Smoothing the Waves of the Perfect Storm:
Could Changes in Pension Funding Rules Ease the Burden for Pension Funds?

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Abstract:

After 2000, pension funds found themselves in a bind. Due to declines in long-term interest rates, liabilities of pension plans rose, and asset prices fell as the stock market bubble burst. The increase in liabilities and assets required companies to make contributions to their pension plans at a time when earnings were low and they are least able to afford it. Moreover, pension funds were discouraged by existing rules from making additional contributions when times were good. The confluence of low interest rates and low rates of returns on stocks, though, is a counter-cyclical phenomenon, which is likely to recur in future recessions. Consequently, addressing the short-term problem of large demands on firms to fund their pension funds should also address the long-term counter-cyclical problem of rising contributions when economic times are bad. We propose to consider three changes to existing funding rules that may help to reduce the cyclicality of funding rules: (1) a long-term average of long-term interest rates as the benchmark discount rate, (2) asset valuation assumptions that adjust for market price deviations from the long-term trend of asset prices, and (3) increases in the required funding level. We use a pension simulation model to evaluate annual contributions and funding limits if the current rules had existed for the past 50 years, and to calculate the likely improvements resulting from alternative funding rules in the future.

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Executive Summary

Pension funds experienced a perfect storm after 2000. Long-term interest rates fell to historic lows, and stock prices dropped precipitously as the stock market bubble burst. This occurred after an economic boom during which tax and funding rules effectively discouraged firms from building up reserves. Hence, many firms had to contribute more to their pension plans amid a recession or reduce the benefits promised to their workers.

Much of the debate has focused on short-term aid to firms. Policymakers seized on the elimination of long-term treasury bonds, as a replacement benchmark rate is needed since long-term treasuries are no longer issued. Replacing this benchmark interest rate with a rate that is traditionally higher, such as the corporate bond rate, as proposed by Rep. Rob Portman (R-OH), would provide short-term relief to pension funds.

Simply replacing the benchmark interest rate will not address the systemic problems arising from current funding rules. Current pension funding rules are counter-cyclical, requiring larger contributions when the economy is weak than when the economy is strong.

We consider three possible changes to pension funding rules to see whether such changes would have helped pension plans in the recent recession and whether they would have stabilized contributions. These three changes are the use of the 20-year average of the 30-year treasury rate as the benchmark rate for pension liabilities, adjustments to equity prices when equity prices deviate from their long-term trends, and a requirement for plan sponsors to contribute up to a limit of 120% of current liabilities.

Our results indicate pension funding could be improved substantially:

- The average contributions to pension plans after 2000 would have been substantially smaller than under current funding rules.

- For the entire period from 1952 to 2002, all alternative rules would have helped to smooth pension funding, while maintaining or lowering contributions, and improving funding ratios.

- A number of hypothetical scenarios show that contributions would have been smaller, their volatility may be lower, required contributions during bad economic times would tend to be lower, and the funding adequacy levels would generally be higher with alternative funding rules. For instance, alternative asset valuation assumptions would reduced average contributions by more than 40%, the volatility of contributions by 14%, contributions when assets are below 90% of liabilities by 16%, and the chance of assets to fall below 75% of liabilities by 6.2 percentage points.

All these improvements can be achieved without compromising the adequacy of funding levels as funding levels on average tend to be higher under the alternative funding rules.

I. Introduction

During the recession that started in early 2001, private pensions in the U.S. received a lot of attention, both from the public as well as from policymakers. In particular, defined contribution plans, such as 401(k), which had grown rapidly since the early 1980s, came under scrutiny as account balances were decimated by the crash of the stock market bubble and corporate fraud, for instance, at Enron. Although traditional defined benefit plans initially appeared to emerge as the safer retirement savings options, sluggish corporate earnings, falling interest rates and tumbling stock market rates of return resulted in some of the largest pension plan terminations since the 1970s.

The combination of poor economic performance, historically low interest rates, and depressed asset market has been dubbed a "perfect storm" for defined benefit plans. Historically low interest rates inflated the value of pension liabilities. The lower the interest rate is, the more the employer has to build up assets to pay for expected benefits in the future. But the bear market wreaked havoc on pension plan assets. With long-term interest rates at historically low levels, and the asset side of pension plans' ledgers weakened by the stock market crash, pension plans across the U.S. economy became underfunded, requiring employers to make significant contributions to shore up their plans. But with corporate earnings weak, many employers found themselves between a rock and a hard place. The price they had to pay to honor the promise to their employees by making the required contributions to their pension plans meant that they were in many cases severely constrained in the resources available for other business activities. In some extreme cases, the honoring of that promise was not possible without compromising the very future of the company itself, leading to plan terminations and drastic benefit reductions for affected employees and retirees. But the "perfect storm" happened after pension plans' "day in the sun". The combination of low interest rates, reduced rates of returns on stocks, and declining earnings occurred after an extraordinarily good economic period, during which plan sponsors were effectively discouraged from building up reserves in their pension plans for the eventuality of a rainy day.

In response to the "perfect storm", most of the policy focus was on the short-term problems facing pension plans. Proposals, such as the Pension Preservation and Savings Expansion Act of 2003, introduced by Reps. Rob Portman (R-OH) and Benjamin Cardin (D-MD) (Portman, 2003), focused on providing pension plans short-term relief during the recession. However, aside from pension plans' short-term problems, a systemic long-term problem also became visible. Specifically, pension funding rules are counter-cyclical, requiring more funding when times are bad. Typically, interest rates decline when the economy is weak, as borrowers are reluctant to borrow more given a weak economy. At the same time, stock market rates of return usually decline even, reflecting weak corporate earnings. The confluence of lower interest rates, declining rates of return on stocks and low profitability in a recession is the rule rather than the exception. And this combination of adverse factors generally follows a period of supportive economic trends, during which pension plans may not be able to build up funds for a recession.

