Volume Title: Issues in Pension Economics

Volume Author/Editor: Zvi Bodie, John B. Shoven, and David A. Wise, eds.

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-06284-8

Volume URL: http://www.nber.org/books/bodi87-1

Publication Date: 1987

Chapter Title: The Incentive Effects of Private Pension Plans

Chapter Author: Laurence J. Kotlikoff, David A. Wise

Chapter URL: http://www.nber.org/chapters/c6863

Chapter pages in book: (p. 283 - 340)

10 The Incentive Effects of Private Pension Plans

Laurence J. Kotlikoff and David A. Wise

The proportion of workers covered by pensions has increased very substantially over the past two or three decades, and in particular the number of older workers with pensions continues to increase. During the same period, and especially in the past decade, the labor force participation of older workers has declined dramatically. The juxtaposition of these two trends suggests the possibility that they may be related. In this paper, we examine the stipulations of private pension plans with a view to analyzing the incentive effects created by their provisions. We find pension plans provide very substantial incentives to terminate work at the current job after the age of early retirement and even greater incentives to leave after the age of normal retirement. While analysis of the plan provisions suggests a potentially large effect of pension plans on labor force participation, the evidence does not directly demonstrate that pension-related work incentives did indeed cause workers to leave the labor force earlier. Such conclusions must rely on the association of individual retirement decisions with the provisions of individual pension plans—an analysis that must await data as yet withheld from public use. Nonetheless, examination of the structure of pension plans suggests the likelihood of a very sizable effect of plan provisions on labor force participation. The analysis of plan provisions also allows inferences about the cost in pension benefits of job

Laurence J. Kotlikoff is professor of economics at Boston University and research associate, National Bureau of Economic Research. David A. Wise is John F. Stambaugh Professor of Political Economy, John F. Kennedy School of Government, Harvard University, and research associate, National Bureau of Economic Research.

Gary Heaton accomplished the very substantial programming task that the paper required and served as a continuous source of information, explanation, and expertise. We thank Tom Gustafson for his very helpful comments.

change. In addition, the examination of plan provisions allows consideration of the differential cost of pension plans for men versus women. The wide diversity of plans and the corresponding wide diversity of the pension-related work incentives is a major theme of the paper.

In an earlier paper Kotlikoff and Wise (1984) emphasized the apparent inconsistency of pension accrual profiles with a spot market view of the labor market. The evidence in this paper, particularly the analysis of post–normal retirement benefit accrual and supplemental benefit formulas, provides even stronger demonstration of the inconsistency. In contrast to the earlier paper, which considered only a limited number of plans with earnings-related benefit formulas, this paper includes the entire universe of defined benefit pension plans.

10.1 Background

10.1.1 Vested Pension Benefit Accrual Profiles

Information on the value of annual vested accrual pension benefits for workers of different ages and with different amounts of service is useful for displaying a variety of pension incentive effects. Vested pension benefit accrual at age a, $I(a)$, equals the difference between pension wealth at age $a + 1$, $Pw(a + 1)$, and pension wealth at age a, $Pw(a)$, accumulated to age $a + 1$ at the nominal interest rate r, that is,

$$I(a) = Pw\,(a + 1) - Pw(a)(1 + r). \tag{1}$$

Pension wealth at age a is defined as the expected value of vested pension benefits discounted to age a. Intuitively $PW(a)$ can be thought of as the worker's pension bank account. If $I(a)$ equals zero, the worker continuing employment with the plan sponsor at age a has exactly the same pension wealth at age $a + 1$ as an identically situated worker who terminates employment at age a. Pension accrual is thus the increment to pension wealth in excess of the return on the previously accumulated pension bank account. Throughout the paper we express pension accrual increments as a fraction of the worker's wage, $W(a)$. Specifically $R(a,t)$ denotes the ratio of $I(a)$ to $W(a)$ for a worker age a with t years of service.

The appendix presents formulas for pension benefit accrual for a very simple defined benefit pension plan, emphasizing the change in the formula at ages of full or partial vesting, at early retirement age, and after noral retirement. This analysis explains why many pension age–accrual profiles show sizable discontinuities at vesting and at early and normal retirement. It is useful here to provide a brief summary of

the iinplications of these formulas. The discontinuities in age accrual profiles associated with vesting are fairly obvious; in the case of cliff vesting (100% vesting occurring at a particular age) $Pw(a)$ in (1) equals zero prior to the age of vesting and suddenly becomes positive at the full vesting age. Hence $I(a)$ is zero prior to cliff vesting and rises to a positive value at the cliff vesting age, a^*; on the other hand, $I(a^* + 1)$ is smaller than $I(a^*)$ because it represents the difference in two pension wealth numbers, rather than simply the value of one, $Pw(a^*)$.

Another discontinuity in $I(a)$ occurs, for most plans, at early retirement. This discontinuity occurs for plans that reduce early retirement benefits using a formula that is less than actuarially fair, and the lower the reduction the greater the decline in $I(a)$. To see this note that prior to the early retirement age $Pw(a)$ is not influenced by the early retirement reduction rate since workers are assumed to start collecting their vested benefits at the most lucrative date, which is almost invariably the age of early retirement; taking benefits at early retirement generally provides a larger present value of vested pension benefits accrued up to this age than opting to begin collecting these accrued benefits later. This reflects the use by pension plans of reduction rates in computing early retirement benefits that typically are lower than the actuarial rate. While $Pw(a)$ and $I(a)$ are independent of the reduction rate prior to early retirement, they are both functions of the reduction factor after early retirement. The smaller the reduction factor, the closer $Pw(a)$ will be to $Pw(a + 1)$, holding other factors constant, and the smaller will be $I(a)$. This is important since the reduction factors of most plans are fairly small, providing substantially less than an actuarial reduction.

A second, more fundamental reason for smaller increments after the early retirement age involves discounting. Prior to early retirement an extra dollar of benefits has a higher present value in the $Pw(a + 1)$ formula than in the $Pw(a)$ formula because at age $a + 1$ the worker is 1 year closer to receipt of these additional benefits than at age a. After the early retirement age benefits are available immediately and, ignoring the worker's shortening life span, an extra dollar of benefits at age $a + 1$ has the same present value as an extra dollar at age a. Stated differently, after early retirement there is no special advantage from raising benefits next year over this year because, like additional benefits earned next year, additional benefits earned this year become available immediately. This lack of discounting after benefits are available raises $Pw(a)$ relative to $Pw(a + 1)$ which implies a smaller annual pension accrual, $I(a)$, and smaller values of $R(a,t)$.

A third factor leading to a drop in $I(a)$ at early retirement is the shorter life span during which benefits will be collected if retirement from the plan is postponed. This factor does not enter into the calculus

for $I(a)$ prior to early retirement because, conditional on reaching early retirement, both $Pw(a + 1)$ and $Pw(a)$ are based on the same potential life span of the worker.

Each of these three factors also plays a role in the significant decline in $I(a)$ at normal retirement. Most pension plans do not increase annual benefits for workers electing to postpone receipt of pensions in years after normal retirement. This implicit zero reduction rate means a smaller value of incremental accrued benefits. The second factor involved in the drop in $I(a)$ after early retirement is the change in discounting of $Pw(a)$ relative to $Pw(a + 1)$. This feature continues after normal retirement as well because benefits remain immediately available. Finally, beyond the normal retirement age there is a more rapid reduction in expected life span and, therefore, in the expected duration of benefit receipt if the worker postpones retiring. This feature also lowers $I(a)$ (see appendix).

While these three features help explain low and even negative values of $I(a)$ after normal retirement, other provisions produce sharp declines in $I(a)$ at normal retirement. According to data in the 1979 BLS Level of Benefits Survey, 23% of covered workers are enrolled in plans that do not credit service at all after normal retirement. Another 30% of covered workers are in plans that provide limited credit after normal retirement, and the remaining pension participants are in plans that credit all service during all years after normal retirement. Plans that provide limited credit typically credit service until the worker reaches a specified age, about age 70 on average.

Once plans stop crediting service they either (1) commence benefit payments immediately regardless of the recipient's work status, (2) defer pension benefits until the worker actually retires, or (3) defer payment until retirement, but actuarially increase the benefit. Of the participants in the plans that provide no or limited credit, 15% receive immediate payments, 76% receive deferred payments with no actuarial increase, and the rest receive deferred payments with an actuarial increase.

10.1.2 Implication of Pension Accrual Discontinuities for Viewing Labor Market Equilibrium

If the labor market exhibits spot market equilibrium, $I(a)$ plus the worker's nonpension compensation at age a, $W(a)$, equals the worker's marginal product at age a, $M(a)$:

$$M(a) = W(a) + I(a). \tag{2}$$

Under the spot market assumption workers always receive $M(a)$ regardless of the firm or its pension plan. If $I(a)$ is smaller in one firm than another, $W(a)$ must be larger in the firm with the smaller value of $I(a)$ to insure equality of total annual compensation across firms. Since

in a spot market equilibrium workers can freely move from one firm to another and firms can freely fire any worker demanding more than $M(a)$, only accrued vested benefits will have any economic value; if the value of this year's pension benefits reflected anything other than those to which the worker had legal title, either the worker or the employer would have an incentive to terminate the employment relationship. Note that the terms in (1) incorporate the spot market free mobility assumption in that workers are assumed to choose the most advantageous date to start collecting previously accumulated benefits since "retiring" for purposes of collecting a pension from one firm does not preclude subsequent work in another firm paying $M(a)$.

Obviously, if $W(a)$ is a smooth function of age, and $I(a)$ exhibits sharp discontinuities, $M(a)$ must exhibit sharp discontinuities at these same ages to satisfy (2). Casual empiricism suggests that $W(a)$ changes smoothly with age, or at least does not abruptly change precisely at ages when $I(a)$ exhibits sharp changes. There is also no reason to believe that $M(a)$ abruptly changes with age to satisfy (2); hence the sizable discontinuities reported here in the $I(a)$ profile appear strikingly at odds with the spot market condition (2).

10.1.3 Calculating Vested Benefit Accrual Profiles

This study calculates accrual profiles for 2,342 of the 2,492 plans identified by the BLS as usable.[1] Throughout the paper we focus on the age profiles of the ratios of $I(a)$ to $W(a)$; that is, we express the pension increments at age a as a fraction of the wage at age a. We utilize the survey's weights in presenting various average accrual profiles. The weights reflect the plan's fraction of total pension participants. To construct accrual profiles for plans which base their benefits on earnings we used a set of industry- and occupation-specific cross-section age earnings profiles estimated from CPS data. Longitudinal age earnings profiles were obtained by assuming 6% overall growth in wages and adding to this the wage growth by age estimated by the CPS cross section data. Kotlikoff and Wise (1984) describe these estimates in detail. In the analysis here we assume that wage earnings after age 65 remain constant in nominal dollars. Our actuarial calculations employ a 9% nominal interest rate and use a unisex mortality table, which represents an average of male and female mortality probabilities. Unlike the simple formulas in the appendix, our calculations take account of the worker's survival probabilities before retirement as well as after.

The BLS Level of Benefits Survey contains highly detailed information concerning the sampled pension plans' vesting provisions, requirements for early and normal retirement, the specifics of their normal and supplemental benefit formulas, and the crediting of service and payment of benefits for those working beyond the normal retirement age.

There is a very considerable amount of diversity in the particular provisions of private plans which generate sizable differences in vested pension benefit accrual. Many seemingly minor features of a plan can have very important effects on benefit accrual. For example, consider a stipulation that service is credited for only 25 years in a plan that permits early retirement at 62. For a worker hired at age 30 the accrual at age 55 will decline sharply to zero and remain at zero until the early retirement age. Without this ceiling on credited service, accrual between ages 55 and 62 could be very sizable; the weighted average ratio of pension accrual to the wage is roughly 15% in our sample of plans with age 62 early retirement. Other examples of very important "details" of pension provisions are age and service requirements for supplemental benefits, ceilings on the amount by which social security benefits can be used to offset pension benefits, maximum values of pension benefits, discontinuous changes by age in the rate of benefit reduction for early retirement, and maximum ages for plan participation. Each of these features, as well as numerous others not mentioned, can produce sharp discontinuities in $I(a)$ at ages other than the ages of vesting, early retirement, and normal retirement. Our calculations take into account each of the seemingly "minor" as well as major pension provisions included in the data.

The considerable variation in plan features within industry and occupation and, consequently, accrual profiles raises several important issues about the functioning of the U.S. labor market. First, equally productive workers are likely to face very different incentives to change jobs or retire because of pension plans. Second, the heterogeneity in accrual profiles across plans suggests that equally productive workers in the same industry and occupation, but in different plans, may be receiving quite different amounts of total compensation both on an annual and on a lifetime basis. Third, equally productive workers of different sexes or ages who join the same pension plan in a firm at the same time are likely to receive very different labor remuneration, even if the quality and quantity of their labor supply is equivalent. Fourth, the complexity of the calculations required to compute the accrual of vested benefits, and therefore the compensation one is currently receiving, calls into question the understanding of pension compensation both on the part of employers and workers.

10.2 Pension Accrual Profiles for Percent-of-Earnings Plans

Percent-of-earnings plans are discussed in this section and flat (non-earnings-related) plans in the next. Variation in pension accrual profiles by early and normal retirement ages is discussed first, followed by a discussion of the wide variation among plans holding early and normal

retirement ages fixed. Next we consider the effect of social security offset provisions and also examine accrual profiles by industry and by occupation. Then the effects of alternative post–normal retirement provision are discussed. Finally there is an analysis of the effects on accrual profiles of early and normal retirement supplements. The cost in pension wealth of job change is discussed in section 10.4. Section 10.5 describes the differences in the pension cost of hiring women versus men.

10.2.1 The Decline in Pension Wealth Accrual at Early and Normal Retirement Ages

Average accrual profiles for the percent-of-earnings plans with 10-year cliff vesting are shown in table 10.1 by early and normal retirement ages. Three of these average profiles corresponding to plans with the respective early and normal retirement ages—55-55, 55-65, 65-65—are graphed in figure 10.1 In this and subsequent figures and tables, annual accrued pension benefits are expressed as a ratio of the wage. The graph depicts the very substantial declines in the rate of pension wealth accrual at several critical ages. The first is the age of normal retirement, which equals the age of early retirement for plans with no early retirement option. Second, there is also a sharp decline in the rate of accrual at the age of early retirement, but this decline is substantially lower than the decline at the normal retirement age.[2] Third, there is a very substantial decline between ages 65 and 66 in the average accrual rate no matter what the ages of early and normal retirement.

The actual declines in average accrual rates at these critical ages indicated in table 10.1 are highlighted in table 10.2. The ages of early and normal retirement are identical in columns, 1, 4, 6, and 8 of the table with respective retirement ages of 55, 60, 62, and 65. At these ages the accrual rates as a percentage of wages decline from .26 to 0, .27 to −.06, .25 to −.13, and .21 to −.19, respectively. Thus, at these ages the total annual compensation (wage plus pension accrual) from working declines by 21%, 26%, 30%, and 33% respectively. Surely then the incentive to continue work with the current employer past these ages is very substantially reduced.

In instances where early and normal retirement ages do not coincide, there is also a very substantial decline in the ratio of pension accrual to the wage at the age of normal retirement. For example, among plans with early retirement at 55 and normal retirement at 60 the decline is from .14 to −.09. There is also a decline at the age of early retirement for these plans, although it is considerably less substantial than the decline at the age of normal retirement. For example, of plans with early retirement at 55 and normal retirement at 65 the decline at 55 is from .10 to .07, while at 65 the decline is from .04 to −.15.

