

# WHAT ARE CORPORATE PENSION LIABILITIES?\*

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Analyses of corporate pension plans often make unstated assumptions about an implicit labor contract. An example of the effect of such an assumption is that many mistakenly believe that if a worker's benefits are tied to final salary, he is protected against inflation until retirement. Also, the value of a worker's claims is often considered to be independent of the status of the firm's pension fund. These "implicit contract" assumptions are examined and questioned. The implications of analyzed pension liabilities in a manner consistent with the analysis of other corporate liabilities are explored.

## INTRODUCTION

The valuation of an ordinary corporate bond depends on three types of factors. First, there are the terms of the contract: dates and amounts of interest and principal payments, call prices, seniority of the debt, any property liens given to the security holders, and so forth. Second is the value of the assets backing the securities. Third are any covenants guiding the firm's behavior: these restrictions may limit distributions, the issuance of new senior securities, and the ability of the management to alter substantially the nature of the firm's business without the permission of the bondholders.

Corporate pension liabilities (worker benefits) can be analyzed in this same manner. However, discussions of pension liabilities by top financial economists (such as Treynor [1976] and Treynor, Priest, and Regan [1977]) and the commonly used actuarial methods (see, e.g., Winklevoss [1977]) generally produce results at variance with normal corporate securities evaluation.

The reason for such differences is that these discussions base their results on the assumption of complex implicit contracts between the firm and its employees. These implicit contracts fall into two categories. First, even assuming that all benefits are riskless, one might believe that the real value of a worker's pension claim exceeds the present value of whatever benefits the worker would receive if his employment were immediately terminated. Second are assumptions that the firm has an implicit obligation to pay off all promised benefits regardless of the firm's legal liabilities.

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This paper shows how pension liabilities can be analyzed similarly to other corporate securities (that is, without the assumption of complex implicit contracts). The implications of the presence or absence of implicit contracts is explored. Finally, arguments are presented about why one might or might not believe in the type of implicit contracts discussed above. The general thrust of the paper is in favor of interpreting the pension contract fairly literally, without much allowance for implicit contracts. However, this issue will probably only be settled empirically, so some suggestions are made as to how one could test for implicit contracts.

The paper is divided into two sections. Section I discusses implicit assumptions that, even assuming all benefits are riskless, lead analysts to project the value of worker benefits to be greater than the amount to which the firm has legally committed itself. Section II analyzes the assumption that the firm has an implicit obligation to pay off all promised benefits regardless of the firm's legal liabilities.

### I. THE "PROJECTED BENEFIT" ASSUMPTION

The nature and importance of the implicit contract assumptions that firms really are obligated to their workers for more pension benefits that have been officially accumulated can best be shown by a simple example.<sup>1</sup>

Consider an employee of a firm that has a defined benefit pension plan, not integrated with social security. Benefits under this plan are calculated as a constant,  $K$ , times the number of years worked, times the highest salary earned by the employee.<sup>2</sup> We shall assume that these benefits are in the form of a lump sum, payable at the normal retirement age.<sup>3</sup> All benefits are immediately vested (nonforfeitable)—an assumption to be discussed later. There are no early retirement provisions to the plan. Finally, assume that the firm always keeps enough money in the pension fund so that there is no chance of any benefits becoming unfunded, and not being paid off. This means that the benefits are an asset of the workers that can be discounted at a riskless rate of return (see, e.g., Sharpe [1976]), and are

1. For a more detailed analysis see Winklevoss [1977].

2. Real defined benefit plans are more complicated, with benefits dependent on some average of several final years' salary and not quite linearly related to years of service.

3. This assumption is made to ignore the obvious effects of inflation on the value of benefits of already retired workers.

equally a liability of the plan that can be discounted at the riskless rate.

For numerical simplicity, assume that the worker's salary is  $W_0$  when he joins the firm and grows at the exponential rate  $g$ . The riskless rate of interest and the return earned on all plan assets is  $i$ . There is no possibility of the worker not receiving vested benefits. The worker commences employment  $R$  years before retirement. Then the present value of vested accrued benefits<sup>4</sup> after  $T$  years of work is

$$(1) \quad B = KTW_0e^{gT}e^{-i(R-T)}.$$

Growth in the value of benefits after working an extra year is

$$(2) \quad \frac{dB}{dT} = \left[ \frac{1}{T} + g + i \right] B,$$

where the  $1/T$  factor comes from increased service,  $g$  from the increased salary base, and  $i$  from benefits being one year closer to being received.<sup>5</sup>

Of the three factors increasing the present value of benefits, the increase due to the interest factor should not be attributed to work in the current year because such an increase would have occurred regardless of whether the employee stayed with the firm. Rather, that part of benefit growth should properly be considered interest on the pension wealth accumulated at the beginning of the year.

