NBER WORKING PAPER SERIES

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Working Paper No. 3085

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 1989

The work reported in this document was supported by the U.S. Department of Labor under Purchase Order Number B9P63408. In addition, Gustman received support from a Martin Segal Memorial Fellowship at Dartmouth College. Any opinions expressed are those of the authors and not those of The Department of Labor, nor the National Bureau of Economic Research. We would like to thank Gary Hendricks, Olivia Mitchell, Sylvester Schieber, John Turner and members of The Labor Economics Workshop at Columbia University for their helpful comments. Allen H. Pulsifer III did an outstanding job in programming the simulation model. This paper is part of NBER's research program in Labor Studies.

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ABSTRACT

A model of the firm and its pension plan is used to simulate the first round effects of pension policies. Pension policies create an imbalance in the pension fund which affects the level of pension contributions and ultimately wages. Changes in the differential between compensation and productivity for individual workers alter the distributions of compensation and of incentives for retirement, mobility and effort. Policies investigated include those regulating vesting, pension calculations for early leavers, early retirees and late retirees, maximum service credits, liabilities at termination, and funding practices.

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I. Introduction

Currently over half of the American labor force will be eligible for pension benefits upon retirement. The large majority of these pensions are of the "defined benefit" type, wherein pension benefits are calculated from a formula specified in advance.[1] A typical plan might specify that, upon attaining the normal retirement age, the worker is eligible for a benefit equal to 1% times his or her final salary times the number of years the worker has been with the firm. Most plans also make it possible to collect reduced benefits a few years before the normal retirement age.

In general, workers who separate from the firm either prior to the age of initial eligibility or who remain after the normal retirement age receive pensions whose values are lower than those of workers who retire between those ages. In the case of workers leaving early, the low value of benefits occurs because the salary figure in the benefit formula is always specified in nominal, not real, terms. As a result, benefits do not reflect wage growth between the time the individual leaves the firm and the time he or she is eligible to begin collecting benefits. If there is substantial inflation, the real value of those benefits is eroded. At the other end of the spectrum, for workers staying beyond the normal retirement age, an additional year of work causes benefits to be lost. Although later benefits are sometimes higher because of the extra year of service and possibly because of a higher final salary, this is rarely sufficient to offset the loss of current benefits.

There are concerns in policy circles that some of these groups are not being treated fairly under this reward structure, and that some pension promises are not kept. These concerns have motivated a number of policy initiatives. To determine the likely effects of these initiatives on the compensation of various groups of workers, one must understand how pensions

and compensation are interrelated.

Whether differences in pension values reflect differences in compensation levels depends on the manner in which pensions are financed. If pensions are funded by reducing, period by period, each worker's wage by an amount equal to the increment in pension value during the period, then differences in pension values are of little consequence. Groups of workers with relatively more valuable pensions will simply pay for them with reduced wages. However, much available evidence suggests that pensions are not funded in this manner. Rather, it appears that the contributions of pensions, relative to wages, are more or less uniform across groups of workers and tend not to vary wildly from year to year for individual workers.

In this scenario, there is sufficient play in the compensation structure of the firm for differences in pension values to be associated with corresponding differences in compensation. Wages will vary so that for the entire employee group, total compensation matches total productivity, but pension policies which affect the values of pensions of specific groups are likely also to affect the total compensation of those groups and to induce offsetting changes in the compensation of other groups.

This paper develops a simple simulation model within which issues of pension policy can be addressed. Changes in pension policy which have the effect of increasing the value of the pensions of some group of workers will require the firm to raise the overall contribution rate to the pension fund and will tend to depress somewhat the overall level of wages at the firm. For example, a policy which raises the value of pensions for those working beyond the normal retirement age may well have the side effect of

reducing compensation for some relatively younger workers who, although not sufficiently unhealthy to be labeled as disabled, may be unable to continue at work.

In all cases, the model in the paper will indicate the first-order effects of the policy changes considered. By first-order effects, we mean the effects on pension values for a fixed hiring pattern on the part of the firm, a fixed retirement pattern on the part of the employees, and a constant level of productivity growth. The magnitude of these effects will vary with the specific age structure of each firm's employee group and with the exact relation of productivity to age for the firm. In addition, second-order changes may occur as firms and workers adjust their hiring and retirement patterns in response to the new environment. Nevertheless, the first-order effects calculated by the model should provide a first cut at the magnitudes of the effects of various policies on pension values and compensation.

Section II discusses in further detail the potential policy changes to be considered in the paper. Section III presents in greater detail the simulation model to be used in the paper and considers further some of the key assumptions of the model. In Section IV, the simulation model is used to analyze the effects of several recent and potential changes in pension policy. Winners and losers under the various policy changes are identified, and rough estimates are derived as to the size of the gains and losses. Conclusions are presented in Section V.

