What the Pension Benefit Guaranty Corporation Can Learn from the Federal Savings and Loan Insurance Corporation*

Zvi Bodie

ABSTRACT

This paper attempts to draw attention to some important lessons that the Pension Benefit Guaranty Corporation (PBGC) can learn from the experience of the Federal Savings and Loan Insurance Corporation (FSLIC). FSLIC was the government agency that insured deposits at savings and loan associations until it was replaced in 1989 leaving a massive deficit to be financed by taxpayers. Like FSLIC, the PBGC is a government agency that guarantees a form of private corporate debt. As guarantor of the pension benefits promised by private plan sponsors, the PBGC bears the risk of a shortfall between the value of insured benefits and the assets securing those benefits.

There has been a significant change in the attitude and behavior of senior public officials and legislators as a result of the S&L debacle. Directors of the PBGC and Secretaries of Labor to whom they report have pointed out the weaknesses of some of the pension funds that the PBGC insures and have pursued an active legislative agenda designed to reduce the PBGC's vulnerability to those weaknesses. Those efforts have resulted in a series of laws and amendments to laws that have significantly improved the U.S. pension guarantee system.

But the magnitude of the PBGC's exposure to shortfall risk depends on three factors:

- the financial strength of plan sponsors,
- the degree of underfunding of insured benefits,
- the mismatch between the market-risk exposure of insured benefits (a form of long-term corporate debt) and the market-risk exposure of the assets securing that debt.

Only the first two of these have been addressed by past legislative reforms. The third factor appears not to be well understood. It is apparently a widespread belief among policymakers that a well-diversified pension portfolio of equity securities provides an effective long-run hedge against liabilities of defined-benefit pension plans, so that there is no mismatch problem. This belief is mistaken.

Equities are not a hedge against fixed-income liabilities even in the long run. Thus, even if the PBGC achieves the goal of full funding at one point in time, the mismatch between the market-risk exposure of the pension benefits it insures and the pension assets backing them creates the potential for large shortfall losses in the future as the economy and capital market rates change in unpredictable ways. Therein lies an uncomfortable parallel with the S&L debacle.

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" One would have to be an ostrich with its head buried in the sand to ignore the warnings and not learn from the analogy of the savings and loan crisis."

Lynn Martin
Former Secretary of Labor and Chairman of the Board
PBGC's 1992 *Annual Report*

1. Introduction

This paper examines some parallels between the United States government system for guaranteeing pension benefits and the failed system for insuring savings and loan associations (S&Ls). The government agency that insures private defined-benefit pension plans was created in 1974 and is called the Pension Benefit Guaranty Corporation (PBGC); the agency that insured the S&Ls until it was replaced in 1989 was called the Federal Savings and Loan Insurance Corporation (FSLIC). Although there are important differences between the circumstances faced by the PBGC and FSLIC, there are also some important similarities. The similarities stem from the fact that like FSLIC, the PBGC is a government agency that guarantees a form of private liability--deposits in the case of FSLIC and pension benefits in the case of the PBGC.

Functionally, guarantees are insurance policies that oblige the guarantor to make the promised payment if the insured institution fails to do so.[2] The economic loss to the guarantor is equal to the difference between the promised payment and the price received from the sale of the assets that are available from the insured institution as collateral for this obligation. This difference is called the "shortfall." All assets of the liability issuer that the guarantor has recourse to seize will be called "collateral" assets, even if they are not formally pledged and segregated. For the guarantee activity to be sustainable without recourse to subsidies from other sources, premiums charged for the guarantees must be large enough to cover both actuarial loss experience and operating costs.

The basic methods that any guarantor (whether private-sector or government) has to manage its business on a sound basis are:

- *Funding Restrictions:* Set standards for the full funding of promised benefits (i.e., "capital adequacy," and act swiftly to limit losses when these funding standards are violated (i.e., avoid "forbearance").
- *Matching Restrictions:* Require the insured entity to hedge its insured liabilities by matching the market-risk exposure of its assets to its insured liabilities.
- *Pricing:* Set a premium schedule for the guarantee commensurate with the guarantor's exposure to the risk of a shortfall.
- *Transparency:* Require disclosure of information about the insured institution's assets and liabilities in a format that is relevant to evaluating the guarantor's exposure to shortfall risk.

[1]The author gratefully acknowledges the helpful comments of Peter Diamond, Robert A. Eisenbeis, Samuel L. Hayes III, Ed Kane, Scott Mason, Robert C. Merton, and Catherine Shavell.

[2]Some use the term "bonding contracts" rather than "insurance contracts" to describe guarantees. See Kane (1993a).

The methods substitute for each other in varying degrees; hence, there is room for tradeoffs among them. With all methods, the guarantor must monitor the market values of the insured liabilities and the assets securing them on a regular basis. The frequency of audits is a parameter to be set in determining the optimal tradeoff among methods.[3]

Past reform legislation has relied heavily on the first of the these methods of guarantee management to correct the PBGC's actuarial deficit. However, even if the PBGC achieves the goal of full funding at one point in time, the mismatch between the market-risk exposure of the pension benefits it insures and the assets backing those promised benefits creates the potential for large future losses as the economy and capital market rates change in unpredictable ways. Therein lies an uncomfortable parallel with the FSLIC situation in the 1970s and 1980s.

There appears to be a belief among policymakers at the PBGC that a well-diversified portfolio of equity securities provides an effective long-run hedge against the liabilities of defined-benefit pension plans, so that there is no mismatch problem. Indeed, the PBGC seems to have decided in 1994 that it should invest significantly more of its own portfolio in equities in the belief that this would lower its overall risk exposure.[4] An important goal of this paper is to demonstrate that this belief is mistaken. Equities are not a hedge against fixed-income liabilities even in the long run. Exactly the opposite is the case: When a pension plan sponsor invests the pension assets in equities, the actuarial present value cost to the PBGC of providing a guarantee against a shortfall *increases* rather than decreases with the length of the time horizon, even for plans that start out fully funded.

