



1-1-2005

The Influence of PBGC Insurance on Pension Fund Finances

Julia L. Coronado
Watson Wyatt Worldwide

J. Nellie Liang
Federal Reserve Board

Follow this and additional works at: https://repository.upenn.edu/prc_papers

 Part of the [Economics Commons](#)

Coronado, Julia L. and Liang, J. Nellie, "The Influence of PBGC Insurance on Pension Fund Finances" (2005). *Wharton Pension Research Council Working Papers*. 383.
https://repository.upenn.edu/prc_papers/383

The published version of this Working Paper may be found in the 2006 publication: *Restructuring Retirement Risks*.

This paper is posted at ScholarlyCommons. https://repository.upenn.edu/prc_papers/383
For more information, please contact repository@pobox.upenn.edu.

The Influence of PBGC Insurance on Pension Fund Finances

Disciplines

Economics

Comments

The published version of this Working Paper may be found in the 2006 publication: *Restructuring Retirement Risks*.

Chapter 6

The Influence of PBGC Insurance on Pension Fund Finances

Julia Coronado and Nellie Liang

The funding position of the Pension Benefit Guaranty Corporation (PBGC), the US government enterprise that insures accrued benefits in private pension plans, has deteriorated steadily in the past few years to its worst levels in its history. Many proposals for reforming the public insurance system for defined benefit (DB) plans attempt to move toward more stringent funding requirements and will possibly depend on the credit ratings of the sponsors. In general, these proposed requirements would give firms less incentive to take on equity risk in their pension portfolios. Stressing the need for reform, Director Bradley Belt has opined that the PBGC's current predicament was the result of flexible funding standards combined with moral hazard incentives, permitting weak firms to less-than-fully fund their plans and take more risk with their portfolios prior to bankruptcy.

This chapter makes use of recently enacted Financial Accounting Standards Board (FASB) requirements for enhanced disclosure of pension fund finances, to explore the degree to which firms have, in fact, responded to the incentives for risk-taking built into the current system. Risk-taking is encouraged because insurance premiums and funding requirements do not reflect sponsor bankruptcy risk nor the riskiness of the pension plan portfolio. Because funding requirements have been fairly flexible, firms have been able to maintain underfunded plans, in which the value of DB assets fell below projected obligations over an extended horizon. We combine firm-specific expected default probabilities with data on funding and newly available information on the allocation of DB assets to determine whether firms with higher expected bankruptcy risk fund their pension plans less generously and take more risk with their pension portfolios through higher allocations to equity. This analysis provides insight into the degree to which flexible funding standards and the absence of risk-based PBGC insurance premiums have distorted pension finances, and thus will be useful in considering the ramifications of possible reforms.

Our results provide support for the notion that moral hazard brought about by the current structure of private pension insurance has had a

significant influence on the financing choices of corporate DB pension sponsors. Moral hazard manifests itself mainly through reduced contributions leading to significant underfunding. This result is not just driven by struggling firms facing liquidity constraints: even after controlling for cash availability, we find that firms closer to bankruptcy have funded their plans much less generously. On the other hand, we find no evidence that the share of DB assets invested in equities is related to firm bankruptcy risk or the plan’s contingent claims on the PBGC.

Private Pension Insurance and Moral Hazard

The PBGC was established by the Employee Retirement Income Security Act of 1974 (ERISA) to insure the benefits of participants in private-sector DB pension plans in the event that (a) the sponsoring firm declares bankruptcy and (b) the value of plan assets is insufficient to cover plan liabilities. When assets fall short of projected obligations at an insolvent sponsor, the PBGC assumes the assets and liabilities of the pension plan and pays participant benefits according to plan provisions subject to a cap.¹ As a result of its insurance activities over the previous three decades, the PBGC is now the trustee and administrator of nearly 3,500 terminated DB pension plans covering over 1 million participants. Yet premium and investment revenue have not kept pace with the net liabilities assumed from terminated, underfunded plans. As shown in Figure 6-1, the net position of the insurance program has fallen deeply into the red in recent years.

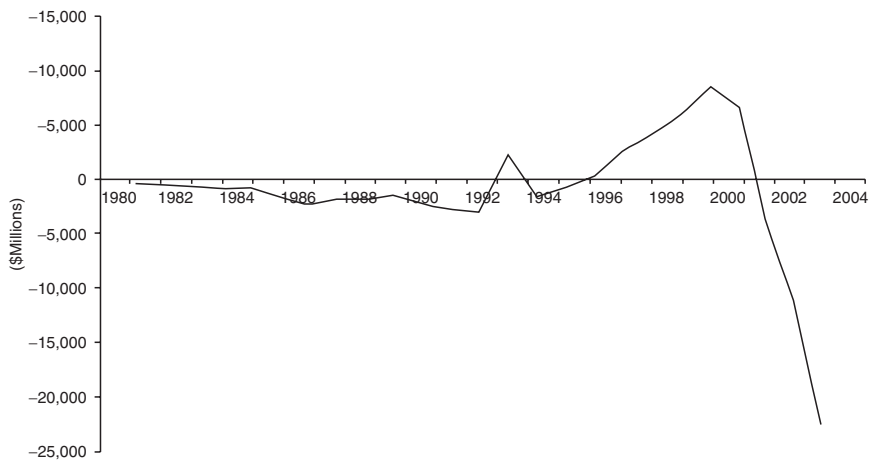


Figure 6-1. Net position of the PBGC single-employer program 1980–2004. Source: PBGC 2004 Annual Report, Pension Benefit Guaranty Corporation.

The deterioration in the PBGC’s position reflects a steep acceleration in claims. As shown in Figure 6-2, claims put to the PBGC—defined as liabilities minus assets for plans taken over by the PBGC—rose sharply, beginning in 2001. Indeed, roughly two-thirds of both the total dollar value of claims and the total number of current and deferred PBGC payees have come from claims since 2001. The amount of these claims is determined by firm’s amount of underfunding at the time of bankruptcy.

The most important factors driving the PBGC’s risk exposure are sponsor bankruptcy and plan underfunding, but pension funding rules and the insurance premium structure do not in any way take into account sponsor bankruptcy risk. For firms nearing insolvency, the lack of consideration of bankruptcy risk in combination with flexible funding standards introduces moral hazard into the system. Flexibility in pension funding standards is built into the system in order to allow firms who are assuming financial market risk on behalf of their employees to manage that risk. Sponsors have some limited ability to overfund their plans, when either their core business and/or asset returns are favorable, and they are allowed to fall below full funding in recognition that there will be times when sponsors will find it difficult to make large cash contributions to the pension plan.

