firms Fail to Fund Pensions They Offer" (Karr 1993); "Pension Fund Managers Face Moment of Truth as Interest Rates Plunge and Equities Stagnate" (Anders 1992); "How Safe is Your Pension?" (Weinstein 1992); "Hopeful Assumptions Let Firms Minimize Pension Contributions" (Pulliam 1993); or "SEC is Challenging Funding for Plans" (Jereski 1993). It would be easy to assume after reading these reports that employees' pensions are dangerously underfunded, that managers have unscrupulously manipulated interest rate assumptions to lower required cash contributions to the plan, or that managers attempt to shift pension risk by either settling their firms' plan(s)[1] or else eliminating defined benefit plans altogether in favor of less desirable defined contribution plans.[2] Much of the gloom surrounding defined benefit pension plans may be attributable to the General Accounting Office (GAO) report noting that the Pension Benefit Guaranty Corporation's (PBGC) single-employer fund[3] deficit was $2.5 billion at the end of 1991, and that its estimate of firms' aggregate underfunded liabilities was $51 billion.

While there is certainly anecdotal evidence of problems with pension plans, there has been little large-scale descriptive evidence documenting the funding status of *Fortune 500* firms' pension plans. In this study, we contribute to the discussion by presenting evidence concerning the pension funding and interest rate disclosures of 223 firms from the *Fortune 500*.[4] We examine both funding and discount rate disclosures for two reasons: first, because discount rates and liability measures are closely linked. A firm using high discount rates may appear fully funded, but the same firm using a lower discount rate may appear underfunded. Since the dollar amounts are so large, and the present value of liabilities is so sensitive to interest rates,[5] it is important to consider both aspects of funding. Second, when the PBGC examines firms' pension plans, they recalculate pension liabilities using their own (lower) discount rates, which increases the magnitude of the liability. This is, in part, what gives rise to the PBGC's "hidden" liabilities.

We first examine firms' "funding ratios." The funding ratio is calculated as the market value of plan assets over the firm's pension liability, and is consistent with funding measures used in prior literature (Francis and Reiter 1987; Thomas 1988; Kwon 1990; Vruwink et. al. 1991) Since the accumulated benefit obligation (ABO) represents the firm's legal liability with respect to funding, we calculate funding ratios based on the accumulated benefit obligation. We believe, however, that the projected benefit obligation (PBO) better

approximates the firm's true pension liability since it is calculated based on future salary levels rather than current salary levels. In support of this contention, Barth (1991) found less measurement error for the PBO than for the ABO when future salary rates were considered, suggesting that financial markets impound information from the PBO. For this reason we also calculate funding ratios based on the projected benefit obligation (PBO). Finally, to approximate the economic liability estimated by the PBGC, we calculate funding ratios for each firm by adjusting the ABO to reflect the liability based on average PBGC annuity rates for the period.[6]

We then examine firms' discount rate estimates and compare these estimates (and changes in estimates) with their funding levels (and changes in funding levels). Using chi-square tests to examine dependence between rates and funding, we attempt to determine whether over (under) funding is simply an artifact of discount rate choice or the result of authentic economic conditions surrounding the plan.

