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TAX ASPECTS OF CORPORATE PENSION FUNDING POLICY

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ABSTRACT

This paper explores four models of firms' pension liabilities. All of the models yield the result that if it is the stockholders who gain or lose from a change in the market value of pension fund assets, a pension fund invested entirely in bonds will maximize that gain. If a firm's pension liabilities are considered to be no more than the present value of accrued benefits, then most plans for salaried employees would maximize the pension's value by having their assets entirely in bonds. However, for less well funded plans such as most union plans, holding both stocks and bonds or even all stocks may maximize the value of the firm. Implicit contracts on the liability side of the pension balance sheet can encourage holding some stock, but implicit contracts on the asset side are likely to encourage increased bondholdings.

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Introduction

What are the advantages of a firm holding all bonds, all stocks, or a mix in its pension fund? Is a firm better off making the minimum or maximum contributions to its pension plan? Does the firm's pension funding policy matter at all to the stockholders?

The task of this paper is to clarify the crucial assumptions on which the answers to each of these questions depend, and how those assumptions affect the answer.

Models developed by Black [1980] and Tepper [1981], Sharpe [1976], and Miller and Scholes [1981] are all discussed. An extended version of the Sharpe model, actually drawing on all three earlier models, is also presented.

The reasons for the differing results of the models can be classified in two groups: assumptions about the asset side of the pension fund balance sheet, and assumptions about the liability side. Sharpe's basic approach is to look at the explicit terms of the pension contract. Black looks at the explicit liabilities of the pension plan but both he and Tepper tend to treat these liabilities as general obligations of the firm. Their model approximates the Sharpe model except in cases where a plan termination would lead to losses for the Pension Benefit Guaranty Corporation (PBGC). Miller and Scholes have in mind a model with very complex implicit contracts between the firm and its employees regarding pension benefits--assets backing pension liabilities may well exceed the money in the fund, and pension liabilities may also exceed the amount to which the firm has explicitly committed.

1. The Black-Tepper Model

The thrust of the models of Black [1980] and Tepper [1980] can be seen by taking an augmented balance sheet approach to pension fund analysis. Black considers the pension fund liability to be no more than the accrued liability of the pension plan--that is, the plan's explicit, legal liability. (For a discussion of this concept of pension liability see Bulow [1979]). Were it not for tax reasons, pension debt would be comparable to ordinary debt. Furthermore, were it not for taxes bonds in the pension fund would be a perfect hedge against either kind (ordinary or pension) of debt.[1]

The fact that bonds in the pension fund can offset ordinary debt presents a tax arbitrage situation. Bonds in the fund earn the pre-tax rate of return. Ordinary debt issued by the firm may be financed with tax deductible interest payments. Thus, an extra dollar of ordinary debt and an extra dollar of bonds in the pension fund provide a net tax benefit.

Unfunded pension debt, on the other hand, is very costly according to Black and Tepper. If the firm does not establish a pension fund its employees can contribute to an IRA account and earn the before-tax rate on bonds. Thus, employees will only be willing to sacrifice current wages for a qualified pension plan if they are offered the pre-tax bond rate. Furthermore, in a competitive labor market if labor supply is inelastic and the firm could earn the pre-tax rate by funding its pension plan such a rate of return would have to be offered to employees.

The Black-Tepper analysis is formally derived below under two sets of circumstances. In the first case, Merton Miller's [1977] argument that there is no equilibrium advantage to corporate debt financing is assumed to hold. In the second case, the result is examined in the situation where there is a tax advantage to debt financing. A simplification that does not alter the results here is that all corporate debt will be assumed to be riskless.

The fact that debt is assumed to be riskless does simplify the analysis in two ways: First, there are no problems involving the relative seniority of pension debt. This enables us to abstract from issues relating to the workers gaining security (at someone's expense) if more money is placed in the fund. Second, worker security is unaffected by whether the plan holds stocks or bonds. These problems are not major if it is assumed that pension contributions and investment policy are implicity or explicitly negotiated. If they are, the firm cannot gain at the expense of employees through funding or investment policy, and the fact that the Black-Tepper model as presented here abstracts from possibilities of this sort is unimportant.

Let V = present value of firm's non-pension assets

S = market value of stock held in the pension plan

B = market value of bonds held in pension plan

D = market value of firm's non-pension debt

L = market value of bonds required to pay off all pension liabilities accrued to date

X = maximum amount by which S + B may exceed L

r_β = rate of interest on riskless bonds

t_c = corporate tax rate

That is, L is the present value of accrued pension liabilities, discounted at the pre-tax nominal interest rate.

Consider a two period model. In the first period the firm contracts for some pension liabilities, acquires real assets, and puts money into its pension plan. The pension money is invested in stocks and bonds. Then to maximize shareholder wealth the firm must

$$(1.1)\quad \text{Maximize } V + S(1-t_c) + \frac{B(1+r_\beta)(1-t_c)}{(1+r_\beta(1-t_c)} - \frac{D(1+r_\beta(1-t_c))}{(1+r_\beta(1-t_c))} - \frac{L(1+r_\beta)(1-t_c)}{(1+r_\beta(1-t_c))}$$

subject to

$$S + B - L \leq X, \qquad S \geq 0,\ B \geq 0$$

if the Miller argument holds. The explanation of (1) is that the value of shareholder claims is equal to the present value of all the claims the firm owns less the present value of the after-tax cost of paying off all bondholders and pensioner claims.

