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5 The Effect of Inflation on the Private Pension System

Jeremy I. Bulow

5.1 Introduction

One clear consequence of the increased inflationary expectations of recent years has been a sharp increase in nominal interest rates. Additionally, nominal interest rates including long-term rates have become much more volatile in recent years. Because the liabilities of defined benefit pension plans are primarily nominal in form, changes in interest rates can greatly affect the value of these liabilities.

Increases in long-term interest rates have provided windfall transfers of tens of billions of dollars from employees to employers. Even workers in plans with benefits linked to final salary have virtually no protection against the effect of an increase in nominal interest rates. The reason is that at any given time the worker holds a fixed nominal claim on the firm. The value of that claim is eroded if inflation rates (and thus interest rates) rise. This loss in benefit value will not in general be compensated for by future salary increases.

The structure of this paper is as follows: In section 5.2 the effect of inflation on the value of individual workers' benefits is discussed. A major point is that even if a plan provides benefits based on final salary, the worker still owns a nominal pension claim and is not hedged against inflation. Next, the section 5.3, the effect of inflation on aggregate benefits is discussed, including the distribution of inflation risk among workers, firms, and the federal government. In section 5.4 some empirical evidence is presented as to how inflation has affected large pension plans. Section 5.5 contains speculation on the likely effect of high inflation rates on the form of the pension contract and on the competing

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interests of different groups of employees (young versus old) given the current status of pension plans. Last, Section 5.6 concludes the paper.

5.2 How Inflation Affects Individual's Pension Benefits

Consider a pension plan which gives a worker a benefit based on final average salary. There are several ways in which the real value of such a worker's benefits are reduced by unexpected changes in the inflation and interest rates:

1. Benefits are generally not indexed for inflation after retirement. Thus an increase in the inflation rate would reduce the worker's real benefits in the years after retirement, below what was expected.
2. If benefits are integrated with social security and social security benefits are tied to inflation, an increase in the price level can mean a decline in private pension benefits received.
3. Often benefits are related to an average of the last several years' salary rates of the employee. Increases in the inflation rate matched by equal increases in salary will reduce the ratio of benefits (based on an average salary) to final pay, below what was expected. For example, if benefits are based on an average of the last five years' pay, this base will likely be close to the actual final salary in a period of no inflation, where it may be significantly below final salary in a period of high inflation.

Such effects are not trivial—Winklevoss (1977) has estimated that a five percentage point increase in both salary growth rates and interest rates would reduce the present value of the benefits of a typical worker by about 13%. However, these "mechanical" effects (derived from assuming that the worker's future real *salary* is unaffected by the inflation rate) represent only a small part of the effect of inflation on the value of workers' benefits.

The most important factor is that the benefits a worker has accumulated at any point in time represent a fixed nominal sum. That is, if a worker left the firm at any particular moment, he would have coming to him some fixed nominal pension benefits. The present value of those nominal benefits can be discounted at the riskless nominal interest rate, assuming that the pension plan is sufficiently well funded so that there is no need to discount benefits any further. An increase in long-term interest rates will thus decrease the value of this nominal claim.

That is, the worker accumulates nominal pension benefits each year. As the worker continues on the payroll, he accumulates more nominal benefits. However, unexpected changes in the inflation rate change the value of previously accumulated pension rights. There is no reason to believe that firms will gratuitously "make up" this loss to employees. Even if benefits are fully indexed for inflation after the employee reaches

the normal retirement age, even if there is no plan integration with social security, and even if benefits are based strictly on the worker's final salary, the employee is not hedged against inflation unless his benefits are also indexed for inflation that occurs while he is working.

A simple three-period example can make this important point clear. Assume that workers work for two periods and then receive a pension in the third period of their lives. Imagine that benefits are indexed from the time after the worker receives his second year's paycheck to the time of the pension payoff in year three. Also, imagine that there is a competitive labor market in which the firm currently can hire an employee for $13,000 in total compensation—whether it is in the form of salary or a combination of salary and pension benefits. Now compare the following four scenarios:

Scenario 1. There is no inflation and the interest rate is zero. The firm establishes a pension plan granting the workers a benefit equal to 30% of final (second-year) salary times the number of years worked.