Exhibit 1
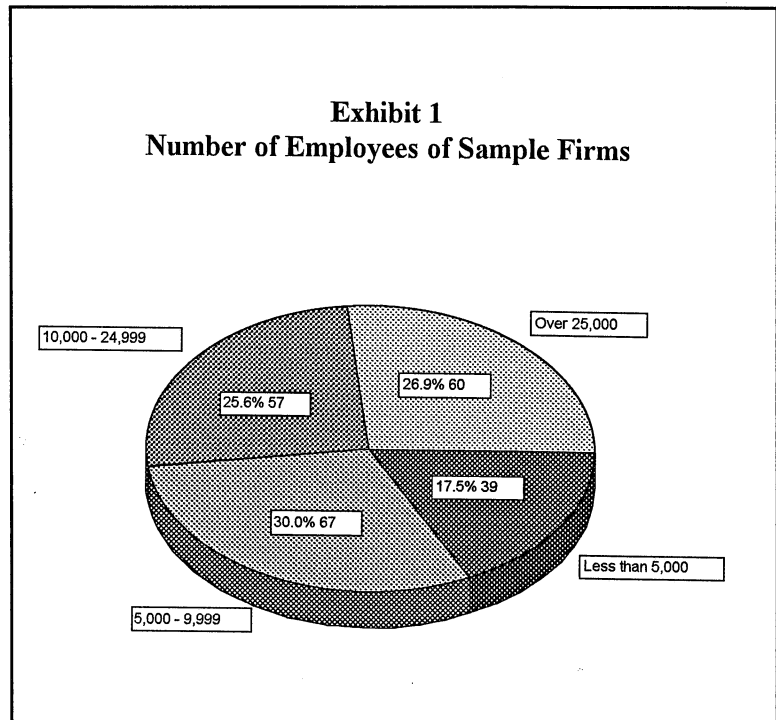Number of Employees of Sample Firms

Our examination of the data from these firms reveals that, while there is room for improvement in employers' defined benefit pension plans, there is little cause for alarm. Firms appear fully funded using both the PBO and ABO as the liability measure in both 1990 and 1991; when the ABO is adjusted to reflect PBGC rates, the sample firms appear fully funded in 1990, and nearly fully funded in 1991 (funding ratio = .98). The funding problems evident appear to arise from a few large plans rather than widespread underfunding, and finally, our tests of comparing discount rates and funding ratios suggest that funding levels are improving.

Data Collection Procedure and Profile of Respondent Firms

In August 1992, we sent letters to directors of investor relations of 250 companies selected randomly from the 1992 *Fortune* 500 directory. These 250 companies were asked to mail us their annual reports for their 1991 fiscal year. After two mailings, we received reports from 223 companies, providing an 89.2 percent response rate.

Since the number of employees covered by the pension plan will have direct bearing on the size of the pension plan (both in dollars and in participants), we estimate size variance among sample firms using the number of employees.

Exhibit 1 charts the number of employees for the 223 respondent firms. Sixty companies (27%) had 25,000

employees or more, while fifty-seven firms (25.6%) had between 10,000 and 24,999 employees. About 30% of the respondent firms had between 5,001 and 9,999 employees. The remaining 39 companies had 5,000 or fewer employees. The number of employees becomes a particularly relevant measure when considering pensions since a firm's pension liability, and, to a lesser extent, its plan assets and pension expense will be directly related to the number of participating employees. Together, those 223 respondent firms had about 6.1 million employees in 1991, representing twenty-four industries. Of these, seven industries had more than ten respondent firms each: electronics (25), food (23), chemicals (22), forest products (17), industrial equipment (16), motor vehicles (11), and publishing (11), while the remaining industries had representation with fewer than ten firms.

Funding Measures

Each year, the PBGC releases its annual report concerning the top fifty underfunded pension plans, which subsequently gets reported by major media outlets. Following the November 1992 report, articles appeared in news publications as diverse as the *Wall Street Journal, Kiplinger's Personal Finance Magazine, and Business Week.* The resultant reporting focuses almost exclusively on the most troubled companies, and stresses the growth in the PBGC's calculated liability exposure for the prior year (thirteen percent) and the dollar amount of the liability (stated at $51 billion). In order to gauge the nature of pension funding in our

Table 1
Total Pension Asset and Liability Amounts of Respondent Firms

Year	Total Plan Assets at Market Value	PBO	Liability Measure ABO	PBGC
1990	$202,192,400,000	$196,892,700,000	$175,405,500,000	$229,627,975,981
1991	$232,934,400,000	$220,602,100,000	$198,483,500,000	$267,005,300,000

sample of *Fortune 500* firms, we first report total dollar amounts for pension assets and liabilities (Table 1), then report sample descriptive statistics for funding ratio measures for both 1990 and 1991 (Table 2).