II. Pension Policies

Pension legislation is motivated by a number of goals. One goal is to recognize and protect a form of the pension contract under the law so as to increase the likelihood that a worker who is promised a pension benefit

will receive it, and to raise the fraction of the promised pension that is paid when the full amount promised is not delivered. Another goal is to alter the distribution of relative payments and incentives in favor of particular groups of workers; typical target groups include those with short tenure accrued earlier in their work lives and others who may be hurt by job mobility (often women), those who wish to work beyond the plan's normal retirement age, and perhaps early retirees who are unable to continue at work. There is also a desire to influence retirement behavior, removing disincentives to continued work by older individuals. Finally, Congress has been giving more weight to controlling the revenue loss resulting from the favorable tax treatment of pensions.[2]

The first set of policies to be considered in this paper are those directed at improving the pension status of individuals who leave the firm before becoming eligible for immediate pension benefits. One such policy has already been enacted, namely reducing the period of time that a worker must be employed by a firm before becoming vested in the pension plan. The Tax Reform Act of 1986 specifies that, with the exception of multiemployer plans, the period of time for cliff vesting can be no longer than five years, as opposed to the maximum ten year period previously. Another potential policy to enhance the pension values of these early leavers is to require that pension benefits be paid on the basis of the wage that the individual is projected to have had at normal retirement rather than the actual wage at the time of separation (CBO, 1987, pp. 116-117). This strategy would prevent the loss in pension value that otherwise occurs because inflation erodes the value of the calculated benefit between the time the worker leaves the firm and the time he or she actually begins to collect the pension.

A second set of policies pertains to early retirees, workers who are

eligible to start collecting benefits immediately upon retirement but who do not qualify for receiving full benefits. Included in this category is a policy to regulate actuarial bonuses at early retirement. Many plans currently provide for less than actuarial reductions of benefits for those who retire early.[3] These actuarial bonuses reduce the marginal reward to continued work and hence discourage such work (Kotlikoff and Wise, 1987b), but they also protect the retirement incomes of older workers who find continued work relatively difficult yet are not eligible for disability benefits.[4] Another policy would mandate benefit payments based on the wage projected to the normal retirement date rather than the wage on the actual retirement date. As with the early leavers, this would prevent inflation from eroding the value of the pensions of early retirees relative to the pensions of workers retiring at the normal retirement age.

A third set of policies is aimed at giving "fair" treatment to workers who work beyond the normal retirement date specified in their pension plans. One of these policies already in place is the requirement that firms must credit work after the normal retirement age toward the service years used in the plan formula. This change follows court decisions and EEOC regulations pertaining to the Age Discrimination In Employment Act (ADEA) and provisions of the Omnibus Budget Reconciliation Act of 1986, which amended the ADEA, ERISA and the IRS code (Commerce Clearing House, 1986, p. 17). A related policy which has not yet been enacted would be to remove caps on the maximum number of creditable service years. Such caps are relatively common in pension plans, and for long term workers these caps have the same effect as the age-based limits on service years which are now illegal.

A fourth set of policies pertains to workers who are employed by firms

that terminate a plan. A worker at a firm that terminates a plan may suffer a considerable loss if the plan settles on the basis of the worker's actual wage at the time the plan is terminated. If the individual is not yet eligible to collect benefits, then he or she suffers the same fate as the worker who leaves the firm early, namely that the value of the pension benefit is eroded by inflation between the time the plan is terminated and the time the worker can start collecting benefits. One potential remedy is to redefine the contractual obligation so that the benefit at termination is calculated on the basis of the projected wage rather than the actual wage at the time the plan is terminated.[5] Another policy to provide protection to workers whose plans are terminated is to raise funding standards. Most recently, the standards for underfunded plans have been tightened under the 1987 Omnibus Budget Reconciliation Act.

The analysis of these policies will focus on their likely redistributive effects. We are particularly interested in the side effects of these policies in affecting groups other than the group that is the target of the particular policy. In general, we will not be concerned with determining whether there is sufficient reason to justify government intervention.

III. A Model of Pension Benefits and Funding.

This section describes a model of the firm and its pension plan. In the model, the firm maintains a steady state labor force. For example, if the firm is presumed to hire an equal number of 25 year old workers every year, and if half of those workers will retire at 55 and half at 62, then in the steady state approximately 3% of the firm's labor force will be in each age category between 25 and 54 and 1.5% will be in each age category between 55 and 61. The productivity of a newly hired worker in 1970 is

assumed to be $10,000. Economy-wide productivity grows at an annual rate of 5%, and individual productivity grows an additional 1% per year due to the additional experience and tenure. The wage rate projections are consistent with those used by the CBO for the late 1980's (1987, p. 154) and with postwar experience.

