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The Integration of Insurance and Taxes in Corporate Pension Strategy

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ABSTRACT

This paper examines the implications of the joint effects of insurance and taxes for the optimal corporate pension strategy. It is shown that neither the "mini-max" nor the "maxi-min" strategy advocated by previous authors is necessarily best in corporate pension management. In the presence of capital market imperfections, the analysis via a single-period contingent-claims model indicates that optimal corporate pension strategy in both asset-allocation and funding decisions can be a noncorner interior solution.

SINCE THE PASSAGE OF the Employee Retirement Income Security Act (ERISA) in 1974, considerable attention has been given to the development of optimal strategies for corporate pension management. Under ERISA, the corporate pension liabilities have become parts of corporate liabilities and consequently the management of corporate pension plans has become an integral dimension of the overall corporate financial policy. At present, corporate pensions are subject to special tax treatments in the Internal Revenue Code as well as various ERISA regulations. Therefore, it is important to analyze the complex tradeoffs among various explicit and implicit benefits and costs in order to derive an optimal corporate pension strategy.

Several important contributions in the area of corporate pension strategy have been developed in finance and economic literature. For instance, Sharpe [18] has shown that in the absence of taxes and under the current structure of a fixed insurance premium charged by the Pension Benefit Guaranty Corporation (PBGC), the "insurance effect" calls for the "mini-max" corporate pension strategy that involves a minimum level of pension-plan funding and a maximum level of pension investment in risky assets. Conversely, Black [1] and Tepper [19] have argued that, in the absence of default risk and pension insurance, the "tax effect" calls for the "maxi-min" corporate pension strategy that suggests a maximum level of plan funding and a minimum level of investment in the low-tax risky assets. In their recent work, Harrison and Sharpe [8] and Marcus [12] have shown that the corner solutions in pension strategy are optimal even when the insurance and tax effects are considered jointly.

The purpose of this study is to examine the joint insurance and tax effects on corporate pension strategies in the presence of some relevant market imperfections. The single-period contingent-claim analysis is applied to examine these important effects on corporate pension strategies.

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The paper is organized as follows. In Section I, the background and scope of the U.S. private pension system are described. The importance of pension policies in the overall corporate management decision is also discussed. In Section II, the "insurance effect" and the "tax effect" on corporate pension policies are discussed separately first and then jointly later. In the absence of capital market imperfections, extreme corner solutions in pension strategy are shown to be optimal depending on whether the insurance or the tax effect dominates. However, in the presence of some relevant market imperfections such as pension termination costs and the progressive and asymmetric corporate income tax structure, it is shown that noncorner interior solutions in pension strategy can be optimal. Thus, the analysis provides reasonable explanation of the empirical observations in pension management. A brief summary of our analysis and some implications are contained in the final section of the paper.

I. Significant Role of Corporate Pensions

A. The Growth of U.S. Private Pensions

Although the first private pension plan in the U.S. was established by the American Express Company in 1875, the rapid growth in U.S. private pension plans did not take place until after World War II. The expansion of private pension plans was mainly stimulated by wartime factors such as wage controls, tax changes, and inflation. The Korean War further stimulated the expansion of private pensions, as employers used pension plans to provide nontaxable fringe benefits to attract workers in the face of wage controls and excess-profit taxes.

The growth in the U.S. private pensions between 1940 and 1980 is shown in Table I. By 1980, approximately 36 million workers and employees were covered by private pension plans financed largely by the contributions of their employers. The annual contributions to private pension funds increased more than two

Table I

U.S. Private Pension Plans, Selected Years, 1940–1980

Year	Workers Covered (million)	Contributions ($ million)	Assets ($ billion)
1940	4.1	310	2.4
1945	6.4	990	5.4
1950	9.8	2,080	12.1
1955	14.2	3,840	27.5
1960	18.7	5,490	52.0
1965	21.8	8,360	86.5
1970	26.3	14,000	137.1
1975	30.3	29,850	212.6
1980	35.8	68,970	407.9

Source: A. Munnell, *The Economics of Private Pensions*, Washington, D.C.: The Brookings Institution, 1982.

hundred times, from $310 million in 1940 to $69 billion in 1980. The value of assets in private pension funds increased about one hundred and seventy times, from $2.4 billion in 1940 to $408 billion in 1980. The significant role of private pension funds in the U.S. capital markets can be easily seen from these numbers.