For our sample, total pension assets exceed total pension liabilities incorporating future salary assumptions (projected benefit obligation) for 1990 by $5.3 billion, and by $12.3 billion in 1991. Total pension assets exceed legal liabilities (ABO) by $26.79 billion in 1990, and by $34.45 billion in 1991. Under both reported liability measures, the market value of plan assets exceeds liabilities for both years. In addition, total asset coverage increases by some 133% against the PBO from 1990 to 1991, and by nearly 29% against the ABO. These numbers suggest that, in total, defined benefit plans are fully funded, and furthermore, that funding levels are increasing.

When liabilities are adjusted to reflect lower PBGC discount rates, however, the situation looks substantially less auspicious. Total plan assets of $202 billion cover adjusted liabilities of just over $229 billion in 1990, indicating total underfunding of $27.4 billion. For 1991, the total underfunding looks even worse: assets of nearly $233 billion cover adjusted liabilities of $267 billion, indicating an increase in underfunding of 24%, from $27.4 to $34 billion.

In spite of the improvement in funding evident under firms' reported liabilities, the PBGC- adjusted liability measure indicates a net decline in funding. This increase is due entirely to an increase in the distance between mean reported discount rates and mean PBGC rates between the two years. We examine this result more closely below.

In general, the funded status of the sample -- whether or not the sample is fully funded -- depends on the discount rate used to estimate liabilities. Using the firms' reported rates, the average pension plan appears fully funded; using the PBGC's rates, the average plan appears underfunded. Clearly, the discount rate used to

determine liabilities has a major impact on the funded status of a plan.

To examine the funding issue more closely, we present descriptive information concerning the funding measures observed for our sample firms in Table 2. Mean funding ratios using the PBO as the measure of pension liabilities for 1990 was 1.021, and for 1991 was 1.059, indicating that mean pension assets were 5.9% greater than the mean projected benefit obligation in 1991 while only 2.1% greater in 1990. Mean funding ratio values using the ABO were 1.268 and 1.289 for 1990 and 1991, respectively. Again, the plans are, on average, fully funded -- assets exceed liabilities by over twenty percent in both years -- and the average funding levels appear to improve. Finally, after adjusting the ABO to reflect mean PBGC discount rates over the period, the funding ratios were 1.02 for 1990, but declined to .98 in 1991. Median values for each measure were both close to one. On average, then, the sample firms appear fully funded, even after adjusting the ABO to reflect the lower PBGC rates in effect during the period. The one exception is the 1991 PBGC funding ratio, which indicates that average assets cover only 98% of average liabilities. Furthermore, mean funding ratios improved from 1990 to 1991 for both reported liability measures, indicating that reported overall funding levels increased during the period. After adjusting for the PBGC's discount rates, however, funding levels appear to decline. These results are consistent with the results for the total dollar amounts presented in Table 1.

Panel A of Table 3 presents the number and percent of firms that are over/under funded for the sample for 1991. Fully funded firms are those with funding ratios greater than, or equal to, one. The data corresponding to this assumption appear in the first three columns. We present the data for funding ratios greater than or equal to .9 (plan assets cover 90% of plan liabilities) in the next three columns to control for sensitivity to the actuarial assumptions necessary in accounting for pensions.[7] In other words, while firms with funding ratios

Table 2
Funding Ratio Descriptive Statistics

	PBO FRATIO		ABO FRATIO		PBGC FRATIO	
	1991	*1990*	*1991*	*1990*	*1991*	*1990*
Mean	1.059	1.021	1.289	1.268	0.9829	1.0263
Median	1.049	1.033	1.253	1.209	0.9547	0.9749
Variance	0.069	0.078	0.121	0.131	0.0852	0.1121
Minimum	0.389	0.277	0.386	0.329	0.2713	0.2499
Maximum	2.655	2.445	2.931	2.938	2.227	2.611

of one or higher are considered fully funded, those that are near one (between .9 and 1) may have been fully funded the year before, or may have appeared fully funded if the interest rate assumptions were a bit different. Thus, in order to gauge the number and percent of firms not funded to what might be considered a "reasonable" level (90%) we use funding ratios of .9 as the cutoff point for the last three columns in the table.

