How Deep is the Hole?

A Stochastic Analysis of the Pension Benefit Guaranty Corporation

by

Richard Dean Apple

Advised by

Patrick Cheridito

A senior thesis

Submitted in partial fulfillment

of the requirements for the degree of

Bachelor of Science in Engineering

Department of Operations Research and Financial Engineering

Princeton University

April 18, 2005

I hereby declare that I am the sole author of this thesis.

I authorize Princeton University to lend this thesis to other institutions or individuals for the purpose of scholarly research.

Richard D. Apple

I further authorize Princeton University to reproduce this thesis by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Richard D. Apple

For my family,
with love and commitment.

Contents

Acknowledgements

I would like to acknowledge a few people for the help they provided to me throughout the process of researching the PBGC and writing this thesis. I am grateful to Patrick Cheridito for serving as my advisor and providing me with good guidance and feedback. I would also like to thank Zhuojuan Zhang, for making herself freely available to help me with the stochastic modeling. More than anyone else, I would like to thank Douglas Elliott for advising me informally over the past several months, and for allowing me to work with his original cash flow model. All of the models developed in this thesis were based on the model he developed for the Center On Federal Financial Institutions. Without his aid this study would not have been possible.

Lastly, I would like to thank my family and friends, who have showered me with love and support throughout my years at Princeton. For them I am eternally grateful.

Chapter 1: The PBGC and its Problems

On September 14th, 2004, the *New York Times* ran an article entitled "An outsider's grim prognosis for Pension Agency." The piece focused on the bleak situation facing the Pension Benefit Guaranty Corporation (PBGC), a federal agency that insures the pension benefits of over 44 million employees. The article mainly relied on an independent analysis of the PBGC's financial position by Douglas J. Elliott, the president of the Center on Federal Financial Institutions and a Wall Street veteran. While most companies have been able to maintain the solvency of their pension programs, the poor market performance of the past three years has pushed too many of the PBGC's clients over the edge, and the agency is slowly but surely running out of money to meet its financial obligations. Elliott's conclusions are plain and simple. If no measures are taken, either the retirees who rely on the PBGC will eventually stop receiving their checks, or the taxpayers will need to bail the agency out. Even if conditions improve, so that fewer companies default on their pension obligations in the upcoming years, the PBGC is still expected to run out of cash by 2023. The PBGC is financially insolvent on the basis of Generally Accepted Accounting Principles (GAAP); as Elliott notes, "Any private insurance company under such circumstances would be shut down" [1]. The PBGC's problem is worsened by the fact that few people know about it. Almost everybody understands that the United States Social Security program is in a financially vulnerable position, but even conservative estimates place its failing point some thirty years into the future – almost twice as far away as the PBGC's.

Background

Created as part of the 1974 Employee Retirement Income Security Act, the Pension Benefit Guaranty Corporation's essential purpose is to protect people against the loss of pension benefits due to company bankruptcy. It aims to protect and provide the regular payment of pension benefits to retirees and to keep pension insurance premiums at a minimum. As of 2003, it insured $1.5 trillion worth of promised pension payments [2]. The PBGC insures only "defined benefit" pension plans, which typically promise to pay a specified benefit at retirement defined by salary and years of service, independent of investment returns. A customary arrangement might be that the pension benefit at retirement equals 1.5 % per year of service times the final salary. Under such a scheme, a worker who put in twenty years of service whose final salary was $60,000 would be entitled to an annual benefit of $18,000. Most private sector companies which have defined benefit retirement plans are insured by the PBGC [3]. These companies pay a yearly premium to participate in the insurance program. While the PBGC does insure some multi-employer pension plans, the majority of the over 31,000 protected pensions are within the single-employer program. The multi-employer and single-employer insurance programs are legally distinct entities, but the PBGC's activities are heavily weighted towards the latter. Of the roughly $46 billion in liabilities taken on by the PBGC, $45 billion were for single-employer plans [3].

It is important to understand that the PBGC does not insure the retirement benefits of the increasingly popular 401K plans, which function quite differently. 401K accounts fall into the "defined contribution" type of retirement plan, whereby an

employer makes a regular contribution to the investment account of an employee who receives the account upon retirement. The primary difference between the two types of retirement plans is that the 401K benefits are contingent upon market returns, whereas the defined benefit plans are not.

The nature of the PBGC is fairly straightforward. The PBGC is designed to operate relatively independently and has not to date received any funding from taxpayers. The first revenue source is the insurance premium charged to any private company that wishes to participate in the program. The level of the premiums is controlled by Congress; however, the current rate has not been adjusted in over a decade. Once an employer's pension fund is determined to be insolvent, the PBGC then takes over all of the fund's assets. This second source of revenue is always less than the value of the liabilities being assumed by the PBGC. Interestingly, this practice makes it possible for the PBGC to be both cash rich and economically insolvent at the same time, since it assumes all of the assets immediately and the liabilities are spread out over future time [4]. Thus, it may be true that even when the PBGC's assets are growing its net present value is still decreasing, as is currently the case. The third source of revenue is bankruptcy recoveries, which the PBGC gains from the estates of insolvent sponsors. Historically, the PBGC has only been able to recover assets equaling 3-4% of the underfunding, and these recoveries usually take several years to materialize [5]. These three streams of revenue are collected and invested in a portfolio consisting of roughly two thirds low-risk debt and one third equities. The PBGC uses these assets to meet the pension obligations of the companies formerly responsible for the plans. When PBGC is forced to take over underfunded plans, the burden often falls heavily on workers and

retirees. In some cases, workers lose benefits that were earned, but not guaranteed. This results for two reasons: some types of health and welfare benefits are unprotected, and there is a cap on annual benefit payments. The maximum guaranteed pension at age 65 for participants in plans that terminated in 2004 is $44,386 a year [3]. This guarantee limit grows every year with inflation.

There are three types of defined benefit pension plan terminations for participants in the PBGC's single-employer program [6].[1] A sponsor with a fully funded pension trust may voluntarily seek a "standard termination" and follow a specific set of procedures to end its responsibility. Because the termination of a defined benefit plan means that activities such as benefit accruals and vesting cease, certain companies with fully funded plans may seek a standard termination to stop providing new benefits. Specifically, the PBGC was created to protect the retirement benefits of those retirees whose pension plans have insufficient assets. There are two ways in which underfunded pension plans can be terminated. In these cases the PBGC assumes both the assets of the pension and the pension obligations. In a "distress termination" a company in financial distress voluntarily seeks to discard its pension obligations in order to remain in business. These are granted in three circumstances: 1) the company is being liquidated in bankruptcy proceedings; 2) a company reorganizing under Chapter 11 cannot remain in business without a plan termination; and 3) the costs of providing pension coverage have become an unreasonable burden because of a decline in the number of participants. In an "involuntary termination" the PBGC may initiate the plan termination if: 1) the plan has not met the minimum funding requirements; 2)

[1] Terminations do not typically occur for the underfunded multi-employer plans. Usually the PBGC provides loans to provide for the payment of pension benefits. The loans are rarely repaid.

the plan will not be able to pay the current benefits when they are due; and 3) the loss to the PBGC will substantially increase if the plan is not terminated. There are degrees of judgment regarding when exactly these conditions are met, and those decisions are often resolved in court proceedings. Obviously, the distress terminations and involuntary terminations account for the bulk of the PBGC's past and future claims.

Until recently, the PBGC typically ran a modest surplus, but the past three years have brought down a number of big pension plans, including Bethlehem Steel, and have turned what used to be a $7.7 billion surplus into a $23.3 billion deficit. In the 2004 fiscal year alone the PBGC reported a net loss of $12.1 billion [7]. What makes the situation even worse is the prospect of more employers, especially in the airline industry, defaulting on their pension promises and shifting their underfunded pension plans onto the PBGC. Overall, the airline industry has accounted for roughly 20% of the total claims against the PBGC even though its plans represent less than 2% of insured participants [8]. Five of the largest ten claims in the PBGC's history have come from the weakened air carriers, and they continue coming in. On December 30th, 2004, the PBGC issued a press release explaining that it planned to assume the pilots pension plan at United Airlines (UAL). This termination meant that the pension benefits of 14,000 active and retired pilots were shifted to the PBGC, with a net claim of around $1.4 billion – the third largest claim in PBGC history [8]. Because pilots tend to have higher salaries, this termination is the perfect example of how workers and retirees often bear the brunt of the plan terminations. Under current circumstances with the PBGC cap on guaranteed benefits, the pilots lost about $1.5 billion dollars in uninsured pension promises. With more anticipated claims on the horizon from UAL, US Air, and

the rest of the airline industry, the PBGC's financial woes will likely intensify. In just the first few months of 2005, the PBGC has already taken over several pension plans covering ground employees at UAL and flight attendants and machinists at US Air [9, 10, 11]. Furthermore, as each of these airlines is successful in shifting pension liabilities off to the PBGC through bankruptcy proceedings, other air carriers feel increasing competitive pressure to follow suit [12].

Unfortunately for the PBGC, the scope of the problem is not confined to the airline industry. In the defined benefit system as a whole the gap between promised benefits and current pension funding levels has soared in recent years. The PBGC estimates that total underfunding in the plans it insures surpasses $450 billion – a staggering number [13]. While the bulk of this is from companies with healthy finances, approximately $96 billion of the underfunding is from pension plans sponsored by companies with below investment grade ratings. The PBGC faces tremendous exposure from the manufacturing sector of the economy which accounts for $48 billion of that underfunding [13].

The roots of the crisis stem from a number of factors. Part of the problem is simply that the premiums charged by the PBGC do not adequately reflect the risks of the business. The current premium levels have proven inadequate to cover the PBGC's position during the recent economic downturn. In 2002, Boyce and Ippolito published a study in the *Journal of Risk and Insurance,* arguing that the PBGC's premiums were at best half of the appropriate rate [14]. They cite other studies which conclude that the premiums might be as low as one sixth the level necessary to sustain the PBGC's insurance business over the long term. The PBGC and various policy advocates are

currently petitioning Congress to reform the premium structure and bring the prices paid by plan sponsors more in line with the risks of the insurance scheme.

In theory, a sponsor is legally obligated to contribute sufficient funds to its pension plan to cover all future payments. Although the tax code and governmental regulations are extremely complex, the basic concept is that the target funding level should be economically equivalent to the net present value of the future pension payments [3]. However, if companies always functioned this way in practice there would be no need for the PBGC.

One big cause of the immediate crisis is the poor market performance of many investments in recent years – the bursting of the bubble. This has dramatically decreased the value of pension trust funds because many employers invest heavily in equities since stocks have historically higher returns. Current funding regulations encourage this sort of behavior since they allow companies to shift much of the downside risk onto the PBGC, while reaping the rewards during times of economic prosperity. When stock returns are high this means that companies need to contribute less money to their pension funds to maintain adequate funding, but when stock returns are low and the value of the pension funds decline the PBGC often steps in to take the loss. Furthermore, typical accounting and actuarial practices usually use something similar to the expected rate of return on a pension fund as the discount rate for valuing future liabilities [3]. Since a higher discount rate lowers the net present value of the pension obligations, this encourages employers to invest their contributions in equities even more. Many people argue that companies ought to be forced to make more conservative investment choices, pointing out that the reason stocks offer higher

expected returns is because they are inherently more risky, and the higher expected rate of return is compensation for the risk involved in the investment. Lobbyists have been very successful, however, in persuading Congress to allow companies a lot of flexibility regarding the funding of their pension plans. And companies have certainly taken full advantage of this.

While on the topic of lax regulations, a related problem is that current funding rules are not strict enough regarding the timing and flexibility of sponsor contributions. Companies are often allowed to stop contributing when a pension plan is only 90% funded, and they are given too much time to catch up when a plan is underfunded [13]. Two ways in which the pension funding rules could be tightened are requiring a higher target level of funding, and requiring higher contributions when plans are underfunded [15].

Shady accounting practices have also exaggerated the problem by enabling companies to treat their pension funds as the source of emergency earnings. An article entitled "Time to End a Scandal" published in the October 28th, 2004 edition of *The Economist* explains how many companies have been conjuring up profits by adopting unrealistic return assumptions on their pension investments and moving the excess cash onto their balance sheets. "In effect, this means the pension fund is making a forced, unsecured loan back to the company, with no interest charges to reflect the concentration of risk the loan involves." [16] And all this is occurring with the simple stroke of an actuary's pen. Such unethical practices have hurt both the employees and the insurers like the PBGC; the Securities and Exchange Commission and the companies themselves ought to take measures to curtail them. Taken together, the

problems presented by loose funding regulations and devious accounting procedures expose the PBGC to significant moral hazard concerns, as companies often have strong incentives to function in ways that put workers' retirement benefits and the PBGC at great risk.

Demographic trends are another structural factor increasing the liabilities. Many of the largest defined benefit pension plans are sponsored by companies in the nation's oldest industries. These industries face growing pension and health care costs due to an increasing number of older and retired workers. Americans are living longer and retiring earlier. While insurance providers do a relatively good job of keeping actuarial tables, they have not been wholly able to keep up with the large increases in recent decades. Often, while they do anticipate much of the increase, they miss a small portion of it. The PBGC published a study in its 2004 financial reports in which it concluded that it had been underestimating how long its retirees were going to live [17]. This inevitably means that more money will be necessary to cover the future payments.

Thus, the crunch at the PBGC is not attributable to any one issue, but rather is the result of a number of factors, and just simply the struggling economy of recent times. Interestingly, the correlation of bankruptcies with economic downturns as a whole generates more downside exposure for the PBGC [18]. If claims against the PBGC were unrelated to prevailing market conditions, the PBGC might be able to fight its way through periods of high claims with higher returns on its investments. Unfortunately for the PBGC, market downturns and company bankruptcies are significantly correlated. Thus, the times when the PBGC is under the greatest amount of financial pressure, are also the hardest times for it to earn significant investment

returns. Some of the models developed in this thesis are designed to account for this effect.

The goal of this study is, in light of the current financial crisis, to gain further insight into the PBGC's situation by evaluating and extending Elliott's cash flow model. The main questions that will be addressed are: How bad are the PBGC's problems? Would they disappear if economic conditions improved? And, if the problems will not disappear, what structural measures ought to be taken to strengthen the PBGC? Hopefully, gaining a better understanding of the problems will facilitate the development of superior solutions.

Chapter 2: The Elliott Model

As touched on in the previous chapter, employers and unions have some interest in not addressing the PBGC's woes. Employers are happy to continue through their investment decisions to shift much of the downside risk onto the PBGC, and unions are constantly afraid that their wages will be reduced. Thus, those with the best knowledge and expertise in the realm of defined benefit pension plans have a vested interest in not addressing the problem. The purpose of Elliott's cash flow model is to refute these forces with factual data, and to educate the policy makers about the growing problem at the PBGC [19]. According to Elliott's model, the situation is dire. He uses the publicly available financial reports of the PBGC and the 10-K financial reports of several airline companies to perform his analysis. The projected cash flow model he constructs is similar to those used by many Wall Street investment bankers in which future cash flows are discounted back to net present value (NPV) using a discount rate. The core equation of the model is:

End of Year Cash & Investments = Beginning of Year Cash & Investments + Investment Income + Premiums + Assets Taken Over for New Claims – Benefits Paid – Net other Expenses [4]

The model assumes the continuation of current law and government policy and projects the cash flows and resulting investment balances out over a 75 year horizon, in line with the standard projection period of Social Security. Thus Elliott's model is deterministic rather than stochastic, taking inputs collected from a variety of financial reports and combining them with a set of reasonable assumptions to calculate specific key results. The most important results are the year of cash exhaustion (the year when

retirees would stop receiving their benefit checks) and the total NPV of the PBGC given the projections for future cash flows. This second result determines the amount of money in today's terms necessary to cover all the future pension payments – it is the size of the monetary hole that needs to be filled given the best estimates.

