Pensions, Economics and Public Policy

RICHARD A. IPPOLITO
Director, Policy and Research
Office of Pension and Welfare Benefit Programs
U. S. Department of Labor

1986
Published for the
Pension Research Council
Wharton School
University of Pennsylvania
by

Dow Jones-Irwin

Homewood, Illinois 60430

Pension Research Council
of the
Wharton School
University of Pennsylvania

ISBN 0-87094-760-5
Library of Congress Catalog Card No. 85–73289

Printed in the United States of America

1 2 3 4 5 6 7 8 9 0 K 3 2 1 0 9 8 7 6

PART TWO

Pension Growth

CHAPTER 5

Growth of Defined Benefit Plan Assets

In 1984, private pension plans in the United States held approximately $1 trillion in assets; defined benefit plans held approximately 70 percent of this total. Public plans held an additional $275 billion.[1] The goal of this chapter and the subsequent two chapters is an ambitious one: to trace the developments in the pension industry that led to the current equilibrium and to use this information to project pension industry size in the year 2000. Part of our task has already been accomplished; a theory of pensions—based primarily on tax advantages—has been developed, one that provides a foundation for understanding post–World War II pension growth. An economic concept of pension liabilities and a framework to understand corporate pension funding policy have also been developed. These concepts are critical to the derivation of target pension assets over the long run because they provide a theory of asset growth. Absent these building blocks, forecasting would take the form of drawing lines through pension asset observations over time, observations which fluctuate widely due to changes in portfolio market valuations.

What remains is the considerable task of assembling available data and arranging it in ways that are consistent with the economic principles of pensions developed above. It is emphasized that the discussion surrounding the projection of pension assets is predicated on the assumption that the fundamental tax structure in the United States remains intact. For reasons discussed in Chapter 2, if changes in relevant

[1] These data are estimated from annual Form 5500 pension reports submitted to the U. S. Department of Labor; and American Council of Life Insurance, *Pension Facts, 1984.*

tax law occur, the projections developed below could be dramatically altered.

This chapter is devoted exclusively to defined benefit asset growth in the private sector; defined contribution asset growth and the relative growth of public versus private plans are described in subsequent chapters.

FOUNDATION OF PENSION LIABILITIES

The Funding Relation

For purposes of estimating asset growth in defined benefit plans, it is important to remember that assets do not grow in a vacuum; they arise to meet pension liabilities incurred by the firm. Asset values are naturally affected by overall market evaluations. For purposes of long-term growth, what is important is not actual asset levels at any point in time but *target* asset levels. Target asset levels are related to pension liabilities by the target funding ratio; that is,

$$A^* = F^*L, \tag{5–1}$$

where A represents pension assets, L, liabilities, and F, the funding level; the asterisk(*) denotes "target" level.

The relationship in equation (5–1) is important for understanding asset growth in defined benefit plans. Expressed in this way, assets are shown to depend on the target funding ratio F^* and liabilities, concepts that have been addressed in detail in previous chapters. In Chapter 4, evidence was presented showing that the target funding ratio was not substantially higher than historical funding ratios, evidence which suggests that actual funding ratios are not increasing to "reach" a higher target. For example, the data suggest that the average funding ratio in pension plans in 1981 (approximately .75) was very close to the target ratio (approximately .70); in many prior years actual funding ratios exceeded the target. The cross-sectional data confirmed this finding: these data, also presented in Chapter 4, evinced only a mild positive relationship between older plans and funding status, suggesting that funding levels in private pension plans are relatively mature.

This is an important finding. Given that funding ratios are mature and relatively stable (apart from variation in asset values), and that liability growth is relatively easy to understand and to project, the job of understanding and projecting target asset growth becomes relatively straightforward. That is, if the target funding ratio is relatively stable, target assets in pension plans should track expected growth in pension liabilities. While we shall proceed using this assumption, it is worthwhile to note that if funding policy suddenly changed, say to a 100

percent target, assets could rather quickly grow 20 percent beyond levels suggested by liability growth alone.

Components of the Pension Liability

In this section, the pension liability equation developed above will become the central focus. That is, since the components of pension liabilities (enumerated below) can be observed and reasonably projected, knowledge of the relationship between these components and the liabilities they create is of critical importance for the purpose of projecting pension liabilities.