A pension plan is introduced by the firm in 1970. The pension plan is characterized by a simple, final average salary defined benefit formula. Benefits are 1% of the average of the final three year's salary times years of credited service. Although this generosity coefficient is somewhat low in comparison with reported generosity coefficients, the pension benefit formula does not include a social security offset which would otherwise reduce the value of the pension. For an employee who joins the firm at age 25, retires at age 62 and dies at age 80 (the presumed age of death of all workers in the model), a generosity coefficient of 1% leads to a pension which has a present value at the time of hire that is 10% of the present value of the wage stream. In comparison with available data (Gustman and Steinmeier, 1989), the ten percent ratio is slightly low, but it is not unreasonable.

Except where otherwise noted in the simulations below, the basic pension plan to be considered has the following characteristics. The normal retirement age in the plan is 62, with early retirement available on an actuarially reduced basis at age 55. In conformance with the Omnibus Budget Reconciliation Act of 1986, work after the normal retirement age is credited. Once benefits are started, there are no cost of living adjustments.

The plan is funded so as to cover its liabilities on a projected liability basis. For those currently employed, the projected liability is calculated as a prorated share of the present value of the pension that

would be paid to each individual if the individual remained with the firm until retirement. The prorated share is the ratio of the present value of the wage paid to date divided by the present value of the wage to be paid over the full term of attachment. The liability is calculated using the actual age at whih an individual will retire, and as a result the analysis does not reflect the effects arising because the firm does not know the age of separation for each individual worker. The interest rate used in these calculations is 6%, which is about 1% lower than the estimate used by CBO.

To finance the pension plan, the firm first calculates each year the amount of contributions which would be necessary to maintain the level of funding as described above. The firm then compares the level of contributions to the total productivity of its labor force in the given year and calculates a contribution rate as a percentage of productivity. This contribution rate (up to a maximum of 25% in any given year) is then applied uniformly to all workers who are employed at the firm that year, and each worker is paid a wage that is equal to the difference between his or her productivity and the amount of the pension contribution. The calculations allow for the feedback effect of wages on the amount of the pension liability, so that in fact the contribution rate and wages are determined simultaneously.

This type of financing is consistent with available evidence regarding the relation between wages and increments in pension values. Certainly for an individual worker, compensation does not appear to match productivity on a year-by-year basis. Bulow (1982) and Kotlikoff and Wise (1985) have shown that pension accrual profiles are characterized by sharp spikes at the time that benefits become vested, and there are even sharper spikes when the worker satisfies the eligibility requirements for early or normal

retirement benefits. At these times, the wage does not appear to be depressed in an offsetting manner. In conjunction with a presumption of a fairly smooth growth in productivity over time, the relatively smooth growth of wages despite the jumps and dips in the accrual pattern of pensions suggests that if workers pay for pensions in the form of reduced wages, these payments are also relatively smooth over time.

Two final assumptions about the model warrant some discussion. One is the omission of a productivity downturn after workers become sufficiently old. This assumption runs counter to some explanations for mandatory retirement and observed incentives for retirement in many defined benefit plans. The other is that productivity of workers does not vary with the incentives from pensions, and consequently does not vary with changes brought about by pension policy. This latter assumption runs counter to many of the explanations as to why pensions have the specific defined benefit form observed for most plans, since these explanations usually involve the effect of the plans on overall productivity. However, at this time there is no consensus as to the shape of age-productivity profile, or whether pensions affect productivity and if so by how much. Almost all of the current hypotheses are not fully consistent with the empirical evidence on at least some points.

To elaborate, explanations for defined benefit pensions typically focus either on the advantages of backloading of benefits under defined benefit pensions for the design of efficient compensation schemes, or on the importance of the incentives for retirement which defined benefit plans create, thereby increasing firm profitability.[6] In the former group, one explanation is that the backloading of defined benefit plans provides incentives to discourage shirking by the workers and thereby increase their productivity (Lazear, 1983). However, given the accrual patterns of

pension plans, the potential pension loss from separation is greatest in the middle years of tenure at the firm and is considerably lower in the first few years after hire and the last few years before retirement. It is unclear why incentives against shirking need to be so much stronger in the middle years than in the early or later years. Another explanation proposed by Oi (1983), that pensions help to screen against early quitters and hence reduce hiring and training costs, runs up against similar objections. Again, if the object is to recover training costs incurred early in the employment relationship, it is unclear why the firms should make the cost of leaving less in the early years than in the middle years. Further doubts about shirking and training cost explanations for pensions come from evidence which indicates a poor understanding of incentives created by pension plans, not only by the workers (Mitchell, 1988, Gustman and Steinmeier, 1989), but by their employers (Kotlikoff and Wise, 1987c). Firms which use pensions to create incentives against mobility and shirking would have good reason to insure that these incentives were well understood.