Salary each year will be $10,000 under this pension scheme, with pension benefits of $3,000 paid to someone who leaves the firm after one year and $6,000 paid to someone who leaves after two years.

Scenario 2. There is a 20% inflation rate, and the interest rate is also 20%. Benefits are indexed from the day the employee leaves the firm until they are actually received. Again the benefit formula is that benefits equal 30% of final salary times the number of years worked.

In this case the first-year salary of the worker will still be $10,000, with a $3,000 pension benefit being accumulated. If the worker left the firm after one year, the actual nominal benefit received in year three would be $4,320, or $3,000 × 1.20 × 1.20 allowing for two years of inflation. If the employee stayed a second year, his salary would rise to $12,000. The eventual pension received would be 60% of $12,000 or $7,200, times 1.20 for one year of inflation. The net pension benefit would be $8,640, or twice the benefit received by the worker who left after one year.

Scenario 3. Now consider the same situation as scenario 2, except that the pension plan only begins indexing benefits after the employee reaches retirement age.

In this situation the worker will receive a salary of $10,400 in the first year of employment. Should the worker leave, he or she would have accumulated a pension worth 30% of that amount, or $3,120. Allowing for a year of indexing between the worker reaching retirement age at year two and receiving a benefit in year three, the net benefit received would be 1.20 × $3,120, or $3,744. The present value of that amount in year one is $2,600, which added to the $10,400 in salary provides the worker with a total compensation of $13,000.

In year two the worker will have to be paid a salary of $11,700. With such a salary, final pension benefits would amount to 0.6 × 11,700 × 1.2 = $8,424. The incremental benefit received from working that second

year would be \$8,424 − \$3,744 = \$4,680. Discounting for a year's interest, the present value of the increase in the worker's benefits from an extra year of service would amount to \$4,680/1.20 = \$3,900. Added to the \$11,700 salary, this would give the worker a total second-year compensation of \$15,600, or \$13,000 in year one dollars.

An important point here is that even with fully anticipated inflation the nonindexation of benefits in the preretirement period leads to higher salaries (and less valuable pension accruals) for young workers relative to older workers. For example, in both scenarios 1 and 2 real salaries and real pension accruals were the same in both working periods. In scenario 3 first-period real salary was higher and second-period real salary was lower than in the other situations. Of course, the corollary of salary being tilted toward the younger worker is that pension benefits are tilted toward the older worker. With inflation the last period of employment provides a disproportionate share of pension benefits because, in addition to increasing years of service, the last year's salary raises the base for which benefits based on prior service is determined.

For a pension plan of the type described above (benefits based on a constant times final salary times years worked) the present value of accrued benefits rises from one year to the next by roughly $[(1/T + g + i]B$, where T is the number of years of prior service, g is the growth rate in salary, i is the interest rate, and B is the beginning value of accrued benefits. This formula would be exact were (1) this analysis done in a continuous rather than discrete form (i.e. looking at the rate of benefit accrual at a moment in time rather than from one year to the next) and (2) the fact that the older worker has a higher chance of surviving to retirement considered.

Of the three reasons that benefits grow, the interest factor i is due to benefits being a year closer to receipt. Benefits would grow by this amount even if the employee did not stay with the firm. This part of growth can rightfully be thought of as interest on previously accrued benefits and is thus not part of the benefits attributable to the latest year's service. The factor $1/T$ accounts for the fact that if the employee has worked, say, twenty-one years instead of twenty his benefits are 1/20 higher. The factor g allows that benefits are based on a final salary $100g\%$ higher. With inflation, the g factor becomes more prominent and a higher fraction of total benefit accumulation occurs in the final years of employment.

Table 5.1 shows the percentage of final pension benefits accrued after ten, twenty, thirty, and forty years of service for a worker whose salary is growing at various rates, with benefits proportional to years of service.