This flexibility in funding standards does not translate into significant increased risk to the PBGC for sponsors with solvent and profitable core

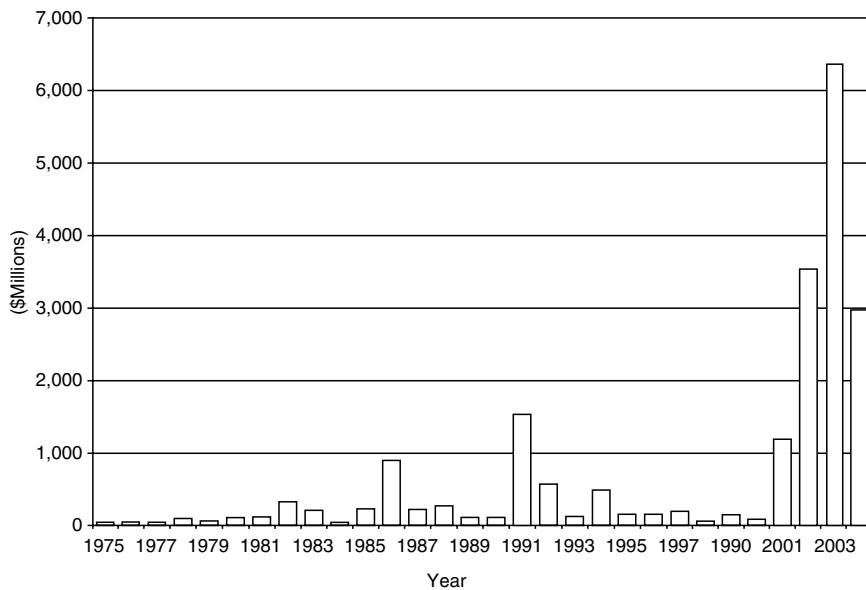


Figure 6-2. PBGC claims for the single-employer program 1975–2004.
 Source: 2004 Annual Report, Pension Benefit Guaranty Corporation.

operations. But for firms at elevated risk of bankruptcy, there is considerable flexibility in exploiting the PBGC put option. This is because rising bankruptcy risk, either because of unanticipated changes in competitive or regulatory environments or because of poor management choices, tends to unfold over a period. Companies which perceive that revenues are faltering and prospects slipping have significant leeway under the current system to fund their existing benefit promises at a slower pace, and they may continue to promise new benefits without funding them. In addition, sponsors nearing bankruptcy have the incentive to take more risks with their pension portfolio, since funding problems arising from poor asset returns can be put to the PBGC.

Analysts have long recognized the incentives inherent in PBGC insurance. Both Sharpe (1976) and Treynor (1977) showed, in theoretical papers, that the guarantee provided by the PBGC creates a put option that firms can maximize by reducing funding and investing in risky assets. Marcus (1987) was modeled on the value of the PBGC guarantee to a firm by incorporating the fact that the guarantee had value only if the firm entered bankruptcy. His model, however, did not recognize the asymmetry in the PBGC's loss function. In particular, the PBGC loses when a firm goes bankrupt and the DB pension plan is underfunded, but it does not receive any surplus when DB plans are overfunded. Pennacchi and Lewis (1994) modeled the PBGC obligation as a put option held by the firm, where the exercise price of the option is the value of the fund's liabilities and a stochastic maturity date equal to the date of the firm's bankruptcy. Their model assumed processes for firm market value and firm liabilities, which together determine firm bankruptcy, and values of pension fund assets and liabilities. In recent work by Neuberger and McCarthy (2005), stochastic bankruptcy probabilities are evaluated. These theoretical approaches illustrate that firms can increase the value of the pension put option in the DB case by reducing contributions, increasing the volatility of fund assets, and increasing pension plan liabilities.

Several factors offset the incentives for moral hazard. First, companies with high value as ongoing entities would rather remain solvent than go bankrupt. Second, there are strong tax-based incentives to fund a pension plan. Pension contributions are tax-deductible, and investment returns accumulate on a tax-free basis, leading Black (1980), Tepper (1981), and Feldstein and Seligman (1981) to note that that sponsors can maximize firm value through full funding of their pension liabilities. These authors have also suggested that plan sponsors should invest in the most heavily taxed assets, usually bonds. Third, there are deadweight losses associated with bankruptcy or underfunded pension plans. These costs include interferences by the PBGC and pension plan participants, legal expenses from law suits, and poor management-labor relations (Bicksler and Chen 1985). The higher expected cost of plan termination implies a lower net value of pension insurance from the PBGC to the firm.

Empirical work on pension finances has generally supported the idea that firms manage their DB plans as part of their overall corporate balance sheet.² Yet measuring the moral hazard incentives directly has been difficult, and various studies have yielded mixed results. Bodie et al. (1987) found that lower credit ratings and a lower return on firm assets were associated with lower levels of pension funding. By contrast, Friedman (1983) and Thies and Sturrock (1988) find no significant relationship or even a negative relationship between return on assets and funding. Hsieh et al. (1997) ask whether firms with underfunded pension funds exhibited riskier asset allocation strategies relative to overfunded pension funds. Using a database of 176 firms with DB pension plans in 1989, they report no significant differences in the percentage of assets allocated to equities, bonds, real estate, Treasury bills, or other asset categories based on funding status. That is, they find no support for the claim that pension funds invest in riskier assets such as equities, when they are worse funded. Yet none of these empirical studies considers the firms' likelihood of bankruptcy, so the analysis below advances the literature by directly measuring the effects of moral hazard.

Evidence of moral hazard from deposit insurance has been found in studies of the bank and thrift industries. For instance, Hooks and Robinson (2002) found that, after deposit insurance was introduced in Texas in the 1920s, state-chartered insured banks increased loan concentrations following declines in equity capitalization, but uninsured banks exhibited no such behavior. Similarly, Cole et al. (1995) showed that savings and loans (S&Ls) with lower capital ratios in 1982 had riskier portfolios several years later, as measured by a higher share of nontraditional assets and greater reliance on purchased funds. Buser et al. (1982) recognized that the risk-taking incentives associated with deposit insurance are mitigated by a bank's charter value, the value of the bank that would be lost if it failed. Firms with greater ongoing charter value would find it more costly to take on additional risks to increase the value of the put option because the loss in charter value would be greater if the firm were to fail.

In what follows, we attempt to evaluate the extent to which moral hazard is prevalent in funding and investment policies of DB plans and expand previous research by explicitly incorporating firm bankruptcy risk and firm charter value.