Consistent with the previous results, a greater number of firms appear fully funded (funding ratio equals one or higher) when using the ABO liability measure (81.12%) and the PBO liability measure (60.43%) than when using the PBGC-adjusted liability measure (42.29%). If we assume that 90% represents a reasonable level of funding, then the number of fully funded firms rises under the PBGC funding ratio measure to 59.63%. It rises to nearly 80% for the PBO measure and almost 90% for the ABO measure. Again, the effect of the discount rate upon liability and funding measures is evident in the comparison, but it is also clear that even under the more stringent assumptions imposed by PBGC rates, a slim majority of firms are either fully funded, or close to it. In 1990, 38.37% of the firms are funded at levels less than 90%, while in 1991, 32.18% are considered underfunded. The evidence from Tables 2 & 3 suggests that serious funding problems are not widespread throughout our sample, but tend to be localized in a minority of firms.

Even so, the funding deficiencies for these firms are severe, and tend to attract attention and skew reporting due to the size and materiality of the deficiencies. Table 4 below identifies the sample companies with the 10 lowest funding ratios based on the PBGC adjusted liabilities for 1991.

For comparative purposes, we identify the funding ratio based on the ABO in the adjoining column. It is interesting to note that the two firms with the lowest adjusted funding ratios (.27 & .29) are significantly lower than the next two (.40 & .43), which are in turn, significantly lower than the following firms. On a firm-specific basis, these ratios represent severe underfunding -- asset coverage for DR Holdings' adjusted liability, for example, is only 27%. On a relative basis, however, the dollar amounts are not large. DR Holdings unfunded liability ($9.68 million) represents only 0.28% of the sample's total dollar amount unfunded after adjusting for PBGC rates ($34 billion estimated). On the other hand, General Motors and Chrysler together account for 98.2% of the estimated total dollar amount unfunded for 1991. Removing General Motors and Chrysler from the analysis reveals that total pension assets would fall short of total adjusted pension liabilities by only $618 million.

These results suggest that while there may be a number of firms with poor funding ratios, the relatively small dollar exposure, and the relatively small size of the plans, tend to mitigate the overall macroeconomic effect of these underfunded plans; most of the underfunding is attributable to a few large plans rather than to (many) smaller plans. This evidence supports that reported by Schroeder (1993) in *Business Week*, who noted that, in the aggregate, $1.3 trillion in pension assets support $900 billion in pension liabilities, and that nearly 85% of all plans insured by the PBGC were fully funded.

Table 3
Funding Ratio for All Liability Measures

Panel A:	Funding Ratio Liability Measure for 1991					
	Fratio =1 PBO	*Fratio =1 ABO*	*Fratio =1 PBGC*	*Fratio= .9 PBO*	*Fratio= .9 ABO*	*Fratio=. 9 PBGC*
Number of Fully Funded Firms	113	159	74	144	169	91
Number of Underfunded Firms	74	29	101	43	19	84
Total Number of Firms	187	188	175	187	188	175
Percentage of Fully Funded Firms	60.43	84.57	42.29	77.01	89.89	59.63
Percentage of Underfunded Firms	39.57	15.43	57.71	22.99	10.11	40.37
Total Percent	100	100	100	100	100	100

Panel B:	Funding Ratio Liability Measure for 1990					
	Fratio PBO	*Fratio ABO*	*Fratio PBGC*	*Fratio= PBO*	*Fratio ABO*	*Fratio=. PBGC*
Number of Fully Funded Firms	113	151	80	144	169	118
Number of Underfunded Firms	74	29	92	43	19	56
Total Number of Firms	187	188	172	187	188	174
Percentage of Fully Funded Firms	60.43	81.18	46.51	77.01	89.89	67.82
Percentage of Underfunded Firms	39.57	18.82	46.55	22.99	10.11	38.37
Total Percent	100	100	100	100	100	100

