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## Pension Investing and Corporate Risk Management

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Pension plan investments have grown to become a major asset of giant corporations. General Motors' pension assets are nearly twice the market value of its total outstanding stock. Interestingly, a portfolio of this size warrants but a footnote to the firm's balance sheet.

Since the corporation ultimately stands behind pension liabilities, risk management within the pension plan can now play a very meaningful role in the firm's overall risk management strategies.

Pension risk can interplay with operating risk to create real problems for management. For example, if the plan manager invests in assets expected to produce low returns in periods of economic difficulty, the plan may require additional cash contributions at a time when corporate cash flows are already at uncomfortably low levels. Given the potential magnitude of these required contributions, a significant change in the asset allocation of pension assets can have a pivotal effect on the firm's ability to weather economic adversity and on its financial well-being.

In spite of this, the investments of most pension plans are managed with little regard for the character of the liabilities they support, and with scant appreciation for the potential impact of the pension fund on the overall risk of the firm. Recently, Arnott and Bernstein (1988) discussed the implications of managing pension assets in relation to pension liabilities on investment choices between common stock, real estate, and short- and longterm bonds. In this article we expand the discussion to address (a) the role of pension risk management in the context of corporate risk management and (b) how pension risk management strategies might optimally be implemented to increase the probability that pension benefits can be financed from plan assets and that, when and if required, unexpected increases in corporate contributions can be made without financial discomfort to the firm.

### I. Corporate Risk Management

Corporations have a long-standing tradition of risk management. For example, they avoid interest-rate risk by matching up the term of debt financing with the expected life of the projects being financed. Inventory expansion is usually financed with short-term instruments, while long-lived projects are financed long-term. Moreover, firms also hedge against unexpected foreign exchange risk through forward and futures contracts to buy and sell foreign currencies. These contracts also hedge against unexpected changes in the prices of raw materials such as oil, copper, and steel. Maintenance agreements and insurance contracts on plant, equipment, and key personnel are also commonplace. The prices of nearly all these contracts are set in highly competitive markets. For example, in efficient markets forward and futures prices are fair prices, as are the relative interest rates on long- and short-term debt. It can safely be assumed that matched-term financing and hedging with forward and futures contracts are roughly zero net present activities, and, by definition, they have no effect on the *present* value of the firm's common stock. The risk eliminated by corporate risk management is usually

idiosyncratic to the individual firm, and it can be diversified away at little cost by its investors on their own account. Thus, even considering possible wealth transfers from bondholders to stockholders, the current stock price is largely unaffected by risk management within the firm.

Given the standard business school directive to manage so as to maximize the present market value of the common stock, what is the economic rationale for expending so much time and so many resources in corporate risk management?

The rationale is that management has many different constituents in addition to its *stockholders*, all with vested interests in the firm's well-being. Among the most important are the firm's *customers*, its *suppliers*, and its *employees* (including management itself). If managerial decisions are based on maximizing the stock price, while preserving the welfare of each constituent, how can corporate risk management, and in particular pension risk management, function consistently with this objective?

## II. Corporate Risk Management Within the Pension Fund

From the perspectives of each of the four constituents, a decision to manage pension assets in a manner consistent with overall corporate risk management is nearly a Pareto optimal strategy—it benefits customers, employees, and suppliers while leaving stockholders largely unaffected.

<p><b>Figure 1a</b>                  ECONOMIC BALANCE SHEET                  (CLOSED-END INVESTMENT COMPANY)</p>	
High-Risk Equities Low Risk Equities	Common Stock

Once again, stockholders can adapt to changes in corporate risk easily by adjusting the composition of their portfolios, including more bonds and less stock, or by exchanging high-risk stocks for low-risk stocks. *The stockholders want management to take actions that will increase the market value of their securities.* Since they can easily adjust, they don't care if these decisions increase or reduce the risk of the securities as well.

To see this, consider the asset-allocation decision of a closed-end investment company. The balance sheet for the closed-end company is given in Figure 1a. Its managers have divided its investments equally between blue chip common stocks and more risky common stocks. The stock of the closed end company is priced in the same market as the stocks in which it is investing, and is represented on the right-hand side of the balance sheet.

Now consider the expected effect on the *current* market value of the closed-end's stock of changing the composition of the investments to a 100/0 allocation to blue-chip equities. So long as transactions costs are small and it sells and buys the stocks at fair prices, the current price of its stock should be largely unaffected by the move. The change in risk is easily neutralized by the shareholders of the company.

We can reach a similar conclusion regarding asset reallocation within the pension plan if we consider the “economic balance sheet” of the corporation represented in Figure 1b. The *economic* balance sheet differs from the standard *accounting* balance sheet in that all entries are market, as opposed to accounting or book values. Thus, the balancing entry on the right-hand side is the market value of the firm's stock, rather than the book value of equity capital. Represented on the left-hand side of the economic balance sheet are the pension assets that, for many firms, are a sizable fraction of total corporate assets. Represented on the right-hand side is the market value of pension liabilities. Because the projected future cash flows (forming the basis of the market value of the firm's non-pension assets) are based on the future productive service of active employees, the market value of the pension liability goes far beyond the liability to retired workers. It reflects amounts expected to be eventually paid to active workers based on past and *future* service. Importantly, the economic value of the pension liability also reflects the probability of default on the pension promise, much as would the economic value of corporate debt reflect the potential for default on interest payments.