Nevertheless, benefit accruals attributable to current work as a function of salary rise according to (3):

$$(3) \quad \left( \frac{dB}{dT} - iB \right) / W_0e^{gT} = K(1 + gT)e^{-i(R-T)}.$$

The interpretation of (3) is that the benefits accrued as a fraction of salary must be discounted by the years remaining until retirement ( $R - T$ ) and are derived from the increase in number of years worked (providing benefits of  $KW_0e^{gT}$ ) and the increase in benefits due to a higher salary base for previously accrued benefits ( $KgTW_0e^{gT}$ ).

4. Vested accrued benefits after working  $T$  years are the benefits the employee would receive at the normal retirement age should his employment terminate after working  $T$  years.

5. Allowing for the possibility of early death and gradual vesting would have led to two more terms in the brackets in (2) for increased probability of survival to retirement age ( $\dot{S}/S$ , where  $S$  is probability of surviving to retirement) and increased percentage of total benefits vested ( $\dot{V}/V$ , where  $V$  equals percentage of benefits currently vested).

Note that according to (3) benefits rise as a percentage of salary as time passes.<sup>6</sup> It is at this point that the significance of the *implicit liability* concept discussed by Treynor [1976] comes into play.

Consider an employee of a firm with a defined benefit plan such as the one described above. Assume that the worker has a lifetime contract with the firm, under which his salary will grow at the rate  $g$ . For the moment, assume that the worker's productivity also grows at the nominal rate  $g$  (this assumption will be relaxed shortly). The worker's total compensation over the life of the contract is assumed to be equal to his marginal product over that period (in present value terms): that is, there is a competitive labor market. Under these circumstances, there is no gain or loss in signing this contract. How should the firm accrue its pension liability to the worker over time, to keep accounting profits consistent with economic profits?

In this case, it is clear that the fact that pension benefit accruals are a higher fraction of an employee's salary late in his work career is of little account.<sup>7</sup> The worker agrees to a contract that allows for small benefit accruals in the early years because it also provides a guarantee of high accruals later on. That is, according to our assumptions, salary plus accrued benefits are less than the worker's marginal product in his early years but greater than his product toward the end of his career. However, it would be incorrect to say that the firm makes a profit on the worker in his early years and a loss later on, because the only reason low early year benefit accruals are tolerated is because of the contractual right to receive extraordinary benefits in the latter part of the contract. If the employee is certain of working the full lifetime, then the appropriate accounting would be that the employee's total compensation is proportional to his output (and therefore, by assumption, salary) each year.<sup>8</sup> In that case the firm should consider its pension liability as a constant fraction of salary, and the cumulative economic profits of the long-term labor contract would always be valued at zero.

This is the theory behind projected benefit actuarial methods, which project benefits to be accrued over an employee's entire career and then apportion the pension liability over the worker's career as

6. Barnow and Ehrenberg [1977] make this point in their excellent paper. They also point out that it is extremely difficult to establish a defined benefit pension plan that is age-neutral or sex neutral or both.

7. In this case when vesting occurred would also be irrelevant.

8. An adjustment for exogenous employee turnover is easily made, with each employee buying a lottery ticket and the ones who leave early subsidizing the long-term employees.

a fixed percentage of salary.<sup>9</sup>

There are two assumptions that need to be challenged here: First, is there any implicit contract under which young workers accept lower total compensation in return for an informal agreement that they be highly paid later in their career? Second, even if older workers are relatively better paid than younger workers, is this differential strictly reflected in rates of pension accrual, or must one look at the entire compensation package of the worker? An answer in the negative for the first question or in favor of the latter alternative for the second provides problems for the projected benefit approach.