The model consists of sixteen individual Microsoft Excel spreadsheets so that the various elements can be broken down and analyzed independently, and then combined to determine the yearly cash flows of the PBGC. Thus, even though the model is quite complex, this modularization allows for manipulation of key inputs and assumptions, and in-depth analysis of the individual components. For example, there is one spreadsheet entitled "Investments" which determines the yearly investment income from the PBGC's assets, one called "Control Panel" which is used to manipulate certain assumptions, and one called "Summary" in which all the individual elements are combined to arrive at the cash flow numbers. The most complicated part of determining the cash flows is projecting the future pension claims.[2] Elliott's model breaks down this component into three sections: existing claims, expected airline terminations, and future non-airline claims. The existing liability pension payments were based on the PBGC's own published estimates, so projecting these existing claims was very straightforward. For the anticipated airline terminations the model is broken down into seven separate spreadsheets; one each for the six legacy carriers, United Airlines, U.S. Air, Delta, American, Continental, and Northwest, and a seventh representing the remaining airlines. The potential claims projections and current pension funding levels for the individual airlines were obtained from their 10-K reports,

[2] As far as the model is concerned this is the most complicated part, not necessarily the most important. Remember, a claim is the amount of underfunding (NPV of assumed liabilities net assumed assets).

and adjusted to account for PBGC guaranty limits. Each company's 10-K financial report contains specific estimates of pension liabilities for the next five years and a total net present value of assets and liabilities. Thus the model analyzes each of the carriers independently, and then sums over them to obtain the anticipated claims on the PBGC resulting from airline terminations. Because the model is compartmentalized, it has the capacity to easily include or exclude each of these seven airlines in the comprehensive PBGC cash flow analysis. As for the future non-airline claims, the model breaks these down by decade. The first decade is based on the PBGC's own estimates, and future decades are projected from a thirty year average of annual claims. There will be more discussion of these future non-airline claims in the following sensitivity analysis.

In addition to the data from the various financial reports, a number of key assumptions were made in the creation of the model. Some of the most important assumptions are: a 5.12% discount rate, the same 5.12% annual return on average investments, the investment allocation of 20% in stocks, the $0.9 billion annual premiums after 2004, and the average new claims of $2.7 billion. The sensitivity of the two key results, the year of resource exhaustion and the PBGC's total NPV based on current projections, to each of these assumptions will be addressed in turn. For this analysis, the "Base Case" review excludes all the airlines, and the "Base + Legacy" includes terminations at all six of the legacy carriers. The reason for including the legacy airlines is that there is currently $31 billion of underfunding in airline pension plans, and a large portion of this was just classified in 2004 by the PBGC as "probable losses" [4, 17].

Sensitivity Analysis

Figure 1: Discount Rate sensitivity analysis

Discount Rate	**4%**	**5.12%**	**7%**	**9%**
Total NPV in millions				
Base Case	-109,864	-66,460	-28,593	-7,420
Base + Legacy	-119,895	-79,036	-37,545	-10,783
Year of Cash Exhaustion				
Base Case	2022	2022	2022	2022
Base + Legacy	2021	2021	2021	2021

The discount rate applied to the future pension payments is very controversial. The general concept underlying most funding requirements is that the amount of assets in a pension fund should be greater than or equal to the net present value of all the future pension payments. Since the benefit obligations of a pension liability are spread over so many years, the decision regarding what discount rate to use is very significant. As evidenced by the table above, a change of just 1% can result in a $40 billion difference in terms of NPV. Most actuarial and accounting practices assume a discount rate that is a conservative estimate of the actual pension investment rate of return. Pension plans usually consist of a mix of equities and fixed income securities, and using typical methods this can result in a discount rate as high as 8-9% [3]. Others, including Elliott, lean more towards using a rate of return that would typically be earned on less-risky investments, or even risk-free investments. Elliott set the discount rate to equal the investment return rate more out of simplicity than anything else, but he expressed that he would not have done this if the expected investment return varied much from low-risk corporate bonds or U.S. Treasury securities [19]. Clearly, the cash flows are not substantively affected by the choice of discount rate, and thus this variable does not

influence the year of cash exhaustion. The discount rate does however have a significant impact on the PBGC's NPV position, as seen in Figure 1.

Figure 2: Investment returns and allocations

Return on Stocks	**8%**	**8%**	**8%**	**10%**	**10%**	**10%**
% Invested in Stocks	**20%**	**40%**	**75%**	**20%**	**40%**	**75%**
Investment return	5.12%	5.84%	7.10%	5.52%	6.64%	8.60%
Year of Cash Exhaustion						
Base Case	2022	2023	2026	2022	2025	2033
Base + Legacy	2021	2022	2024	2021	2023	2031

The model assumes a 4.4% return on bonds, so the overall investment return is a blend of the stock return, the investment allocation, and 4.4%. Since the rate of investment returns is not fundamentally connected with the choice of discount rate, the opposite effect is seen here. The investment return, being in the future, does not influence the NPV of the PBGC at all, but only has implications concerning the year of cash exhaustion. The PBGC's current target investment allocation is 20% in stocks and 80% in bonds, which is somewhat lower than its historical average of 33% and 67% [17]. One proposed remedy for the PBGC's current deficit is to invest more heavily in equities since they generally earn a higher return. In the Base Case, a more aggressive allocation could easily push the cash crunch out a few more years until 2026. One of the model's biggest weaknesses is that there is no way to vary the investment allocations or the returns over time. Historically, stock returns have varied dramatically, so a more aggressive investment portfolio would necessarily entail increased downside risk. While it may be wise for the PBGC to seek a higher return, it

is unreasonable to assume that higher investment returns offer a comprehensive solution to the PBGC's woes.

Interest rates influence the model through both the investment return and the choice of discount rate. A higher interest rate will not only aid the PBGC by yielding a higher investment return, but also by increasing the discount rate which would decrease the NPV of PBGC pension obligations.

Figure 3: New Claims sensitivity analysis

New Annual Claims	**1,700**	**2,700**	**3,700**
Total NPV in millions			
Base Case	-48,158	-66,460	-84,761
Base + Legacy	-60,735	-79,036	-94,705
Year of Cash Exhaustion			
Base Case	2023	2022	2021
Base + Legacy	2021	2021	2020

As the data show, the new claims numbers do have a significant impact on the total NPV, and a less significant but still noticeable impact on the year of cash exhaustion. The Base Case assumes $2.7 billion of new annual claims from non-airline sources for the next ten years. The PBGC's own stochastic model, the Pension Insurance Modeling System (PIMS), predicts $22 billion NPV of new claims over the next decade in the median case [20]. The PIMS model is very complex, taking into account multiple stochastically related variables such as inflation, GNP, stock market returns, and interest rates [21]. The $2.7 billion number is simply the annual amount of new claims necessary to reach an NPV of $22 billion. Projected claims in following decades are made by averaging over roughly a thirty year period; the past twenty years and the next ten years as predicted by the PIMS median case. In doing this, Elliott's

model implicitly assumes that this is a bad decade, which judging by the historical averages is probably true. The thirty year horizon he adopted has both very bad and very good years in it, and he believes that it is a sensible representation of the PBGC business cycle [19]. Upon initial inspection, the $2.7 billion estimate seems questionable since only in 2002-2004 were claims ever even greater than $2 billion annually. However, considering that the PBGC has assumed over $30 billion in new claims over the past three years alone, it does not seem unreasonable to estimate that there will be an additional $22 billion of new claims over the whole next decade. These sorts of dramatic variations in claims against the PBGC are typical of all catastrophic insurance providers, where the losses incurred tend to be very high but less frequent [18]. Thus, the business tends to look extremely appealing in good economic periods, and very unattractive during the downturns.

Figure 4: Sensitivity of total NPV to premiums (numbers in $ millions)

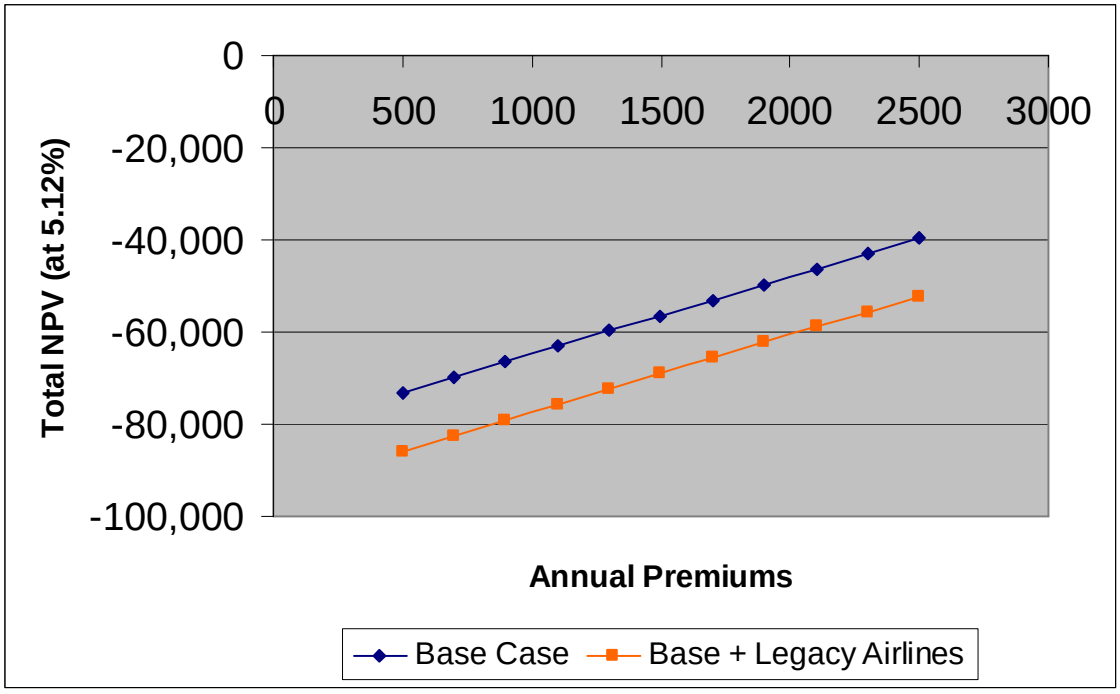
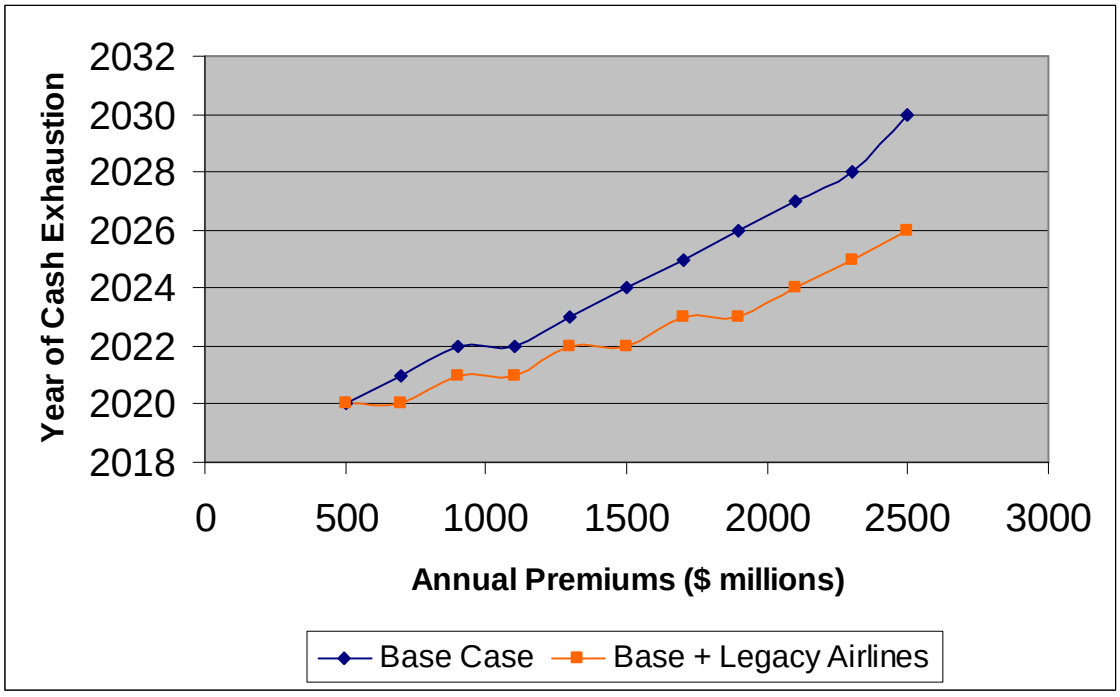


Figure 5: Sensitivity of Cash Exhaustion to premiums



The graphs show that both total NPV and the year of cash exhaustion are moderately influenced by the level of premiums charged by the PBGC for its pension insurance. The Base Case year of cash exhaustion is understandably more sensitive to the changes in premium levels than the Base + Legacy scenario, since the probable airline terminations would cause the PBGC to assume significant pension obligations over the next 10-20 years. The model currently supposes that the cumulative premium levels will remain near $900 million annually. Raising the price that companies pay for the insurance to more adequately reflect the financial risk being taken on by the PBGC has been widely discussed. The Bush administration in January unveiled a plan to increase flat-rate premiums by roughly 50% from $19 to $30 per worker, and to add on a supplementary risk-based premium which would be dependent on the degree of underfunding in the pension plan [22]. The current fixed-rate level has been in place

since 1991, and ought to be adjusted to account for wage and price increases. If such a plan were to be implemented, annual premiums totaling $1.5 billion would likely result. Yet even this projected influx of funds by itself would only push the year of cash exhaustion out by a few more years. One potential policy problem that could arise if premium levels are raised is that this action could drive the healthier companies out of the PBGC umbrella leaving only those with higher probabilities of bankruptcy or pension insolvency. However, introducing a risk-based premium could severely mitigate the effects of the larger financial problem.

The results of various scenarios explored above all confirm the central conclusion that it is not a question of whether the PBGC will run out of money, but of when the cash will be ultimately exhausted. Because there are so many assumptions influencing so many different variables, it is difficult relying on this deterministic model to get a sense of the likelihood of a certain scenario happening. Varying all of the above assumptions, it is possible to obtain a scenario involving plausible assumptions where the total NPV was only minus $17 billion, and the year of cash exhaustion was 2031.[3] The fundamental limitation is that the model yields no information regarding the probability of such an outcome.

[3] I used: Discount rate of 7%, allocation of 60% in stocks earning 9%, $1.5 B annual premiums, and $1.7 B annual new claims.

Chapter 3: Stochastic models of the PBGC and Monte Carlo simulation results

The impetus for expanding the original deterministic Elliott model into a stochastic model is obviously to obtain a more comprehensive understanding of the financial problems facing the PBGC by gaining information about the relative likelihood of various scenarios. While Elliott's model does have significant value in its ability to project the PBGC cash flows given a certain set of reasonable assumptions about the future, and it has also enabled him to help warn both Congressional policy makers and private industry of the deep financial crisis at PBGC, it is in some respects limited by its own simplicity. In reality, the PBGC's financial situation will improve or worsen as a result of a variety of different economic factors such as interest rates, stock returns, and bankruptcy rates – all of which will vary over time. The sensitivity analysis conducted in Chapter 2 of the original Elliott model seems to confirm the conclusion that even under substantially improved economic conditions the PBGC still faces serious financial problems. The limitation of the original Elliott model is that it is unable to provide any information regarding the relevant probabilities associated with different possible outcomes, and such information could yield substantial insight into determining both the severity of the financial situation at PBGC and the appropriate policy steps to alleviate the problem.