While scenario 3 pointed out the effect of anticipated inflation in flattening out wage/age profiles (raising the salaries of younger workers and reducing the salaries of older workers), scenario 4 points out the risk the worker takes with regard to anticipated inflation.

Table 5,1 **Benefits Accrued as a Function of Salary Growth Rate and Years of Service, as a Percentage of Final Benefits**

Years of Service	Salary Growth 0%	3%	5%	8%
10	25.0	10.3	5.8	2.5
20	50.0	27.7	18.8	10.7
30	75.0	55.8	46.0	34.7
40	100.0	100.0	100.0	100.0

Scenario 4. No inflation is expected, but benefits are indexed for the period after the employee reaches normal retirement age. The pension formula is still that benefits will equal 30% times years of service times final salary.

In the first year the worker is paid $10,000 just as in scenario 1. The value of the worker's pension benefit is $3,000. Now, however, assume that between year one and year two the inflation rate jumps to 20% per year. Since benefits will only be indexed after year two, the employee who leaves after year one will receive a benefit of only $3,600.

At the beginning of year two the present value of that benefit is only 3,000 year two dollars rather than the $3,600 present value of benefits with full indexation (as under scenario 2).

If the worker stays with the firm, his second-year salary will be $11,625. The worker's pension will be $0.60 \times \$11{,}625 \times 1.20$ to allow for postretirement indexation. This works out to a pension of $8,370, which has a present value in year two of $6,975. Subtracting the $3,000 present value of benefits if the employee quits after one year leaves the value in terms of pension benefits from working the second year at $\$6{,}975 - \$3{,}000 = \$3{,}975$. This added to a salary of $11,625 gives a total second-year compensation of $15,600. The employer will not be willing to pay more than this amount because he can go out in the labor market and hire other workers for $15,600, which is the total cost of this employee at a wage of $11,625.

Relative to scenario 2, scenario 4 shows that lack of protection against first-period inflation causes the worker to receive a salary that is $375 lower and a pension benefit that is lower by $225 in year two dollars ($270 in year three dollars, or $8,640 less $8,370). This total reduction of $600 in year two compensation exactly equals the difference in the value of the worker's pension benefits ($3,600 versus $3,000) because the first-year benefits were not indexed until retirement in the event the worker left the firm.

What scenario 4 shows is this: A worker receives a pension benefit tied to his salary. His total compensation rises with inflation. His pension benefits are indexed to inflation, after retirement. The worker does not

terminate his employment prior to the normal retirement age, and the rules under which pension benefits are determined are not changed. Nevertheless the worker ends up paying the price of unanticipated inflation.

Of course, if the inflation rate dropped from 20% to 0, the worker would have had a gain. Assuming no preretirement indexation and an expectation of 20% inflation, the first year's pay would have been \$10,400 in salary with a promise of a nominal pension of \$3,120 plus postretirement indexation as in scenario 3. If there is no inflation instead of the anticipated 20%, the value of this package is \$13,520 instead of \$13,000 (the pension having a value of \$3,120 instead of \$2,600). Thus workers gain if the inflation rate is below expectations and lose if the inflation rate exceeds expectations.

5.3 The Effect of Inflation on Aggregate Pension Benefits

The passage of the Employee Retirement Income Security Act of 1974 (ERISA) established the maximum liability of a firm in the event of the termination of its pension plan(s).

The firm's liability beyond the money in the pension fund can be written as

$$\text{FL} = \min [A-F, \max [0, \min (G-F, .3E)]], \tag{1}$$

where FL = firm liability, A = accrued pension benefits, F = amount of money in the pension fund, G = benefits guaranteed by the Pension Benefit Guaranty Corporation (PBGC), and E = market value of the firm's equity. A and G are both calculated by discounting benefits at the nominal interest rate.

Guaranteed benefits G differ from accrued benefits primarily in that (1) only vested benefits are guaranteed; (2) there is a limit to the amount of guaranteed benefits any individual can receive; (3) any benefits due to plan amendments made during the last five years are only partially guaranteed; and (4) only pension benefits (not death and miscellaneous benefits) are guaranteed.