Thus, policymakers faced two issues simultaneously. For one, pension plan sponsors clamored for short-term relief for struggling pension plans, so that employees can still receive promised benefits without putting so much pressure on corporate finances in an economic downturn that employers have to terminate plans to sustain their business. And at the same time, pension funding rule changes could be considered to avoid a recurrence of these funding problems, while at the same time not jeopardizing the future of pension plans by reducing the adequacy of pension funding.

The chance of adverse economic factors occurring simultaneously should be reduced if the assumptions that pension plans are using both for calculating their liabilities and their assets are decoupled from regular business cycle fluctuations. Thus, we first consider the possible effects of averaging the benchmark interest rate over 20 years, instead of 4 years. Thus, the interest rate assumption would better match pension plans' duration, while potentially removing cyclical fluctuations at the same time. Similarly, a smoothing procedure could be applied to the assets of a pension plan, thereby possibly reducing swings in assets. And it is possible that pension funding could be further strengthened, if plans are required to build up reserves during good times if plan sponsors are required to contribute up to a limit of 120% of current liabilities.

We evaluate these proposed funding rule changes in three scenarios. We first consider whether different funding rules would have reduced the contribution requirements for plan sponsors after 2000. Second, we study if a particular set of funding rules would have smoothed pension plan contributions and maintained similar levels of funding adequacy if it had been in place between 1952 and 2002. But since the experience of the past 50 years may be unique, we contemplate a number of randomly created hypothetical scenarios for the next 50 years to see which sets of funding rules, if any, could help to smooth pension contributions, while maintaining funding adequacy.

I. Pension Fund Characteristics

Traditionally, most pension plans were defined benefit (DB) plans[1][2]. Under a DB plan, the employee is guaranteed a benefit upon retirement, usually based on years of service, age and either final earnings or a benefit multiplier. The benefit formula is designed such that employees accrue most of their benefits during their last years of service[3]. Employees are often not immediately vested in their DB plan, but the maximum vesting period is five years under existing regulations[4]. Accrued benefits for private sector DB plans are insured by the Pension Benefit Guaranty Corporation (PBGC).

[1] Throughout this paper, pension plan will refer to DB type plans.

[2] Defined contribution (DC) plans are another form of retirement savings. But they are not governed by the same rules as DB plans.

[3] Another form of DB plans are cash balance plans. Under a cash balance plan, the employee accrues benefits proportionately to his or her current earnings. A worker's (hypothetical) pension account is credited with a fixed share of a worker's wage each year, and the account balance is assumed to increase at a pre-determined interest rate.

[4] Employers may use an alternative graded vesting schedule under which a worker vests gradually, with 100% vesting occurring as late as 7 years after the worker first becomes employed.

DB plan coverage has generally been in decline. The Department of Labor (2002) reported that 37% of private sector workers were covered by a defined benefit plan in 1979, but only 21% were in 1998. The number of private sector workers covered by a DB plan also declined, but not as dramatically, from 29 million in 1979 to 23 million in 1998. Similarly, Wolff (2002) showed that 45.9% of households headed by somebody between the ages of 47 and 64 could expect to receive some retirement income from a DB plan in 1998, down from 67.8% in 1983. Still, the share of households with some benefits from DB plans in 1998, was almost as large as the share of households with a defined contribution plan, such as 401(k) plans, which was 47.8% in 1998 (Wolff, 2002).

The funding of the plan's liabilities (promised benefits) is usually the employer's responsibility, although employees are occasionally asked to make contributions. Should a fund become overfunded because the plan's assets performed better than expected or received more contributions than needed to fund actual benefits, employers may face tax penalties for additional contributions, effectively discouraging employers from contributing to an overfunded plan.

II. Pension Underfunding and Pension Insurance after 2000

Pension funding gained attention because it puts the affected firms in a bind. Firms have made a promise to their employees that they will provide a certain level of retirement benefits. But honoring this promise will require large contributions from these firms to their pension plans when financial resources are already scarce.

A report by Merrill Lynch found that many of the 348 firms in the S&P 500 that offered a pension plan would end 2002 with a total shortfall equaling $323 billion (Blackburn, 2003; Kansas, 2002). Of course, not every underfunded pension plan will fail. Most firms will make additional contributions or even resort to reducing benefits. For instance, GM said that it expects to make additional contributions of $15.5 billion to their pension plan to meet federal minimum required contributions (Clair, 2003).

Only when plans become severely underfunded does the chance of failure increase. Since 1975, 94% of all insurance claims on the Pension Benefit Guaranty Corporation (PBGC) came from plans that had less than 75% of liabilities in assets (PBGC, 2002). And the PBGC saw losses equal to only $9 billion due to completed and probable pension plan terminations in 2002 (PBGC, 2003a), a relatively small amount compared to an estimated $323 billion in underfunding for 346 S&P 500 firms alone.

The underfunding of pension plans received a lot of attention because pension fund failures were concentrated in two industries, airlines and steel. Nine of the largest ten plans taken over by the PBGC since 1974 were based in the steel or the airline industry (PBGC, 2002). Both industries received public support in their financial struggles as President Bush raised tariffs on steel imports and Congress instituted loan guarantees for airlines following September 11, 2001. The cyclicality of the airline industry, for example, meant that its ability to support its pension funding obligations is put to the test when the economy is weak, regardless of how well-funded pension plans

were during the good economic times. For example, US Airways pilots' pension plans was funded with assets of 104% of liabilities in 2000. The perfect storm conditions prevailing after 2000 reduced the funding status to 50% in 2003. Ultimately, US Airways' pilots were faced with the choice of allowing the company to terminate their pension plan or seeing the company liquidate in bankruptcy.