Some observers point out that the private defined-benefit pension system as a whole is well funded.[5] They argue that therefore taxpayers need not worry about having to bail out the PBGC, at least not in the short run. The implication is that the PBGC can increase its premiums on well-funded plans of healthy plan sponsors to pay for the losses incurred on underfunded plans of financially weak

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[3]For an extensive discussion of the methods of managing guarantees, see Merton and Bodie (1992).

[4]The PBGC's *1994 Annual Report*, for example, contains the following statement of investment policy on page 21:
"With the approval of the Board of Directors, PBGC implemented a strategic change in its investment program to maximize long-term investment return within acceptable levels of risk...
Under the new strategy, PBGC increased its equity investment level from 17 percent at the beginning of the fiscal year to approximately 30 percent at fiscal yearend.... This diversification in the overall portfolio protected PBGC's assets and reduced potential investment losses in 1994."

[5]See Employee Benefits Research Institute (1992).

sponsors that default. However, it is doubtful that sponsors of well-funded plans will voluntarily tolerate being "taxed" through high actuarially unfair premiums to bail out underfunded plans of financially weak sponsors. The defined benefit system thus is vulnerable to a "stampede" that is analogous to a bank run, in which the depositors rush to withdraw their deposits before everyone else does. The result of such a stampede is that due to adverse selection, only sick and undercharged firms will be left in the insurance pool.

The possible "doomsday" scenario for the defined-benefit pension system would be an event such as a sharp and prolonged drop in stock prices that causes a sharp decline in the market value of pension asset portfolios. Underfunding becomes much more prevalent. Several major defaults of underfunded pension plans lead the PBGC to significantly raise premiums on the remaining plans in the system. Expectations of even higher premiums in the future lead sponsors of the well-funded plans to terminate their defined-benefit plans to avoid the PBGC "tax." They buy annuities to settle all benefits accrued under the terminated plans and replace them with generous defined-contribution plans, thus avoiding criticism from their employees or from the public. Ultimately, the United States could be left only with bankrupt defined-benefit plans with the benefits financed directly by tax-payers.

This doomsday scenario for the PBGC is not inevitable, just as the S&L debacle was not inevitable. In the environment of stable interest rates that prevailed throughout the 1950s and 1960s, everyone viewed S&Ls as very safe institutions. The problems began in the 1970s when interest rates became high and volatile. Even S&Ls that held well-diversified portfolios of mortgages became insolvent in the environment of rising interest rates of the 1970s because the mortgages were long-term and fixed-rate while their deposit liabilities were short-term and rolled over at increasingly higher market rates. Still more S&Ls became insolvent in the late 1980s because the real estate market collapsed. Thus *both* of the market risks to which S&Ls were exposed C interest rate risk and real-estate risk C took their toll. The biggest losses to FSLIC were incurred not as a result of fraud or even of poorly diversified asset portfolios, but rather as a result of failure on the part of regulators to act quickly to stem the losses resulting from the asset-liability mismatch.[6]

In the case of the PBGC, the nature of the liabilities of private defined-benefit pension plans is very different from the short-term deposit liabilities that were insured by FSLIC. Therefore, the type of assets which match those liabilities is different. The similarity is that in both cases, there is a mismatch between the market-risk exposures of the assets and liabilities that exposes the government guarantor to substantial shortfall risk.

To understand the nature of the PBGC's exposure, consider the market-risk exposures of pension liabilities and assets. The pension benefits that are currently guaranteed by the PBGC are level-payment annuities fixed in dollar amount, and their present value is extremely sensitive to changes in long-term interest rates. At the same time, defined-benefit pension fund assets are heavily invested in equity securities.[7] Consider the PBGC's situation if there were a large decline in the value of common

[6]There is an extensive literature about the S&L crisis. See, for example, Barth and Brumbaugh (1992), Benston, Carhill, and Olasov (1991), Benston and Kaufman (1990), Kane (1989), Mayer (1990), National Commission on Financial Institution Reform, Recovery, and Enforcement (1993), and White (1991) for detailed descriptions.

[7]According to the Employee Benefits Research Institute (1993), private trusteed defined-benefit plans had 42% of their assets in equity securities at the end of 1993.

stocks, a drop in long-term interest rates, or both. As history has shown, any of these is a plausible economic scenario, and in any of them the PBGC's deficit could grow rather quickly.

It is not inevitable that the PBGC will face a crisis. The stock market may not decline, and long-term interest rates may not fall. The point, however, is that it could happen, and as an insurer the PBGC must plan for such contingencies.

As evidenced by the quote that opens this paper, there has been a significant change in the attitude of senior public officials as a result of the S&L debacle. Regulatory vigilance seems more likely in the current political environment. Directors of the PBGC and Secretaries of Labor to whom they report have consistently pointed out the weaknesses of some of the pension funds that they insure and have pursued an active legislative agenda designed to reduce the PBGC's vulnerability to those weaknesses. Those efforts have resulted in a series of laws and amendments to laws that have significantly improved the U.S. pension guarantee system.[8] Nonetheless, if government officials are unaware of a major risk and are subsequently confronted with its financial consequences, there may be a temptation to delay acknowledging their error publicly as long as possible. Many S&Ls were economically insolvent long before they were shut down, and as a consequence the loss to taxpayers was much greater than it should have been.[9]

The paper is organized as follows. Section 2 examines the reasons for government involvement in providing insurance of private pension plans. Section 3 discusses the nature of the PBGC's exposure to shortfall risk and attempts to show the fallacy of thinking that equity securities provide a long-run hedge against defined-benefit pension liabilities. It does this by using option pricing theory to demonstrate that the cost of providing a shortfall guarantee for a fully funded pension plan that invests in equities *increases* rather than decreases with the maturity of the pension obligation. Section 4 explores the PBGC's policy alternatives for dealing with the risk that arises from a mismatch between insured pension liabilities and the assets securing them. Finally Section 5 summarizes the paper and draws some conclusions.