<p><b>Figure 1b</b></p> <p>ECONOMIC BALANCE SHEET (CORPORATION)</p>	
<p>Corporate Assets</p> <p>Pension Assets</p>	<p>Corporate Liabilities</p> <p>Pension Liabilities</p> <p>Common Stock</p>

What is the expected impact on the stock price of a major restructuring of the asset allocation within the pension plan? Assume, temporarily, that there is no guarantee by the Pension Benefit Guarantee Corporation on pension benefits. Suppose there is a massive shift in asset allocation within the plan so as to change the risk characteristics of the equity component of the pension plan's portfolio, or a similar shift between equity and fixed-income securities. The consequences of such a shift will surely affect the *expected return* to the assets of the pension fund. However, if the assets are traded at fair prices, the change in the asset allocation should have no effect on the market value of the pension assets on the left-hand side of the economic balance sheet. Given this, will the shift in asset allocation leave the market value of the firm's common stock unaffected as well?

That depends. While the market value of pension assets remains intact, the reallocation of pension assets may trigger *secondary wealth transfers* between the employees and the stockholders of the firm.

Suppose, for example, the risk associated with the pension investments is substantially increased. To the extent that this increases the probability of default on the pension plan, the market value of the pension liability is reduced. Since common stock is the balancing entry in the economic balance sheet, if nothing else occurs, the value of the common stock should increase, reflecting a transfer of wealth from the employees of the firm to its common shareholders.

However, an important, countervailing effect can now be expected to appear. Since the market value of the employees' claim to their pension income has been reduced, unless their bargaining position has somehow been reduced as well, they can be expected to press for renegotiation of their compensation package to restore its former value. If they choose to renegotiate promised pension benefits, the market value of the pension liability can be restored. If they renegotiate for increases in direct compensation, or fringe benefits, expected future cash outflows to labor will increase, and the market value of corporate assets will be reduced, lowering the value of the firm's common stock to its former value. In any case, in the presence of a well functioning labor market, the market value of the common stock should not be significantly affected by the reallocation of investments within the pension fund.

Now suppose pension benefits are guaranteed by an agency such as the PBGC. Assume also that the premium schedule is such that insurance premiums paid to the PBGC by the firm increase as the funded status of the pension deteriorates. (This is indeed the case under the Omnibus Budget Reconciliation Act of 1987.) How are the secondary wealth transfers affected by the presence of the guarantee?

Given market confidence in the PBGC guarantee, the market value of the pension liability should remain intact even if the risk of pension investments, and the probability of default by the *firm*, is increased. The PBGC now bears the burden of any increase in the probability of default within the pension plan. Once again the common stockholders enjoy the prospect of a secondary wealth transfer, but this time the potential source is the PBGC rather than the employees and plan beneficiaries. Why only a *potential* wealth transfer? Because the increased probabilities of deterioration in the plan's funded status also increase the expected value of future premiums paid by the firm to the PBGC. Increased cash outflows- going to the PBGC in the form of additional premiums require a corresponding reduction in the present value of corporate assets. To the extent the potential wealth transfer induced by the increase in pension risk is recaptured by the PBGC through the nature of their premium schedule, secondary wealth transfers to common stockholders are once again mitigated.

Viewed in this context, the effects of risk management within the pension plan should have a relatively insignificant effect on the welfare of the firm's common stockholders. The firm's other three constituents, however, stand to benefit significantly from the activity.

### **III. Pension Risk Management and the Welfare of Management's Other Constituents**

Now consider the perspectives of customers, employees, and suppliers. Un less they own some stock, they are not very interested in maximizing its value. Instead, they are jointly concerned about maintaining a prolonged, stable relationship with a healthy firm.

Prospective customers want a continued source of supply of the firm's goods and services. This is especially true for firms with a lengthy expected product life. Customers count on a continuing relationship with the firm for future service. Thus, corporate risk management can be a potentially important determinant of product demand.

Employees want stable employment. Job stability may have an impact on the firm's ability to attract good people, as well as on the level of their required compensation. There are many elements of the total employee compensation package: In addition to direct compensation, these include fringe benefits, working conditions, and *job security*. There are significant transactions costs associated with changing employment, and given two identical positions—one with a volatile firm and another with a more stable firm—one would expect the required direct compensation to be smaller for the more stable firm. This keeps the *total* compensation package in balance.

The firm's suppliers also want a prolonged, stable relationship. With economies of scale in their own production, marketing, or distribution process, the expected term and stability of this relationship may affect the effort they are willing to expend in terms of service and the price they charge for their products.

All these people are interested in the firm's survival, and their welfare is enhanced by optimal risk management in the pension plan in the same way that their welfare is enhanced by insuring the main plant against fire. Moreover, their interest potentially can connect the firm's risk management activities to both costs and revenue.

## **IV. Risk Management in the Financial Sector and In the Firm's Basic Business**

The firm conducts its operations in both the real and the financial sectors of the economy. Pause and imagine the terrain—in terms of relative net present values—for different investment opportunities in these two sectors.

The real sector—where capital goods, consumption goods, and services are traded—is hardly characterized by perfect competition. Because of this, when the firm faces its array of real investment opportunities, some will be clearly more profitable than others. When picturing different investment opportunities in terms of their relative net present values, the terrain here has tall mountains and deep valleys. The consequences of selecting one production opportunity over another may go well beyond the secondary wealth transfers discussed above. If adopted, the more profitable projects of the real sector may dramatically increase the *current market value* of the firm's common stock relative to the less profitable projects. However, the most profitable projects may also be the ones which will increase the *risk* of the firm. Adopting these projects may put the firm at greater risk, but they must be adopted if the management is to benefit its stockholders. If the firm is to actively engage in risk management, it must find ways that do not significantly penalize its stock price.

The financial markets, on the other hand, are characterized by near perfect competition. These markets are relatively efficient in the sense that security prices usually reflect a reasonably fair assessment of the value of the claim being traded. The terrain here is nearly as flat as America's central plains. Aside from the secondary wealth transfers discussed above, management can select from a wide variety of investment opportunities in the financial sector without materially affecting the current value of its common stock. Thus, when trading in these markets, the firm can act to reduce the overall risk of its operations without materially affecting its stockholders.

