A Better Defined Benefit Contribution Policy: Contribute No Less than the Normal Cost

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Abstract

A frustrating aspect of pension funding rules for U.S. plan sponsors is that contribution requirements are adversely correlated with business cycles. For example, not only did plan sponsors get hit with large contribution requirements in the perfect storm of the early 2000s, but many sponsors were prohibited from contributing in the late 1990s boom because of full funding limitations.

In this paper I propose that plan sponsors be allowed to contribute the normal cost as a deductible contribution each year. In hindsight, this would have allowed plan sponsors to pay for benefits as they accrued in the late 1990s and ultimately mitigated some of the crash of the early 2000s. This change could be layered onto existing regulations or be part of a new set of regulations.

I demonstrate that a contribution policy allowing contributions to be at least equal to the normal cost will result in less volatility of contributions and improve the funded status over time. Clearly, with this outcome the proposed contribution policy would be better than the current system in the United States, where the full funding limit can restrict contributions to zero.

For comparison, this paper also considers additional proposals:

- *Current Law*—U.S. ERISA/Internal Revenue Code rules
- *Proposal 1*—Allow the normal cost to be a deductible contribution
- *Proposal 2*—Require the normal cost to be contributed each year plus a supplemental contribution if needed
- *Proposal 3*—Eliminate the full funding limitation rules
- *Proposal 4*—President's funding reform proposal.

This paper explores the range of contribution policies allowable under the above sets of rules and determines optimal contribution strategies for different objectives.

I show that adopting Proposal 1 achieves several objectives of the Society of Actuaries' (SOA's) stated funding system constraints, namely:

- Maximum flexibility for participants
- Minimal volatility of contributions for plan sponsors
- Maximum predictability of contributions for plan sponsors
- Minimal risk to shareholders
- Minimal risk to participants
- Minimal risk to guaranty agencies.

The same constraints are examined for Proposals 2–4 with mixed outcomes. Additional funding system constraints as outlined by the SOA will not be addressed.

1. Introduction

1.1 Statement of the Problem

One of the most pressing issues facing private pension plan sponsors in the United States today is the burden of large contributions in a weakened economy. Looking back a few years, many plan sponsors were prohibited from contributing during the economic boom of the late 1990s by the full funding limit. Another way of saying this is that the current U.S. funding rules produce contribution requirements that are negatively correlated with the business cycle.

There are many factors that have gotten us to the current situation, and there has been much discussion about possible remedies. One key fact is that participants continue to accrue benefits during good and bad economic times. Having regulations such as the full funding limit that prohibit contributions when a plan has a large surplus means that plan sponsors cannot contribute to keep up with the continued accruals of benefits.

The remainder of this introduction gives a high-level overview of the proposals, model, and outcomes of the analysis. The main body of the paper, Section 2, is divided into analysis of the current U.S. funding rules, Proposals 1–3, and Proposal 4. Proposal 4 is handled separately because of its fundamentally different approach. Section 3 contains a summary, conclusion, and areas for future research. Additional details regarding the proposals and the model are contained in the Appendix.

1.2 Proposals

In this paper I propose three potential solutions to the contribution problem outlined above. In addition, I examine the recent proposal for funding reform from the Bush administration under the same analysis. A common feature of all the proposals is that "funding holidays" are not mandatory as they are under the current rules. This feature is critical if funding reform hopes to address the negative correlations with the business cycle.

The proposals vary in other ways that impact the plan sponsor's flexibility with contributions as well as the factors outlined in the SOA's funding system constraints as outlined below. The proposals considered are the following:

- *Proposal 1*—Maximum deductible contribution at least as large as the normal cost (with interest)

- *Proposal 2*—Minimum required contribution at least as large as the normal cost (with interest)
- *Proposal 3*—Eliminate the full funding limitation
- *Proposal 4*—The president's proposed funding reform.

Proposals 1–3 are considered as single changes to ERISA. All other aspects of ERISA still apply in these proposals. Proposal 4 is a set of new rules entirely.

1.3 Objectives of the Model

Section 2 explores the relationships between contribution ratio, funded ratio, and shortfall ratio for a "random" valuation through a simulation. The model simulates multiple economic scenarios and projects a pension fund under various contribution policies to a terminal point. The contribution ratio is the ratio of the contribution (under a specific policy) to the normal cost, the funded ratio is the ratio of the terminal fund amount over the actuarial liability, and the shortfall ratio is the lesser of the funded ratio and 1. At the terminal point, the average of the contribution ratio μ_C, the standard deviation of the contribution ratio σ_C, the average funded ratio μ_F, the standard deviation of funded ratio σ_F, and the standard deviation of shortfall ratio σ_F^- are calculated over all the scenarios.

The purpose of the projection is to mimic a plan sponsor's consistent application of a funding policy over time. The funding policies considered are weighted averages of the minimum required and maximum deductible contributions for the various proposals.

It is important for us to discuss the risk to the plan sponsor, participants, guaranty agencies, and shareholders. We must characterize these risks systematically. We will use the above ratios to get a sense of proportion, rather than an absolute dollar measure of risk. With the additional assumption of a stationary population in which all valuation assumptions are met, the normal cost and actuarial liability are constant (net of inflation), so the ratios calculated are scalar multiples of the dollar figures.

For the SOA constraints, we will use the following metrics:

- Maximum flexibility to participants—the average funded ratio μ_F
- Minimal volatility of contributions for plan sponsors—the standard deviation of the contribution ratio σ_C
- Maximum predictability of contributions for plan sponsors—the standard deviation of the contribution ratio σ_C

- Minimal risk to shareholders—the standard deviation of funded ratio σ_F
- Minimal risk to participants—the standard deviation of shortfall ratio σ_F^- and
- Minimal risk to guaranty agencies—the standard deviation of shortfall ratio σ_F^-.

For flexibility to participants: the larger the fund, the more flexibility. Clearly, volatility of the contribution ratio σ_C is a meaningful concept of risk and predictability of contributions for the plan sponsor. Shareholders must ultimately bear the volatility of the fund. For the participants and guaranty agencies, a shortfall of plan assets poses a greater risk than a surplus. The volatility σ_F does not distinguish between a shortfall and a surplus and a deficit, so we calculate the volatility of just the shortfalls σ_F^-.

One could argue that there are better measures of risk than the ones selected. These were chosen for their applicability and ease of calculation.

In addition to the goal of improving the metrics for the above constraints, an effective set of pension funding rules should provide a range of allowable contributions that give flexibility in choosing an optimal strategy. It is shown below that Proposals 1–3 do in fact give more flexibility than the current ERISA rules. The risks under each proposal are compared, and the optimal contribution strategies for each are calculated by maximizing or minimizing the relevant metric.

1.4 Conclusions

Proposal 1, allowing the deduction of the normal cost, provides the greatest improvement over the current rules on all of the factors analyzed. This is the main reason why I believe this proposal is worthy of consideration. Another reason is that it is a very minor change. This has the advantages that it can be incorporated easily into the current rules (making it a good candidate for a "quick fix"), and it can be incorporated easily into other proposals.

Proposals 2 and 3 have mixed results on improving the factors analyzed when compared to the current rules. Nevertheless, the analysis provides valuable concrete information about the pros and cons of each proposal.

Proposal 4 improves on or stays materially the same as ERISA on all of the factors analyzed. Two drawbacks of Proposal 4 are the possibility of overly large surpluses (suggesting the possibility of corporate tax avoidance) and an increase in the magnitude and, in many cases, the volatility of the contribution ratio.

2. Analysis of Contribution Policies

As stated in the Introduction, we will examine the average of the contribution ratio μ_C, the standard deviation of the contribution ratio σ_C, the average funded ratio μ_F, the standard deviation of funded ratio σ_F, and the standard deviation of shortfall ratio σ_F^- of a random valuation under a consistent contribution policy.