III. Replacing the 30-Year Treasury Bond Yield as Benchmark

A pension plan's funding status depends on its current liabilities[5]. Current liabilities are the sum of payments to current retirees and of benefits that workers have already earned. Future benefits are forecast given reasonable assumptions about life expectancy, inflation and other relevant demographic and economic variables. Based on these forecasts, pension plans need to determine how many assets they currently need to fund benefits. Pension plans thus assume how much interest they expect to earn on their assets. The higher this interest rate is, the fewer assets are needed since the difference is covered with more interest earnings.

It is obviously in an employer's interest to assume a high interest rate for discounting their liabilities since this would require the least amount of assets today. To avoid abuse, regulators have set a very narrow range of interest rates that pension plans can choose from. To calculate their current liabilities, pension plans need to choose an interest rate that is between 90% and 105% of the four-year weighted average of the 30-year treasury bond yield[6]. This rate dropped to its lowest level since 1967 after declining from 6.6% in early 2000 to 4.6% in early 2003, resulting in rising pension liabilities for every pension plan in the U.S. For instance, Winkelvoss' rule of thumb says that a one percentage point decrease in the 30-year treasury rate results in a 26% increase in pension liabilities. To ease the additional burden in funding pension plans, the U.S. Congress, as part of the economic stimulus package passed in 2001, granted temporary relief to pension plans by allowing firms to use an interest rate of up to 120% of the four-year weighted average of the 30-year treasury bond yield.

Since the current rules guiding the calculation of pension plan liabilities have been in place only since 1994, this is the first recession where funding rules have been put to the test. The funding relief embodied in the Economic Security and Worker Assistance Act may indicate that they may not work well enough during times of extreme economic distress. As will be demonstrated further below, the fact that firms with pension plans find themselves in a bind as earnings and interest rates declined simultaneously is the rule, not the exception. In other words, the current funding rules will typically result in more contributions when the ability to pay for firms is low.

On October 31, 2001, the U.S. Treasury announced that it will no longer issue 30-year bonds, and it stopped doing so in February 2002. Much of the discussion since has

[5] Although this discussion does not explicitly deal with lump sum distributions, the same arguments would hold here, too. To protect workers near retirement from receiving substantially lower lump sums than they had expected, alternative interest assumptions could be phased in over a long enough time.

[6] The Economic Security and Worker Assistance Act of 2001 raised the upper limit to 120% for 2002 and 2003, thereafter it will revert to the previous limit.

centered on replacing the 30-year treasury bond rate as benchmark rate. For instance, GAO (2003) considered corporate bond rates, interest rates on agency debt with 30-year maturities, 30-year interest rate swap rates, and the PBGC interest rate factors, which result from surveys of insurance companies and their use of different interest rates to calculate annuities. Also, John Parks and Ron Gebhardtsbauer of the American Academy of Actuaries (2002) contemplated a move towards long-term corporate bond rates as it would arguably make it less likely that employers would terminate their pension plans. Typically, corporate bond rates are higher than treasury bond rates, which would lead to lower pension liabilities if the treasury rate were to be replaced with the corporate bond rate, thus making it presumably easier for firms to cover their liabilities. When the U.S. Congress took up this issue again in April 2003, the proposal was to replace the 30-year treasury with the corporate bond rate (Portman, 2003).

But it appears equally reasonable to replace the 30-year treasury rate with the 10-year treasury bond rate. The benchmark rate is supposed to be risk free, and reflect the long-term nature of pension liabilities. Both the 10-year and the 30-year treasury bond reflect the most secure assets since default risks and liquidity risks are negligible. And the 10-year treasury bond yield reflects the long-term nature of pension liabilities. The federal government is expected to have a sizable debt for the foreseeable future that is likely to grow in the medium term. The financing instrument with the longest maturity currently issued by the government is the 10-year treasury bond. Thus, the yield on this bond reflects the long-term nature of the federal debt, similar to the 30-year treasury bond rate. Further, data on the 10-year treasury bond rates are readily available since 1953 – substantially longer than the 30-year treasury which was introduced in 1977. Thus, 10-year treasury bonds' history is more likely than the shorter history of the 30-year treasury bond to reflect the range of interest rates that pension plans will experience during their duration. Lastly, there is also an assumption that the rate should reflect prices in the annuities market. Insurance companies already assume interest rates that are higher than the 30-year treasury when calculating annuities. Consequently, using an interest rate that is lower – about 160 basis points since 1977 (Parks and Gebhardtsbauer, 2002) – than the 30-treasury bond yield should address the concern that higher interest rates will result in assets that are too low to cover the current pension plan liabilities.

IV. Addressing Pension Underfunding through Interest Rate Smoothing

The debate over replacing the 30-year treasury bond rate, though, does not fully address the pension underfunding issue. The funding distress that many employers experienced after 2000 was attributable to the fact that interest rates sunk to low levels, when corporate earnings were also hurt by the weak economy.

However, this is not an isolated phenomenon. Typically, interest rates are more likely to decline when the economy is weak than vice versa. During the post-war era, the long-term treasury rate[7] declined during every single recession, with the exception of the

[7] Prior to 1977, the 20-year treasury bond rate is used.

high inflation era of the early 1970s (table 1)[8]. On average, the long-term treasury rate was 0.2 percentage points lower during the 12 months after its business cycle peak than during the 12 months prior to it, excluding the high inflation periods of the early 1970s and 1980s[9]. Simultaneously, the corporate profit share also usually fell. On average, the corporate profit share out of national income was about 1 percentage point lower after a recession than before it began, a significant decline considering that the profit share on average amounted to 11% (table 1).