The basic liability equations have been estimated in Chapter 4; for convenience, they are reproduced here with one minor modification. In particular, both sides of equation (4–1) are divided by national employment and wage levels:

$$L/WE = (P/W)(D - R)[e(C/E) + f(N/E)], \qquad (5–2)$$

where e and f are constants interacted with discount factors.[a] In this form, liabilities are expressed as a fraction of total private worker earnings: the average wage in the private sector W times the private sector employment level E. This variant of liabilities is used because liabilities are expected to grow with employment and real wages. What is more difficult is explaining growth distinct from these factors. This "net" liability growth is determined by four factors:

a. The pension coverage rate among workers, C/E.
b. The size of the retiree group relative to the workforce, N/E.
c. The number of years pensions are expected to be collected (expected age of death minus average retirement age), $D - R$.
d. The average pension payment as a percent of the private sector nonagricultural wage, P/W.

None of these factors is independent. For example, if workers retire earlier, the average pension annuity may fall and, also, the number of retirees will increase relative to the active covered population. A brief discussion of these factors sets the stage for an informed judgment about the future growth of defined benefit plans.

Pension coverage. The first important characterization of the pension industry (and the one probably most often cited) is the pension

---

[a] That is, $e = (s/s)\, d_c$ and $f = d_n\,(D–J)/(D–R)$. The assumption that s/s and $(D–J)/(D–R)$ are constants is satisfied for example, when the densities of active and retiree participants are uniform. See note 10. The values of s/s and $(D - J)/(D - R)$ were estimated in Table 4–1. The discount factors d_c equals $\exp(-b_c i_c)$ where b_c was estimated in Table 4–1 and i_c is the discount rate applied to active workers; the discount factor d_n equals $\exp(-b_n i_n)$ where b_n was estimated in Table 4–1 and i_n is the discount rate applied to retiree liabilities.

TABLE 5–1 Components of Defined Benefit Liabilities, 1950–2000

(1) Year	(2) Pension Coverage Rate (× 100)	(3) Retirees to Work Force Ratio (× 100)	(4) Expected Years of Retirement	(5) Pension Annuity to Wage Ratio
1950	25.0	1.1	14.7	1.26
1955	32.4	2.2	14.8	1.03
1960	40.8	3.8	15.3	.94
1965	42.9	5.4	15.9	1.05
1970	44.7	8.1	16.8	1.01
1975	46.5	11.1	18.0	1.01
1981	47.4	15.2	18.4	1.04
1990	48.1*	23.0*	19.5*	1.04*
2000	48.4*	31.8*	20.1*	1.04*

Data source and projections algorithms are described in the text.
*Denotes projected value.

coverage rate; that is, the proportion of the private work force covered by a pension plan. It is not a perfect index for the purpose of predicting the proportion of workers who will retire with a pension. On the one hand, some (especially young) workers covered by a pension may change firms before they vest; on the other hand, some (again, especially young) workers who are not covered by pensions may ultimately switch to jobs that offer covered employment. But as a broad index of the popularity of pensions—one which measures firms' propensities to offer pensions—the coverage rate is a dependable parameter to gauge the natural growth of the pension system as a whole.

Coverage statistics are available for the post–World War II period.[3] These data for the private nonagricultural work force are presented in column 2 of Table 5–1. The data make it apparent that the rapid spread of pension coverage, which began in earnest during the 1940s, was almost over by 1960. During the 10 years from 1950–60 the participation rate grew by 15.8 percentage points; during the next 20 years, the participation rate grew only by 6.6 percentage points. In light of our earlier discussion, the data are not surprising. If tax policy is primarily responsible for the creation of the pension universe, it would be expected that most pension plan growth would take place relatively quickly after the dramatic change in tax policy in the 1940s (see Table

[3]These data are available through 1974 from A. M. Skolnik, "Private Pension Plans, 1950–1974," *Social Security Bulletin* 39 (June 1976), pp. 3–17, and are projected beyond 1974 based on data found in the American Council of Life Insurance, *Pension Facts*. While the data include some participants in firms that offer only defined contribution plans, the proportion of participants in such firms is small; hence the data reflect defined benefit plan participation.

2–4). Once it became apparent that the new tax structure was permanent, not just a wartime quirk, the pension coverage rate expanded rapidly.

With the tax theory in hand, we can be comfortable predicting that the coverage rate is near its saturation point. Cross-sectional observations in 1972, 1979, and 1983 confirm the relative flatness of the coverage rate since 1970, evinced in the table.[4] In fact, the data are almost perfectly described by the following equation:

$$C/E = K(1 - Ae^{-\alpha t}),$$

where t is time and K, α and A are constants. The parameter K represents the saturation coverage rate in the long run (as t goes to infinity, $C/E = K$). Estimating this equation using data over the period 1950–1983, an estimate of $K = 48.6$ percent is derived.[5] Using the same equation to project coverage to the year 2000, an estimated coverage rate of 48.4 percent is derived.