The values of the above metrics are computed through a simulation of several economic scenarios over a period of time. The plan sponsor is assumed to contribute under a policy over time that is a (fixed) weighted average of the minimum required and maximum deductible contributions. The terminal funded ratio and contribution ratio are calculated for each scenario, and averages and standard deviations are computed over all the scenarios.

To isolate the effect of the different contribution policies and proposals, all other factors are held fixed. The same economic scenarios are used for each contribution policy and each proposed set of funding rules. We will assume a stationary population under fixed demographic assumptions and that all demographic assumptions are met each year. We will assume a constant valuation rate and salary scale to determine liabilities. This implies that the actuarial liability and normal cost are constant, net of inflation. These assumptions are the same for all the proposals with the exception that the interest rates used for the valuation in Proposal 4 are from the yield curves generated by the model described below. (Actuarial liabilities and normal cost were calculated with Lynchval; simulations and projections were calculated in MatLab.)

The pension plan considered is a traditional final average pay formula. Benefits are paid at normal retirement at age 65 in the form of a life annuity. There are no early retirement, disability, or death benefits. Participants may terminate vested after five years with a deferred life annuity. No lump sums are payable from the plan.

For the economic scenarios, we assume that the fund is invested in a mixture of risky stocks and risk-free bonds with an asset mix that is constant over time. The stock returns are random draws from a normal distribution. Bond returns are determined from the prices of 30-year bonds generated from a (discretized) Cox-Ingersoll-Ross (CIR) interest rate model. We will use the same CIR interest rate model to develop a risk-free yield curve used for the 30-year treasury rates incorporated in current liability calculations and in Proposal 4 for the calculation of liabilities. Technically, Proposal 4 calls for the use of a corporate yield curve that should involve margins above the risk-free yield curve. However, for simplicity of the model we will retain the same CIR

model. We will assume that the yield curves and the stock returns are independent. Additional information regarding the model can be found in the Appendix.

2.1 Analysis of Current U.S. Funding Rules

2.1.1 Summary of U.S. Funding Rules

As a baseline, we will consider the problem in the United States under ERISA and the Internal Revenue Code. A brief summary of the rules used follows.

Actuarial liability and normal cost are calculated using the projected unit credit method with a constant valuation rate and salary scale. Current liability is calculated using unit credit and a four-year weighted average of the 30-year treasury rates. The valuation asset method is the fair market value of assets.

The minimum required contribution is the sum of the normal cost, five-year amortizations of gains and losses, and the additional funding charge, offset by the credit balance (with interest) and full funding credit.

The maximum deductible contribution is the sum of the normal cost and 10-year amortizations with interest. The maximum deductible may not be less than the minimum required, greater than the full funding limit, or less than the projected unfunded current liability.

Note that for the minimum required contribution, only the five-year amortization of gains and losses is used. The projection assumes that the fund is well past the amortization of any initial unfunded liability and that there are no plan amendments, assumption, or method changes. It is interesting to observe that the "basic" contribution rules of five-year amortization for the minimum required and 10-year amortization of the maximum deductible would usually result in a minimum required contribution that exceeds the maximum deductible for an underfunded plan.

Additional details of the current U.S. rules and those of the other policies are included in the Appendix.

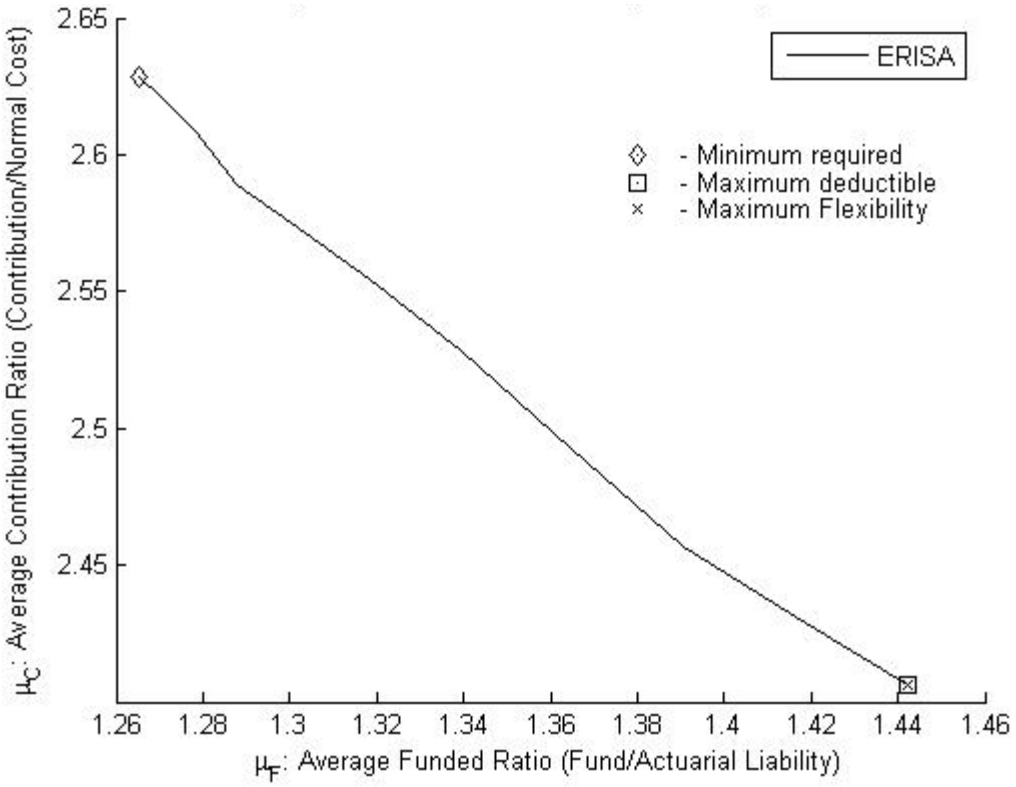
2.1.2 Maximum Flexibility to Participants

We will examine the first of the metrics under the current U.S funding rules in the simulation in Figure 2.1. The curve represents the set of all contribution policies possible between the minimum required and maximum deductible contributions.

Points on the curve are obtained by assuming that the plan sponsor contributes x percent of the minimum required contribution and (100 percent − x percent) of the maximum deductible contribution for all years in the projection. A contribution policy of x percent = 100 percent corresponds to always contributing the minimum required (indicated on the graph with a diamond), and a contribution policy of x percent = 0 percent corresponds to always contributing the maximum deductible (indicated on the graph with a square). The optimal contribution policies on all graphs throughout the paper are indicated with a + or ×.

A comparison of the average contribution ratio and the average funded ratio shown in Figure 2.1 provides the first counterintuitive result. In any given year, the maximum deductible contribution cannot be less than the minimum required contribution. However, Figure 2.1 shows that *on average* the maximum deductible is lower than the minimum required. This occurs because by consistently contributing the maximum, the plan sponsor can maintain a more well-funded plan and thus lower future contribution requirements.

FIGURE 2.1
Maximum Flexibility to Participants



It is important to note that the scale of Figure 2.1 as shown exaggerates the difference in the average contribution ratio over the various policies. The minimum required contribution ratio is 2.63, and the maximum deductible contribution ratio is 2.41, within 10 percent of each other.

We also note that the average funded ratio was comfortably above 1 for all policies. This came as a surprise, given the current situation for U.S. pension plans. We will select the valuation rate to be within the reasonable range of expected outcomes of the simulated fund return, consistent with ERISA. Upon examination of the terminal funded ratios in the scenarios, the majority had ratios exceeding 1 (surplus). We may conjecture that (1) the assumption that the stock and bond returns are independent may not be appropriate or (2) the "real world" conditions of the past few years are unlikely occurrences. The second conjecture may not be much consolation to plan sponsors, but it may emphasize the growing role of extreme value theory in risk management.