2. The Role of Pension Guarantees[10]

An analysis of the issues facing the Pension Benefit Guaranty Corporation should begin with an understanding of its economic function. The primary objective of the PBGC is to enhance the retirement-income security of Americans. An often-used metaphor for describing the retirement-income system in the United States is the three-legged stool. The first leg is Social Security and government welfare programs for the aged; the second is employer or labor union-provided pensions, and the third is direct individual saving. The relative importance of these three sources of retirement income varies significantly across households.

The Social Security part of the system provides a "floor" that is mandatory and nonassignable. It has as one of its goals to redistribute income from those who earn more during their working careers

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[8]The most recent of those reform measures was passed in 1994. For details, see Pension Benefit Guaranty Technical Update 95-1 (1995). For a review of previous reforms see Utgoff (1993).

[9]For an estimate of the cost of this regulatory forbearance see Kane (1993b).

[10]This part of the paper draws heavily from Bodie and Merton (1993).

to those who earn less. In addition, the government actively encourages employers and households themselves to provide the other two legs of the retirement-income stool. Through tax-incentives, it encourages employers to provide pension plans that--like Social Security--are mandatory and nonassignable. It also offers tax-incentives to self-employed individuals and households who are not otherwise covered to provide a retirement fund for themselves, and imposes penalties on early withdrawal of money from the fund. Finally, in the United States, the government insures private-sector defined-benefit pension plans against default risk through the Pension Benefit Guaranty Corporation.

One can view the mixed public-private system of retirement-income provision in the United States as a way of reducing the risks of each separate component by diversifying across providers. The government can change the law and reduce benefits already promised under Social Security. Private-sector pension-plan sponsors are committed by law (and perhaps reputation) to pay promised benefits, but they may default. An additional linkage reinforcing the second leg of the retirement-income stool in the United States is government insurance of private pension benefits.

There are two Apure@ types of pension plans: *defined contribution* and *defined benefit*. In a defined-contribution plan, a formula specifies contributions but not benefit payments. At retirement the employee applies the total accumulated value of contributions and earnings on those contributions to purchase an annuity. The employee bears all the investment risk; the retirement account is, by definition, fully funded by the contributions, and the employer has no legal obligation beyond making its periodic contributions.

In a defined-benefit plan, a formula specifies benefits, but not the manner, including contributions, in which these benefits are funded. The plan sponsor or an insurance company hired by the sponsor guarantees the benefits and thus absorbs the investment risk. The obligation of the plan sponsor to pay the promised benefits is a long-term debt liability of the sponsor.

For a defined-benefit plan, one must distinguish between the pension *plan* and the pension *fund*. The plan is the contractual arrangement setting out the rights and obligations of all parties; the fund is a separate pool of assets set aside to provide collateral for the promised benefits. In defined-contribution plans, by definition, the value of the benefits equals that of the assets, so the plan is always exactly fully funded. But in defined-benefit plans, there is a continuum of possibilities. There may be no separate fund, in which case the plan is said to be unfunded. When there is a separate fund with assets worth less than the present value of the promised benefits, the plan is underfunded. And if the plan's assets have a market value that exceeds the present value of the plan's liabilities, it is said to be overfunded.

Why and how does funding matter? The assets in a pension fund provide collateral for the benefits promised to the pension plan beneficiaries. A useful analogy is that of an equipment trust. In an equipment trust, such as one set up by an airline to finance the purchase of airplanes, the trust assets serve as specific collateral for the associated debt obligation. The borrowing firm's legal liability, however, is not limited to the value of the collateral. By the same token, if the value of the assets serving as collateral exceeds the amount required to settle the debt obligation, any excess reverts to the borrowing firm's shareholders. So, for instance, if the market value of the equipment were to double, this would greatly increase the security of the promised payments, but it would not increase their size. The residual increase in value accrues to the shareholders of the borrowing firm.

The relation among the shareholders of the firm sponsoring a pension plan, the pension fund, and

the plan beneficiaries is similar to the relation among the shareholders of the borrowing firm in an equipment trust, the equipment serving as collateral, and the equipment trust lenders. In both cases, the assets serving as collateral are "encumbered," (i.e., the firm is not free to use them for any other purpose as long as that liability remains outstanding), and the liability of the firm is not limited to the specific collateral. Any residual or "excess" of assets over promised payments belongs to the shareholders of the sponsoring firm. Thus the greater the funding, the more secure the promised benefits. However, whether the plan is underfunded, fully-funded, or overfunded, the size of the *promised* benefits does not change.

It is important to emphasize that funding is always measured *ex ante*. The present value of the benefits promised computed using current interest rates is compared to the market value of the pension assets serving as specific collateral. A pension fund that is well funded today at current interest rates and asset prices, may become under- or over-funded tomorrow when those rates and prices change. An implication is that a plan sponsor wishing to remove surplus assets should therefore not be allowed to do so by the guarantor of the liabilities without marking to market and rechecking funding adequacy.

A major putative advantage of a defined-benefit pension plan over a defined-contribution plan is that it protects the employee against investment risk.[11] The economic efficiency of this protection against investment risk is enhanced by the provision of guarantees against default risk. To understand the efficiency gains from guarantees of pension annuities, it is critical to distinguish between employees and investors (stockholders and bondholders) in firms that provide pension annuities. The distinction is that unlike the firm's investors, the employees holding the sponsor's pension liabilities strictly prefer to have the payoffs on their contracts as insensitive as possible to the default risk of the firm itself. The function served by a pension annuity is for the beneficiaries to receive a specified benefit upon retirement. That function is less efficiently performed if the contract instead calls for the benefit to be paid in the joint event that the employee retires *and* the firm is still solvent.[12]

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[11]Each of the two plan types, defined benefit and defined contribution, has advantages and disadvantages. For example, while defined benefit plans offer employees insurance against investment risk, they do present problems for employees who switch jobs during their working careers, especially if benefits are not automatically protected against inflation. For a more complete discussion, see Bodie, Marcus, and Merton (1988).