The other category of explanation for pensions influencing productivity focuses on the retirement incentives created by pensions. In a model discussed by Parsons (1983), older workers are characterized by a much wider dispersion of productivity than are younger workers. Either because the firms cannot distinguish well which older workers are productive and which are not, or because firms are unable to act on their knowledge, they find it more efficient not to employ workers past a certain age. In this explanation, pensions are the instrument to provide the workers with the incentives to retire at the appropriate age, thereby increasing overall productivity. The major drawback of this explanation is

its failure to account for the large number of plans in which eligibility for retirement depends partly if not entirely on years of service, as for example plans which permit retirement with full benefits after thirty years of service regardless of age. If the object of pensions is to induce retirement at an appropriate age, then it would seem that eligibility for retirement should be based on age, not service years.

Kotlikoff and Wise (1985, 1987a and b) have found that there is extraordinary variation in incentives for mobility and retirement among plans. This variation should be useful for empirical studies of the various explanations for defined benefit pensions, but thus far it is still far from clear whether the form of pensions significantly affects productivity, and if so by how much. In the absence of any strong consensus on this issue, the following analysis ignores any effect of changes in pension rules on productivity. For similar reasons, the analysis also abstracts from any changes in pension plans by firms in response to policy changes other than to change the pension contribution rates as necessary to keep the plans funded.

IV. Analysis of Potential Pension Policies.

This section presents the results of numerous simulations designed to investigate the effects of pension policies aimed at various target groups. The policies simulated fall into four categories according to the target group of interest: policies aimed at early leavers, early retirees, late retirees, and workers involved in plan terminations.

A. Policies for Early Leavers.

This part presents the results of simulations evaluating policies which are designed to increase pension portability. In these simulations, the firm hires the same number of 25 year old workers every year. Of the

new hires, half are assumed to remain for only five years and the other half are assumed to remain until retirement at age 62. Table 1 provides details for the cohort hired in 1980. The results for this cohort are representative of subsequent cohorts but not for earlier cohorts. Some of the earlier cohorts benefit from contributions made on behalf of workers in still earlier cohorts who were in their last decade of employment at the time the plan was adopted and who fail to meet the vesting when they retire.

One approach to improving the situation of early leavers is to require earlier vesting. The top part of the table contrasts the effects of ten year cliff vesting with those of five year cliff vesting. The present value of the cash wage, shown in row 3, is calculated as the difference between the present value of productivity and of the contribution to the pension fund, row 1 minus row 2. Compensation is the sum of the cash wage plus the pension. When vesting is reduced to five years, the pension value for early leavers increases slightly, from zero to $660. This is associated with an increase in net compensation of only 1.4%, from $41,685 to $42,273. Given that the assumed turnover for early leavers is after five years, the comparison is between absence of vesting and complete vesting for this group, and should if anything exaggerate the effects of reducing vesting to five years. Nevertheless, the analysis indicates that reducing the vesting period so that benefits are fully vested for early leavers has only a minor effect on the value of the pension they receive.

Accordingly, even if one's benefits are fully vested, pension benefits received by early leavers are worth proportionately less than the benefits of those who stay to retirement. A mechanical reason for this result is that benefits for early leavers are calculated using the wage at separation

rather than the wage that would be received had the worker stayed until normal retirement (Bulow, 1982). A policy requiring that an employer use the wage projected to the age of qualification for normal retirement when computing the benefits for terminated, vested employees would eliminate the loss due to the practice of using the current nominal wage in computing benefits under a defined benefit plan. The bottom part of Table 1 shows the result of such a policy. When there is full vesting and the projected wage at age of normal retirement is used instead of the current wage in calculating benefits for early leavers, their pension value rises to $4,287. Since this is the value that results when there is no pension backloading, it is evident that the pension backloading inherent in the practice of using the nominal wage at the time of separation to calculate pension benefits reduces the present value of the pension for early leavers by about 85% as compared to a non-backloaded pension.

Nevertheless, under a policy where the pensions of early leavers are paid on the basis of the projected wage, the pension remains small compared to the value of earnings calculated over the remainder of the work life. For example, the elimination of pension backloading would increase compensation for early leavers by $3286 ($45,559 - $42,273), which is only 1.1 percent of compensation from age 30 to age 62 ($339,407 - $45,559). Accordingly, pension backloading does not appear to create much of a financial penalty for workers who change jobs within the first decade of attachment to the firm.

In addition to vesting requirements and the choice of wage to use in the pension formula, there are other relevant features of pension plans affecting pension portability. Eligibility requirements for normal retirement based on years of service and actuarial bonuses for early retirement will raise the penalty on early leavers because such provisions

raise the value of the pensions of other groups and hence the contribution rates of all. Also, there are many idiosyncratic features of pensions affecting incentives for mobility. Frequently a single plan uses different formulas in calculating benefits for terminated vested workers, early retirees and normal retirees. Indeed, the choice of formula used for calculating normal retirement benefits may vary with the years of service accumulated by the worker. Using the projected wage in the pension formula would not eliminate these influences on portability, and any effort to make pensions fully portable would have to take these plan features into account.