In financing a capital investment, for example, the stock price should be relatively unaffected by a decision to finance with short-term, as opposed to long-term, debt. The *risk* of the firm is affected by this decision, however. If the investment being financed produces cash flows over a longer period of time into the future, management will reduce the risk of the firm by matching the term of the financing to the term of the cash flows produced by the investment. Financing with short-term debt exposes the firm to the risk that interest rates may be much higher when the short-term debt matures. The firm may have to refinance at an interest rate which can't be supported by the cash flows of the investment project. The firm's financial health may now be in jeopardy.

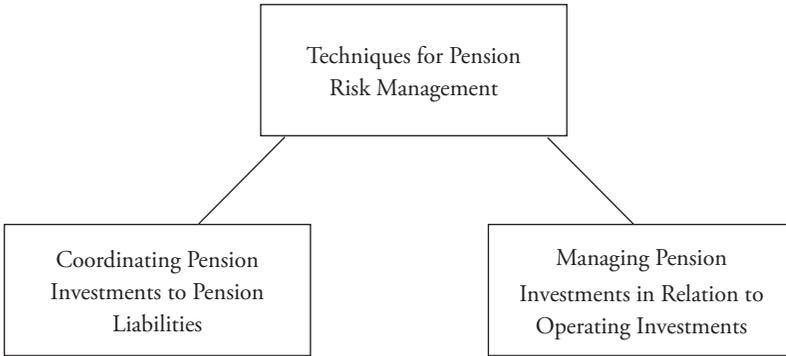
In reality, when management deals in the financial sector, it usually takes actions that are consistent with reducing risk because, although they are subject to the very same secondary wealth transfers discussed above, choices in the financial sector have little effect on the market value of its stock. Thus, if the firm has liquid funds that are to be used in the near future for short-term commitments, it usually invests these funds in the money market, matching the maturity of the investments with the timing or maturity of the commitments. When expanding inventories, it finances the expansion with short term debt instruments, and when constructing major, long-term investment projects, if it finances with debt at all, it usually finances with long-term bonds. In effect, it is seeking to coordinate the structure of its liabilities with the nature of its invested assets, much in the same way a pension fund might coordinate the structure of its investments in the financial sector with the nature of the pension liabilities.

## V. Techniques of Pension Risk Management

Figure 2 provides a basic organization for the techniques of pension risk management discussed in this article. Risk management within the pension fund may focus on (a) preserving funded status relative to some concept of the pension liability or on (b) diversifying pension investments relative to the firm's other operational investments. Setting aside contributions made by the beneficiaries themselves, pension benefits will ultimately be paid from the *returns from investments* made by the pension fund itself and from *cash contributions* to the fund made by the corporation. Strategy a focuses on enhancing the probability that pension benefits can be paid from pension assets, while strategy b attempts to increase the probability that, if the firm is called upon to increase its support for the plan, it will be in a comfortable position to do so. In essence, the first focuses on managing plan assets to maintain *funded status (surplus) relative to the pension liability*, while the second focuses on managing plan assets to maintain *funded status relative to underlying corporate strength*. Under the second strategy plan assets are

managed to reduce the probability that significant adverse developments in the firm's basic business will accompany significant increased required corporate contributions to the pension plan. Both strategies are consistent with the form and objective of the company's generalized risk management activities.

**Figure 2**



An example of type a risk management is the popular dedicated or immunized bond portfolio strategy. An example of type b risk management are investments in foreign securities by pension funds. To the extent that foreign markets and economies have low degrees of correlation with the domestic economy, increasing pension investments in foreign markets reduces the probability that deterioration in funded status and required increases in pension contributions will coincide with adversity in the firm's basic business.

The two strategies are not mutually exclusive. For example, to the extent that the firm is overfunded relative to the pension liability, the overfunded component of plan assets might be directed at the second strategy, while the remaining component might be managed to maintain and enhance its existing relationship to the liability.

## VI. Managing Funded Status Relative to the Liability

Figure 3 shows the economic balance sheet for a corporate pension fund. This balance sheet is best thought of as a component of the aggregate economic balance sheet for the firm as a whole. Pension liabilities are represented on the right-hand side of the pension balance optimal positions sheet, while the invested pension assets are on the left. The Xs denote the weights or positions in each of the investment components.

In modern portfolio analysis, weights are assigned to the various investments in the portfolio. They denote the fractions of the investor's wealth in each investment. Long positions carry positive weights and short positions, which would be represented on the right side of this balance sheet, carry negative weights.

**Figure 3** *Economic Balance Sheet for Corporate Pension Fund*

ASSETS	LIABILITIES AND SURPLUS
$X_1$ Small Stocks	$X_{n+1}$ Pension Liability
$X_2$ Large Stocks	_____
$X_3$ Corporate Bonds	Surplus
...	
...	
...	
$X_n$ Venture Capital	

Pension funds rarely sell short, but through the pension promise, they have in fact taken negative positions in their pension liabilities. Should these short positions on the *right* side be considered in the allocation of the assets on the *left*-hand side of the pension balance sheet? It seems intuitively obvious that they should. Just as modern portfolio analysis takes the character of short positions into account in determining the nature of the long positions, so should a pension fund account for the properties of its liabilities in making allocation decisions for its invested assets.

However, most pension funds, if they manage risk at all, concentrate exclusively on the risk associated with the portfolio of invested *assets*. If, instead, liabilities are to be given their due consideration, the focus shifts from one of managing the risk associated with the assets to managing the volatility of the pension *surplus*.

Relative expected return considerations aside, surplus risk is minimized by investing in assets that correlate positively with changes in the value of pension liabilities. Ignoring changes in actuarial assumptions about early retirement and mortality, the dominant factor governing changes in the value of nearly all concepts of the pension liability is interest rates. Should interest rates fall, the appropriate rate of discount used to bring future benefit payments to a present value will fall as well, increasing the present value of the liability. Since long-term bonds are interest-sensitive, they are most commonly suggested as the type of investment that will reduce the volatility of pension surplus.