The liability of the PBGC in the event of plan termination can be written as

$$\text{PBGCL} = \max [0, G-F - .3E], \tag{2}$$

where PBGCL = PBGC liability and the value of the workers' claims in termination can be written as

$$T = \text{FL} + \text{PBGCL} + F \text{ or} \tag{3}$$

$$T = \max [G, \min (A, F)], \tag{3'}$$

where T equals the value of the workers' claims in the event of plan termination.

Of these variables, A and G are directly related to nominal interest rates. The value of pension fund assets, F, and the market value of the firm, E, are not directly related to interest rates.

When inflation and interest rates change, the value of the claims of the firm, government, and workers in termination are all affected. These termination liabilities are probably the best estimate of the true economic position of the three parties, even though a plan may be unlikely to terminate. The argument is analagous to saying that the value of the worker's individual pension claim can be calculated on the basis of what the worker could receive if the worker immediately terminated employment, even if we are certain that the worker will end up staying on with the firm until the normal retirement age. This argument is made in detail in my NBER Working Paper no. 402 (pp. 23–26).

Increases in interest rates have reduced both A and G. On the basis of formulas (1) through (3′) we can say who gains and who loses when these changes in interest rates occur.

If $F > A$ (the plan is overfunded), then an increase in interest rates simply reduces accrued liabilities. The value of the workers' claims are reduced, with the benefit going to the firm.

If $A > F > G$ (the plan has enough benefits to cover guaranteed but not all accrued benefits), then a termination leaves the workers with F and the firm with no extra liability. Changes in the values of A and G do not influence the value of aggregate worker benefits (which remain at F) though there is a potential transfer of benefits among workers.

If $F + .3E > G > F$, the PBGC still has no liability and the workers have benefits worth G. An increase in interest rates will reduce G and thus both worker benefits and firm liability.

If $G > F + .3E$, then the firm is facing a maximum liability of $.3E$ beyond the money in the pension fund. An increase in interest rates which reduces G hurts workers but does not affect the firm. In this case $G - F - .3E$ is the liability of the PBGC, and this liability is reduced when interest rates increase.

The above analysis is in reality only an approximation, in part because of long-term labor contracts. For example, with long-term contracts, just because all benefits are currently funded (i.e. $F > A$) does not mean that a drop in interest rates gives workers an increase in wealth proportional to the increase in A. The reason is that the decreased spread between F and A increases the likelihood that the firm will be able to make use of its option to limit its liability to F. Essentially the pension debt becomes more risky as it grows in value relative to the amount of money in the pension fund, and this increased risk in benefits is what holds down the

gain to workers. In general, workers will lose from interest rate increases while the PBGC and the firm will gain. The exact amount and allocation of gain will vary depending on the relative values of A, F, G, and E with the earlier analysis providing a rough distribution of the burden.

5.4 The Effect of Inflation on the Value of Pension Benefits

The purpose of this section is to provide a rough estimate of the aggregate funding status of defined benefit pension plans and an indication of the sensitivity of this liability to changes in nominal interest rates.

In their annual report "Funding Costs and Liabilities of Large Corporate Pension Plans" (1980) the firm of Johnson & Higgins stated that the 432 of the Fortune 500 firms for which they could collect data had vested liabilities of \$163.363 billion, of which 80% of the benefits were funded. Of the 200 largest nonfinancial corporations, they were able to collect data on 139, finding 94% of \$53.361 billion in vested benefits were funded at the end of 1979. The firm attempts to include only defined benefit plans in their analysis; however, sometimes it is difficult to separate defined contribution and defined benefit assets on the basis of publicly available data.

(Note: "Total vested liabilities . . . were calculated by adding the total unfunded vested liabilities of plans for which a plan asset value was available to the total plan asset figure. The ratio of plan assets to total vested liabilities was then calculated. This overstates aggregate total vested liabilities to some degree and correspondingly understates the ratio of plan assets to total vested liabilities, i.e., the funded percent of total vested liabilities. This is countered in part, however, by the fact that most vested liabilities figures are as of the beginning of the year, while assets—usually not including book accruals—are as of the end of the year" [Johnson & Higgins 1980, p. 40].)