This thesis seeks to modify and improve on Elliott's existing Excel cash-flow model by stochastically modeling both stock returns and new claims against the PBGC. In the real world these things will inevitably vary and not remain constant as the deterministic model assumes. Another key way in which this thesis seeks to expand and strengthen the original Elliott model is to adapt it to account for the correlation of

investment returns with pension bankruptcies. Because of the way the markets operate, both good and bad economic times tend to build on themselves from the PBGC's perspective. A booming stock market like we saw in the mid 1990's is likely to have both higher returns for PBGC investments and a lower probability of pension plan bankruptcies. At present, Elliott thinks that his model does not adequately account for the variable nature of either investment returns or pension bankruptcies, let alone for their correlation [19].

The principle technique employed in this thesis to capture the stochastic processes is the Monte Carlo simulation, whereby information regarding the relative probabilities of different outcomes is obtained by randomly generating values for uncertain variables over and over. The probability of any particular outcome occurring in real life is assumed to equal the number of times that outcome occurred in simulation divided by the total number of simulations. For the purposes of this thesis, 5000 simulations were conducted using macros in Excel to generate the stochastic results for each model. It can be shown mathematically that if the probability distributions describing the random variables are accurate, a large enough simulation size will converge on the true solution. Of course, the probability distributions this thesis employs to describe the relevant uncertain variables (stock returns and new claims), while adequate for the scope of this thesis, are not perfect representations of reality. It is impossible to model these random variables perfectly. As explained above, the core equation of the model is: **End of Year Cash & Investments = Beginning of Year Cash & Investments + Investment Income + Premiums + Assets Taken Over for New Claims – Benefits Paid – Net other Expenses** [4]

The two biggest and most uncertain components of this equation are the *Investment Income* and *Benefits Paid*. *Investment Income* is a combination of interest on bonds and stock returns. While returns on fixed income tend to be somewhat stable over time, stock returns have historically been very volatile and far more difficult to predict. The *Benefits Paid* component is broken down into three parts as outlined earlier: payments from existing claims against the PBGC, payments from probable airline industry claims against the PBGC, and payments from new non-airline claims in the future.[4] Of these three, the first two can be known with a good degree of certainty but the third is both very uncertain and largely significant. Stock returns and new claims are the two elements of Elliott's original deterministic model which this analysis seeks to represent stochastically.

This chapter sets forth five consecutive attempts to model the PBGC in a stochastic fashion by building on Elliott's base model and expanding it. Stock returns and new claims are simulated on a year by year basis over the projection horizon of the model to obtain a specific set of resulting cash flows and two associated explanatory key results. Monte Carlo simulations are used to create new sets of cash flows over and over in order to determine probability distributions of the key results. The different model attempts are simply named in the order in which they were developed: Model 1, Model 2, up through the final attempt Model 5. Model 1 models only investment returns stochastically and leaves the new claims deterministic as they were in the original spreadsheet model. The other four models allow both stock returns and new claims to vary stochastically, and the final three models attempt to capture the

[4] Future non-airline claims will be simply referred to as new claims, and stock returns will frequently be referred to as investment returns.

correlation of investment returns and new claims. The final version of the stochastic cash-flow model, Model 5, appears as a significant improvement to the simple deterministic model, and actually produces results very much like those produced by the PBGC's own complex stochastic PIMS model.

The two key results focused on in this thesis are the year of cash exhaustion and the financial position of the PBGC in 2013. The year of cash exhaustion is simply the year that the PBGC's financial resources will run out and pension checks will stop being sent to retirees whose pensions are managed by the PBGC. As of the end of fiscal year 2004, the PBGC has only $39 billion in assets against $62 billion worth of liabilities, leaving a whopping $23 billion shortfall [17]. While the PBGC has enough resources to continue to pay pension benefits for some time, it is clear that it lacks the assets to satisfy its benefit obligations over the long-term. Elliott's deterministic model puts the year of cash exhaustion near 2021, and the expanded models confirm that, given current law and policy, the PBGC will likely run dry in the early 2020's .

The second key result is the financial position of the PBGC in 2013. This result, unlike the NPV used in the sensitivity analysis of Chapter 2, is dependent on both investment returns and new claims. It yields a good representation of what the PBGC's future financial position would look like assuming no reform in the system. This key result is calculated by taking the investments at the beginning of 2013 and subtracting all of the pension benefit payments in 2013 and beyond and then putting the result in 2004 dollars. It only takes into account payments from existing claims or claims that arise up through 2012, and does not account for benefit payments from claims that are lodged against the PBGC in 2013 and beyond. This result is very similar to the

projected GAAP financial position of the PBGC in 2013, although it ignores non-investment assets and non-pension payment liabilities which do exist even though they are overshadowed by the other numbers. The year 2013 was chosen because the PBGC annually publishes its own stochastic results of its financial position ten years down the road, and at the time this analysis was conducted the PBGC's most recent annual report was the 2003 annual report. In the time elapsed since the bulk of the simulations and analysis in this report were completed, the PBGC released its 2004 annual report detailing the PIMS predictions of the 2014 financial position of the PBGC. At the end of this chapter there is a comparison of Model 5's stochastic results with the PIMS results for the financial position of the PBGC in 2014.

Just as with Elliott's original model, the expanded stochastic model also relies on many assumptions. In line with Elliott's base case, this model assumes that there will be airline terminations at three of the legacy carriers, United Airlines, U.S. Air, and Delta, in the near future.[5] Together, these three expected claims amount to $11.9 billion. Thus the stochastic models incorporate the airline termination claims against the PBGC in the calculations although not all of the claims have yet been filed. GAAP accounting for insurance providers mandates that "probable losses" be included. Therefore, if at the end of the fiscal year the PBGC expects a claim based on the information they then have, the PBGC is required to book the charge in their financial statements, even if the actual claim does not come in for some time. In 2004, $11.8 billion of the PBGC's GAAP claims were from such "probable losses" and these certainly reflect expected airline claims [17].

[5] Elliott's base case included these three airlines, however the "Base Case" for the sensitivity analysis of Chapter 2 did not.

The stochastic models also assume an investment allocation of 30% in stocks and 70% in fixed income securities. In the real world, of course, the asset allocations will change over time. At the end of fiscal year 2003, the PBGC had an investment allocation of 37% equity and 63% bonds and cash, which was not too far from its historical average of 33% invested in equity and 67% invested in bonds [5]. In 2004, the PBGC appeared to be slowly moving to decrease its investment in equity and increase investment in fixed income in an effort to reduce its exposure to adverse stock performance and better match the duration of its assets with liabilities [3].

Other assumptions employed include: using the same 5.12% discount rate as Elliott's model (which is only used to bring the 2013 financial position into 2004 dollars), a 4.4% return on bonds, and $900 million in annual premiums. This final assumption is fairly significant both financially speaking and in the sense that it is likely to change given the recent discussion among the policy makers about changing the premium structure for the PBGC. The likelihood of a change in the premium structure prompted an inclusion of two additional sets of simulations, one assuming $1,500 million annual premiums and another assuming $2,000 million. The $1,500 million number is much closer to that which would likely result if the Bush administration's plan for pension reform is implemented. The results of these simulations are included at the end of this chapter. As expected, the increase in premiums always pushes the expected year of cash exhaustion further into the future and improves the expected 2013 financial position of the PBGC.

What follows is a presentation of the five stochastic models along with the two key results associated with each Monte Carlo simulation.

Model 1

$R_{2004} \ldots R_{2005} \ldots R_{2006} \ldots R_{2007} \ldots R_{2008} \ldots R_{2009} \ldots R_{N-1} \ldots R_N$

$R_n \sim N(\mu,\sigma) \quad \mu = .0849, \sigma = .176$

The first step taken towards developing the stochastic model was the expansion of the cash-flow computation to incorporate simulated stock returns on a year by year basis. Whereas in the original Elliott model the annual stock returns were set equal to 8% per year, Model 1 allowed them to vary according to a set probability distribution. The yearly investment returns R_n are independent and identically distributed (iid) normal random variables with mean of 8.49% and standard deviation of 17.6%. The mean stock return and standard deviation were calculated using historical market returns from the Standard and Poor's 500 stock index which was gathered from Bloomberg, a financial data service. While the PBGC's real equity portfolio is not allocated in such a way to exactly replicate the S&P 500 returns, this method is an adequate approximation for the real result. Seventy years of historical data were used to calculate the average market return and volatility. The Excel feature "macros" allowed for the programming and implementing of a set procedure for generating the random yearly investment returns from the given probability distribution, recording the two key results, and repeating the process over and over again. In this manner Monte Carlo simulations tracked the impact of 5,000 independent sets of yearly stock returns ($R_{2005} \ldots R_{2006\ldots}$) on both the PBGC's projected year of cash exhaustion and 2013 financial position. The graphs on the following page show the distribution of results. Model 1 sets the expected year of cash exhaustion in the early 2020's; with a 95% certainty that it will come before 2027.

Figure 6: **Model 1** Monte Carlo results for PBGC YOCE[6] ($900 million premiums)

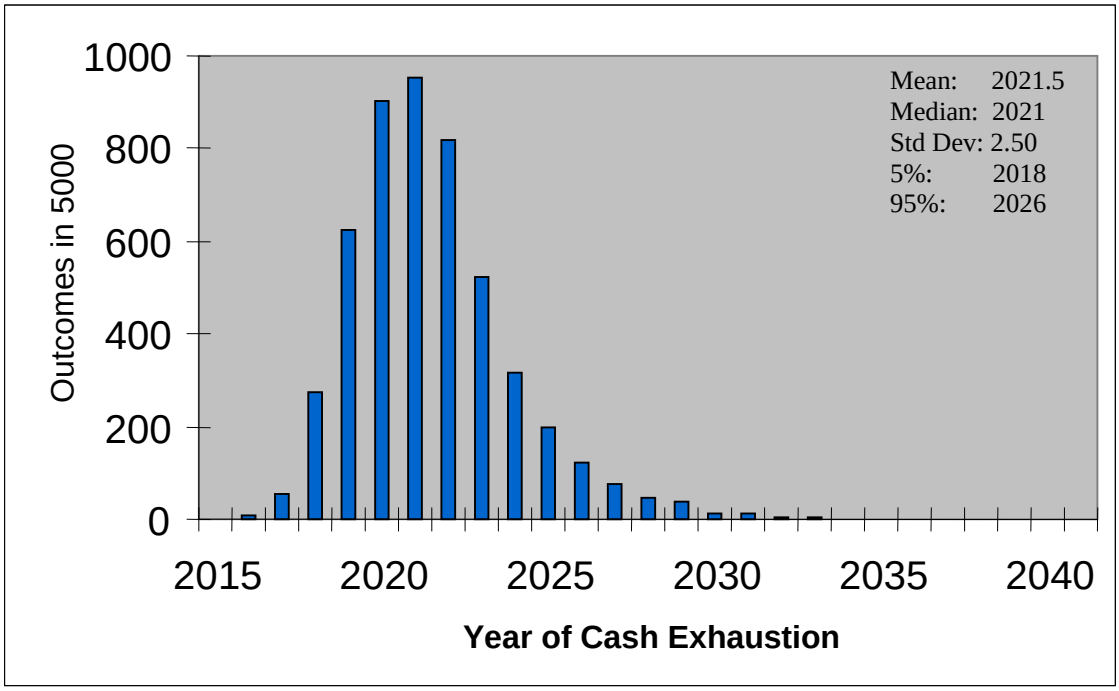
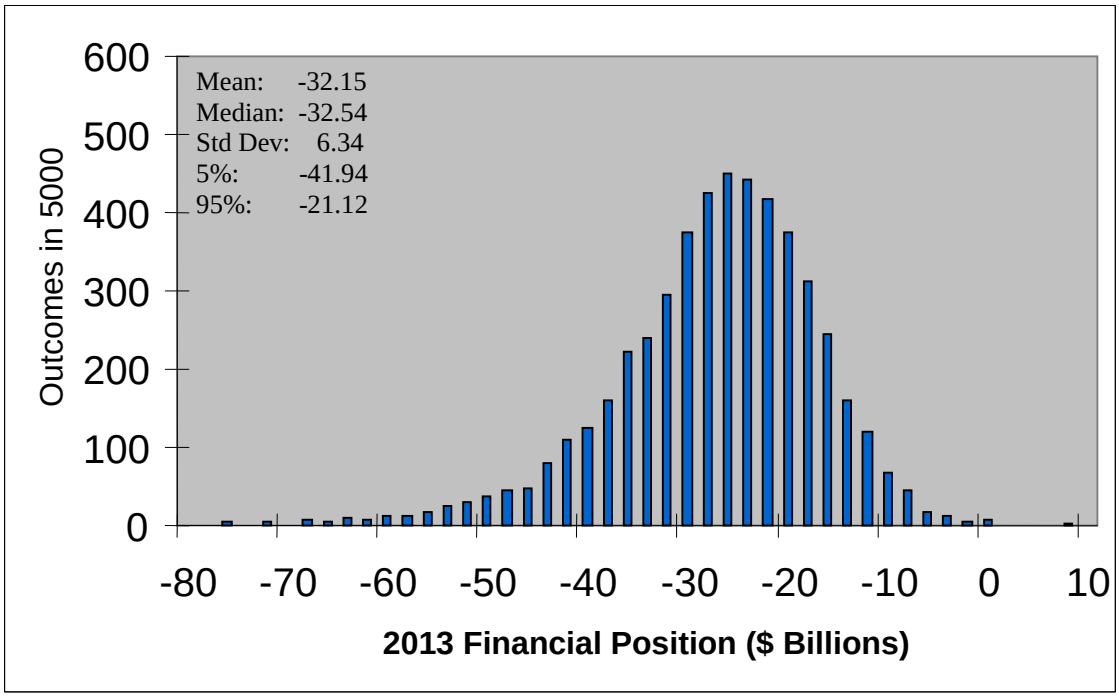


Figure 7: **Model 1** Monte Carlo results for 2013 PBGC position ($900 million premiums)



[6] YOCE (Year of Cash Exhaustion – the year in which PBGC's financial assets run out)

The Model 1 results also indicate that the PBGC's financial position will likely continue to deteriorate in the upcoming decade given present law. The PBGC's current deficit of $23 billion would grow by almost $10 billion to a mean expected result of $32 billion dollars. This analysis indicates that prompt reforms of the current government policies regarding the PBGC in particular and of the defined benefit pension system in general are necessary to prevent the financial hole from growing deeper. The stochastic element of Model 1 represents a significant improvement over the purely deterministic representation because it yields some useful information regarding the probabilities of different outcomes based on different possible stock returns. There are a few policy makers who argue that the PBGC's deficit would quickly disappear if equity returns were to increase in the future. This analysis contradicts such claims.