B. Importance of Pension Plans in Corporate Management

The change in the legal status of pension liabilities under ERISA and the rapid growth of pension plans in the postwar period have made pension liabilities the major component of corporate financial structure. Prior to ERISA, pension liabilities were not liabilities of the firm. Upon the termination of a pension plan, the beneficiaries had legal claims on only the assets of the pension fund. If pension funds were not sufficient to cover the accrued liabilities, the beneficiaries of the plan would not have recourse to the general assets of the company.[1] However, pension liabilities have now become part of corporate liabilities under ERISA, and management of corporate pension plans have accordingly become an integral part of corporate capital structure and the financial strategy of the firm.

The rapid growth of pension plans making pension assets and pension liabilities important components of the financial structure of large corporations is illustrated via the recent sample survey of 470 of the Fortune 500 companies. The result of this survey indicated that companies incurred $21.5 billion in pension costs in 1980, which was about 12.6% of pretax profits and 8.1% of wages and salaries.[2] Pension assets for these companies amounted to about 13% of total corporate assets and about 31% of net worth. On the liabilities side, the sample companies had accumulated about $151 billion of vested pension liabilities, which was about 24% of their total outstanding corporate liabilities.

The importance of pension plans in corporate financial structure of a firm is shown in an augmented balance sheet for General Motors (GM) as of the end of 1982, in Table II. At the end of 1982, GM had an actuarial present value of plan benefits obligation of $18.1 billion. With pension assets of about $14.4 billion, the company had "unfunded" pension liabilities of $3.7 billion. The pension assets of the company amounted to about 25.8% of its total corporate assets. GM's unfunded pension liabilities at the end of 1982 amounted to about 25.5% of the company's net worth in book value.[3] Moreover, the pension liabilities of GM at the end of 1982 were about 41.3% of its outstanding corporate liabilities and were about four times its book value of long-term debt. This GM pension

[1] In Allied Structural Steel Co. versus Spannaus (1978), the U.S. Supreme Court invalidated a Minnesota law which previously ruled that a company owed a pension funding charge beyond its contribution upon its pension termination (Source: United States Reports, vol. 438, p. 238).

[2] Johnson and Higgins, *Funding Costs and Liabilities of Large Corporation Pension Plans: 1981 Executive Report* (New York: Johnson and Higgins, 1981), pp. 4–5.

[3] It should be noted that in 1983, GM slashed its large unfunded pension liabilities down to $111 million, which is less than 1% of its net worth. The five largest unfunded pension liabilities in 1983 are: (1) Chrysler with $947 million (69.3% of net worth); (2) International Harvester with $698 million (287.4% of net worth); (3) Bethlehem Steel with $503 million (38.3% of net worth); (4) Pan American with $499 million (115.5% of net worth); and (5) American Motors with $269 million (131.0% of net worth).

Table II

General Motors: Augmented Balance Sheet, December 31, 1982 (All figures in billions of dollars)

Assets		Liabilities and Common Equity	
Pension Fund Assets	14.4	Pension Liabilities	18.1
Plant and Equipment	21.5	Long-term Debt	4.5
Other Long-term Assets	5.9	Equity	14.5
Current Assets	14.0	Other Long-term Liabilities	6.3
		Current Liabilities	12.4
	55.8		55.8

example indicates the presence of a large amount of pension liabilities. Accordingly, the management of pension plans should be an important part of the financial management strategy of the firm and should be of much concern to the workers, shareholders, creditors, and corporate management.

II. ERISA and Corporate Pension Policies

The passage of ERISA has had significant impact on the private pension system in the United States. Under ERISA, the pension liabilities of defined-benefit pension plans have become a component of corporate liabilities, and management of pension plans has become an integral part of the overall corporate financial policy. ERISA has influenced the funding decision and the asset allocation (i.e., the asset mix) decision of defined-benefit pension plans largely through its "insurance effect" and "tax effect." These effects are analyzed below.

A. Insurance Effect on Pension Policy

The defined-benefit pension plans are now regulated by the provisions of ERISA that include the establishment of the pension benefit insurance program and rules on pension coverage and minimum vesting and funding requirements.[4] Some of ERISA's major provisions are briefly reviewed in the following.