Table 10.1 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting, by Early and Normal Retirement Age**

	Retirement Age (Early/Normal)							
Age	55/55 (N = 152)	55/60 (N = 115)	55/65 (N = 513)	60/60 (N = 78)	60/65 (N = 53)	62/62 (N = 19)	62/65 (N = 8)	65/65 (N = 50)
40	**.244**	**.111**	**.071**	**.034**	**.047**	**.038**	**.054**	**.036**
41	.045	.022	.013	.007	.010	.016	.009	.010
42	.051	.026	.016	.008	.011	.017	.010	.011
43	.058	.029	.018	.010	.013	.120	.011	.012
44	.066	.033	.020	.011	.015	.029	.013	.014
45	.075	.036	.023	.013	.017	.036	.013	.016
46	.085	.043	.026	.016	.019	.042	.015	.018
47	.097	.050	.031	.028	.022	.047	.017	.021
48	.110	.057	.035	.039	.025	.054	.019	.024
49	.124	.064	.040	.056	.029	.060	.021	.027
50	.141	.077	.046	.065	.034	.068	.023	.031
51	.159	.072	.052	.084	.040	.077	.026	.033
52	.180	.087	.062	.091	.050	.090	.028	.043

53	.204	.099	.072	.105	.060	.101	.032	.050
54	.231	.113	.083	.117	.068	.114	.035	.055
55	.261	**.130**	**.097**	.149	.082	.128	.039	.065
56	−.003	.100	.068	.170	.094	.144	.036	.068
57	−.012	.111	.072	.192	.107	.162	.039	.076
58	−.020	.118	.076	.224	.127	.184	.044	.089
59	−.028	.129	.077	.241	.146	.208	.048	.105
60	−.038	**.143**	.079	**.269**	**.167**	.241	.054	.118
61	−.048	−.090	.068	−.061	.133	.220	.059	.128
62	−.058	−.091	.064	−.091	.115	**.248**	**.066**	.145
63	−.067	−.091	.056	−.114	.114	−.130	.017	.163
64	−.076	−.092	.053	−.121	.114	−.136	.012	.186
65	**−.085**	**−.094**	**.044**	**−.121**	**.112**	**−.144**	**.006**	**.211**
66	−.292	−.169	−.152	−.138	−.088	−.266	−.081	−.194
67	−.294	−.174	−.162	−.155	−.115	−.263	−.080	−.204
68	−.295	−.179	−.171	−.171	−.142	−.260	−.079	−.213
69	−.296	−.182	−.179	−.184	−.162	−.258	−.078	−.221
70	−.297	−.184	−.186	−.196	−.182	−.255	−.077	−.234

NOTE: Plans with early or normal retirement supplements are excluded.

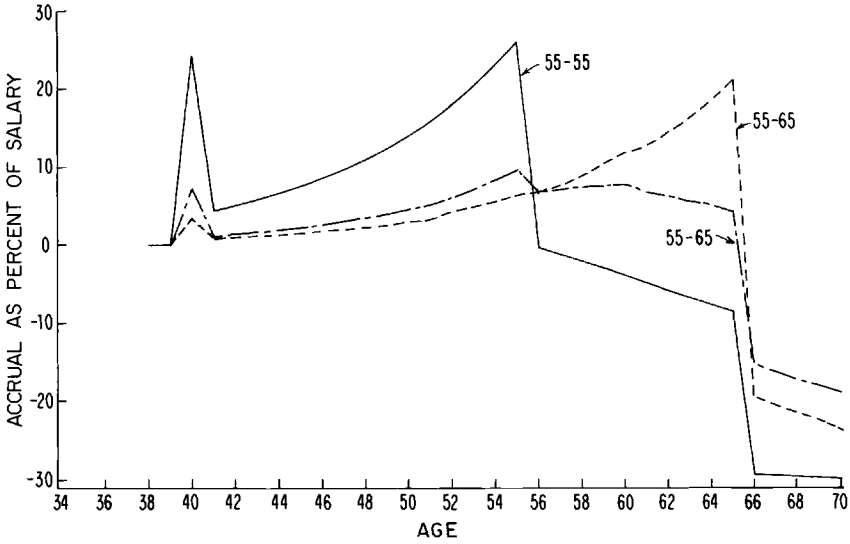

Fig. 10.1 Weighted average accrual rates for percent-of-earnings plans with 10-year cliff vesting, for selected early and normal retirement ages. Plans with early or normal retirement supplements are excluded.

Table 10.2

	Retirement Age (Early/Normal)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age	55/55	55/60	55/65	60/60	60/65	62/62	62/65	65/65
40	.244	.111	.071	.034	.047	.038	.054	.036
55	**.261**	.130	.097					
56	**−.003**	.100	.068					
60		**.143**		**.269**	.167			
61		**−.090**		**−.061**	.113			
62						**.248**	.066	
63						**−.130**	.017	
65	−.085	−.094	**.044**	−.121	**.112**	−.144	**.006**	.211
66	−.292	−.169	**−.152**	−.138	**−.088**	−.266	**−.081**	−.194
70	−.297	−.184	−.186	−.196	−.182	−.255	−.077	−.234
65–66	20	8	19	2	20	12	8	40

Finally, in all cases there is a substantial decline in the rate of pension accrual between ages 65 and 66. The effective reduction in compensation ranges from 8% to 40% of the wage rate except for plans with early and normal retirement at 60, in which case the decline is from $-.12$ to $-.14$. Thus while the stipulations of plans vary tremendously, these plans, on average, seem to provide a substantial inducement to retirement after age 65, no matter what the inducement before this age.

The figure and the table also show a large variation in average pension accrual at 40, the age of cliff vesting. It is highest, on average, for plans with early and normal retirement at 55 and lowest, on average, for plans with early and normal retirement at 65. As mentioned, because the early retirement reduction typically is less than actuarially fair, pension wealth is generally greatest if benefits are taken at the age of early retirement. Thus the accrued wealth at the age of vesting is usually calculated by discounting benefits from the age of early retirement, assuming that the worker could begin to collect benefits at that age. Figure 10.1, for example, shows a vesting spike of almost 25% of earnings for 55-55 plans, 7% of earnings for 55-65 plans, and about 4% of earnings for 65-65 plans.

In summary, it seems apparent that continued participation in the labor force after the age of normal retirement and sometimes even after the age of normal retirement typically involves a substantial reduction in compensation because of the very large declines in the rate of pension wealth accrual. After the age of 65, there is typically a substantial loss in pension accrual, no matter what the ages of early and normal retirement. And, the sharp changes in average pension accrual at particular ages provides rather strong prima facie evidence against annual spot market clearing; neither wages nor marginal products appear to adjust at these critical ages to meet the spot market equilibrium condition written in (1).

10.2.2 Variation Among Plans

Even among plans with the same early and normal retirement ages there is wide variation in accrual rates at each age, particularly after the age of early retirement. To demonstrate this fact, average accrual rates for the 513 plans of table 10.1 with early retirement at 55 and normal retirement at 65, together with median, maximum, minimum, and upper and lower 5 percentile levels, are shown in table 10.3. The lower 5 percentile points for any age group for example is that accrual rate such that 5% of plans have accruals below that level. The upper 5 percentile point is defined analogously. Consider the accrual ratio at vesting. While the average vesting ratio for this sample is .071, the median is .021, the maximum is .383, and the minimum is zero. The ratio at the lowest fifth percentile is 0, while it is .201 for the largest

Table 10.3 **Dispersion of Accrual Ratios for Table 10.1 Plans with Age 55 Early Retirement and Age 65 Normal Retirement (N = 513)**

Age	Weighted Average Accrual Ratios	Median Accrual Ratios	Minimum Accrual Ratios	Maximum Accrual Ratios	Lowest Fifth Percentile	Largest Fifth Percentile
40	**.071**	**.021**	**0**	**.383**	**0**	**.201**
41	.013	.012	−.025	.071	0	.036
42	.016	.013	−.025	.080	0	.041
43	.018	.014	−.027	.091	0	.046
44	.020	.016	−.026	.103	0	.052
45	.023	.019	−.029	.116	0	.058
46	.026	.023	−.028	.131	0	.066
47	.031	.028	−.024	.162	0	.076
48	.034	.032	−.020	.167	0	.083
49	.040	.039	−.020	.188	0	.093
50	.046	.046	−.011	.212	0	.106
51	.052	.052	−.020	.240	0	.119
52	.062	.061	−.019	.270	0	.140
53	.072	.072	−.015	.305	0	.157
54	.083	.083	−.015	.344	0	.180
55	**.097**	**.100**	**−.005**	**.405**	**0**	**.208**
56	.068	.075	−.065	.424	0	.165
57	.072	.079	−.063	.363	0	.171
58	.076	.083	−.051	.248	0	.183
59	.077	.083	−.046	.286	−.0006	.190
60	.079	.086	−.064	.345	−.014	.204
61	.068	.074	−.156	.339	−.038	.181
62	.064	.068	−.154	.325	−.050	.190
63	.056	.062	−.192	.310	−.115	.191
64	.053	.060	−.221	.460	−.119	.210
65	**.044**	**.052**	**−.323**	**.326**	**−.148**	**.205**
66	−.152	−.136	−.558	.121	−.203	0
67	−.162	−.159	−.550	.060	−.406	0
68	−.171	−.179	−.541	.043	−.412	0
69	−.179	−.190	−.534	.029	−.414	0
70	−.186	−.197	−.618	.014	−.424	0

fifth percentile. A similarly large dispersion in annual accrual ratios is indicated for each of the ages 40 through 70. Weighted average accrual rates together with upper and lower 5 percentile levels are graphed in figure 10.2. While the average accrual rates between ages 55 and 65 are positive, for many plans the rates by 65 are very negative. Thus it is important to base judgment about the labor force participation incentive effects of pension plans on more than average accrual rates.

Additional evidence of the variability of pension accrued profiles is obtained by comparing profiles of particular plans. Figure 10.3 plots the accrual profiles of four of the sample's 30 largest plans. Plan 1

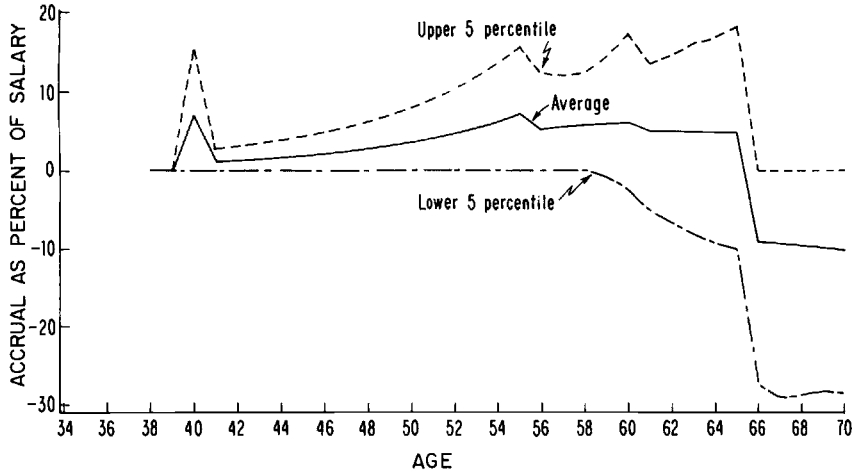

Fig. 10.2 Weighted average accrual rates and upper and lower 5 percentile levels for percent-of-earnings plans with 10-year cliff vesting, early retirement at 55 and normal retirement at 65. (Note: Plans with early or normal retirement supplements are excluded.)

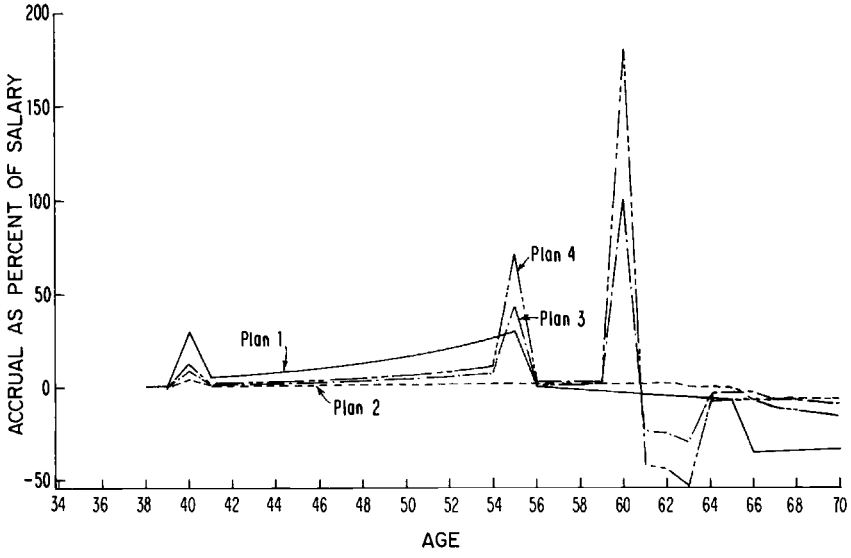

Fig. 10.3 Accrual profiles for four large plans.

exhibits a 29% vesting spike, a reduction of 30 percentage points in the accrual ratio at age 55 and a further major reduction at age 65 from −.063 to −.351. In contrast the vesting spike is only 4% for plan 2 in the figure. This plan also exhibits no major reduction in the accrual ratio at early retirement and only a minor reduction at normal retirement. Plan 3's vesting spike is much less than that of plan 1, but the drop off of the accrual ratio at age 55 is very much larger than that in plan 1. This plan also exhibits extremely sharp changes in accrual ratios at ages 60 and 63. Plan 4 exhibits even greater discontinuities in the accrual profile. Thus the plans' incentive effects on labor force participation also vary widely.

10.2.3 The Effect of Social Security Offsets

As described above, a substantial number of plans have social security offset provisions, under which pension benefits are reduced by an amount depending upon the recipients' social security benefits. The offset provisions vary widely among plans. In some instances the offset is enough to completely eliminate payment of pension benefits from the private pension plan. Private pension benefit payments are typically substantially lower with than without the offset provision. Accrual rates for percent-of-earning plans with 10-year cliff vesting and early retirement at 55 are shown in table 10.4 for selected normal retirement ages, with and without social security offset provisions. The average profiles for offset and non-offset plans with early retirement at 55 and normal retirement at 62 are graphed in figure 10.4. A noticeable difference between the two groups of plans is the relatively large spike at vesting for plans without the offset compared with the low rate of accrual at vesting or plans with the social security offset. In addition, the accrual ratio at 55 is larger for plans without the offset than for plans with it, and the drop in the rate of accrual is substantially larger for plans without than for plans with the offset. The accrual ratio for plans without an offset is .21 at 55 and drops by almost 60% to .09 at 56. In contrast, the accrual rate for plans with an offset is about 16% at 55 and drops by only about 26% to .12 at age 56. Both groups of plans show negative accrual rates after the age of normal retirement, 62, and both groups of plans show much larger negative accrual rates after 65. Table 5.4 indicates that the relative accrual rates of the two groups for plans with different normal retirement ages are similar to those shown in the figure.