In addition, the large difference in funding ratios notice able between the PBGC measure and the ABO measure indicates that no conclusions concerning funding should be drawn without careful attention to the actuarial assumptions underlying these funding measures. Note, for example, Warner-Lambert, whose plan appears fully

Table 4 Most Underfunded firms based on PBGC Discount Rates			
Rank	Company Name	PBGC Funding Ratio 1991	ABO Funding Ratio 1991
1	DR Holdings Inc. of Delaware	0.27	0.39
2	Duracell Holdings	0.29	0.39
3	Chrysler	0.40	0.53
4	GAF	0.43	0.59
5	UCC Investors Holding	0.50	0.66
6	Occidental Petroleum	0.52	0.74
7	Beckman Instruments	0.55	0.98
8	Federal Paper Board	0.58	0.82
8	Warner-Lambert	0.58	1.05
8	Meredith	0.58	0.71
9	General Motors	0.60	0.88
10	Navistar International	0.61	0.87

the individual firm, but also to retirees, employees, regulators, and capital markets; it is, in many ways, vital to both the nation's public policy concerns and economic well being.[8]

If firms are, in fact, reducing their apparent pension liability by assuming higher discount rates, as well as influencing the timing and extent of cash payments to the pension plan, then an association between discount rates and funding measures should be empirically observable: the higher the discount rate, the higher the funding ratio; the lower the discount rate, the lower the funding ratio. If, on the other hand, there is no association -- in other words, firms with lower discount rates have funding ratios as high (or higher) as those with high discount rates -- then it is possible to conclude that discount rate choices are not driving funding measures. In other words, managers are not systematically selecting higher discount rates to improve the appearance of the firm's pension plan.

funded (funding ratio = 1.05) using the ABO as a measure of pension liability. After adjusting the ABO to reflect average PBGC rates, however, the funding ratio drops to .58. The difference is attributable solely to the lower discount rate applied to liabilities for 1991. Indeed, the difference between Warner-Lambert's discount rate (10.5) for 1991 and the average PBGC rate (6.96) in 1991 amounts to 3.54, a considerable distance. Whether Warner-Lambert has an unrealistically high discount rate which makes its plan funding look artificially good, or whether the PBGC has an excessively conservative discount rate, which makes the plan funding look artificially poor, is beyond the scope of this paper. The important point is that any funding measure is acutely dependent on the veracity of the assumptions underlying it; to take the PBGC liability funding ratio at face value without first recognizing its interest rate assumptions automatically increases apparent funding deficiencies.

Discount Rates

Determining a "true" or "accurate" or "representationally faithful" measure of a firm's (and the economy's) pension funding status is critically important not only to

Table 5 below presents descriptive statistics for the discount rate and the change in discount rate from 1990 to 1991. Sample mean discount rates were 8.716 for 1990, but declined to 8.548 for 1991. Median discount rates are similar, and the range is identical for both years: the minimum observation is 7.0% and the maximum observation is 10.5%. Given that the range remained the same, but the mean rate declined, we examined the number and percent of firms that changed discount rate estimates between the two years. Seventy-seven firms (44.3%) changed rates; ninety-seven firms (55.7%) did not.[9] The average change was a small reduction of 0.168. While the majority of firms did not change rates between 1990 and 1991, nearly 45% did. This is, in fact, a noticeably large percentage of firms, indicating managerial attention to the rate.[10] Finally, the mean PBGC rate for 1990 was 7.48, and 6.96 for 1991.