1. The sponsoring firms with defined-benefit plans must enroll in the pension benefit insurance program of the PBGC which insures roughly 85% of workers' pension benefits. Thus, the workers' losses are limited to about 15% of the vested pension benefits upon plan termination. The fixed dollar amount of insurance premium charged by the PBGC is currently $2.60 per employee per year.
2. ERISA specified that if a defined-benefit pension plan were terminated, the PBGC had the authority to place a lien on the sponsoring firm's assets up to 30% of the company's net asset value. This lien would be senior to all unsecured liabilities of the company except wages.
3. ERISA imposed vesting standards and minimum funding requirements. It also imposed fiduciary responsibility for pension plan administrators.

[4] A detailed discussion of the important provisions of ERISA can be found in Treynor et al. [21].

4. The PBGC was empowered by ERISA to monitor corporate pension plans, and, if necessary, to terminate a pension plan.

Hence, the establishment of pension benefit insurance programs with a fixed fee structure is one of the important factors that influence corporate pension strategies of the firm. To see how the insurance effect influences corporate pension strategy, a single-period contingent-claim analysis will be used to determine the economic value of a pension claim after the passage of ERISA. The pension claim of the PBGC at the end of the year can be expressed as follows.[5]

$$PC(T) = \min[PA(T), B(T)], \tag{1}$$

where

$PA(T)$ = the market value of assets in pension plan plus 30% of the market value of the firm's net assets at the end of the year; the "augmented" pension assets;
$B(T)$ = the vested pension benefits at the end of the year.

The expression for the pension claim in Equation (1) can be written as

$$\begin{aligned} PC(T) &= \min[PA(T), B(T)] \\ &= B(T) - \max[B(T) - PA(T), 0]. \end{aligned} \tag{2}$$

Therefore, the current value of a pension claim can be expressed in the following equation:

$$PC = B - P(PA, B(T), \sigma^2), \tag{3}$$

where

PC = the current value of the pension claim;
B = the present value of the vested pension benefit, discounted at the nominal riskless interest rate; the "contractual" value of a pension claim;
$P(\ )$ = the put option with relevant parameters in parentheses;
PA = the current value of the "augmented" pension assets; and
σ^2 = the variance of the rate of return of the assets that underlie the pension put.

Therefore, viewing the pension claim in this way, the economic value of any pension claim can be shown to consist of two parts: (1) the "contractual" value of the pension claim, that is, the present value of the pension benefit, discounted at the nominal riskless interest rate; and (2) the pension put on the "augmented" pension assets, with an exercise price equal to the vested pension benefit. In other words, under ERISA, a firm with a defined-benefit pension plan has purchased an "implicit pension put" from the PBGC at a fixed insurance premium.

From the Black-Scholes option pricing formula, the expression for the pension

[5] For simplicity, we ignore the presence of other corporate liabilities here. See Chen [5] for the more complete model using the complex option pricing technique.

put is given as

$$P(PA, B(T), \sigma^2) = -[PA \cdot N(-h) - B \cdot N(\sigma\sqrt{T} - h)]$$

where

$$h = \ln(PA/B)/\sigma\sqrt{T} + \tfrac{1}{2}\,\sigma\sqrt{T}.$$

$N(\cdot)$ = the cumulative standard normal distribution; and

r = the riskless rate of interest. (4)

Some general characteristics of a pension put are as follows:

$$\frac{\partial P}{\partial PA} = -N(-h) < 0 \tag{5a}$$

$$\frac{\partial P}{\partial B(T)} = e^{-rT}N(\sigma\sqrt{T} - h) > 0 \tag{5b}$$

$$\frac{\partial P}{\partial \sigma} = PA\sqrt{T}\,N'(h) > 0. \tag{5c}$$

The above results indicate that the value of pension put decreases if the value of the pension assets increases; the value of the pension put increases if the vested pension benefits increase; and the value of the pension put increases if the risk of pension assets increases. Sharpe [18] has shown that in the absence of taxes and given the current structure of a fixed insurance premium charged by the PBGC, the "insurance effect" calls for the "mini-max" strategy in pension management (i.e., a minimum level of pension funding and a maximum level of investment in the risky assets). This "mini-max" strategy is to maximize the value of pension put and accordingly maximize shareholder wealth.