There were two significant developmental steps between Model 1 and Model 2. The first was expanding the new claims worksheet to accommodate stochastically varying new claims in addition to the stochastically varying investment returns. The original model projected out new claims against the PBGC on a decade by decade basis, where the average claim for the first decade was $2.7 billion annually and the average claims for subsequent decades were about $1.5 billion annually.[7] The original Elliott model was wholly reworked to gain the capacity to simulate new claims on a year by year rather than decade by decade basis. The revised model was checked against the previous one by deterministically managing the year by year claims of the new model so that they would equal $2.7 billion for the first ten years and $1.5 billion in later years, and then running a Monte Carlo simulation over the revised model and checking

[7] The $2.7 billion number was taken from the median PIMS case published in the PBGC's 2003 annual report. See the discussion of new claims in the Sensitivity Analysis of Chapter 2 for further information.

the results against the original. When the simulation was run it yielded the same 2021 mean year of cash exhaustion as Model 1, which legitimized the revised version. Following the calibration, the manual management of the new claims ceased and was replaced by a stochastic element.

The second adjustment was the implementation of lognormal probability distributions in place of normal probability distributions for the random variables. Among academics, stock returns are typically modeled as lognormal, where the natural logs of the returns are assumed to be normally distributed and not the returns themselves. As Luenberger says, "Based on an analysis of past stock price records, the price distributions of most stocks are actually quite close to lognormal" [23]. Lognormal probability distributions have the property of being positively skewed, implying that the mean of the distribution is greater than the median. Not only is a lognormal representation more appropriate for the PBGC's investment returns, but it is also very suitable for modeling the new claims against the PBGC. The nature of the PBGC's insurance scheme is like that of many high-liability low-frequency insurers, where claims in most years are low, but when substantial claims finally do occur they can become extremely high. Historically speaking, the PBGC's mean claim over the years 1985-2004 was $1,500 million, whereas the median claim was only $370 million (in terms of 2004 dollars). Finally, the lognormal distribution has "fatter tails" than a normal distribution of the same standard deviation. This means that more extreme values occur somewhat more frequently than would be expected using the normal distribution, which in practice is a better representation of both stock returns and claims against the PBGC.

Model 2

$R_{2004} \ldots R_{2005} \ldots R_{2006} \ldots R_{2007} \ldots R_{2008} \ldots R_{2009} \ldots R_{N-1} \ldots R_N$

$C_{2004} \ldots C_{2005} \ldots C_{2006} \ldots C_{2007} \ldots C_{2008} \ldots C_{2009} \ldots C_{N-1} \ldots C_N$

$R_n \sim \boldsymbol{LN}(\mu_r, \sigma_r)$ $\quad\quad$ $\mu_r = 0.0767, \sigma_r = 0.1557$

$C_n \sim \boldsymbol{LN}(\mu_c, \sigma_c)$ $\quad\quad$ $\mu_c = 6.748, \sigma_c = 1.224$

Both the investment returns R_n, and the new claims in a given year C_n are lognormal random variables (denoted here by ***LN***). In this model, the investment returns and new claims are assumed to be independent of each other. As in Model 1, new sets of yearly investment returns for the cash flow model are randomly generated over and over again using Monte Carlo simulations, only this time new sets of annual new claims data are also being randomly generated and incorporated. The mean log return and standard deviation were again calculated using the Bloomberg historical S&P 500 returns, and the mean log claim and its standard deviation were calculated from a twenty-nine year of average using both historical data on the PBGC and the 2003 PIMS projections. The results of the simulations are displayed in Figures 8 & 9 on the following page. The spread of the two key results widens with the introduction of varying new claims in addition to the varying investment returns; notice how both standard deviations of results in Model 2 are significantly greater than those of Model 1, and how the percentiles of Model 2 also edged outward from the center when compared with those of Model 1. Also noteworthy is the fact that the results of Model 2 are mildly better from the PBGC's perspective, since both the year of cash exhaustion increased and the mean 2013 deficit decreased.

Figure 8: **Model 2** Monte Carlo results for PBGC YOCE ($900 million premiums)

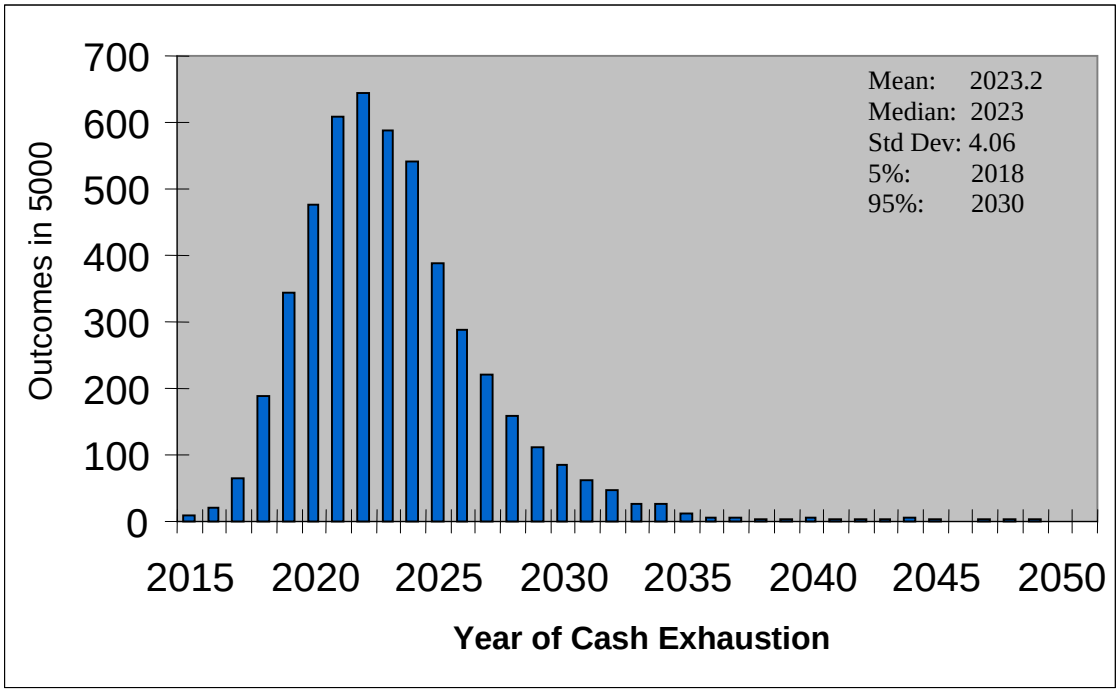
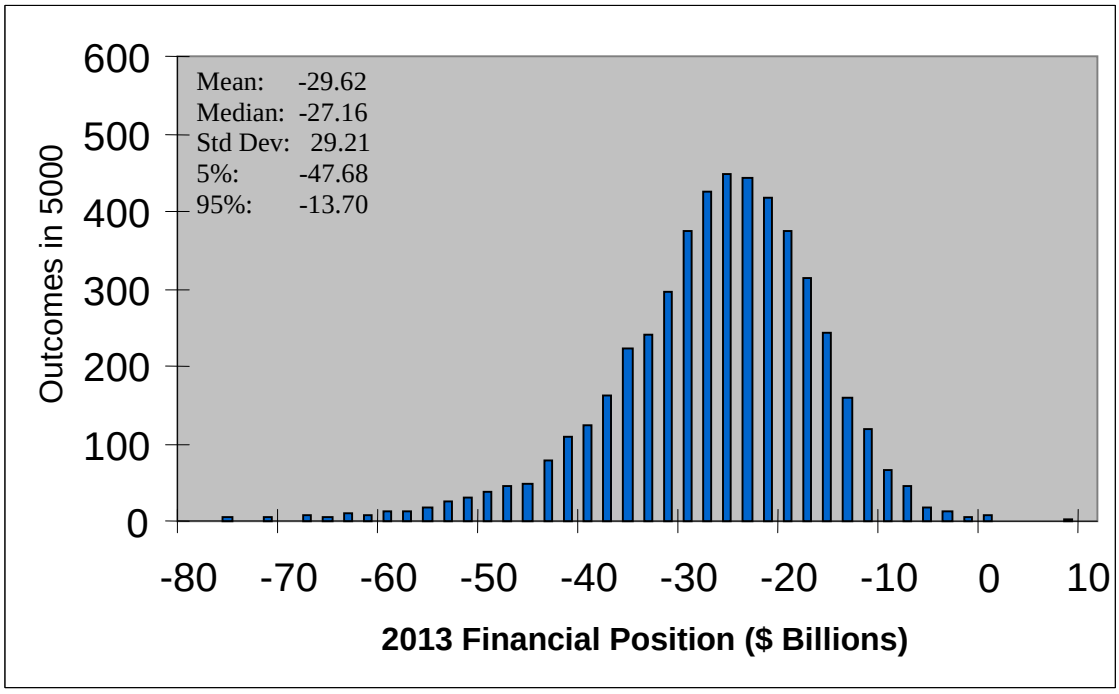


Figure 9: **Model 2** Monte Carlo results for 2013 PBGC position ($900 million premiums)



Model 3

$$R_{2004} \ldots R_{2005} \ldots R_{2006} \ldots R_{2007} \ldots R_{2008} \ldots R_{2009} \ldots R_{N-1} \ldots R_N$$

$$\Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow$$

$$C_{2004} \ldots C_{2005} \ldots C_{2006} \ldots C_{2007} \ldots C_{2008} \ldots C_{2009} \ldots C_{N-1} \ldots C_N$$

$R_n \sim \boldsymbol{LN}(\mu_r, \sigma_r)$	$\mu_r = 0.0767, \sigma_r = 0.1557$	
C_n = \$250 Million	$Log(R_n) > (\mu_r + \sigma_r)$	"Good"
\$5000 Million	$Log(R_n) < (\mu_r - \sigma_r)$	"Bad"
\$1500 Million	otherwise	"Normal"

This model represents an attempt to capture both the variability of investment returns and new claims, and the dependency between the two (note the arrows linking the claim C_n in a given year to the stock return R_n in that year). Here, the claim on the PBGC in a given year is directly dependent upon the investment return in that year. The investment returns are simulated using the same lognormal distribution as in Model 2, but the new claims can take only one of three different values. If investment returns are high, it is assumed that the PBGC will enjoy a "good" year and that claims will be low (\$250 Million). If investment returns are very poor, the model assumes that the PBGC will experience a "bad" year and a high claim (\$5000 Million). In the absence of a high or low investment return, the model assumes that the new claim on the PBGC in that year will be at a "normal" level (\$1500 Million). The measure of which investment returns are abnormally high or low is simply the mean log return plus or minus the standard deviation, as shown above.

The base assumption underlying Model 3 is quite sound, it is the idea that high market returns will be accompanied by relatively good economic years for the PBGC

and that low market returns will be accompanied by comparatively bad economic times for the PBGC. Indeed, during the 1990's as the stock markets boomed the PBGC experienced very low claims and during the early 2000's as stocks plummeted the PBGC experienced record claims. This inverse correlation is entirely natural given that both the PBGC's financial assets and the pension trust funds of the private companies it insures will be strong during periods of good investment returns and weak during periods of poor investment performance.

The results for the Model 3 year of cash exhaustion are nearly duplicates of those from Model 2, with the same mean, the same median, and very similar standard deviations and percentile values. However, for the 2013 financial position key result, Model 3 differs in that it lacks the skewness toward extreme negative values. Although the means and 95th percentiles are more or less the same, the graph of Model 3 appears quite balanced about its mean. This is reflected in the much smaller standard deviation, the median lying very close to the mean, and the 5th percentile being tighter to the mean than in Model 2. The results associated with Model 3 are on the following page. All in all, Model 3 represents a somewhat crude attempt to model the correlation of investment returns with new claims against the PBGC.

The largest stride in this thesis' development of a stochastic model was the implementation of a method whereby investment returns and claims were assumed to be jointly lognormal, which is discussed with Models 4 & 5.

Figure 10: **Model 3** Monte Carlo results for PBGC YOCE ($900 million premiums)

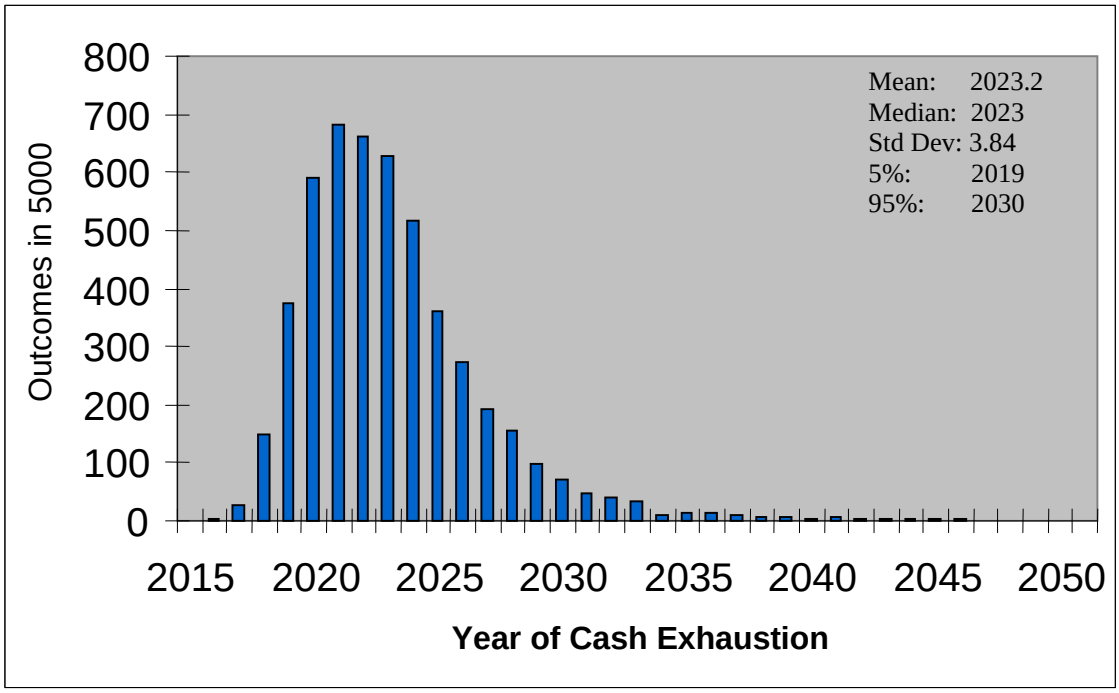


Figure 11: **Model 3** Monte Carlo results for 2013 PBGC position ($900 million premiums)