Unfortunately, long-term bonds also have relatively low expected rates of return. Thus, there is a significant reduction in overall portfolio return associated with reducing surplus risk by increasing the portfolio weights in long-term bond investments.

Optimal choices in asset allocation for pension plans require a careful balancing of *expected return* and the *correlation* between pension assets and liabilities. By the power of compound interest, increasing investments in high-return equities drives down the possibility of funding shortfalls in the long run. However, the volatility of equities and their low degree of correlation with pension liabilities drives up the possibility of funding shortfalls in the short run. Increasing investment in long-term, low-return, fixed-income securities, of course, has the opposite effect.

To extend the expected life of the firm, the relative investment in both must be carefully balanced, and this balance must reflect management's relevant horizon period. For example, if the relevant horizon extends only five to ten years out, the relative investment in bonds with maturities that are comparable to pension liabilities may be increased.

In this context, risk management in the pension fund may be viewed as a dynamic process where both the relevant horizon and the optimal pension strategy may change with (a) changing economic conditions and (b) changes in the firm's operational strategy. The pension strategy that is optimal in terms of risk management is also dynamic, changing with firm prosperity and strategy.

As discussed above, in perfectly competitive financial markets focusing on the long term, short-term focus on funded status relative to liabilities *at all* should be expected to have no effect on the current market price of the firm's stock. It is still the case, however, that given their lower compound return, increasing pension investments in long-term bond investments may still mean that surplus risk may be reduced in the short run, but increased in the long run relative to stocks, as their relatively high expected returns eventually compound to larger expected terminal values.

An alternative to bond investments is to construct a stock portfolio that has a dependably high degree of interest sensitivity. As it turns out, this strategy may reduce pension risk in both the short term and the long term.

## VII. Interest-Sensitive Stock Portfolios

Table 1 shows the results of a simulation that spans the period 1974 through 1987, whereby an interest-sensitive stock portfolio is constructed from a base sample of the 400 equities with the largest market capitalization on the NYSE at the beginning of 1974.<sup>1</sup> The portfolio is reconstructed at the beginning of each year and is designed to minimize the volatility of the differences between its return and the return to a 10-year, zero-coupon bond, (which has roughly the same interest sensitivity as an Accrued Benefit Obligation (ABO) under FAS 87). The weights in the portfolio are set based on rates of return on the stocks and the 10-year, zero-coupon bond during the 2-year period *prior* to portfolio construction. The weights are allowed to drift in the course of the year as relative market values change. At the end of each year the portfolio is reconstructed, again based on returns in the trailing 2-year period. The portfolio weights are constrained to be positive, with no more than 3% in any one stock and no more than 10% in any one industry. Thus, the portfolios are not dominated by holdings in utilities and financial companies. The results reflect an assumed transactions cost of 1%, a conservative figure for an institutional trader.

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<sup>1</sup> Source: Interactive Data Corporation database. Patent applied for on portfolio construction process.

TABLE I. Results for Simulated Period 1975-1987

	Interest Sensitive Stock Portfolio	S&P 500 Stock Portfolio
Average Return	19.2%	16.3%
Correlation with 10-Year Liability	70.0%	33.0%
Return Volatility	14.0%	14.0%

Table 1 shows that the portfolio has a significantly greater degree of correlation with the 10-year “ABO liability” than does the S&P 500 index. The superior correlation is shown clearly in Figures 4 and 5, which plot the returns on the two stock portfolios against the returns to the 10-year zero coupon bond.

Interestingly, the portfolio of interest-sensitive stocks also has a higher average return than its S&P 500 counterpart. Thus, pension funds adopting such a strategy in this period could have reduced surplus volatility without lowering expected return—the result associated with increasing investments in bonds. As discussed above, as long as both bonds and stocks are selling at fair prices, this means little to the current market value of the firm’s stock. Nevertheless, increasing the compounded expected return to pension assets does have a definite bearing on the relative ability of the pension fund to meet its obligations *in the long run*.

Figure 4a. Portfolio versus Liability (Annual Returns)

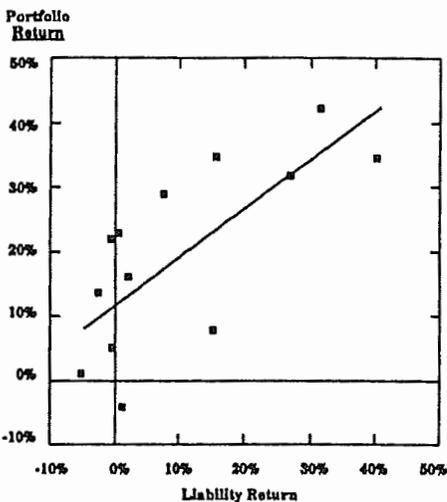
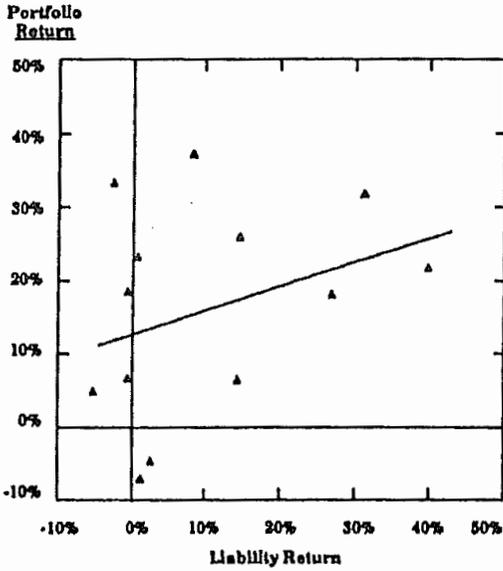
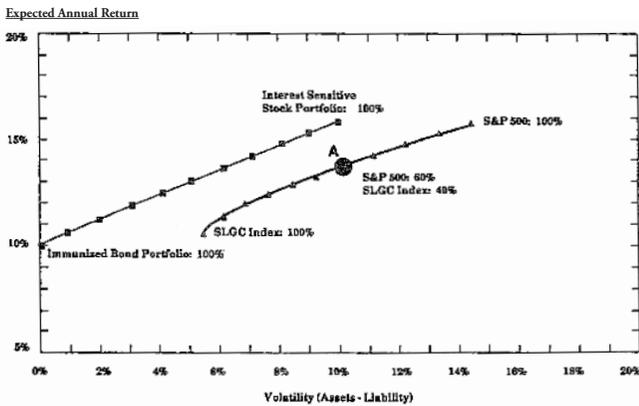