	Table 5 Discount Rate Descriptive Statistics		
Descriptive	1990 Discount Rate	1991 Discount Rate	Discount Rate Change
Mean	8.716	8.548	-0.168
Median	8.750	8.500	0.000
Mode	9.000	9.000	0.000
Minimum	7.000	7.000	-1.500
Maximum	10.500	10.500	1.000

predictable. What is more interesting, however, is found in the individual cells. For those firms which lowered the discount rate, nearly half also increased their funding ratio. For these firms, the increase in funding is clearly not an artifact of the discount rate; it represents an economic improvement in funding. The same is also true for those 68 firms which made no change in the discount rate, yet also enjoyed an increase in the funding ratio. Thus, of the 115 firms which improved their funding from 1990 to 1991, 108 represent true economic increases rather than actuarial gains. Of the 80 firms having lower funding ratios in 1991, 43 also lowered the discount rate. While it is unlikely that the reduction in funding observable for these firms was due entirely to the reduction in discount rates, it is probable that at least a portion of the funding reduction is attributable to the reduced discount rates. Finally, only 8 firms raised discount rates between 1990 and 1991, with resulting lower funding ratios. For these firms, the rate increase may have offset an even greater reduction in funding levels for 1991 than that realized.

PBGC rates are significantly lower than mean discount rates for both years, and they declined by more than average firm rates as well. PBGC rates dropped by .52, while firm discount rates dropped by only .168.

In order to test whether or not firms are reporting rates higher than PBGC rates merely to minimize their pension liabilities, rather than to capture firm-specific demographic characteristics such as employee length of time to retirement, average age, gender, or mortality assumptions, we conducted chi-square tests for ABO and PBO funding quartiles and discount rate quartiles for both 1990 and 1991; the results appear in Table 6 below.

The chi-square tests indicate that some dependence existed between the discount rate and funding ratio (both PBO and ABO) measures in 1990. Firms with discount rates in the lowest twenty-five percent had significantly lower funding ratios than firms with discount rates in the topmost quartile. No association proved evident, however, in 1991; the dependence between discount rates and funding measures observable in 1990 disappears in 1991. These results suggest that while discount rate choices may have explained, in part, the reported funding in 1990, they had less influence in the observable funding ratios for 1991. Examining the contingency table for first differences helps illustrate the result. Table 7 presents chi-square results for discount rate changes by funding ratio changes for the PBO.[11]

Chi-square results indicate that firms lowering their discount rates tended to lower their funding ratio more often than increase it; conversely, firms raising their discount rate tended to increase the funding ratio more often than decrease it. This result is what we might reasonably expect, being, ceteris paribus, mathematically

The chi-square results indicate that in 1990, reported funding levels may have been overstated due to the nature of firms' discount rate choices; in 1991, however, no such dependence is observable. This observation is supported by the generally lower discount rates for the sample in 1991 as well as the number of firms whose funding levels improved, yet at the same time, changed the discount rate estimate in a direction counter to that expected (or made no change to the rate).

Conclusion

Despite the tenor of much of the reporting concerning defined benefit pension plan funding, our sample of Fortune 500 company pension disclosures reveals that funding levels are not, on average, problematic, nor are funding problems particularly widespread. The exact status of pension funding is difficult to determine since the liability measure is heavily dependent on actuarial assumptions, of which the discount rate is arguably the most important. Any attempt to measure whether or not a firm is fully funded will therefore be dependent on the liability measure used, which is in turn dependent on the discount rate used to discount each firm's future

Table 6
Chi-Square Contingency Tables for Funding Ratios and Discount Rates by Quartile

Panel A: PBO Funding Ratio 1990

Discount Rate Quartiles - 1990

		1st	2nd	3rd	4th	Totals
1990 PBO	1st	30	3	10	14	57
Funding Ratio	2nd	21	6	12	7	46
Quartiles	3rd	22	1	20	3	46
	4th	25	1	14	6	46
	Totals	98	11	56	30	195

Chi Square = 18.668   p-value = .028   df = 9

Panel B: PBO Funding Ratio 1991

Discount Rate Quartiles - 1991

		1st	2nd	3rd	4th	Row Totals
1991 PBO	1st	23	13	15	4	55
Funding Ratio	2nd	16	12	15	4	47
Quartiles	3rd	12	16	16	3	47
	4th	18	9	18	1	46
	Totals	69	50	64	12	195