The bonds held in the pension fund will earn a rate of return r_β and thus be worth $B(1+r_\beta)$ at the end of the period. This amount must only be discounted by the after-tax rate $r_\beta(1-t_c)$. Debt on the firm's balance sheet costs $r_\beta(1-t_c)$ after tax, and must be discounted at the same rate. Finally, the firm will have to pay pension beneficiaries a rate of return r_β on pension claims because that is the rate they can earn in IRA accounts or, say, in defined contribution plans run by competitors. Stockholders, however, will only discount these payments by the after-tax bond rate of $r_\beta(1-t_c)$. Also pension assets and liabilities are only worth 54 cents on the dollar $(1-t_c)$ because liabilities can be absolved with pre-tax dollars.

This version of the model assumes that firms can only contribute the maximum amount deductible for tax purposes. Actually, as Tepper points out, a firm can sometimes contribute beyond the deductible limit and gain tax postponement benefits. Such benefits would not appear in a two-period model.

For any set of assets V and pension debt L the way to maximize shareholder wealth is to set S = 0 and B = X + L. The value of D is indeterminate. The gain from having a plan is $\frac{(B-L)r_\beta t_c}{(1+r_\beta(1-t_c))}$. Thus, firms

should fund entirely with bonds, and put as much money as possible into bonds. If the plan is underfunded, the firm loses because employees could have earned r_β on their own. For every dollar that the firm can overfund, however, it earns the pre-tax rate of return while stockholders only expect the post-tax rate on such riskless securities.

Whereas legally a firm is limited to operating a fully funded plan, judicious choice of actuarial assumptions can actually enable a firm to vastly overfund. For example, IBM has 5,000 million dollars in pension assets and lists its pension liabilities at 5,000 million. However, the liability figure is calculated by discounting future benefits at a 4-3/4 percent rate of interest. Using current interest rates would yield the result that IBM is several billion dollars overfunded.

Now consider the case where there is a tax advantage to debt financing via the tax deductibility of interest payments. Thus future debt payments should be discounted at the pre-tax rate of interest. The management's problem is then to

$$(1.2) \quad \text{Maximize } V + S(1-t_c) + \frac{B(1+r_\beta)(1-t_c)}{(1+r_\beta)} - \frac{D(1+r_\beta(1-t_c))}{(1+r_\beta)} - \frac{L(1+r_\beta)(1-t_c)}{(1+r_\beta)}$$

subject to

$$S \geq 0,\ B \geq 0,\ S + B - L \leq X,\ D + L(1-t_c) - B(1-t_c) \leq k$$

where k = the "debt capacity" of the firm.

The last constraint limits the amount of tax-advantaged debt that the firm can issue. The assumption above is that (1) a dollar of pension debt displaces a dollar of ordinary debt, and (2) a dollar of bonds in the pension fund fully offsets a dollar of ordinary debt. This model can be

dressed up so that the optimal amount of debt is endogenously determined by perhaps some tradeoff between bankruptcy costs and tax benefits, but the resulting analysis would be identical.

Solving (1.2) yields $S = 0$, $B = L + X$, $D = k + \frac{X}{(1-t_c)}$. That is, the firm should try to issue as much ordinary debt as possible. The way to do this is to hold as many bonds as possible in the pension fund, because each dollar of bonds allows the firm to issue one more dollar of ordinary debt.

There are a couple of points to make about the "non-Miller" analysis. First, no one I know claims to understand much about "debt capacity." What if the "debt capacity" constraint is different from that above: for example, $D + (L - B - S)(1-t_c) \leq k$ (unfunded pension liabilities plus ordinary debt are less than or equal to "debt capacity"). In this case, there is an advantage to being funded to increase the amount of ordinary debt the firm can support, but no advantage to holding bonds rather than stock in the pension fund.

If debt capacity is proportional to a firm's beta (so that there are no tax advantages to diversification) then in a model where all securities yield the same pre-tax returns adjusted for risk holding zero-beta stocks in the pension fund would yield the same tax advantage as holding bonds. (Of course, it may be quite difficult to create a zero-beta stock portfolio.) In a Miller world, zero-beta stocks have a lower pre-tax return than bonds and are not a good pension investment. Thus, in a Miller world the tax advantage of funding a plan is due to the firm being able to earn the pre-tax rate of return on bonds held in the fund. The tax advantage is directly related to the plan's interest income. In a non-Miller world the

advantage of funding a plan is that the amount of ordinary debt that the firm can issue is increased, and a bigger interest tax deduction is received. Of course, in the non-Miller model selling bonds and acquiring a zero-beta portfolio of stocks in other firms, with the stock held in the corporation's general account, would provide the same tax advantage.

The contrast is most notable in the case of junk bonds which bear a strong resemblance to equity. In the Miller model such investments are ideal for pension funds because they yield taxable interest coupons that exceed the risk-adjusted total return on the security. In a "debt-capacity" model where the tax advantage came through increasing the amount of ordinary debt one could issue, holding junk bonds would yield no advantage over holding equivalent-risk equities in the pension plan.

Another point to make is that many firms may effectively be in a zero marginal corporate tax bracket. Airlines and utilities often pay very low current federal taxes. Oil companies have started paying the last few years, but it is possible that they have political reasons for wanting to pay income taxes. For such firms the tax value of extra "debt capacity" is zero because there is no more tax liability to offset. Thus, on the margin there would be no advantage to either funding a plan or holding bonds.[2] In a Miller world, however, where the tax advantage arises directly through the plan assets there would still be the same advantage to putting bonds in a fund.

There may also be a tax advantage to timing contributions to allow for changes in corporate tax rates. The corporate rate was as high as (52.8 percent in 1970) and is now 46 percent. Further reductions are possible. The individual firm may certainly find its tax rate changes over the years.