Compare the above long-term contract case with a situation where a worker's salary is subject to renegotiation at many points in his working career. This is a more common situation. For simplicity, consider the extreme case of constant renegotiation. At each point in time the firm should be willing to pay its employees their marginal product, in the form of a combination of salary and benefits. The fact that the employer gives higher pension benefits to older workers should be counterbalanced by older workers receiving salaries lower relative to young workers than they would in firms without pension plans or with defined contribution plans.<sup>10</sup> The employer will not be able to pay young workers less than their marginal product in benefits and salary, as did the employer in the long-term contract case—unless he gives those workers such a contract. Similarly, the employee will be unable to receive compensation in excess of marginal product toward the end of his career. The projected benefit method may thus be thought of as assuming that workers' salaries are proportional to marginal product, with an implicit contract giving the workers high pension benefits in the latter part of a working career. The accrued benefit method assumes no such implicit contract, and instead can

9. Note that the situation described above differs significantly from that pertaining to a long-term fixed payment term life insurance policy. Under such a policy the consumer does pay more than an actuarially fair premium in the early years of a policy and less than a fair premium in the later years. However, in that case the insurance company has an *explicit* obligation to provide insurance for a low premium in the last years of a policy. The firm should properly consider part of its early years' policy as pre-payment of later years' premiums. If workers had long-term explicit contracts with the firm of the type described in the text, it would make sense for the firm to consider the difference between accrued and projected benefits as part of current economic pension expense. However, in the absence of such explicit contracts, any difference between accrued and projected benefits can be part of current costs only if there are implicit contracts taking the place of the missing explicit agreements.

10. Under defined contribution plans the firm generally contributes a defined percentage of the worker's salary to a pension fund. Generally, such contributions are a constant fraction of an employee's salary. TIAA-CREF is an example of a defined contribution pension plan.

be interpreted here as arguing that the firm and the employee explicitly negotiate total compensation rather than just salary.

Our second question makes a stronger case against projected benefits. Assume that there is an implicit contract between firms and workers to overpay old workers at the expense of young ones. This still does not imply that the projected benefit method is best for analyzing a defined benefit plan. There is no particular reason to assume that employers with defined benefit plans have larger implicit contracts than do firms with, say, defined contribution plans. Therefore, there is no reason to assume that if there are implicit contracts, the cost of these agreements to a firm is correlated with the difference between projected and accrued benefits.

As an example, there is no reason to assume that IBM, which has a defined benefit pension plan, subsidizes workers when they are old relative to when they are young any more than does Stanford University, which contributes a constant fraction of faculty members' salaries to their pension accounts. Perhaps in both cases one would want to write up a firm liability equivalent to some estimate of the differential between what the current work force (which is older than the average starting employee) will be paid in the future and the present value of those employees' future work contributions. However, this is an issue divorced from pension fund analysis.

Thus, the projected benefits implicit contracts make sense only if (1) there are implicit labor contracts overpaying old workers at the expense of younger ones and (2) the value of a firm's implicit contract liability is systematically related to the difference between the present value of its pension liabilities, as calculated under the projected benefit and accrued benefit methods.

It is important to emphasize here that we are not addressing the question of what actuarial method a firm should use to determine plan contributions. That can be entirely independent of the calculation of benefits earned. For example, a firm may wish to put as little or as much as possible into its pension plan for tax or other reasons. Thus, a firm may rationally choose a pension funding method that projects benefits beyond those legally accrued. The analogy is that a firm might choose to use LIFO accounting or accelerated depreciation even if it felt these methods were not the most descriptive for the security analyst attempting to calculate the value of the firm. The point here is that an extraordinary set of implicit contracts is necessary, but not sufficient, for projected benefit methods to be appropriate for estimating the firm's economic pension liabilities.

Thus, if one believed that workers were paid a total compensation

package in relation to marginal product, the projected benefit assumption would have to be rejected. However, even if older workers are provided with total compensation in excess of marginal product, there is no reason to adopt the projected benefit assumption. Using that assumption may increase the accuracy of a balance sheet (including pension footnotes) for a firm using a defined benefit plan because of an arbitrary allowance for the excess compensation to be paid older workers later on. In terms of comparing firms, though, the data are misleading because the amount of the implicit debt to older workers is not necessarily related to the particular assumptions made by the firm's pension plan, and whether a firm uses a defined benefit or defined contribution plan. If older workers are overpaid relative to younger workers, one might wish to estimate an implicit liability, or consider the age structure of a firm's work force to be valuable financial data, but the problem cannot be helped by an ad hoc adjustment to the firm's pension liability.

Whether, and to what extent, one believes that there exist implicit contracts between firms and workers *specifically regarding pension benefits* (rather than total compensation) is the crucial issue in determining how quickly pension benefits are really accumulated by workers.

In favor of the accrued benefit analysis are four arguments:

1. The simplest labor market theory—that total compensation is negotiated proportional to marginal product for each period—supports the accrual method.

2. Even under more complicated labor market theories with implicit contracts, there is no particular reason to assume that the degree to which a firm tilts its compensation to older workers is systematically related to the difference between the calculation of pension benefits under the projected benefit and accrued benefit methods.