In sum, the recent easing of vesting requirements will not provide much additional protection to early leavers. Eliminating the backloading of pensions will have greater effect. Neither policy is likely to have much of an impact on the incentives for turnover for those in the first decade of attachment to the firm.

B. Policies for Early Retirees.

This section investigates the effects of abolishing actuarial bonuses favoring the early retiree. One may advocate such a policy to raise the marginal compensation for continued work, which may be reduced by early retirement bonuses. There are, however, good reasons for paying a pension bonus to at least some early retirees. Ippolito (1989) argues that in an inflationary environment, plans with benefits based on nominal wages must include actuarial subsidies simply in order to avoid economic penalties for early retirement. Further, workers in difficult jobs or with health problems that are not severe enough to qualify them for disability will find their lot eased by an early retirement bonus. Again there is conflict between the compensation of those who leave early and compensation and

incentives for those who continue at work.

Results do not vary widely by year of hire and thus are reported in Table 2 for a representative cohort hired in 1970, the year the plan is established. The simulations assume that an equal number of workers join the firm each year at age 25. Half of these will retire early at age 55 and the other half will remain until normal retirement at age 62. The top left part of the table reports results for a plan providing early retirement benefits on an actuarially fair basis, while the top right part assumes that those retiring at age 55 will receive a bonus of 20% of the value of the pension. These differences correspond roughly to the differences between plans which reduce yearly benefits by 6% and 3% respectively for each year an individual retires before the age of early retirement. Alternatively, the bonus may be in the form of supplemental "bridge" benefits between the age of early retirement and the age of eligibility for benefits under Social Security.

Consider first the actuarially fair plan. The first column reports results for workers retiring at age 55, while the second column pertains to workers retiring at the normal retirement age. Comparing the two columns, it can be seen that the backloading of the defined benefit plan reduces the ratio of compensation to productivity to 0.982 for those who retire early, while raising it to 1.013 for those who stay until normal retirement age. With the backloaded pension, lifetime compensation is 27.5 percent higher for the worker who stays until age 62 rather than leaving at 55.

In comparison with the actuarially fair plan, the plan with a 20% actuarial bonus reduces the spread in the compensation-productivity ratios by about one-third. The ratio for early retirees rises to 0.989 and falls to 1.009 for those staying until the normal retirement age. The twenty

percent increase in the pension value resulting from the early retirement bonus amounts to about a third of a year's compensation but is nevertheless too small to reduce substantially the incentive for continued work. Without the bonus, the compensation difference between early and normal retirement is 27.5%, and with it the difference is reduced only to 25.9%. Contrary to government policies which limit the ability of firms to reduce the reward to older employees, early retirement bonuses do limit the net reward for continued work by that group. However, our example suggests that the backloading of pensions more than offsets the effect of a simple early retirement bonus. Even with the early retirement bonus, the compensation-productivity ratio continues to rise with employment.

A similar effect occurs if instead of an early retirement bonus, a cost of living adjustment is introduced into the plan. A cost of living adjustment would prevent the benefits of early retirees from being eroded by inflation and hence should improve the position of early retirees relative to those staying to normal retirement. In results not reported in the table, a cost of living adjustment equal to one half the rate of wage growth increases the compensation-productivity ratio to 0.989 for early retirees and lowers it to 1.012 for those retiring at age 62.

It is also of interest to ask what the effects would be if early retirement benefits were based on the projected wage, as discussed by the CBO (1987, p. 118). The bottom part of Table 2 presents the relevant figures for a plan which calculates the benefits of early retirees using the wage projected to the normal retirement age. This plan yields compensation approximately equal to productivity for both early retirees and those working to normal retirement. Working to age 62 rather than age 55 increases compensation by 23.5%, a somewhat smaller figure than for the other plans considered. The conflict in goals among different policies is

apparent when it is noted that in comparison with an actuarially fair plan, basing early retirement benefits on the projected wage increases the compensation of those who must retire early by about half of one year's compensation, while reducing the compensation of normal retirees by a comparable amount.

C. Policies for Late Retirees.

One aim of pension policies has been to insure that pension plans do not discourage work by older individuals. In the past, many firms did discourage work by older individuals by not crediting such work toward their pensions (Kotlikoff and Wise, 1987a). The Omnibus Budget Reconciliation Act of 1986 made it illegal to stop crediting work after some specified age. However, firms may still legally take another approach by placing a ceiling on the number of years of service that will be credited toward the pension. This section investigates the effects of policies forbidding pension provisions which cease to credit work on the basis of either age or a maximum on years of service.

Table 3 investigates the effect of not crediting work past the normal retirement age for a representative cohort, the cohort hired in 1970.[7] In these simulations, the firm is again presumed to hire the same number of 25 year old workers each year, but in this case the new hires are presumed to be evenly split between individuals who will retire at the ages of 55, 60, 65 and 70. The inclusion of groups retiring later is obviously necessary in order to investigate issues regarding the crediting of work after the normal retirement age.