B. Tax Effect on Pension Policy

The special tax status of corporate pension plans is one of the major economic incentives prompting firms to offer pensions to their employees. Accordingly, a brief summary of the major tax provisions for qualified pension plans is provided to understand the economic implications of the Tax Code for optimal corporate pension strategies. ERISA has continued the tax advantages for the qualified pension plans that were specified in the Internal Revenue Act of 1942 including:

1. The employer's contribution to a pension plan on behalf of an employee is not taxable as income to the employee until it is realized as a pension payment.
2. The employer's contributions to a pension plan are immediately deductible from business income for tax purposes.
3. The investment income of a pension plan is tax exempt.

The special tax treatment of corporate pension plans not only provides a strong economic incentive for employers to offer pension plans, but this tax treatment constitutes the primary determinant of optimal corporate pension strategy. Black

[1] has argued that a firm maximizing shareholder wealth should employ the corner-point strategies in pension management to capture the tax advantage under the current tax laws. Specifically, he recommends funding the pension with debt borrowing to the greatest possible extent and investing the entire pension fund in corporate bonds. Black's reasoning is that holding more bonds instead of stocks in a firm's pension portfolio will increase the firm's debt capacity which in turn can be utilized to obtain additional tax subsidies through additional corporate leverage. Tepper [19] has derived a similar recommendation on pension strategy based upon a different model of capital market equilibrium. He has argued, based upon Miller's [4] equilibrium model, that in the presence of corporate as well as personal taxes under certainty, that the sources of funding a pension plan are of no significant importance. However, a full funding should be utilized to obtain the greatest possible tax deductibility, and the entire pension fund should be invested in bonds to earn the pre-tax corporate interest rates. Therefore, the studies of both Black and Tepper on the effects of taxation on corporate pension policy has led to the "maxi-min" strategy that calls for funding the pension plans to the maximum level and investing the entire pension fund in bonds (a minimum zero investment in common stocks).

C. Joint Insurance and Tax Effects on Pension Policy

The antipodal "mini-max" and "maxi-min" recommendations on pension policies described in the preceding sections are based upon either the insurance effect or the tax effect alone and not upon the joint consideration of both variables. Furthermore, the corner-point pension strategies are not consistent with empirical observations. As Tepper [19] has pointed out, equities accounted for approximately 50% of pension investments in 1981, and they have ranged from a low of 19% in 1950 to a high of 74% in 1972. In other words, the observed actual portfolio allocation mixes in corporate pension plans have followed neither the strategy of investing the entire pension funds in bonds as prescribed by the tax-effect advocates nor the strategy of investing the entire pension funds in risky assets as prescribed by the insurance-effect advocates. Further, regarding the question of pension funding, Mumy and Manson [16] have observed a steady rise in the average level of underfunding for the period 1973 through 1978. In their sample of 200 firms, the average ratio of total unfunded vested benefits to total assets had increased from 3.9% in 1973 steadily to 5.4% in 1978. The current tax laws do give the firms the economic incentive to fund their pension plans fully, because the pension contributions made by employers are tax deductible immediately. The rhetorical question is, of course, why do we observe underfunding among firms? Since the insurance effect calls for a pension strategy of minimum funding, one can presume that the insurance effect dominates the tax effect for some firms, and that these firms obtain greater value for pension puts from underfunding than from the known benefits of tax deduction.

Harrison and Sharpe [8] and Marcus [12] have recently examined the joint effects of insurance and taxation on corporate pension policies. Under the assumption of no capital market imperfection besides corporate income taxes,