3. Under a “projected benefit” implicit agreement, employees face a great deal of nonsystematic risk that does not exist if the accrued benefit method is right. With an implicit contract workers who, due to luck of the draw, leave the firm earlier than average end up subsidizing workers who stay with the firm longer. Unless individuals' financial well-being is negatively correlated with tenure at the firm, having such a system creates additional risk for the workers. This predominantly nonsystematic risk will force the firm to pay out higher salaries without reducing its cost of capital. It is hard to understand why the firm and workers would set up an arrangement that forces the workers to gamble a substantial part of their pension wealth on

the chance that they will individually stay with the firm longer than an average amount of time.

4. There is the logical question of why an implicit contract of significant importance should exist. An implicit understanding might make sense when the cost of writing a contract covering every contingency exceeds the benefit. With pension plans this is not the case. Defined contribution plans do not depend on implicit contracts. Defined benefit plans can be written to provide for a much flatter benefit accrual-wage ratio than they often do. Thus, it seems that any implicit pension agreement could be easily (cheaply) formalized. That being the case, and there being an obvious advantage to an explicit arrangement (in the sense of eliminating the possibility of either side renegeing), it is logically hard to justify implicit pension contracts.

In favor of implicit contracts and the projected benefit method, the following points can be made:

1. *The vesting question.* Workers do not immediately have all their benefits vested. Under one common method called "cliff" vesting, any worker who leaves the firm after less than ten years of service forfeits all accrued benefits. Workers do not seem to take wage cuts in their tenth year; thus it can be argued that there is an implicit contract that the firm will not consider the vesting question in its salary negotiations with a worker. If this is not true for all firms, it is certainly true for most that there is some implicit agreement on the vesting question.

Conceding this point, three arguments can be made to modify its force. First and by far most important, firms may not be able to cut employee salaries or discharge workers shortly before vesting for fear of being sued for unfair employment practices. Thus, it is not necessary to count on implicit agreements of any sort to state that accrued but not yet vested benefits should be partially included in worker pension wealth. These benefits are protected via laws other than the Pension Reform Act, and one need not rely on implicit contracts.<sup>11</sup>

Second, the amount of money involved in the vesting question tends to be small. Because of the skewness of benefit accruals under defined benefit plans, the accrued benefits of nonvested employees times their actuarial probability of becoming vested is very small:

11. For G.E. the unvested figure was about \$130 million compared to vested benefits of about \$4 billion for 1976. For Esmark (which uses "cliff" vesting) their Pension Plan for Non-salaried Employees had \$188,192,000 in vested benefits and total accrued liabilities (vested and nonvested) of \$190,436,000. Woolworth, the third company examined, also had nonvested liabilities with a value of less than 2 percent of the value of vested benefits.

Examination of the form 5500s of General Electric, Woolworth, and Esmark indicates that for each firm the actuarial value of all pension liabilities (vested and unvested) is only very slightly larger than the vested figure.<sup>12</sup> For a young company, unvested benefits may represent a greater percentage of accrued benefits, but the absolute amount of money will still be small for each worker.<sup>13</sup> Thus, an argument can be made that while technically a dip in salary should occur in the tenth year of employment for firms with ten-year cliff vesting, this lump sum may be spread over the few years prior to the vesting date as a matter of convenience. A similar argument can be made to rationalize the pricing schemes of printers, for example. Rather than charge a fixed cost and a constant marginal cost, many firms will simply use block pricing, spreading the fixed cost over the units of the first block.

Third, even if there is an implicit agreement not to consider pension vesting in salary negotiations or termination decisions, making accrued benefits a better measure of pension liability than vested benefits, there is not necessarily an implicit agreement that makes projected benefits a better measure than accrued benefits.

2. Some plans have increased the benefits of their retired workers. Most such increases represent a small percentage increase in the firm's total pension liabilities, but such increases can only be attributed to an implicit arrangement.

3. There may be effective institutional restraints that cause firms to pay two similar workers identical salaries even if they have different pension accruals.

The implications of whether or not an implicit agreement exists brings to light numerous interesting points. First, if the accrued benefit method is correct (no implicit agreement), then empirical work on pension funds is made much simpler: accrued benefits, roughly equal to vested benefits, are the appropriate measure of firm pension liability. Since vested benefits are readily measured (they are not nearly so dependent on subjective actuarial assumptions as projected benefits are, except for a nominal interest assumption that can be

12. I am grateful to Robert C. Clark of Harvard Law School for bringing this point to my attention.

13. For example, consider a plan that provides a retirement benefit equal to 1.5 percent times the number of years worked times the average of the employee's last five years of salary. Assume the plan uses "cliff" vesting so that the worker becomes fully vested after ten years of service, but is not vested at all before that. Consider an employee who becomes vested at age 40. To be conservative, assume a 6 percent rate of salary growth over the previous five years and a long-term nominal interest rate of 9 percent. Then the value of accrued benefits on the day of vesting will be less than two months' salary.

adjusted), researchers will have a much easier time using those figures than if they have to work with projected benefit figures.