[12]For an alternative view, see Ippolito (1986, Chapter 10). Ippolito argues that when workers are represented by a union, they accept default risk of the sponsoring firm (through the pension plan) as a way of binding the union to bargain

Even if the sponsoring firm offers an actuarily-fair increase in the employee's cash wages to reflect the risk of insolvency, it is still likely that an employee would prefer a pension annuity with the least default risk. Employees typically have a large nondiversified stake in the firm already.[13] They may have invested in firm-specific human capital, which loses value if the firm does poorly. Thus, few employees would consciously agree to accept default risk on their pension benefits in order to increase their expected cash wages. This is true even when the employee has all of the relevant information necessary to assess the default risk of the firm. In most cases, the employees do not have the relevant information, and this fact makes the welfare loss even greater.

For example, consider the profile of a Atypical@ defined-benefit plan beneficiary. The vast majority of those covered by PBGC guarantees are blue-collar and white-collar workers for whom pension benefits constitute a large portion of total retirement savings. These employees are very unlikely to have asset portfolios of sufficient size or the investment expertise necessary to hedge the nondiversifiable risks of their defined-benefit pension asset. Only the most highly compensated managerial employees of the firm might have the financial wealth and knowledge required to diversify away the risks of their defined-benefit pension claims. But to hedge this risk, they would have to effectively take a short position in the sponsoring firm's equity. Typically, managers and employees are prohibited from shortselling the firm's securities by the provisions of their incentive compensation package.

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more cooperatively with management. Under his assumptions, therefore, a defined-benefit plan with default risk is efficient.

[13]Note that the risk exposure is especially large for a lifetime employee of a single firm. Even if the employee is willing to bear risk, we know from portfolio theory that efficient risk-bearing calls for broad diversification across various firms and asset classes. Here, the employee's entire pension benefit is tied to the fortunes of a single firm.

In contrast, an investor in the stocks or bonds issued by the sponsoring firm is explicitly taking an interest in the fortunes of the firm itself. The function of these securities is to allow investors to participate in the risk and return prospects of the firm. Investors can diversify away much of the default risk associated with any one specific firm as part of their total portfolios. Employees with a substantial part of their wealth in firm-specific defined-benefit pension annuities usually cannot achieve such optimal diversification. They resemble investors constrained to hold a large fraction of their wealth in the form of long-term bonds issued by a single firm, which is also their employer.[14] Thus, both their tangible and human capital are significantly exposed to the fortunes of a single firm.

The above reasoning establishes a rationale for insuring defined-benefit pensions against the risk that the plan sponsor will default on its promise to provide benefits. It does *not* establish a rationale for the *government* to provide such insurance. Indeed, a look at the pension systems in other countries reveals that the number of governments which do provide such insurance is quite limited.[15]

Some have suggested that government insurance of private pension benefits should be viewed as part of the system of social insurance, in which the redistribution of income from the wealthy to the poor is a major objective.[16] Insuring private pensions, however, does not redistribute income to the poor. Indeed, less than half of the labor force in the United States has any PBGC coverage at all, and those who are covered by private defined-benefit pension plans tend to be among the more fortunate members of the work force. They work for relatively large firms and earn relatively high incomes. It is hard to understand the case for redistributing income to this group of the population.

Even if income and wealth were redistributed in socially desirable ways under the PBGC, for the system to work without taxpayer assistance, we must assume that sponsors of well-funded plans will *voluntarily* subsidize underfunded plans of financially weak sponsors by paying actuarially-unfair premiums. In a capitalist economic system, private-sector firms should be assumed to operate according to the principles of shareholder wealth maximization. Firms try to minimize their taxes and

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[14]Should employees want to invest in the securities of their firm, they typically can do so through a variety of special employee stock ownership programs. These investment programs are usually voluntary. By contrast, participation in an employer's defined-benefit plan is usually a condition of employment.

[15]Pesando (1995) points out that in Canada, where pension regulation is carried out at the provincial level, only one of the 11 provincial governments has opted to insure pension benefits.

[16]For an example of this "social-insurance" perspective, see Employee Benefits Research Institute (1992).

maximize the subsidies they receive from government and government-run programs. They will tolerate voluntary subsidies to other private firms, some of whom are their competitors, only if it contributes to the goal of shareholder wealth maximization of their *own* firm. To assume that they will behave otherwise in structuring government programs is counter-productive.[17]

Whether or not the government offers pension insurance, there is a case for government oversight. Given that we have social security and have established incentives for private pension plans to be put in place as a matter of public policy, it is unlikely that the government could stand by and watch a significant part of the system fail. That is the political reality. Thus even in the absence of a *formal* system of pension insurance, the government is probably the *de facto* "pension guarantor of last resort." It should manage that responsibility without creating a misallocation of resources or unintended transfers of wealth as occurred in the case of FSLIC.

[17]The history of deposit insurance in the United States has repeatedly demonstrated the lack of viability of such systems when the parties to it can leave at will. See, for example, English (1993).

3. Stocks Are Not a Hedge Against Pension Liabilities

It is important to understand why the PBGC's market-risk exposure is great even when pension fund equity portfolios are well-diversified across industry groups and consist entirely of "blue chip" stocks. Contrary to the view that a stock portfolio is an effective hedge against the pension liability when the investment horizon is long-term, this section shows that the cost of insuring a pension liability collateralized with stocks actually *increases* with the maturity of the pension obligation.[18]

Assume a defined-benefit plan sponsor is faced with the obligation to pay a fixed amount as a pension benefit *T* years from now. It fully funds its obligation by contributing to the pension fund an amount equal to the present value of the promised benefit. It can invest in an *immunized* default-free bond portfolio maturing in *T* years earning a certain risk-free rate of interest. If instead the sponsor invests in a stock portfolio then there is a risk of a shortfall at the maturity date.[19]

The basis for the proposition that stocks are less risky in the long run appears to be the observation that the longer the time horizon, the smaller the *probability* of a shortfall. If the *ex ante* mean rate of return on stocks exceeds the risk-free rate of interest, it is indeed true that the probability of a shortfall declines with the length of the investment time horizon. For example, suppose the rate of return on stocks is lognormally distributed with a risk premium of 8% per year and an annualized standard deviation of 20%. With a time horizon of only 1 year, the probability of a shortfall is 34%, whereas at 20 years that probability is only 4%.