Vested liabilities are often used by actuaries as an approximation for the maximum firm liability in the event of plan termination. The differences are that benefits vested in the last five years are only partially guaranteed, there is a limit to the benefits guaranteed to each individual, firms have a maximum liability equal to 30% of the market value of their equity, and if the plan has enough money to pay all vested benefits it is also liable to pay any other accrued benefits in termination.

Guaranteed benefits can sometimes be significantly less than vested benefits. Every three years the auto companies sign new contracts that greatly increase unfunded vested benefits. Those benefits might rightfully be written off at least over the three years of the labor contract, but instead they are immediately placed on the pension fund balance sheet. Thus, counting all vested benefits as part of the firm's current pension liability may make the firm seem worse off than it really is because the

liability is immediately recorded while the corresponding asset (present value of future labor services provided in return for the pension benefits) is only recognized over the life of the contract.

On the other hand, arguments have been made by some authors (including Feldstein and Seligman 1980) that a high fraction of accrued but not vested benefits should be included as part of the firm's pension liability. For the sake of agrument, we will include an estimate of all such liabilities, times their actuarial probability of being vested, as part of the firm's pension liability. Winkelvoss [1977] estimates that for a prototypical plan the additional cost of immediate vesting versus vesting after 10 years is that the plan's accrued liability rises by a little over 2% (p. 178). This is consistent with the actual numbers reported by the few firms (e.g. Esmark, Woolworth, and General Electric) for which I have been able to obtain figures for both vested and accrued benefits. To be conservative, no reductions will be made here for the differences between vested and guaranteed benefits, but 5% will be added to vested benefits to allow for accrued but not vested benefits.

The most important adjustments that must be made are for the interest rate assumptions used by firms. A 1978 survey of 246 large plans by Reporting Research Corporation found an average interest rate assumption (weighted by plan assets) of 6.0%. A May 1977 survey by *Institutional Investor* magazine (unweighted by fund assets) yielded an average assumption of 5.85%. The Bell System, with over $20 billion in pension fund assets (little of which was included in the Reporting Research survey), used an interest rate assumption of 6%. Allowing for the possibility of some recent increases in rate assumptions, this analysis will use an average interest assumption of 6.5%.

Next it is necessary to choose the correct interest rate at which to discount pension liabilities. The minimum rate to use is the long-term riskless rate of interest. Moody's Aaa bonds yielded 8.19% at the end of 1977, 9.94% at the end of 1978, and 12.06% at the end of 1979. Since the end of 1979, long-term rates have gone even higher, while fluctuating substantially. This analysis will include calculations using interest rate assumptions of 8, 10, and 12%.

Finally, it is necessary to estimate the effect of a change in the interest rate assumption. There are some rules of thumb used in the actuarial profession. Basically, an approximation is that a change in the interest rate assumption from 5 to 6% reduces pension costs by 20%. The implication is that the duration of pension debt is slightly longer than the duration of a consol. Furthermore, the timing of pension debt is such that its duration is less sensitive to interest rates than is a consol's duration.

For example, in figure 5.1 we see that vested pension benefits (in dollar terms, not adjusted for interest) owed tend to have a distribution which peaks several years in the future. A consol has constant payments. Now

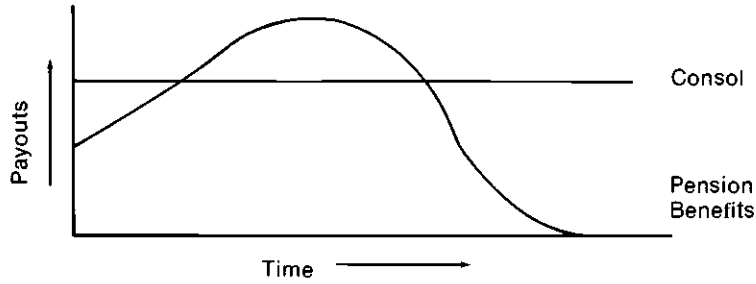

Fig. 5.1 Sample distribution of maturity of currently vested pension benefits.