The question of who bears the risk of inflation for a pension plan also depends crucially on whether there is an implicit agreement. Consider a plan where benefits are tied to final salary and all benefits are paid out in a lump sum at retirement (so there is no issue about inflation decreasing the present value of a stream of constant nominal benefits received after retirement). Assume that the Fisher effect holds—that inflation and interest rates rise one for one. Then *unanticipated increases in inflation benefit firms at the expense of workers* according to the accrued benefit scenario. That is, the inflation will decrease the value of any accrued benefits and equally reduce the value of the firm's pension liability. This result holds even if the plan is not revised. What will happen is that the worker will simply receive a lower salary, not keeping up with inflation, in return for the plan not being amended. Under a projected benefit method inflation risk is borne by the firm, because it is presumed that salary is negotiated independent of the implications for pension accrual.

Finally, if there is no implicit agreement, one can find an important justification for the existence of defined benefit plans—the very nature of their tilt in benefit accruals to older workers produces what may be a favorable clientele effect—young workers receive only a small fraction of compensation in the form of pension benefits, while older workers receive a large share in this form. With a defined contribution plan it may not be so easy to tilt benefits toward older employees.<sup>14</sup>

Note that this tilt is increased as the rate of inflation rises. Thus, a higher fraction of pension benefits has been accruing to older workers in recent years. One would expect this effect to be offset either by a flatter wage-age profile or by a higher fraction of new fringe benefits being geared to younger workers. (With most of the pension benefits going to older workers, the younger workers may be compensated with greater maternity benefits.) There is a reasonable hope of gathering empirical evidence on the existence of “projected benefit” implicit contracts. An ideal test would be to compare the wage-age profile of workers who are members of defined benefit pension plans with the profile of workers who are members of defined contribution plans. Defined contribution plans typically involve the employers contributing a constant fraction of salary to a pension plan. Since

14. Another justification may be that it is possible for a firm to overfund a defined benefit pension plan (i.e., deposit sums in excess of accrued benefits). There may be tax advantages to overfunding pension plans. (See Tepper [1981], Black [1980], Miller and Scholes [1981], and Bulow [1981].)

accrued benefits are accrued mostly in the latter part of an employee's career, one would expect *ceteris paribus* a steeper wage-age profile for workers participating in the defined contribution plan: given the same total compensation at each point in time, one would expect the younger worker to receive more salary when young and less when old with a defined benefit plan.

## II. THE OBLIGATION TO PAY ALL PROMISED BENEFITS

The purpose of this section is to provide an analytic basis for valuing pension fund liabilities of the firm as a whole, rather than on a worker-by-worker basis. Since the value of firm liabilities plus government liabilities (via the claim of the pension plan on the Pension Benefit Guaranty Corporation, or PBGC) must equal the value of workers' benefits, those claims are also valued. In writing the liabilities as a function of other variables, we also can determine the effect of changes in these variables on firm liabilities. That is, we can determine who bears the risk of changes in the value of the equity value of the firm, plan assets, and plan liabilities.

Sharpe [1976] did the first work on valuing plan liabilities as a function of both firm value and plan assets, while Arnott and Gersovitz [1980] did a more complex, dynamic analysis of risk in firm value, ignoring plan asset and liability risk. This paper will emphasize liability risk and the interaction of all three types of risk.

Throughout the first section of this paper, it was assumed that the pension plan was always sufficiently well funded that all benefits could be valued at the riskless rate of interest. Now that assumption will be relaxed to examine the effect of funding policy on the firm's pension position.

This section models corporate defined benefit plans and examines the effect of ERISA. A distinction is made between unionized and non-union plans regarding potential for underfunding. *The "projected benefit" assumption will not be made*, so that with immediate full vesting and a fully funded plan the value of the plan's liabilities would equal the value of vested benefits. A regime of constant wage and pension negotiation will be considered so that we can abstract from the portfolio strategy issues analyzed by Sharpe [1976].