In short, the coverage rate by itself suggests that the pension system is relatively mature. At current coverage levels, it is estimated that approximately two thirds of the full-time private work force will retire with a pension.[6] Most who will not are lower wage workers (see Table 2–3) for whom the tax advantages of pensions are of doubtful significance.

Retirees. While the coverage rate is an important indicator of pension plan growth, it is in some sense a misleading index of the overall maturity of the system. First, even though many and even most large defined benefit plans awarded at least some past service credit when they originated,[7] it takes approximately 15 to 20 years before the plan will be paying benefits to a full complement of retiree cohorts. And to the extent that some plans offered no past service credit or offered reduced past service credits— as many plans did—the adjustment process could take much longer. For example, suppose a firm employs one person at each age level. Then, even if past service is granted, in the first year of plan operations, the retiree-active participant rate is zero. If starting age is zero and retirement age R, the retiree-

---

[4]See Dan Beller, "Coverage Patterns of Full-Time Employees under Private Pension Plans," *Social Security Bulletin* 44 (July 1981), pp. 3–11. Data reported therein cover the two survey years 1972 and 1979. Data found in the 1983 Consumer Population Survey confirm the saturation level of the coverage rate.

[5]In particular, the estimated equation using nonlinear least squares is:

$$C/E = \underset{(106.5)}{48.6}[1 - \underset{(39.9)}{.578}\exp(-\underset{(15.4)}{.105} \times t)]$$

[6]This inference is made by evaluation of coverage patterns of workers in the 50–54-year-old age bracket. See Dan Beller, "Coverage Patterns of Full-time Employees."

[7]For data about past service credit practices, see Banker's Trust, *Corporate Pension Plan Study*, various years.

worker ratio after one year of operation is 1/R, after two years, 2/R. In general,

$$\text{Retiree-active participant ratio} = [(D - R)/R][1 - e^{-at}]$$

where D is age of death, a is a constant, and t is plan age. As the plan matures (t becomes large), the retiree-active ratio settles to $(D - R)/R$; in the interim, the ratio grows rapidly. If a is .15, the ratio reaches 90 percent of its maturity value in 15 years.

Second, as shown below, the number of years over which pension annuities are expected to be received has increased markedly over the past 30 years. Because of earlier retirement trends, "covered" workers are counted as "retirees" earlier in their career; because of mortality factors, workers remain as "retirees" for longer periods.

These factors mean that while the coverage rate may show signs of saturation, it by no means implies that "retiree" participation rates have matured. The data in column 3 of Table 5–1 show the remarkable increase in retired persons collecting pensions from private-sector plans relative to the private employed work force.[8] In 1950, the ratio was only 1.1 percent; by 1970, when actual coverage rates were beginning to reach saturation, the retiree ratio was still only 11.1 percent. By 1980, it was 14 percent. But in contrast to the active participation rate which had almost peaked by 1980, the retiree ratio is not even close to its peak.

To estimate the future values of the retiree index, a simple (but nonlinear) time trend is used. The maturing process embedded in the retiree-worker ratio is in some sense on automatic pilot; it is largely determined by past events. Also, the trend toward longer retirement years are expected to continue, albeit at a slower rate of increase. Based on this understanding of the retirement process, it is reasonably safe to project the retiree/employment ratio based on the following functional form equation:

$$R/E = k/(1 + Be^{-bt}),$$

where k is an estimate of the final equilibrium value of the pension retiree-private work force ratio and $k/(1 + B)$ is an estimate of the same ratio for 1950 (when t is set equal to zero).

Based on an estimate of this equation for the period 1950–1980, the projected retiree-worker ratio was estimated.[9] The estimates suggest

---

[8] Data describing the retiree population are available in Skolnick, "Private Pension Plans"; and the American Council of Life Insurance, *Pension Facts*.

[9] The estimated equation, using a maximum likelihood estimate is:

$$R/E = .437/(1 + 28.7 \exp(-.087 \times t)).$$
$$(5.67) \quad (72.7) \quad (18.55)$$

that the rate will reach 23.0 percent by 1990 and 31.8 percent by the year 2000. The estimates suggest that ultimately *if* the same growth process continues over a very lengthy period, the ratio will reach 43.7 percent, almost as high as the coverage rate itself. It is apparent that the pension retiree population will be expanding its size relative to the private work force at a rapid rate for the next 15 years. Substantial growth in pension liabilities will occur as a result.