There are a number of assumptions which could be made about the situation in which work past normal retirement is not credited. Firms might not credit years of work but take account of the higher wage, or they

might not take account of either. Credit might be given for work after normal retirement, but only for a few years. To highlight the central issue, the simulations in the top part of the table assume that once the normal retirement age is reached, both the final wage and years of service are frozen. The simulations in the bottom part of the table assume that both the wage and years of service after the normal retirement age are treated the same as before.

The source of concern to those who wish to prolong labor force participation by older individuals is apparent in the top part of the table. With no crediting of work past the normal retirement age, the ratio of pension wealth to wealth from wages for 70 year old retirees is only 4%, compared to 11% for those retiring at age 60. While working the five years from 65 to 70 increases the number of working years by 12.5% (from 40 to 45), it increases compensation by only 8.1% (from $408,030 to $441,002). On the other hand, work from age 55 to 60 increases compensation by 19.8%, although time at work is increased by 16.7%.

Crediting work after normal retirement raises the lifetime compensation of those who would remain to age 70 by 1.8% (from $441,002 to $448,809), which is about four-fifths of one year's salary. The incentive to continue work from 65 to 70 is raised substantially, with cumulative compensation increasing 9.6% over those years as compared to 8.1% if no work is credited after the normal retirement age. Note that because after normal retirement age each year of work causes a year of pension benefits to be forgone, even when work after normal retirement is credited by the formula, the accrual rate declines at normal retirement age (Bulow, 1982; Kotlikoff and Wise, 1987a; and Gustman and Steinmeier, 1989).

Table 4 investigates the effects of policies to remove limits on the

number of years that will be credited toward retirement benefits, a practice that is still legal. A cap on years of service that will be credited toward the pension has very different effects on those joining the firm at different ages. Accordingly, these simulations assume that every year the firm hires the same number of workers, with new hires evenly split among 25, 30, and 35 year olds. Among each group of new hires, equal numbers will retire at 55, 60, 65 and 70. Also, to highlight the key interaction between the service cap and the age of normal retirement, we assume for these simulations only that the normal retirement age for the plan is 65.

Table 4 presents the compensation-productivity ratios for the cohort hired in the year 2000, a year in which the transition is complete. The top part of the table describes situation where no more than thirty years of service will be credited towards the pension and the salary for work beyond the thirtieth year is not used in computing the pension benefit. In the bottom part of the table, there are no limits on the number of years of service that may credited toward the pension.

A plan with a 30 year cap on creditable service would be expected to provide the greatest reward to those who retire at 65 having joined the plan 30 years earlier. For such a worker, compensation exceeds productivity over the term of attachment by four percentage points, or about 1.2 years of compensation. Moreover, such a worker faces a very strong incentive to remain until 65, and a much reduced reward for work after 65 than before. Under this kind of plan, the worst one can do (relative to own productivity) is to come early and stay late. For a worker who joins the firm at age 25 and stays until age 70, compensation is lower than productivity by almost three percentage points. In contrast, a plan without a cap encourages work until age 65, whatever the age of

joining the firm.

Consider now the redistribution brought about by the policies to eliminate age-related or service-related limits on creditable service years. In both Tables 3 and 4, those who leave early (age 55) because of physical or health difficulties will find their lifetime compensation reduced by about two percent compared to what they would have received if limitations on creditable service years were still in place. In a sense, limitations on creditable service years protect the relative benefits of early retirees, and their removal worsens their position. Thus programs to increase the benefits for late retirees will reduce the welfare of early retirees--some of whom may simply be unable to continue at work.[8]

D. Policies for Protecting Workers in Terminated Plans.

If a defined benefit plan is terminated, the amount that the firm owes its workers under the law is the legal liability, calculated by using the current wage in the defined benefit formula together with covered employment to date. As previously noted, a termination may severely reduce the value of the pension to the worker because inflation erodes the value of the benefit between the time of the termination and the time the individual begins to receive the benefits. One approach to reducing the damage to the worker in such a case is to strengthen the funding standards for pensions to increase the probability that a firm going bankrupt will be able to honor its pension obligations. Another approach is to specify the obligation using the projected wage rather than the actual wage. This would eliminate the damage done by inflation between the time a plan is terminated and the time benefits begin.

Table 5 describes the results of simulations to investigate these issues. In these simulations, the firm hires equal numbers of 25 year old

workers each year, and all workers retire at age 62. All plans in this table are terminated in 2080. The compensation-productivity ratios for groups still at the firm in 2080 refer only to the time periods during which they were covered by the pension.

The first column of the table describes a plan which is funded to cover the legal liability and which which settles the plan according to the legal liability at termination. Many union plans are currently of this type. The second column also concerns a plan which settles according to legal liability at termination, but in this case the plan changes its funding method from a legal liability basis to a projected liability basis beginning in the year 2000. Projected liability is calculated by multiplying the present value of the benefit that each worker would receive at retirement by the fraction of the present value of wages from lifetime attachment that has been earned to date. Most nonunion plans are funded in this manner. Finally, the third column describes plans which shift the funding basis from legal to projected liability in the year 2000 and which, in addition, settles its obligations at termination by using the projected wage rather than the current wage in the benefit formula.