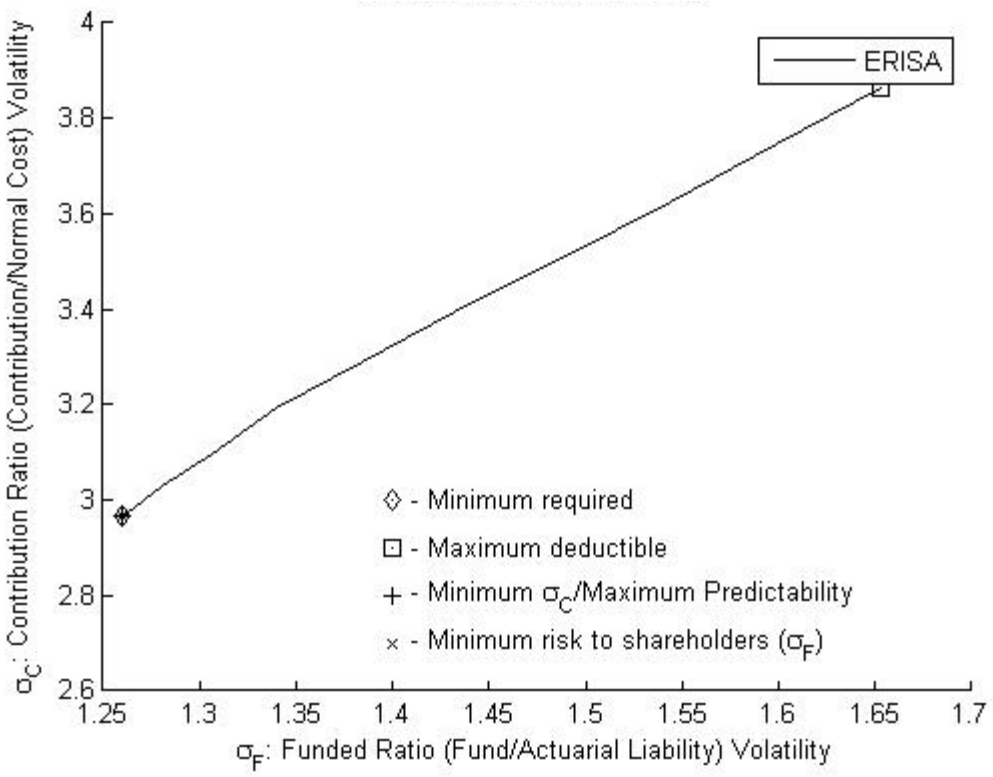
Optimal Policy: Maximum deductible contribution. From the perspective of a plan participant's flexibility, the optimal contribution policy is the maximum deductible policy giving the highest average fund value. This comes as no surprise.

2.1.3 Minimum Volatility and Maximum Predictability of Contributions, Minimum Risk to Shareholders

We will now consider the relationship between the contribution ratio volatility and the fund volatility in Figure 2.2. Clearly, minimizing σ_C, the standard deviation of the contribution ratio, is the same as minimizing the standard deviation of contributions themselves since the normal cost is constant (net of inflation). By the same argument, the minimal value of σ_C will occur for a policy that has maximum predictability of contributions.

For the shareholders' perspective, we use σ_F as the characterization of risk. Shareholders must ultimately bear the burden of an underfunded plan, and, on the other hand, a large surplus may not be the best use of corporate assets. For these reasons, the two-sided nature of σ_F is appropriate.

FIGURE 2.2
Minimum Volatility/Maximum Predictability of Contributions
Minimum Risk to Shareholders



In Figure 2.2 we see that contributing the maximum deductible contribution greatly increases the volatility of the contributions, while at the same time it increases the volatility of the fund.

This is perhaps counterintuitive but is explained by the fact that frequently the maximum deductible contribution is the projected unfunded current liability, which is a target more volatile than just the fund itself since the current liability is dynamic. In other words, the funded ratio is with respect to the (constant) actuarial liability, but the maximum policy is funding to the (dynamic) current liability. Thus for the maximum deductible contribution policy, the ratio as plotted reflects the volatility of the assets and the current liability.

It is also interesting to note that the smallest value of σ_C occurs with the minimum required contribution policy. This may be surprising since many plan sponsors who contributed at the minimum required level for years are currently frustrated at the recent volatility of contributions. However, the recent volatility of the minimum required contributions says nothing about the volatility of the maximum

deductible contribution. Most sponsors would agree that fully funding the current liability each year in the present environment would be extremely volatile.

Optimal Policy: Minimum required contribution. From the perspective of minimizing contribution volatility, maximizing contribution predictability, and minimizing shareholders' risk, the optimal contribution policy is the minimum required policy.

2.1.4 Minimum Risk to Participants and Guaranty Agencies

Volatility of the funded ratio σ_F does not distinguish between an overfunded and an underfunded plan. For this reason, we consider the volatility of the shortfall ratio σ_F^- for the characterization of the risk to participants and guaranty agencies. The metric σ_F^- is the volatility of the lesser of the funded ratio and 1, only to take into account underfunded plans.

FIGURE 2.3
Minimum Risk to Participants/Guaranty Agencies

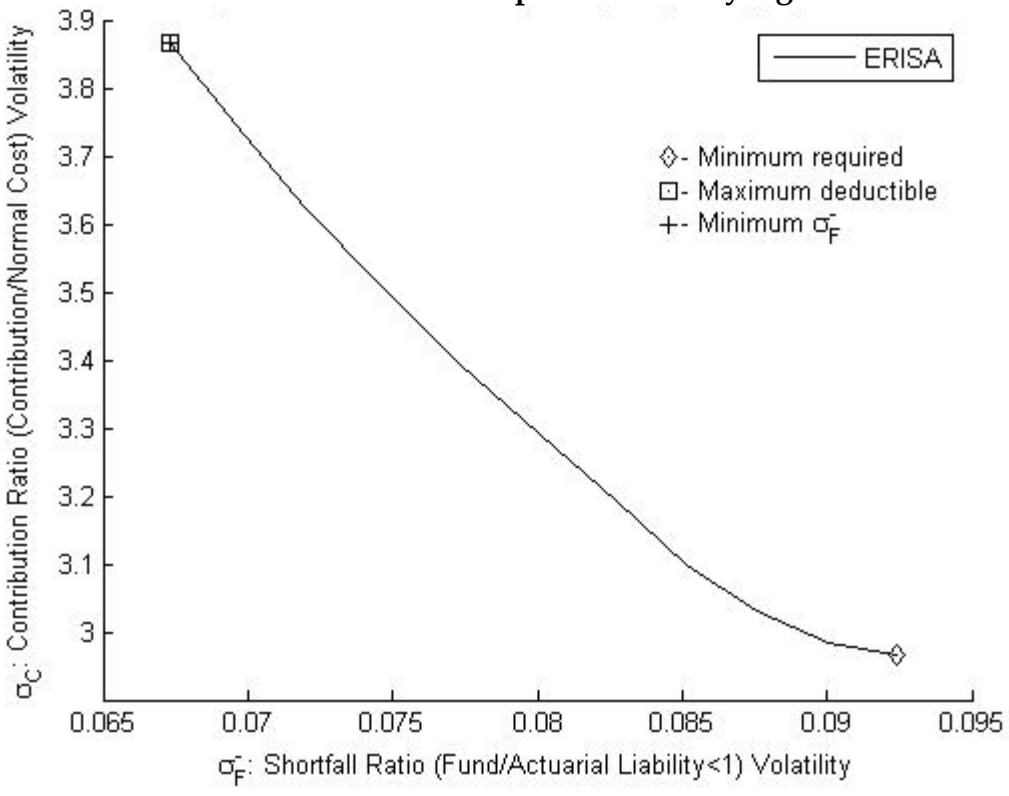


Figure 2.3 conforms to conventional wisdom that contributing higher amounts reduces the risk of shortfall. Note that the magnitude of σ_F^- is rather small, because the shortfall ratio equals 1 in the majority of scenarios, and even if a deficit occurs, it

generally does not become very large because the current funding rules react very quickly to eliminate shortfalls.