Years of retirement

Ensure no double-counting. Even though the number of retirees partially reflects the impact of a longer retirement period, the number of years of retirement must be considered as a separate factor for purposes of calculating pension liabilities. Its separate influence can be easily demonstrated by again appealing to our simple example. Consider the liability expression in equation (5–2). For simplicity, multiply both sides by *WE* to redefine absolute, not relative liabilities. Suppose there is one participant at each age from zero (the first year of participation) through retirement age R through death age D. Also assume the interest rate is zero. In this simple example, the number of active workers C equals R (one for each age from zero to retirement R); the number of retirees is $D - R$ (one for each age between retirement age R and death age D). It also turns out that the constants e and f are each .5.[19] Thus, in this example, liabilities are defined by the following relation:

$$L = .5P(D - R)[R + (D - R)]. \qquad (5–3)$$

The first term is one half the pension annuity P; the second, the number of years the annuity is collected $D - R$; the first term in brackets R is the number of active participants and the second term, the number of retirees $D - R$. If the age of retirement falls, the decrease in covered participants is exactly offset by an increase in retirees: the plus and minus R-values in brackets cancel. Thus, while the retirement age influences the active and retiree counts, they exactly cancel in the liability formula, leaving the number of years of annuity collection as the sole influence of retirement age on the liability calculation—no double-counting occurs. Of course, if the firm reduces the annuity payment P to offset the longer collection period, the net effect of a reduction in retirement age may be zero. The value of P will be measured separately.

If the expected age of death increases, it is apparent that the pension liability should increase for two reasons: first, because the annuity period lengthens (the term $D - R$ in parenthesis outside the brackets

---

[19]Since the interest rate is zero then $e = a/R$ where a is the average tenure of active participants. But a must be $R/2$ in the simple example; thus $e = R/2R = .5$. The constant $f = (D - J)/(D - R)$. But in the example, the average age of a retiree is $J = (D - R)/2$; thus, $f = .5$.

in 5–3); second, because the number of retirees increases (the second term $D - R$ within the brackets in equation 5–3). Suppose $D - R$ equals five years. Then there are five retirees at any given time who expect on average to collect their pension annuity for 2.5 more years. If longevity suddenly increases by one year for all living workers and retirees, then two things happen: the number of retirees increases from five to six (this factor is counted in the retiree population above) and the average collection period increases by one fifth from 2.5 to 3.0 years. Of course, to the extent that the size of the pension annuity falls to accommodate the longer collection period, liabilities will not increase by the full amount implied by the extended retirement period.

Trends, 1950–1980. The increase in the retirement period over the past 30 years has been dramatic. Two major factors account for this trend. First, pension-covered workers have been retiring at ever earlier ages. In 1950, the average private pensioner retired at age 63.3; in 1978, at age 61.4.[11] This factor alone increased the retirement period by 1.9 years. Second, expected lifetime has been increasing. In 1950, a 63-year-old male expected to live to age 77; in 1981, he expected to live to the age 78.3, an increase of 1.3 years in the retirement period. In addition, during the same 30 year period, the proportion of retirees who are female increased from 13.6 percent to 22.7 percent.[12] Since females on average live five years longer (evaluated at age 63), this factor added an additional .5 years to the average beneficiaries' retirement period.

Data describing average years of pension collections are presented in column 4 of Table 5–1. Together, these factors added a remarkable 3.7 years to the average pensioner's retirement period over the years 1950–1980. This phenomenon, one of the truly impressive social trends of the post–World War II period, was a major contributing factor to the rapid expansion of the retiree population observed over the same period.

Projections to the year 2000. The retirement period will almost surely continue to increase over the next 15 years. The female portion of retirees is nowhere near its long-term peak. Consider that while females represent only 23 percent of current retirees, they represent 40 percent of active participants.[13] Fitting a curve to the increase in female representation among retirees—a growth process that is on automatic pilot—suggests that females will represent 29.9 percent of retirees in

---

[11] These data are calculated from the U.S. Department of Labor, Survey of Pension Benefit Amounts, which contains retirement information about 500,000 retirees collecting pensions in 1978. The number includes workers retiring on disability and "special early" retirement.

[12] Ibid.

[13] See Dan Beller, "Coverage Patterns of Full-Time Employees."

the year 2000.[14] Given an added longevity of approximately five years for females, this factor alone will add .35 years [=(.299 − .23) × 5] to the average annuity period. Overall mortality effects will add an additional .12 years by the year 2000.[15]

The average retirement age is more problematic. Surely the rapid decrease in retirement age observed over the past 30 years cannot continue. Yet the data do not show any signs that the trend toward ever earlier retirement ages is abating. A straight line explains the post–World War II data best; average retirement age for retirees has been falling at the rate of .125 years per year.[16] To be conservative, and arguably more realistic, it is assumed that the rate of decrease in retirement age will continue but at one half the rate of the last 30 years. This means that by the year 2000, the average retirement age will fall by an additional 1.2 years.