Figure 4b. S&P 500 versus Liability (Annual Returns).



The extent to which surplus risk can be reduced with interest-sensitive stock investments, both in the short run and in the long run, is considered next.

Figure 5. Efficient Frontier Comparisons



## VIII. The Effect of Shifting to Asset-Liability Management

The expected return to pension assets against expected volatility in pension surplus is plotted in Figure 5. We are focusing on sources of ABO volatility stemming from investment-related factors. Thus we do not consider changes in the ABO resulting from demographic changes in the work force, changes in early retirement experience, or changes in experienced mortality. Rather we focus on changes in the ABO present value stemming from changes in interest or discount rates. We also assume that the plan is fully funded relative to its liability. In terms of the economic balance sheet of Figure 3, this means that the weights on the left-hand side sum to 100% and the weight assigned to the pension liability is -100%. Surplus is zero.

First consider the point labeled “A”. This represents an asset allocation whereby 60% of the funds are invested in a portfolio of stocks perfectly indexed to the S&P 500 and the remaining 40% are invested in a portfolio of bonds indexed to the Shearson-Lehman Government-Corporate Index. The position of the portfolio relative to the *vertical* axis reflects an assumed expected return of 10.7% for the bonds and 16.30% for the stocks. These numbers are taken from the average rates of return to these investments during the period of the simulation discussed in the previous section, 1974 through 1987. Portfolio A’s position relative to the horizontal axis reflects the respective volatilities and correlation of the S&P and Shearson-Lehman indexes with the assumed 10-year duration pension liability, also during the period of the simulation.

The curve running through point A shows the impact of shifting away from a 60%-40% mix between the S&P 500 and the Shearson-Lehman Index. The lowermost point represents a 100% investment in the Shearson Lehman Index. The uppermost point, on the other hand, represents a 100% investment in the S&P. Other points on the curve represent intermediate positions at 10% portfolio weight increments.

Now consider the points along the straight line to the left of the curve. At the lowest extreme, we have a strategy where 100% is invested in 10-year, zero-coupon bonds—an immunized bond strategy. Since both the investment and the pension liability have precisely the same interest sensitivity, the periodic differences in their returns is always zero by assumption. The fact that the anchor point for this line is riskless accounts for its linearity. Note that the 10-year zero is assumed to have a 10% expected return, which is also its average return during the simulation period.

Now consider the other end of the line. This portfolio represents a 100% investment in interest-sensitive stocks. The portfolio is assumed to have the volatility and correlation characteristics of the interest-sensitive stock portfolio shown in Table 1, and to have the same expected return as the S&P 500. In moving from one extreme point to the other, we once again increase the investment in the interest-sensitive stocks in 10% increments.

Note that the standard 60%-40% allocation of point A is dominated by a number of the portfolios in the linear “efficient set.” In moving away from the standard allocation, the pension fund can actually increase its expected return to its assets while reducing the volatility of its surplus. Because of this the

risk of underfunding is reduced in the short run as well as the long run. The reduction in the threat of the pension fund to the survival of the firm is actually associated with an increase in expected return.

## **IX. Managing Pension Assets Relative to the Firm's Economic Strength**

Managing pension assets in relation to pension liabilities is an important factor in managing pension risk, but corporate risk must also be considered to complete the picture.

Obviously, each firm faces a unique set of potential problems in its business, so appropriate solutions to these problems will thus be peculiar to each firm as well.

To illustrate a single case, consider an aerospace company that has contracted to deliver a series of airplanes to a commercial airline corporation at a fixed price. The principle threat to the manufacturer is an inflation rate that turns out to be higher than expected during the period of the contract. This threat can be addressed by adopting investment strategies that are consistent with hedging against unexpected increases in the inflation rate with a portion of pension assets. Stock portfolios can be constructed that can be expected to outperform the market averages when the rate of inflation is above its expected value and underperform when it is below.

Now consider a different firm that is instead sensitive to swings in the business cycle. By investing in the equities of firms of quite the opposite nature, the cyclical firm can hedge against its own volatility. In this way, required increases in corporate contributions to the pension fund will be more likely to come in periods of corporate prosperity when they can be comfortably funded.

In both these applications the probability of meeting benefit obligations is enhanced by increasing the probability that the firm will be able comfortably to make additional cash contributions to the pension fund when and if they are needed.

How does managing pension assets in relation to pension liabilities *interface* with managing pension assets in relation to corporate strength? The horizontal axes of Figures 6a and 6b plot the firm's yearly minimum required contribution to its pension plan. This minimum level is unknown going into each year, being dependent on the year's investment results and actuarial experience. The minimum is determined by management, considering legal requirements as well as the economics of the funding situation. For purposes of this discussion, *management feels it imprudent to contribute less than the defined minimum, and they are willing to make sacrifices in the basic business to avoid doing so.* The vertical axes of Figures 6a and 6b plot the cash flow available for contributions after considering the firm's cash revenues and operating costs, capital expenditures and funds raised through optimal levels of external finance, as well as the costs associated with financing in place, including interest expense and the stockholder's annual dividend. This available cash flow is also unknown at the beginning of each year.