Let

$A$  = accrued benefits<sup>15</sup>

$E$  = market value of equity of the firm

15. Accrued benefits are all benefits accrued to date including unvested benefits. If a plan had immediate full vesting, accrued benefits would equal vested benefits.

$F$  = funded benefits = money in pension fund

$G$  = guaranteed benefits<sup>16</sup>

$T$  = termination benefits<sup>17</sup>

$V$  = vested benefits

$FL$  = firm liability beyond money in pension fund

$PBGCL$  = PBGC liability.

$A$ ,  $G$ ,  $T$ , and  $V$  are all calculated by discounting at the riskless interest rate.  $F$  is just the market value of fund assets.

Before ERISA the value of the employee's claim upon termination was

$$(4) \quad T = \min(F, V),$$

assuming that there were no outstanding labor contracts specifying future pension contributions at the time of termination. This is because the firm had the right to terminate the plan and not be liable for any excess liability if  $V > F$ .<sup>18</sup>

A persistent situation of  $V > F$  is viable for a union plan, but in the pre-ERISA era seems less viable for a non-union plan. Assume that de facto a non-union worker recognizes that his firm will not terminate its pension plan. Then the worker will value his vested benefits at face amount, the work force as a whole valuing benefits at  $V$ . In order to keep each of their employees, the firm would have to pay out, in salary and pension benefits, the market value of the workers' future work plus  $V$ . If it paid less, workers could do better by leaving the firm. On the other hand, if the firm terminated the plan, it would have to pay out only  $F$ , plus the market value of future work. If  $F < V$ , a profit-maximizing firm would do this, for example, by terminating the defined benefit plan and starting a defined contribution plan.

16. Guaranteed benefits are benefits that the Pension Benefit Guaranty Corporation (PBGC) guarantees in the event of plan termination. Basically, they are less than vested benefits (1) because of limits on the amount of benefits that will be guaranteed for each individual and (2) increases in vested benefits due to plan amendments are only guaranteed over a period of five years. For more details see *Federal Register* [February 11, 1976, and November 3, 1976].

17. The value of workers' benefits in the event of immediate plan termination.

18.  $V > F$  does not imply that the plan will terminate, only that if a union is negotiating a new contract, part of the cost of the contract will be any new accrual of pension wealth. In these negotiations beginning pension wealth is the lesser of  $V$  and  $F$ .

If funded benefits are less than the vested benefits of already retired workers, there is an incentive to terminate, because otherwise current workers will have to sacrifice part of their compensation to maintain benefits to retired workers. This is probably why many plans give priority to the benefits of already retired workers. For a plan to be substantially underfunded in relation to retirees' benefits and still be viable, retired workers must have a say in union matters, as they do in the United Mine Workers union.

With a union to negotiate, things are different. The value of the union's pension wealth is clearly defined, and negotiations to continue an underfunded plan proceed from the basis that benefits are worth  $F$ . If the union can (a) extract above-market wages or (b) concentrate bargaining power in the hands of older workers, the instability of the non-union case can be explained away. If old workers always control the union, compensation scales can be consistently set to favor older workers at the expense of young workers. Young workers tolerate this and do not leave because they know they will eventually be old workers (able to benefit equally from the next group of young workers). In this way the financial incentive for leaving early (and thus benefiting from plan continuation at others' expense) is eliminated. The mechanism enabling continuation is a private social security system of the union members, with younger members subsidizing older members. Note that large unfunded liabilities are much more common in union plans (which tend to have benefits fixed rather than automatically salary-adjusted) rather than in non-union plans (which tend to be salary-adjusted).

If  $F < V$ , the firm's legal liability is only  $F$ , while under all actuarial methods an amount  $V$  will be calculated. Using  $V$  presumes an implicit agreement between the firm and the work force, *quite independent from any projected benefit implicit agreement*, that the firm will pay out  $V - F$  in excess of the market value of future services it will receive, with no legal obligation to do so. This is the "ongoing plan" implicit contract.

The passage of ERISA made a substantial difference. Now the firm's net liability can be written as

$$(5) \quad FL = \min[A - F, \max[0, \min(G - F, 0.3E)]]$$

If the plan terminates with funded benefits in excess of accrued benefits ( $F > A$ ), the firm actually has a net surplus in the plan. If funded benefits are greater than guaranteed benefits but less than accrued benefits, the firm takes on no additional liability and whatever money is in the fund is distributed according to the PBGC priority system. If funded benefits are less than guaranteed benefits, the firm is liable up to a maximum of 30 percent of the value of its equity, with the PBGC making up any difference.<sup>19</sup>