Because interest rates are pro-cyclical and funding requirements move in the opposite direction as interest rates, current pension funding rules are counter-cyclical. To demonstrate the impact of the counter-cyclical rules, a simple ratio is calculated, termed here the "funding burden". It is the ratio of the changes of the 4-year weighted average of the 30-year treasury bond relative to the corporate profit share - profits, inventory adjustments, and capital consumption relative to national income[10]. The profit share is a good indicator for the ability of most firms with pension plans to pay for them since corporations tend to be larger firms, which are more likely than smaller firms to have pensions. The funding burden rose in each recession, except in the early 1970s, by an average of 65%. Most of the increase occurred in the first twelve months following the start of the recession, with the notable exception of the recession of the early 1980s, when inflation worries resulted initially in rising interest rates (table 1).

It may be in the interest of public policy to reduce the counter-cyclicality of current pension funding rules, so as to avoid a recurrence of the perfect storm that hurt pension plans after 2000. One possibility to smooth the funding burden may be to use a long-term average of the benchmark rate that is used to discount liabilities. Typically, the duration of pension liabilities is close to 20 years, which is one of the reasons to use a long-term interest rate as benchmark to discount pension liabilities. The difference between using the current interest rate on a 30-year security and using a 20-year average of the 30-year interest rate lies in the implicit assumptions. Using a market rate implicitly assumes that pension plans would buy the security today and hold it until it matures. In comparison, a long-term average assumes that pension funds will continuously buy and sell securities, and that these transactions will occur at different interest rates. Given that pension funds are going concerns, the latter assumption of fluctuating investment needs appears to be more reasonable. A long-term average of long-term interest rates is non-cyclical, unlike the currently used 4-year weighted average. Moreover, replacing the 4-year weighted average with the 20-year average would have raised the assumed interest rate for liabilities in 2002 (figure1), except in the case of a weighted average where it would have remained roughly the same, thus also providing short-term funding relief.

[8] Current pension funding rules were introduced with the Employee Retirement Security Act (ERISA) of 1974 and refined thereafter. The figures used here are only meant as illustrative examples.

[9] Interest rates and the economy do not peak at the same time, although the time difference between the peak of the economic business cycle and the peak of the treasury rate is about one month.

[10] It is assumed that a one percent increase in the interest rate lowers liabilities by 25% (McGill et al., 1996). Since the focus is on changes in the funding burden, not on levels, the exact elasticity can be ignored.

To understand the effect of different interest assumptions on pension funding, consider the changes in the funding burden that result (table 1). In each case, the funding burden would have actually declined during recession, instead of increased. If a 20-year average had been used instead of a 4-year weighted average, the funding burden would have declined by an average of 42% during post-war recessions, compared to a 65% increase that would have occurred had the current interest rate rules been in place. Since the preceding 20 years may be unique, especially as they include the high interest rate years of the early 1980s, there are alternative measures to calculate long-term average. An alternative may be to consider all 20-year period for which data exist at any given point in time and calculate their average up to the current period. Again, the funding burden would have declined on average during recessions, but the average decline would have been 33%, less than would have resulted from the simple average for the preceding 20 years. This method, though, weighs the years in the middle of the series more heavily than the early and late years. Consequently, a weighted average that weighs the tails more heavily may be a third alternative. In this scenario, the funding burden would have declined by an average of only 12% during the post-war recessions (table 2).

V. Smoothing Asset Values

After 2000, pension plans were hurt not only by declining interest rates, but also by falling asset prices. Many pension plans valued their assets at fair market values, which meant that they were quickly impacted by the bursting of the stock market bubble after 2000 (SOA, 2001). As the recent experience shows, the market valuation of assets presents a serious problem, since the valuation at a moment in time can diverge substantially from the price the asset will command when it will be needed to meet pension liabilities.

The divergence in market prices from their long-term averages can stem from a stock market bubble, a bear market on the stock market, or simply cyclical fluctuations since stock prices depend on corporate earnings expectations, which will be high during economic booms and low during a recession. In fact, stock prices are generally seen as a leading indicator for the economy, as capital appreciation rates of stocks peak about three quarters before the business cycle reaches its peak. For the post-war period, the average capital appreciation rate of stocks during the 12 month before the stock market peaks is about 27 percentage points higher than during the 12 months after the peak. In other words, pension plans are likely to have seen capital losses or at least substantially lower rates of gains than expected by the time the economy enters a recession.

To see how large the divergence of market prices and trend prices was during the 1990s, consider the movements of the price to earnings ratio. It is a standard indicator of stock price fluctuations by measuring how much investors are willing to pay at given point in time for one dollar of earnings of a particular company. The price to earnings ratio has historically averaged about 15. But price to earnings ratios fell below 10 in the 1970s and exceeded 30 in 1999 and 2000. While the daily, or even annual, movements in the market are unpredictable, there is a tendency for price to earnings ratios to converge toward their long-term average (Campbell and Shiller, 1987).

Adequate pension funding depends on the expected income that stocks can generate for the pension plan, and not on a momentary market valuation. It thus would be desirable to devise a method to evaluate stocks held by pension plans that assesses the predicted return on assets through time, and ignores the erratic fluctuations in the market. Such a method would also help to smooth asset fluctuations, and therefore help to reduce the cyclicality of current pension funding practices. Under current law, pension plan sponsor can choose from a range of asset valuation methods. The majority of pension plans in the U.S. evaluated their assets at fair market value in 2001 (SOA, 2001), with 48.6% of large pension plans using this method. This method evaluates assets at the price for which the assets could be sold on the valuation date. Another 36.4% of large pension plans used a smoothed value method, of which the so-called write-up method was the most frequently selected one. With this method, the prior year's actuarial value of the assets is increased by contribution and decreased by benefit payments. These preliminary assets are increased by an assumed interest rate or by a specific interest rate formula. Additional adjustments can be made towards fair market value over a period of no more than five years. Although this allows for more smoothing of asset values than the fair market value, the large fluctuations of the stock market tend to take longer than 5 years to move towards the long-term average, e.g. 20 years. A 20-year smoothing period would also offer the advantage that it mirrors our assumptions for pension liabilities.