Data and Sample Characteristics

Evidence consistent with moral hazard would imply greater costs to the PBGC when a firm declares bankruptcy and turns over its DB plan, and would suggest that the PBGC would benefit by addressing sponsor bankruptcy risk in the structure of its funding requirements and premiums in order to limit claims. To determine how much influence the incentives

embedded in PBGC insurance have on pension funding and asset allocation decisions, we combine data-sets from three sources. First, we use data on cash contributions, funded status, and asset allocation for pension plans sponsored by Fortune 1000 firms, from Watson Wyatt's database on FASB disclosures collected from the sponsor's 10-k filings with the Securities and Exchange Commission for 2003. Funded status on the 10-k statements is based on market values of assets and liabilities, and these reports may differ from measures filed with the PBGC based on actuarial values of assets and liabilities. The marked-to-market values in the 10-k filings are more relevant to our analysis as they represent the current position of the plan, whereas the actuarial values smooth in the effects of market movements over time. In addition, the funded status in the financial statements is for all DB plans sponsored by the firm on a combined basis, and may also include some nonqualified executive pension plans, as well as foreign plans that are not insured by the PBGC. For qualified plans, the consolidated funding figures are the measure of interest because it represents the total net pension position of the firm. We will control for the presence of nonqualified plans in our analysis and, while we cannot control for the presence of foreign plans, these plans represent a small minority of the total assets.

As a second datasource, to capture sponsor risk, we use firm-specific measures of the probability of bankruptcy from Moody's KMV that combine detailed financial data from balance sheets and income statements with a firm's stock price and its volatility. These measures are commonly referred to as the expected default frequency (EDF) in the coming year. We eliminate from the sample any firms for which an EDF was unavailable, essentially firms that are not publicly traded, as well as those firms that had already declared bankruptcy before 2003. This process leaves us with 523 firms, roughly 85 percent of Fortune 1000 DB sponsors. The third datasource is Standard & Poor's (S&P) Compustat database, containing plan sponsor assets, operating income, pretax income, interest expenses, capital expenditures, market value, and bond ratings. Our ultimate sample is of 468 firms.

The distribution of funding ratios in the DB plans sponsored by these firms is shown in Figure 6-3 (for the fiscal year-end 2003). The funding ratio is defined as the mark-to-market value of plan assets divided by the projected benefit obligations. Most of these plans were underfunded in 2003, with the mean and median funding ratios at almost 80 percent. These figures are very similar to those reported for DB sponsors among firms in the S&P 500 Composite (Zion and Carache 2005). Overall, the financial condition of DB plans in 2003 reflected some recovery from the three preceding years, during which falling interest rates had increased the present value of liabilities while falling equity prices punished their asset values.

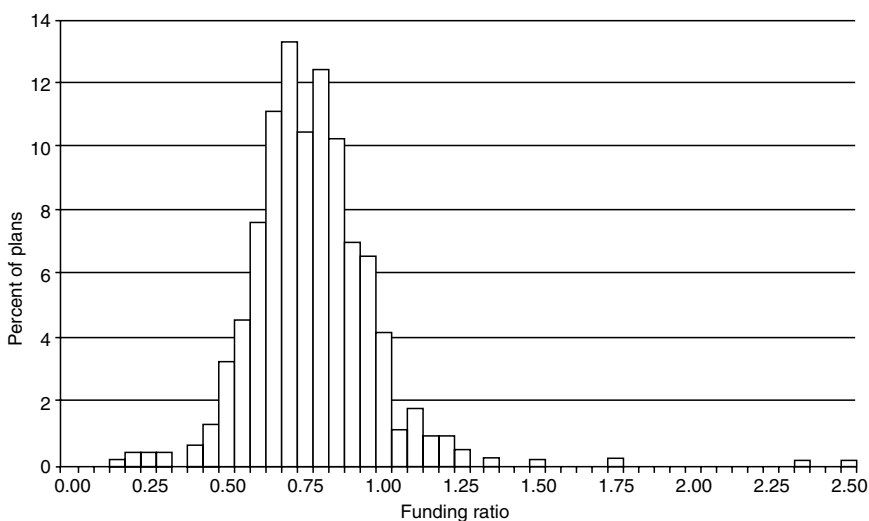


Figure 6-3. Funding ratios 2003.

Source: Authors' calculations from data collected from company 10-k reports.

The vast majority of firms made cash contributions to their pension plans in 2003, but most did not get their plans to a fully funded status. Employer contributions relative to underfunding at the beginning of the plan year are shown in Figure 6-4. Contributions of the median firm were only 23 percent of underfunding, and over three quarters of the firms contributed less than half of the amount of underfunding at the beginning of the year. Only 17 percent made contributions that equaled or exceeded underfunding in the year before (ignoring new costs incurred in 2003), and another 6 percent of firms made contributions even though the plan at the start of fiscal year 2003 was not underfunded. The high degree of variation in contributions and funding ratios is an indication that firms are able to pursue a wide array of funding strategies with respect to their DB pensions.

There is considerably more uniformity in DB plan asset allocation patterns than funding ratios. As seen in Figure 6-5, about two-thirds of the firms allocated between 60 and 75 percent of their DB assets to equity securities. Similarly, two-thirds of the firms allocated between 20 and 35 percent of the portfolio to fixed income securities. On average, about 5 percent of DB portfolios were split between real estate and other assets. Yet there are a handful of firms with very high allocations to equity. Table 6-1 lists the ten firms with the highest stock allocations. The moral hazard that arises from the put option available through PBGC insurance implies that firms closest to bankruptcy should take more risks with their portfolios suggesting high allocation to equity should be associated with poor credit

6 / Influence of PBGC Insurance on Pension Fund Finances 95

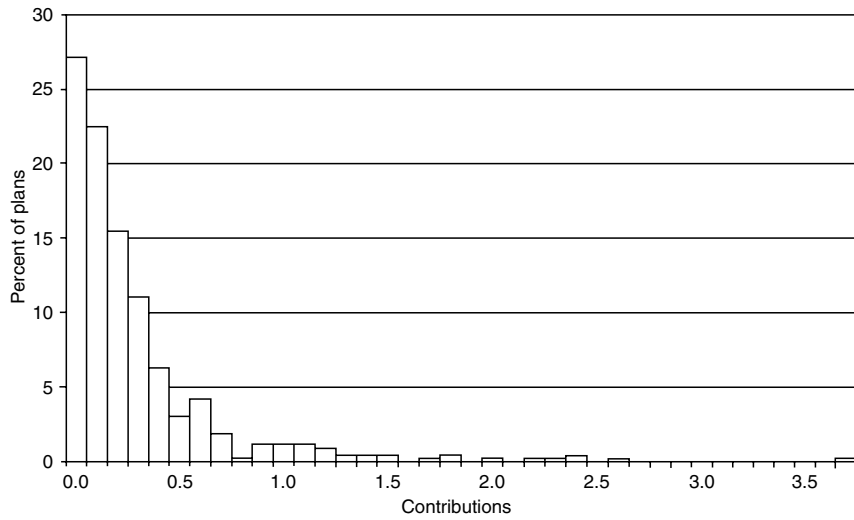


Figure 6-4. Contributions 2003.
Source: Authors' calculations from data collected from company 10-k reports.
Notes: Excludes four observations where contributions is greater than four times the underfunding at the beginning of 2003.