Also, it should be noted that there are ways for a corporation to receive interest income taxable as dividends through the use of special investment companies (see Bulow [1979]). If such tactics can be employed at low cost then the tax advantage of being able to earn tax free interest would be significantly smaller.[3]

Summarizing, the firm must pay the pre-tax rate of return on its pension liabilities. In the Miller world it derives a tax advantage through holding bonds in the plan that also earn a pre-tax rate of return. (Returns on equity already reflect a corporate tax.) If the firm has more bonds than are needed to cover its liability, it derives a tax advantage relative to having a defined contribution plan. In a non-Miller world the tax advantage of funding a pension plan is derived from the fact that increased plan funding increases the amount of ordinary bonds the firm can issue, with tax-deductible interest payments.

2. The Sharpe Model

Sharpe [1976] recognizes that directly adding the pension fund to the balance sheet does not take into account the value of the pension put. As an approximation, he takes the pension liabilities guaranteed by the PBGC to equal the present value of employees' claims, or roughly L in the notation of the previous section. In Section 4 the Sharpe analysis is extended to take into account the precise PBGC rules.

Again, resorting to the two-period model, the workers' claim is fixed at $L(1+r_\beta)$ at the end of the second period. The firm owns the plan assets, but has the right to put the liability to the government in return for the plan assets plus 30 percent of the firm's equity. Equivalently, the firm can be thought of as having a call on the plan assets with an exercise price equal to L - .3E, where E is the market value of the firm's equity.

This result derives from the fact that if pension assets are less than guaranteed benefits the firm has to make up the difference up to 30 percent of net worth.[4]

In determining funding policy the firm must trade off, in a Miller world, (1) the tax advantage to holding bonds in a pension fund and earning the pre-tax rate of interest, and (2) gains the firm may make from the government by putting the pension fund's assets to the government for L - .3E. For any given level of pension funding the optimal investment strategy is to hold either all stocks or all bonds. (Sharpe and Harrison have proven that this result will hold up in the multi-period context.) Generally, holding bonds will yield a tax advantage so that the bonds in the fund have a positive net present value while equity investments have a zero net present value. However, the riskiness of the stocks may make a call option on the equities more valuable than a call option on a portfolio of bonds. In either event, either an option on a portfolio with 100 percent bonds or an option on a portfolio with 100 percent stock will be at least as valuable as an option on a portfolio containing positive amounts of both assets.

To see that you would want to hold either all stocks or all bonds if you are choosing between just two assets, add the following notation:

V_S = the value of a firm's call option in a pension fund's assets if all the assets are invested in stock.

V_B = the value of a firm's call option on a pension fund's assets if all the assets are invested in bonds.

V_c = the value of a firm's call option on a pension fund's assets if 100α percent is invested in stock and the remainder in bonds.

P_S = the (uncertain) terminal value of each dollar's investment in in stock. If αF is invested in stock at the beginning of

the period the stock portfolio is subsequently worth αFP_S.

P_B = the (uncertain or certain) terminal value of each dollar's investment in bonds.

E = market value of firm's equity.

On exercise date

$$V_S = \text{Max}(0,\ FP_S + .3E - L)$$

$$V_B = \text{Max}(0,\ FP_B + .3E - L)$$

$$V_c = \text{Max}(0,\ \alpha FP_S + (1-\alpha)FP_B + .3E - L)$$

That is, the firm will only exercise the call option and pay off all liabilities if the sum of the assets in the plan plus thirty percent of the market value of the firm's equity exceeds the present value of the pension liabilities. By stochastic dominance, then, we can find that $V_c \leq \alpha V_S + (1-\alpha)V_B$ for $0 \leq \alpha \leq 1$. That is,

$$\text{Max}(0,\ \alpha FP_S + (1-\alpha)FP_B + .3E - L) \leq$$

$$\text{Max}(0,\ \alpha FP_S + .3\alpha E - \alpha L) + \text{Max}(0,\ (1-\alpha)FP_B + .3(1-\alpha)E - (1-\alpha)L) =$$

$$\alpha\text{Max}(0,\ FP_S + .3E - L) + (1-\alpha)\text{Max}(0,\ FP_B + .3E - L)$$

So we know that on the last day an option on the portfolio containing some stocks, bonds, and firm equity will be at most as valuable as a portfolio of options on the same assets with the same cumulative exercise price. This result is due to Merton [1973]. Consequently, one would be at least as happy today owning α of a call option with payoffs identical to those produced by the all-stock portfolio and $(1-\alpha)$ of a call option with payoffs identical to those produced by the all-bond portfolio as with an option on a portfolio invested α in stocks and $(1-\alpha)$ in bonds.

Once we have the result $V_c \leq V_S + (1-\alpha)V_B$ the rest is easy: $\alpha V_S + (1-\alpha)V_B \leq \text{Max}(V_S, V_B)$. That is, unless the market value of the call options yielded by the all stock and all bond portfolio are identical one will necessarily prefer owning a call worth either V_S or V_B rather than some linear combination of the two.

Thus, combining two observations: (1) an option on a portfolio is worth no more than a portfolio of options and (2) the weighted average of the market values of the options in a portfolio of options must be no greater than the market value of the most valuable option we find that a firm cannot do better than a portfolio with either all stocks or all bonds.

Sharpe and Harrisson [1981] are working on a paper which will show that in a multi-period model one will always want to hold either all stocks or all bonds each period.

If the amount of money plus the value of thirty percent of the firm's equity in the pension fund is low, stocks will likely be the better investment because holding bonds will guarantee that the firm's call option expires worthless. If the fund has a great deal of money, the ability to put the fund to the PBGC becomes less valuable and an all-bond strategy makes sense.