Optimal Policy: Maximum deductible contribution. From the perspective of minimizing risk to participants and guaranty agencies, the optimal contribution policy is the maximum deductible policy.

2.1.5 Summary of Results for Current Law

A summary of the optimal contribution policies for the various factors for current ERISA law is shown in the following table. A final comment on the current law is that, for all the factors studied, the optimal contribution ended up being at one end or the other of the allowable range of contributions. One could argue that an optimal contribution policy being strictly between the minimum and the maximum shows that the system of rules is flexible enough to allow the plan sponsor more discretion.

Optimal Contribution Policies: Current Law		
Objective	**Parameter**	**ERISA**
Maximum flexibility to participants	σ_F	Maximum deductible
Minimal volatility of contributions for plan sponsors	σ_C	Minimum required
Maximum predictability of contributions for plan sponsors	σ_C	Minimum required
Minimal risk to shareholders	σ_F	Minimum required
Minimal risk to participants	σ_F^-	Maximum deductible
Minimal risk to guaranty agencies	σ_F^-	Maximum deductible

2.2 Analysis of Proposed Solutions 1–3

2.2.1 Summary of Proposals 1–3

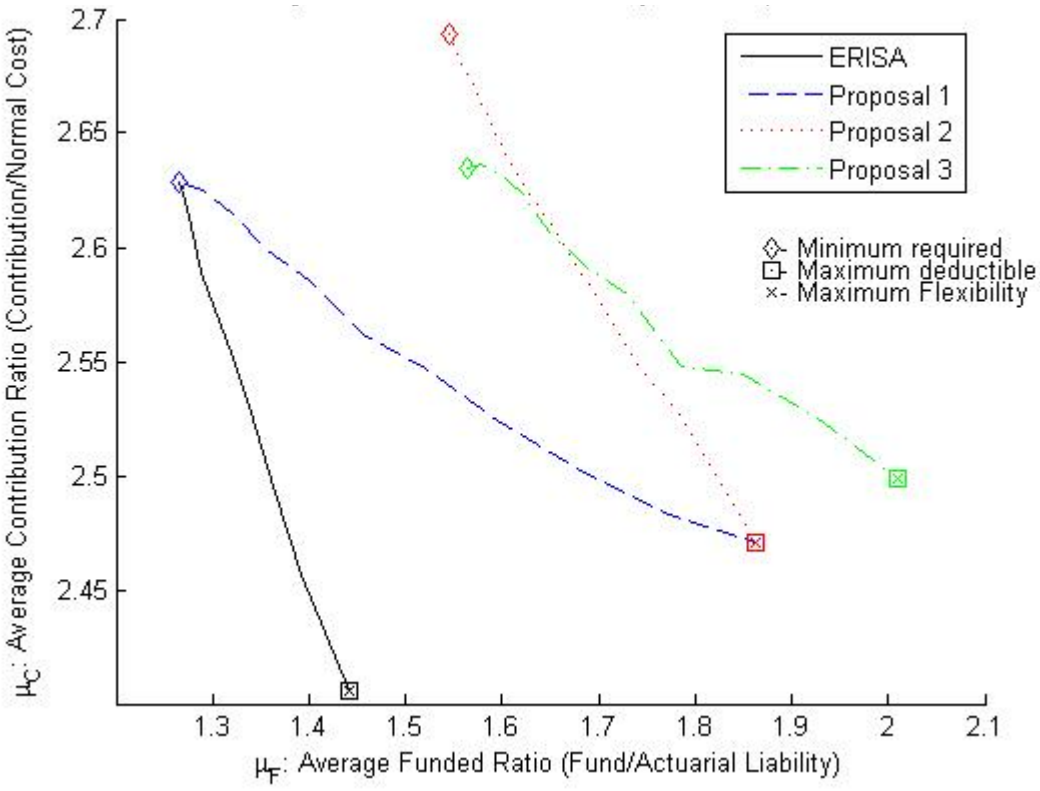
Proposals 1–3 involve changes to the existing U.S. funding rules without a complete overhaul. Proposal 4 is a complete rewrite of the rules. Because of their inherent similarity, the first three proposals are included on the same graphs below. Because of its fundamentally different nature, Proposal 4 is graphed separately. A brief summary of Proposals 1–3 follows. More detailed descriptions can be found in the Appendix.

- *Proposal 1*—The maximum deductible contribution is at least as large as the normal cost (with interest). The rationale for this rule is that accruals continue to occur, so a plan sponsor should always be able to fund those new accruals. This has the added advantage that the "normal cost" can be understood by stakeholders as it was meant to be—the current cost of this year's accruals—and other contributions can be more clearly seen as responses to underfunding or a sponsor's elective prefunding.
- *Proposal 2*—The minimum required contribution is at least as large as the normal cost (with interest). This proposal extends the idea of paying for the new accruals to a requirement rather than an option. Any credit balance built up would only reduce contributions in excess of the normal cost (with interest). This proposal is perhaps less desirable in the sense that it removes flexibility for the plan sponsor by narrowing the range of allowable contributions.
- *Proposal 3*—Eliminate the full funding limitation. One of the primary reasons for the full funding limitation is to limit corporate deductions. In an academic sense, the full funding limit has no purpose in pure funding. In practicality, the full funding limit prohibited many plan sponsors from managing their pension risk during the economic boom of the late 1990s.

2.2.2 Maximum Flexibility to Participants

As with ERISA, we will examine the same metrics under the same factors described in Section 2.1.2. Figure 2.1a shows a comparison of the average funded ratio and the average contribution ratio for contribution policies under the current ERISA rules and Proposals 1–3.

FIGURE 2.1a
Maximum Flexibility to Participants



Each proposal increases (or maintains) the average funded ratio across all policies compared to ERISA. The average contribution ratios increase for the maximum deductible (as expected) in all three scenarios and in Proposals 2 and 3 (particularly 2) for the minimum required.

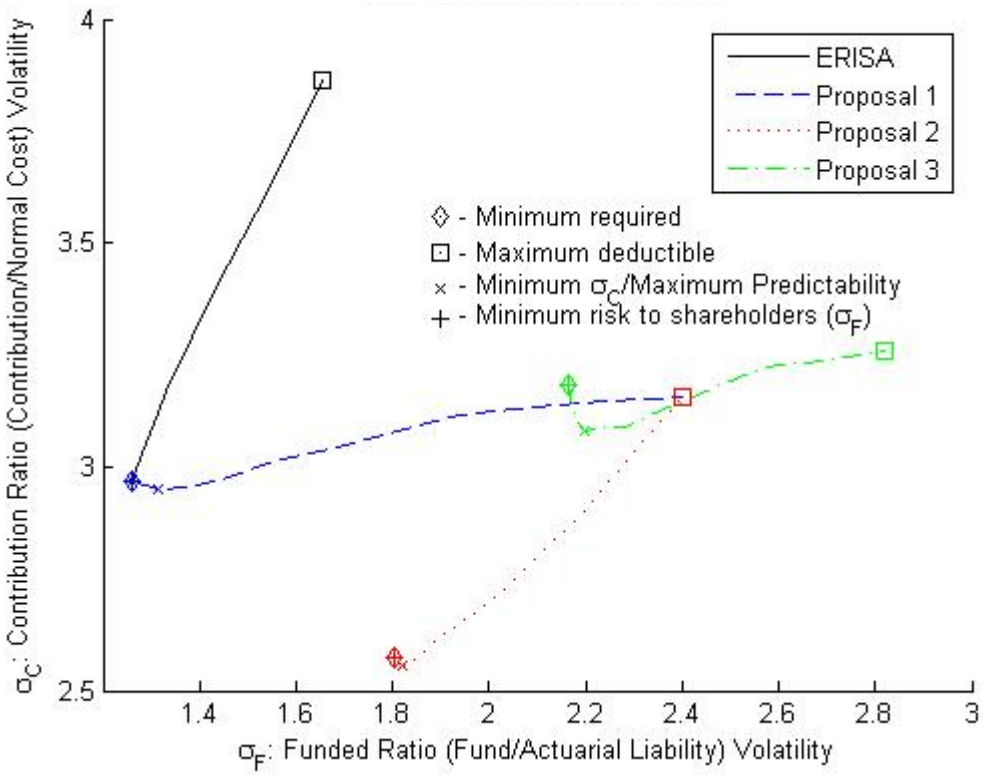
It is interesting to note that Proposal 3, eliminating the full funding limitation, does not greatly affect μ_C for the minimum required but does improve μ_F. This indicates that plan sponsors would be better able to maintain a surplus without radical changes to the average contributions. Since plan participants gain more flexibility with a larger fund, this is a win-win proposal.