Together, these projections suggest that by the year 2000, the average pension annuity period will increase by a total of 1.67 years compared to 1981 to 20.1 years (1.2 years from earlier retirement, .35 years from more female retirees, and .12 years from overall increases in mortality). This projection is shown in column 4 in Table 5–1.

Pension annuity. An important element of the pension liability is the real value of the average pension annuity. To the extent that the present value of the average pension does not change over time—that is, if the pension amount falls to accommodate a longer retirement period—the total impact of longer annuity periods would be offset by smaller annuities. To test this notion, available data were used to calculate the average pension annuity;[17] this annuity was indexed to the private nonagricultural wage. The results are presented in the last column of Table 5–1.

---

[14]Using data referred to earlier from the U.S. Department of Labor, Survey of Pension Benefit Amounts, the following trend is fitted:

$$\ln(\text{percent female}) = \underset{(21.0)}{-3.35} + \underset{(10.51)}{.55}\ln(\text{time}),\ R^2 = .83.$$

After projecting this growth to the year 2000, the 29.9 percent figure is determined.

[15]It is assumed that mortality improvements are made at a continually declining rate. Suppose $D - R = X\,(\text{time})^a$ where time equals one in 1950. Thus, if the expected life of a 63-year-old male in 1950 is 14.7 years and in 1960, 15.3 years, it follows that $X = 14.7$ and $a = .017$. Projecting this trend to the year 2000, we have $D - R$ increasing by .12 years.

[16]Data from the U.S. Department of Labor Survey of Pension Benefit Amounts is fitted very tightly by the following straight line:

$$\text{Retage} = \underset{(448.1)}{65.0} - \underset{(17.1)}{.125}\,\text{time},\ R^2 = .93,$$

where Retage represents the average retirement age.

[17]Pension payments and beneficiary data are available in A. M. Skolnick, "Private Pension Plans"; and American Council of Life Insurance, *Pension Facts*. There are some lump sum benefits included in the payment data but it only includes lump sums for profit sharing plans; hence the distortion is expected to be minimal.

The ratio is remarkable in its constancy over the period. Except for a relatively high value in 1950 (1.26), the ratio hovers around unity over the entire 30-year period. This is a dramatic finding in light of the lengthening retirement period. It means that the generosity of pension plans in real terms has been systematically increasing over the post–World War II period so that, by 1980, pension annuities were preserved in terms of wages even though they were expected to be paid out 4.1 years longer on average. Pension liabilities have therefore been growing by the full value of the lengthening retirement period calculated above.

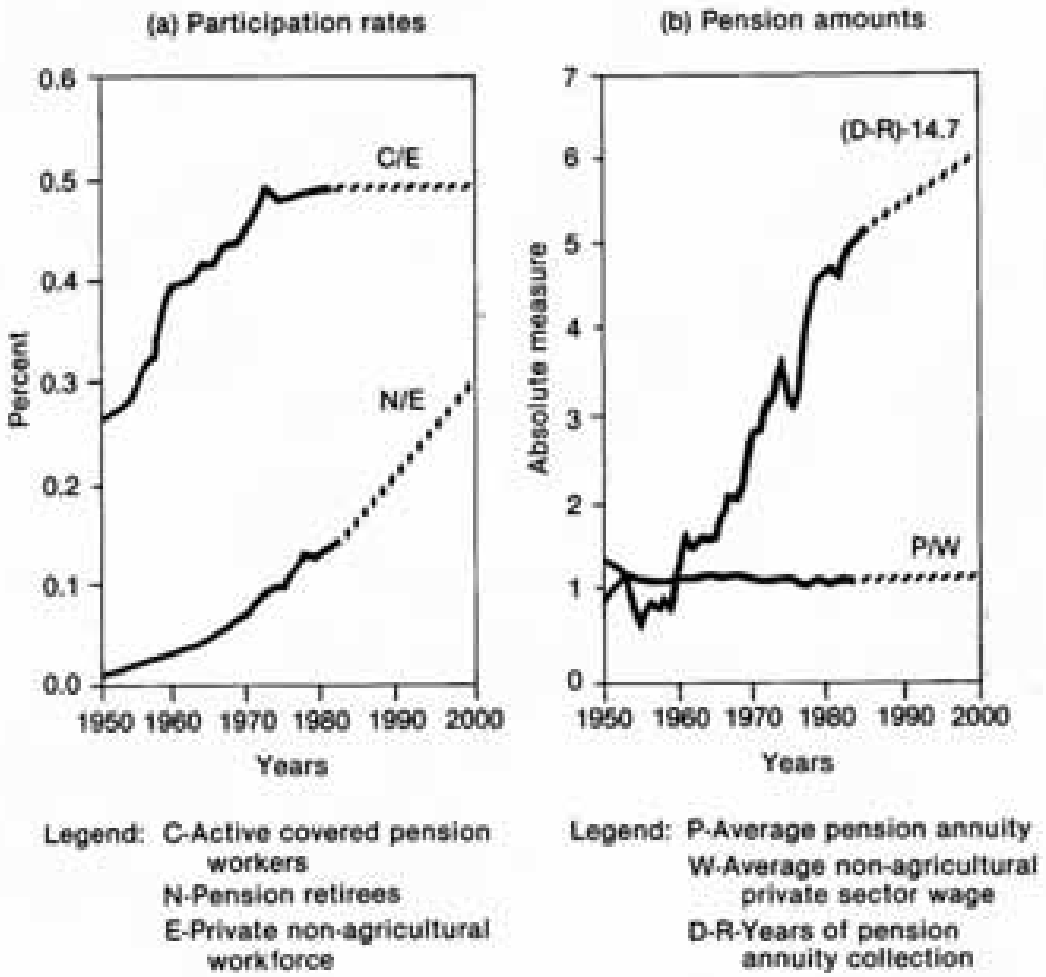
There is no sound reason to believe that annuity values will remain constant in terms of wage, but in view of its staying power over a very lengthy period of time, a period marked by substantial increases in the length of the annuity period, it seems warranted to assume that the pension annuity will retain its relationship with the wage level. This assumption is reflected in the projections made in the last column of the table.