The table also shows that pension accrual at the age of vesting is rather substantial for plans without a social security offset even among plans with normal retirement at 65. The average accrual rate at vesting for all plans with early retirement at 55 and normal retirement at 65 is .071, as shown in table 10.1 above. It can be seen in table 10.4 that

Table 10.4 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at Age 55, by Normal Retirement Age and Social Security Offset**

	Normal Retirement Age					
	55		62		65	
Age	Without Offset (N = 135)	With Offset (N = 17)	Without Offset (N = 103)	With Offset (N = 84)	Without Offset (N = 254)	With Offset (N = 259)
40	**.260**	**.073**	**.175**	**.030**	**.121**	**.016**
41	.049	.005	.034	.010	.022	.004
42	.055	.008	.039	.014	.026	.005
43	.062	.010	.044	.017	.029	.006
44	.071	.013	.049	.020	.033	.007
45	.080	.017	.064	.024	.037	.009
46	.090	.030	.064	.027	.041	.011
47	.102	.039	.074	.034	.078	.013
48	.115	.047	.086	.040	.052	.016
49	.130	.061	.100	.049	.058	.019
50	.147	.074	.112	.066	.065	.025
51	.166	.089	.127	.079	.072	.029
52	.187	.108	.143	.096	.081	.041
53	.211	.127	.165	.112	.091	.051
54	.238	.146	.185	.132	.102	.062
55	**.269**	**.175**	**.213**	**.155**	**.116**	**.076**
56	.008	.042	.090	.115	.078	.058

Table 10.4 (continued)

	Normal Retirement Age					
	55		62		65	
Age	Without Offset (N = 135)	With Offset (N = 17)	Without Offset (N = 103)	With Offset (N = 84)	Without Offset (N = 254)	With Offset (N = 259)
57	−.016	.036	.092	.120	.077	.065
58	−.025	.040	.103	.135	.076	.076
59	−.034	.034	.096	.140	.073	.082
60	−.043	.025	.087	.143	.069	.091
61	−.052	−.004	.090	.109	.071	.066
62	−.062	−.012	**.087**	**.110**	.061	.068
63	−.071	−.024	−.075	−.066	.047	.066
64	−.081	−.026	−.086	−.069	.040	.067
65	**−.090**	**−.032**	**−.098**	**−.074**	**.025**	**.066**
66	−.309	−.109	−.224	−.154	−.203	−.097
67	−.309	−.132	−.248	−.170	−.212	−.108
68	−.308	−.153	−.270	−.184	−.219	−.119
69	−.307	−.172	−.280	−.196	−.227	−.128
70	−.307	−.191	−.290	−.204	−.233	−.136

NOTE: Plans with early or normal retirement supplements are excluded.

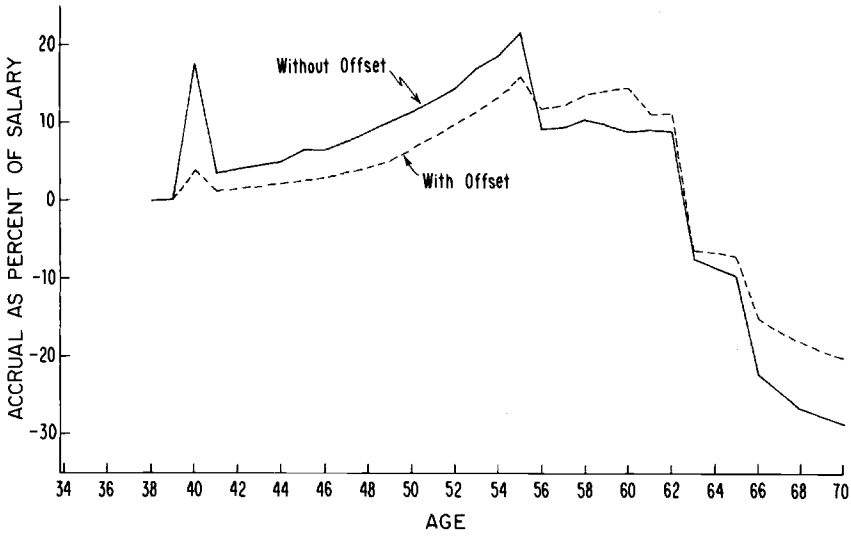

Fig. 10.4 Weighted average accrual rates for percent-of-earnings plans with 10-year cliff vesting, early retirement at 55 and normal retirement at 62, for plans with and without social security offsets. (Note: Plans with early or normal retirement supplements are excluded.)

the accrual is over 12% for plans without a social security offset while it is less than 2% for plans with an offset.

10.2.4 Accrual Ratios by Industry and Occupation

Industry

Accrual profiles for selected industries are shown in table 10.5. For purposes of comparison and for ease of exposition, profiles are presented only for plans with early retirement at 55, although profiles for three normal retirement ages, 55, 62, and 65, are shown. The most apparent difference among industries is in the proportion of plans with particular early and normal retirement ages. For example, in retail trade and services almost all plans have normal retirement at 65; only a few plans have early retirement at 55 or 62. On the other hand, almost 62% of plans in transportation have early and normal retirement at 55; approximately 20% of plans show normal retirement at 62 and 20% at 65. In manufacturing, 66% of plans have normal retirement at 65, 28% at 62, and about 6% at 55.

But among plans with the same early and normal retirement age, table 5.5 indicates little difference in average accrual profiles across industries. Table 10.6 isolates accrual ratios at critical ages, in particular

Table 10.5 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at 55, by Industry and Normal Retirement Age**

	Manufacturing			Transportation		
Age	55/55 (N = 22)	55/62 (N = 107)	55/65 (N = 256)	55/55 (N = 120)	55/62 (N = 37)	55/65 (N = 37)
40	**.227**	**.091**	**.056**	**.257**	**.168**	**.122**
41	.039	.019	.011	.048	.035	.021
42	.045	.024	.013	.055	.040	.024
43	.051	.028	.015	.062	.045	.027
44	.058	.032	.017	.070	.050	.030
45	.066	.037	.020	.079	.075	.034
46	.078	.041	.023	.090	.067	.035
47	.089	.050	.026	.101	.075	.040
48	.101	.060	.030	.114	.085	.045
49	.115	.073	.035	.129	.096	.052
50	.129	.080	.041	.146	.110	.060
51	.146	.092	.046	.165	.127	.067
52	.165	.103	.052	.187	.147	.081
53	.187	.119	.063	.211	.178	.098
54	.211	.134	.074	.238	.201	.111
55	**.240**	**.158**	**.087**	**.269**	**.228**	**.127**
56	−.008	.100	.067	−.003	.078	.091
57	−.178	.099	.072	−.011	.093	.094
58	−.025	.103	.079	−.019	.126	.100
59	−.035	.102	.081	−.028	.126	.103
60	−.046	.098	.084	−.036	.125	.109
61	−.057	.096	.074	−.045	.098	.093
62	−.068	**.101**	.074	−.054	**.087**	.086
63	−.079	−.080	.071	−.062	−.077	.063
64	−.088	−.087	.070	−.071	−.085	.062
65	**−.099**	**−.095**	**.068**	**−.080**	**−.094**	**.058**
66	−.288	−.158	−.141	−.300	−.242	−.206
67	−.288	−.174	−.152	−.301	−.276	−.217
68	−.288	−.189	−.161	−.302	−.309	−.227
69	−.288	−.204	−.170	−.302	−.320	−.237
70	−.288	−.216	−.177	−.302	−.329	−.246

NOTE: Plans with early or normal retirement supplements are excluded.

before and after the age of early retirement and before and after the age of normal retirement. Averages are only presented for cells with more than 10 plans. Two dashes indicate that there were fewer than 10. The cell was left blank if the corresponding age did not represent a critical age for the plan in question. Only in manufacturing and transportation were there a substantial number of plans with early and normal retirement at 55. In these two industries, the accrual profiles look very similar. Three industries had a significant number of plans with

Retail Trade			Finance			Services		
55/55 (N = 2)	55/62 (N = 6)	55/65 (N = 90)	55/55 (N = 2)	55/62 (N = 18)	55/65 (N = 70)	55/55 (N = 3)	55/62 (N = 3)	55/65 (N = 33)
.021	**.001**	**.080**	**.068**	**.086**	**.077**	**.251**	**.179**	**.068**
.020	.001	.014	.027	.020	.017	.047	.033	.013
.019	.001	.0126	.033	.023	.020	.053	.037	.015
.018	.001	.017	.039	.026	.023	.060	.042	.017
.017	.002	.019	.048	.031	.026	.068	.048	.019
.015	.002	.021	.057	.035	.030	.076	.054	.023
.016	.002	.023	.068	.041	.033	.086	.061	.027
.016	.003	.026	.080	.047	.038	.098	.069	.030
.016	.003	.028	.095	.054	.044	.110	.078	.034
.087	.007	.031	.109	.067	.050	.124	.087	.041
.110	.015	.035	.130	.117	.058	.140	.099	.048
.125	.020	.038	.152	.135	.066	.157	.111	.056
.140	.022	.043	.203	.172	.092	.178	.126	.064
.163	.025	.046	.230	.193	.104	.200	.142	.075
.172	.080	.050	.267	.220	.122	.226	.160	.086
.196	**.098**	**.056**	**.306**	**.250**	**.146**	**.254**	**.182**	**.098**
−.182	.087	.034	.092	.141	.092	−.010	.162	.082
−.176	.084	.032	.083	.140	.096	−.018	.161	.087
−.171	.114	.027	.083	.143	.104	−.027	.158	.096
−.167	.107	.018	.074	.140	.108	−.035	.153	.106
−.164	.097	.018	.064	.134	.110	−.045	.1248	.112
−.161	.070	.013	−.052	.054	.099	−.053	.277	.080
−.159	**.045**	.002	−.065	**.044**	.098	−.062	**.367**	.075
−.158	−.040	−.017	−.078	−.093	.097	−.072	−.075	.069
−.159	−.054	−.027	−.088	−.100	.098	−.081	−.086	.063
−.106	**−.068**	**−.059**	**−.099**	**−.108**	**.096**	**−.090**	**−.096**	**.054**
−.040	−.160	−.156	−.150	−.187	−.167	−.316	−.406	−.144
−.044	−.158	−.158	−.206	−.214	−.175	−.311	−.400	−.152
−.048	−.157	−.160	−.256	−.238	−.192	−.807	−.395	−.158
−.045	−.158	−.161	−.300	−.245	−.207	−.302	−.390	−.164
−.050	−.159	−.162	−.339	−.251	−.222	−.297	−.384	−.169

early retirement at 55 and normal retirement at 62, and again there seems to be little noticeable difference among the plans by industry. All industries have plans with normal retirement at 65. but even in this case, the profiles seem quite similar. The only possible exception seems to be retail trade, where pension accrual relative to the wage rate is less generous than in the other industry groups.

Nonetheless, a typical worker apparently faces a much greater incentive to leave the labor force early in some industries than in others.

Table 10.6 **Weighted Average Accrual Rates at Selected Ages for Percent-of-Earnings Plans with 10-Year Cliff Vesting Early Retirement at 55, Early and Normal Retirement Ages and Industry**

Early/ Normal Retirement Ages, Age	Industry				
	Manufacturing	Transportation	Retail Trade	Finance	Services
55/55					
40	.227	.257	—	—	—
55	.240	.269	—	—	—
56	−.008	−.003	—	—	—
62					
63					
65	−.099	−.080	—	—	—
66	−.288	−.300	—	—	—
70	−.288	−.302	—	—	—
55/62					
40	.091	.168	—	.086	—
55	.158	.228	—	.250	—
56	.100	.078	—	.141	—
62	.101	.087	—	.044	—
63	−.080	−.077	—	−.093	—
65	−.095	−.097	—	−.108	—
66	−.158	−.242	—	−.187	—
70	−.216	−.329	—	−.251	—
55/65					
40	.056	.122	.080	.077	.068
55	.087	.127	.056	.146	.098
56	.067	.091	.034	.092	.082
62					
63					
65	.068	.058	−.059	.096	.054
66	−.141	−.206	−.156	−.167	−.144
70	−.177	−.246	−.162	−222	−.169

For example, a large portion of workers covered by pensions in transportation would experience a 27% reduction in effective compensation by continuing to work between 55 and 56. Whereas at age 55 pension accrual would be equivalent to about 27% of wage rates for many workers in this industry, if the worker continued in the labor force until age 66, his annual loss in pension wealth would be equivalent to 30% of wage earnings at 66. A large proportion of workers in manufacturing have plans with early retirement at 55 and normal retirement at 65. In this case, the accrual at 55 averages about 9% of the wage at 55 and declines only to about 7% of the wage by 65. But then the accrual rate becomes negative, and if the worker were to continue in the labor force

between 65 and 66, the decline in pension accrual would amount to an effective reduction in compensation of about 21%.

Occupation

Among plans with the same early and normal retirement ages, the pension accrual ratios do not differ noticeably by occupation. Accrual ratios for professions, clerical workers, and production workers are shown in table 10.7 for plans with early retirement at age 55 and three normal retirement ages—55, 62, and 65. Plans in the 55-65 group are graphed by occupation in figure 10.5. It seems clear from the table and the figure that given the age of normal retirement, there appear to be no substantial differences in accrual ratios by occupational group. Consider, for example, plans with normal retirement at age 55: at age 55, the accrual ratio is .29 for professionals, .25 for clerical workers, and .25 for production workers. At age 66, the accrual ratio has dropped to −.30 for professionals, −.30 for clerical workers, and −.29 for production workers. Similarly, close ratios are observed for the other two normal retirement ages. For example, at age 62 the accrual ratios for plans with normal retirement at 62 are .10 for professionals, .10 for clerical workers, and .10 for production workers. This is not to say that there are no differences in pension coverage by occupational groups. It simply says that conditional on having a plan with given early and normal retirement ages, the accrual ratios for the occupational groups are very similar. The data in table 10.7 may, however, be concealing intra-industry variation in accrual profiles by occupation for given retirement ages.

To address this potential ambiguity, accrual ratios for the same plans treated in table 10.7 are presented in table 10.8 but only for manufacturing. But here again there is very little difference in the accrual profiles by occupation. Consider, for example, the drop in accrual ratios between ages 55 and 66. For plans with normal retirement at age 55, the decline is .58 (.287 minus −.295) for professionals, .51 for clerical workers, and .50 for production workers. Analogous declines are .29 for professionals, .30 for clerical workers, and .35 for production workers, respectively, in plans with normal retirement at 62. Only among plans with normal retirement at age 65 is there a noticeable difference in the accrual ratios by occupation. In this case, the drop between age 55 and age 66 is .29 for professionals, .25 for clerical workers, but somewhat less than .18 for production workers. Thus we conclude that differences in pension accrual ratios by occupation are primarily due to different plan types or to differences in early and normal retirement, given the general type of plan. Production workers, for example, are more likely to have flat benefit plans than professionals.