Chi Square = 7.013   p-value = .636   df = 9

Panel C: ABO Funding Ratio 1990

Discount Rate Quartiles - 1990

		1st	2nd	3rd	4th	Totals
1990 ABO	1st	27	2	11	16	56
Funding Ratio	2nd	22	5	14	6	47
Quartiles	3rd	25	3	15	3	46
	4th	24	1	16	5	46
	Totals	98	11	56	30	195

Chi Square = 15.848   p-value = .070   df = 9

Panel D: ABO Funding Ratio 1991

Discount Rate Quartiles - 1991

		1st	2nd	3rd	4th	Totals
1991 ABO	1st	23	9	16	6	54
Funding Ratio	2nd	16	13	17	2	48
Quartiles	3rd	11	17	16	2	46
	4th	19	11	15	2	47
	Totals	69	50	64	12	195

Chi Square = 10.337   p-value = .324   df = 9

liabilities. To estimate funding, we calculated funding ratios (market value of plan assets scaled by the liability measure) using three liability measures: the ABO, a measure of the liability based on current salary assumptions; the PBO, a measure of the liability based on future salary assumptions; and the PBGC liability, a measure of the ABO adjusted to reflect the PBGC's average annuity rates for each period.

Descriptively, the sample was, on average and in total, fully funded under both reported liability measures (PBO and ABO) for both 1990 and 1991. When the ABO was adjusted to reflect PBGC rates, the sample firms appeared fully funded in 1990, but fell to just under full funding in 1991 (funding ratio = .98). In addition, the excess of liabilities over assets proved to be between $27 and $34 billion for the two years. Most of the underfunding was attributable to significant underfunding of a few very large plans, however, rather than a widespread problem among all sample firms. General Motors and Chrysler's plans alone accounted for fully 98% of the underfunded amounts in the sample.

Since such disparity exists between funding measures based on different discount rates, we also tested the two funding ratios based on reported liabilities against the firm's discount rate choice. Chi-square tests

Table 7
Contingency Table for Discount Rate Changes by Funding Ratio Changes
between 1990 and 1991

PBO		Discount Rate Change 1990 - 1991			
		Decrease	No Change	Increase	Row Totals
Funding Ratio	Decrease	43	29	8	80
Change 90 - 91	Increase	40	68	7	115
	Col. Totals	83	97	15	195

Chi Square = 9.892   p-value = .007   df = 2

indicated that these was an association between high discount rates and high funding (and vice versa) for 1990, but not for 1991. Chi-square test results are also consistent with real, economic improvement in funding levels for 1991.

Suggestions For Future Research

While there are many avenues of possible research into pensions, two aspects of research seem directly relevant to funding concerns. First, further research into pension issues should investigate the effect of declining interest rates on funding levels during the 1991-1993 period. Interest rates were relatively stable during the early 1990s, then began to decline rapidly from 1991-1993. As interest rates declined, pressure began to build for employers to lower discount rates and expected rates of return on plan assets, which had the combined effect of increasing liabilities and pension expense. Did this pressure actually result in significant actuarial changes by employers? Did the changes in rates result in decreased funding levels, as might be expected, or did employers increase cash contributions to their plans in order to offset the effects of declining rate assumptions? In other words, did liability and expense metrics worsen over the 1991-1993 period, or did they remain relatively stable? Second, future research could profitably focus on the economic effects of the most severely underfunded firms. Since these firms represent the greatest risk to the PBGC and ultimately to taxpayers, and since most of the underfunding appears concentrated in a few large firms, it would be worthwhile to investigate these particular firms more closely. What is the nature of the risk represented by, say, General Motors' underfunding, compared to Duracell Holdings? Is there a market penalty to these firms for having underfunded plans? Is there a political cost to the firms in the form of in-

creased regulation and reporting costs? More empirical research into these issues will enhance our understanding of the nature and health firms' pension plans.