Optimal Policy: Maximum deductible contribution, greater flexibility than ERISA for all three proposals. As with ERISA, from the perspective of a plan participant's flexibility, the optimal contribution policy is the maximum deductible policy giving the highest average fund value.

2.2.3 Minimum Volatility and Maximum Predictability of Contributions, Minimum Risk to Shareholders

We now consider the relationship between the contribution ratio volatility and the funded ratio volatility in Figure 2.2a, comparing the three proposals and ERISA. As expected, Figure 2.2a shows an increase in volatility σ_F for all three proposals.

FIGURE 2.2a
Minimum Volatility/Maximum Predictability of Contributions
Minimum Risk to Shareholders



Of considerable interest is the fact that, for all three proposals, the minimum volatility σ_C occurs for contribution policies other than the minimum or maximum. This property is critical for creating a set of funding rules that gives the plan sponsor the flexibility to take advantage of the allowable range of contributions.

All three proposals reduce the contribution volatility. In particular, Proposal 1 has the narrowest range of values for σ_C. This is also desirable from the plan sponsor's perspective since any policy chosen should have similar volatility.

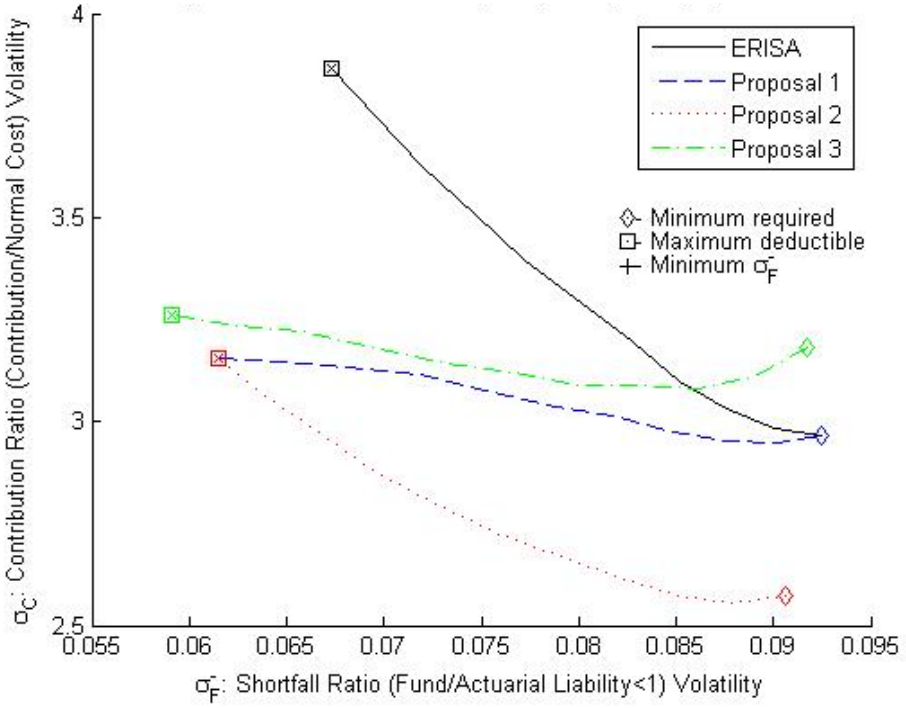
Optimal Policy: Minimum volatility and maximum predictability of contributions: intermediate contribution, improvement over ERISA for Proposals 1 and 2; minimum risk to shareholders: minimum required contribution, same as ERISA for Proposal 1. From the perspective of minimum volatility and maximum predictability of contributions, Proposal 1 has optimal σ_C with a contribution weighted 90 percent minimum/10 percent maximum; Proposal 2 has optimal σ_C with a contribution weighted 90 percent minimum/10 percent maximum; and Proposal 3 has optimal σ_C with a contribution weighted 80 percent minimum/20 percent. The specific weightings are not greatly significant since different plan formulas, populations, assets mixes, etc., may give rise to different optimal policies. The significance lies in the fact that the optimal policy is not constrained by the rules.

As with ERISA, from the perspective of minimum risk to shareholders, the optimal contribution policy is the minimum required policy.

2.2.4 Minimum Risk to Participants and Guaranty Agencies

We will now consider the relationship between the contribution ratio volatility and the shortfall ratio volatility in Figure 2.3a, comparing the three proposals and ERISA. As expected, Figure 2.3a shows a decrease in volatility σ_F^- for all three proposals in the case of the maximum deductible contribution.

FIGURE 2.3a
Minimum Risk to Participants Guaranty Agencies



Although there are improvements in the metric for each proposal in the case of the maximum deductible contribution policy, they are not material. However, for all three proposals the improvement of σ_F^- occurred simultaneously with improvement of σ_C.

In the case of Proposal 2, the contribution ratio volatility increased in the case of the minimum required policy. This is the price for the "win-win" situation of the average contribution ratio remaining relatively the same (as noted in Section 2.2.2)—more volatility.

Optimal Policy: Maximum deductible contribution, improvement over ERISA for all three proposals. As with ERISA, from the perspective of minimum risk to participants and guaranty agencies, the optimal contribution policy is the maximum deductible policy.

2.2.5 Summary of Results for Proposals 1–3

A summary of the optimal contribution policies for the various factors for Proposals 1–3 is shown in the following table. In addition, the table shows whether the relevant metric improved, stayed the same, or worsened compared to ERISA.

Optimal Contribution Policies: Proposed Changes			
Objective	**Proposal 1**	**Proposal 2**	**Proposal 3**
Maximum flexibility to participants	Maximum improved	Maximum improved	Maximum improved
Minimal volatility of contributions for plan sponsors	90/10 improved	90/10 improved	80/20 worsened
Maximum predictability of contributions for plan sponsors	90/10 improved	90/10 improved	80/20 worsened
Minimal risk to shareholders	Minimum same	Minimum worsened	Minimum worsened
Minimal risk to participants	Maximum improved	Maximum improved	Maximum improved
Minimal risk to guaranty agencies	Maximum improved	Maximum improved	Maximum improved

Proposal 1 is the only proposal that improves on or is the same as ERISA.

2.3 Analysis of Proposed Solution 4

2.3.1 Summary of Proposal 4

The president's proposed funding reform takes a fresh look at pension funding. This proposal rewrites all the funding rules without features such as the full funding limitation, additional funding charge, and variable amortization periods that have evolved over time in ERISA. In addition, the president's proposal restricts the choice of asset method, funding method, and the valuation interest rate assumption.

The proposal calls for a minimum required contribution of the normal cost plus seven-year amortizations. The asset method must be the fair value of assets, and the liabilities must be calculated as the present value of cash flows based on accrued benefits (unit credit) discounted with a corporate yield curve. No credit balance is allowed, but the minimum required contribution may effectively be reduced by any surplus in the plan.