Table 10.7 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at Age 55, by Normal Retirement Age and Occupation**

	Normal Retirement Age = 55			Normal Retirement Age = 62			Normal Retirement Age = 65		
Age	Prof. (N = 53)	Cler. (N = 51)	Prod. (N = 48)	Prof. (N = 75)	Cler. (N = 74)	Prod. (N = 38)	Prof. (N = 204)	Cler. (N = 199)	Prod. (N = 110)
40	**.251**	**.240**	**.242**	**.091**	**.111**	**.115**	**.072**	**.077**	**.062**
41	.047	.046	.044	.020	.023	.024	.015	.014	.011
42	.054	.052	.050	.026	.027	.028	.017	.017	.013
43	.061	.059	.056	.030	.031	.032	.019	.019	.016
44	.069	.066	.064	.035	.036	.036	.022	.022	.018
45	.078	.075	.073	.044	.044	.047	.025	.025	.020
46	.092	.084	.082	.045	.048	.047	.029	.028	.022
47	.105	.095	.093	.054	.057	.053	.036	.033	.025
48	.119	.107	.106	.062	.067	.063	.039	.036	.028
49	.135	.122	.120	.071	.078	.078	.045	.042	.033
50	.154	.137	.135	.086	.095	.089	.053	.048	.037
51	.175	.154	.153	.100	.108	.103	.060	.055	.041

52	.199	.175	.173	.116	.128	.117	.072	.068	.046
53	.226	.196	.196	.132	.147	.141	.083	.077	.055
54	.256	.220	.222	.155	.166	.160	.098	.089	.063
55	**.291**	**.248**	**.252**	**.177**	**.191**	**.187**	**.112**	**.104**	**.075**
56	.020	−.025	−.005	.102	.113	.093	.079	.070	.058
57	.012	−.036	−.012	.106	.115	.096	.082	.074	.060
58	.006	−.046	−.020	.116	.127	.112	.086	.080	.064
59	−.001	−.058	−.027	.119	.126	.109	.087	.081	.065
60	−.010	−.070	−.035	.118	.121	.104	.084	.082	.072
61	−.019	−.087	−.044	.103	.098	.097	.069	.072	.064
62	−.027	−.101	−.052	**.100**	**.098**	**.096**	.062	.067	.063
63	−.036	−.114	−.060	−.069	−.077	−.068	.053	.060	.055
64	−.042	−.128	−.068	−.074	−.087	−.074	.051	.052	.054
65	**−.049**	**−.140**	**−.075**	**−.080**	**−.098**	**−.083**	**.038**	**.042**	**.052**
66	−.295	−.295	−.290	−.171	−.203	−.199	−.167	−.157	−.133
67	−.298	−.298	−.289	−.185	−.223	−.224	−.175	−.169	−.143
68	−.303	−.300	−.288	−.199	−.242	−.247	−.184	−.180	−.149
69	−.306	−.302	−.287	−.206	−.252	−.260	−.193	−.190	−.156
70	−.310	−.304	−.286	−.214	−.261	−.272	−.201	−.199	−.160

NOTE: Plans with early or normal retirement supplements are excluded.

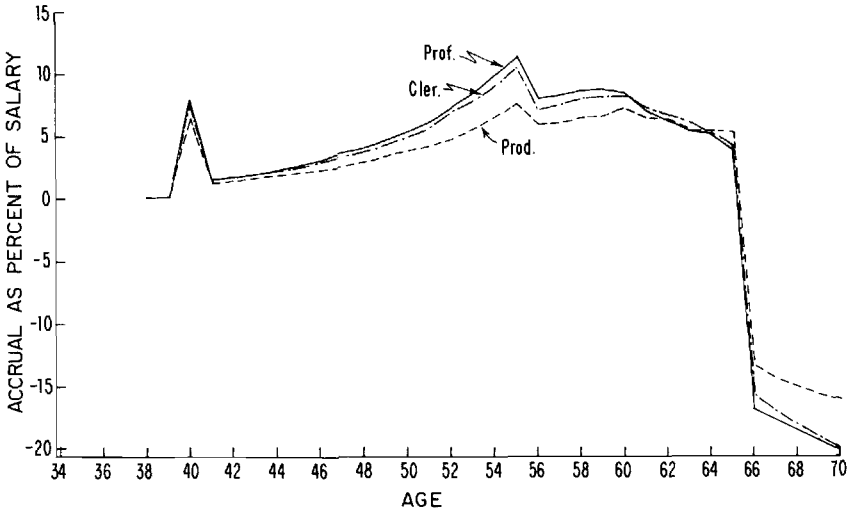

Fig. 10.5 Weighted average accrual rates for percent-of-earnings plans with 10-year cliff vesting, early retirement at 55 and normal retirement at 65, by occupation. (Note: Plans with early or normal retirement supplements are excluded.)

10.2.5 The Effect of Alternative Post–Normal Retirement Provisions on Pension Accrual

Accrual ratios for percent-of-earnings plans with early retirement at 55 are shown in table 10.9 for selected normal retirement ages and for alternative post–normal retirement provisions. The post–normal retirement provisions have been grouped into five categories:

1. *Full credit, deferred:* Plans providing full credit according to the standard formula for years worked past the age of normal retirement, but with benefits beginning only after retirement.
2. *No credit, deferred:* Plans with no credit given for work after the the age of normal retirement and with benefits beginning only after retirement.
3. *No credit, immediate payout or actuarial increase:* Plans with no credit given for additional work after the age of normal retirement, but with benefits beginning immediately or increased actuarially until benefits are taken.
4. *Limited credit, deferred:* Plans with limited credit given for work after the age of normal retirement or with full credit for service post normal retirement up to a specified age or number of years; benefits are deferred in these plans until retirement.
5. *Limited credit, immediate payout or actuarial increase:* Plans with provisions analogous to the third category above but with limited credit rather than no credit.

Table 10.8 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at Age 55, by Normal Retirement Age and Occupation, for Manufacturing**

	Normal Retirement Age = 55			Normal Retirement Age = 62			Normal Retirement Age = 65		
Age	Prof. (N = 9)	Cler. (N = 7)	Prod. (N = 6)	Prof. (N = 44)	Cler. (N = 45)	Prod. (N = 18)	Prof. (N = 101)	Cler. (N = 99)	Prod. (N = 56)
40	**.247**	**.213**	**.219**	**.082**	**.081**	**.108**	**.064**	**.059**	**.050**
41	.045	.037	.036	.018	.080	.022	.013	.009	.010
42	.051	.043	.042	.026	.021	.025	.016	.011	.012
43	.057	.049	.048	.030	.024	.028	.018	.012	.014
44	.064	.056	.054	.035	.028	.032	.021	.015	.015
45	.072	.065	.063	.040	.032	.036	.024	.017	.018
46	.091	.075	.071	.041	.039	.041	.029	.020	.020
47	.106	.085	.081	.053	.049	.046	.035	.023	.023
48	.120	.096	.091	.060	.061	.059	.040	.028	.026
49	.137	.109	.103	.068	.071	.078	.046	.034	.030
50	.155	.123	.116	.078	.077	.086	.055	.040	.034
51	.175	.139	.132	.089	.088	.099	.063	.047	.037
52	.198	.158	.148	.100	.100	.110	.072	.053	.040
53	.224	.180	.167	.114	.116	.126	.084	.064	.050
54	.253	.202	.188	.130	.131	.142	.102	.073	.058
55	**.287**	**.231**	**.216**	**.148**	**.155**	**.172**	**.117**	**.087**	**.070**
56	.003	.002	.018	.089	.113	.099	.085	.071	.055

Table 10.8 (continued)

Age	Normal Retirement Age = 55			Normal Retirement Age = 62			Normal Retirement Age = 65		
	Prof. (N = 9)	Cler. (N = 7)	Prod. (N = 6)	Prof. (N = 44)	Cler. (N = 45)	Prod. (N = 18)	Prof. (N = 101)	Cler. (N = 99)	Prod. (N = 56)
57	−.008	−.006	−.027	.088	.120	.093	.087	.084	.057
58	−.015	−.012	−.034	.093	.128	.093	.093	.095	.062
59	−.027	−.020	−.044	.095	.127	.087	.093	.102	.064
60	−.039	−.028	−.055	.094	.126	.077	.091	.107	.068
61	−.051	−.036	−.066	.092	.126	.076	.080	.101	.059
62	−.062	−.045	−.077	**.097**	**.139**	**.072**	.077	.099	.061
63	−.076	−.053	−.089	−.084	−.047	−.104	.070	.101	.057
64	−.081	−.062	−.100	−.088	−.053	−.113	.064	.098	.059
65	**−.092**	**−.070**	**−.111**	**−.094**	**−.061**	**−.124**	**.057**	**.095**	**.060**
66	−.295	−.280	−.286	−.142	−.148	−.176	−.176	−.151	−.114
67	−.304	−.276	−.282	−.151	−.176	−.198	−.182	−.166	−.127
68	−.314	−.272	−.278	−.161	−.193	−.217	−.194	−.179	−.133
69	−.323	−.270	−.273	−.171	−.211	−.235	−.203	−.189	−.141
70	−.329	−.268	−.270	−.179	−.224	−.250	−.212	−.198	−.146

NOTE: Plans with early or normal retirement supplements are excluded.

Table 10.9 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at 55, by Normal Retirement Age and Post-Normal Retirement Provision**

	Normal Retirement Age = 55			Normal Retirement Age = 62					Normal Retirement Age = 65				
Age	Full Credit, Defer. (N = 18)	No Credit, Defer. (N = 5)	Limited Credit, Defer. (N = 129)	Full Credit, Defer. (N = 76)	No Credit, Defer. (N = 7)	No Credit, Immed. Payout or Actuarial Increase (N = 2)	Limited Credit, Defer. (N = 66)	Limited Credit, Immed. Payout or Actuarial Increase (N = 35)	Full Credit, Defer. (N = 212)	No Credit, Defer. (N = 207)	No Credit, Immed. Payout or Actuarial Increase (N = 63)	Limited Credit, Defer. (N = 22)	Limited Credit, Immed. Payout or Actuarial Increase (N = 9)
40	**.186**	**.009**	**.252**	**.104**	**.120**	**.243**	**.105**	**.087**	**.077**	**.057**	**.082**	**.063**	**.023**
41	.035	.009	.046	.022	.034	.047	.021	.018	.016	.011	.012	.013	.007
42	.040	.009	.053	.028	.039	.053	.024	.021	.018	.012	.013	.015	.014
43	.045	.008	.060	.032	.044	.060	.028	.024	.021	.014	.015	.017	.016
44	.051	.008	.068	.036	.050	.068	.032	.028	.024	.016	.017	.020	.019
45	.058	.007	.077	.041	.057	.076	.050	.033	.028	.018	.019	.025	.022
46	.072	.007	.087	.045	.064	.086	.045	.038	.031	.019	.022	.029	.028
47	.085	.007	.098	.053	.073	.097	.054	.045	.036	.025	.025	.034	.037
48	.096	.007	.111	.063	.082	.110	.062	.051	.040	.026	.028	.039	.045
49	.110	.026	.125	.076	.093	.124	.072	.060	.046	.029	.031	.045	.052
50	.125	.048	.142	.091	.104	.139	.081	.081	.053	.035	.035	.052	.058
51	.143	.054	.160	.106	.119	.156	.094	.093	.060	.040	.039	.054	.067
52	.166	.060	.181	.123	.133	.176	.109	.109	.072	.048	.044	.066	.076
53	.188	.070	.204	.145	.150	.198	.125	.124	.081	.057	.054	.082	.087
54	.214	.074	.231	.164	.168	.223	.147	.140	.092	.068	.063	.094	.098
55	**.244**	**.084**	**.261**	**.191**	**.190**	**.250**	**.170**	**.161**	**.105**	**.081**	**.077**	**.112**	**.116**
56	.015	−.080	−.007	.119	.137	.091	.058	.094	.071	.051	.062	.097	.112

Table 10.9 (continued)

	Normal Retirement Age = 55			Normal Retirement Age = 62					Normal Retirement Age = 65				
Age	Full Credit, Defer. (N = 18)	No Credit, Defer. (N = 5)	Limited Credit, Defer. (N = 129)	Full Credit, Defer. (N = 76)	No Credit, Defer. (N = 7)	No Credit, Immed. Payout or Actuarial Increase (N = 2)	Limited Credit, Defer. (N = 66)	Limited Credit, Immed. Payout or Actuarial Increase (N = 35)	Full Credit, Defer. (N = 212)	No Credit, Defer. (N = 207)	No Credit, Immed. Payout or Actuarial Increase (N = 63)	Limited Credit, Defer. (N = 22)	Limited Credit, Immed. Payout or Actuarial Increase (N = 9)
57	.006	−.077	−.016	.116	.145	.073	.070	.094	.074	.054	.067	.098	.116
58	.008	−.075	−.024	.120	.152	.064	.098	.099	.076	.059	.068	.104	.128
59	−.007	−.073	−.033	.116	.161	.053	.097	.105	.075	.062	.071	.108	.127
60	−.017	−.071	−.042	.110	.169	.042	.093	.106	.074	.063	.082	.109	.122
61	−.039	−.070	−.051	.092	.158	−.079	.090	.073	.061	.057	.090	.071	.071
62	−.048	−.069	−.060	**.082**	**.216**	**−.091**	**.094**	**.066**	.053	.056	.088	.067	.063
63	−.058	−.068	−.069	−.064	−.378	0	−.033	−.051	.041	.052	.085	.052	.056
64	−.063	−.079	−.078	−.074	−.357	0	−.037	−.063	.038	.048	.083	.048	.049
65	−.071	−.016	−.087	−.085	−.337	0	−.045	−.074	**.027**	**.041**	**.080**	**.041**	**.037**
66	−.113	−.018	−.317	−.166	−.318	0	−.026	0	−.154	−.179	0	−.165	−.112
67	−.115	−.020	−.312	−.208	−.314	0	−.260	0	−.175	−.177	0	−.175	−.148
68	−.196	−.021	−.308	−.247	−.309	0	−.257	0	−.194	−.174	0	−.185	−.179
69	−.236	−.020	−.303	−.268	−.304	0	−.256	0	−.211	−.171	0	−.201	−.207
70	−.272	−.023	−.298	−.290	−.299	0	−.251	0	−.226	−.168	0	−.210	−.230

NOTE: Men only. There were no plans with the provisions corresponding to the two deleted categories under the 55 normal retirement heading.

With the exception of plans of type 3, these provisions typically lead to very negative accrual ratios after the age of normal retirement. Table 10.9 compares accrual ratios across these five types of plans with varying post–normal retirement benefit provisions. The table examines alternative normal retirement ages, with early retirement occurring at 55. The figures in table 10.9 are somewhat surprising, indicating quite negative accrual ratios for plans that fully credit post–normal retirement service; indeed, in certain cases, these negative accrual ratios are larger in absolute value than negative accrual ratios of plans that provide no credit.

To isolate the impact of the choice of post-retirement provisions, accrual ratios for percent-of-earnings plans with early retirement at 55 and selected normal retirement ages were calculated first assuming that all of the plans had a full credit provision and second assuming that all of the plans had a no-credit provision. These results are shown in table 10.10. The table indicates that the effect of crediting service after normal retirement depends importantly on the age of normal retirement. For plans with a normal retirement age of 55, negative accrual ratios are larger in absolute value under no crediting prior to age 66 and smaller in absolute value thereafter.