A further obvious implication is that if a firm adopts the all-bond policy, and gives up on the pension put having any value, the firm should be pouring money into the pension fund as fast as it can. This result is similar to the Black-Tepper result. If, on the other hand, the firm's decision is to go all equity there is no tax advantage to putting money in the plan but the pension put becomes more valuable as less and less money is invested in the plan. Firms which are underfunded, then, might try to minimize contributions and maximize the risk of the pension portfolio subject to whatever constraints are imposed on them by their actuaries' interpretation of ERISA.

If the Miller model does not hold, the same "debt capacity" issues that arose in the first section of the paper reappear. The tax advantage to holding bonds instead of stocks would be determined by how much additional "debt capacity" was created by holding bonds rather than stocks.

The primary conclusion of this type of analysis, then, is that there is a tax advantage to holding bonds and, often, an advantage in terms of the value of the pension put to holding stocks. In the simple example above, the firm would either hold as many bonds as possible or as little stock as possible. However, it should be noted that if the firm feels constrained to limiting the riskiness of its pension portfolio it may do well to hold bonds plus very risky stocks (or call options) rather than a portfolio with the same variance but all equities. In the context of the Miller model, the tax advantage of holding bonds earning the pre-tax rate is maintained while holding portfolio variance constant means that the pension put has not been devalued. In Section 4, when a more elaborate version of the PBGC rules are introduced, it will be possible to have cases were the firm holds a portfolio with some stock and some bonds even if portfolio choices are only between one bond mutual fund and one stock mutual fund.

3. The Miller-Scholes Model

Miller and Scholes [1981], in an interesting paper, go beyond looking at the explicit terms of the pension contract. They argue that defined benefit pension plans involve implicit contracts between the firm and its employees.

There is something of a puzzle as to why defined benefit plans exist, when from the point of view of defining the value of any employee's claim and any employer's liability a defined contribution plan is so much

simpler. One argument is that a defined benefit plan can be overfunded while a defined contribution plan cannot be, thus providing a tax advantage in the Sharpe and Black-Tepper models to overfunding. Another reason, also tax related, is that defined benefit plans systematically bias the accrual of pension benefits to older workers, who may wish to receive a higher fraction of their total compensation in pension benefits than would younger workers. Defined contribution plans are more limited as to how much benefits can be tilted to older workers. However, it is difficult if not impossible to find a firm that keeps as much money as possible in its pension fund. (Though firms such as IBM and Morgan, Stanley do have much more than enough to cover the present value of accrued liabilities.) Also, Scholes argues that tax lawyers can probably find a way to tilt pension compensation to older workers without resorting to a defined benefit plan.

Miller and Scholes suggest a third reason for the existence of defined benefit plans. They contend that the point of tying benefits to salary is to signal an implicit contract. The employee's pension is tied in part to his final salary, and salary is tied to how well the firm does. If the firm has a good year, the worker participates in the windfall through both high salary and a pension based on that salary. If the firm does poorly, the worker also participates by getting a lower salary and a pension based on that lower salary. There is an ex-post settling up with workers having an implicit agreement tying their fortunes to the firm.

Such a settling up could also be accomplished through bonuses or just through raises to people receiving a defined contribution pension benefit, but the defined benefit plan makes total compensation much more sensitive to salary. Thus, if the firm and its employees wish to have total worker compensation tied to the firm's equity but do not want the employee's total non-pension compensation to change quickly, then a defined benefit

plan with an implicit agreement tying salaries to the firm's progress is a sensible idea.

While the Black-Tepper and Sharpe models both attributed to the stockholders (or the PBGC) the gains or losses on the pension portfolio, Miller and Scholes' view of the complex implicit contract between the firm and the employees is that the stockholders are often out of the game completely.

Miller and Scholes argue that there are many similarities between defined benefit and defined contribution plans. Whereas in a defined contribution plan the workers explicitly benefit or lose from any gains or losses on the pension portfolio, in a defined benefit plan workers have an implicit contract giving them those same gains and losses. However, the workers also hold part of the equity of the firm in the Miller-Scholes model. This equity can be held explicitly, to a limited extent, through shares of stock held in the pension fund. Mostly, it may be held in the form of treasury stock.

In a defined contribution plan, pension liabilities are perfectly correlated with pension assets--if the stocks and bonds in the fund rise in value the present value of the liability to the work force rises by the same amount. In the Miller-Scholes interpretation of a defined benefit scheme, pension liabilities are also highly correlated with pension assets--including the company's own stock that is implicitly held.

While Miller and Scholes actually appear to have an extremely rich model in mind, at the risk of being overly simplistic I will write down a potential one-equation version.

Let G = the level of benefits guaranteed by the PBGC

PE = equity in the firm implicitly included in pension assets

T = value of employee benefits if the plan immediately terminated.

S = current market value of stocks held in the pension plan

B = current market value of bonds held in the pension plan

The model is:

(3.1) $T = \text{Min}(\text{Max}(G, S + B + FE), L(PE, S, B))$

If the plan terminated at any moment the workers would receive at least G--the amount guaranteed by the PBGC. If implicit plus explicit plan assets exceeded G then in a termination the workers would receive a package of benefits equal to the total value of the plan assets, up to a maximum of L(PE, S, B). If the firm did well then both the asset and liability side of the pension balance sheet would rise. However, we will leave open the possibility that if plan assets became sufficiently great the workers would not receive all of the gain.

In negotiating compensation for the coming period, the firm offers workers a choice of packages of equal cost to the firm. Each package defines a schedule L(PE, S, B), G, contributions to the plan, and an investment policy. The firm is quite content for the employees to choose any of the packages.

The workers may well choose a package consisting of some stocks and some bonds. The simplest example is when neither the pension put or the ability of the firm to call away the pension assets for L(PE, S, B) has any chance of being effective. Then the value of the workers' claims are exactly equal to S + B + PE. Just as workers in a defined contribution plan may choose to hold some equities even if the net present value of debt securities (because of tax reasons) is higher, the employees in the defined benefit plan may make the same decision.