Figure 6a.

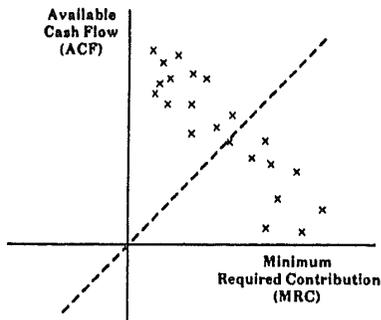
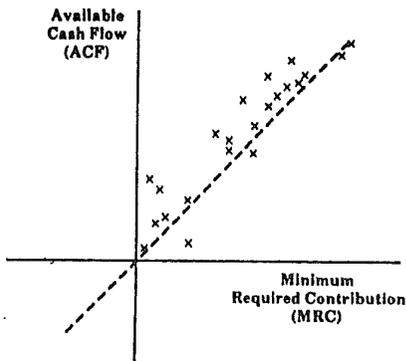


Figure 6b.



If, in a given year, management ends up in a position (denoted by an “X”) above the 45 degree broken line, available cash flow is more than adequate to meet the minimum required contribution. If, on the other hand, they find themselves below the broken line, management faces some hard choices. Either (a) the funded status of the pension plan must be allowed to deteriorate to what has been defined to be an unacceptable level, or (b) the firm must either trim capital spending, raise additional, and presumably sub optimal, amounts of money from external sources, or cut the common dividend. In short, if the firm finds itself below the broken line, the funding of the pension plan induces sub-optimal behavior in the firm’s basic business.

Each asset allocation selected by the pension fund implies an expected pattern of experience in terms of

cash required and cash available. The asset allocation represented in 6a is one where plan assets tend to produce high returns (and, thereby, reduce required contributions) when the firm is producing a relatively high level of cash flow (a domestic auto company investing pension assets in domestic auto stocks). On the other hand the asset allocation of 6b tends to produce high returns in times of corporate weakness (a domestic auto company investing in *foreign* auto stocks). Note that both allocation strategies have the same volatility of cash contribution requirements. Thus, the volatility of pension *surplus* is likely to be very similar as well.

As indicated in Figure 7a, both strategies may be on the efficient set when it is drawn in terms of the volatility of pension surplus. However, as we see in Figure 7b, where risk is defined in terms of the difference between cash available and cash required, the asset-allocation strategy B is dominant. The firm is likely to experience fewer funding problems with B, because higher minimum required contributions are more likely to come at times when the firm is better able to make them.

Viewed in this way, we can clearly see where the various components of the asset-allocation problem comes into play. Suppose first that fund managers concentrate on assets alone in making the decision. To the extent that they act to increase expected asset return, they reduce the expected minimum required contribution in Figures 6a and 6b, but, if they ignore pension liabilities and manage the volatility of asset returns, they leave the *volatility of the minimum required contribution* largely unmanaged. These pension funds are likely to take inefficient positions, even in terms of Figure 7a. If, on the other hand, liabilities are considered, efficient positions can be taken in terms of 7a, but these may still be inefficient in terms of 7b. To minimize the chance of interference in the basic business, and to maximize the expected life of the firm, pension asset returns must be simultaneously coordinated with both liability requirements as well as with corporate strength.

Figure 7a

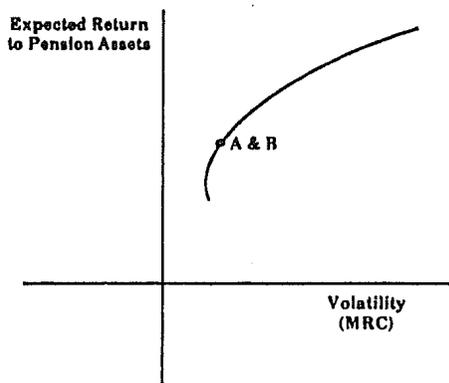
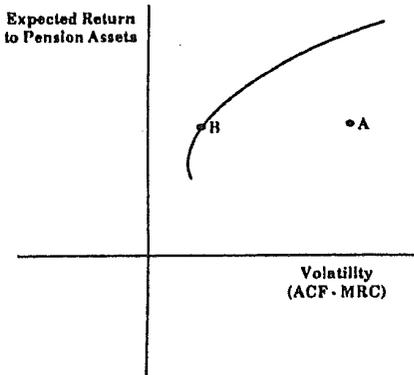


Figure 7b



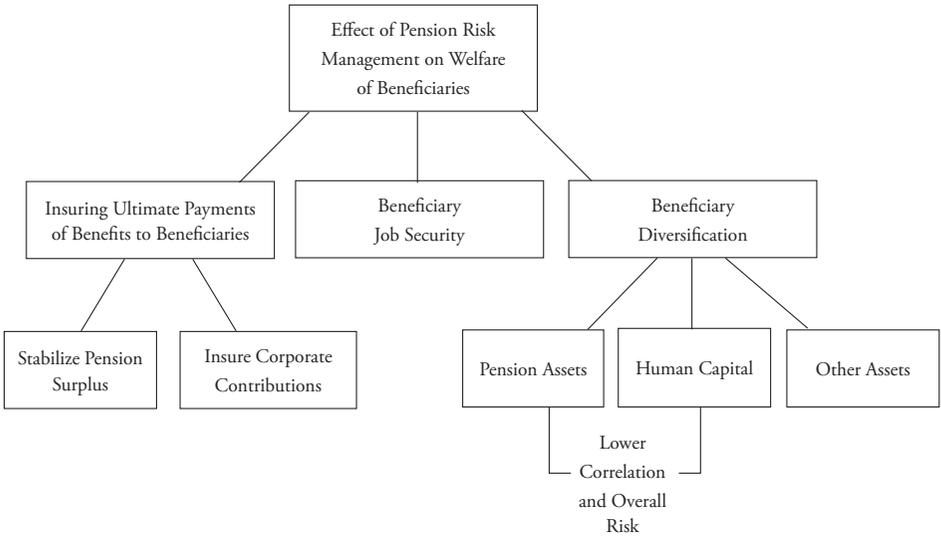
## X. The ERISA Law and Pension Risk Management