10.2.6 Early and Normal Retirement Supplements

Approximately 11.4% of plans have early and 7.5% have normal retirement supplements. The typical normal retirement supplement provides an addition to otherwise calculated benefits if the individual postpones retirement until the normal retirement age. The typical early retirement supplement provides an addition to benefits if retirement occurs after the age of early retirement. The average accrual rates for percent-of-earnings and flat plans with supplements and with 10-year cliff vesting and early and normal retirement at 55 and 65, respectively, are shown in table 10.11 by type of supplement. There are only two plans in the category with only normal retirement supplements, but nonetheless the effect of the supplements can be seen in the first column of the table. The accrual rate jumps from about 8% of the wage at age 64 to 60% of the wage at age 65. Thus the supplement apparently provides a relatively strong incentive to remain with the firm until age 65, but thereafter there is a sharp drop in the accrual rate to −18%. Accrual rates for plans with early retirement supplements are shown in the second column of the table. In this case there is a sharp increase in the accrual rate from .12 at age 54 to .44 at age 44, with a sharp drop thereafter. Again, the provision seems to provide a substantial incentive to remain with the firm to the age of early retirement, with a very substantial decline thereafter. Accrual rates for plans with both types of supplement are shown in the last column of the table. In this

Table 10.10 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting and Early Retirement at 55, by Normal Retirement Age, *Assuming* Full-Credit and No-Credit Post-Retirement Provisions**

Normal Ret. Assumed Post-Normal Ret. Provision Age	Normal Retirement Age = 55		Normal Retirement Age = 62		Normal Retirement Age = 65	
	Full Credit (N = 152)	No Credit (N = 152)	Full Credit (N = 187)	No Credit (N = 187)	Full Credit (N = 513)	No Credit (N = 513)
40	.244	.244	.106	.106	.071	.071
41	.045	.045	.023	.023	.013	.013
42	.051	.051	.027	.027	.016	.016
43	.058	.058	.032	.031	.018	.018
44	.066	.066	.035	.035	.020	.020
45	.075	.075	.045	.045	.023	.023
46	.085	.085	.046	.046	.026	.026
47	.097	.097	.055	.055	.031	.031
48	.110	.110	.064	.064	.035	.035
49	.124	.124	.076	.076	.040	.040
50	.141	.141	.090	.090	.046	.046
51	.159	.159	.104	.104	.052	.052
52	.180	.180	.120	.120	.062	.062
53	.204	.204	.140	.140	.072	.072
54	.231	.231	.160	.160	.083	.083
55	**.261**	**.261**	**.185**	**.185**	**.097**	**.097**
56	−.002	−.244	.102	.102	.068	.068
57	−.011	−.229	.105	.105	.072	.072
58	−.019	−.215	.118	.118	.076	.076
59	−.027	−.202	.117	.117	.077	.077
60	−.037	−.139	.114	.114	.079	.079
61	−.049	−.178	.099	.099	.068	.068
62	−.059	−.167	**.098**	**.098**	.064	.064
63	−.068	−.157	−.060	−.284	.056	.056
64	−.077	−.148	−.069	−.267	.053	.063
65	−.086	−.139	−.079	−.252	**.044**	**.044**
66	−.133	−.130	−.150	−.237	−.132	−.225
67	−.177	−.128	−.192	−.233	−.153	−.222
68	−.219	−.127	−.231	−.232	−.172	−.219
69	−.261	−.124	−.260	−.227	−.190	−.216
70	−.301	−.123	−.285	−.223	−.205	−.212

case there is a rather large spike at the age of early retirement, equal to 62% of the wage in that year, with a smaller but still noticeable spike at about the age of normal retirement.

Accrual rates for percent-of-earnings and flat plans with either type of supplement are shown in table 10.12 for selected early and normal retirement ages. The spikes in the accrual rates are

Table 10.11 **Weighted Average Accrual Rates for Percent-of-Earnings and Flat Plans with 10-Year Cliff Vesting, Early and Normal Retirement at 55–65, and Early or Normal Retirement Supplement, by Type of Supplement**

	Type of Supplement		
Age	Normal (N = 2)	Early (N = 10)	Both (N = 10)
40	**.065**	**.111**	**.035**
41	.012	.197	.009
42	.013	.023	.011
43	.015	.026	.013
44	.017	.031	.018
45	.019	.035	.023
46	.022	.040	.030
47	.025	.047	.037
48	.028	.053	.044
49	.032	.060	.052
50	.036	.069	.060
51	.040	.079	.070
52	.045	.094	.081
53	.051	.106	.095
54	.057	**.121**	**.108**
55	.065	**.442**	**.621**
56	.047	−.0007	−.051
57	.051	−.008	−.049
58	.054	−.014	−.043
59	.058	−.022	−.046
60	.061	−.011	−.051
61	.066	−.049	−.068
62	.070	−.058	−.072
63	.074	−.073	**−.080**
64	**.078**	−.022	.009
65	**.601**	−.031	**.008**
66	−.181	−.247	−.092
67	−.180	−.213	−.167
68	−.179	−.207	−.164
69	−.179	−.204	−.163
70	−.178	−.201	−.160

highlighted with dashed lines. Consider, for example, plans with early retirement at age 55. The spike created by the early retirement supplement is from .22 to .39 for plans with normal retirement at 55, from .12 to .50 for plans with normal retirement at 60, and from .11 to .48 for plans with normal retirement at 65. Of the 56 plans with normal retirement at age 60, the pension accrual rate at that age is on average equivalent to 100% of the wage rate. Similar discontinuities in the accrual ratios are evident

Table 10.12 **Weighted Average Accrual Rates for Percent-of-Earnings and Flat Plans with 10-Year Cliff Vesting and Early or Normal Retirement Supplements, by Early and Normal Retirement Ages**

Age	55/55 (N = 19)	55/60 (N = 56)	55/65 (N = 22)	60/60 (N = 37)	60/65 (N = 2)	62/62 (N = 19)
40	**.199**	**.136**	**.082**	**.078**	**.068**	**.056**
41	.039	.024	.015	.014	.012	.010
42	.045	.027	.018	.016	.013	.011
43	.052	.030	.021	.018	.015	.013
44	.059	.034	.025	.020	.017	.151
45	.068	.038	.030	.022	.019	.180
46	.077	.043	.036	.023	.022	.020
47	.088	.049	.041	.027	.025	.023
48	.100	.055	.048	.030	.028	.026
49	.114	.062	.056	.035	.032	.030
50	.129	.070	.064	.039	.036	.035
51	.148	.080	.074	.044	.040	.029
52	.167	.090	.087	.050	.046	.033
53	.191	.103	.099	.057	.053	.039
54	**.220**	**.117**	**.113**	.066	.061	.044
55	**.389**	**.498**	**.484**	.075	.069	.060
56	−.019	.071	.016	.086	.080	.064
57	−.078	.071	.019	.099	.092	.161
58	−.048	.071	−.021	.114	.107	.097
59	−.057	**.069**	−.026	**.132**	**.123**	.110
60	−.067	**1.079**	−.008	**.643**	**.233**	.127
61	−.085	−.292	−.049	−.208	.048	**.146**
62	−.093	−.301	−.056	−.212	.045	**.183**
63	−.108	−.353	−.067	−.227	.039	−.078
64	−.079	−.079	**−.006**	−.102	.072	−.086
65	−.086	−.043	**.018**	−.099	.194	−.094
66	−.124	−.088	−.182	−.100	−.048	−.169
67	−.141	−.116	−.195	−.088	−.064	−.111
68	−.150	−.124	−.191	−.092	−.072	−.112
69	−.151	−.132	−.188	−.097	−.112	−.113
70	−.151	−.141	−.186	−.102	−.120	−.114

NOTE: There are no plans in the 62–65 or in the 65–65 early-normal retirement groups.

for plans with other early and normal retirement ages. For example, of plans with early and normal retirement at age 60, the accrual rate at that age is equivalent to 64% of the annual wage for persons aged 60. Thus these special supplements create very significant one-time additions to pension wealth and therefore provide potentially very important incentives to remain with the firm until the age at which the special supplement is awarded. The special supplements also further dramatize the wide variation in the incentive effects implicit in the provisions of private pension plans.

10.3 Flat Benefit Plans

Accrual ratios for flat benefit plans with selected early and normal retirement are shown in table 10.13. This table can be compared to table 10.1 above, which presents comparable numbers for percent-of-earnings plans. The accrual profiles for flat plans with early-normal retirement at age 55-55, 55-60, 55-65 are shown graphically in figure 10.6. In general, the accrual profiles for the flat benefit plans look quite similar to those for percent-of-earnings plans. Recall that we have assumed that the flat benefit increases with the rate of inflation, assumed to be 6% annually in our calculations. While it is not possible to make comparisons for plans with each of the early and normal retirement combinations because of the relatively small sample sizes in some of them for flat benefit plans, for several early-normal retirement age combinations there are rather large numbers of plans of both types, for example, the combinations 55-60, 55-65, and 60-65. The average decline in the accrual ratio between the age of early retirement to age 66 is .30 for percent-of-earnings plans versus .39 for flat benefits plans in the case of the 55-60 retirement age combination. It is .25 versus .16 for the 55-65 combination, and .26 versus .17 for the 60-65 combination.

Accrual ratios at several critical ages for plans with early retirement at 55 and normal retirement at 65 are shown below for percent-of-earnings and flat benefit plans.

Age	Percent-of-Earnings Plans	Flat Plans
40	.071	.070
55	.097	.073
56	.068	.052
65	.044	.049
66	−.152	−.091
70	−.186	−.102

The accrual rates for these plans are graphed in figure 10.7. The evidence seems to indicate that the two types of plan provide rather similar incentive effects.

The provisions of flat rate plans, like those of percent-of-earnings plans, also yield widely different ratios, even among plans with the same early and normal retirement ages. Indications of the dispersion of the accrual ratios among flat plans with early and normal retirement at 55 and 65, respectively, are shown in table 10.14 and in figure 10.8. While the average accrual rate at age 55, for example, is 7% the minimum value is zero and the maximum is 24%. Similarly at age 56, while the average is about 5% the maximum is 20% and the minimum about

Table 10.13 **Weighted Average Accrual Rates for Flat-Rate Plans with 10-Year Cliff Vesting, by Early and Normal Retirement Age**

Age	55/55 (N = 3)	55/60 (N = 90)	55/65 (N = 106)	60/60 (N = 10)	60/65 (N = 48)	62/62 (N = 3)	62/65 (N = 17)	65/65 (N = 14)
40	**.304**	**.104**	**.070**	**.022**	**.046**	**.033**	**.025**	**.019**
41	.052	.027	.012	.004	.008	.006	.004	.006
42	.059	.031	.013	.004	.009	.007	.005	.006
43	.066	.035	.015	.005	.010	.007	.006	.006
44	.075	.039	.017	.006	.012	.008	.007	.007
45	.084	.044	.019	.006	.013	.009	.007	.007
46	.096	.049	.022	.007	.015	.010	.008	.007
47	.108	.052	.025	.029	.017	.011	.009	.008
48	.123	.058	.029	.053	.019	.013	.011	.009
49	.139	.064	.032	.063	.022	.015	.012	.009
50	.158	.073	.037	.067	.025	.016	.013	.010
51	.180	.093	.042	.079	.028	.018	.015	.011
52	.205	.105	.048	.084	.032	.021	.017	.012
53	.235	.121	.054	.098	.037	.024	.020	.014
54	.269	.138	.062	.110	.042	.027	.022	.015
55	**.308**	**.163**	**.073**	.150	.048	.030	.025	.017
56	−.121	.079	.052	.171	.055	.035	.028	.018
57	−.119	.077	.055	.189	.063	.040	.032	.020
58	−.118	.095	.058	.228	.073	.045	.037	.030
59	−.117	**.105**	.060	.258	.084	.052	.043	.036
60	−.117	.105	.061	**.285**	**.101**	.059	.050	.042
61	−.263	−.029	.050	.005	.061	.068	.058	.042
62	−.253	−.036	.050	−.012	.062	**.078**	**.068**	.049
63	−.244	−.052	.049	−.042	.063	−.014	.067	.058
64	−.235	−.091	.049	−.058	.034	−.015	.066	.069
65	**−.227**	**−.104**	**.049**	**−.079**	**.069**	**−.017**	**.063**	**.083**
66	−.280	−.131	−.091	−.174	−.074	−.085	−.037	−.074
67	−.275	−.164	−.093	−.267	−.076	−.083	−.040	−.074
68	−.271	−.175	−.096	−.255	−.078	−.082	−.042	−.074
69	−.267	−.181	−.099	−.246	−.080	−.081	−.046	−.074
70	−.263	−.203	−.102	−.244	−.083	−.080	−.049	−.074

NOTE: Plans with early or normal retirement supplements are excluded.

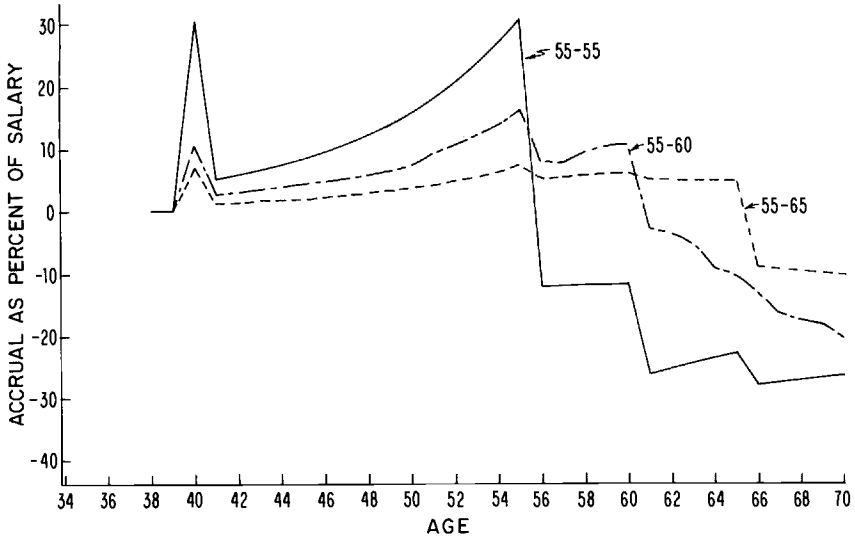

Fig. 10.6 Weighted average accrual rates for flat rate plans with 10-year cliff vesting, for selected early and normal retirement ages. (Note: Plans with early or normal retirement supplements are excluded.)

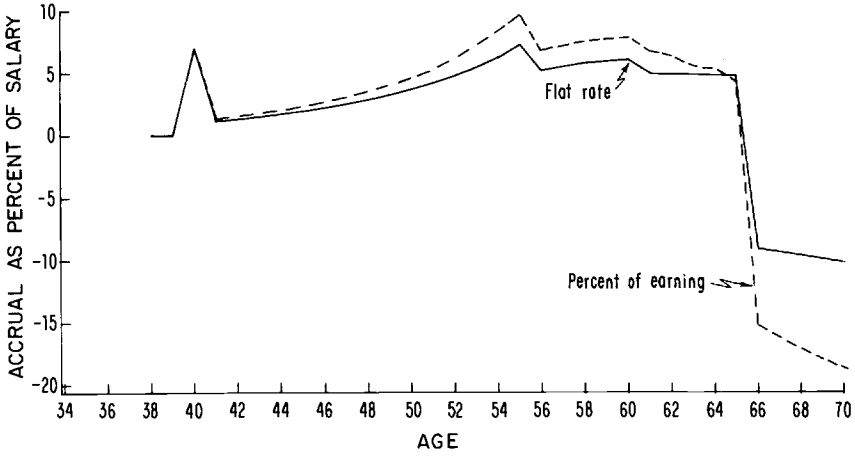

Fig. 10.7 Weighted average accrual rates for percent-of-earnings and flat rate plans with 10-year cliff vesting, early retirement at 55, and normal retirement at 65. (Note: Plans with early or normal retirement supplements are excluded.)

