Commentary

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The recent failures of several very large corporations with severely underfunded pension plans (e.g., United Airlines, U.S. Airways, and Bethlehem Steel) have made the risk exposure of the Pension Benefit Guaranty Corporation (PBGC), the government agency that insures defined-benefit plans, front page news. Further, the prospect that other large corporations are likely to follow has motivated legislators to introduce several new proposals aimed at limiting the PBGC's risk exposure. In his paper, Bodie (2006) reminds us of the straightforward but often ignored fact that much of the risk to the PBGC could be avoided if limits were imposed on the share of pension assets invested in stocks and other risky assets. Presumably, the lack of interest by Congress in imposing such restrictions is due to very strong resistance from the business community. The fundamental question, then, is why do managers believe that it is imperative to invest pension assets predominantly in stocks, despite the volatility in funding requirements that they have experienced following this strategy?

In these comments I will focus on two broad questions raised by Bodie's analysis: First, what are the main drivers of the PBGC's risk exposure? Second, why do pension managers choose to invest pension assets the way they do and when should the optimal hedge portfolio contain some stocks?

THE PBGC'S RISK EXPOSURE

The PBGC assumes responsibility for a plan's defined-benefit pension obligations when two conditions are simultaneously met: the sponsoring firm is financially distressed and the pension plan is sufficiently underfunded. As such, PBGC insurance is a compound put option held by defined-benefit plan sponsors, and PBGC liabilities can be valued using options pricing methods. Recently, Wendy Kiska and Marvin Phaup of the Congressional Budget Office (CBO) and I have developed an options-pricing model to quantify the PBGC's prospective net costs and to serve as a tool to evaluate the effect of various policy alternatives. The results described here are drawn from that CBO (2005) analysis.

To briefly describe the model, it employs a Monte Carlo simulation that takes into account the evolution of firm assets, firm liabilities, pension assets, and pension liabilities and their interaction with program rules. For simplicity, firm and pension assets are assumed to be stochastic, whereas firm and pension liabilities are taken to be deterministic. Both firm and pension assets are affected by correlated market risk, and taking into account this risk adds significantly to the estimated value of the put option. The model is calibrated using 2004 data covering the top 1,179 companies with defined-benefit pension plans.

Although reported underfunding in 2004 totaled $450 billion, the forward-looking estimate of the PBGC's net cost is only a fraction of this. Over a 10-year horizon, we project a net cost of

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about $63 billion; and this increases to $119 billion over a 20-year horizon. The forward-looking cost is much lower than the amount of contemporaneous underfunding because, for any company, the probability of the joint occurrence of bankruptcy and underfunding is much lower than the probability that the pension plan is underfunded at a point in time. That is, as long as a firm remains solvent, it gradually must close any funding gap that arises, although shocks to pension assets and liabilities will continue to generate new episodes of underfunding.

The model is useful for quantifying the savings that might be realized from Bodie's suggestion of limiting the share of pension fund assets invested in stocks. In the base-case analysis, stocks are set to the typical 70 percent share of each company's asset portfolio. Limiting the stock share to 30 percent saves $9.9 billion of the $63 billion in forward-looking net costs. There are several reasons why this cap on stock holdings reduces but does not eliminate the forward-looking cost.

One reason that the PBGC remains at risk in this experiment is that stocks still comprise 30 percent of pension investments, so there is still an assumed mismatch between the risk of assets and liabilities. More importantly, however, when the PBGC takes over a pension plan, there is typically a jump-up in pension liabilities that averages 20 percent. For example, U.S. Air reported that it was 90 percent funded in the year prior to termination but was found to be only 45 percent funded at termination. "Termination liabilities" are systematically higher than "current liabilities" (the basis for funding requirements) because of factors such as the triggering of early-retirement benefits and the propensity of distressed companies to stop making contributions to their pension plans. This implies that even a fully funded plan can generate substantial costs if the sponsor becomes distressed. How regulation should deal with this phenomenon is not obvious. Forcing all firms to fund to the level of termination liabilities instead of current liabilities would result in systematic overfunding and would further discourage healthy firms from staying in the system.

Basing funding requirements on current liabilities rather than on the systematically higher termination liabilities is one example of how underestimating liabilities increases costs to the PBGC. Liabilities also will be systematically underestimated if regulators allow firms to use too high a discount rate. This puts the PBGC at risk because it makes the target for full funding too low and reduces average funding levels. For example, the model implies that making permanent the higher discount rate that has been in effect for the past few years would add $8.1 billion to net costs over a 10-year horizon, under the assumption that the original, risk-free discount rate is the correct rate. Again, though, forcing firms to value liabilities too conservatively can place an unfair burden on pension providers.