DEFINED BENEFIT PLAN ASSETS 1950–2000

All of the elements required to project liabilities in defined benefit plans—and by implication target defined benefit asset holdings—have been made. The four principal components of the liability equation are shown graphically over time in Figure 5–1. In panel a of the figure the pension coverage rate for workers in the private sector is traced over the period 1950–1983 and is projected using the estimated relation reported above to the year 2000. In the same panel, the pension retiree population rate is also shown. In panel b of the figure, the pension annuity (indexed to wage) is portrayed and projected to the year 2000; this is the remarkable constant in the pension system described above. Finally, the number of years of retirement *minus* 14.7 is also depicted in the bottom panel; this curve tracks additional years of retirement beyond the 1950 level (14.7 years) over the period.

The graphical representation of the private pension system in Figure 5–1 tells the dramatic story of pension growth in the post–World War II period. Viewed from 1950, growth over the ensuing 20 years was driven by impressive increases in the pension coverage rate and by equally impressive increases in the length of the annuity period. Viewed from 1983, growth over the next 20 years is expected to be driven by sharp increases in the pension retiree population relative to workers and by continued modest increases in the annuity period. The big unknown in the system is the level of the pension annuity itself. Though remarkably constant over the past 30 years, there is no theoretical reason to believe that it cannot or will not fall ultimately as the retirement annuity period continues to increase.

FIGURE 5–1 Components of Defined Benefit Pension Growth



Liabilities in the year 2000 are determined directly by substituting the components in Table 5–1 (also depicted graphically in Figure 5–1) into the liability function shown in equation (5–2), then multiplying through by employment levels and the real wage. (Recall that the constants e and f in equation (5–2) have been estimated in Chapter 4.) Liabilities relative to the private employment bill – wage times employment *WE* – and the size of the wage bill are shown separately in columns 2 and 3 of Table 5–2. The multiple of these components – total liabilities – is shown in column 4. All calculations are indexed to 1981. This index is convenient because 1981 is a year in which not only are assets known but their relation to liabilities in 1981 is consistent with long-term funding levels; that is, actual assets in 1981 were approximately equal to target asset levels (see Chapter 4).

The results show explicitly what analysis of the liability components showed implicitly. During the 20 years 1950 to 1981, pension growth was dramatic; liabilities relative to the wage bill increased by a factor of 2.7. Wages and employment were also increasing rapidly; thus, in real dollars, *total* defined benefit pension liabilities increased by a factor of 6.7 over the period 1950–1981.

Projections to the year 2000 are straightforward. Projected pension components (see Table 5–1) are substituted into equation (5–2). Wage and employment growth are also projected.[18] These results are also quite dramatic. They show that the system will continue to grow rapidly through the year 2000. Even relative to the wage bill, real pension liabilities will increase by approximately 50 percent between 1981 and the year 2000. Again this growth is primarily attributable to the continuing maturity process, now manifesting itself in a burgeoning pension retiree population. If employment and real wages continue to grow at the same rate that occurred between 1950–1980—a reasonable assumption—the real wage bill itself will increase by an additional 67 percent between 1981 and the year 2000. Together, these results suggest that liabilities in private defined benefit plans in the United States in the year 2000—in real terms—will be two and one half times their 1981 value.