Table 10.14 **Dispersion of Accrual Rates for Table 10.11 Plans with Age 55 Early Retirement and Age 65 Normal Retirement (N = 106)**

Age	Weighted Average Accrual Ratios	Median Accrual Ratios	Minimum Accrual Ratios	Maximum Accrual Ratios	Lowest Fifth Percentile	Largest Fifth Percentile
40	**.070**	**.073**	**0**	**.260**	**0**	**.157**
41	.012	.013	0	.045	0	.027
42	.013	.015	0	.050	0	.030
43	.015	.016	0	.057	0	.034
44	.017	.018	0	.064	0	.038
45	.019	.021	0	.072	0	.043
46	.022	.024	0	.081	0	.049
47	.025	.027	0	.091	0	.055
48	.029	.031	0	.102	0	.062
49	.032	.035	0	.115	0	.071
50	.037	.039	0	.130	0	.080
51	.042	.045	0	.147	0	.092
52	.048	.041	0	.166	0	.104
53	.054	.058	0	.187	0	.119
54	.062	.067	0	.212	0	.137
55	**.073**	**.077**	**0**	**.240**	**.006**	**.157**
56	.052	.053	−.006	.195	0	.123
57	.056	.055	−.007	.192	0	.121
58	.058	.055	−.010	.189	0	.125
59	.060	.055	−.013	.183	−.008	.146
60	.061	.056	−.031	.184	−.024	.173
61	.050	.042	−.217	.204	−.051	.137
62	.050	.040	−.213	.226	−.066	.148
63	.049	.035	−.209	.400	−.082	.162
64	.049	.034	−.204	.561	−.093	.169
65	**.049**	**.029**	**−.198**	**.328**	**−.101**	**.184**
66	−.091	−.067	−.560	0	−.275	0
67	−.093	−.073	−.552	.008	−.291	0
68	−.096	−.079	−.545	.055	−.287	0
69	−.099	−.096	−.536	.045	−.283	0
70	−.102	−.101	−.528	.035	−.286	0

zero. At 65, the average is 5% with a maximum of almost 33% and a minimum of about −20%. At 66, after the age of normal retirement, the average accrual rate is −9% while the minimum is −56% and the maximum is zero. Thus the incentive for retirement varies widely among flat as well as among percent-of-earnings plans.

10.4 The Pension Cost of Job Change

There are many ways to think about the effect of job change on pension accrual and the potential incentive effects of pension provisions

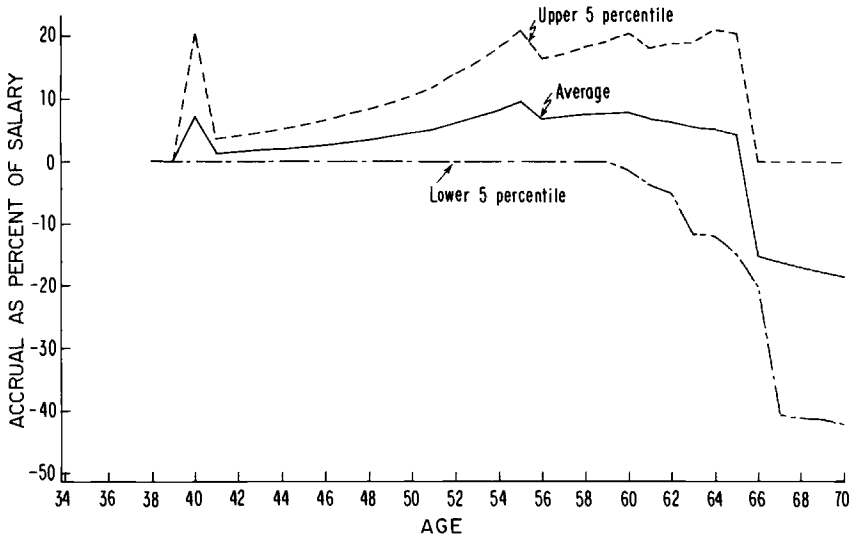

Fig. 10.8 Weighted average accrual rates and upper and lower 5 percentile levels for flat rate plans with 10-year cliff vesting, early retirement at 55, and normal retirement at 65. (Note: Plans with early or normal retirement supplements are excluded.)

on the job change decision. One approach is to consider the effect of job change on accrued pension wealth at the age of retirement, say the age of plan-normal retirement. Another way is to consider the expected loss in future pension wealth from changing job as a proportion of expected future wages. We shall consider variations of both measures.

10.4.1 If Change to a No-Pension Job

Consider a person who starts a job at some age, say 31. Suppose that at a given subsequent age the person could change to another job and obtain the same future wages as on the current job. Assume that his decision is either to stay on the current job until normal retirement or to switch to the second job and stay on that one until the age of normal retirement. But suppose that the new job has no pension. Then the loss in pension wealth is equal to the pension wealth that the worker would accrue if he were to stay with the current employer until the age of normal retirement. This loss relative to the present value of expected future wages is shown in tables 10.15, 10.16, and 10.17. Table 10.15 assumes that an individual begins employment with the first firm at age 31. Table 10.16 assumes a starting age of 41, and table 10.17 a starting age of 51. The tables present these loss ratios by plan-normal retirement age, and loss ratios are calculated through the age of normal retirement. To obtain a more concise picture of the losses, they are

Table 10.15 **Loss in Expected Pension Wealth If Change to No-Pension Job, as Percent of Expected Wages, by Age of Job Change and by Normal Retirement Age, Starting Initial Job at Age 31**

	Age at Normal Retirement			
Age	55 (N = 184)	60 (N = 446)	62 (N = 442)	65 (N = 858)
31	.072	.055	.048	.026
32	.076	.058	.050	.027
33	.080	.061	.053	.028
34	.084	.064	.055	.029
35	.089	.067	.058	.030
36	.095	.071	.060	.032
37	.101	.075	.064	.033
38	.108	.079	.067	.035
39	.116	.084	.071	.037
40	.106	.083	.069	.035
41	.111	.087	.072	.037
42	.116	.092	.075	.038
43	.122	.097	.078	.040
44	.128	.103	.081	.041
45	.134	.108	.083	.043
46	.140	.115	.086	.044
47	.145	.121	.089	.046
48	.151	.128	.092	.047
49	.156	.135	.094	.048
50	.161	.143	.095	.049
51	.163	.152	.097	.050
52	.163	.161	.097	.050
53	.154	.171	.096	.050
54	.124	.182	.093	.048
55		.182	.082	.044
56		.174	.080	.043
57		.199	.077	.042
58		.237	.071	.040
59		.310	.062	.037
60			.031	.032
61			.022	.030
62				.026
63				.023
64				.016
65				

shown for selected ages of job change in table 10.18. For plans with normal retirement at age 65, the loss in pension wealth relative to expected wages is relatively small, between 4% and 6% for all ages of job change, with the exception of job change at age 59 when joining the firm at age 51. In the latter case, the remaining working life of the individual is short and he is not yet vested. Thus the loss in potential pension accrual is relatively large compared to future earnings. Among

Table 10.16 **Loss in Expected Pension Wealth If Change to No-Pension Job, as Percent of Expected Wages, by Age of Job Change and by Normal Retirement Age, Starting Initial Job at Age 41**

	Age at Normal Retirement			
Age	55 (N = 57)	60 (N = 349)	62 (N = 546)	65 (N = 1009)
41	.079	.064	.062	.034
42	.086	.068	.066	.036
43	.093	.073	.071	.038
44	.103	.079	.076	.040
45	.114	.085	.082	.043
46	.127	.092	.088	.046
47	.143	.101	.096	.050
48	.164	.111	.104	.054
49	.191	.122	.114	.058
50	.117	.096	.097	.048
51	.121	.100	.102	.049
52	.122	.103	.106	.051
53	.119	.106	.110	.052
54	.103	.108	.115	.053
55		.104	.111	.052
56		.105	.106	.053
57		.105	.111	.053
58		.100	.119	.052
59		.085	.130	.051
60			.132	.047
61			.168	.046
62				.044
63				.040
64				.031
65				

plans with earlier normal retirement—55, 60, or 62—the potential loss in future pension accrual is considerably larger, typically on the order of 8%–20% of future earnings. The loss if one changes jobs just before normal retirement, however, is in some instances much larger than this, as high as 30%–50%. For example, if at age 31 one enters a plan with normal retirement at age 60, the loss ratio if one changes job at 59 is 31%. If the individual enters at 51 and leaves at 59, the loss is almost 50%.

The greater relative loss with earlier normal retirement is shown in figure 10.9, which presents loss ratios versus age for normal retirement at 55 and at 65, starting at age 31. The effect of starting age is shown graphically in figure 10.10 for plans with normal retirement at 60.

A limiting case of numbers like those presented in table 10.18 is the present discounted value of expected pension benefits at the age of hire as a proportion of expected wages at that time. These numbers of course

Table 10.17 **Loss in Expected Pension Wealth If Change to No-Pension Job, as Percent of Expected Wages, by Age of Job Change and by Normal Retirement Age, Starting Initial Job at Age 51**

	Age at Normal Retirement			
Age	55 (N = 32)	60 (N = 178)	62 (N = 451)	65 (N = 1287)
51	.000	.080	.094	.046
52	.000	.091	.105	.051
53	.000	.104	.118	.056
54	.000	.122	.134	.062
55		.146	.150	.069
56		.178	.169	.079
57		.229	.203	.090
58		.313	.251	.104
59		.482	.325	.122
60			.183	.059
61			.246	.060
62				.059
63				.055
64				.044
65				

Table 10.18 **Loss in Expected Pension Wealth If Change to No-Pension Job, as Percent of Expected Wages by Age of Job Change, Age of Starting Job, and Age of Normal Retirement**

Starting Age and Age	Age at Normal Retirement			
	55	60	62	65
31:				
44	.13	.10	.08	.04
49	.16	.14	.09	.05
54	.12	.18	.09	.05
59	—	.31	.06	.04
41:				
44	.10	.08	.08	.04
49	.19	.12	.11	.06
54	.10	.11	.15	.05
59	—	.09	.13	.05
51:				
44	—	—	—	—
49	—	—	—	—
54	—	.12	.13	.06
59	—	.48	.33	.12

NOTE: With expectations evaluated to plan normal retirement age.

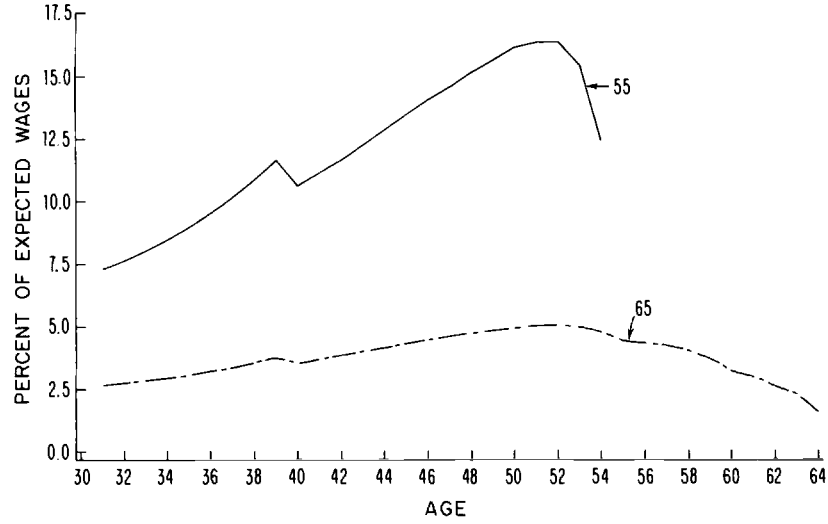

Fig. 10.9 Loss in expected pension wealth if change to no-pension job, as a percentage of expected wages, for normal retirement at 55 v. 65.

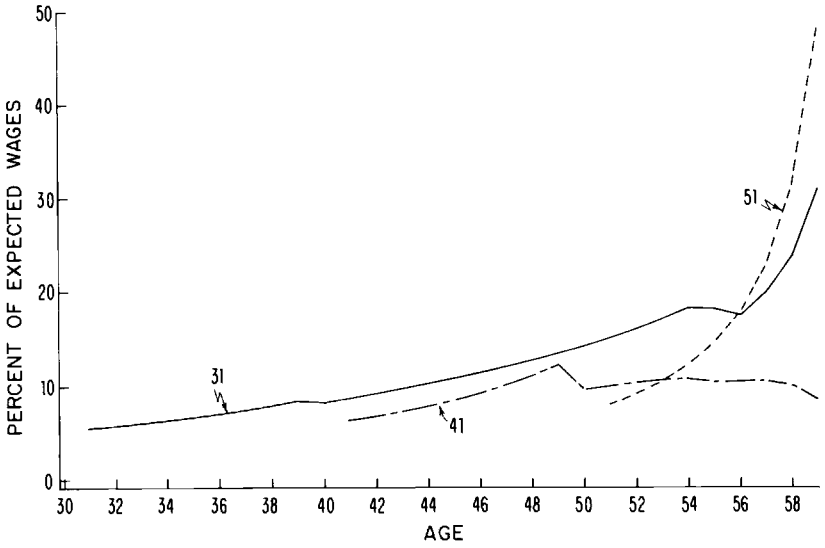

Fig. 10.10 Loss in expected pension wealth if change to no-pension job, as a percentage of expected wages, for normal retirement at 60, by age started job.

indicate the cost to the employer of pension benefits versus wages if a person stays with the employer from the time of hire to the age of early or normal retirement. Such ratios are presented in table 10.19 by age of initial employment and plan-normal retirement age. The ratios are presented first assuming that the individual remains with the firm until the age of early retirement and then assuming that the person remains until the age of normal retirement. It can be seen from the table that the present discounted value of pension versus wage compensation is small on average, ranging from about 2% to about 10%. The average proportion of compensation in pension benefits is typically larger the later the age of initial employment. For example, the ratio of pension benefits to wages for plans with normal retirement at 62 is .049 if one enters the firm at 31 and stays to the age of normal retirement. The ratio is .062 if one enters at 41, and .094 if one enters at 51. It is important to understand that while these ratios may appear relatively small, the pattern of pension accrual may still have a very substantial effect on worker labor force participation, as demonstrated above.

Possibly the most striking feature of these loss ratios is the wide variation among plans. To demonstrate the dispersion, the mean loss ratio and the minimum and maximum at each age are shown in table

Table 10.19 **Present Discounted Value of Expected Pension Benefits as a Proportion of Expected Wages, at Age of Hire, by Age of Hire and Plan Normal Retirement Age**

Age of Hire and Plan Normal Retirement Age	If Retire at Early Retirement Age	If Retire at Normal Retirement Age
31:		
All	.038	.044
55	.072	.072
60	.044	.055
62	.043	.049
65	.022	.026
41:		
All	.042	.049
55	.078	.079
60	.060	.064
62	.051	.062
65	.027	.034
51:		
All	.045	.060
55	—	—
60	.069	.080
62	.054	.094
65	.039	.046

10.20 for plans with normal retirement at 65 and for persons who enter the firm at age 31. Up to age 55—which is the age of early retirement for a substantial proportion of plans—the loss is close to zero for some plans and indeed is even negative for some. For other plans, however, the loss is very high, ranging up to 26% of future earnings at age 54. After 55, the maximum loss is typically over 30%, while the minimum is close to −20% at each age. Pension accrual after the age of early retirement is negative in many instances. For a member of such a plan,

Table 10.20 **Dispersion of Loss in Expected Pension Wealth If Change to No-Pension Job, for Plans in Table 10.15 with Normal Retirement at Age 65**

Age	Mean	Minimum	Maximum
31	.026	0	.098
32	.027	0	.101
33	.028	0	.105
34	.029	0	.110
35	.030	0	.115
36	.032	0	.120
37	.033	0	.125
38	.035	0	.131
39	.037	0	.137
40	.035	−.010	.139
41	.037	−.009	.145
42	.038	−.008	.152
43	.040	−.007	.158
44	.041	−.005	.166
45	.043	−.003	.173
46	.044	−.004	.182
47	.046	−.005	.190
48	.047	−.005	.199
49	.048	−.007	.209
50	.049	−.012	.219
51	.050	−.022	.229
52	.050	−.034	.240
53	.050	−.049	.252
54	**.048**	**−.068**	**.264**
55	.044	−.182	.276
56	.043	−.181	.289
57	.042	−.178	.301
58	.040	−.175	.313
59	.037	−.187	.325
60	.032	−.229	.335
61	.030	−.221	.341
62	.026	−.233	.339
63	.023	−.248	.321
64	.016	−.220	.367
65			

it would pay to leave this firm, taking early retirement benefits, and join another firm, assuming that one could join the second firm and obtain the same expected future wages.