As Bodie mentions, there is considerably more interest in raising premiums or making them more sensitive to risk than in limiting investment risk. However, the premium increases being contemplated are far below the level the model suggests are actuarially fair. Abstracting from behavioral responses, the model generates a fair premium multiple of 6.5 times the current premium rate, whereas the leading proposal calls for an increase that is only 2.1 times the current rate. Potentially, plan managers' incentives for controlling risk could be improved by implementing risk-based premiums; but again it is unlikely that it is politically feasible to create fair differentials between low- and high-risk firms. For example, the model implies that a fair premium for below-investment-grade firms would have to be 18.5 times higher than it is at present to match the current cost to the PBGC for investment-grade firms. These kinds of estimates, both because of their magnitude and because they impose very high costs on firms that are the most distressed, suggest that, although incremental improvements could be made through premium reform, controlling the risk of the system through the premium structure is not feasible.

Bodie draws an analogy to the Savings and Loan (S&L) Crisis, where the mismatch in the market sensitivity of assets and liabilities created predictably huge losses when interest rates moved sharply higher. Also, as for the S&Ls, it is likely that regulatory forbearance will exacerbate the problems of the PBGC, this time because of the reluctance of Congress to force struggling companies to devote scarce capital to funding their pension plans.

The propensity of S&Ls to take on excessive risk is often attributed to the incentives created by deposit insurance—the "down-side risk" is partially absorbed by the government. An important and unresolved question is whether PBGC insurance is an important reason why plan sponsors prefer to invest in stocks. Although many observers assume this to be the case, the CBO's analysis suggests that, at least for healthy companies, the value of the insurance put option is very small and that those companies' plan managers should largely internalize the investment risk. Consistent with this view, Rauh (2006) finds no evidence that higher-risk companies gamble more with pension plan assets than do lower-risk companies.

Why, then, do even healthy companies choose to invest such a high proportion of pension assets in stocks? Bodie argues that managers are misled by the fallacy that stocks always outperform bonds in the long run and so mistakenly believe that their strategy is less risky than it is. Although this is quite possibly a contributing factor for many managers, in the remainder of this discussion I will consider a rational alternative—that there is a role for stocks in hedging future pension liabilities because some liabilities behave more like stocks than like bonds.

WHAT SHOULD THE HEDGE PORTFOLIO LOOK LIKE?

Under Bodie's assumption that future pension obligations are fixed nominal quantities, it is clear that nominal bonds provide a perfect hedge. In the example of a pension liability of $1,000 that comes due in 10 years, putting away the present value of $\$1000/(1+r)^{10}$ in risk-free bonds ensures that the payoff will match the liability.

In practice, defined-benefit pensions typically link the level of the retirement annuity to a worker's years of service and to wage earnings in the final year (or years) of service. This means that the future benefit is a random variable and that the best hedge portfolio is maximally correlated with what wage earnings, and hence the benefit, will turn out to be. For example, the benefit for a worker expected to retire in 10 years might be 40 percent of wage earnings in 10 years. If the correct object to hedge is this broadly defined liability (i.e., the broadly defined PBO [pension benefit obligation] rather than the ABO [accrued benefit obligation]), then the best hedge is to invest an amount equal to the present value of the liability in a portfolio maximally correlated with earnings in 10 years.

This line of reasoning implies that if wage earnings and stock returns are correlated and if the broadly defined pension obligation is the right measure of the liability to hedge, then the optimal hedge portfolio will contain stocks as well as bonds. Intuitively, it seems likely that wages and stock returns should be correlated over long horizons. Black (1989) suggested this as a reason for pension funds to hold stocks, but he did not quantify the effect.

When wage earnings and stocks are correlated, the value of the pension liability can be modeled as a derivative on the stock market. Such a model can also be solved for the time-varying share of stock in the optimal hedge portfolio. An illustrative example of this is given here (see Lucas and Zeldes, 2006, for a much more complete analysis).

The model proposed for the joint process for stocks, human capital, and wage earnings is consistent with the near-zero correlation between wage earnings growth and stock returns observed at a 1-year horizon and also with the hypothesis that there is a higher correlation over longer periods. The model, as parameterized in Table A1, produces a correlation of 0.11 between wage earnings growth and stock returns over three years and 0.36 over five years.

Specifically, I assume that the aggregate value of stock, S, evolves according to

$$S_{t+h} = S_t \exp\Big((r_s - div - 0.5\sigma_s^2)h + \sigma_s \sqrt{h}(dz_s)\Big),$$

where dz_s is a draw from a standard normal distribution, the expected return on stocks is r_s, the dividend yield is div, and the standard deviation of stock returns is σ_s. The time step is h, taken in the calibrations to be one year.