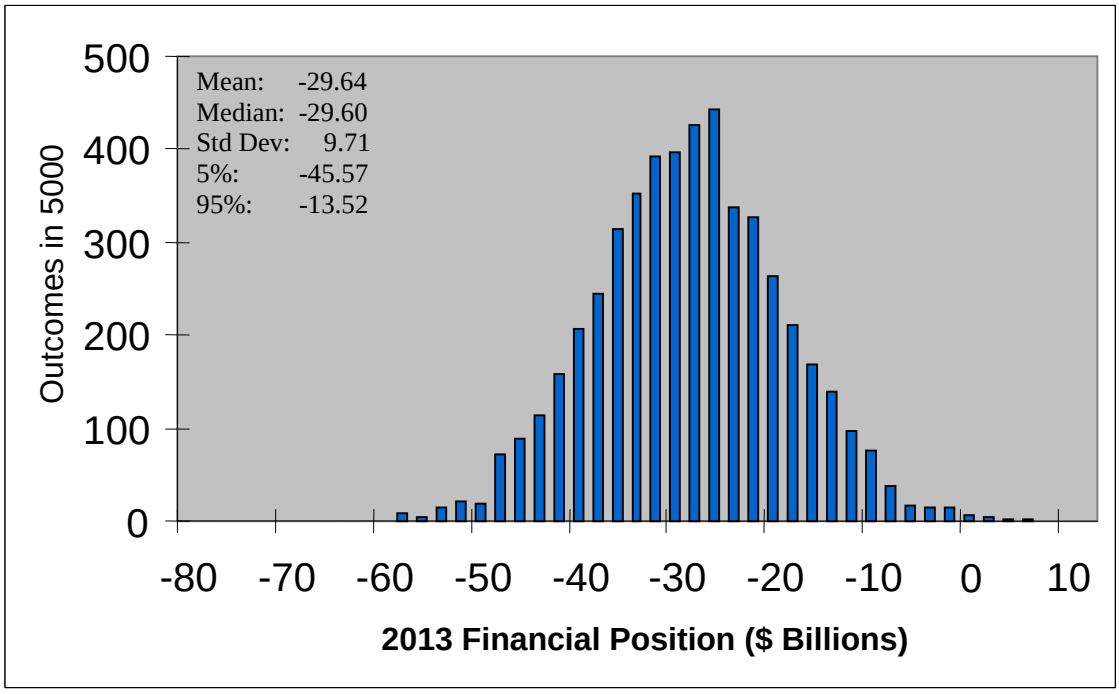


Figure 12: Annual S&P 500 market returns and historical claims against the PBGC

Year	%Return	Pure Return	Log Return	Claim	Log Claim
2003	26.38	1.2638	0.2341	6,404	8.7646
2002	-23.37	0.7663	-0.2662	3,839	8.2531
2001	-13.04	0.8696	-0.1397	1,451	7.2801
2000	-10.14	0.8986	-0.1069	116	4.7530
1999	19.53	1.1953	0.1784	195	5.2718
1998	26.67	1.2667	0.2364	91	4.5081
1997	31.01	1.3101	0.2701	257	5.5492
1996	20.26	1.2026	0.1845	213	5.3604
1995	34.11	1.3411	0.2935	211	5.3536
1994	-1.54	0.9846	-0.0155	665	6.5001
1993	7.06	1.0706	0.0682	181	5.2003
1992	4.46	1.0446	0.0436	816	6.7038
1991	26.31	1.2631	0.2336	2,257	7.7219
1990	-6.56	0.9344	-0.0679	163	5.0960
1989	27.25	1.2725	0.2410	174	5.1619
1988	12.4	1.124	0.1169	433	6.0714
1987	2.03	1.0203	0.0201	350	5.8591
1986	14.62	1.1462	0.1365	1,508	7.3188
1985	26.33	1.2633	0.2337	389	5.9643
1984	1.4	1.014	0.0139		
Average	11.78	1.11777	0.09971	1037.64	6.1417
Std Dev	16.87	0.16869	0.15985	1609.69	1.2237
Variance	284.59	0.02845	0.02555	2591095.05	1.4974
	Same Yr	Correlation	-0.2191		
		Covariance	-0.0406		
	One Year	Correlation	-0.7096		
	Lag	Covariance	-0.1296		

In order to model the investment returns and new claims as having a jointly lognormal distribution, the covariance between the log of the stock returns and the log of the new claims must be determined. There only exists nineteen years of good historical data from which to calculate the average log and standard deviation of PBGC claims, since before 1985 the regulations governing PBGC activities were substantially different then today's. Accordingly, only the last twenty years of S&P 500 stock returns were used to calculate the average log return and its standard deviation. The pivotal insight in developing the joint lognormal stochastic model was the realization

that the new claims exhibit a very strong inverse correlation with the investment returns of the previous year, and are only weakly correlated with the investment returns of the same year. Figure 12 on the previous page displays this information with the crucial results shown in red. Correlations only range from negative one to positive one, so a negative correlation coefficient of -.71 is very significant, and certainly much more significant than -.22. Thus, knowing the investment return in any particular year yields substantial information regarding the claim on the PBGC in the following year. This result confirms the basic assumption of Model 3, that periods of low investment returns will see higher claims against the PBGC and that times of high investment returns will mean lower claims for the PBGC. The only modification to the original logic is that there exists a time lag between the two. This seems to be reasonable, as the process of companies going through bankruptcy and shifting their pension obligations to the PBGC takes some time and is not simply an overnight matter.

Model 4

$$R_{2004} \ldots R_{2005} \ldots R_{2006} \ldots R_{2007} \ldots R_{2008} \ldots R_{2009} \ldots R_{N-1} \ldots R_N$$

$$\Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \qquad \Downarrow$$

$$C_{2004} \ldots C_{2005} \ldots C_{2006} \ldots C_{2007} \ldots C_{2008} \ldots C_{2009} \ldots C_{N-1} \ldots C_N$$

$R_n \sim \boldsymbol{LN}(\mu_r, \sigma_r)$ $\qquad \mu_r = 0.0997,\ \sigma_r = 0.1598,\ \sigma_{rr} = 0.0256$

$C_n \sim \boldsymbol{LN}(\mu_n, \sigma_n)$ $\qquad \mu_c = 6.142,\ \ \sigma_c = 1.224,\ \ \sigma_{cc} = 1.497$

$\sigma_{rc} = -0.130,\ \sigma_n = \sqrt{(\sigma_{nn})}$

$$\mu_n = E(\mathrm{Log}(C_n) \mid R_{(n-1)}) = \mu_c + (\sigma_{rc} / \sigma_{rr}) * (\mathrm{Log}(R_{(n-1)}) - \mu_r)$$

$$\sigma_{nn} = Var(Log(C_n) \mid R_{(n-1)}) = \sigma_{cc} - (\sigma_{rc})\text{^}2 / \sigma_{rr}$$

Model 4 implements the joint stochastic model based on the conclusion that there is a one year lag between the correlation of market returns and claims against the PBGC. The random variables R_n and C_{n+1} are distributed as a joint lognormal with the averages and variances reflecting the nineteen years of historical data shown above in Figure 12. Thus, the stochastic model first generates a random set of yearly investment returns, and then generates a random set of yearly claims against the PBGC based on those investment returns, where each of the new claims is conditioned only upon the investment return in the previous year (as indicated by the arrows). As with the other models, this process is then repeated over and over again via Monte Carlo simulation and the key results are collected.

More specifically, Model 4 first generates a random log stock return from the normal probability distribution specified above by μ_r and σ_r. Then, using the conditional distribution for normal random variables, Model 4 generates a random log claim $Log(C_n)$. The log claim is taken from a normal probability distribution whose mean μ_n is dependent on the particular log stock return from the previous year $Log(R_{(n-1)})$, but whose standard deviation σ_n remains constant since it is only dependent on the variances and covariance calculated in Figure 12. The conditional distribution for normal random variables is more fully explained by Chatfield [24].

The graphical results of the simulations on the next page reveal that accounting for the correlation of stock returns and new claims substantially widens the range of results. The standard deviation of the YOCE data is more than twice that of any of the first three models. The YOCE exhibits an extreme positive skew.

Figure 13: **Model 4** Monte Carlo results for PBGC YOCE ($900 million premiums)

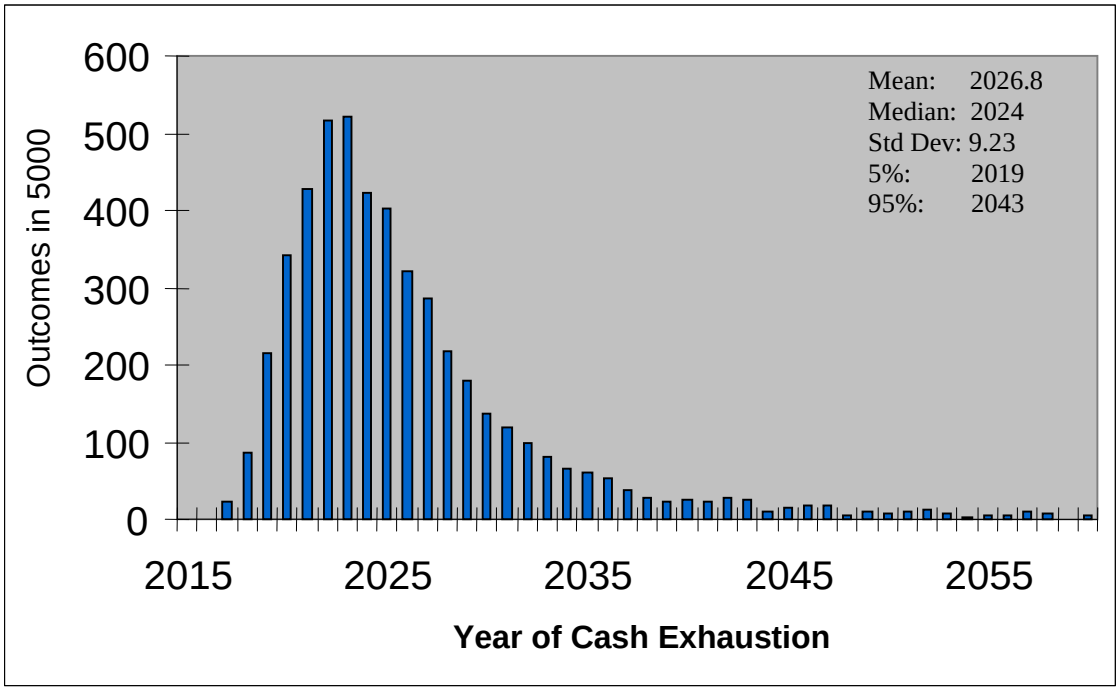
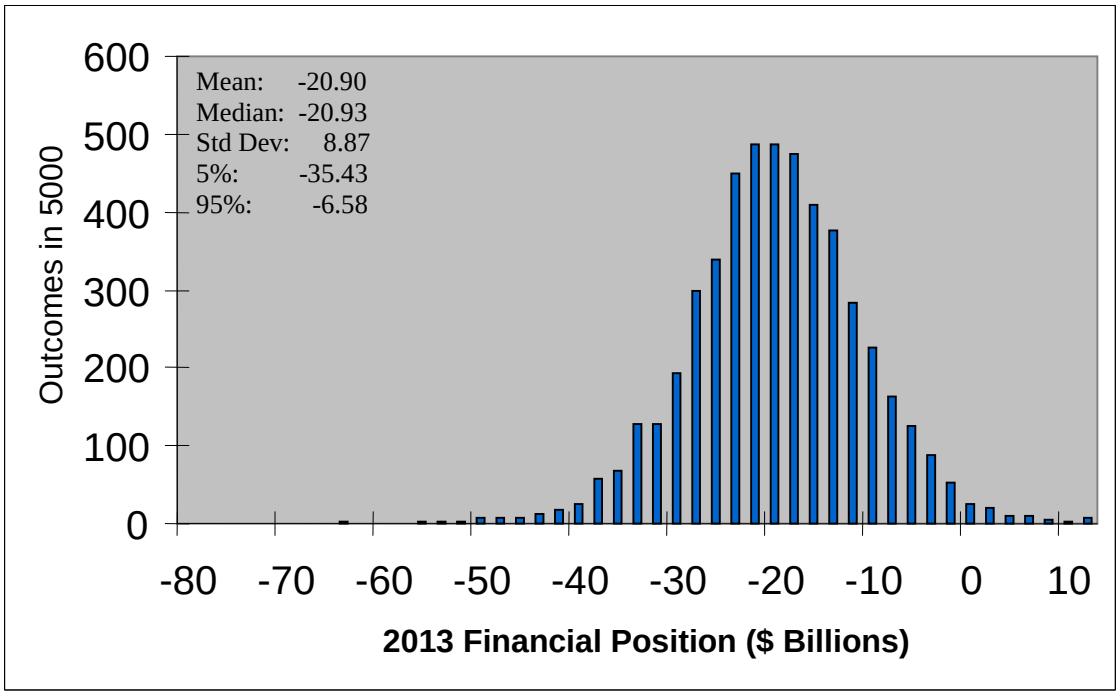


Figure 14: **Model 4** Monte Carlo results for 2013 PBGC position ($900 million premiums)



Though not shown on the histogram, Model 4 predicts that 1.2% of the time the PBGC will not actually even run out of cash before 2080 (because in 56 of the 5000 iterations the PBGC never exhausted its financial resources). The standard deviation of the 2013 financial position is also relatively high compared to the other models, and the graph of the results appears quite symmetric.

The most notable feature of the output is that it is consistently more favorable than the other three models from the PBGC's perspective. The predicted YOCE is the furthest into the future of all the models, and the projected 2013 deficit is the smallest. Model 4 indicates that there is a 1.1% chance that the PBGC will not even have a deficit in 2013, but instead will actually be running a surplus.

Model 5

$$R_{2004} \ldots R_{2005} \ldots R_{2006} \ldots R_{2007} \ldots R_{2008} \ldots R_{2009} \ldots R_{N-1} \ldots R_N$$

$$\Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \quad \Downarrow \qquad \Downarrow$$

$$C_{2004} \ldots C_{2005} \ldots C_{2006} \ldots C_{2007} \ldots C_{2008} \ldots C_{2009} \ldots C_{N-1} \ldots C_N$$

$R_n \sim \boldsymbol{LN}(\mu_r, \sigma_r)$ $\qquad \mu_r = 0.0767,\ \sigma_r = 0.1557,\ \sigma_{rr} = 0.02424$

$C_n \sim \boldsymbol{LN}(\mu_n, \sigma_n)$ $\qquad \mu_c = 6.748,\ \sigma_c = 1.224,\ \sigma_{cc} = 1.497$

$\sigma_{rc} = -0.130,\ \sigma_n = \sqrt{(\sigma_{nn})}$

$$\mu_n = E(\mathrm{Log}(C_n) \mid R_{(n-1)}) = \mu_c + (\sigma_{rc} / \sigma_{rr}) * (\mathrm{Log}(R_{(n-1)}) - \mu_r)$$

$$\sigma_{nn} = Var(Log(C_n) \mid R_{(n-1)}) = \sigma_{cc} - (\sigma_{rc})\text{^}2 / \sigma_{rr}$$

The only difference between Model 4 and Model 5 is the parameters. Because the mean log return μ_r and mean log claim μ_c were calculated over such a short time

horizon, the results of Model 4 were unrealistically positive for the PBGC. The mean log return used in Model 4 correlated with an investment return of nearly 10.5% per year, and the mean log claim correlated with a claim of only $465 million.

Figure 15: Parameters for Models 4 & 5

	Model 4	Model 4	Model 5	Model 5
	μ_r	μ_c	μ_r	μ_c
μ	0.0997	6.142	0.0767	6.748
$e \wedge (\mu)$	1.105	465.0	1.080	852.6

The nineteen years of historical data shown in Figure 12 indicate that this period was one of higher than normal investment returns. The average S&P 500 stock return over the period 1985-2003 was roughly 12%, which is significantly higher than the longer-horizon average of about 8%. Model 5 eliminates this bias toward higher investment returns by using the same long-term mean log stock return and standard deviation as were used in Models 2 & 3, in place of the short-term average used in Model 4.

Model 5 also implements the same long-term mean log claim as in Model 2, which raises the mean log claim from 6.142 in Model 4 to 6.748 in Model 5. Using this method, the nineteen years of historical PBGC claims are combined with the 2003 PIMS projections of $2.7 billion annual new claims over the next ten years and the average log claim over the resulting twenty-nine year horizon. The only key parameters which are unchanged from Model 4 to Model 5 are the one-year lagged covariance of the log returns and log claims, and the variance of the log claims themselves, since there are only nineteen years of data from which to calculate them. In the opinion of the author of this study, Model 5 is the most robust stochastic representation of the PBGC's financial horizon among those presented, combining varying stock returns and new claims in a way which takes into account the real-world correlation between the two.