The goal of a new set of asset assumptions is it to pay contribute to the fact that stock prices can fluctuate in the short-run, but that in the long-run, they will move towards their long-run average. Given that stock prices are expected to move towards their long-run price to earnings ratio, the adjustment can be made in a fairly straightforward manner. First, the difference between market price and trend price is calculated for the current period:

$$(\frac{MP}{TP})_t = \frac{MP_t}{TE_t * \overline{PE}} = \frac{MP_t}{TE_{t-1} * (1+e) * \overline{PE}} \qquad (1)$$

where *MP* is the current market price as measured by the S&P 500 index and *TP* is the trend price. The trend price is equal to the trend earnings, *TE*, times the long-term average price to earnings ratio, *PE*, since 1927 of 15.3. Further, the trend earnings in period *t* are equal to the trend earnings in the previous period after having grown at the long-term average earnings growth rate, *e*, of 5.0%.

Next, it is assumed that the difference between market price and trend price disappears over a period of 20 years, which generates an adjustment factor to the market price of stocks of:

$$AF_t = \frac{1}{1 - r_{adj}}{}_t \qquad (2)$$

where the adjustment rate, r_{adj}, is defined as:

$$r_{adj,t} = \ln\left(\frac{TP}{MP}\right)_t / 20 * 100 \qquad (2')$$

such that the adjusted price, P_{adj}, is described by:

$$P_{adj,t} = MP_t * AF_t \qquad (2'')$$

Since the expected rate of return to stocks is the sum of the rate of capital appreciation and the dividend yield – dividends relative to market price – the adjustment made to the price also affects the expected dividend yield:

$$DY_{adj,t} = \frac{D_t}{P_{adj,t}} \qquad (3)$$

where the adjusted dividend yield, DY_{adj}, is equal to the ratio of dividends, D, to the adjusted market price, P_{adj}.

Two more assumptions for asset valuations are made in the following discussion. First, we assume that the difference between the actuarial value and the fair market value is decreased over a 20 year period, and with respect to assets other than stocks, we assume the same long-term interest rate as for liabilities plus 50 basis points.

VI. Addressing Pension Funding Problems by Saving for a Rainy Day

The perfect storm for pension plans followed their day in the sun. Due to high rates of return on assets in the late 1990s, many pension plans enjoyed so-called contribution holidays. That is, firms did not contribute to their pension plans during the good times, largely because there were strong tax disincentives to do so. When pension plans are overfunded, additional contributions to the pension plans are not tax deductible and they can carry an excise tax with it. The contribution limit beyond which further contributions are discouraged by the tax code is 100% of current liabilities.

It has been argued that increasing the contribution limit beyond 100% of current liabilities would have allowed companies to contribute to their pension plans during the good times, thus effectively saving for the inevitable rainy day (Gebhardtsbauer and Jerbi, 2003). However, whether companies will or will not save for a rainy day during good economic times will depend on many factors. In fact, the PBGC reported that 41.9% of all pension plans could have received further contributions in 1999, and in 2000, still 18.6% of all pension plans could have received further contributions (PBGC, 2002, 2003b). Instead of allowing companies to build up funds to more than 100% of current liabilities, we consider a requirement for companies to build up funds to 120% over a period of 30 years, which is the currently maximum allowable time.

VII. The Effects of Funding Rule Changes on Pension Funds

One argument against smoother funding rules for liabilities and assets is that it may leave pension funds with too few assets when plans are terminated. Plans may not be

able to purchase enough annuities on the private market to cover their promised benefit, and hence they may burden the PBGC. Although the goal of new funding rules is to stabilize pension plan contributions, the achievement of this goal should obviously not come at the expense of less adequate funding. The entire rationale for the existing of pension funding rules under the Employee Retirement Income Security Act of 1974 (ERISA) was to improve the adequacy of pension funding, so that benefits will be paid when workers retire. But the smoother interest rate assumptions may reduce the chance that a plan finds itself in trouble, reducing the demands on the PBGC since fewer plans have to be terminated. In particular, smoother assumptions could presumably help to reduce the cyclicality of funding rules, requiring fewer contributions when times are bad compared to current rules. Consequently, we consider how well a proposed funding rule change would have stabilized contributions, while maintaining pension fund adequacy.

In the following discussion, we consider alternative pension funding rules that may help to smooth the funding stream. For instance, we consider the effect of replacing the current four-year weighted average with the 20-year average of the long-term treasury bond as the discount rate[11]. Similarly, we adjust stock prices and dividend yields for price deviations from long-term trend prices. And lastly, we incorporate a requirement of plan sponsors to fund their pensions up to 120% of current liabilities.

To evaluate the proposed funding rules, we develop a simulation model, which incorporates a basic pension plan with the following features. The number of workers is assumed to have been 10,000 in 1952, equally distributed from age 20 to 65, with 80% of workers blue collar and 20% white collar, labor force growth equal to 1% annually, and annual wage growth equal to 3%. Assumed attrition is 5%, equally distributed over all ages, and the number of vested workers proportional to that of job leavers.

The age earnings profile – from Engen et al. (1999) – for blue collar workers is described by:

$$E_t = 7.906 + 0.105 * AGE - 0.0012 * AGE^2 \qquad (1)$$

where E_t denotes the annual earnings at age t. And the age earnings profile for white collar workers is described by:

$$E_t = 6.850 + 0.165 * AGE - 0.0017 * AGE^2 \qquad (2)$$

Retirement benefits are based on average final pay, with retirement benefits equaling 1% of the average of the last five years of earnings for each year of service, with five years of vesting, and no ancillary benefits. Current liabilities are then calculated using the unit credit method.