But as has been shown in the literature, the probability of a shortfall is a flawed measure of risk because it completely ignores how large the potential shortfall might be.[20] It is easy to see this point if we assume that stock returns follow a simple "random walk." In any 1-year period, assume the rate of return on stocks can take only one of two values C either +20% or –20%, independent of its past history. Consider the worst possible outcome for time horizons of increasing length. For a 1-year horizon one can lose 20% of the initial investment, for a 2-year period 36%, and for a 20-year period as much as 99%. Using the probability of a shortfall as the measure of risk, no distinction is made between a loss of 20% or a loss of 99%.

If it were true that stocks are less risky in the long run, then the cost of insuring against earning less than the risk-free rate of interest should decline as the maturity of the pension obligation increases. But the opposite is true.

To see this, define the cost of shortfall insurance, *P*, as the additional amount of money one has to add at the investment starting date to assure that at the maturity date the pension portfolio will

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[18]For a more complete development of the material in this section see Bodie (1990c, 1991, and 1995).

[19]See, for example, Leibowtiz and Krasker (1988).

[20]See Harlow (1991).

have a value at least as great as it would have earning the risk-free interest rate. Thus, for each dollar insured against a shortfall, the total amount actually invested at the starting date is \$1 + *P*.

To find *P*, we use modern option pricing methodology.[21] Insurance against shortfall risk is effectively a *put* option. The put is of the European type (i.e., it can only be exercised at the expiration date), and it matures in *T* years. The put's exercise price is the insured value of the portfolio. If at the expiration date *T* years from now the portfolio's value exceeds its insured value, then the put expires worthless. If, however, there is a shortfall, then the put's payoff is equal to the shortfall.

Because we are insuring a pension obligation that grows at the risk-free interest rate, the exercise price of the put equals the price of the underlying stock portfolio compounded at the risk-free *T*-year interest rate.[22] Therefore the *put-call parity theorem* tells us that the price of the put equals the price of the corresponding call.[23]

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[21]The reference here is to the option-pricing theory originally developed by Black and Scholes (1973), and Merton (1973). There is an extensive literature on using option-pricing models to estimate the value of financial guarantees. For a comprehensive list of references, see Merton and Bodie (1992).

[22]Another way to state this is that the exercise price of the put equals the forward price of the underlying stock.

[23]The put-call parity theorem for European options says that:

$$P + S = C + E\, e^{-rT}$$

where P is the price of the put, S is the price of the underlying stock, C is the price of the corresponding call, E is the exercise price, and r is the risk-free interest rate. In our case:

$$E = S\, e^{rT}$$

By substituting into the put-call parity relation we get:

$$P = C$$

To show that the value of the put increases with *T*, we could use any option pricing model based on the condition that the financial markets do not allow anyone to earn risk-free arbitrage profits.[24] Because it is so compact and so widely used in practice, we will use the Black-Scholes formula. In our special case a *simplified* form of the formula can be used to compute *P*. Moreover, with no loss

$$\frac{P}{S} = N(d_1) - N(d_2)$$

$$d_1 = \frac{s\sqrt{T}}{2}$$

$$d_2 = \frac{-s\sqrt{T}}{2}$$

of generality, we can express the price of the put as a fraction of the price of the stock:

where:
S = price of the stock
T = time to maturity of the option in years
s = standard deviation of the annualized continuously compounded rate of return on the stock

[24]The option price is derived by considering a dynamic investment strategy involving only the underlying stock and the risk-free asset, which has as its objective to produce at the horizon date a payoff equal to that of the put. The strategy is self-financing, that is, no additional infusions of money beyond the original $P are required. As is well known in the literature, an option's price can also be expressed using a ? risk-neutral? valuation method. This method makes explicit that the cost of shortfall insurance reflects a weighting of the possible shortfall magnitudes.

N(*d*) = *the probability that a random draw from a standard normal distribution is less than d.*

Note that *P/S* is independent of the risk-free interest rate; it depends only on s and *T*. *Figure 1* shows the result of applying the formula to compute *P/S* assuming the annualized standard deviation of stock returns (s) is .2.

The cost of the insurance rises with *T*, the maturity of the pension obligation. For a one-year maturity, the cost is 8% of the investment. For a 10-year maturity, it is 25%, and for a 50-year maturity it is 52%. As the maturity grows without limit, the cost of the insurance approaches 100% of the investment. In other words, it can never cost more than $1 to insure that a dollar invested in stocks will earn the risk free rate. This is because one can always invest the $1 insurance premium in risk-free bonds maturing in *T* years, so that even if the value of stocks falls to zero, the investor still will have the guaranteed minimum.

The cost of shortfall insurance as defined here should not be confused with the PBGC's insurance premium. Conceptually *P* is the one-time up-front cost of insuring against a shortfall at the maturity date of the pension obligation. The horizontal axis (*T*) in *Figure 1* measures the maturity of the pension obligation, not the time between payments of premiums to the PBGC. PBGC insurance premiums are paid once a year, but the insured pension liabilities have maturities that generally are much longer than one year. We discuss how to set the PBGC's premiums separately in Section 4.

Some financial economists and other observers of the stock market have claimed that stock returns do not follow a random walk in the long run. Rather, they argue, the behavior of stock returns is best characterized as a mean-reverting process.[25] It is mean reversion in stock returns, some say, that is the reason stocks are less risky for investors with a long time horizon.[26]

[25]See, for example, Poterba and Summers (1988).