Figure 16: **Model 5** Monte Carlo results for PBGC YOCE ($900 million premiums)

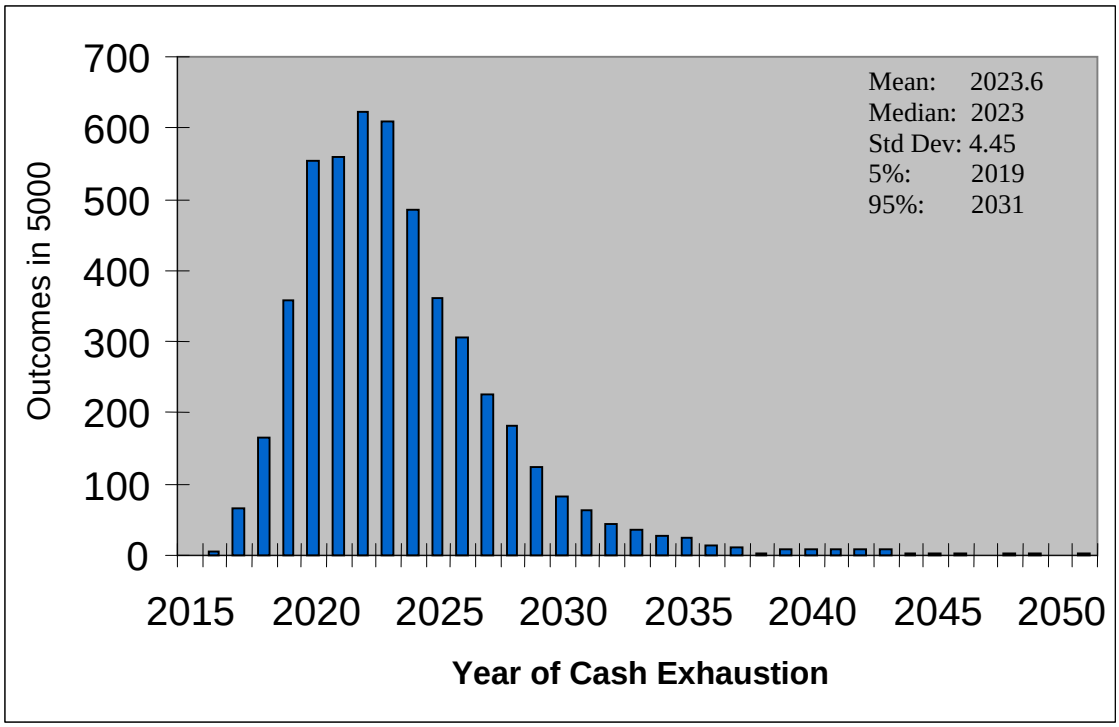
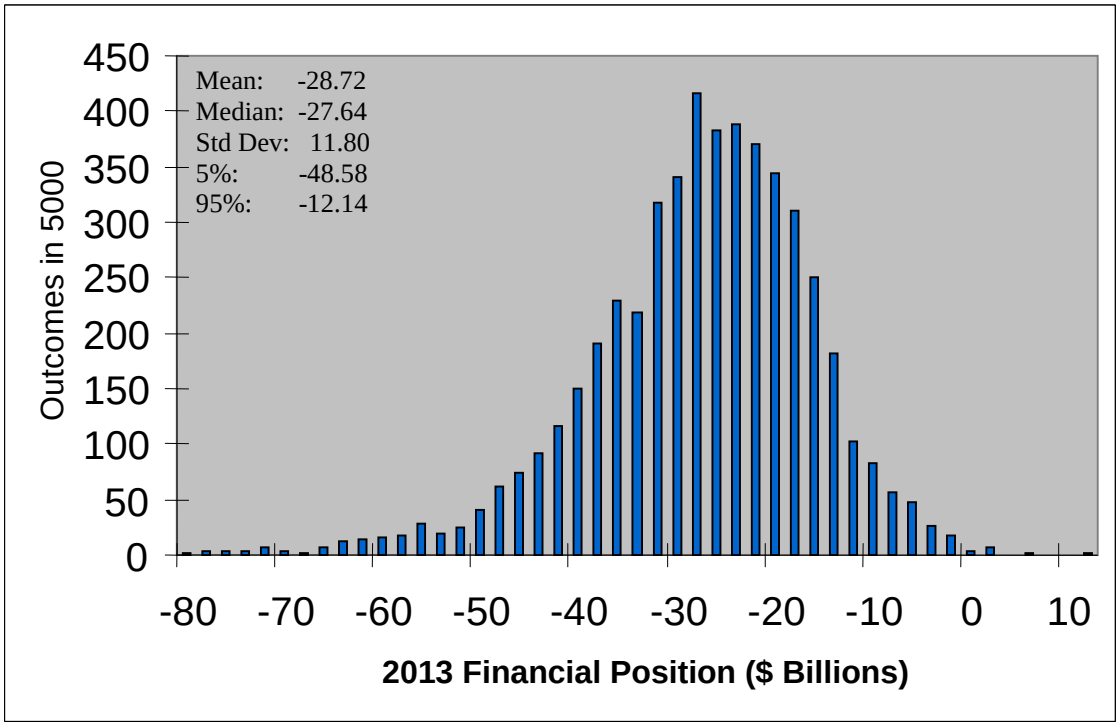


Figure 17: **Model 5** Monte Carlo results for 2013 PBGC position ($900 million premiums)



The Model 5 simulation results depict a bleaker outlook for the PBGC than those of Model 4, but they are very much similar to those of the first three models and are based on more conservative estimates of future investment returns and new claims against the PBGC. This analysis predicts that only in an extremely unlikely scenario would the PBGC have enough resources to cover all of its pension payment obligations until 2030, and that there is less than a 50% chance that the PBGC could survive until 2024. In a similar way, these results indicate that without pension policy reforms or a financial bailout the PBGC deficit is expected to widen in the upcoming decade, with the median outcome equaling minus $27 billion (in terms of 2004 dollars).

Premium Sensitivity

One of the biggest assumptions made in the development of these stochastic models was the decision to set annual premiums paid to the PBGC at $900 million dollars. In reality, these premiums change somewhat over time depending on the number of companies participating in the PBGC insurance scheme and the rate at which those companies are charged that is set by Congress. The sensitivity analysis in Chapter 2 shows that changes in premiums paid to the PBGC cause a moderate effect on the results of the cash flow model. Naturally, higher premiums yield more favorable results from the PBGC's perspective and lower premiums produce less favorable results.

Figure 18: Model 5 Monte Carlo results at three different premium levels

	Year of Cash Exhaustion					2013 Financial Position ($B)		
Premium	*$900 M*	*$1500 M*	*$2000 M*		*Premium*	*$900 M*	*$1500 M*	*$2000 M*
Mean	2023.6	2026.5	2029.9		*Mean*	-28.7	-26.5	-24.7
Median	2023	2025	2028		*Median*	-27.63	-25.41	-23.43
5%	2019	2020	2021		*5%*	-48.58	-45.76	-45.04
25%	2021	2023	2024		*25%*	-34.91	-32.39	-30.67
75%	2025	2029	2032		*75%*	-20.89	-19.11	-16.39
95%	2031	2038	2047		*95%*	-12.14	-9.78	-7.85

Figure 19: Comparison of **Model 5** YOCE at two different premium levels

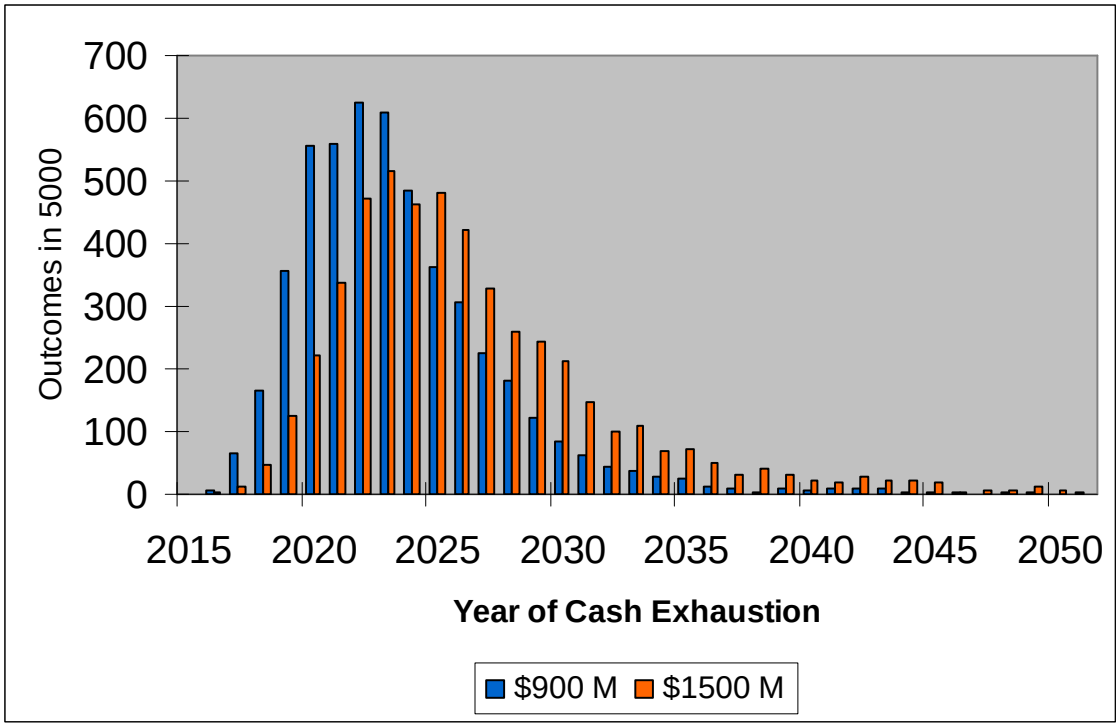
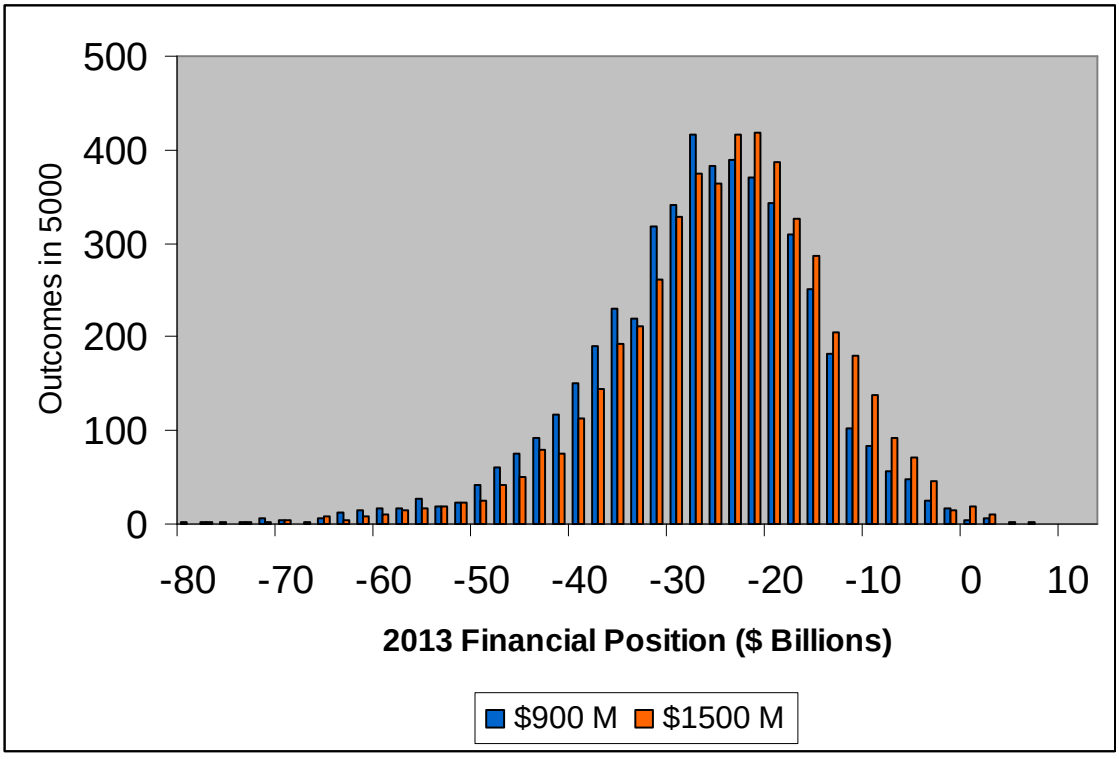


Figure 20: Comparison of **Model 5** 2013 position at two different premium levels



The graphs on the previous page display the anticipated effect of higher premium revenues for the PBGC. In addition to pushing the expected YOCE farther out into the future, the increases in premiums also widen the spread of the histogram. Broadly speaking, the additional premiums only serve to postpone the cash crisis and mildly improve the overall financial situation of the PBGC – new premiums alone appear incapable of solving the problem as a whole.

Comparison with PIMS Model

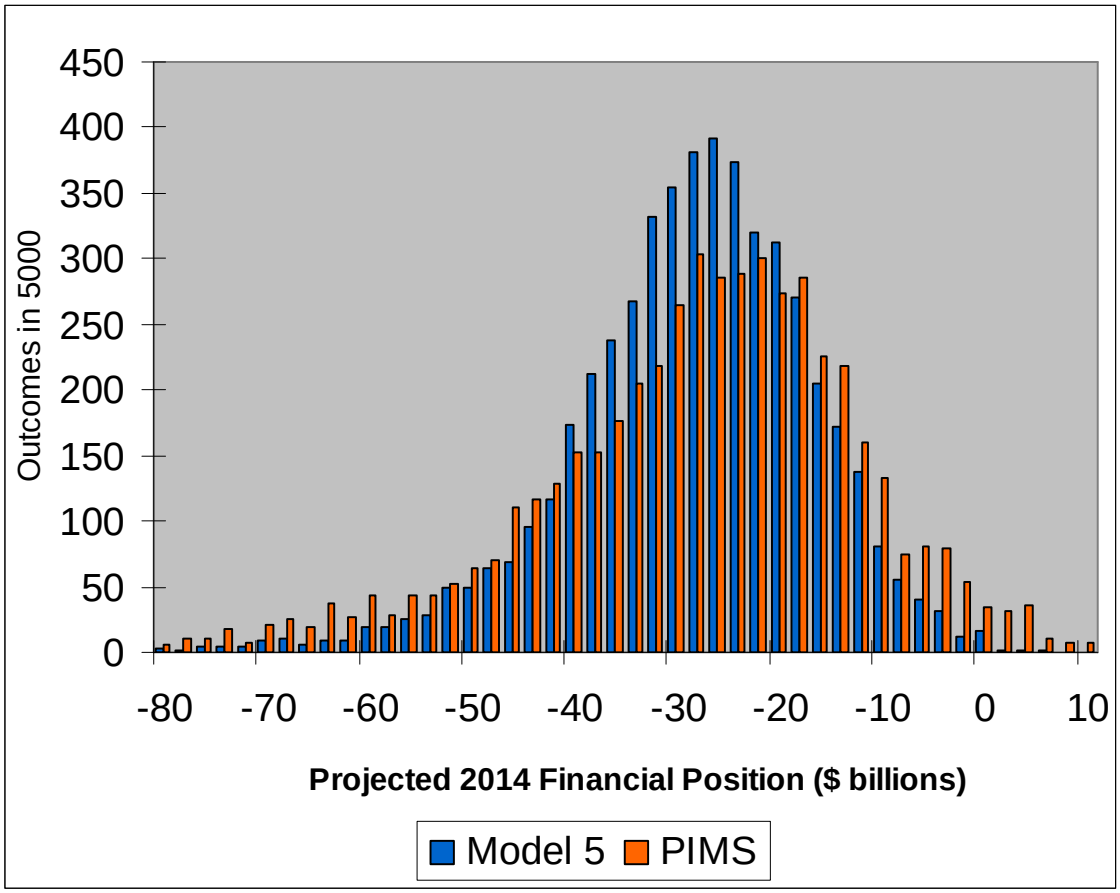
As noted earlier, the PBGC has its own stochastic model, the Pension Insurance Modeling System (PIMS). The PIMS model recognizes the uncertainty of future economic conditions, and simulates the flows of claims against the PBGC that could develop under thousands of combinations of interest rates, stock returns, and bankruptcy rates [21]. The PBGC annually publishes the PIMS projections of the PBGC's potential financial position over a ten year horizon. Like the Monte Carlo simulations employed in this thesis, the PIMS results include data collected from 5000 separate simulations. Since the completion of the bulk of the simulations presented in this chapter, the PBGC released its 2004 annual report, which includes the updated PIMS projections for 2014.[8] A version of Model 5 was adapted to report the 2014 projected financial position rather than that for 2013, and the results of the comparison are on the following page.