The basic messages of this table are fairly straightforward. Younger workers at firms which terminate their pensions suffer sharp losses unless plans settle at termination on the basis of the projected wage. The losses are proportionately higher for the youngest groups but are absolutely greater for middle age groups at the time of termination. For example, with legal liability funding and settlement, members of the 2080 cohort would effectively be paid 8.8% below their productivity for their one year of pension coverage. Members of the 2060 cohort, who are 45 years old at the time of termination, are paid 6.4% less than their productivity, but

over the much longer time period of 21 years.

When plans change from legal liability to projected liability funding, workers at the firm at the time in effect pay for the improved funding through wages that are lower than they would otherwise be. The hardest hit workers are those who are approaching retirement when the change occurs, since they suffer lower wages during the period of increased pension funding and then suffer reduced pension benefits since those benefits are based on wages at the end of the working career. In this example, members of the cohort of 1970, who are within two years of retirement when the funding change is instituted in 2000, suffer about a 2% loss in compensation relative to the compensation they would have received if the funding change had not taken place. Other cohorts who are at the firm at the time of the change also suffer reduced compensation, generally on the order of 1.5%.

Therefore, to the extent that this model is correct, any policy that requires projected liability rather than legal liability funding is likely to create a redistribution among cohorts. Those on board during the transition from legal to full funding will suffer losses. If the settlement at termination is based on the projected wages, those employed at the time of plan termination will be better off if the plan had changed to funding on a projected basis, and otherwise it is the firm that will be better off at termination by being able to recapture the excess funding.

V. Conclusions

The analyses reported in this paper pertain to stylized pension plans. We have tried to select plan parameters which, on the basis of our previous work, appear representative. Nevertheless, the plans examined are much simpler than most of the plans we have encountered in our empirical work

(Gustman and Steinmeier, 1986a, 1986b, 1987, and 1989). Moreover, the effects of these various policies will depend on the actual employment mix within the firm, on whether employment is growing or shrinking, on the expected patterns of turnover in the future, and on the productivity-age-tenure relationship. The effects will also depend on any potential feedback from the policies to productivity, worker turnover, retirement, and market level adjustments.

An important implication of the model is that when the compensation budget is constrained, policies redistribute compensation among covered workers so that efforts to help certain classes of workers may have adverse implications for the benefits and incentives facing other classes of workers. Those workers who are adversely affected are often the subject of other policies which are designed to improve their status or the incentives they face. Consequently, different policies may have conflicting effects and compatibility among goals becomes an issue.[9] In addition, the effects of the policies pursued on the welfare and incentives facing different groups of workers are not always symmetric, making policy design all the more difficult.

Footnotes

1. The other major type of pension plan is the "defined contribution" plan which bases pension benefits on the amount contributed to individual accounts set up for each worker. Although most employees with pensions are covered by defined benefit plans, recent evidence suggests that there may be a trend developing toward defined contribution plans, not just as secondary plans, but as primary plans (Ippolito, 1986; Clark, 1987).

2. Other goals motivating pension legislation are the desire to secure comparable treatment for those low wage workers who are employed by firms offering generous pensions to their high wage workers, to extend pension coverage as widely as possible, to increase savings, to insure adequate retirement income and to remove pressure from the social security system. For a useful discussion of pension policies and their origins, see CBO (1987, Appendix A).

3. See Ippolito (1989) for a discussion of actuarial verses economic adjustments for early retirement.

4. Workers in physically difficult jobs and in ill health retire substantially earlier than do others. For relevant estimates, see Gustman and Steinmeier (1986a).

5. For discussion of such a proposal using price rather than wage indexing, see CBO (1987, p. 117). Ippolito (1986, p. 250,) discusses policies that make it easier for workers and firms to write real contracts. For example, he recommends that the Treasury issue indexed bonds that could be purchased under such contracts. However, Ippolito argues against any policy that would redefine or alter the terms of asset ownership under pension plans as we now understand them.

6. In this paper backloading refers to the fact that under a defined benefit plan, benefits accrue disproportionately in the later years of employment. See Bulow (1982) and Kotlikoff and Wise (1985) for analyses of accrual patterns under defined benefit plans.

7. The simulations in this table, and this table only, include a post-retirement cost of living adjustment which raises pension benefits by one half of the annual rate of the increase in general wage levels. This is roughly consistent with results found by Clark, Allen and Sumner (1986) which suggest that the average post retirement adjustment in pensions covered about 40% of cost of living increases from 1973 to 1979.

8. It should be noted that to the degree the number of 70 year old retirees is overstated, the effects of the policy on younger workers is likely also be overstated.