There are two important, interrelated, questions that must be asked. First, what would happen if the plan became overfunded. For example, what

if L(FE, S, B) was a random variable equal to 15 percent of the firm's market value plus the value of 50 million dollars worth of stock and 40 million dollars worth of bonds, but the firm had over $90 million (say, $110 million) in the pension fund. Miller and Scholes agree if a plan can be overfunded in this way it makes sense for the firm to hold its share of the plan assets in bonds so as to earn the pre-tax rate of return in a Miller [1977] world. However, they claim that "The IRS will not allow corporations to fund a pension fund in excess of the pension promise" (p. 18). The IRS, though, confines itself to looking at the explicit terms of the pension contract and, as pointed out earlier, many firms do in fact overfund their explicit pension liabilities. Given that firms can overfund, one would, according to Miller-Scholes' reasoning, expect any stockholder assets stored in the pension fund to be held in bonds. Thus, the argument with the Black-Tepper and Sharpe models center around whether it is the shareholders, the employees, or the PBGC whose wealth is correlated with the return on pension assets. In all three models, if the stockholders are the beneficial owners of any pension assets they desire to hold those assets in bonds.

A second question relates to the nature of the implicit contract between the firm and the employees regarding the pension fund. In the Miller-Scholes model the firm's own stock may be held by the plan in the form of an unfunded liability. However, the employees have an explicit claim on the stocks and bonds held in the plan and not on other securities held by the firm. One might make an argument for a slightly more extensive implicit contract of the following sort: the employees receive a return on a portfolio of stocks, bonds, and firm equity but the only assets held in

the pension fund are bonds. For example, in the case above, employees wanted 50 million dollars worth of stock, 40 million dollars of bonds, and 15 percent of the firm's equity. What if instead of holding 50 million dollars of stock and 40 million of bonds in the pension plan the firm held 90 million of bonds in the plan, 50 million of stock outside the plan, and borrowed 50 million dollars, with an implicit agreement that the workers would get the return on the stock and the firm would get the returns on the bonds in the pension plan. If such an implicit arrangement were possible, an all-bond strategy for investment in the plan would again make sense unless more could be extracted ex ante from the government through underfunding and making use of the pension put. Thus, the Miller-Scholes model encompasses certain types of implicit arrangements, but there are also some somewhat explicit arrangements--e.g., that workers have a claim on pension fund assets and some firm equity, rather than just a more general implicit claim. This is not meant to be a criticism of the Miller-Scholes model; rather a clarification of the kind of contracts they are referring to.

Myron Scholes has pointed out that essentially the same result as the more extensive implicit contract can be achieved, in the context of the Miller [1977] model by the plan holding mostly bonds plus some call options and reproducing the riskiness of a portfolio of some stocks and bonds. As mentioned earlier, in the Miller model the tax advantage of having a plan is directly proportional to the amount of interest payments the firm can receive in its plan on a tax-free basis. In a debt capacity model the implicit contract arrangement does enable the firm to issue more bonds on its own account to offset the bonds in the pension fund. However, such a model does not yield any advantages to holding a bonds plus options

portfolio: in the debt capacity model all tax advantages come from increasing debt capacity, and altering the pension portfolio's composition but not changing its risk characteristics does nothing to increase debt capacity.

The Miller-Scholes model can also be presented using the augmented balance sheet approach. The balance sheet, for a firm with no ordinary debt, looks like this:[5]

Assets	Liabilities
S = stocks in pension fund	L = firm's pension liabilities
B = bonds in pension fund	
V = firm's non-pension assets	E = stockholder's equity

The liability is the one specified by the implicit contract between the firm and its workers. Firms are constrained to not deposit more money in the fund than the present value of the workers' total implicit pension claims less the value of their claims on the firm's non-pension assets. By choosing the appropriate mix of stocks and bonds in the pension fund, the firm can perfectly hedge its pension liability.

If the nature of the agreement is that the employees own whatever is in the pension plan, plus some fraction of other assets, the firm should be quite content to let employees choose the asset mix of the portfolio. However, another interpretation of the implicit claim is that the workers have a claim providing well-defined benefits in each possible state of nature and what assets are held specifically in the pension plan does not alter the nature of this claim.

In this case, the tax arbitrage scheme discussed above can be employed. The firm should issue ordinary debt D in an amount equal to S, the amount of stock needed to hedge out the pension claim. The stock in the pension plan should be sold and replaced with bonds. The proceeds of the debt issue can be used to acquire an equal amount of stock on the corporation's own account. The net result: on an augmented balance sheet basis assets are increased by S = D and ordinary debt of D is issued. It is clear that under either the Miller [1977] or debt capacity model a tax gain is made: both the amount of bonds in the pension fund and the amount of ordinary debt has increased. The firm is still perfectly hedged against its pension liability: it is just that the stock in other firms that it needs to hedge this liability is held outside the pension fund instead of inside.

With the Miller model the firm can achieve the same objective approximately by holding mostly bonds plus a few options in the pension portfolio: the tax advantage coming from holding bonds is still produced. In the debt-capacity model the bonds plus options strategy does nothing for debt capacity and hence provides no tax advantages.

Summarizing, Miller and Scholes see a defined benefit plan as being much like a defined contribution plan with three major differences: (1) workers are guaranteed a minimum benefit G; (2) workers have an implicit claim on part of the firm's equity, and (3) workers may have a maximum benefit. In the defined benefit plan the workers are the primary beneficial owner of pension assets. If a fund does contain some assets of which the stockholders are the beneficial owners, those assets ought to be bonds. The Miller-Scholes analysis is the first analysis we have seen which allows for a strategy of the firm holding some stock and some bonds in the pension plans.