The PBGC's liability is

19. If a wage contract provides for continuation of a plan and the firm decides to terminate (for example, it closes the plant where the plan was effective), the workers may be able to force the firm to increase termination benefits. (See in re: Strick Corporation, UAW Pension Plan, *PBGC 4th Quarter Bulletin July 1, to September 30, 1978.*)

$$(6) \quad PBGCL = \max(0, G - F - 0.3E),$$

and the value of termination benefits to the employees is

$$T = PBGCL + FL + F,$$

or equivalently,

$$(7) \quad T = \min[A, \max(G, F)].$$

In terms of negotiation, if a union plan were very well funded, the union's termination position would be worth  $A$ , an amount in excess of vested benefits. For a non-union plan the firm could more appropriately consider its liability to be  $V$ , because in its salary offers to each individual that person's benefit should he leave would only amount to  $V$ .<sup>20</sup> Underfunded plans (union and non-union) are partially supported by the PBGC's termination liability. This does not mean such plans will immediately terminate. Minimum funding standards may be sufficiently lenient that the plan's total cost of continuation (costs of pension insurance plus funding costs) may be less than the amount of guaranteed benefits that can be newly accrued via plan continuation.

Grossly underfunded plans are not very stable. For non-union plans the same issues discussed for underfunded pre-ERISA plans reappear. Union plans should terminate unless the discrepancy between guaranteed benefits and funded benefits can grow fast enough to make it worthwhile to postpone exercising the pension put.

However, even with a management dedicated to working in the stockholders' interest, there may be good reason not to terminate an underfunded plan. For example, a large firm will typically have a complex relationship with the federal government, and one might worry that termination of an underfunded pension plan might lead to less favorable treatment in other matters.<sup>21</sup>

ERISA can also be considered in terms of its shifting of pension fund portfolio risk. Consider three types of risk: (1) risk in the assets of the pension portfolio; (2) risk in the value of pension liabilities due

20. This is an extreme anti-implicit contract view stating that a worker who is with a firm with cliff vesting suddenly has a change in his pension wealth from zero to the amount of his accrued benefits. A more realistic assumption is that there is an implicit contract equilibrium in which workers consider the value of their pension wealth before termination to be equal to unvested accrued benefits times the plan's expected vesting probabilities. This is effectively the view taken by the FASB in its Exposure Draft [1979].

21. For example, Chrysler Corporation's pension plan for hourly workers is substantially underfunded. However, given the complex nature of Chrysler's dealings with the federal government, the firm cannot consider the effect of a plan termination in a vacuum.

to a change in real interest rates; and (3) risk in the value of pension liabilities due to a change in nominal interest rates, offset by an equal change in inflation (salary growth) rates. With an "ongoing plan" implicit contract, ERISA makes no difference because the firm is assumed to continue the pension plan. Risks of type (1) are borne by the firm, which must increase funding if a loss is suffered on the portfolio. Risks of type (2) exist because changes in real interest rates do not mean changes in nominal benefits under an implicit contract. Thus, a real interest rate increase benefits the firm in terms of lower pension costs, and the firm's gain equals the employees' loss.<sup>22</sup> There is very little inflation (type (3)) risk, because the firm is committed to raising benefits if inflation increases. Ignoring gains due to non-indexation of benefits after termination, neither side benefits or loses from inflation.

Without the "ongoing plan" implicit contract, the situation is more complex. Equation (4) helps analyze the pre-ERISA situation, while (5), (6), and (7) are useful in examining the current regime. Before ERISA, the workers' position was worth the minimum of  $F$  and  $V$ . Thus, for an overfunded plan all portfolio risk was borne by the firm, and for an underfunded plan, by the workers. (If wages are renegotiated periodically rather than continuously, or if discontinuous jumps are possible in the value of the portfolio, then the risk is shared between workers and the firm, with the firm's share increasing as the plan becomes better funded.) All interest rate risk, whether type (2) (real) or type (3) (nominal) can be analyzed in the same way. That is because in calculating the value of accrued vested benefits, one needs to know only the benefits the employee would receive if he terminated today (a fixed nominal amount independent of future inflation or salary growth assumptions) and the nominal rate at which to discount such benefits. For a well-funded plan the workers' position would be worth the present value of vested benefits, so changes in nominal interest rates would inversely affect the value of the employee's claim (and thus the firm's liability). For a poorly funded plan, benefits were only worth  $F$ , so a change in interest rates, having no direct effect on  $F$ , would not affect the value of pension claims.