It is useful to convert these relative amounts into actual dollar amounts. In 1981 defined benefit pension liabilities (in 1984 dollars) were approximately $766 billion.[19] The results shown in column 4 (last entry) in Table 5–2 suggest that by the year 2000, these liabilities (again in 1984 dollars) will increase to 1.9 *trillion* (= 2.53 × $.766 trillion). Asset holdings in defined benefit plans in 1981 were approximately 75 percent of liabilities, or approximately $574 billion in 1984 dollars. Assuming the same post–World War II funding policy continues (target funding ratios in the 75 percent range) then in 1984 dollars, target assets held in private defined benefit pension plans will be approximately $1.45 trillion (=.75 × $1.938 trillion). Target asset amounts are shown in column 6 in the table. This represents an impressive real growth. *Actual* asset holdings, of course, will depend partly on market values

---

[18]Exponential curves fitted to the 1950–1980 real wage and private employment data yield the following estimates:

$$\ln(\text{wage}) = \underset{(212.1)}{4.97} + \underset{(8.07)}{.010}\ \text{time},\ R^2 = .68;$$

$$\ln(\text{employment}) = \underset{(592.7)}{6.31} + \underset{(31.6)}{.0177}\ \text{time},\ R^2 = .97.$$

[19]This estimate is derived directly from the 5500 annual pension reports. Assets are calculated directly. The funding ratio was derived in Chapter 4. Liabilities equal assets in the defined benefit system divided by the funding ratio.

TABLE 5–2 Liabilities in Defined Benefit Plans, 1950–2000

(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Absolute Liabilities[b]	Target Assets[c]	Actual Assets[d]
Year	Liabilities Relative to Wage Bill[a]	Wage Bill WE[a]	Total Liabilities[a]	1984 dollars (Billions)		
1950	.37	.41	.15	$ 114	$ 85	$ 45
1955	.41	.52	.21	161	120	92
1960	.50	.59	.29	222	166	153
1965	.64	.73	.47	360	270	270
1970	.73	.85	.62	475	356	323
1975	.90	.90	.81	620	465	360
1981	1.00	1.00	1.00	766	574	574
1990	1.23*	1.27*	1.57*	1,203*	902*	—
2000	1.52*	1.67*	2.53*	1,938*	1,453*	—

*Denotes projected value.

[a]Indexed to unity in 1981.

[b]Liabilities are calculated by substituting liability components in Table 5–1 into equation (5–2) and indexing to 1981. Since defined benefit liabilities in 1981 are known directly from the U.S. Department of Labor 5500 Annual Pension Plan Reports, the indexes can be converted to absolute levels.

[c]Target assets are calculated from equation (5–1). Liabilities are known (column 5 above); the target funding ratio F* is assumed to be in the vicinity of 75 percent (see Chapter 4).

[d]Actual private pension assets are available from the U.S. Department of Labor, Annual (5500) Pension Plan Reports from 1977 onward. The Federal Reserve Board (through their *Flow of Funds* data) publishes pension asset figures from 1947 onward, but because of technical problems these data have understated the magnitude of pension assets. See "Non-Federal Pension Assets Exceed Previous Estimate," *Pension and Investment Age*, December 7, 1981, p. 1. Recently, the Federal Reserve series has been adjusted upwards to reflect the annual report data but there remains a discrepancy between the two data series. Defined benefit plan assets in the Federal Reserve data equal private pension assets times the share of assets held in defined benefit plans (see Chapter 6).