Table 1

Simulation Results

Initial wage replacement rate	0.6	0.5	0.3	0
Years to retirement	**5**	**10**	**20**	**35**
Present value using correct risk adjustment	0.218	0.179	0.109	0.040
Present value discounting at the risk-free rate	0.220	0.189	0.138	0.074
Present value discounting at the average stock return	0.189	0.140	0.076	0.026
Initial share in stocks to get the average discount rate	0.063	0.195	0.389	0.589
Share of cohort making it to 65 with the firm	0.766	0.5948	0.371	0.1694

The aggregate value of human capital, H, evolves according to

$$H_{t+h} = H_t \exp\left((\alpha - 0.5\sigma_w^2)h + \sigma_w \sqrt{h}(dz_w)\right) + \gamma h\left(T^* - \frac{H_t}{S_t}\right)S_t - W_t,$$

where dz_w is (idiosyncratic) risk and α is the average drift. Human capital slowly adjusts toward the long-run human capital to stock ratio, T^*, at an annual rate of γ. The stock of human capital is reduced by earnings at time t, W_t, which is analogous to a dividend. Finally, wage earnings evolve according to

$$W_{t+h} = W_t + \beta(hr_w H_t - W_t),$$

where next-period earnings equals current earnings plus a term that pulls earnings toward a target fraction of current human capital, r_w, at an annual rate of β.

With regard to pension benefits, the benefit is assumed to increase with service years at a rate of 2 percent per year. The lifetime annuity at retirement is based on wage earnings in the year of separation or retirement, times service years, times the 2 percent. Separation is stochastic, as is mortality. All parameters are reported in Table A1.

The results of the analysis are reported in Table 1. The table shows the implied present value of pension liabilities as a function of remaining years to retirement, under various assumptions about the discount rate for liabilities. Specifically, liabilities are discounted at the risk-free rate, the average assumed stock return, and using the derivative pricing implied by the model (and, hence, at the correct rate). The assumption that the correlation between wage earnings and stock returns increases over time suggests that for young workers the liability is more like a stock than a bond. For instance, for a worker with 20 years to retirement, the correct discount rate would have a 39 percent weighting on stocks and a 61 percent weighting on bonds. Wrongly assuming that the liability is like a bond and discounting at the risk-free rate overstates its value by more than 30 percent. Lucas and Zeldes (2006) show that the corresponding optimal hedge portfolio is more heavily skewed toward stocks for active workers than suggested by the discount-factor weights because of the dynamic nature of the portfolio.

CONCLUSIONS

The bottom line of this analysis is that there is a role for stocks in the investment portfolios of defined-benefit pension plans. The optimal share of pension assets invested in stocks increases with employment horizon and changes over time with the demographics of a firm's workforce. When workers separate from the firm, their benefits become bond-like and any stocks invested on their behalf should be reallocated to bonds. Bonds also are the natural hedge for firms whose obligations are predominantly to retired workers and their dependents. Firms with mostly young workers, however, have a legitimate reason to prefer to hold at least a portion of their investments in the stock market.

I conclude from this analysis that a blanket prohibition on stock investments in defined-benefit pension plans would be inappropriate and for some firms it could actually increase risk. Nevertheless, further analysis (Lucas and Zeldes, 2006) suggests that the typical firm holds far more in stocks than can be justified by this hedging demand. We argue there that Financial Accounting Standards Board rules for how pensions are accounted for in earnings may provide a strong incentive to overinvest in stocks, a point Bodie briefly alludes to also in his paper.

Finally, any policy that seriously addresses the PBGC funding gap will likely accelerate the switch from defined-benefit to defined-contribution pensions. Hence, the costs of PBGC insurance must be considered in the broader context of the goals of an employer-based retirement savings system.

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APPENDIX

Table A1

Parameter Values for Simulations

Dividend yield	0.02
Standard deviation of stock return	0.18
Standard deviation of idiosyncratic wage return	0.02
Standard deviation of idiosyncratic own-firm return	0.2
Mean growth of human capital	0.02
Speed of reversion to target	0.1
Speed of reversion in wages	0.5
Target human to physical capital	2
Risk-free rate	0.02
Inputs to defined-benefit pension	
Initial replacement rate	Various
Years of earnings	Various
Separation and mortality	
Mortality rate ≤ age 65	0.003
Mortality rate > age 65	0.05
Separation rate x < age 35	0.06
Separation rate age 34 < x < age 46	0.045
Separation rate age 45 < x < age 56	0.04