9. See Kotlikoff and Wise (1987b) for a discussion of conflicting goals under social security and pension policies.

Table 1
Policies for Early Leavers

Dollar Figures Are Present Values Over the Term of Attachment
in 1970 Dollars for the Cohort Hired in 1980

	Ten Year Vesting Using Actual Wage at Separation		Five Year Vesting Using Actual Wage at Separation	
	Leave At 30	Retire At 62	Leave At 30	Retire At 62
Productivity	$ 45,521	$339,413	$ 45,521	$339,413
Pension Contribution	3,836	28,705	3,908	29,178
Wages	41,685	310,708	41,613	310,235
Pension Benefits	0	32,027	660	31,979
Total Compensation	41,685	342,735	42,273	342,214
Pension/Wage Ratio	0	0.103	0.016	0.103
Compensation/ Productivity	0.916	1.010	0.929	1.008

	Ten Year Vesting Using Projected Wage at Normal Retirement	
	Leave At 30	Retire At 62
Productivity	$ 45,521	$339,413
Pension Contribution	4,249	31,723
Wages	41,272	307,690
Pension Benefits	4,287	31,717
Total Compensation	45,559	339,407
Pension/Wage Ratio	0.104	0.103
Compensation/ Productivity	1.001	1.000

Table 2
Policies for Early Retirees

Dollar Figures Are Present Values Over the Term of Attachment in 1970 Dollars for the Cohort Hired in 1970

	Actuarially Fair Plan Using Actual Wage at Separation		Plan with Actuarial Bonus to Early Retirees and Using Actual Wage at Separation	
	Retire At 55	Retire At 62	Retire At 55	Retire At 62
Productivity	$302,061	$373,159	$302,061	$373,159
Pension Contribution	24,366	30,110	25,889	31,991
Wages	277,695	343,049	276,172	341,168
Pension Benefits	19,005	35,360	22,681	35,166
Total Compensation	296,700	378,409	298,853	376,334
Pension/Wage Ratio	0.068	0.103	0.082	0.103
Compensation/ Productivity	0.982	1.013	0.989	1.009

	Actuarially Fair Plan Using Projected Wage at Normal Retirement	
	Retire At 55	Retire At 62
Productivity	$302,061	$373,159
Pension Contribution	28,204	34,853
Wages	273,857	338,306
Pension Benefits	28,274	34,870
Total Compensation	302,131	373,176
Pension/Wage Ratio	0.094	0.093
Compensation/ Productivity	1.000	1.000

Table 3
Policies for Late Retirees

Dollar Figures Are Present Values Over the Term of Attachment in 1970 Dollars for the Cohort Hired in 1970

Work After Normal Retirement Not Credited

	Retirement Age 55	60	65	70
Productivity	$302,061	$352,821	$403,701	$454,701
Pension Contribution	20,149	23,603	27,090	30,622
Wages	281,912	329,218	376,611	424,079
Pension Benefits	23,070	36,087	31,419	16,923
Total Compensation	304,982	365,305	408,030	441,002
Pension/Wage Ratio	0.082	0.110	0.083	0.040
Compensation/ Productivity	1.010	1.035	1.011	0.970

Work After Normal Retirement Credited

	Retirement Age 55	60	65	70
Productivity	$302,061	$352,821	$403,701	$454,701
Pension Contribution	25,397	29,645	33,920	38,238
Wages	276,664	323,176	369,781	416,463
Pension Benefits	22,678	35,483	39,824	32,346
Total Compensation	299,342	358,659	409,605	448,809
Pension/Wage Ratio	0.082	0.110	0.108	0.078
Compensation/ Productivity	0.991	1.017	1.015	0.987

Table 4
Further Policies for Late Retirees

Figures are Compensation/Productivity Ratios
for the Cohort Hired in 2000

30 Year Maximum on Creditable Service

Age of Hire	Age Of Retirement 55	60	65	70
25	1.001	0.997	0.991	0.972
30	1.001	1.018	1.012	0.982
35	1.001	1.017	1.040	0.997

No Maximum on Creditable Service

Age of Hire	Age Of Retirement 55	60	65	70
25	0.980	0.997	1.019	0.998
30	0.980	0.997	1.019	0.998
35	0.980	0.997	1.018	0.998

Table 5
Policies for Plan Terminations

Figures are Compensation/Productivity Ratios

Cohort	Legal Funding and Settlement	Full Funding After 2000; Legal Settlement	Full Funding After 2000; Full Settlement
1970	1.015	0.994	0.994
80	1.003	0.986	0.986
90	0.996	0.981	0.981
2000	0.993	0.981	0.981
10	0.993	1.000	1.000
20	0.993	1.000	1.000
30	0.993	1.000	1.000
40	0.993	1.000	1.000
50	0.965	0.972	1.000
60	0.936	0.943	1.000
70	0.920	0.927	1.000
80	0.912	0.919	1.000

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