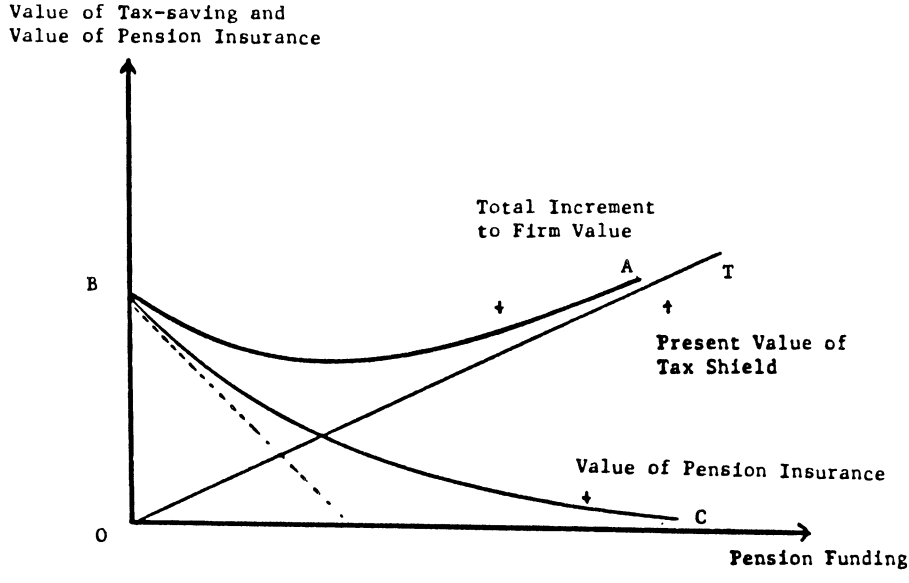
both Harrison and Sharpe and Marcus have concluded that the extreme corner solutions are optimal for pension strategies. For instance, they conclude that a firm should fund its pension plan either to the maximum or the minimum level permitted. They reach these extreme but divergent strategies based upon the following reasoning. Assume that pension benefits are fully insured by the PBGC and that there is no deadweight loss of plan termination, then the value of pension insurance (i.e., pension put) is a decreasing convex function of the amount of pension funding, while the marginal benefit in tax-saving arising from pension contribution is constant. This implies that the total increment value (the sum of insurance value and the value of tax-saving) to the firm from pension funding is represented by a *U*-shaped curve as shown in Figure 1A. Thus, a value-maximizing firm will always adopt an extreme strategy in pension funding (i.e., it will fund a pension plan to the maximum or the minimum level permitted).

It should be pointed out that the corner-point solutions of pension funding strategy described above is based upon the assumption that there is no capital market imperfection besides taxes. Given the presence of some capital imperfections, the insurance effect and the tax effect on pension funding policy need to be modified. This modification is discussed below:

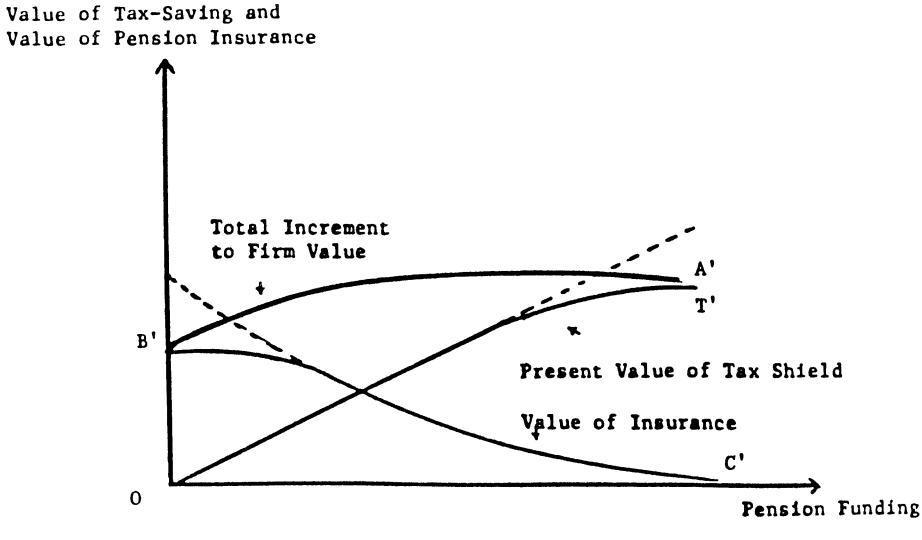
D. Insurance Effect

If the pension benefits are 100% guaranteed by the PBGC with a fixed insurance premium and in the absence of any deadweight losses of pension termination, the net value of pension insurance (i.e., the value of pension put minus the fixed fee for insurance) is a decreasing convex function of the amount of pension funding. However, as mentioned above, ERISA has imposed a limit on the amount of basic benefits insured by the FBGC, which is adjusted annually to reflect increases in the social security wage base. The maximum amount of basic benefits was $750 a month originally, but it was increased to $1,381 a month by 1982. The amount is roughly 85 percent of pension benefits. Thus, an increasing underfunding of the pension plan means a greater default risk of the plan and a higher expected loss of benefits to the workers. A highly underfunded pension plan does invite interferences from both the PBGC and the pension beneficiaries. In addition, the sponsoring firm of a pension plan has to incur various types of explicit and implicit costs of plan termination such as large legal expenses arising either from law suits due to plan termination or poor labor management relations that cause business interruptions. Finally, the Internal Revenue Service might not allow favorable tax treatment for a new pension plan established by a firm which has terminated a pension plan in the past that resulted in a loss of shareholders' wealth. Thus, the explicit and implicit costs of plan termination represent significant deadweight losses that cannot be ignored in the analysis of ERISA's insurance effect on corporate pension strategies. In an efficient capital market, most of the costs of plan termination would be borne by the shareholders of the sponsoring firms. The risk of default is determined by the level of pension funding and the risk of assets in the pension plans. Consequently, the expected costs of pension termination increase with an increase in the risk of default due to a reduction in the pension funding or an increase in