The proposal states that the maximum deductible contribution is the normal cost plus 30 percent to the ongoing liability plus the increase due to future salary increases or full funding of the at-risk liability. Taken literally, the normal cost plus 30 percent of the ongoing liability rule does not take into account any possible plan surplus. This would essentially grant a large tax deduction for corporations indefinitely. Following this interpretation, a policy of contributing the maximum deductible frequently results in an average funded ratio of over 1,000 percent in this model. It is therefore reasonable to interpret this provision of the proposal to mean that the maximum deductible contribution sets a target funded ratio of 130 percent. This interpretation (a target funded ratio of 130 percent) has been used for the purposes of this paper.

The rules vary depending on whether a company is healthy or weak. Only healthy companies are considered for this paper. Additional details are contained in the Appendix.

2.3.2 Maximum Flexibility to Participants

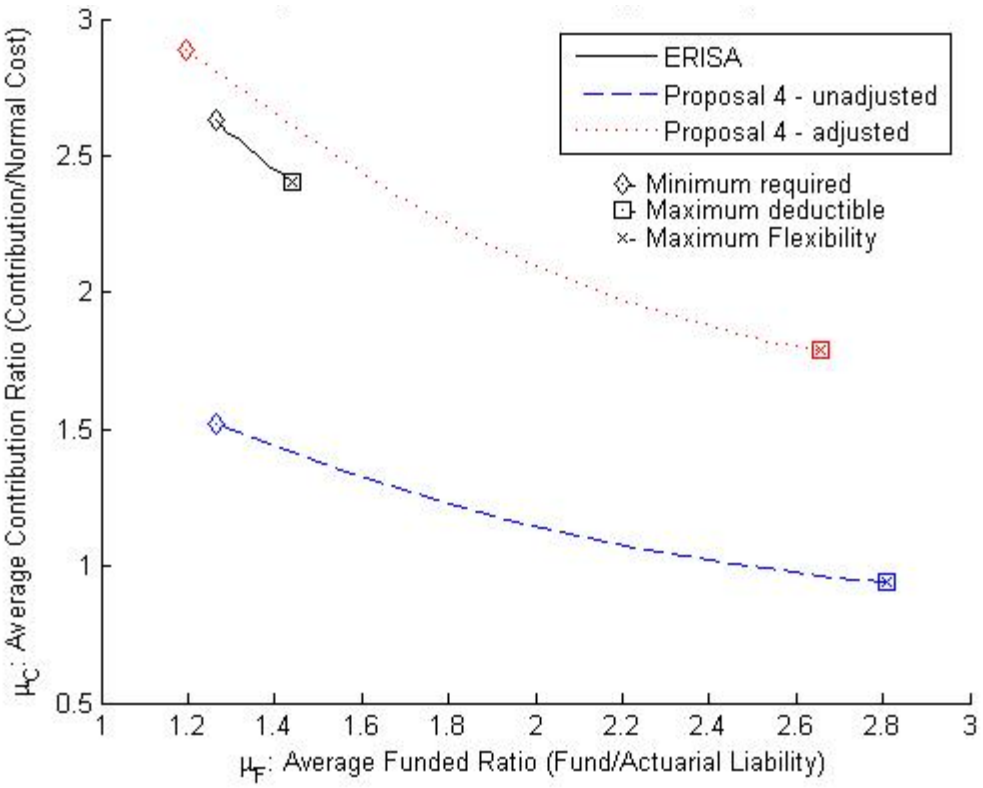
Figure 2.1b shows a comparison of the average funded ratio and the average contribution ratio for contribution policies under the current ERISA rules and Proposal 4. The comparison of contribution ratios is no longer as straightforward since the underlying funding methods are different. In particular, the normal cost as calculated under Proposal 4 depends on the yield curve and thus is subject to volatility unlike the

constant normal cost (net of inflation) under ERISA. Therefore, the contribution ratio of Proposal 4 potentially will understate the volatility of the contributions.

To make a fair comparison between the results for ERISA and Proposal 4, an adjusted value of the contribution ratio for Proposal 4 is included. The adjusted contribution ratio for Proposal 4 is the contribution divided by the ERISA normal cost, rather than the normal cost under the proposal. With this adjustment, the ERISA and (adjusted) Proposal 4 contribution ratios are both scalar multiples of the true contributions by the same factor. The difference between the curves for the unadjusted and adjusted contribution ratios for Proposal 4 is entirely attributed to the volatility of the normal cost. Similarly, the funded ratio is adjusted to be the fund divided by the ERISA actuarial liability.

These adjustments are also made to the other metrics. The graphs show both the adjusted and unadjusted results. All analysis is based on the adjusted results.

FIGURE 2.1b
Maximum Flexibility to Participants



We see in Figure 2.1b that Proposal 4 (adjusted) increases flexibility for participants as measured by μ_F. In fact, the increase is quite dramatic for the maximum deductible contribution policy. In several scenarios the funded ratio target of 130 percent results in a surplus that proceeds to grow far beyond that level. If we interpret the proposal that the normal cost plus 30 percent of the ongoing liability may always be deducted, the average surplus becomes astronomical.

When comparing this result with the current state of pension funding, we must take the same cautious approach that (1) many but not all of the scenarios in the model maintain a large surplus and (2) the model assumes stock and bonds returns are independent. We may therefore conclude that the fact that some pension plans in the United States were over 130 percent funded in the late 1990s and are now underfunded does not mean the results of this analysis are invalid.

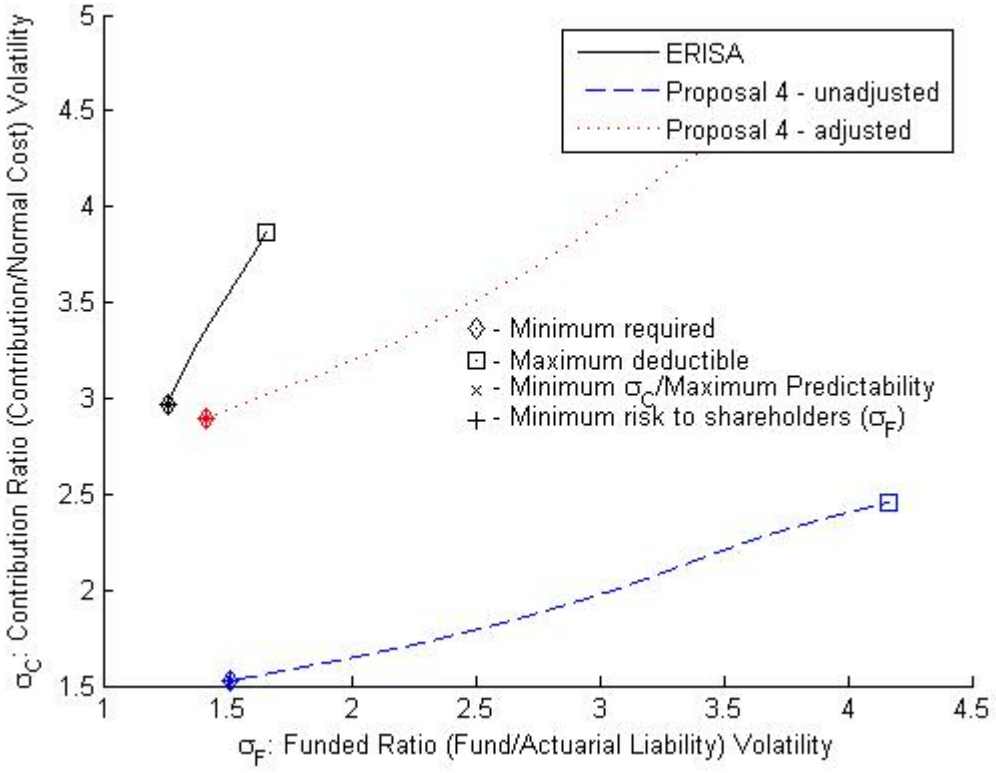
Also note that the average contribution μ_C is higher for Proposal 4 (adjusted) than for ERISA, at least in the case of the minimum required contribution. This is due in part to the lower interest rates used in the valuation, but also due to the fact that there is no credit balance or full funding limitation reducing the contributions in Proposal 4.