imagine that the consol and the pension benefits had the same duration. An increase in interest rates will decrease the duration of the pension debt by less than the consol. That is because with an increase in interest rates the consol, with more short term and very long term liabilities, will find the relative weight of its short debt increased relative to the pension case. For example, in the extreme case where all pension debt is due after twenty years, a 5% interest rate would give the consol and pension debt identical durations (and some sensitivities in value to the interest rate). However, if the interest rate rose to 6%, the duration of the consol would be 16⅔, while the duration of the pension debt would still be twenty. This analysis implies that a conservative estimate of the change in value of pension debt with regard to an interest rate increase is to assume the debt is proportional to one divided by the interest rate.

Winklevoss estimated (p. 197) that for a typical plan using a 7% interest rate assumption, changing the assumption to 5% would make the accrued liability 138.7% as large, while 9% would make benefits 74.9% as large and 11% would drop the present value of benefits to 57.9% of the 11% rate. These numbers are all consistent with the statement that assuming the present value of benefits for a plan is inversely proportional to the interest assumption will slightly understate the impact of an increase in interest rates. The assumption to be used here is more conservative: that for every 5% increase in the interest rate (e.g. from 10 to 10.5%) the present value of benefits would fall by 4%. More precisely the market value of liabilities were estimated by the formula:

$$\text{market value of liabilities} = \text{book value of liabilities} \times (\text{book interest rate/market interest rate})^{4/5}.$$

Assuming that other relevant (e.g. mortality) actuarial assumptions are accurate, it is now possible to estimate corrected pension liabilities. (Remember, the salary growth assumption is irrelevant to valuing

accrued liabilities, so an unrealistically low estimate on that account has no effect.)

The 571 firms cited in the Johnson & Higgins survey have funded benefits of $0.80 \times \$163$ billion plus $0.94 \times \$53$ billion, or \$180 billion, and vested benefits of \$217 billion. Adding 5% for accrued but not vested liabilities yields total liabilities of \$228 billion.

Unfunded liabilities are \$228 billion less \$180 billion = \$48 billion for these firms. This number would have to be projected over the corporate sector as a whole, but the firms surveyed here do represent the bulk of private defined benefit pension plan assets. Now, however, corrections must be made for the interest rate assumption used in calculating these liabilities. Under the assumption that liabilities are inversely proportional to the interest rate, liabilities drop to \$193 billion with an 8% interest assumption. Using a 10% assumption drops the present value of the liabilities to \$162 billion. At an interest rate of 12% the present value of liabilities falls to \$140 billion and at 14% it falls to \$123 billion. Comparing these liabilities with \$180 billion in pension assets produces net unfunded liabilities of the following amounts.

Interest Rate	*Unfunded Liabilities*
6.5%	\$48 billion
8.0%	\$13 billion
10.0%	−\$18 billion
12.0%	−\$40 billion
14.0%	−\$57 billion

Note that as the interest assumption rises pension plans as a whole appear to be better and better funded. Using a rate of roughly 9% or more to discount liabilities is sufficient to put pension plans as a whole in the black.

During 1980 the stock market rose while interest rates also increased. The net effect was that pension assets, consisting of both equities and debt of shorter duration than pension liabilities, on the whole almost surely rose in value while the present value of liabilities was reduced. Therefore taking into account recent developments would make the pension system appear even better funded.

It is important to recognize how sensitive the net liability position is to changes in stock prices and long-term interest rates. A one percentage point change in interest rates affects the present value of liabilities by about \$10 billion. To the extent that plans do not hedge all these liabilities with fixed interest assets of similar duration, or nonpension assets negatively correlated in value with interest rates, firms (and the PBGC) bear significant interest rate risk in their pension funds. Workers also bear

tremendous interest rate risk. Whether having workers bear this risk is "bad" is not an easy question. It could be that the owners of vested benefits also tend to have mortgages which cancel their pension risk. However, the issue is one that deserves some thought.