4. Extended Sharpe Model

A more extensive version of the Sharpe model, allowing for a more detailed look at ERISA, and also considering the possibility of certain implicit contracts on the liability side of the pension fund balance sheet (but not on the asset side) also yields circumstances under which the employees may be the ones who benefit from the returns to the securities in the pension fund portfolio, thus allowing for the possibility of a portfolio with some stocks and some bonds. This model looks at the specific rules of ERISA and, assuming different types of contracts (explicit or implicit) between firms and workers, draws implications for funding policy.

Let A = accrued pension benefits

F = funded benefits = S + B

FE = firm equity in the event of plan termination

(negative if the firm has to contribute funds)

The major differences between guaranteed and accrued benefits are that (1) nonvested benefits are not guaranteed; (2) there is a limit to the amount of benefits an individual can receive each year from the PBGC; (3) benefit increases due to plan amendments only become gradually guaranteed over a five year period.

The third item—that benefit increases only gradually become guaranteed is extremely important for union pension plans. If a new contract is signed every three years, then for two of every three years benefits due to the last two new contracts are not fully guaranteed. For plans where benefits are related to salary amendments tend to be much less frequent, so virtually all vested benefits may be guaranteed. However, as explained in

Bulow [1979] salaried plans tend to be much better funded than union plans and thus the guarantee of payoffs may well be much less valuable.

Under ERISA the firm's net equity upon termination (pre-tax) can be written as

$$(4.1) \quad FE = \text{Max}(F - A, \text{Min}(0, \text{Max}(F - G, -.3E)))^{6/}$$

If accrued benefits are less than the amount of money in the pension fund the firm can actually terminate the pension fund and get money back. If accrued benefits are greater than funded benefits then the workers get whatever is in the pension fund, subject to a minimum of the guaranteed benefits. If pension assets are less than guaranteed benefits the firm has to make up the difference up to 30 percent of the firm's net worth, where net worth is the market value of the firm's equity according to the PBGC opinion letters.

The value of the workers' claim upon termination is

$$(4.2) \quad T = \text{Max}(G, \text{Min}(A, F))^{7/}$$

Taking the PBGC rules literally, we can now look at the explicit position of the firm and the workers under various funding levels, and examine investment policy. As a first approximation we will follow Bulow [1979] and assume constant renegotiation of pension benefits and funding policy, and assume A, E, F, and G change continuously. The advantage of this approach is that no "boundaries" get crossed so that if, for example, $F > A$ at the beginning of a period $F > A$ also at the end of the period (an instant later). After going through the analysis with this approximation the effect of modifying this assumption will be discussed.

TABLE 1

RISK BEARING OF PENSION FUND ASSET VALUES

1.	$F < G - .3E$	PBGC
2.	$G - .3E < F < G$	Stockholders
3.	$G < F < A$	Employees
4.	$A < F$	Stockholders

Table 1 summarizes which party bears the risk of changes in pension fund asset values for various levels of funding.

If a plan is significantly underfunded (line 1: $F < G - .3E$) the firm is liable for 30 percent of its equity and the PBGC is left having to pay the balance. If a firm is in such a situation (where it plans to eventually exercise the pension put or, like Chrysler, may find it advantageous in its dealings with the government to at least have the threat of putting a large liability--even if the threat is never exercised) it is only the PBGC's liability that is reduced by an increase in F. Clearly, the firm has no compelling incentive to increase F through contributions, so contributions to the plan would be minimized. In this analysis, the firm is indifferent to holding stocks or bonds in the portfolio, as are the employees. This result will be modified later.

If $G > F > G - .3E$ the workers will come out with G, the PBGC will have no liability, and thus the firm has a fixed liability of G. Consistent with the analysis of earlier sections, the firm would benefit most by holding an all-bond portfolio.

If A > F > G then workers benefits are worth F. The firm has no interest in changes in plan value. Consequently, the firm should be willing to hold whatever assets the employees want. As Miller and Scholes [1981] point out, despite the tax advantages of bonds employees may well choose to hold some equity in the fund under these circumstances. With the Miller [1977] model the employees may choose to hold bonds plus call options.

Finally, if F > A the employees are fully protected: all benefits will be paid off in the event of plan termination. In this case it is again the firm which bears the risk of changes in plan asset values. The firm has a certain liability of A. Again, it would choose to hold all bonds in the plan to get a maximum tax advantage.

The remainder of this section will discuss four questions related to the funding decision in this extended Sharpe model. First, we have always assumed that the legal funding maximum has been independent of the assets of the plan. There is a question as to whether this is true. Second, empirically which of the four categories of level of funding are most firms likely to fall into? A third related question is whether certain restricted implicit agreements may change one's view of accrued benefits. Fourth, what is the effect of allowing for the possibility that boundaries may be crossed so that, for example, a plan may change from being "underfunded" (F < A) to being "overfunded" (F > A).

The first question is are the maximum funding level and the investment decision at all related? I have no good answer. However, consider an extremely well funded plan such as IBM's, which manages to generally keep all accrued benefits funded, with accrued benefits discounted at 4-3/4 percent. If IBM invested strictly in bonds with a yield to maturity of roughly three

times the assumed interest rate, it would be quite clear that most of the money in the IBM plan was there to fund not-yet accrued benefits. It is at least possible that the firm would be forced to reduce its level of funding.[8]

In answering the second question, as to which funding category most plans fall into--one must differentiate between union and non-union pension plans; or, more to the point, flat dollar versus salary-related plans. In a flat dollar plan, benefits are raised every few years, and a new unfunded liability is created. This liability will be funded over ten to thirty years. Thus, there is always a large supply of unfunded liabilities--especially in an era of inflation where new benefits may be a high fraction of total benefits. Also, as mentioned earlier, there can be a significant difference between guaranteed and accrued benefits in a union plan. A flat dollar plan is likely to be at least somewhat underfunded, unless its interest rate assumption is extremely low and the plan has existed for a long time.