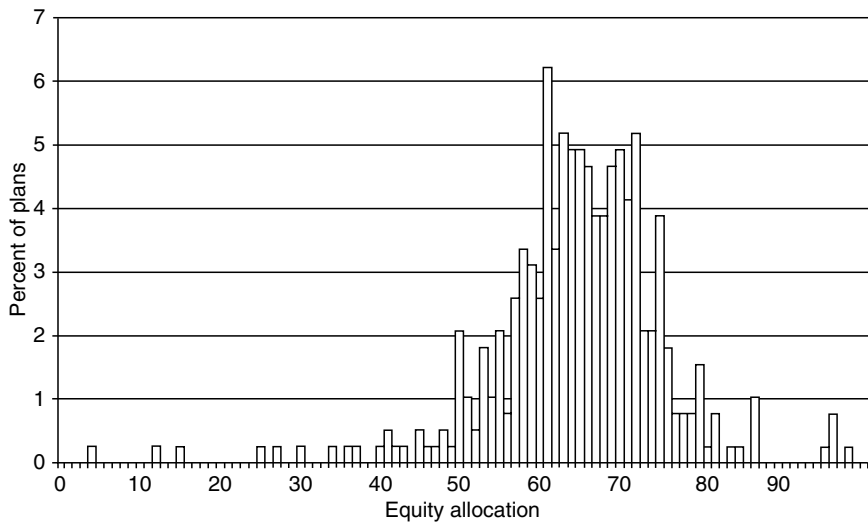


Figure 6-5. Equity allocation.
Source: Authors' calculations from data collected from company 10-k reports.

TABLE 6-1 Companies with the Highest Allocation to Equity

<i>Company name</i>	<i>Equity allocation</i>	<i>Proxy for duration</i>	<i>Funding ratio 2003</i>	<i>S&P bond rating</i>
1. Intel Corporation	100	0.78	0.61	A+
2. United Defense Industries, Inc.	97	0.30	0.96	BB+
3. U.S. Bancorp	97	0.34	1.10	A+
4. Cincinnati Financial Corp.	97	0.50	0.83	A
5. General Dynamics Corp.	96	0.32	0.97	A
6. Autoliv, Inc.	87	0.63	0.57	BBB+
7. Masco Corp.	87	0.29	0.72	BBB+
8. R. R. Donnelley and Sons Co.	87	0.31	0.95	A-
9. Electronic Data Systems Corp.	87	0.45	0.75	BBB-
10. Federal National Mortgage Assn.	86	0.51	0.64	AAA
<i>Sample average</i>	65	0.33	0.82	

quality. Yet despite the fact that our sample includes a number of firms estimated to be very close to default, all on this list but one had an above investment-grade bond rating. Given equity market declines since 2000, it is not surprising that most plans on the list are in a poorer-than-average funding position.

In our test for moral hazard, the key independent variable is firm risk, as measured by the firm's EDF. Data on EDFs are produced by Moody's KMV, in which bankruptcy is deemed likely to occur when a firm's asset value falls below its liabilities. Bankruptcy risk rises with the distance between the value of a firm's assets and liabilities and also depends on the volatility of its asset values, which is based on stock prices. The EDFs are a continuous measure of bankruptcy risk and more forward looking than bond ratings which adjust more slowly. To smooth through monthly fluctuations caused by stock price volatility, we measure the likelihood of bankruptcy using a twelve-month average of EDFs. These are depicted in Figure 6-6.

We are also concerned with reverse causation, that is, that unfunded pension liabilities may be reflected in the capital market prices used to calculate the EDFs. There is mixed evidence that stock market investors appropriately value unfunded pension liabilities; for instance, Coronado and Sharpe (2003) find that equity investors inappropriately focus on accounting measures, while Jin et al. (2004) show that stock prices do reflect risk to a firm from its pension plan. There is also evidence that bond prices incorporate unfunded pension liabilities (Cardinale 2005). In order to control for this potential endogeneity, we use the EDFs over the twelve months before the beginning of the firm's fiscal year 2003.

The data show that the distribution of bankruptcy probability was concentrated at low levels in 2003. Most firms (72 percent) had only a negligible expected default probability in the year ahead, and another 19

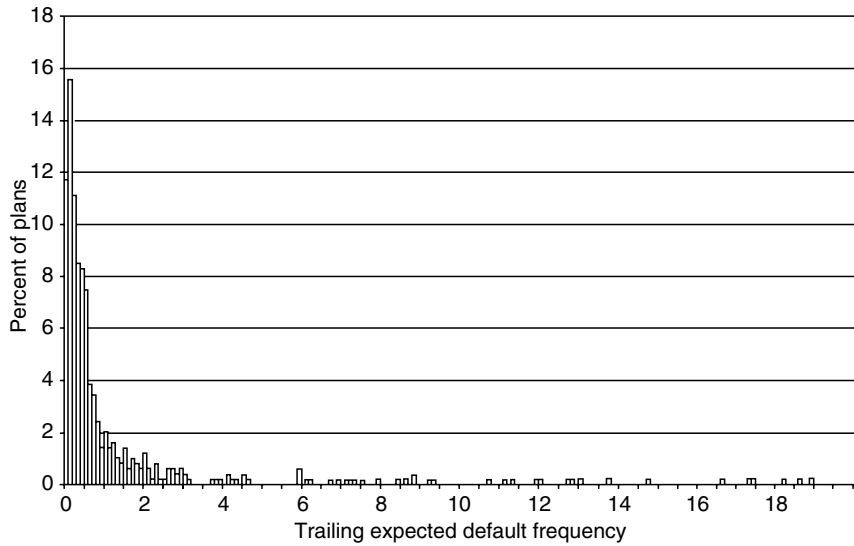


Figure 6-6. Distribution of default probabilities.
Source: Moody's KMV Corporation.

percent had an EDF of between 1 and 5 percent, a still moderately low rate. About 9 percent of the firms would be considered high risk: that is, they had a likelihood of default in the coming year of more than 5 percent. The Moody's KMV probabilities are truncated at 20 percent, implying that the true distribution is even more skewed than indicated in Figure 6-6. This skewness highlights the strong potential for moral hazard under the current system of pension insurance: specifically, the PBGC's contingent liabilities are more dependent on the likelihood of default than underfunding and yet variable premiums and funding standards are based solely on underfunding. As firms enter the tail of the distribution of default probabilities, the value of their put option expands rapidly.