5.5 The Effect of Inflation on Future Pension Agreements

Increases in interest rates affect the pension system in three main ways. First, higher interest rates make the present value of the same nominal benefits lower. Thus the nominal terms of a pension plan could be uniformly improved without a change in pension costs, should interest rates move to a higher level. Second, high rates reduce the present value of younger workers' benefits more than they reduce the value of older workers' benefits. That is because the younger workers will not receive their benefits for a longer period of time, and thus their benefits are reduced more sharply by higher interest rates. Third, the higher variance in inflation rates increases the pension liability risk discussed in section 5.3. Changes in interest rates cause transfers to and from workers. More variance causes the magnitude of such transfers to be larger.

The obvious consequence of the first effect—higher interest and inflation rates reducing the value of the benefits under any given pension contract—is that the terms of pension plans will be improved if the percentage of total compensation to be paid in pension benefits is to remain constant.

The second effect—any given plan terms giving younger workers a lower share of total pension benefits—should produce several subtle changes in pension compensation arrangements. First, pension plan terms may be changed to tilt benefits slightly more to younger workers in the absence of inflation. As an example, a plan could be changed to provide a worker with a pension equal to final salary times 2% for each year worked up to fifteen, and 1.5% for each additional year rather than for the fraction of final salary to just be directly proportional to years worked. Second, salary/age profiles could be slightly flattened. Pension costs of the Forture 500 have run about 8% of wages in recent years. A shift in how this money is allocated (e.g. from say 6% of wages for the younger half of a payroll and 10% for the older half, to 4% for the younger half and 12% for the older workers) may be correctable by giving younger workers slightly larger wage increases than older workers. Third, with the older workers getting a higher fraction of pension benefits, the younger workers may be able to negotiate a greater percentage of new fringe benefits. For example, in a union bargaining situation the young workers may go along with an increase in pension benefits, which do not help them much, if the older workers will go along with a push for maternity benefits.

A fourth possibility is the increased use of early retirement plan provisions. Such provisions tend to give early retirees a better than actuarially fair deal. Early retirement plans can be shown to essentially flatten out the accrual of pension benefits over a normal working life. At the normal retirement age a worker still has the same accrued benefits, but the early retirement option makes the value of young workers' benefits significantly higher.

Fifth, it is possible that the future will see some integrated defined contribution/defined benefit plans. Under such a plan the firm could contribute a fixed percentage of salary to a defined contribution fund and could provide a deferred annuity equal to some fixed percentage of salary (i.e. a defined benefit) for each year of service. (This could be done in two separate plans: a defined benefit and a "thrift" plan.) Under moderate inflation, defined benefit plans provided a distribution of benefits which gave younger workers a somewhat lower fraction of their compensation in the form of pension benefits than older workers received. With current high inflation rates this effect has been greatly exaggerated. Within the bounds of ERISA it may not be possible to create a defined benefit plan with the same effective "tilt" in pension compensation as was achieved before. A straight defined contribution plan, however, would eliminate the "tilt" entirely. Should older workers prefer to receive a higher fraction of their income in pension benefits than younger workers do, the defined contribution solution may not be entirely satisfactory. A combination plan may be one way of approximating the same tilt in the accrual of benefits as existed under moderate inflation.

Note that little has been mentioned about the indexing or partial indexing of benefits. Indexing is a natural topic to consider as a remedy for all three effects cited at the begining of this section. However, the indexing problem is not simple. Indexing already accrued benefits would sharply raise their value, essentially representing a gift from the firm (and, less voluntarily, the PBGC) to its employees. Such a gift would raise the value of benefits accrued by workers in the past without reducing their future negotiating position for compensation. Under a union plan some indexing is possible if the workers agree to pay for this indexing by taking lower compensation over the life of a new contract. However, the cost of indexing can be so great that such an arrangement is impractical. For example, indexing up to 4 or 5% inflation could easily double the value of a plan's vested benefits (just as reducing the interest rate by that amount would do). A firm like General Motors, which has a present value of vested benefits approaching eleven figures, could only agree to double these benefits if its workers were willing to take billions less in salary each year for the duration of a three-year labor contract. Thus formal indexing of past benefits seems unlikely.