Managing pension assets to hedge against (a) unexpected changes in the value of the pension liability and (b) unexpected changes in the underlying profitability of the firm's other assets are *both* consistent with increasing the probability that pension benefits will ultimately be paid as promised. The first strategy increases the likelihood that invested pension assets themselves will be sufficient to cover promised benefits, while the second ensures that if additional corporate contributions are required, the firm will be able to meet them without difficulty. Thus, both strategies enhance the welfare of pension beneficiaries.

As Figure 8 shows, pension risk management has other implications for the welfare of beneficiaries. In addition to increasing their job security by extending the expected life of the firm, and, therefore, the expected value of future cash flows to their human capital, pension risk management also has desirable diversification benefits. We have broken the wealth of beneficiaries into three parts—pension assets, human capital (the present value of expected future earnings), and other assets or investments. Given the significant transactions costs associated with changing employment, changes in the “market value” of the beneficiaries’ human capital are likely to be positively correlated with changes in the profitability of the firm. To the extent that pension assets are managed so as to reduce their correlation with the firm’s basic business, this enhances diversification and reduces the risk associated with the beneficiaries’ overall portfolio of assets. Quite the opposite would result if the firm were instead to make pension investments in its own stock. This increases the beneficiaries’ stake in the firm, increases their risk, and

increases the risk of the firm at the same time. Such a strategy is obviously Pareto sub-optimal. We might also note that strategies of this type have, in fact, resulted in legal actions under ERISA.<sup>2</sup>

**Figure 8**



## XI. Summary

Pension assets have grown to become the most significant component of the economic balance sheet for many firms. They constitute a potentially powerful tool for reducing the overall risk associated with corporate operations and extending the expected life of the firm. Because most pension investments are priced in the highly competitive financial sector of the economy, this extension can be accomplished without material effect on the firm's stock price. However, the welfare of management's other significant constituents, including the pension beneficiaries, can be significantly enhanced by pension risk management.

## Reference

Arnott, Robert, and Peter L. Bernstein, "The Right Way to Manage Your Pension Fund," *Harvard Business Review* (January-February 1988).

*Editor's Note: Reprinted with permission from Managing Institutional Assets, edited by Frank J. Fabozzi, 1990, HarperCollins.*

<sup>2</sup> Section 407 of ERISA states that no company should invest more than 10% of plan assets in qualified employer securities.

Comments on

## “Pension Investing and Corporate Risk Management”

by Charlie Cahill

Today many pension consulting actuaries and investment consultants incorporate corporate risk management concepts when they advise their clients on the management of their pension plans and the plans' assets. It is safe to say that in 1990, when Robert Haugen, Ph.D., issued his article “Pension Investing and Corporate Risk Management,” these concepts were rarely incorporated in the advice given or the investment policies adopted by plan sponsors. Hindsight being 20/20, we know today that if plan sponsors and their advisers had reflected risk management techniques in managing their plans over the last 23 years, the security of those sponsors and their plans would have been stronger.

Haugen clearly lays out the basic concepts of corporate risk management, how those concepts can be applied to pension plans, and why it is important to sponsors to apply them. To quote Haugen, “Since the corporation ultimately stands behind pension liabilities, risk management within a pension plan can now play a meaningful role in the firm's overall risk management.”

The world has changed in many ways since 1990. Haugen bemoans that pension plan liabilities warrant only a mere footnote on financial disclosures on corporate balance sheets, pointing out that General Motors' assets were twice the size of its market value—oh the irony! The interest rate environment has certainly changed since the paper was authored as the author uses 10 percent as the proxy for the risk-free rate of return, as that had been the average rate on 10-year Treasuries for the prior decade. Today rates are much lower and most advocates of “financial economics” would use a spot rate for such calculations. However, while disclosure requirements have significantly increased and interest rates are much lower (and maybe somewhat less risky), the concepts and principles discussed in this paper remain important to actuaries and plan sponsors in today's world.

### Overview of the Paper

Haugen's paper is organized into 10 sections, essentially flipping between broader corporate risk management topics and then applying the concepts to pension plans. The paper focuses on the asset side of pension plans rather than on “risk management” from a liability perspective (e.g., plan design—final average vs. career average vs. hybrid designs, lump sum and annuity settlements ...).

Haugen states that corporations have a “long standing tradition of risk management.” (Section I—Corporate Risk Management). What was a tradition in 1990 has become institutionalized in many, if not most, corporations, which have now have added chief risk officers to the “C” suite. Corporations “avoid interest-rate risks by matching up the term of debt financing with the expected life of the projects being financed.” For example, short-term financing is used to increase inventory and long-term

financing is used for longer-term projects (e.g., building a plant). Further, corporations hedge against unpredictable events that will impact their business like foreign exchange rates and commodity prices.

While risk management does not theoretically change the value of the corporation (owners/stockholders can theoretically mitigate the risks on their own), corporations are compelled to take such interest to protect the interests of their customers, suppliers and employees (Section III ...the Welfare of Managements Constituents). These stakeholders are counting on the survival of the company and the company relies on these stakeholders; customers want a continual source of supply, employees want stable, attractive employment, and suppliers want long-term stable relations. Strong risk management increases a company's stability and the probability of survival, and therefore benefits these stakeholders.