Another way of measuring the influence of moral hazard is to measure the current value of the contingent claim on the PBGC, or expected losses of the PBGC based on the firm's EDF. Expected losses can be estimated by multiplying the EDF by the amount of underfunding if the plan is underfunded. The distribution of this expected loss measure is also skewed, and even more so than the distribution of EDFs because underfunding is more pronounced for high-risk firms.

In addition to expected bankruptcy or expected losses to the PBGC, the empirical model controls on several other firm-specific variables that proxy for the willingness and ability of firms to make contributions and fund their DB pension plans. To measure a firm's ability to fund its pension plan, we

use excess cash flow, defined as operating income before depreciation less interest expenses and capital expenditures, relative to assets. Firms with greater excess cash flow would likely be less financially constrained from making contributions to an underfunded pension plan.³ Firms that face higher corporate tax rates will have a greater incentive to keep their plans fully funded because contributions are tax-deductible. To estimate a firm's corporate tax rate, we adopt a method proposed by Plesko (2004) that uses information on both taxable income and the availability of tax loss carryforwards to separate firms that face a high marginal tax rate from other firms. Firms that have both positive taxable income and do not have tax loss carryforwards are considered to face high-tax rates, while firms with negative taxable income or both positive taxable income and tax-loss carryforwards are considered to face a zero or uncertain marginal tax rate. Because our sample of firms is based on Fortune 1000 firms, it is not surprising that 59 percent of the firms are determined to face the highest marginal tax rate.

Firm charter value is measured by a firm's market-to-book value of assets; a value greater than 1 suggests ongoing value that exceeds its replacement cost. As for bankruptcy risk, we measure a firm's market-to-book ratio at the beginning of 2003, so as to reduce endogeneity with the financial status of the pension plan. The average value is 1.5, again consistent with relatively successful firms. In addition to firm charter value, we include variables to measure the financial viability of the industry that may affect the ability of all firms in the industry to offer a DB pension plan. For example, firms in declining industries may be less willing to bear the costs of contributing to or fully funding their pension plans if competitors have already failed and put their plan to the PBGC.

Finally, we include in the model characteristics related to the DB plan that might affect funding decisions. These include an indicator variable for whether the firm has a nonqualified plan embedded in its consolidated pension finance measures. Since nonqualified plans are rarely funded, the presence of such a plan should lead to lower funding ratios for firms with these plans. An indicator is also included if new obligations reflect a merger of the sponsoring firm in the previous year, since this could imply movements in funding ratios and portfolio allocation not reflective of specific pension funding decisions. Finally, we control on whether the firm sponsors a cash balance or other hybrid plan. We would expect this to be particularly important in the asset allocation regressions as these plans allow for more preretirement lump-sum payout and therefore have a greater need for liquidity.

Tests for Moral Hazard

The empirical analysis first tests for evidence of moral hazard behavior in direct funding decisions, specifically cash contributions, changes in net obligations, and funding ratios. Next, we test for moral hazard in

asset allocation decisions. The low degree of dispersion in asset allocations might be thought to indicate that moral hazard would not be apparent in DB plan portfolio choices, a conclusion verified in the multivariate framework. We also find compelling evidence of moral hazard in direct funding decisions, suggesting that regulatory reform efforts should recognize that this behavior may impose costs on the PBGC.

Funding Decisions. Analysis of contributions and funding ratios appears in Table 6-2. As noted, contributions refer to the firm's cash contributions to the DB plan in fiscal year 2003, scaled by the amount of underfunding at the beginning of the year. This variable is a direct measure of how aggressively the firm funds its pension plan in that year. For the 6 percent of firms that made cash contributions when the plan was not underfunded, we reset the contribution value to the 95th percentile of the distribution, signifying that contributions are largely relative to what might be required.

To test for moral hazard, we estimate regressions of contributions on measures of firm risk. Firm risk is measured at the beginning of the period to reduce the potential endogeneity problem that high-firm risk could reflect that a firm's DB plan is underfunded and represents a financial drain on the firm.⁴ As shown in Column 1, the EDF estimated coefficient is negative and statistically significant. The magnitude of the coefficient suggests that the EDF effect is substantial for very risky firms, but small for most firms with a very low probability of bankruptcy in the near term. Were the EDF to increase from the 25th to 75th percentile, from 0.19 to 1.07, the estimated coefficient of -0.017 indicates that contributions at the median plan would fall by 1.5 percentage points (from 23 percent). But if the EDF were to rise from the 90th to 99th percentile, from roughly 3 to 17, the coefficient indicates that a firm with a 17 percent chance of default would make excess contributions of 23 percentage points less than a firm with a 3 percent chance of default.

Because the majority of firms in our sample face only a minimal chance of default in the near-term horizon, it may be difficult to discern moral hazard for the average firm. To capture the subset of companies more likely to value the put option on the PBGC, we identify firms with both an EDF in the top 10 percent of the distribution of EDFs and whose DB plans are underfunded, about 8 percent of the sample. Column 2 reveals that the coefficient on this new interaction variable is negative and significant, and larger than the EDF coefficient, consistent with the skewed distribution for EDFs. An alternative risk variable is the expected dollar losses to the PBGC, a continuous measure of high risk and an underfunded DB plan, which is the product of the EDF and the amount of underfunding in the DB plan. As with the other two measures of risk, the estimated coefficient on expected losses in Column 3 is significant and negative. These findings provide strong empirical support that moral hazard is at play and that firms

TABLE 6-2 Regressions of Cash Contributions and Funding Ratios on Firm Risk

	Contributions				Funding ratio			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
EDF	-0.017** (2.54)	—	—	—	-0.007*** (2.40)	—	—	—
EDF*under	—	-0.219*** (3.61)	—	—	—	-0.092*** (3.43)	—	—
Expected loss to PBGC	—	—	-0.059*** (2.99)	0.059*** (2.97)	—	—	-0.041*** (-6.37)	-0.042*** (6.37)
Excess cash flow	1.08** (1.96)	1.09** (2.01)	1.05** (1.93)	—	0.345*** (3.07)	0.345** (3.10)	0.269*** (2.49)	—
High tax	0.059 (0.77)	0.056 (0.72)	0.057 (0.74)	0.073 (0.97)	0.022 (1.14)	0.020 (1.05)	0.015 (0.81)	0.020 (1.05)
DB assets	0.026 (0.79)	0.025 (0.76)	0.025 (0.73)	0.025 (0.73)	0.028*** (4.84)	0.028*** (4.76)	0.026*** (4.55)	0.026*** (4.49)
Market-to-book	—	—	—	0.156*** (2.63)	—	—	—	0.019** (2.08)
<i>N</i>	468	468	468	460	468	468	468	460
<i>R</i> ²	0.07	0.07	0.07	0.08	0.19	0.19	0.22	0.22

Source: Authors' calculations.