Optimal Policy: Maximum deductible contribution, greater flexibility than ERISA. As with ERISA, from the perspective of the plan participant's flexibility, the optimal contribution policy is the maximum deductible policy giving the highest average fund value.

2.3.3 Minimum Volatility and Maximum Predictability of Contributions, Minimum Risk to Shareholders

We now consider the relationship between the contribution ratio volatility and the funded ratio volatility in Figure 2.2b, comparing Proposal 4 and ERISA.

FIGURE 2.2b
Minimum Volatility/Maximum Predictability of Contributions
Minimum Risk to Shareholders



The volatility of the contributions $\boldsymbol{\sigma_C}$ for Proposal 4 (adjusted) is not materially different from that of ERISA. This indicates that Proposal 4 is only marginally different from ERISA in terms of minimizing volatility and maximizing predictability of contributions. This is perhaps not too surprising since the introduction of the dynamic interest assumption itself adds to the volatility of contributions.

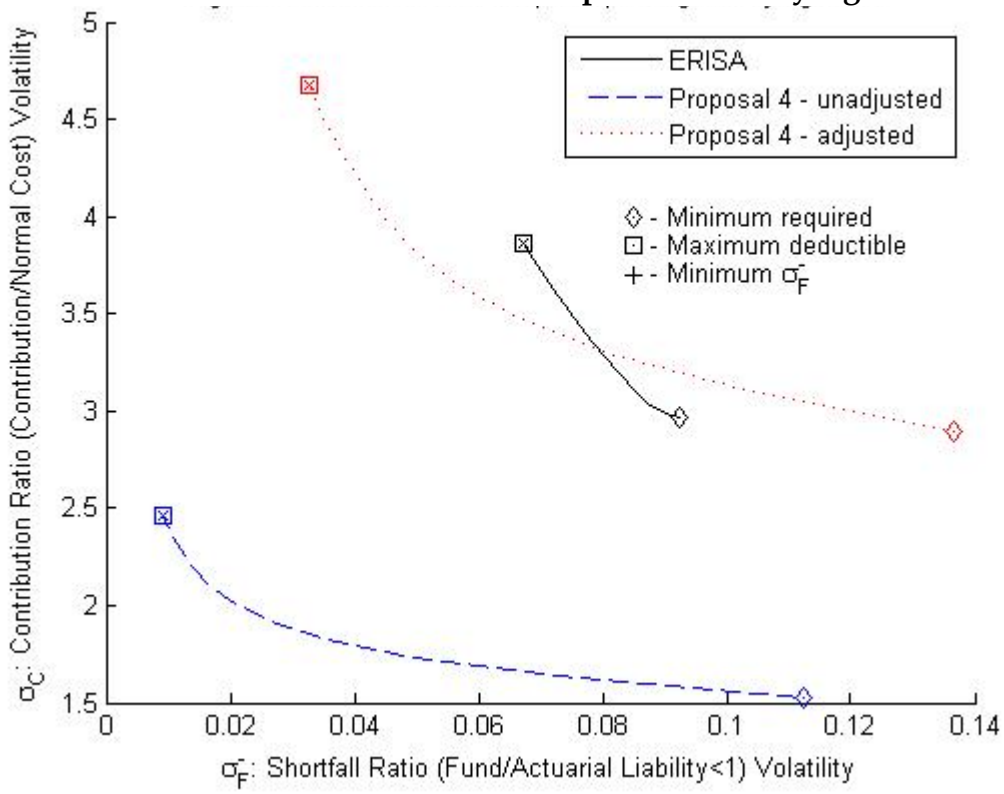
We see that the volatility of the fund $\boldsymbol{\sigma_F}$ increases dramatically, especially in the case of the maximum deductible contribution for Proposal 4 (adjusted). This is due in part to the fact that rather large surpluses can occur (as noticed in Section 2.3.2), and because underfunded plans are not uncommon (due to the volatility of the assets and the funding target).

Optimal Policy: Minimum required contribution, minor improvement over ERISA. From the perspective of minimum volatility and maximum predictability of contributions and minimum shareholder risk, Proposal 4 has optimal $\boldsymbol{\sigma_C}$ with a contribution policy of the minimum required contribution. The volatility for ERISA is $\boldsymbol{\sigma_C} = 2.97$, and for Proposal 4 is $\boldsymbol{\sigma_C} = 2.89$, an improvement of less than 3 percent.

2.3.4 Minimum Risk to Participants and Guaranty Agencies

The last comparison is the relationship between the contribution ratio volatility and the shortfall ratio volatility in Figure 2.3b, comparing Proposal 4 and ERISA.

FIGURE 2.3b
Minimum Risk to Participants/Guaranty Agencies



Proposal 4 provides substantial improvement of the standard deviation of the shortfall ratio σ_F^- over ERISA in the case of the maximum deductible contribution policy. However, in the case of the minimum required policy, Proposal 4 does a worse job minimizing the risk to participants and guaranty agencies.

In the case of the maximum deductible contribution policy, the improvements in σ_F^- came at the expense of σ_C. This is to be expected since typically focusing on eliminating shortfalls quickly should increase contribution volatility.

It is likely that some of the provisions of the proposal that were not tested (i.e., those for financially weak companies) might actually improve this metric (σ_F^-). However, the proposal is somewhat self-contradictory in that it has more stringent contribution requirements for financially weak companies but still allows funding waivers. For the purposes of modeling, we would assume that any company that is

financially weak would very likely be eligible for a funding waiver, making the additional requirements a moot point.

Optimal Policy: Maximum deductible contribution, improvement over ERISA. As with ERISA, from the perspective of minimum risk to participants and guaranty agencies, the optimal contribution policy is the maximum deductible policy.

2.3.5 Summary of Results for Proposal 4

A summary of the optimal contribution policies for the various factors for Proposal 4 is shown in the following table. In addition, the table shows whether the relevant metric improved, stayed the same, or worsened compared to ERISA.

Optimal Contribution Policies: Proposed Changes	
Objective	**Proposal 4**
Maximum flexibility to participants	Maximum improved
Minimal volatility of contributions for plan sponsors	Minimum improved (materially the same)
Maximum predictability of contributions for plan sponsors	Minimum improved (materially the same)
Minimal risk to shareholders	Minimum improved (materially the same)
Minimal risk to participants	Maximum improved (worse at minimum)
Minimal risk to guaranty agencies	Maximum improved (worse at minimum)

Proposal 4 improves on or is the same as ERISA for the optimal policies.

However, the minor improvement in contribution volatility for the minimum required along with the increase in risk to participants and guaranty agencies in that case make the proposal less desirable than Proposal 1.

3. Summary and Conclusion

3.1 Summary

The purpose of this paper is to analyze four proposals for U.S. pension funding reform under six risk factors identified in the SOA's funding system constraints. I proposed six metrics for the different factors and determined optimal contribution policies between the minimum required and maximum deductible contributions for each proposal through use of a simulation.

A summary of the metric used and the optimal contribution policies for ERISA is shown in the table below. These results were verified in Section 2.1.