Plans in which benefits are tied to salary usually are well funded. The actuarial reason is that such types of plans have salary growth assumptions that are typically within a few percent of plan interest rate assumptions. (The effective benefit growth assumptions for a flat benefit type plan is zero.) The big increase in nominal interest rates has reduced the present value of accrued benefits so that salaried plans tend to be fully funded.

Additionally, because salaried plans do not need amendments to raise benefits, guaranteed benefits differ from accrued benefits only because of limits on individuals' annual benefits and the difference

between accrued and vested benefits. This amount can be quite small.

Salaried plans, then, appear to be usually overfunded ($F > A$) and seldom in a situation where $A > F > G$. Thus, it is unlikely that the plan should hold stocks unless there are some implicit agreements between the employees and the employer that make accrued benefits an understatement of employees' pension claims. Union plans are much more likely to be in a situation where $A > F > G$, and even without any implicit arrangements the employees bear the risk of changes in the value of pension assets in that circumstance.

Finally, there is the question of what happens when contracts are negotiated for long periods, so that "boundaries" may be crossed and an underfunded plan may become an overfunded plan before any change in policy occurs. First, it is important to note, as Miller and Scholes [1981] emphasize, that equilibrium requires that firms cannot gain by choosing funding policies that systematically take advantage of the stockholders. Funding policy is negotiated, so that no gain can be made at the expense of the employees. Thus, the only participant in the pension fund who can be gamed against is the government. However, it is also important to note that even if pension policy is negotiated it is important to have some idea of what a given funding policy that has been negotiated provides for the employees.

For a badly underfunded plan ($F < G - .3E$) equity funding clearly makes sense if bonds are highly correlated with G. Portfolio variance is increased and the firm has a better chance of reducing its liability. Ideally, it might only wish to hold one stock, but prudent man rules may

require it to hold many. In such cases where the amount of any given stock held is limited it is possible that the firm may wish to hold some types of bonds. That is, if the firm is constrained by "prudent man" requirements to hold at least 100 securities it is quite possible that the portfolio which maximizes the value of the pension put may include a number of securities that are bonds. This is because short term bonds are not a close hedge against pension liabilities, which are like bonds with extremely long durations. The way to maximize the value of the pension put is to create a portfolio with as low a correlation (preferably a negative correlation) as possible with the pension liabilities.

It is important to note here that there is no particular incentive for the firm to exercise its pension put so long as its minimum legal requirements for maintaining the plan are less than the value of newly guaranteed benefits. One reason firms may not be exercising now, then, is that it might be even more attractive to exercise later.

Consider a firm that is thinking of exercising its pension put ($F + .3E < G$). The costs of delaying exercise are (1) the minimum contributions to the plan that the firm will be required to make plus (2) any premia that must be paid to the PBGC. The benefits to delay are that (1) any newly accrued guaranteed benefits directly reduce labor costs because employees can regard such compensation as certain to be paid; (2) if the pension portfolio does well the firm can keep any increase in the value of F beyond $G - .3E$; and (3) any dividends that are paid on the firm's stock reduce the market value of the PBGC's claim on the firm's assets, because this claim is not dividend-protected. It is possible that $F + .3E < G$ but it is still in the firms' interest to keep their plans operating.

This type of analysis is a realistic depiction of the PBGC's problem in writing tougher rules for pension plan contributions, and for setting the terms under which multi-employer plans (generally greatly underfunded) can enter the insurance system. By making the cost of staying in the system more expensive the PBGC encourages immediate terminations. However, not getting tough has even greater costs. The market value of the PBGC's liability is exactly the negative of the market value to the firm of the pension put. If this put has a positive value the only way to forestall exercise is to make the terms for continuation sufficiently lenient that the firm's claim upon continuing the plan has at least as great a present value as it would upon immediate termination.

The fact that few firms with substantially underfunded plans actually do terminate does not dilute the value of the pension put even without the above argument. The firm can be compensated for not terminating its pension fund through the behavior of other government agencies besides the PBGC.

One of the reasons for the Chrysler loan guarantees may have been to save the PBGC from bankruptcy through a Chrysler default. While de facto Chrysler has not terminated its pension plan it may have gotten full benefit from its option to terminate.

With modest underfunding ($G - .3E < F < G$) a portfolio of all bonds also limits employees' benefits to G. It is conceivable they would be willing to compensate the firm for lost tax benefits (less increase in value of the pension put) in return for the firm placing some stock in the portfolio. With $G - .3E < F < G$ if F is close to $G - .3E$ the firm may prefer stocks just to take advantage of the pension put, and if F is near G employees may encourage the firm to hold some stocks so that benefits

might possibly rise in value above G. The stockholders would be compensated for the employees' call on the pension assets and the net cost (lost tax benefits plus change in value of pension put) through including equity in the portfolio.

In these cases of lost tax benefits the employees and employer would clearly jointly gain if they could establish an implicit agreement with the firm to hold some stocks for the employees' benefit outside the pension plan and to hold bonds for the employer's benefit within the plan. Also, as mentioned earlier, according to the Miller [1977] model holding bonds and options will dominate holding an equally risky stock portfolio for the employees, in the case where no implicit agreements are possible.

If $G < F < A$ the employees get to put the assets to the employers if assets fall below G and the employers get to exercise a call on the assets if assets rise above A. As employees hold more stock in the plan the value of the pension put falls and of the pension call call rises.