Notes: The table presents coefficients (robust *t*-statistics) from regressions of cash contributions on measures of firm risk, using a White correction for heteroskedasticity. Cash contributions to the DB plan in 2003 are scaled by the excess of PBO and the value of DB assets at the beginning of the period; when PBO is less than DB assets (plan is overfunded), the value is reset to equal to the 95th percentile value to signify high contributions. Funding ratio is the DB assets to PBO from 10-k filings. EDF is an average of monthly values for EDFs from KMV Corp. in 2002; EDF*under is an indicator variable for firms with an EDF in the top 5th percentile and an underfunded pension plan; Expected loss is EDF multiplied by the amount of underfunding. Excess cash flow is operating income less interest expenses and capital spending, high tax is an indicator variable that firm has positive taxable income and no tax loss carryforwards, and market-to-book is the ratio of the market value of assets to the book value of assets. All regressions include indicator variables for whether the DB plan is a nonqualified plan and if the firm was acquired or merged in 2002, and eight broad industry dummy variables.

with a higher chance of default respond to the risk-taking incentives in the system and systematically underfund their DB pensions.

We also include a direct measure of cash-flow constraints in these regressions to address a potential interpretation problem. It is possible that firms with high probability of bankruptcy may reduce contributions—not to exploit the PBGC insurance, but because they do not have the financial resources to boost plan funding levels. Thus we include excess cash flow, measured as the ratio of operating income less capital spending and interest expenses to assets, in the regressions to proxy for financial constraints. As predicted, the coefficients on excess cash flow are positive and statistically significant in all of the regressions. In other words, companies with greater excess cash flow are indeed more likely to make greater cash contributions relative to their underfunding.⁵ The important implication is that, after controlling for financial constraints, coefficients on the expected default rates remain negative and significant, consistent with moral hazard.

High excess cash flow is also positively related to a firm's charter value and so may reflect management's interest in preserving the firm as an ongoing entity as well as financial constraints. In Column 4, we replace excess cash flow with the market-to-book value of assets, and the estimated positive coefficients indicate that firms with greater charter value more aggressively fund their DB plans, consistent with our hypothesis that these firms have considerable value to lose before they can exploit the put option on the PBGC. The coefficients on expected loss to the PBGC are unaffected and remain significant. Other control variables are also of interest. Firms that face a higher corporate tax rate will receive a higher tax deduction for the DB plan contributions. The variable indicating that the firm faces a high marginal corporate tax rate is positive though not significant in the contribution regressions. Coefficients on an indicator variable for whether the DB plan is nonqualified or a variable for if the plan sponsor was acquired or merged are not significant in any specification.⁶

Contributions are only part of the story: companies can also promise additional benefits to employees without funding those promises. To capture this broader concept of underfunding, we define a net increase in obligations as the increase in obligations less the increase in assets, both in 2003, again scaled by the amount of underfunding at the beginning of the period. We find no statistical relationship between the net increase in obligations and bankruptcy risk or expected losses to the PBGC (results not shown), although additional work is needed to control for differences in discount rates that may vary with firm risk. While these results do not provide evidence of moral hazard as suggested by results for contributions and excess contributions, we also find no evidence that firms in weak financial condition take actions to reduce their net pension obligations.

The results for funding ratios at fiscal year-end 2003 are also shown in Table 6-2, in Columns 5 to 8. This variable can be viewed as a good

summary measure of the various funding decisions, since it reflects the net effect of contributions and increased obligations. Consistent with results supporting moral hazard in the contribution outcomes, here we again find that the coefficient on EDF is negative and significant. This suggests that a firm with an EDF of 1 will have a funding ratio that is 7 percentage points higher than a firm with an EDF of 11, an economically significant difference. As with excess contributions, however, the difference in the funding ratio for most firms with low risk is small. Significant coefficients on an indicator of high default probability and DB underfunding and the variable measuring expected losses to the PBGC are also consistent with moral hazard.

In addition, as found in the contribution regressions, the coefficients on excess cash flow are positive and statistically significant, indicating that firms not facing financial constraints are more likely to have better-funded DB plans. The positive coefficient on market-to-book, when used in place of excess cash flow, also suggests that firms with high ongoing charter value see little gain from exploiting the put option. The coefficient on DB assets is positive and significant, suggesting larger plans are more likely to be better funded. This could reflect that management at firms with large and thus more prominent plans find it in their interest to avoid the costs of underfunding such as more interference by pension plan participants or the PBGC. The indicator for whether the firm faces a high marginal tax rate is positive, but not significant. Finally, nonqualified DB plans tended to have lower funding ratios.

In summary, the results for the funding ratios are consistent with the view that riskier firms underfund their DB plans by a greater amount, but not because they lack the financial resources to boost funding. The underfunding at riskier firms stems from lower contributions and not greater unfunded promises to workers. To try to parse out the effect that lower contributions have on reduced funding ratios at riskier firms, we perform some comparative static exercises. As illustrated earlier, estimated coefficients on the risk measures we consider imply large changes in funding ratios due to increased firm risk when firm risk is high, but only small changes at the majority of firms that have a low probability of default. For low-risk firms, estimated contingent claims on the PBGC are minimal and their behavior is mostly unaffected by the put option. For high-risk firms, if the expected probability of default rises from the 90th to 99th percentile, from 3 to 17, the funding ratio would be predicted to fall by 10 percentage points. Holding the amount of dollar obligations constant, this implies a drop of \$64 million dollars in assets at the median plan (with DB assets of \$542 million). In this same scenario, if the EDF rises from 3 to 17, we estimate that contributions would fall from their median rate of 0.23 to about 0. At the median plan, this fall would imply that about 40 percent of the lesser funding at high-risk firms would come from lower current cash

contributions. The contributions regression captures only a year of funding choices. The fact that the dollar amount of underfunding from an increase in risk is so much larger than the estimate from one year of contributions suggests that the lower contribution behavior may persist over a number of years. It is also possible that some of the underfunding may be due to different returns on assets owing to risk-taking in the pension portfolio.