[11] Although the 30-year treasury bond rate will likely be replaced as the benchmark rate, we use it here because insufficient data are available for the corporate bond rate or the 10-year treasury bond rate to perform similar analyses. Since these rates are closely linked, the conclusions should stay the same.

Pension plan assets are either held in stocks or in bonds. From 1952 to 2002, the pension plan's asset allocation into equities is equal to the share of directly held corporate equities out of assets for all pension plans, including DC plans (BoG, 2003). The rate of return earned on stocks is set equal to the increase in the S&P 500 plus the dividend yield, and the rate of return on bonds is equal to the treasury rate plus 50 basis points.

We use the simulation model first to study whether alternative funding rules could have helped to avoid pension plans' perfect storm after 2000[12]. The results for the years from 1998 to 2002 show that all alternative rules would have maintained or reduced the burden on plan sponsors. The baseline model shows that contributions up to 2000 were low or zero due to the good performance of the stock market[13]. By 2002, the annual contribution would have risen to 6% of total salary. In model (2), we use the 20-year average of the long-term treasury bond yield as the discount rate for liabilities, which would have resulted in contribution holidays through 2002. Next, we use the alternative asset valuation method described above (model (3)), which would have resulted in a contribution holiday after 1999 during the stock market downturn and the recession. Further, we require that contributions are made up to 120% of current liabilities (model (4)). The results show that there would have been no contribution holiday, but that contributions would have been equal or less compared to the baseline model. And in model (5), we make all three changes simultaneously, showing that the pension fund would have enjoyed a contribution holiday for all five years.

Lower contributions did not come at the expense of less funding adequacy. In each case, the actuarial funding ratio would have been equal to or higher than in the baseline case. Since market prices may matter in the event of a plan termination, we also calculate an alternative funding ratio which relates the fair market value of assets to current liabilities discounted at the 4-year weighted average. Again, the funding ratio in 2002 would have been at least as high as in the baseline case.

To evaluate the long-term performance of the alternative funding rules we consider their effect on contributions and funding ratios from 1952 to 2002. In particular, we are interested to see whether contributions stay the same, whether the funding rules would have resulted in different funding adequacy ratios, and whether contributions would have become less volatile, especially during recessions. Since the economic environment after 1980 differed from the prior period as interest rates declined and the stock market experienced an unprecedented boom, we calculate the same statistics for the period from 1980 to 2002.

With respect to contributions, the results in table 4 show that in most cases alternative funding rules would have reduced the average contribution. For the period from 1952 to 2002, a different discount rate, a higher required funding level, and the combination of all three funding rule changes would have resulted in lower average

[12] Current funding rules are assumed for a period during which they did not apply for illustrative purposes.
[13] Since we are choosing an equity allocation based on all pension plans, including defined contribution plans, our rates of return are below those experienced by many pension plans during the stock market boom. Consequently, our model plan was less likely to experience a contribution holiday in the 1990s.

contribution. Only the change in asset valuation assumptions would have resulted in higher contributions. For the period from 1980 to 2002, all funding rule changes would have resulted in substantially lower contributions since plans would have built up enough reserves to enjoy prolonged contribution holidays. Again, the switch to alternative asset assumptions would have left average contributions relatively close to the baseline.

The change in contributions does not appear to be traded off against less funding adequacy for the period from 1952 to 2002. In each case, the average actuarial funding ratio is higher than in the baseline case. However, the chance of falling below 75% of liabilities would have been slightly higher with a different discount rate and the implementation of all rule changes between 1952 and 2002[14]. If instead, this probability is based on the ratio fair market value to current liabilities discounted by the 4-year weighted average of the interest rate, the chance of assets being less than 75% of current liabilities would have risen only for model (5) from 1952 to 2002.

One of the reasons for the implementation of alternative funding rules would be the reduction of cyclical fluctuations, so that contributions during bad economic times would be reduced. There is no clear indication that the proposed funding rules would have reduced the volatility of contributions. From 1952 to 2002, the standard deviation of contributions would have been very similar to that of the baseline model. But for the period from 1980 to 2002, the volatility would have been lower, except in case of alternative asset valuation assumptions. The important issue, though, is whether contributions on average would have declined when economic times were bad. Thus, we calculate the average contribution for periods when the actuarial value of assets fell below 90% of liabilities, and when it was above 90% (table 5). In almost all cases, the contributions during periods when assets were below 90% of assets would have been higher than in the baseline scenario, with the requirement to fund up to 120% of assets as the notable exception. The average contribution during periods when assets were above 90% of liabilities would have been relatively similar to the baseline model.

However, higher contributions with assets below 90% of liabilities are not only expected, they may not necessarily reflect the economic environment adequately in which these contributions are being made. Hence, we consider contributions during recessions and non-recessions separately (table 5). From 1952 to 2002, only the alternative asset assumptions would have lowered the contributions during the recessions compared to the baseline model. But for the period from 1980 to 2002, all models would have lowered contributions during recessions.