[8] The graph of the PIMS projected 2014 financial position is on page 12 of the 2004 annual report. The source data for the comparison graph on the next page was obtained directly from the PIMS experts at the PBGC.

Figure 21: Comparison table of PIMS output with that of Model 5

2014 Financial Results ($ Billions)		
	PIMS	*Model 5*
Mean	-28.91	-29.42
Median	-26.91	-28.37
Std Dev	16.94	12.16
5%	-60.27	-50.44
10%	-49.84	-43.93
25%	-37.33	-35.90
75%	-18.07	-21.50
90%	-10.72	-15.49
95%	-4.97	-12.11
Any Surplus	2%	0.20%

Figure 22: Comparison graph of PIMS output with that of Model 5



The results of the two stochastic models match up quite closely. The means of the two distributions are within a half billion dollars of each other, and both sets of data exhibit a mild skew towards extreme negative results depicted in both the graph and the fact that the medians are higher than the means. The PIMS model generates a broader distribution of the results as indicated by both the higher standard deviation of results and the graph itself. The chief cause of the more concentrated results for Model 5 compared with those of the PIMS model is most likely the fact that Model 5 allows fewer inputs to vary stochastically. Model 5 only accounts for varying stock returns and new claims over time, whereas the PIMS model accounts for variation among a greater number of economic parameters. The main way in which Model 5 could be expanded would be to include a stochastic component modeling the interest rates on the PBGC's fixed income assets. A majority of the PBGC's financial resources are invested in non-stock assets and Model 5 assumes that this large portion of the PBGC investment portfolio performs consistently over time. The inclusion of a stochastic element modeling interest rates, however, is beyond the scope of this thesis.

Summary of Results

The fact that the two independent efforts to stochastically model the PBGC's finances match up as well as they do lends substantial credibility to the results. The overwhelming conclusion of the modeling efforts described in this thesis is that the PBGC is in deep financial problems which will only continue to intensify over time. If no action is taken, the PBGC will eventually exhaust its ability to meet the pension obligations of over a million Americans. Although the PBGC is intended to be self-

financing and the Corporation is technically not backed by the full faith and credit clause of the Constitution (meaning that the United States is not legally liable for the PBGC's debts), a failure to reform the system now would almost certainly mean a massive taxpayer bailout of the PBGC in the future on the order of $30 billion. Furthermore, the results from the stochastic models indicate that the advent of good economic conditions would not adequately alleviate the PBGC's financial troubles. Even if the PBGC experiences fewer claims, superior investment returns, and higher premium revenue, it will almost certainly still be running a deficit and be in danger of running out cash. In light of these conclusions it would be prudent for the policy makers to enact structural reforms to place the PBGC on sounder financial footing. An exploration of the possible remedies and ways in which such restructuring might be accomplished is the subject of the next chapter.

Chapter 4: Policy Options

As the models described in this thesis indicate, the existing laws governing pension funding and the PBGC have proven inadequate, and without major structural reforms the financial problems will only intensify. Fortunately, thanks to the management of the PBGC and the work of outside analysts like Doug Elliott, the PBGC has been receiving increasing attention from Congress. The Bush Administration has already unveiled its plan for strengthening retirement security and it appears as though the policy makers are taking steps toward enacting meaningful reforms. Many experts on the PBGC, government officials, and various union and pension lobbyists have testified before both Senate and House Committees in an effort to help design and shape legislative reforms.

One person who has frequently appeared to testify about the PBGC's problems is David Walker, the current Comptroller General of the United States and the former executive director of the PBGC. Walker has both a detailed working knowledge of the PBGC and an ability to view the problems at PBGC within the wider context of the federal budget and umbrella. As Comptroller General, he is the head of the Government Accountability Office, which is responsible for monitoring the condition of the nation's finances. In testimony before Congress on March 2, 2005, Walker emphasized the need to address the financial problems of the PBGC as part of the broader fiscal problems of the U.S. government as a whole [25]. In his view, the PBGC represents a microcosm of what he views as unsustainable fiscal policy by the federal government. As detailed more thoroughly in the GAO's report on *21st Century Challenges*, under current law the federal government faces huge structural deficit,

because spending on retirement and healthcare programs will increase as the American population continues to age. The report explains that current revenue streams will be insufficient to cover the rising costs and that the Congress ought to re-examine the fundamental question of what programs the government should be providing and how they ought to be financed. Either some of the programs will need to be scaled back or taxes will have to be raised, and difficult choices will need to be made [26]. In line with this analysis, Walker encouraged Congress to first reevaluate and settle on the core purposes of the PBGC, and then to make appropriate structural reforms that would allow the PBGC to serve those purposes over the long-term [25]. Decisions about the best way to fix the PBGC's financial problems cannot be made in isolation from the program's underlying goals.

The most fundamental question Congress needs to address is whether or not the government should be involved in insuring defined benefit pensions at all. One potential policy alternative is to simply shut down the PBGC and mandate that no new premiums be charged and no new claims be accepted. The PBGC's existing assets and liabilities would then be allowed to die out over future years. Such action would prevent the hole from growing deeper, but would still require a $23 billion infusion, since that is the size gap between the PBGC's financial assets and projected liabilities. Another radical option which has been suggested would be to privatize the PBGC. Richard Ippolito, a former economist at the PBGC, proposed that the agency not be shut down but instead turned over to private hands [15]. Any such a measure would likely also include a substantial financial cost to taxpayers, but privatization offers the combined benefits of limiting the size of the financial hole as well as maintaining the

insurance scheme to provide future retirement security. Undoubtedly, the new private leadership would employ the usual market tools to reform the existing structure and more effectively balance the premium levels with the risks of the insurance business. Yet neither one of these options, shutting down or privatizing the PBGC, is receiving serious consideration right now from Congress, and it appears as though there is a consensus that the government ought to continue to play a role in strengthening retirement security through the PBGC program.

Another fundamental question, related to the first, is the issue of what form that retirement security ought to take. The PBGC protects only defined benefit pension plans, where the monthly retirement benefit is not contingent upon market returns but rather determined by a specific set of criteria, like average salary and years of service. Defined benefit plans however, are becoming less common, and defined contribution plans are becoming more widespread. Defined contribution plans such as 401K's, are contingent upon market returns, as employers and employees make regular contributions of a fixed amount to personal investment accounts to be received upon retirement. Right now, President Bush is pressuring Congress to consider restructuring the government's primary pension program, Social Security. The President wants to gradually adapt the current fixed-payment system into one based on individual private accounts, where a portion of each person's own payroll taxes are diverted into his or her own investment portfolio. The resulting portfolio would be somewhat similar to a typical 401K account, and the President's desire to shift Social Security from a completely defined benefit pension structure to one with a defined contribution component is in step with the trend in retirement plans nationwide. When the PBGC

was first established in 1974, part of its explicit purpose was to encourage the continuation and maintenance of defined benefit private defined benefit pension plans, and the legislators who created the PBGC probably expected that defined benefit plans would continue to be popular in the future [25]. In determining the future of the PBGC, Congress ought to consider to what extent it should encourage private participation in defined benefit plans over defined contribution plans.

There is little consensus on this question, and perhaps the government should simply yield to the markets and not influence company decisions about which type of pension plan to offer. There are advantages and disadvantages to the rise of defined contribution plans. Many workers prefer the flexibility offered by defined contribution plans of choosing among different investment allocations, and they often opt to invest more in equities which have provided historically higher returns [2]. Defined contribution plans also frequently allow workers to borrow against their retirement to supplement earlier consumption. Furthermore, defined benefit plans limit job mobility because they often involve a vesting period and they usually employ a "final average pay" formula to determine the level of pension benefits, which means that workers who stay on for more years will receive substantially higher retirement benefits. However, defined contribution plans also have many shortcomings. Many workers covered by them continue to decide not to participate in the programs, potentially leaving them with inadequate retirement income. Furthermore, the increased flexibility offered by the defined contribution plans places increased responsibility on the employees, who might squander their retirement through poor spending and investment decisions. In particular, the decision to hold large amounts of stock exposes the participants to a

heightened level of risk. Although they are not as flexible, the strength of traditional defined benefit plans is that they better insulate workers from variations in investment performance and lifespan. In this light, the decision that Congress needs to make is one of balancing the weights of individual freedom on the one hand and government oversight on the other.

In his testimony before Congress on March 2, 2005, Elliott highlighted many of the same things as Walker. He said that "Congress should stop making infrequent, ad hoc decisions about PBGC and the pension system," but rather "make some major strategic choices" regarding the purpose of PBGC, particularly whether PBGC should be understood of as a social insurer or a regular insurance company [27]. Social insurers spread costs relatively equally among various participants, whereas traditional insurers usually charge premiums that are expected to cover future claims and expenses. Currently, the PBGC's premium structure makes it conform more to the model of a typical social insurer, although at the same time the PBGC is paradoxically expected to be self-financing. Understandably, there are strong pressures from lobbies for both of these positions. Many unions and pension sponsors prefer the social insurance scheme because it provides them with a strong financial safety net for a minimum price. In reality, they would be quite happy if the PBGC enjoyed a taxpayer bailout, and also content if the regulations concerning pension funding and the PBGC were not significantly changed. Such an arrangement amounts more or less to a series of transfer payments, as financially weak firms can shift responsibility for their underfunded retirement promises to the general public, to firms in other industries, and even to their competitors. On the other side of the debate, advocates of fiscal responsibility and

firms that are in a healthy financial position would prefer the PBGC to operate as a typical private insurer, where the premiums charged by the PBGC would be more closely related to the creditworthiness of the plan sponsors. Under such a system, financially strong companies would pay comparatively less for the insurance, and the general tax-paying public would not be held to account for the failures of some firms to adequately fund their pension promises. Walker and Elliott were both adamant that Congress should either mandate that PBGC premium rates remain consistent for all companies with the added understanding that the government would subsidize any shortfall, or affirm that future premiums must be adequate to cover costs [25, 27]. The first methodology is more like that of a social insurer, and the second more like a typical private insurer.

Beyond addressing these more fundamental issues, there are various concrete options for reforming current law to remedy the structural financial problems facing the PBGC. What follows is a discussion of four different focus areas for reform and a brief section detailing a few less likely avenues for change. Each of the four key areas is introduced by a quote in the latest PBGC Annual Report to the Congress from Bradley Belt, who is the current Executive Director of the PBGC and one of the key individuals urging Congress to enact reforms.

1. Change funding rules

> "We must streamline and strengthen the current funding rules to provide sounder pension funding. Weaknesses in current law should be eliminated to ensure that troubled plans are brought closer to full funding, and the rules should be simpler and provide greater flexibility to financially healthy plan sponsors." [17]

Overall, the funding rules are extremely complex, employing several different liability measures and various discount rates. Two simple ways in which the laws surrounding pension funding could be tightened would be to require that firms maintain a higher level of funding and to reduce the amount of time firms are given to catch up when they fall behind. Clearly, the current minimum funding requirements have not sufficiently protected the PBGC. Existing laws do stipulate that a pension sponsor is required to pay an additional penalty premium in cases of severe underfunding, but as long as the plans are funded at 90% of current liability, sponsors do not have to pay the variable-rate premium. Most firms can employ actuarial assumptions and methods so that their plan can meet the minimum funding requirement, even if the amount of underfunding is significant. Congress could raise the minimum funding requirement and close the loopholes which companies have used to avoid paying the variable premiums, thus providing them with a strong incentive to keep their pension trusts at healthy funding levels.

One of the most common methods of actuarial manipulation is for a firm to adopt an unrealistically high expected rate of return on its pension investments, and then use that inflated rate to discount its future liabilities. This factor also encourages firms to invest their pension assets quite heavily in equities, which exposes the pension trust to significant levels of risk. Furthermore, because of the way in which pension expense is calculated under GAAP accounting rules, pension losses resulting from poor stock

returns are averaged in over a period of years and in the short term have only a small negative impact on a firm's financial statements. Accounting rules thus provide companies with perverse incentives to assume very risky investment positions, because higher expected rates of return investment return mean higher stated operating earnings and net income for the plan sponsor, with little regard to actual investment performance.

Funding laws could also be revised to limit the time volatility of contributions. Under present guidelines, sponsors can make contributions at any point within a fairly broad time span, depending on past contributions and various other factors. Sometimes companies seek to accelerate their contributions to take advantage of tax deductions, but other times companies will defer contributions as an inexpensive source of financing for other operations. By forcing plan sponsors to make more regular contributions to their pension trusts, Congress could limit the ability of companies to both avoid taxes and borrow against the retirement savings of their employees. Right now, there is a maximum limit on the amount to which plan sponsors can make tax-deductible contributions to their pension trusts. The maximum limit is set to both allow firms to adequately fund their pension plans and limit the loss of tax revenue. Raising this limit would give firms an additional incentive to adequately fund their pension promises, but at the cost of government revenues.

Opponents of tougher funding requirements argue that changes would cause job losses as companies would be forced to divert into their pension funds money that might otherwise be used for wages, or to strengthen the business prospects of the firm. In this line of thought, stricter funding rules might actually push a good deal of troubled firms into bankruptcy, and thus exacerbate the PBGC's problems. In the past, corporate

lobbyists have been extremely successful at preventing Congress from enacting more stringent funding requirements.

2. Change premium structure

> "We must implement a rational premium structure for the pension insurance program. This structure should meet the program's long-term revenue needs, provide incentives for full funding of covered plans, and appropriately reflect the risks faced by the program, including both potential claim incidence and claim severity." [17]

As it was explained earlier in this paper, the current premium levels do not reflect the financial risks assumed by the PBGC, and thus the premium revenues have proven inadequate in covering claims. Two ways the premium structure could be strengthened would be to raise the fixed rate premium or to add more risk-based premiums [15]. Increasing fixed rate premiums would be more appropriate if Congress conceives of the PBGC as more of a social insurer, and adding more variable premiums would be more appropriate if Congress decides that the PBGC should operate more like typical private insurers. The level of the fixed rate premiums has not changed since 1991, when it was set by Congress at $19 per worker. At the very least, this number should be adjusted to reflect inflation, but a more significant increase would be necessary to fully cover the PBGC's expected claims. Currently, there is also a variable rate premium of 0.9% annually on a pension plans unfunded vested benefits when the plan falls below a certain funding level. But, as described in the previous section, most sponsors have to date successfully avoid paying the variable rate premium [13]. Historically, the majority of the PBGC's premium revenues have come from the fixed-rate rather than variable premiums. As for reform, what is most likely is that both fixed-rate and variable risk-based premiums will be increased.