Asset Allocation Decisions. A different channel through which firms might display moral hazard is by choosing to take greater risks with their pension assets as they move closer to bankruptcy. Hsieh et al. (1994) found no effect of DB underfunding on pension equity allocations, but no studies have looked at whether equity allocations are systematically related to plan sponsor risk. Our newly available data from disclosures in company financial statements on equity allocations allow us to assess this issue directly.

In considering the influences of risk on asset allocation, we need to consider some other factors as well. As noted earlier, one factor much discussed in the theoretical literature is that firms with higher marginal tax rates can create value for shareholders by investing more of their DB assets in bonds as they are the most highly taxed security, implying a negative relationship between high-tax status and allocations to equity. In addition, finance theory predicts that firms should mitigate the risk on their balance sheet by immunizing their pension liabilities through bond investments. A corollary of this hypothesis is that plans with shorter duration liabilities should be more inclined to immunize their portfolios, implying a larger allocation to fixed investments. Since we do not observe actual liability duration, we develop a proxy by taking the service cost, which is the value of benefits earned by employees as a result of their work during the current year, divided by the sum of service cost and interest cost, which is the cost of losing a year of discounting and is calculated by multiplying the discount rate by the present value of liabilities. The larger is this fraction, the greater is the share of increased benefits that is due to current service and, therefore, the longer the duration of liabilities. The average value of our duration proxy is 33 percent for firms in our sample. Finally, we include an indicator for whether the plan is a cash balance plan in our equity share regressions. Cash balance plans generally have a greater need for liquidity and could therefore hold less equity.

Regression results linking the equity share of the DB assets to firm risk and other variables appear in Table 6-3. The coefficients on the three measures of firm risk are not statistically significant, providing no evidence that riskier firms systematically put a greater share of their DB assets in equities. We find similar results, not reported here, when we add the share held in 'other' assets, primarily venture capital and other private equity funds, to the equity share. Nor do we find a relationship when firm risk

TABLE 6-3 Regressions of Equity Allocation on Firm Risk

	<i>Equity share of DB assets</i>		
	(1)	(2)	(3)
EDF	-0.038 (0.26)	—	—
EDF*under	—	-0.82 (0.47)	—
Expected loss to PBGC	—	—	-0.351 (-1.14)
Excess cash flow	8.35 (1.13)	8.16 (1.13)	7.27 (1.00)
High tax	3.31*** (2.86)	3.26*** (2.82)	3.22*** (2.83)
DB assets	-0.75 (0.89)	-0.76 (0.90)	-0.78 (0.92)
Duration	13.02** (2.44)	12.99*** (2.43)	13.32*** (2.48)
DB assets-to-firm assets	8.88* (1.67)	8.81* (1.67)	8.88* (1.67)
Cash balance plan	-1.84 (1.22)	-1.80 (1.20)	-1.80 (1.23)
<i>N</i>	363	363	363
<i>R</i> ²	0.13	0.13	0.13

Source: Authors' calculations.

Notes: The table presents coefficients (robust *t*-statistics) from regressions of the share of DB assets in equities on measures of firm risk, using a White correction for heteroskedasticity. Equity share of DB assets is disclosed in the footnotes of company financial statements. EDF is an average of monthly values for EDFs from KMV Corp. in 2002; EDF*under is an indicator variable for firms with both an EDF in the top 5th percentile and an underfunded pension plan; Expected loss is EDF multiplied by the amount of underfunding. Excess cash flow is operating income less interest expenses and capital spending, high tax is an indicator variable that firm has positive taxable income and no tax loss carryforwards, and market-to-book is the ratio of the market value of assets to the book value of assets. Duration is the ratio of service cost to the sum of service cost and interest cost. All regressions include indicator variables for whether the DB plan is a nonqualified plan and if the firm was acquired or merged in 2002, and eight broad industry dummy variables.

lagged an additional year is added, to allow for a longer adjustment period to higher risk. Thus, while riskier firms appear to reduce contributions and have underfunded pension plans, they do not invest more of the DB assets in higher-risk assets, at least as measured by the share of the portfolio allocated to equity. Another possibility is that while the allocation to all equities is not affected, weaker firms are investing in equities with higher risk, but our data are unable to capture that.

Even if there is no relationship of firm risk and risk-taking in the pension portfolio, these results do not imply that the high share of assets held in equities cannot explain a good portion of PBGC losses. In fact, because firm bankruptcies and general stock market returns are procyclical and both tend to be low at the same time (Neuberger and McCarthy 2005), high equity allocations are likely a big contributor to PBGC losses. Instead, our results merely reflect that firms tend to congregate around an equity share of between 60 and 75 percent, and the limited variation is not related to the risk of the firm. It is possible that as firms grow riskier and their plans are underfunded, they may face greater pressure from participants or the PBGC to hold more liquid assets and thus less equity. But when we estimate similar regressions of the cash share, or the combined cash and fixed-income securities share of the pension portfolio, the coefficient on firm risk is insignificant. This suggests that equity allocations are more likely to be explained by nonrisk factors.

An alternative hypothesis for equity allocations is the higher expected returns to equities receive favorable treatment from both actuaries and accountants. Actuaries tend to smooth the value of assets, thereby suppressing the volatility of equities. Current accounting standards under FAS 87 allow firms to reduce their stated pension costs by offsetting benefit accruals with an expected return on assets that include an equity premium unadjusted for risk. Firms are then allowed to smooth actual returns that deviate from this expected return, effectively obscuring the realizations of risk in stated earnings. To the degree that investors fail to 'see through' pension accounting, the value of this apparent cost reduction will be greater for firms with larger pension plans. In order to write down a higher expected return, in general firms must allocate a higher fraction of their portfolio to equity. The positive coefficient on the size of the DB plan relative to the firm is consistent with this hypothesis. A related hypothesis, but one that cannot be tested with our data, is that pension fund managers do not want to deviate greatly from other pension funds in terms of asset allocations so that returns do not deviate, because managers who fail to match benchmark returns to pension assets might be fired. The costs of underperformance might help explain the concentration of equity assets at between 60 and 75 percent. In terms of other variables, the coefficient on duration is positive and significant as predicted, indicating that plans with longer durations invest more in equity. The coefficient on the high-tax rate, however, has the opposite sign of what would be predicted by tax efficiency.