The results so far consider only one unique scenario – that of the last 50 years. During this unique environment, all alternative funding rules would have lowered average contributions and generally improved funding adequacy, while raising the possibility of smoother funding during bad economic times. But to test the effectiveness of the rule changes in a more generalized environment, we create 200 random observations for each year over the next 50 years for the rates of return on stocks and

[14] It appears that the chance of plan termination rises with funding levels below 75%. 43.4% of plans terminated by PBGC had a funding ratio between 50% and 75% (PBGC, 2003b).

treasuries[15]. That is, our summary statistics are based on 10,000 hypothetical observations. The starting point in each case is a funding ratio of 90%, and the asset allocation in equities is held constant at 50%. To generate the random rates of return, we use historical distributions. For long-term treasury bonds, we assume a nominal average yield of 5.5% with a standard deviation of 2.9%. To control for outliers, the rate of return cannot be less than two and half standard deviations below the mean or more than two and half times above the mean[16]. For stocks we assume a nominal average appreciation of 5.2% per year with a standard deviation of 19.2%, and assuming an average of 4.1% and a standard deviation of 1.6% generates the dividend yield. To control for outliers, we apply the same bandwidth rule as for treasury bond yields. Also, to model the serial correlation of asset returns, we take a weighted average of the capital appreciation and the dividend yield. This weighted average is identical to the one used under current rules for the 30-year treasury bond yield[17].

Table 6 summarizes the results of our simulations for the next 50 years. In particular, contributions are significantly lower when the alternative asset valuation assumption is used (models (3) and (5)). The funding adequacy, though, is improved in each case as the chance of assets falling below 75% of liabilities is lower in each alternative scenario. Moreover, the alternative funding rules appear to smooth funding during difficult economic times. For one, average contributions are less, and where they are similar to the baseline, their volatility is reduced. And the average contribution during times when assets fall below 90% of liabilities are generally lower than in the baseline.

VIII. Conclusion

Tens of millions of households still depend on traditional defined benefit plans for their retirement. After scandals shook the faith in the staying power of newer and fast growing defined contribution plans in late 2001, defined benefit plans initially received some new found attention as secure retirement income vehicles. However, by 2002, defined benefit plans increasingly experienced difficulties themselves, resulting in large plan termination, reduced benefits and large financial demands on corporate resources. Some observers dubbed the economic environment underlying DB plans' difficulties in 2002 a "perfect storm". Long-term interest rates that are used to calculate pension liabilities fell to lows not seen in decades, raising pension liabilities. And asset prices fell precipitously as the largest stock market bubble in U.S. history burst. Interestingly, this perfect storm occurred after firms had their day in the sun, during which tax and funding rules effectively discouraged firms from building up reserves for a rainy day when times were good. As a result, many firms had to either contribute more to their pension plans in the middle of a recession or reduce the benefits promised to their workers after 2000.

[15] While our future scenarios consider only changes to interest rates and to rates of return, other regulatory changes will also likely change the outlook for pension plans. For a detailed and thoughtful discussion on what lies ahead for pension plans, the reader is referred to Munnell and Soto (2003).

[16] Since historically interest rates have been lower than the average of the past 30 years, current liabilities and contributions are subsequently higher than in the previous calculations.

[17] We also set the maximum actuarial funding ratio at 200%, and the minimum at 50%, and we require that the actuarial value of assets remains within 80% and 120% of the fair market value of assets.

Much of the public policy debate has focused on short-term aid to firms caught in this perfect storm, so that promised benefits to workers can be honored. To provide this help, policy makers have seized on a unique occurrence, the elimination of long-term treasury bonds. The interest rate that pension funds are required to use for the calculation of their liabilities is tied to the 30-year treasury. As long-term treasuries are no longer issued, a replacement is needed. Replacing this benchmark interest rate with a rate that is traditionally higher, such as the corporate bond rate, as proposed by Rep. Rob Portman (R-OH), would provide short-term relief to pension funds.

However, simply replacing the benchmark interest rate will not address the systemic problems ailing current pension funding rules. Specifically, current pension funding rules are counter-cyclical, requiring larger contributions when interest rates and rates of return are low and the economy is weak than when the economy. Instead of simply replacing the benchmark interest rate, the assumptions for liabilities and asset calculations could also be changed to reduce the volatility of pension contributions without adversely affecting the adequacy of pension funding.

In this paper, we consider three possible changes to pension funding rules that could reduce the cyclicality of pension funding rules. These three changes are the use of a long term average of the long-term treasury yield as the benchmark rate for liabilities, adjustments to equity prices when equity prices deviate from their rends, and a requirement for plan sponsors to contribute up to a limit of 120% of current liabilities.

Our results indicate that each change would have constituted an improvement over current rules. Contributions would have been smaller, their volatility may be lower, required contributions during bad economic times would tend to be lower, and the funding adequacy levels would generally be higher. For instance, assuming a number of hypothetical scenarios for the future shows that an alternative set of asset valuation assumptions would reduce average contributions by more than 40%, the volatility of contributions by 14%, contributions when assets are below 90% of liabilities by 16%, and the chance of assets to fall below 75% of liabilities by 6.2 percentage points.

Tables

Table 1
Changes in Long-term Interest Rates and Profit Rates during Post-War Recessions

Recession	Interest rate change in recession	Interest rate diff. during 12 mos. before recession and 12 mos. after recession		Profit share diff. during 12 mos. before recession and 12 mos. after recession		Funding burden change in recession	
		Bus. cycle peak	Interest rate peak	Bus. cycle peak	Profit share peak	During recession	12 months after bus. cycle peak
July 1953 to May 1954	-0.46	0.11	0.02	1.17	1.37	107.48	115.18
August 1957 April 1958	-0.58	0.04	0.11	1.57	1.08	73.52	29.77
April 1960 to February 1961	-0.39	0.30	0.15	1.10	1.03	82.97	89.47
December 1969 to November 1970	-0.33	-0.53	0.28	1.97	0.70	35.33	35.33
November 1973 March 1975	0.69	-0.99	-0.41	1.35	0.27	-51.13	-108.39
January 1980 to November 1982	-0.06	-1.98	-1.53	1.65	0.68	116.68	-6.15
July 1990 to March 1991	-0.21	-0.14	0.14	0.03	0.03	153.37	313.12
March 2001 to February 2003	-0.33	0.19	0.48	0.51	0.72	0.85	80.04

Notes: Sources are Board of Governors, Federal Reserve System, Release H.15; Board of Governors, Federal Reserve System, Flow of Funds Accounts of the United States; TraderTools.com; Bureau of Economic Analysis, National Income and Product Account Table 1.14. The profit share is defined as profits plus inventory valuation adjustments plus capital consumption allowance relative to national income. Interest rate refers to the long-term treasury bond yield. The interest rate peaked about one month after the business cycle peaked, and the profit share peaked about three quarters before the business cycle peaked.