While newly granted benefits could be more easily indexed, employees

would still have to adjust to paying a large amount in the nominal terms of a plan for indexing. It is unclear whether workers would wish to pay such a price. For example, a sixty-five-year-old worker may prefer a fixed nominal pension to one that starts at a lower amount but is indexed to the CPI. One reason is that such a person may prefer to get his money out of the pension plan earlier and to consume more at sixty-five than seventy-five. Another reason is that the individual is not constrained to spending the funds when received, and after retirement age may prefer to manage his assets himself rather than have them tied up in a pension plan which no longer is providing large tax benefits. A third reason is that the index used (e.g. CPI) may not be representative of this person's future consumption expenses. Social security is already indexed to the CPI, and in recent years the CPI has seemingly outstripped the inflation of prices in many older people's consumption baskets because of housing prices. Thus the employee may not want to hedge his non–social security income against the CPI. Such a person might prefer to have the cash to hedge against his own future consumption via, say, the purchase of some desired durable assets.

Nevertheless, some partial indexing on a formal or informal basis has appeared in some pension plans. Many firms make ad hoc adjustments to the benefits of already retired employees. A much smaller number of firms have formal, usually limited, indexing plans. Also, some firms allow workers to take as a lump sum the present value of their pension benefits—with their benefits being discounted at low fixed nominal interest rates.

All such provisions tend to raise the present value of worker benefits. To the extent that such options were not fully considered, the numerical estimates of the surplus in the previous section are high. Provisions such as those listed above also mean that the worker is not always fully exposed to the risk inherent in changes in nominal interest rates. For example, if workers have the option of receiving a lump sum discounted at a fixed nominal rate, the present value of their benefits is protected at least against changes in postretirement interest rates. Note, however, that even full postretirement indexing does not protect the worker against changes in interest rates in the years remaining until retirement, the issue emphasized in the first section of the paper.

It is important to remember that the pension plan is not the only way the worker can hedge against inflation. Many younger workers may prefer to hedge by buying a house and taking out a mortgage. Older workers may also prefer to hedge against their personal wants rather than a general index.

The higher variance in inflation rates is likely to make both firms and workers want to reduce the size of transfers that occur when interest rates change. One possible change other than partial indexing could be a move

toward determination of benefits more by what happens to the asset side of the pension fund balance sheet than by what happens to the liability side. The most obvious way to do this is by shifting at least partially toward defined contribution plans. Thus it is possible that firms may decide to increase profit sharing and thrift plans relative to pension plans in the coming years.

Finally, firms may also decide to hedge their pension liabilities by placing more fixed interest debt in their pension funds. Such debt will fluctuate in value along with the firm's pension liabilities. Also, some authors have argued that there may be a tax advantage to placing bonds in the firm's pension fund. (This argument has been made most prominently by Fischer Black and Irwin Tepper.) While the tax advantage question is still open to debate, if the Black-Tepper argument holds, the tax effect is directly proportional to interest rates. Thus higher interest rates would provide an incentive for the firm to hold more debt in its pension plan.

5.6 Conclusion

Inflation, primarily through the channel of higher interest rates, has caused important changes in the private pension system. Workers have lost out to both firms and the Pension Benefit Guaranty Corporation. Benefits have been skewed toward older workers. The plans' capital gains on their nominal liabilities have made the private pension system extremely solvent.

Indexing private pensions would be extremely expensive and does not appear imminent. However, other changes in plan structure may lead to reducing workers' inflation risk in their pension assets. Finally, both the increased variance and levels of nominal interest rates may actually lead to an increase in the proportion of pension assets held in long-term fixed interest securities.

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