In summary, these results provide support for the hypothesis that moral hazard brought about by the current structure of private-pension insurance has a significant influence on the finances of corporate DB pensions. It appears that this moral hazard manifests itself mainly through reduced contributions which lead to lower funding among very high-risk firms. We do not find evidence that firms nearing bankruptcy allocate a greater

fraction of their portfolio to risky assets, although the risk-taking may occur within the broad stock portfolio, and the equity share can still account for a large part of PBGC losses since firm bankruptcies and low-equity prices tend to be correlated. As illustrated here, lower contributions likely occur over a number of years and imply substantially lower funding levels for firms nearing bankruptcy.

Conclusions

Firms' actions as they approach bankruptcy influence the pension claims put to the PBGC, a topic not explored in previous empirical work. While some previous literature seems to suggest that most of these claims can be explained by the high share of plan assets in equities, we suggest the behavioral channel is quite important. We find that riskier firms tend to make lower cash contributions to their DB plans and have lower funding ratios, even after controlling for excess cash flow. Our estimates suggest that reduced current contributions at high-risk firms can account for about 40 percent of the lower funding ratios at these firms. On the other hand, we do not find evidence that firms closer to bankruptcy invest more of their DB assets into equities.

This is not to say that the PBGC does not bear a substantial amount of risk from equity investments, since bankruptcies tend to increase at times when stock prices are low. However, the fact that pension insurance does not account in any way for firm insolvency risk combined with our evidence of moral hazard among riskier firms suggests that attempts to shore up the insurance system need to provide strong incentives for weaker enterprises to make different choices with their pension fund finances.

Endnotes

1. If an insolvent sponsor has sufficient assets to meet obligations, the PBGC is involved only in overseeing compliance with ERISA requirements through the termination process. Likewise, if a solvent sponsor decides to terminate the PBGC oversees the termination but the company is responsible for fully funding promised benefits.
2. See Orszag (2005) for a comprehensive review of the literature.
3. We also included a firm's debt-to-asset ratio, in that less-leveraged firms could raise debt to fund their pension plan, but this variable was not statistically significant and is not reported.
4. Although it is possible that an underfunded DB plan could cause a firm's bankruptcy risk to increase, we find in a simple regression model that a firm's expected default frequency is not significantly related to its current period or previous period DB funding ratio.
5. We also include firm debt-to-asset ratios, to proxy for the ability to issue bonds or secure a bank loan to fund the DB plan, but this variable is not significant in any regressions, and so was excluded in the regressions that we report.

6. We also examined a variable of two-digit industry market-to-book values to distinguish declining industries from growth industries and interest in offering a DB plan, but it was not significant in any of the regressions, and so is not included. Instead, industry dummy variables appear to pick up industry effects.

References

- Bicksler, James L. and Andrew H. Chen (1985). 'The Integration of Insurance and Taxes in Corporate Pension Strategy', *Journal of Finance*, 40(3): 943–55.
- Black, Fischer (1980). 'The Tax Consequences of Long-run Pension Policy', *Financial Analysts Journal*, 36 (July–August): 1–28.
- Bodie, Zvi, J. O. Light, Robert Morck, and R. A. Taggart, Jr. (1987). 'Funding and Asset Allocation in Corporate Pension Plans: An Empirical Investigation', in Zvi Bodie, John B. Shoven, and David A. Wise (eds.), *Issues in Pension Economics*. Chicago, IL: University of Chicago Press, pp. 15–47.
- Buser, Stephen, Andrew Chen, and Edward J. Kane (1981). 'Federal Deposit Insurance, Regulatory Policy, and Optimal Bank Capital', *Journal of Finance*, 36(1): 51–60.
- Cardinale, Mirko (2005). 'Corporate Pension Funding and Credit Spreads'. London: Watson Wyatt Technical Paper.
- Cole, Rebel, J. McKenzie, and Lawrence White (1995). 'Deregulation Gone Awry: Moral Hazard in the Savings and Loan Industry', in A. Cottrell, M. Lawlor, and J. Wood (eds.), *The Causes and Consequences of Depository Institution Failures*. Amsterdam: Kluwer Publishing, pp. 29–57.
- Coronado, Julia L. and Steven Sharpe (2003). 'Did Pension Plan Accounting Contribute to a Stock Market Bubble?' *Brookings Papers on Economic Activity*, 1: 323–59.
- Feldstein, Martin S. and Stephanie Seligman (1981). 'Pension Funding, Share Prices and National Savings', *Journal of Finance*, 36(4): 801–24.
- Hooks, Linda M. and Kenneth J. Robinson (2002). 'Deposit Insurance and Moral Hazard: Evidence from Texas Banking in the 1920s', *The Journal of Economic History*, 62(3): 833–53.
- Hsieh, Su-Jane, Kenneth R. Ferris, and Andrew H. Chen (1997). 'Evidence on the Timing and Determinants of Overfunded Pension Plan Termination', *Review of Quantitative Finance and Accounting*, 8(2): 129–50.
- Jin, Li, Robert C. Merton, and Zvi Bodie (2004). 'Do a Firm's Equity Returns Reflect the Risk of its Pension Plan?' NBER Working Paper No. W10650.
- Marcus, Alan J. (1987). 'Corporate Pension Policy and the Value of PBGC Insurance', in Zvi Bodie, John B. Shoven, and David A. Wise (eds.), *Issues in Pension Economics*. Chicago, IL: University of Chicago Press, pp. 49–79.
- Neuberger, Anthony and David McCarthy (2006). 'The UK Approach to Insuring Defined Benefit Pension Plans', this volume.
- Pennacchi, George G. and Christopher M. Lewis (1994). 'The Value of Pension Benefit Guaranty Corporation Insurance', *Journal of Money, Credit and Banking*, 26(3): 735–53.
- Plesko, George A. (2003). 'An Evaluation of Alternative Measures of Corporate Tax Rates', *Journal of Accounting and Economics*, 35(2): 201–26.

108 Julia Coronado and Nellie Liang

Sharpe, William F. (1976). 'Corporate Pension Funding Policy', *Journal of Financial Economics*, 3(3): 183–93.

Tepper, Irwin (1981). 'Taxation and Corporate Pension Policy', *Journal of Finance*, 36(1): 1–13.

Thies, Clifford F. and Thomas Sturrock (1988). 'The Pension-Augmented Balance Sheet', *Journal of Risk and Insurance*, 55(3): 467–80.

Treynor, Jack L. (1977). 'The Principles of Corporate Pension Finance', *Journal of Finance*, 32(2): 627–38.

Zion, David and Bill Carache (2005). *The Magic of Pension Accounting*, Part III. Credit Suisse First Boston Equity Research.