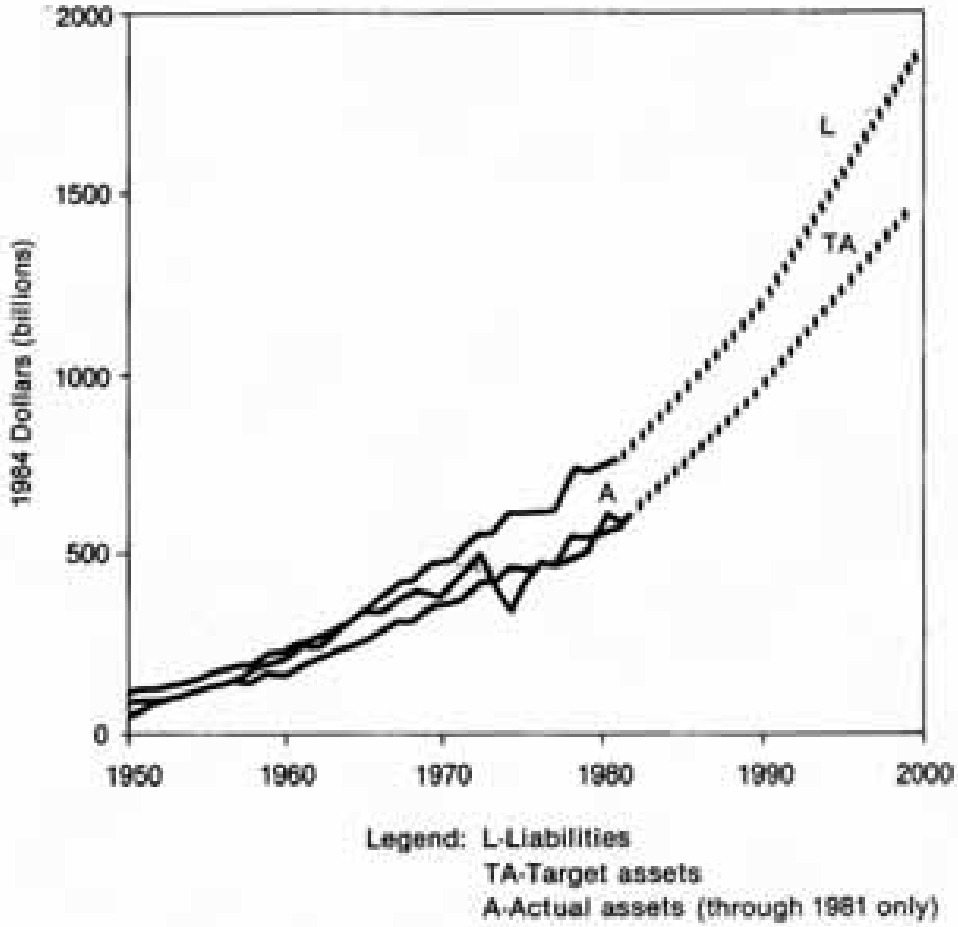
and performance; their values (in 1984 dollars) through 1981 are shown in column 7 in the table.

The projected growth of the defined benefit system is shown graphically in Figure 5–2. Real growth in total private liabilities are shown by the top curve. Target assets are projected by a mirror trend equal to 75 percent of the liability curve. Finally, actual asset growth is shown by the more erratic curve around the target asset schedule in the diagram. The diagram illustrates the importance of separating true underlying growth in the system from observed movements in actual asset holdings.

CONCLUSION

This chapter has covered considerable ground. Its principal yield is an estimate of liabilities and target asset holdings by private defined benefit plans in the year 2000. Both measures are expected to increase by a

FIGURE 5–2 . Defined Benefit Liabilities and Assets: 1950–2000



factor of 2.5 in the year 2000 relative to 1981. In 1984 dollars, pension liabilities in defined benefit plans will be $1.9 trillion in the year 2000 compared to $766 billion in 1981. Target asset holdings will be $1.45 trillion compared to $574 billion in 1981.

The growth estimates were not dependent on actual asset growth measures. Market value of assets is highly dependent on exogenous influences. Instead, growth prospects were evaluated in terms of a more fundamentally sound measure of the size of the pension system: economic liability calculations. The foundation for this concept was laid in Chapters 2–4 where the fundamental growth rationale was developed as well as principles of liability and economic funding calculations. Evaluations of growth on the basis of reported funding liability calculations would prove to be as elusive and misleading as evaluations based on actual asset values. Reported liabilities are highly unstable depending heavily on current nominal long-term interest rates. True

economic liabilities are much more stable. The key to translating economic liabilities—which were more straightforward to calculate—to asset growth lay in an understanding of funding policy in industrial America. This policy was developed in Chapter 4.

Perhaps the most surprising result in this chapter is the finding that, contrary to the impression given by stable coverage rates, the pension system in the United States has not yet attained its full maturity. The "second-wave" of the maturity process—the gradual "filling-up" of the retiree ranks—is still in progress and promises to continue at least to the year 2000. The second surprising result is that despite increases in the annuity period of 3.7 years over the period 1950–1980, the real pension annuity in terms of wages remained remarkably constant over the period. This result suggests that pension plans as a whole became considerably more generous as a share of wages over the post–World War II period.[20]

---

[20]One rationale for this finding is that as successive cohorts plan to retire early, they plan to save a larger portion of compensation for a pension to enable them to retire with the same replacement ratio. This describes a solution to the retirement model in Appendix 2–1 when the desired retirement age falls.