On the pension side (Section II—Corporate Risk Management Within the Pension Plan), while allocating assets to lower risk has no impact on shareholders (the market value of a bond equals the market value of a stock), it does impact the other stakeholders as they can shift their investments in their personal accounts based on the asset allocation of the plan. Of course, this is theoretical and ignores different tax treatments, and assumes the shareholders have full transparency/awareness of the pension plan's asset allocation. Haugen points out that a "secondary wealth transfer" between shareholders and employees occurs by increasing asset allocation to equities rather than bonds. The equities have a higher expected return because they also have higher risk. For employees this means a higher probability of default on their pension promise, and therefore the promise has less value. Employees countervail this effect by demanding higher benefits or higher wages. Haugen again predicted the behavior found too often in the '90s—sponsors took on more risk and employees demanded higher benefits. When markets and rates turned we know what happened.

Haugen points out that the Pension Benefit Guaranty Corporation (PBGC) promise mitigates this "secondary wealth transfer." Consistent with the nature of PBGC coverage we now find bigger problems with Taft-Hartley plans that have lower PBGC coverage and higher premiums (MAP-21) for single employer plans that have better PBGC coverage.

Haugen discusses the difference in the risks companies face in the financial sector versus the "real" sector where the company operates (Section IV—Risk Management in the Financial Sector and In the Firm's Basic Business). The basic conclusion is that companies should take their risks in the "real" sector where they do business and those risks can lead to increasing the market value of the company. In the financial markets where investments do not impact the market value of the company, actions should be of lower risk.

Pension fund risk management (Section V—Techniques of Pension Risk Management) focuses on two aspects: 1) preserving funded status; and 2) "diversifying investments relative to the firm's other operational investments." The first focuses on the probability that benefits will be paid by assets and the second on the probability that the company can contribute when required. Haugen uses immunized portfolios (what have now evolved into liability-driven investment (LDI)) as an example of the first aspect. He uses investing in foreign securities as an example of a technique to address the second aspect due to the low correlation with domestic equities. In the last 23 years the world economy has become

much more integrated and highly correlated, so this approach is not as helpful. However, looking at a company's ability to make contributions when times are tough is certainly an important aspect to pension fund management.

In Section VI—Managing Pension Fund Status Relative to the Liability, Haugen adroitly discusses the nature of these risks. He points out that through the pension promise sponsors have taken a negative position in their pension liabilities. The character of this negative position should be reflected in the pension investments. In 1990—almost 20 years before the current interest in LDI—Haugen wrote, “Surplus risk is minimized by investing in assets that correlate positively with changes in the value of pension liabilities.” He discusses optimizing asset allocation by balancing expected return and correlation between assets and employing a dynamic process that reflects time horizon, economic conditions and the company's operational strategy.

Haugen discusses the merits of “interest sensitive stock portfolios” in Section VII—a technique that I do not believe was widely adopted and probably had more merit at the time retrospectively than it turned out to have prospectively.

In Section VII—The Effect of Shifting to Asset-Liability Management, Haugen analyzes the merits of this approach at a basic level and relying on the thinking of Section VII. The tools and analysis used today are much more sophisticated.

In Section IX—Managing Pension Assets Relative to the Firm's Economic Strength, Haugen incorporates the importance of corporate risk considerations in managing pension assets. He illustrates this by highlighting the risks of pension funding requirements for corporations that are inflation or interest rate sensitive. These companies need to hedge these risks as the pension cash calls are likely to occur at the same time the corporation is experiencing business strain. Haugen illustrates the difference in the timing of cash requirements for pension investments that match and do not match these risks. Haugen concludes: “To minimize the chance of interference in the basic business and to maximize the expected life of the firm, pension asset returns must be simultaneously coordinated with both liability requirements as well as with corporate strength.” This is certainly a worthy goal.

In Section X—The ERISA Law and Pension Risk Management, Haugen points out that inappropriately risky pension strategies can result “in legal actions under ERISA.”

## Conclusion

Professor Haugen passed away this year. We are thankful for the contribution to the pension industry made by this article. If plan sponsors and their advisers had better understood the concepts discussed in this paper in 1990, plans would have been better served. Pension risks are better understood and managed today due to the thinking and analysis presented in this paper.

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## Response to Comments by Charlie Cahill

By Aaron Weindling

This space would ordinarily have been reserved for Dr. Robert Haugen's response to Charlie Cahill's review of his paper. Because Haugen has recently passed away, I was asked by the SOA Pension Section Council to provide brief comments.

I became an actuary shortly after this paper was published, but I did not become familiar with the concepts described in the paper until much later. I suspect that those embarking on actuarial careers today will be exposed to these ideas earlier in their careers. As Cahill noted, many of these concepts have in some form become accepted principles of pension plan management.

Reading the article felt like reading an insightful, decades-old science fiction novel that predicts the present day. Some concepts that may have seemed unlikely at the time have now been validated. Others, as Cahill describes with regard to the "interest sensitive stock portfolio" concept, did not gain traction. Still other ideas were addressed differently by Haugen than they might be in today's literature, but are similar in essence.

The last decades were marked by dramatic capital market events, both positive and adverse. The impact of this volatility contributed to the recognition that risk management for pension plans was important, but this idea had been less generally accepted at the time of this paper's publication. Which thoughts of today—published and available, but viewed as only theoretical—will be confirmed by upcoming experience? What do actuaries overlook now that will seem obvious in retrospect?

The primary benefit that I gained from revisiting Haugen's paper was not technical; it was reinforcement of how important it is to stay abreast of the state of actuarial art, which would in 1990 have included this paper. It is interesting to consider what might be said about our profession 25 years from now, roughly the same time as has elapsed since Haugen's paper was written. I hope that discussion will celebrate theoretical advances, practical application of new ideas, and favorable results for plan sponsors and participants. An ongoing commitment to learning is an important step toward making that happen.

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