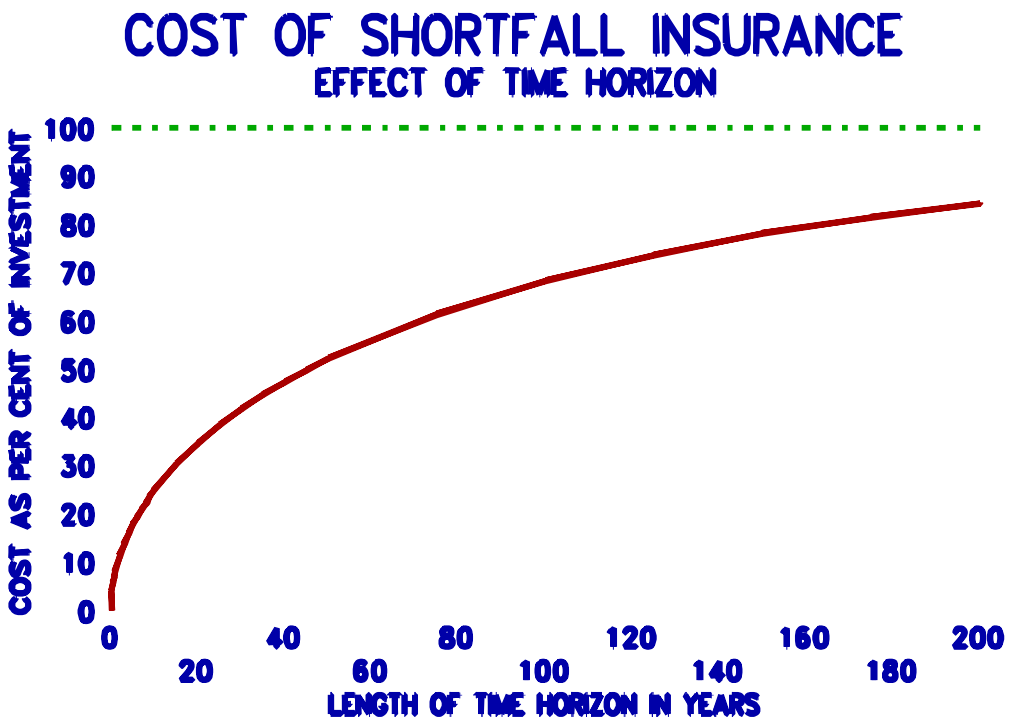
[26]See, for example, the footnote on page 344 of Malkiel (1990).

But *Figure 1* is valid for mean-reverting processes too. The reason is that arbitrage-based option pricing models, such as the Black-Scholes or binomial models, are valid regardless of the process for the mean. They are based on the law of one price and the condition of no-arbitrage profits. Investors who disagree about the mean rate of return on stocks, but agree about the variance, will therefore agree about the option price. This is a feature of these models that may at first seem Acounter-intutitive,@ but is nonetheless true.[27]

For the relation depicted in *Figure 1* to be invalid, mean reversion is not enough. Stock prices would have to behave just like the price of a *T*-period zero-coupon bond that converges towards the bond's face value as the horizon date approaches. In other words, stocks would have to be indistinguishable from the risk-free asset for a *T*-period horizon.

[27]There is an extensive literature, including many textbooks, explaining why the formula holds regardless of the mean rate of return on stocks. We will not attempt to repeat those explanations here. While mean reversion does not affect the Black-Scholes formula, it does affect the *measured* variance over the observation period. See Lo and Wang (1994) for a discussion of this effect.

Figure 1. Cost of Shortfall Insurance as a Function of Maturity of Pension Obligation



4. The PBGC's Policy Alternatives

One policy parameter that the PBGC can in principle control is the frequency of audits. Currently, auditing is done very infrequently. For a fixed insurance premium and with relatively infrequent auditing, the principles of guarantee management dictate that the PBGC must restrict the volatility of the difference between the value of a plan's assets and the value of its insured liabilities. For example, plan sponsors could be required to hedge all of their PBGC-insured liabilities by investing in default-free fixed-income securities with the same cash flow pattern as the promised benefitsCa procedure known as "immunization."[28]

If, for example, the plan sponsor has an obligation to pay $100 per year for the next 5 years, it can provide this stream of benefit payments by buying a set of 5 zero-coupon default-free bonds, each with a face value of $100 and maturing sequentially. This eliminates the risk to the PBGC stemming from uncertainty about future interest rates and from uncertainty about the solvency of the issuers of the fixed-income securities. The only remaining risk to the plan sponsor and therefore to the PBGC is mortality risk. If funding requirements are set to provide an adequate cushion for the mortality risk, the PBGC can charge low premiums and still be a viable entity.

While simple in concept, the immunization of pension liabilities is not always simple to implement in practice. Thus, one might believe that plan sponsors can hedge the interest rate risk of their benefit liabilities by investing in long-term fixed-rate mortgages or bonds. However, at least in the United States, virtually all mortgages and bonds have prepayment or call provisions that allow the issuer to retire them early. Plan sponsors that attempt to immunize must therefore deal with this prepayment risk.[29]

An alternative way for the PBGC to maintain solvency and create appropriate incentives for plan sponsors is to charge risk-related premiums. The PBGC already has a premium structure that takes into account a plan's level of underfunding, but the premiums are unrelated to the mismatch between the market-risk exposures of the pension assets and liabilities. The fair market premium for a fully-funded plan that is fully immunized is zero. However, if the pension sponsor invests the pension assets in common stocks or other types of equity securities rather than in fixed-income securities that immunize the guaranteed benefits, then the exposure of the PBGC to a potential shortfall is increased.

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[28]See Leibowitz (1986) for a complete development of immunization procedures.