Besides being based on the degree of underfunding, variable premiums could be designed to also reflect the other firm-specific risks of the plan sponsors, such as the risk of bankruptcy and the risk associated with the pension trust's investment allocation. Such adjustments seem quite reasonable. After all, underfunding only represents a financial threat to the PBGC if the sponsoring company is in danger of going bankrupt, and basing the variable premiums on pension asset allocations could help to eliminate the problem of overly-aggressive investment portfolios.

Some critics argue that raising the fixed rate premium creates an incentive for firms that are stronger financially to exit the system and simultaneously attracts less-creditworthy firms. On the flip side, other critics complain that charging more variable premiums makes it more difficult for those firms which are in the greatest need of pension insurance. Some opponents oppose any increase in premiums at all, and fear that a hike in premium levels could spark a mass exodus of firms from the PBGC and from the defined benefit system as a whole. However, such extreme fears are probably overstated, with PBGC premiums making up less than 1% of company pension costs [2].

The bottom line is that any private venture providing similar insurance to the PBGC would be charging significantly higher premiums. In light of the present financial crisis at the PBGC, Congress should seriously consider reforming the existing premium structure. Although such action could constitute a significant part of a broader PBGC rescue strategy, it is important that Congress not rely on increased premiums alone. Both the sensitivity analysis in Chapter 2 and the premium sensitivity analysis of

Model 5 in Chapter 3 strongly indicate that moderate increases in premiums by themselves would not be enough to fix the financial problems at the PBGC.

3. Give PBGC more tools and regulatory control

> "PBGC needs better tools to carry out its statutory responsibilities in an effective way. Providing the insurance program with additional options would strengthen the program while prompting creditors to encourage better plan funding." [17]

The PBGC has no say over which plans it insures or the level of premiums, and thus must offer coverage willingly to most companies, regardless of the company's creditworthiness. And, as already explained, the premium levels set by Congress for the PBGC have been consistently much lower than a private firm would charge. One possible policy change would be to give the PBGC significant regulatory control in the arena of pension funding and allow the PBGC to set its own premiums. Not only would this equip the PBGC with more tools to meet its objectives, but such a change would also remove from Congress the cumbersome responsibility of setting premiums and overseeing funding guidelines.

The PBGC lacks the authority, unlike other regulatory agencies, to effectively protect itself. In his statement before Congress on March 2, Comptroller Walker suggested expanding the powers of PBGC to look more like those of the Federal Deposit Insurance Corporation (FDIC) [25]. The FDIC possesses some say in setting premium levels, the right to reject applications to insure deposits at banks which are determined to carry unreasonably high risk levels, and also the authority to negotiate with troubled banks. Giving the PBGC similar powers to these would help it to efficiently conduct its business in a way that is financially sustainable. The ability to negotiate with troubled firms would especially help the PBGC, as it would potentially

enable the PBGC to collect more money than it otherwise would under a normal plan termination. Banks frequently operate in a similar way, reducing the principal and interest on their loans to troubled debtors in an effort to gain more than they otherwise would.

4. Increase transparency

> "We must require more timely, meaningful information on pension plans' funding levels. This will ensure that those with a stake in the pension system—workers, retirees, investors and regulators—can make decisions based on current, accurate information." [17]

One of the biggest problems in the defined benefit pension system is that the publicly available information is outdated and often confusing or downright misleading. Regulators and pension experts refer to this problem as a lack of transparency in the system. All too often, workers realize too late that benefits they earned and had been promised are inadequately funded. An increase in freely available and accurate information would encourage employer accountability and market discipline, and strengthen the retirement security of millions. Furthermore, a better understanding of pension plans would help employees make wiser employment and savings decisions. Traditional defined benefit plans are often poorly understood by participants. Part of this lack of knowledge results from the complexities of the plans themselves, since the ultimate value to an employee depends on a number of unknowable factors including lifespan, number of years of continued employment, and future pay rates. However, part of the general lack of employee knowledge is also a result of receiving outdated and complicated information regarding the funding status and other aspects of their pension plans. Requiring plan sponsors to regularly provide up-to-date information

regarding the funding levels, recent contributions, and investment allocations of their pension trusts could significantly improve employee understanding of their pension assets.

5. Other options

Another one of the solutions proposed to deal with the PBGC's problems is increasing the PBGC's investment returns. Advocates of this plan believe that the PBGC should hold more of its assets in stocks and that such a strategy would likely raise long term investment returns and diminish the need for other reforms. The major problem with this thinking is that the reason equities offer a higher expected return is that they are far more risky. Even over the long term, stocks could easily return less than bonds, and perhaps lose money. While most policy makers acknowledge that the high risk involved basically prohibits the PBGC from adopting such an aggressive investment portfolio, there is some debate as to precisely what kind of mix of stocks and bonds the PBGC ought to hold. Also, current policies mandate that all premium revenue be invested in bonds, yet at the same time allow financial assets assumed from plan takeovers to be invested in almost anything. In considering reform, Congress could give the PBGC more precise investment guidelines regarding appropriate levels of risk, and probably should eliminate the irrational distinction between investing premium income and investing assumed assets from pension trusts [27].

There has been some discussion about trying to improve the PBGC's overall position in bankruptcy proceedings [15]. The PBGC usually recovers roughly 3-5% of the value of claims in bankruptcy. Placing the PBGC ahead of other creditors could

significantly increase recoveries and improve the PBGC's finances, but largely at the expense of the other lenders. Such a change could significantly increase funding costs for financially weak firms as creditors would require a higher interest rate because of the heightened risk. This could even have the unwanted effect of actually pushing troubled firms into bankruptcy. Furthermore, any changes in the bankruptcy hierarchy would take time to phase in, as it would be patently unfair to immediately leapfrog the PBGC ahead of other creditors.

While there are already caps on the PBGC's guarantees, another feasible option would be to further limit these. Employing such a remedy would seem to be a lot like mistaking the symptom for the illness, since the structural cause of the crisis at the PBGC is not the insurance scheme itself, but the lax funding regulations and insufficient premiums. One reasonable limitation would be to not allow companies in financial distress to increase their retirement promises in lieu of wage increases. Lately many unions have been willing to accept such promises, even when they believe there is a high probability of bankruptcy, because they have the knowledge that the PBGC will guarantee at least part of the pension increases.

The final policy alternative would simply be to bail out the PBGC with United States taxpayer dollars. While the PBGC is not backed by the full faith and credit clause of the Constitution (and thus the Federal Government does not technically stand behind the PBGC), Congress could not politically afford to let the PBGC fail. The public outcry would be too damaging. A taxpayer bailout could take a number of different forms, ranging from completely shutting down the PBGC and assuming its excess liabilities to making up the PBGC's existing deficit and leaving the pension

regulations and structure of the insurance program virtually untouched. It is somewhat likely that taxpayer funds will need to supplement the PBGC's financial resources at some point; however, if thoughtful reforms are enacted soon the need for such funds could be minimal.

The Bush Administration's Plan

Although the PBGC and the Bush Administration have called for statutory and policy reforms for several years, the magnitude of the present crisis has prompted the Bush White House to step up its efforts at persuading Congress to enact reforms. In February 2005, Department of Labor Secretary Elaine Chao unveiled the Bush Administration's latest proposal for strengthening Retirement Security [28]. The comprehensive proposal embraces many of the policy options outlined earlier in this section, and addresses all four of the key areas for pension reform: (1) changes in funding rules; (2) changes in the PBGC's premium structure; (3) allowing the PBGC more control; and (4) improving transparency.

The plan calls for sweeping changes to the funding of pension plans by standardizing asset and liability measures, applying restrictions to financially unhealthy on making new benefit promises, and shortening the time companies have to catch up when their plans are underfunded. The proposed changes to the premium structure would increase the flat-rate premium and strengthen the risk-based premium so that sponsors with underfunded plans could no longer avoid paying it. While the Administration did propose basing the variable premium in part on the credit risk of the plan sponsor, its proposal did not include any consideration of the sponsor's investment

allocation. In regard to increasing the PBGC's regulatory authority, the proposal only highlights giving the PBGC some say in setting premiums, and does not discuss other possible measures like giving the PBGC more freedom to negotiate with troubled firms. Implementing the plan would increase transparency, as the companies would be required to provide more timely information on the funding status of their plans.

Impressive in its scope, the Administration's proposal has received support from many who are familiar with the PBGC's financial problems. In testimony before Congress on March 2, Comptroller Walker described the plan as "comprehensive" and Elliott agreed that it could significantly "shore up" the PBGC [29]. Current PBGC Executive Director Bradley Belt agrees with this perspective. In statement released on the PBGC's website, Belt said "We look forward to working with Congress to promptly enact the Administration's proposal" [30]. Understandably, there are also groups which for one reason or another oppose enacting the Administration's proposal. The American Benefits Council, a prominent corporate lobby, opposes some of the plan's most essential features, such as the way it would increase premiums and base them more on the credit status of plan sponsors [31]. At the present time, the passage of the Administration's proposal is far from certain. While knowledge of the PBGC's financial problems is becoming more widespread among members of Congress, enacting comprehensive structural reforms of the pension system could prove to be quite difficult.

Conclusion

The stochastic models developed in this thesis support Elliott's original claim: the PBGC is slowly but surely running out of money. Even if economic conditions improve dramatically so that the PBGC experiences higher investment returns and fewer claims, the agency will almost certainly be running a deficit, and the retirement savings of millions will remain in jeopardy. While the models are limited in the sense that they do not incorporate the uncertainties of variables such as bond returns and future inflation, they do paint a more vivid picture of the PBGC's financial horizon. The probability distributions for the key results yield substantial information about the relative likelihoods of various scenarios, and perhaps further research could be devoted to refining the models to include more stochastic features.

Most importantly, the models show that reforms ought to be enacted soon in order to prevent the financial hole from becoming deeper. They indicate that without reform, the PBGC deficit is expect to widen in the upcoming years. In light of this, the responsibility is with the government, particularly the Congress, to promptly address the problem. Swift action on this issue could limit the cost to taxpayers and place the defined benefit pension system in America on more solid ground.

References

1. Walsh, Mary W. “An outsider’s grim prognosis for Pension Agency.” *The New York Times.* September 14, 2004.

2. Elliott, Douglas J. “PBGC: Fundamental Questions.” Original issue date: April 7, 2004. <http://www.coffi.org/pubs/PBGC%20Fundamental%20Questions.pdf>

3. Elliott, Douglas J. “PBGC: A Primer.” Original issue date: April 7, 2004. <http://www.coffi.org/pubs/PBGC%20A%20Primer.pdf>

4. Elliott, Douglas J. “PBGC: When Will the Cash Run Out?” Original issue date: September 13, 2004. <http://www.coffi.org/pubs/PBGC%20When%20Will%20the%20Cash%20Run%20Out%20v8.pdf>

5. ASDF Elliott, Douglas J. “PBGC: Updated Cash Flow Model from COFFI.” Original issue date: November 18, 2004. <http://www.coffi.org/pubs/PBGC%20Updated%20Cash%20Flow%20Model%20from%20COFFI.pdf>

6. PBGC Website. “PBGC Fact Sheets.” Printed November 2004. <http://www.pbgc.gov/publications/factshts/default.htm>

7. Elliott, Douglas J. “PBGC: 2004 Showed Record Losses.” Original issue date: November 16, 2004. <http://www.coffi.org/pubs/PBGC%202004%20Results.pdf>

8. PBGC Website. “PBGC to Assume Responsibility for Pilots Pension Plan at UAL.” Printed January 13, 2005. <http://www.pbgc.gov/news/press_releases/2004/pr05_18.htm>

9. Carey, Susan. “United Sets Deals with Unions, But Judge Rejects Pilots’ Pact.” *The Wall Street Journal.* January 10, 2005.

10. PBGC Website. “PBGC Takes $2.3 Billion Pension Loss from US Airways.” Printed February 2, 2005. <http://www.pbgc.gov/news/press_releases/2005/pr05_22.htm>

11. PBGC Website. “PBGC will assume Ground Employee Pension Plan at UAL.” Printed March 11, 2005. <http://www.pbgc.gov/news/press_releases/2005/pr05_30.htm>

12. Mulvey, John, et al. “Modernizing the Defined-Benefit Pension System.” *The Journal of Portfolio Management*. 73-82. 2005.

13. Belt, Bradley D. Testimony before the Subcommittee on Government Management, Finance and Accountability, Committee on Government Reform, United States House of Representatives. March 2, 2005.

14. Boyce, Steven, and Ippolito, Richard A. "The Cost of Pension Insurance." *The Journal of Risk and Insurance.* Volume 69, No 2, 121-170. 2002.

15. Elliott, Douglas J. "PBGC: Policy Options." Original issue date: January 6, 2005. <http://www.coffi.org/pubs/PBGC%20Policy%20Options%20%20January%206%202005.pdf>

16. "Time to end a scandal." *The Economist.* October 28, 2004.

17. PBGC. "2004 Annual Report." Issued in February, 2005. Acquired via mail in March 2005. <http://www.pbgc.gov/publications/annrpt/default.htm>

18. Ippolito, Richard A. "How to Reduce the Cost of Federal Pension Insurance." Original issue date: August 24, 2004. <http://www.cato.org/pubs/pas/pa523.pdf>

19. Elliott, Douglas J. Personal emails. November 2004-March 2005.

20. PBGC. "2003 Annual Report." Issued December 22, 2003. Acquired via mail in November 2004. <http://www.pbgc.gov/publications/annrpt/default.htm>

21. PBGC. "Pension Insurance Data Book 1998." Originally issued in 1998. <http://www.pbgc.gov/publications/databook/databk98.pdf#xml=http://pbgc.gov.master.com/texis/master/search/mysite.txt?q=Pension+Insurance+Modeling+System&order=r&id=701972122c597e5c&cmd=xml>

22. Schroeder, Michael. "Bush is pushing for pension reform." *The Wall Street Journal.* January 11, 2005.

23. Luenberger, David G. *Investment Science.* Oxford University Press: New York: 1998.

24. Chatfield, Christopher. *Introduction to Multivariate Analysis*. Chapman and Hall: New York: 1980.

25. Walker, David M. Testimony before the Subcommittee on Government Management, Finance and Accountability, Committee on Government Reform, United States House of Representatives. March 2, 2005.

26. United States Government Accountability Office. *21st Century Challenges: Reexamining the Base of the Federal Government.* Publication number GAO-05-325SP.February 2005.

27. Elliott, Douglas J. Testimony before the Subcommittee on Government Management, Finance and Accountability, Committee on Government Reform, United States House of Representatives. March 2, 2005.

28. United States Department of Labor website. "Strengthen Funding For Single-Employer Plans." Printed February 7, 2005. <http://www.dol.gov/ebsa/pensionreform.html>

29. Apple, Richard D. Personal notes from House hearings. March 2, 2005.

30. PBGC Website. "Statement by PBGC Executive Director Bradley D. Belt on Pension Reform Proposal in Administration's Budget Submission." Printed February 10, 2005. http://www.pbgc.gov/news/press_releases/2005/pr05_23.htm

31. American Benefits Council. Funding our Future: *A Safe and Sound Approach to Defined Benefit Pension Plan Funding Reform.* February 2005.