A. Case With No Market Imperfection



B. Case With Market Imperfections



Explanation:

1. OT and OT' represent values of tax-saving from pension contributions.
2. BC and B'C' represent the net values of pension insurance at different levels of pension funding.
3. BA is verticle sum of OT and BC at different levels of pension funding; and B'A' is the verticle sum of OT' and B'C' at different levels of pension funding.

Figure 1. Total Increment of Pension Funding to Firm Value

the risk of pension assets. Hence, a higher expected cost of plan termination implies a lower net value of pension insurance from the PBGC to the firm. This intuition can also be analyzed within our single-period contingent-claim model.

Let $K(T)$ be the sum of explicit and implicit costs of plan termination to be borne by shareholders of the sponsoring firm at the end of the year,[6] then the present value of these costs will be

$$K(PA, B(T), K(T), \sigma^2) = e^{-rT}K(T) \cdot N(\sigma\sqrt{T} - h), \tag{6}$$

where

$$h = \ln(PA/B)/\sigma\sqrt{T} + \tfrac{1}{2}\,\sigma\sqrt{T};$$

$$N(\cdot) = \text{the cumulative standard normal distribution.}$$

And we can easily show the following properties

$$\frac{\partial K}{\partial PA} < 0; \quad \frac{\partial K}{\partial B(T)} > 0; \quad \frac{\partial K}{\partial K(T)} > 0 \quad \text{and} \quad \frac{\partial K}{\partial \sigma} > 0. \tag{7}$$

Therefore, in the presence of deadweight losses of pension plan termination, the net value of pension insurance (NVPI) to a firm with defined-benefit pension plans is given as follows:

$$\text{NVPI} = P(PA, B(T), \sigma^2) - K(PA, B(T), \sigma^2) - I, \tag{8}$$

where I = the fixed fee for pension insurance.

In the absence of the costs of plan termination (i.e., K is zero), the net value of pension insurance is NVPI $= P(PA, B(T), \sigma^2) - I$, and is a decreasing convex function of the amount of pension funding as represented by the put-value curve shown in Figure 1A. However, in the presence of pension-termination costs, the net value of pension insurance to the sponsoring firm consists of the following three components: (1) the gross value of pension put; (2) the insurance premium, and (3) the present value of pension-termination costs. Therefore, for a given asset-mix in a corporate pension plan, the sum of the insurance premium and the present value of pension-termination costs could outweigh the gross value of pension put and result in a negative marginal net value of pension insurance as the underfunding of the plan continues. In other words, the net value of pension insurance could be a concave function of pension funding (especially at a relatively high level of risk of the pension assets).

E. Tax Effect

In the analysis of tax effects on corporate pension strategies, the previous authors such as Black [1], Tepper [19], Harrison and Sharpe [8], and Marcus [12] have assumed a constant corporate income tax rate and a certainty of tax

[6] $K(T)$ is assumed constant for simplicity. It would be, however, an increasing function of the risk of default due to a reduction in the pension funding or an increase in the risk of pension assets. Furthermore, similar to the arguments put forth by Buser et al. [4] in the case of the FDIC insurance, one can argue that the regulatory dominion by the PBGC and the IRS on pension management constitutes a significant implicit insurance premium that reduces the gross value of pension put under the current pension-benefit insurance program.

deduction. As a result, they have concluded that the marginal benefit in a tax deduction arising from pension contribution would be constant as depicted in Figure 1A.