[29]Unlike mortality risk, prepayment risk is systematically related to the level of interest rates which affects all fixed-income security prices. Therefore diversification across different kinds of fixed-income instruments with different issuers will not eliminate or even significantly reduce this risk exposure. Many of the innovations in the US fixed-income securities markets in the 1980s (such as collateralized mortgage obligations or CMO's) have been driven by the desire of pension funds and other intermediaries with long-term annuity liabilities to hedge the prepayment risk of mortgages. See Bodie (1990a).

The risk-related premium must therefore also be related to the volatility of the difference between the value of the pension assets (excluding the value of the guarantee) and the present value of guaranteed benefits.

For any system of risk-based premiums to work, net-worth volatility need not be reduced to zero, but it does have to be known (or at least bounded) and not subject to significant unilateral change by the insured pension plan after the premium has been set. If the insured pension-plan sponsor can unilaterally change the composition of the asset portfolio *ex post*, then the PBGC faces a problem of moral hazard since some sponsors will have an incentive to increase the risk of their assets. As Kane (1993a) points out, this makes the shortfall risk to some extent endogenous.

One feasible risk-related premium structure was presented and illustrated in Bodie and Merton (1993).[30] In this hypothetical system each plan sponsor pays the PBGC a risk-based premium once a year. The premium is set to reflect both the fund's net worth--market value of pension assets less the present value of the guaranteed benefits--and its volatility over the coming year. The volatility of the fund's net worth is determined by the fraction of the guaranteed benefits immunized and the kinds of assets in which the nonimmunized portion of fund balances can be invested. The PBGC sets an upper bound on the fund's net worth volatility. If the guaranteed pension benefits are fully immunized with default-free bonds, then the net worth volatility is zero.[31] At the end of the year, the fund must either pay another premium for the period to follow that reflects its new funding status and net worth volatility, or the plan is terminated and the assets are seized by the PBGC. If the plan is terminated, then the PBGC makes up the shortfall.

This hypothesized system differs from the current system in four important respects: (1) the premiums charged by the PBGC reflect the volatility of the pension fund net worth; (2) the pension fund assets include any of the sponsoring firm's corporate assets serving as collateral (thus pension assets as defined here include 30% of the sponsoring firm's net worth *plus* a general claim against the rest of the firm's net worth); (3) there is no cap on the premium, and (4) the plan is terminated if the sponsor fails to make a premium payment. Under these assumptions, Bodie and Merton use well-known techniques to compute the competitive market premium for any combination of parameter values.

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[30] As is well known in the finance literature, the guarantee provided by the PBGC is analogous to a put option. Using this analogy, one can use the known response of the value of a put option to a change in the risk characteristics of the underlying asset to gain insight into the sensitivity of the PBGC guarantee's value to the pension fund asset mix. Sharpe (1976) was the first to develop this idea.

[31] The PBGC has to monitor insured plans to make sure that the pension asset mix is not changed once the premium is set.

If the PBGC charges less than this premium, the guarantee will have a negative net present value (i.e., the premium charged is less than the present value of the contingent future payments the PBGC is obliged to make.) Note that a negative net present value on its guarantees does not necessarily imply that the PBGC will run out of money. As with other insurance processes, good fortune might permit the situation to go on for many years even though the guarantor is actuarily insolvent. Moreover, overcharging healthy sponsors of well-funded plans can help to keep the PBGC solvent as long as the actuarially unfair premiums do not induce such healthy plan sponsors to terminate their defined benefit plans and stop paying premiums to the PBGC.

Starting in the 1980s, the development of trading in derivative securitiesCfutures, forward contracts, and optionsCgreatly enhanced the ability of pension funds to reduce their exposure to risk. Thus, by entering into an appropriate position in derivatives, a pension fund can effectively convert its stock portfolio into a fixed-income portfolio that matches its benefit liabilities. However, just as pension funds can quickly reduce both the volatility of their net worth and the exposure of the PBGC by using derivatives, so they can quickly reverse the process and become unhedged. Indeed, a pension fund can actually increase rather than decrease its unhedged risk exposure by taking positions in derivative securities that accentuate the imbalance between its asset/liability positions. Thus, the very efficiency of the derivative-securities markets in permitting rapid and low cost hedging of positions, can also put greater demands on the PBGC to keep track of the pension fund's exposure to shortfall risk.

In order for the PBGC to monitor asset restrictions effectively, it must be aware of and understand the implications of all positions that the pension fund holds in derivative securities at each point in time. None of the three federal bodies that regulate the private pension system C the Internal Revenue Service, the Department of Labor, and the PBGC C currently have systems in place to do this.[32]

While a system where risk-based premiums are adjusted frequently in the way just described is possible in principle, its successful implementation by a Federal government agency is difficult. There can be political pressure for the government to charge less than the fair market premium for its guarantees. Some well-informed observers claim that from its inception the PBGC has always had as an important function the revitalization of some depressed industries through assumption of part of the burden of providing pension benefits to workers.[33] If firms can transfer their pension obligations to the PBGC, then the PBGC winds up paying part of the workers' compensation.[34]

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[32]In a research report commissioned by the Department of Labor (Bodie, 1990c), I recommended some changes to improve the ability of DOL to monitor the risk exposure of private defined benefit plans. I suggested how with a few additions, the Form 5500 could be much more informative about the investment strategies being pursued by corporate plan sponsors. In particular, I suggested collecting data on the use of derivative securities by plan sponsors. To date, none of these suggestions have been implemented.