Optimal Contribution Policies: Current Law		
Objective	**Parameter**	**ERISA**
Maximum flexibility to participants	μ_F	Maximum deductible
Minimal volatility of contributions for plan sponsors	σ_C	Minimum required
Maximum predictability of contributions for plan sponsors	σ_C	Minimum required
Minimal risk to shareholders	σ_F	Minimum required
Minimal risk to participants	σ_F^-	Maximum deductible
Minimal risk to guaranty agencies	σ_F^-	Maximum deductible

In Sections 2.2 and 2.3, the same metrics for the four proposals were examined and the following conclusions made.

Optimal Contribution Policies: Proposed Changes				
Objective	**Proposal 1**	**Proposal 2**	**Proposal 3**	**Proposal 4**
Maximum flexibility to participants	Maximum improved	Maximum improved	Maximum improved	Maximum improved
Minimal volatility of contributions for plan sponsors	90/10 improved	90/10 improved	80/20 worsened	Minimum same
Maximum predictability of contributions for plan sponsors	90/10 improved	90/10 improved	80/20 worsened	Minimum same
Minimal risk to shareholders	Minimum same	Minimum worsened	Minimum worsened	Minimum improved
Minimal risk to participants	Maximum improved	Maximum improved	Maximum improved	Maximum improved
Minimal risk to guaranty agencies	Maximum improved	Maximum improved	Maximum improved	Maximum improved

Proposals 1 and 4 improve on or stay the same as ERISA for all factors considered.

3.2 Conclusion

The current pension funding crisis is the result of the unlikely simultaneous occurrence of poor stock returns and low interest rates. A good set of funding rules would allow for contingency planning to protect plans from such adverse conditions. Unfortunately, there is almost universal agreement that the current U.S. pension funding rules prohibited such contingency planning. The need for funding reform has never been greater in the United States.

I hope to help the debate over the best way to draft new rules by introducing clear and consistent analysis of risk factors for various proposals. The outcome of this analysis shows that all four proposals have some advantages, and this methodology provides a meaningful way of comparing the pros and cons of the proposals.

Proposals 1 and 4 show the most promise for improving the risk factors considered. I believe that Proposal 1 has the added advantages that it is parsimonious, effective, politically feasible, and flexible enough to be combined with other approaches.

It is my hope that the final consensus on pension funding rules in the United States will include a provision for plan sponsors to deduct the plan's normal cost each year, enabling the funding of new benefit accruals as they occur.

3.3 Areas for Future Research

The analysis used in this paper can be extended easily to include other pension plan formulas such as cash balance plans, plans offering lump sums, early retirement subsidies, disability benefits, etc. Moreover, additional funding methods and asset valuation methods could be added to the model.

The economic scenarios used could be improved to allow correlation between stock and bond returns and/or correlation between assets and liability cash flows. Different or varying asset mixes could also be examined. The impact of inflation and variable wage growth and salary scale consistent with the economic scenarios would enhance the model significantly.

The assumption of a stationary population with all assumptions being met each year could be replaced by dynamic demographic assumptions. For example, early retirement windows for plans with early retirement subsidies could be modeled with a Monte Carlo simulation. This method has been used successfully to value early retirement features as options in the pension plan.

The model could also simulate whether a company is healthy or weak. This could be correlated with the economic scenarios.

Appendix

A.1 Valuation

The funding method for the valuation of liabilities for ERISA and Proposals 1–3 is projected unit credit. Current liability is calculated using unit credit. For Proposal 4, the valuation method is unit credit. The asset valuation method is fair market value.

A stationary population was assumed based on the following demographic assumptions:

Retirement:	100 percent at age 65
Mortality:	1983 Group Annuity Mortality (male/female)
Withdrawal:	Table T-7 (from the Actuary's Handbook) less 1951 GAM
Disability:	1975 Social Security Disability.

New entrants occur only at age 20 with a salary of $20,000.

Economic assumptions used in the valuation are a funding rate of 7 percent, salary scale of 4.5 percent, and inflation of 3 percent. Valuation liabilities were calculated using Lynchval Systems Worldwide Inc.'s LVWin valuation system. Current liability interest rates are the four-year weighted average of 30-year treasury rates. Interest rates for Proposal 4 are from a yield curve.

The pension plan formula is 1.5 percent of the final average five years of salary times years of service paid as a life annuity at age 65. Benefits are paid at normal retirement at age 65 in the form of a life annuity. There are no early retirement, disability, or death benefits. Participants may terminate vested after five years with a deferred life annuity. No lump sums are payable from the plan.

A.2 Economic Scenarios

The assets of the pension fund are assumed to be invested 60 percent/40 percent in stocks and bonds. The stock return each year is independently generated from a normal distribution with mean 2 percent and standard deviation 20 percent.

The interest rates are generated from a one-parameter (discretized) CIR interest rate model. The CIR interest rate model assumes that the short rate will follow a Wiener process

$$dr = a\,(b - r)\,dt + \sigma\, r^{1/2}\, dz,$$

where a = 14 percent, b = 6 percent, σ = 5 percent, and dz is normally distributed, independent of the normal random stock return.

A.3 Funding Rules

The ERISA funding rules in more detail are as follows.

The minimum required contribution is the sum of the normal cost (with interest at the funding rate), five-year amortizations of gains and losses (with interest at the funding rate), and the additional funding charge, offset by the credit balance (with interest at the funding rate) and full funding credit.

The additional funding charge occurs if the plan's funded current liability ratio (assets over current liability at the valuation date) is less than 80 percent or is between 80 and 90 percent and has not been over 90 percent for two of the last three plan years. The additional funding charge is the applicable percentage multiplied by the unfunded current liability plus the current liability normal cost, offset by the ERISA normal cost and amortization charges less credits adjusted with interest to the end of the year at the current liability interest rate. The applicable percentage is 30 percent less 40 percent of the funded current liability ratio in excess of 60 percent.

The full funding credit is the excess, if any, of the minimum required contribution (disregarding the credit balance) over the projected unfunded actuarial liability (or the unfunded value of 90 percent of the current liability, if greater), where the assets are reduced by the credit balance. In the event of a full funding credit, all bases for the minimum required contribution are eliminated in the following year's valuation.

The maximum deductible contribution is the sum of the normal cost and 10-year amortizations with interest. The maximum deductible may not be less than the minimum required, greater than the full funding limit, or less than the projected unfunded current liability.

The full funding limit is the projected unfunded actuarial liability (or 90 percent of the unfunded value of 90 percent of the current liability).

Note that for the minimum required contribution, only the five-year amortization of gains and losses is used. The projection assumes that the fund is well past the amortization of any initial unfunded liability and that there are no plan amendments, assumption, or method changes.

Proposals 1–3 use the ERISA rules with the exception of the changes as noted earlier. Proposal 4 calls for a minimum required contribution of the normal cost plus seven-year amortizations. The seven-year amortizations are based on the interest rates as determined by the same yield curve used for the valuation of liabilities. Amortization payments are constant for seven years for each base. Each year a new amortization base is established if the liability exceeds the assets plus the present value of all future amortization payments. If the market value of assets exceeds the liability at the valuation date, all amortization bases are eliminated.

The asset method must be the fair value of assets, and the liabilities must be calculated as the present value of cash flows based on accrued benefits (unit credit) discounted with a corporate yield curve. No credit balance is allowed.

Proposal 4 states that the maximum deductible contribution is the normal cost plus 30 percent to the ongoing liability plus the increase due to future salary increases or full funding of the at-risk liability. Taken literally, the normal cost plus 30 percent of the ongoing liability rule does not take into account any possible plan surplus. This would essentially grant a large tax deduction for corporations indefinitely. Following this interpretation, a policy of contributing the maximum deductible results in an average funded ratio of over 1,000 percent. It is therefore reasonable to interpret this provision of the proposal to mean that the maximum deductible contribution sets a target funded ratio of 130 percent. This interpretation (a target funded ratio of 130 percent) has been used for the purposes of this paper.

The rules stated above for Proposal 4 apply to financially healthy companies only. Additional rules apply to financially weak companies, but are not considered for this paper.

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