Finally, if $F > A$ it is hard to see any reason to hold stocks. Throughout this analysis G and A have been assumed to be constants. It should be emphasized that, as extremely long-term obligations, G and A fluctuate perhaps more rapidly than do pension assets.

Summarizing, if the explicit analysis is carried through, nonunion plans will generally find $F > A$, in which case all debt financing seems called for. The exceptions to this rule would be caused by (a) implicit pension liabilities exceeding the explicit liabilities; or (b) institutional constraints on what a prudent portfolio may consist of. In a flat dollar plan, however, it appears very likely that the workers

will be responsible for any change in pension asset values. In that case, the firm will be indifferent as to what is held in the plan and will hold whatever the employees desire.

Conclusion

Several models of pension liabilities have been presented here. The basic conclusions are as follows: In the Black-Tepper model the present value of the employee's claim is independent of the pension fund portfolio, and the possibility of making money from a plan termination is ignored. The stockholders gain or lose from any change in pension fund asset values, and wish that those assets be held in bonds because either (a) with a Miller [1977] model bonds earnings the pre-tax rate of return are a positive net present value investment or (b) with a debt capacity model, bonds in the plan may increase debt capacity.

The original Sharpe model also gives employees a claim with a value independent of the value of the firm's pension portfolio. However, the firm also holds a valuable pension put. The firm will wish to either fund as little as possible and hold all stocks (assuming that stocks have a lower correlation with pension liabilities than do any fixed income securities), thereby taking advantage of the pension put, or fund as much as possible and hold all bonds for the Black-Tepper reasons.

Under the Miller-Scholes model the employees have a complex implicit claim on the firm. If that claim includes whatever assets are in the pension fund, then the stockholders cannot gain by altering the pension portfolio. (Under the assumptions of the Miller [1977] model, however, the employees will gain from having bonds plus options rather than stocks and bonds.)

However, if it is merely that the employees hold a claim which may be hedged by holding stocks in the pension fund, then in the Miller-Scholes model also the firm should try to hold as many bonds as possible in the pension plan and, if hedging the pension liability is desirable, the liability should be hedged either with stocks outside the pension plan or, under the Miller [1977] model, with call options in the pension portfolio.

The extended Sharpe model, which looks at the explicit terms of ERISA, notes that if the market value of pension fund assets exceeds the present value of guaranteed benefits but is less than the present value of accrued benefits, then the employees have a claim worth exactly the market value of the pension fund's assets. Many union plans may have assets in this range. In such a situation the firm will be happy to let the employees choose investment policy. Outside this range, the extended Sharpe model yields the same strategy as the original Sharpe model: either all stocks or all bonds, depending on whether the pension put or the tax advantage of bonds is more valuable.

In general, if the Miller [1977] model is assumed, then if firms are the beneficial owners of any assets in the pension fund they would want those assets to be held as bonds if the plan is well funded (to maximize tax advantages) and as stocks if the "pension put" becomes more important. If the employees are the beneficial owners of the assets they may wish any combination of stocks and bonds, as in a defined contribution plan. If the Miller model is assumed, then the tax advantage of holding bonds is indirect, and the argument must be made that holding bonds in the plan increases firm "debt capacity" and allows for more on-balance sheet debt.

Clearly, the important question to be answered is who in fact does bear the risk of changes in pension asset values. That question is answered in a slightly different manner in each of the above models.

FOOTNOTES

1. The crucial elements about Black and Tepper's view of the pension liability are that (1) the workers negotiate a claim whose value is independent of the pension fund's performance, and (2) the possibility of gaining at the expense of the PBGC is ignored. They can accommodate views of implicit pension contracts, so long as the contracts do not make the terminal value of benefits dependent upon fund performance.

   The same results can also be achieved by making assumptions about worker preferences. For example, a stronger than needed assumption would have workers indifferent among all streams of pension benefits with the identical present value. Then the problem of the firm could be thought of as how to minimize the present value of pension costs, given the present value of pension liabilities, the tax laws, and the stipulation of ignoring the PBGC.

2. However, to the extent that such firms can sell off their tax shelters to other firms in the normal corporate tax bracket these firms benefit equally from extra debt capacity. Therefore, only if the firm could not dispose of its tax benefits would there be no advantage to holding bonds. Since many firms (especially financial institutions) are in low but positive average tax brackets and high marginal brackets (see, e.g., Feldstein and Summers [1979]) every year despite changes in income, one might assume that in fact some of these firms are able to dispose of excess tax shelters.

3. Fischer Black has pointed out to me that the effectiveness of such funds has been reduced by Revenue Ruling 80-345. While in principle these funds can in fact turn much interest income into dividends, it should be noted that very substantial portfolio turnover may be necessary to achieve this purpose.

4. As a technicality, the percentage is more like 3/13, or 23 percent. If a firm has a market value of $10 million it can be liable for $3 million. If stockholders anticipate this payout the market value of equity will only be $10 million if it would be $13 million without the pension payout.

5. This approach was suggested to me by Myron Scholes.

6. This assumes that the PBGC values guaranteed benefits at market for the purposes of assessing firm liability. Actually, the PBGC has its own set of interest assumptions derived from looking at insurance company rates which tend to be quite conservative (averaging about eight percent at the end of 1980). For the consequences of this effect, see Bulow [1979].

7. For example, if stocks are more highly correlated with the price of annuities than short term bonds are, then holding short term bonds is the way to maximize the value of the pension put. This may be true if the stock market tends to fall in response to an increase in long term nominal interest rates.

8. However, as long as the amount of interest income the firm could receive would increase, the net tax impact of such a move would still be favorable.

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