Notes

1. Exposure to risk from settlements, according to Kiplinger's Personal Finance Magazine, stems from the employer's purchasing annuities from a troubled insurance company which in turn becomes insolvent, leaving employees and retirees without pension benefits.
2. Whether defined contribution plans are, in fact, less desirable is a matter of debate. Many employees, if given the option, choose defined contribution plans. They tend to be more flexible, have shorter vesting periods, be more portable, and with the increased investment risk comes the potential for much higher long-run returns. Still, both the tone and substance of many of the articles we cite imply that defined contribution plans are inherently less desirable than defined benefit plans.
3. Single-employer fund refers to plans offered by individual employers, not those offered by multiple employers. The PBGC's multiemployer plan fund had an accumulated surplus of $187 million as of 1991 (Delfico 1993).
4. We analyze Fortune 500 firms since they are most likely to have significant defined benefit plans covering the greatest number of employees.
5. Winklevoss (1993) suggests that for each ¼ percent increase in the discount rate estimate, liabilities decrease by some 4%.
6. The adjustment is based on the difference between

the firm's discount rate and the PBGC's immediate rate. Using the 4% rule-of-thumb (Winklevoss 1993; Francis and Reiter 1987), we alter reported benefits 4% for each ¼ difference between the two rates based on the following formula: for firms whose discount rate is 1% higher than the PBGC rate (i.e., a decreasing discount rate), the adjustment factor is [(1.04)^4 - 1]; for firms whose discount rate is 1% lower than the PBGC rate (i.e., an increasing discount rate), the factor is [1- (1.04)$^{-4}$].

7. It may legitimately be argued that PBGC rates represent better estimates of current market conditions than firm-specific rates because they are derived from annuity price data obtained by the PBGC from private insurers, and hence capture the rates implicit in long-term annuity contracts as required by SFAS 87 (FR Doc. 76-31422). Given this assumption, then any funding ratio under one indicates underfunding. On the other hand, it may also be argued that PBGC rates are too conservative since they include an adjustment for anticipated expenses and administrative costs in providing benefits, and thus understate rates on high-quality fixed-income investments, also allowable under SFAS 87. Given this assumption, a firm with an adjusted funding ratio less than one may still be fully funded, but may simply not appear fully funded due to use of the lower discount rate. Our purpose in presenting funding ratios greater than .9 in Table 3.A is to control for this ambiguity.

8. Both the academic and professional literature support this contention. Ippolito (1986), for instance, devotes considerable attention not only to the public policy effects of pension funding, but also to the long run implications regarding discount rates for both retired and active worker groups; he also notes that the stock market discounts pension liabilities with discount rates lower than those disclosed in public reports. Barth, Beaver, and Landsman (1992) report that market participants assign more weight to pension cost components than to non-pension components of income when determining security prices. In addition, the PBGC itself adjusts firms' liabilities to reflect its own mortality rates and discount rates rather than relying on firms' reported rates (Delfico 1993). This has the effect of increasing its perceived risk exposure substantially and raising the negative exposure and political cost to underfunded firms, as well as increasing its own stature and political importance. Finally, over the last year, several articles have appeared in the *Wall Street Journal* linking pension actuarial rate estimates with funding; the articles stated that firms' actuarial assumptions were too optimistic, and were used by many firms to hide the size of the liability and to reduce cash contributions to the plan (see Anders, October 5, 1992; Pulliam, September 2, 1993; and Jereski, November 17,

1993). The result of such exposure is that the Securities and Exchange Commission (SEC) is now urging firms to lower their discount rates (Jereski November 17, 1993).

9. The difference between 177 firms reporting discount rates and 174 firms having values for discount rate changes is attributable to three firms reporting the discount rate for only one year, rather than both years.

10. By comparison, firms tended to change the other two rate estimates required under Statement of Financial Accounting Standards (SFAS) no. 87 -- the expected rate of return on plan assets and the expected rate of future compensation -- much less often. On average, only 27.3% of firms tested changed the expected rate of return on assets, and only 17.3% changed the compensation rate assumption.

11. The test was conducted using the ABO funding measure as well; results were nearly identical.

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