Since ERISA, the government has become a partner in sharing the pension liability. For a very well-funded plan ( $F > A$  for an unionized plan) asset risk is absorbed by the firm. If  $A > F > G$ , asset

22. Of course, the employees hold pension wealth as an asset but have future consumption needs as a liability. They may be hedged to the extent that an increase in real interest rates reduces the value of both pension wealth and the consumption liability.

risk is held by the workers, while if  $F < G < F + 0.3E$  the workers' position is stable at  $G$ , while the firm reassumes the asset risk. If  $F + 0.3E < G$ , then the firm's liability is limited, and the government assumes the added risk.

Note that in the pre-ERISA case it is possible to assign risk exactly where there are constantly renegotiated contracts and no jumps in asset prices or interest rates. However, in the post-ERISA case liability cannot be precisely apportioned, unless the mandate of the PBGC is taken literally. If so, then the PBGC would bear no risk in a plan where  $F > G$  because it could terminate if  $F$  dropped to  $G$ . If  $F < G$ , then both the firm and the PBGC would be in position to terminate the plan, making the PBGC's liability exactly equal to  $G - F$ . However, if it is assumed that the PBGC has more limited termination power, its status is more similar to that of a long-term creditor. In that case, the firm's right to terminate is valuable even if  $F > G$ . Consequently, asset risk is borne partially either by the firm or by the workers and partially by the PBGC.

Regarding liability risk, roughly speaking, the following situation exists: If  $F > A$ , the value of pension claims equals  $A$ , so changes in the value of a liability involve a transfer between the firm and its workers. If  $A > F > G$ , the value of pension claims equals  $F$ , and changes in the value of liabilities have no impact. If  $F < G < F + 0.3E$ , the value of pension claims, all to be paid by the firm, is  $G$ , and changes in the value of that liability again involve firm/employee transfers. Finally, if  $G < F + 0.3E$ , the firm's liability is limited, and changes in  $G$  affect the PBGC's payouts to workers. The same issues involving the long-term nature of the PBGC position as in the asset risk case make the liability risk situation more complicated. Also, the above analysis is for union plans. For non-union plans if the plan is well-funded, a consistent analysis applies; but, if the plan is poorly funded, the plan stability problem makes the situation difficult to analyze.

The results of the last few pages are summarized in Tables I and II.

TABLE I  
APPORTIONMENT OF RISK WITH "ONGOING PLAN"  
IMPLICIT CONTRACTS

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(1) Asset risk: firm
(2) Real interest rates: firm-worker transfers
(3) Inflation risk: none (hedged)

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TABLE II  
 APPORTIONMENT OF RISK WITHOUT "ONGOING PLAN" IMPLICIT  
 CONTRACTS<sup>a</sup>

	Asset risk	Liability risk
$F > A$	firm	firm-worker transfers
$A > F > G$	workers	none
$F < G < F + 0.3E$	firm	firm-worker transfers
$G < F + 0.3E$	PBGC	PBGC-worker transfers

a. Figures approximate because of long-term nature of PBGC position.

Perhaps the crucial point of this section is that even with a defined benefit plan, the worker is not immune to changes in fund asset values. The reason relates to the company's net position in the event of plan termination. This result is not dependent upon the plan's ever actually terminating. This is true, unless there is an "ongoing plan" implicit contract.

There is some hope for testing the "ongoing plan" implicit contract hypothesis. Theoretically, if the implicit contract holds, a firm's market value should be negatively correlated with *all* unfunded vested benefits, while without the "ongoing plan" assumption, market value should be correlated only with the maximum liability the firm would incur in a termination of the plan. (The "projected benefit" assumption would also argue that firm value should be negatively correlated with projected benefits in excess of vested benefits.) By regressing market value on the different types of pension liability, we could get an estimate of how "real" these liabilities are. No implicit contracting, for example, would imply that market value would be related only to the firm's minimum legal pension obligation.

### CONCLUSION

Pension fund analysts must be wary of two important and common assumptions made in evaluating pension liabilities. These assumptions, which have been termed here the "projected benefit" and "ongoing plan" assumptions, assume an implicit agreement on the part of firms to make future compensation payments in excess of whatever would have been paid had the firm used either no pension plan or a defined contribution plan, plus whatever legal liabilities have been accrued to date.

These assumptions play a crucial role in any pension fund eval-

uation, and alter the analysis of many crucial issues, such as how exposed are employees in defined benefit plans to inflation risk. This paper has criticized these assumptions on theoretical grounds. However, there are some empirical tests that can be made to determine whether the implicit agreement assumptions hold. The results of such future empirical work should have a major effect on subsequent pension studies.

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