[33]For example, one of the key architects of ERISA has written that the actuarial soundness of the PBGC was deliberately sacrificed at its inception in order to gain political support for passage of ERISA. In his ADissenting Comments≅ on Ippolito's *The Economics of Pension Insurance* (1989), Michael S. Gordon writes:

> AThe supposition that Congress was prepared to accept loss of jobs and further industrial decline in return for sound insurance principles is preposterous and is why, even today, there will be stiff resistance to redesigning pension insurance along the lines he (Ippolito) proposes.≅

[34]Utgoff (1993) documents the sizable government subsidies that have taken place through the PBGC. See her footnote

Whatever the merits of helping distressed industries through government subsidies, there are good reasons *not* to use "cheap" pension guarantees as the way to subsidize. They are less visible to the public than other subsidies, and they can lead to serious distortions in resource allocation. In the past, some among both the general public and politicians have mistakenly believed that a loan guarantee costs the government nothing unless there eventually turns out to be a shortfall.[35] However, perhaps due to the large losses in the deposit insurance funds, such arguments seem to appear less frequently now. Indeed, the United States government has since 1990 taken steps in its budget process to account for the cost of the guarantees it issues.[36]

If faced with a political constraint limiting the size of the premiums it can charge, the PBGC can still adopt procedures using the other tools of management to maintain the solvency of its guarantee activity, prevent excessive risk-taking, and avoid unintended subsidies. If it can, for instance, establish an effective system for maintaining funding standards on a mark-to-market basis, then premiums can be kept low with the system solvent.

But, if it can neither charge adequate risk-based premiums nor achieve continuous full funding of insured plans, then the only route left open to the PBGC is asset restrictions. As already discussed, even in a guarantee system that relies on risk-based premiums, some asset restrictions are required to limit moral hazard and make the guarantee contract viable. But to rely primarily on asset restrictions (with little monitoring) to keep premiums low, the guarantor must require the insured intermediary to completely hedge its insured liabilities. If the imposition of strict matching restrictions by the government guarantor is also ruled out because it is perceived as too much government "regulation," then the guarantor is left with no feasible way to perform its guarantee function efficiently.

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[35]This same mistaken belief, if applied to the private sector, would imply that insurance companies do not incur a liability when they issue policies, but only when there are actual damage claims.

[36]See Office of Management and Budget, *Budget of the US Government for 1993*, Section 13, AIdentifying Long Term Obligations and Reducing Underwriting Risks.≅

As a longer run solution to the problem, it might be best to get the government out of the business of managing guarantees of private pensions. Economic reasoning establishes a rationale for insuring defined-benefit pensions against the risk that the plan sponsor will default on its promise to provide benefits. It does *not* establish a rationale for the *government* to provide such insurance. The federal government is probably not in the best position to carry out such a task.[37]

When the PBGC was created in 1974, it was argued that no private insurer could provide the kind of shortfall-risk insurance required by beneficiaries of private defined-benefit plans. If that was ever true, it certainly is no longer true today. In the 1980s a whole new industry devoted to offering such risk-management products developed in the United States and has become a large global business.[38] In this new financial environment it is enough for the government to provide the basic hedging instruments necessary for private-sector firms to fashion financial products to match the market exposures of pension plans. The US Treasury already does this by issuing default-free dollar-denominated debt instruments.

I do not believe that the problems faced by the PBGC warrant taking steps to discourage the continuation or growth of defined-benefit pension plans and to encourage their replacement with defined-contribution plans. Both plan types have advantages and disadvantages for plan beneficiaries and plan sponsors alike, and absent government insurance there does not appear to be a case for public policy intervention on the choice of plan type.

The government could perhaps enhance the efficiency of the US private pension system by providing the instruments needed to hedge against inflation risk.[39] But that is another topic.[40]

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[37]For a detailed exposition of this point of view, see Pesando (1995) or Weaver (1994).

[38]Financial service firms such as Bankers Trust Company, J.P. Morgan, Salomon Brothers, and Goldman Sachs have been in the forefront of these developments.

[39]The government of the United Kingdom did this in 1981 and has continued to do so ever since.

[40]For a discussion of inflation protection of pension benefits, see Bodie (1990d) and Bodie and Merton (1993) section 7.

5. Conclusions

If the only goal of the PBGC were to operate a system of default-risk insurance according to sound economic principles, there are a number of alternative ways to efficiently manage the guarantee function through some combination of enforcement of full funding standards, matching restrictions, and risk-based premiums. Every guarantor, regardless of whether it is a private-sector or governmental entity, must employ some feasible combination of these methods if it is to maintain economic viability without creating unintended and undesirable side effects.

Among the possible side effects in the case of the PBGC is the prospect that overcharging the sponsors of well-funded plans in order to subsidize the underfunded plans of financially-distressed firms might cause financially healthy sponsors to terminate their defined-benefit plans. Ultimately, the United States could be left only with bankrupt defined-benefit plans with the benefits financed directly by tax-payers.

There has been a significant change in the attitude and behavior of senior public officials and legislators as a result of the S&L debacle. Directors of the PBGC and Secretaries of Labor to whom they report have pointed out the weaknesses of some of the pension funds that the PBGC insures and have pursued an active legislative agenda designed to reduce the PBGC's vulnerability to those weaknesses. Those efforts have resulted in a series of laws and amendments to laws that have significantly improved the U.S. pension guarantee system.

But there is apparently a belief among policymakers at the PBGC that a well-diversified pension portfolio of equity securities provides an effective long-run hedge against liabilities of defined-benefit pension plans, so that there is no asset-liability mismatch problem. This belief is mistaken. Equities are not a hedge against fixed-income liabilities even in the long run. Thus, even if the PBGC achieves the goal of full funding at one point in time, the mismatch between the market-risk exposure of the pension benefits it insures and the pension assets backing them creates the potential for large shortfall losses in the future as the economy and capital market rates change in unpredictable ways. Therein lies an uncomfortable parallel with the S&L debacle.

Note that the S&L debacle was not inevitable. In the environment of stable interest rates that prevailed throughout the 1950s and 1960s, everyone viewed S&Ls as very safe institutions. The problems began in the 1970s when interest rates became high and volatile. Similarly, it is not inevitable that the PBGC will face a crisis. The stock market may not decline, and long-term interest rates may not fall. The point, however, is that it could happen, and as an insurer the PBGC must plan for such contingencies.

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