10.4.2 Job Change and Pension Wealth at Age of Normal Retirement

Pension wealth at the age of normal retirement may be reduced very substantially by job change, as shown in table 10.21. A person who began work at 31 and changed to another job at 41 would have accrued, on average, only 72% of the pension wealth of a person who began at 31 and remained in the same firm. If he changed jobs at 41 and again at 51, he would accrue only 43% of the pension wealth of a person with no job change. This percentage ranges from a low of 30% on average in transportation to 60% in construction. Thus the loss in pension wealth with job change seems to provide a potentially large incentive against job mobility.

Because some plans place a limit on years of service that are credited in calculating benefits, it may in some instances pay to change jobs and begin to accrue benefits in a new plan. This leads to ratios that are greater than one in a few instances. The minimum and maximum values over all industries arise in anomalous plans, and these should not be given much weight; but they do suggest that there is substantial variation among plans in this respect, as well as in other respects discussed above.

Table 10.21 **Weighted Average Pension Wealth (or Ratio) at Normal Retirement, by Age of Initial Employment, and by Job Change, and by Industry, All Plans**

Industry (No. of Plans)	Age of Initial Employment			Pension Wealth at Normal Retirement Relative to Wealth Without Job Change If:		
	31	41	51	Change at 41	Change at 51	Change at 41 and 51
All industries (N = 2342)	32491	21410	10924	.72	.85	.43
Minimum	0	0	0	0	0	0
Maximum	197070	175899	117291	4.97	8.18	5.09
Mining (N = 39)	44856	27237	13147	.62	.81	.38
Construction (N = 9)	35778	28680	16837	.87	1.02	.60
Manufacturing (N = 1297)	31448	20393	10633	.73	.85	.44
Transportation (N = 328)	38680	22350	8598	.57	.81	.30
Wholesale trade (N = 100)	30836	21989	13135	.74	.87	.50
Retail trade (N = 260)	19453	13002	6024	.67	.80	.41
Finance (N = 7)	38864	30766	17309	.91	1.01	.58
Services (N = 8)	29993	22551	12520	.77	.87	.47

10.4.3 Pension Accrual Ratios and Age of Initial Employment

Pension accrual rates for percent-of-earnings plans with 10-year cliff vesting are shown in tables 10.22 and 10.23 for persons beginning employment at ages 41 and 51 respectively. The tables are analogous to table 10.1 above, presenting information by plan early and normal retirement ages. To provide an easier comparison of the accrual rates by starting age, accrual rates for selected ages are shown in table 10.24. The numbers are taken from table 10.1, table 10.22, and table 10.23. Accrual ratios for plans with early and normal retirement at 55 and 65 respectively are graphed in figure 10.11. The accrual rate at vesting is the most important difference across initial employment ages. For example, as shown in table 10.24, the accrual rate at vesting is .24 for persons beginning employment at 31, it is .62 for those beginning at age 41, and .92 for those beginning at age 51. The difference is simply due to the fact that the later the age of initial employment, the nearer is the time of benefit receipt at the age of vesting. The accrual rate at vesting increases with age of initial employment for each early-normal retirement age category. Otherwise, the pattern of accrual rates does not vary by starting age, except that the absolute value of the rates, both positive and negative, is smaller as the age of initial employment increases. Again, this is simply because potential benefits are lower with later starting ages and, thus, potential losses after the age of early or normal retirement are smaller. Notice that the accrual rate after the age of 65 is negative in each case. Plan provisions typically make the age of early and normal retirement dependent upon age and years of service. Thus in practice, the ages of early and normal retirement are typically somewhat higher for persons beginning employment at age 51. But in no case is the age of normal retirement greater than 65.

10.5 Pension Accrual Rates and Pension Cost by Sex

Because women on average live longer than men, women would typically receive pension benefits longer than otherwise equivalent men. The effect of this difference in life expectancy on pension accrual and the value of pension benefits is considered in this section. The ratios of the weighted average of the accrued benefits of women to that of men by age are shown in table 10.25 for all plans in the sample. At the most common vesting age, 10 years, the ratio is about 1.08, so that women's vested benefits are approximately 8% higher than men's. The ratio increases gradually to about 1.10 at age 60 and about 1.13 at 65. If otherwise identical men and women were to work until age 70, the average ratio would be 1.17. The ratios do not vary significantly by

Table 10.22 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting, by Early and Normal Retirement Age, Starting Job at Age 41**

Age	55/55 (N = 38)	55/60 (N = 63)	55/65 (N = 576)	60/60 (N = 169)	60/65 (N = 86)	62/62 (N = 27)	62/65 (N = 10)	65/65 (N = 56)
50	.618	.347	.209	.349	.127	.017	.135	.126
51	.106	.066	.040	.065	.026	.051	.021	.029
52	.123	.082	.046	.075	.029	.059	.024	.033
53	.141	.095	.052	.085	.035	.068	.027	.038
54	.160	.109	.060	.098	.041	.083	.030	.044
55	**.184**	**.125**	**.070**	.112	.047	.095	.034	.052
56	.006	.094	.069	.128	.055	.101	.037	.061
57	.002	.099	.065	.146	.064	.118	.042	.070
58	.0003	.107	.068	.167	.077	.137	.047	.085
59	−.004	.116	.071	.185	.088	.155	.053	.099
60	−.010	**.120**	.073	**.209**	**.103**	.179	.056	.116
61	−.016	.001	.075	−.007	.080	.198	.061	.123
62	−.022	−.004	.074	−.015	.081	**.223**	**.067**	.138
63	−.029	−.006	.075	−.023	.080	−.016	.035	.161
64	−.036	−.012	.075	−.031	.083	−.027	.034	.181
65	**−.043**	**−.019**	**.073**	**−.040**	**.084**	**−.038**	**.032**	**.204**
66	−.116	−.115	−.107	−.192	−.060	−.193	−.077	−.117
67	−.128	−.137	−.117	−.195	−.074	−.191	−.077	−.126
68	−.141	−.159	−.125	−.197	−.089	−.190	−.076	−.134
69	−.154	−.167	−.134	−.197	−.102	−.189	−.075	−.141
70	−.166	−.174	−.142	−.198	−.114	−.188	−.074	−.148

NOTE: Plans with early or normal retirement supplements are excluded.

Table 10.23 **Weighted Average Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting, by Early and Normal Retirement Age, Starting Job at Age 51**

Age	55/55 (N = 23)	55/60 (N = 23)	55/65 (N = 143)	60/60 (N = 60)	60/65 (N = 419)	62/62 (N = 52)	62/65 (N = 11)	65/65 (N = 425)
55	**.000**	**0**	**.001**	.0002	.000	.004	0	.000
56	.000	0	.001	.0002	.000	.004	0	.000
57	.000	0	.001	.0002	.000	.004	0	.000
58	.000	0	.001	.0002	.000	.003	0	.000
59	.000	0	.001	.0002	.000	.003	0	.000
60	**.923**	**.774**	**.613**	1.040	**.451**	**.644**	**.541**	**.449**
61	.041	.033	.081	.034	.056	.132	.091	.084
62	.036	.029	.081	.028	.059	**.169**	**.103**	.098
63	.028	.023	.082	.021	.063	.047	.077	.112
64	.022	.018	.084	.015	.065	.039	.079	.126
65	**.013**	**.012**	**.081**	**.007**	**.067**	**.030**	**.083**	**.145**
66	−.104	−.045	−.076	−.039	−.036	−.057	−.075	−.070
67	−.108	−.059	−.083	−.052	−.043	−.061	−.074	−.077
68	−.113	−.073	−.091	−.066	−.050	−.066	−.079	−.085
69	−.118	−.077	−.099	−.074	−.051	−.068	−.083	−.092
70	−.124	−.080	−.106	−.081	−.056	−.076	−.088	−.099

NOTE: Plans with early or normal retirement supplements are excluded.

Table 10.24 **Pension Accrual Rates for Percent-of-Earnings Plans with 10-Year Cliff Vesting, by Early and Normal Retirement Age and by Age of Initial Employment, for Selected Ages**

Starting Age and Age	Early-Normal Retirement							
	55/55	55/60	55/65	60/60	60/65	62/62	62/65	65/65
31:								
40	**.24**	**.11**	**.07**	**.03**	**.05**	**.04**	**.05**	**.04**
50	.14	.08	.05	.07	.03	.07	.02	.03
55	.26	.13	.10	.15	.08	.13	.04	.07
60	−.04	.14	.08	.27	.17	.24	.05	.12
62	−.06	−.09	.06	−.09	.12	.25	.07	.15
65	−.09	−.09	.04	−.12	.11	−.14	.01	.21
66	−.29	−.17	−.15	−.14	−.09	−.27	−.08	−.19
41:								
40	0	0	0	0	0	0	0	0
50	**.62**	**.35**	**.21**	**.35**	**.13**	**.02**	**.14**	**.13**
55	.18	.13	.07	.11	.05	.10	.03	.05
60	−.01	.12	.07	.21	.10	.18	.06	.12
62	−.02	−.00	.07	−.02	.08	.22	.07	.14
65	−.04	−.02	.07	−.04	.08	−.04	.03	.20
66	−.12	−.12	.11	−.19	−.06	−.19	−.08	−.12
51:								
40	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0
60	**.92**	**.77**	**.61**	**1.04**	**.45**	**.64**	**.54**	**.45**
62	.04	.03	.08	.03	.06	.17	.10	.10
65	.02	.01	.08	.01	.07	.03	.08	.15
66	−.10	−.05	−.08	−.04	−.04	−.06	−.08	−.07

early and normal retirement age, and thus a breakdown by plan type is not presented.

10.6 Summary

The ratios of pension benefit accrual to wage earnings are presented for a wide range of pension plans. Typical plan provisions provide a strong incentive for retirement after the age of plan-normal retirement, and several plan types provide a strong incentive for retirement after the age of early retirement. A striking feature of the incentive effects of pension plans is their wide variation among plans. For example, while the average plan may provide reduced but still positive accrual after the age of early retirement, for a large proportion of plans the accrual rate after this age is very negative. It would not be unusual for the reduction in pension benefit accrual after the age of early retirement

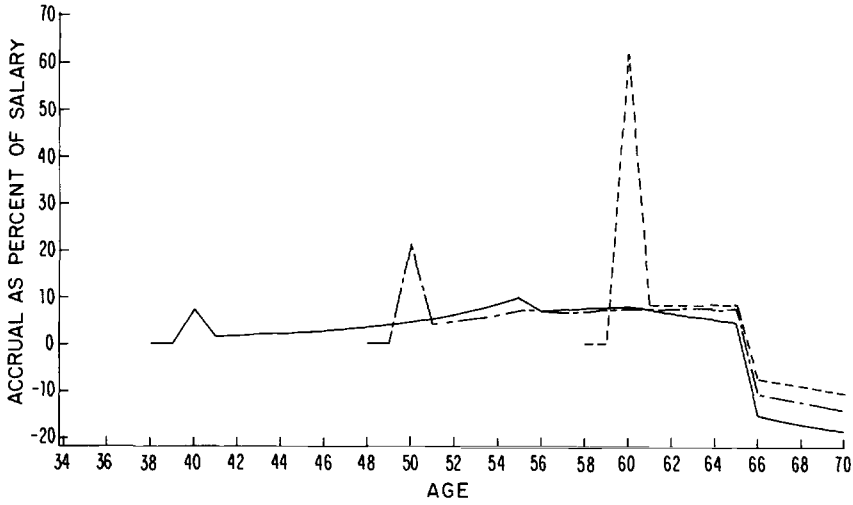

Fig. 10.11 Weighted average accrual rates for percent-of-earnings plans with 10-year cliff vesting, early retirement at 55, and normal retirement at 65, by age started job. (Note: Plans with early or normal retirement supplements are excluded.)

Table 10.25 **The Ratio of Accrued Pension Benefits of Women to That of Men, by Age, All Plans**

Age	Ratio	Age	Ratio
31	1	51	1.109
32	1	52	1.106
33	1	53	1.103
34	1	54	1.099
35	1.032	55	1.094
36	1.030	56	1.096
37	1.032	57	1.098
38	1.037	58	1.101
39	1.036	59	1.103
40	1.082	60	1.102
41	1.083	61	1.108
42	1.085	62	1.113
43	1.087	63	1.120
44	1.089	64	1.126
45	1.091	65	1.131
46	1.094	66	1.138
47	1.096	67	1.145
48	1.099	68	1.153
49	1.102	69	1.161
50	1.105	70	1.170

NOTE: There are 2342 plans. Starting age is 31.

to be equivalent to a 30% reduction in wage earnings. Thus even a relatively small proportion of plans with such benefit losses could have a substantial effect on aggregate labor force participation rates of older workers. The accrual rate at the age of vesting can range from as low as 2% of wage earnings in that year to as high as 100% of wage earnings, depending upon the plan type and on the age of initial employment. Thus for some employees, vesting could be a very important determinant of labor force participation decisions. Special early and normal retirement provisions may also add very substantially to accrued pension wealth at particular ages and may thus encourage workers to remain with a firm until these benefits are received. The accrual profiles under flat benefit plans seem very similar to the accruals under percent-of-earnings plans, if one assumes that the flat benefit is increased to keep pace with the rate of inflation. Given early and normal retirement ages, there is little difference in plan accrual profiles by industry or by occupation. Differences in pension benefits by industry depend more on the type of plan than on variations among plans with the same basic provisions. While the expected loss in pension benefits due to job change is apparently relatively small in many instances, it is rather large in others, and there is very wide variation among plans with the loss very high in some cases and, indeed, in other cases a gain may be had by changing jobs. In addition, accrued benefits at the age of retirement are typically very much lower with job change than if a person remains on the same job. Because women typically live longer than men, accrued pension benefits at any age are higher for women than for men, about 13% on average at age 65, for example. In short, the evidence suggests that the rapid increase in pension plan coverage over the past two or three decades may well have contributed very substantially to the reduction in the labor force participation of older workers during this period. The plans may also have an important effect on labor mobility.