Both the progressive corporate income tax structure and the asymmetric corporate income tax structure under the current tax laws have important implications on the tax effects on corporate pension strategies. Under a progressive corporate income tax structure, it is readily apparent that the marginal benefit in tax deduction arising from pension contributions is diminishing rather than constant even if the tax deduction is unlimited for the firm. The current U.S. corporate income tax system has a five-step graduated tax rate structure (see Tables III and IV).

Therefore, the income tax is a piecewise convex function of corporate taxable income. As a result, the marginal economic benefit from tax deductions of pension contributions will be diminishing rather than constant. Further, in the absence of negative income tax, the current tax structure is asymmetric and the secondary market for tax credit is not perfect. A firm has to pay corporate income taxes if its taxable income (gross income minus deductions such as interest payments, depreciation, and pension contributions) is positive. But, it will not receive funds from tax authorities if its taxable income is negative. Although tax credit for any firm can be carried backward and forward for a number of years, it can not be utilized without limit. Also, the secondary market for a firm's tax credit has not yet been fully developed. Therefore, the marginal benefit in tax deduction from pension funding cannot be constant as maintained by previous authors. As shown in Figure 1B, the general shape of the function of the tax-saving value from pension funding should be concave rather than linear.

Table III

Tax-Rate Structure

Corporate Taxable Income	Tax Rate (%)
$0 to $25,000	15
$25,000 to $50,000	18
$50,001 to $75,000	30
$75,001 to $100,000	40
Over $100,000	46

Note: From the above, we can obtain Table IV showing the amount of income tax corresponding to the taxable income.

Table IV

Taxable Income and Taxes

Corporate Taxable Income	Income Tax
$25,000	$3,750
50,000	8,250
75,000	15,750
100,000	25,750

F. Joint Effects

We have seen the directions of the offsetting effects between the insurance value and the tax-saving value arising from the pension-funding decisions. The jont effects will be the sum of the two. In the absence of market inperfections, the total value (the sum of insurance value and tax-saving value) to the sponsoring firm is represented by the *U*-shaped *BA* curve in Figure 1A. However, in the presence of market imperfections, the jont effects of insurance and tax saving on corporate pension policies can be different from what has been described by the previous authors. As illustrated in Figure 1B, the function of the total increment to the value of the sponsoring firm represented by the B′A′ curve may be a concave function of the level of pension funding. Thus, an interior solution, rather than a corner solution, may be optimal for pension funding decisions for some firms. If the "tax effect" dominates, the level of pension funding will be higher, and the asset-mix will consist of more bonds than stocks. On the other hand, if the "insurance effect" dominates, a firm should fund its pension plan at a lower level and invest more of its funds in stocks. However, the important point is that noncorner solutions in corporate pension strategies may be optimal in the maximization of corporate shareholder wealth.

III. Conclusions

Under ERISA, the "insurance effect" and the "tax effect" are the two major factors that influence corporate pension strategies. The defined-benefit pension plans are required to be enrolled in the pension-benefit insurance program of the PBGC and to pay an explicit fixed insurance premium as well as some implicit premiums. Using contingent-claim analysis, we have shown that the sponsoring firms of defined-benefit pension plans purchase implicit pension puts from the PBGC. Contrary to the previous analyses on the joint effects of insurance and tax on pension strategies, we have shown that noncorner solutions may be optimal if relevant market imperfections are taken into consideration. Therefore, the financial managers' optimal set of strategies in pension management will include many others besides simple corner solutions. Indeed, an interior solution or an estimated range of interior solutions in pension management are consistent with the best interests of their shareholders. Also, dynamic pension strategies revising intertemporally the asset-allocation and funding decisions in pension management are important in achieving optimality.

The space limitation prevents us from discussing the effects of inflation on corporate pension strategies. Based upon the option pricing models with an uncertain exercise price developed by Fischer [7] and Margrabe [13], one can analyze the impact of inflation on corporate pension strategies. The results of such analysis of the effects of inflation on the value of pension puts would likely to have some important implications for the pricing policies of the PBGC. The Guaranty Corporation should not only charge a risk-based insurance premium but should also adopt an adjustable premium schedule pegged to levels of inflation in the economy. This is an important and interesting area that requires additional research.

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DISCUSSION

GUILFORD C. BABCOCK*: This article by Bicksler and Chen sets up the logic of two extreme positions on pension fund management, points out that neither is consistent with the real world, and thus seeks a reconciliation between "theory and practice" based on the existence of some market imperfections.

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