Appendix

The source of discontinuities in age accrual profiles is clarified by considering a simple earnings-related defined benefit plan with cliff vesting at 10 years of service. Vested accrued benefits are clearly zero prior to the age at which the worker has 10 years of credited service in the plan. Let $R(a,t)$ denote the ratio of $I(a)$ to $W(a)$ for a worker age a with t years of tenure, where $I(a)$ is defined in (1) in the text. Then

$R(a,t)$ is zero for $t \leq 9$. If a person age a with 9 years of service works an additional year, the ratio of the increment to the wage, $W(a)$, is

$$\text{(A1)} \qquad R(a,9) = \frac{B(a,t)A(55)\,(1 + d)^{-10}\,(1 + r)^{-[55-(a+1)]}}{W(a)}.$$

In (A1), $B(a,t)$ is the retirement benefit available to the worker who terminates employment with the plan sponsor at age a after t years of service, but who delays receipt of pension benefits until the plan's normal retirement age. The normal and early retirement ages assumed for this stylized plan are 65 and 55, respectively. Terminating workers in this example are eligible for early retirement benefits. Our hypothetical plan reduces benefits by $d\%$ for each year that early retirement preceeds normal retirement. The benefit reduction rate, d, is assumed to be less than the actuarial fair rate.

The function $A(55)$ is the actuarial discount factor that transforms benefit flows initiating at age 55 into expected stocks of pension wealth at age 55. Expectations here are taken with respect to longevity. Thus $A(55)$ is the annuity value of a dollar's worth of pension benefits to be received each year until death, beginning at age 55. For simplicity assume that the probability of dying prior to age 55 is zero. Hence the present value at age a of $A(55)$ is $A(a) = A(55)\,(1 + r)^{-(55-a)}$ for $a \leq 55$. If pension benefits are determined as a constant λ times the product of final year's earnings and service, and there is no offset for receipt of social security benefits, $B(a,t)$ is simply

$$\text{(A2)} \qquad B(a,t) = \lambda W(a)t$$

and

$$\text{(A3)} \qquad R(a,9) = \lambda(1 + d)^{-10}\,(1 + r)^{-[55-(a+1)]}\,A(55)10\,\frac{W(a + 1)}{W(a)}.$$

$R(a,t)$, for t increasing paripassus with age, is zero prior to t equals 9 and jumps at t equals 9 to the value given in (A3). Cliff vesting thus produces spikes in the accrual profiles such as that in figure 5.1 at 10 years of service. Between the age at cliff vesting and age 55 pension wealth, $Pw(a)$, is given by

$$\text{(A4)} \qquad Pw(a) = \lambda W(a)(1 + d)^{-10}\,(1 + r)^{-(55-a)}A(55)t,$$

and the increment to pension wealth $I(a)$ divided by the age $W(a)$ is given by

$$\text{(A5)} \qquad R(a,t) = \lambda(1 + d)^{-10}\,(1 + r)^{-[55-(a+1)]}\,A(55)t\left[\frac{W(a + 1)}{W(a)}\,\frac{t + 1}{t} - 1\right].$$

Equations (A3) and (A5) suggest a drop in $R(a,t)$ as a increases to $a + 1$ concurrent with an increase in t from 9 to 10. Equation (A5) will be positive if the bracketed term exceeds zero. This will be the case if the percentage increase in the wage plus the percentage increase in years employed ($1/t$) is greater than zero. Assuming the term in brackets is positive and is roughly constant, $R(a,t)$ will increase exponentially due to the exponential decline in the discount factor, $(1 + r)^{-[55-(a+1)]}$, as a approaches 55.

If the value of d is considerably less than actuarially fair, a discontinuity in $R(a,t)$ occurs at the early retirement age, 55. At ages 55 and 56 we have

$$Pw(55) = \lambda W(55)(1 + d)^{-10} A(55)t \tag{A6}$$

and

$$Pw(56) = \lambda W(56)(1 + d)^{-9} A(56)(t + 1). \tag{A7}$$

Hence,

$$R(55,t) = \lambda(1 + d)^{-10} (1 + r)A(55)t \left[\frac{W(56)}{W(55)} \frac{t + 1}{t} \frac{A(56)}{A(55)} \frac{(1 + d)}{(1 + r)} - 1 \right]. \tag{A8}$$

Assuming wage growth at 54 is close to that at 55 and $A(56)$ approximately equals $A(55)$, then $R(55,t)$ primarily differs from $R(54,t - 1)$ because the first term in the bracket in (7) is now multiplied by $(1 + d)$ while the second term, -1, is multiplied by $(1 + r)$. Since r exceeds d by assumption, $R(55,t)$ can easily be less than $R(54,t - 1)$. Indeed, this change in the functional form of $R(a,t)$ can produce sharp drops in accrual rates at the early retirement age for a host of pension plans and a range of realistic economic assumptions.

It is important to realize that the early retirement reduction, lower wages, and one less year of tenure yield lower benefits at 55 than at 56. The early retirement reduction reduces benefits at rate d. But if benefits were taken at 55 they could accrue interest at rate r. Thus by forgoing the early retirement option of receiving benefits at 55, one incurs a cost that depends on the difference $r - d$. If this loss is not offset by the increase due to wage growth and one year of additional tenure, there will be a drop in the benefit accrual rate between 55 and 56.

The same considerations pertain to benefit increments between 56 and 65. Recall that we have assumed a less than fair early retirement reduction so that benefits accrued before 55 are valued based on the assumption that benefits are received starting at the age that yields maximum pension wealth. The optimum time to receive benefits ac-

crued between 55 and 56 is 56, between 56 and 57 is 57, and so forth. But to gain benefits from working another year, it is necessary to forgo the option of immediately taking accrued benefits at an advantageous reduction rate.

Between ages 56 and 65, $R(a,t)$ equals

$$(A9) \quad R(a,t) + \lambda(1 + d)^{-(65-a)}(1 + r)A(a)t \left[\frac{W(a+1)}{W(a)} \frac{(t+1)}{t} \frac{A(a+1)}{A(a)} \frac{(1+d)}{(1+r)}\right].$$

In contrast to the $R(a,t)$ formula in (A5) that applies to the period between cliff vesting and early retirement, (A9) indicates that the actuarial reduction factor d, rather than the interest rate r, imparts an upward tilt in the $R(a,t)$ profile between early and normal retirement, as long as the term in brackets is positive. In (A9) as in (A5) and (A8) the accrual rate, $R(a,t)$, is an increasing function of the rate of nominal wage growth. Larger nominal interest rates reduce accrual rates at all ages, with a negative interaction with age prior to early retirement.

While the expression (A5) is unlikely to be negative, large differences between wage growth and the interest rate r can yield negative increments in pension wealth after the early retirement age. To a first approximation, the bracketed term in equation (A9) will be positive if $\Delta W/W + 1/t > r - d$, where $\Delta W/W$ is the percentage increase in wages and $1/t$ is the percentage increase in tenure. It is easy to see, however, that low wage growth and high interest rates will yield negative increments.

Pension accrual after normal retirement can be significantly negative. Assume that our hypothetical plan neither credits service after normal retirement nor provides an actuarial increase in benefits for postponing benefit receipt beyond the normal retirement age. In this case $R(a,t)$ after normal retirement is given by

$$(A10) \quad R(a,t) = \lambda t^* A(a) \left[\frac{A(a+1)}{A(a)} - (1 + r)\right],$$

where t^* equals the worker's service prior to age 65. Note that for the following reasonable parameter values—$\lambda = .02$, $t^* = 30$, $A(a) = 15$, $r = .04$, and $A(a + 1) = 14$—$R(a,t) = -.96$, a quite substantial negative accrual ratio.

While the preceding formulas suggest the general shape of accrual rate profiles, there are few earnings-based plans with features as simple as the one considered here. In addition to more complicated rules for plan participation and vesting that often involve age as well as service requirements, there are a variety of methods of computing earnings bases, including career averages and averages of earnings, possibly

highest earnings, over a specified period or number of years. Reduction rates for early retirement are often a specified function of age, if not length of service. Some plans allow no further accrual after a given number of years of service. Roughly 30% of defined benefit participants belong to plans that are integrated with social security, and the form of "integration" can have an important effect on the pattern of benefit accrual. Other plans, in particular those with social security offset formulas, provide supplemental benefits for early retirees prior to their receipt of social security benefits. In addition to these earnings-related plans, a significant number of plans covering over 40% of defined benefit participants calculate benefits independent of the participant's earnings. Finally, there are plans that specify minimum and maximum benefit levels.

Notes

1. Only plans with incomplete or inconsistent information were classified by the BLS as unusable.

2. Our calculations ignore service requirements for early retirement, since this inclusion could have considerably complicated our accrual computations. Excluding early retirement service requirements from the analysis is not likely to alter the results significantly. Virtually all workers covered by such requirements are enrolled in plans with early retirement service requirements of 15 years or less (Kotlikoff and Smith 1983).

References

Bulow, J. 1979. Analysis of pension funding under ERISA. NBER Working Paper no. 402.

Kotlikoff, Laurence J., and Smith, Daniel, eds. 1983. *Pensions in the American economy.* Chicago: University of Chicago Press.

Kotlikoff, Laurence J., and Wise, David A. 1984. Labor compensation and the structure of private pension plans: Evidence for contractual versus spot labor markets. Working Paper no. 1290.

Lazear, E. P. 1981. Severance pay, pensions, mobility, and the efficiency of work incentives. University of Chicago. Mimeographed.

———. 1983. Pensions as severance pay. In *Financial aspects of the United States pension system,* ed. Zvi Bodie and John B. Shoven. Chicago: University of Chicago Press.

Comment

Thomas A. Gustafson

This paper reports on extensive simulation exercises exploring the detailed structure of pension accrual profiles by age. It builds directly on work by the same authors presented in a paper entitled "Labor Compensation and the Structure of Private Pension Plans: Evidence for Contractual versus Spot Labor Markets" (Kotlikoff and Wise 1984). Both papers employ information on the structure of a large number of actual pension plans from the 1979 Level of Benefits survey prepared by the United States Department of Labor. In both papers, information on individual plans was weighted by the number of plan participants. Unfortunately, information on the wage profiles of plan participants, which would be desirable for calculating pension profiles, is not available because of privacy restrictions. The authors instead used wage profiles derived from the Retirement History Survey to represent workers in the plans under investigation.

The first paper found age profiles of pension accruals characterized by a number of "spikes" at key ages—the age of vesting, of eligibility for early retirement benefits, and of eligibility for normal retirement. The authors argue that these lumpy pension profiles are inconsistent with a spot market interpretation of the operation of labor markets, since no compensating troughs are observed in wage profiles.

Findings presented in the present paper are generally consistent with the first. The same sort of profiles are observed; the authors also present evidence on the rather substantial dispersal to be found around the average pattern. This paper extends the limited empirical analysis contained in the first paper to explore a number of additional dimensions of pension profiles.

First, the authors examine accrual ratios beyond the normal retirement age for the plans, and discover substantial discontinuities at the age of normal retirement and negative values in the post-normal-retirement-age range. Second, they examine differences in profiles across industries and occupations. They discover that most apparent differences result from the distribution across industries and occupations of plans with particular configurations of early and normal retirement ages, but that industry and occupation do not seem to matter much once account is taken of plan type.

Third, they examine early and normal retirement supplements, and find these features accentuate the "spikes" on the profiles at the ages they become available. Fourth, they examine the effect of offsets for

Thomas A. Gustafson is a staff economist with the Office of the Assistant Secretary for Planning and Evaluation, United States Department of Health and Human Services.

social security benefits. Offset provisions vary widely, but in general plans without offsets have higher accrual profiles and higher spikes at vesting. Fifth, they provide information on flat benefit plans; the prior analysis was limited to earnings-related plans. The profiles observed for these plans are very similar to those for earnings-related plans, given an assumption that the flat benefit increases in line with a rate of inflation of 6%.

Finally, the paper gives new evidence on the effect of a job change late in life, which can be dramatic, and on the effect of differences in life expectancies of men and women on overall pension benefits, which can result in differences of 10% or more in total lifetime benefits.

These results reflect an obviously extensive encounter with the data, and the authors are to be commended for their energy in this exercise. While the effort extends our knowledge beyond its precedessor and Lazear's earlier paper (1983), it cannot be described as a dramatic leap forward. The results are simulations based on data on real plans, but they rely on earnings profiles that are only hypothetically connected to the information on the plans. As mentioned above, nothing better was available, but the results cannot be seen as having the same reliability as would calculations involving actual microdata on individuals.

An additional drawback is that Kotlikoff and Wise are in fact looking at only a relatively small portion of pension plans. The level-of-benefits data are restricted to private plans with certain minimum size restrictions. The authors chose to analyze, however, only a subset of the plans in the data set; almost all the analysis in this paper treats only defined benefit plans with 10-year cliff vesting. In 1977, plans with this vesting schedule represented only about 28% of private defined benefit plans; these plans, however, included 65% of plan participants (see Kotlikoff and Smith 1983, p. 184).

Limiting the analysis to plans with cliff vesting serves to dramatize the size of the spike in the accrual profile at the age of vesting; plans with more gradual, "graded" vesting schedules, such as the "rule of 45" or the "40-5-10" rule, should have a much flatter accrual profile in the early years of service. The profiles with cliff vesting are thus most at variance with a spot labor market interpretation. Restricting the analysis to this group of plans, however, means the profiles are not necessarily indicative of the experience of many workers, and the reader should be cautioned to interpret the results presented as suggestive of a modal pattern, rather than necessarily an average, "normal," or universal pattern.

The analysis does not treat three major types of plans: (1) defined benefit plans with other than 10-year cliff vesting, (2) defined contribution plans, and (3) public plans. Especially considering the evidence presented by the authors about extent of variability around the average

pattern, these restrictions are limiting. In particular, the authors' claim that they are looking at the whole universe of defined benefit pension plans is overstated.

I find the discussion of spot labor markets not particularly enlightening, mostly because in this context the spot market model is very much a straw man, a hollow foe whose defeat gives little surprise and also little indication of the mettle of the victor. Of course, the pension accrual profiles might be less interesting if one rejected this model in advance. It is the spot market model that demands attention to vesting, as opposed to some other measure of pension accruals. A 9-year veteran in a plan with 10-year cliff vesting may be thought of as having substantial expectations of pension benefits, even though they have not yet been given the legal status we call "vested." A less rigorous measure of expectations, however, would mean a smoother accrual profile, at least in the early years.

Finally, the results presented by Kotlikoff and Wise, and those by Lazear as well, refer only to pension accruals and ignore all other fringe benefits. Let me cautiously advance the hypothesis that other fringe benefits may exhibit age-related patterns that are of interest in this context. In particular, the cost of providing health benefits probably exhibits a rising profile with the age of the worker. (Of course, the extent to which the firm perceives this rise may depend on the bargain it makes with its health insurance carrier.) This profile may even rise steeply in the years following early retirement, just when we observe pension accruals falling off; in such a case, the sum of declining pension accruals and rising health benefits might be more nearly straight. This question seems to deserve further attention.

References

Kotlikoff, Laurence J., and Smith, Daniel E. 1983. *Pensions in the American Economy.* Chicago: University of Chicago Press.

Kotlikoff, Laurence J., and Wise, David A. 1984. "Labor Compensation and the Structure of Private Pension Plans: Evidence for Contractual Versus Spot Labor Markets." NBER Working Paper no. 1290.

Lazear, Edward P. 1983. "Pensions as Severance Pay." In Zvi Bodie and John B.Shoven, eds., *Financial Aspects on the United States Pension System.* Chicago: University of Chicago Press.

This Page Intentionally Left Blank