Table 2
Funding Effects of Interest Rate Smoothing

Recession	Funding burden in recession	Change in funding burden	Percentage difference to current rules	Change in funding burden	Percentage difference to current rules	Change in funding burden	Percentage difference to current rules
	4-year weighted avg.	20-year average		Avg. of 20-year averages		Weighted avg. of 30-year avgs.	
July 1953 to May 1954	107.48	-308.12	-415.60	1.86	-105.62	-12.51	-119.98
August 1957 April 1958	73.52	22.86	-50.66	-135.96	-209.48	-16.62	-90.14
April 1960 to February 1961	82.97	-3.76	-86.73	-50.67	-133.65	18.79	-64.18
December 1969 to November 1970	35.33	-7.27	-42.60	-30.04	-65.37	-30.24	-65.56
November 1973 March 1975	-51.13	-40.11	11.03	-32.54	18.60	-32.93	18.20
January 1980 to November 1982	116.68	-18.64	-135.32	-59.71	-176.39	-60.16	-176.84
July 1990 to March 1991	153.37	-7.16	-160.53	7.87	-145.50	9.73	-143.64
March 2001 to February 2003	0.85	23.53	22.68	35.28	34.43	27.76	26.91
Average	64.5	-42.33	-107.22	-32.99	-97.87	-12.02	-76.90

Table 3
Funding Status of Model Pension Plan with Different Funding Rules

	Baseline model			Model (2)			Model (3)			Model (4)			Model (5)		
Discount rate for liabilities	4-year weighted average of long-term treasury bond yield			30-year average of long-term treasury bond yield			4-year weighted average of long-term treasury bond yield			4-year weighted average of long-term treasury bond yield			30-year average of long-term treasury bond yield		
Asset assumptions	Fair market value			Fair market value			Adjustments for level and ROR on stocks, and long-term average interest rate for bonds			Fair market value			Adjustments for level and ROR on stocks, and long-term average interest rate for bonds		
Contribution limit	100%			100%			100%			120%			120%		
	Cont. to salary	Fund. Ratio (1)	Fund Ratio (2)	Cont. to salary	Fund. Ratio (1)	Fund Ratio (2)	Cont. to salary	Fund. Ratio (1)	Fund Ratio (2)	Cont. to salary	Fund. Ratio (1)	Fund Ratio (2)	Cont. to salary	Fund. Ratio (1)	Fund Ratio (2)
1998	0.0	100.7	100.7	0.0	157.3	119.7	8.3	90.5	137.1	3.3	97.7	97.7	0.0	168.7	243.1
1999	4.8	98.2	98.2	0.0	161.1	117.6	6.7	96.6	142.2	3.1	97.8	97.8	0.0	178.6	253.5
2000	0.0	101.9	101.9	0.0	159.4	118.7	0.0	105.3	149.7	2.2	100.1	100.1	0.0	184.3	255.2
2001	3.6	87.6	87.6	0.0	135.6	102.7	0.0	109.2	131.0	3.6	87.5	87.5	0.0	182.6	220.6
2002	6.0	76.4	76.4	0.0	113.5	87.6	0.0	102.4	113.2	6.0	76.3	76.3	0.0	167.2	188.3

Notes: All figures are in percent. Funding ratio (1) denotes the ratio of actuarial assets to current liabilities evaluated at the model's rules. Funding ratio (2) denotes the funding ratio of fair market value to current liabilities evaluated at the four-year weighted average of the long-term treasury yield.

Table 4
Summary Measures for Different Funding Rules, 1952 to 2002

	Baseline model			Model (2)			Model (3)			Model (4)			Model (5)		
Discount rate for liabilities	4-year weighted average of long-term treasury bond yield			30-year average of long-term treasury bond yield			4-year weighted average of long-term treasury bond yield			4-year weighted average of long-term treasury bond yield			30-year average of long-term treasury bond yield		
Asset assumptions	Fair market value			Fair market value			Adjustments for level and ROR on stocks, and long-term average interest rate for bonds			Fair market value			Adjustments for level and ROR on stocks, and long-term average interest rate for bonds		
Contribution limit	100%			100%			100%			120%			120%		
	Avg. cont. to salary	Avg. fund. ratio	Prob. of less than 75%	Avg. cont. to salary	Avg. fund. ratio	Prob. of less than 75%	Avg. cont. to salary	Avg. fund. ratio	Prob. of less than 75%	Avg. cont. to salary	Avg. fund. ratio	Prob. of less than 75%	Avg. cont. to salary	Avg. fund. ratio	Prob. of less than 75%
1952-2002	2.6	98.6	4.1	2.0	116.6	6.9	2.7	101.1	3.0	2.4	109.1	3.0	2.5	137.2	5.4
	(2.7)	(13.6)	(4.1)	(2.7)	(28.1)	(3.4)	(3.0)	(13.9)	(0.7)	(1.5)	(18.1)	(3.0)	(3.4)	(38.7)	(7.7)
1980-2002	3.0	100.3	9.5	0.0	144.4	0.0	2.8	102.6	7.0	1.7	115.4	4.6	0.0	176.2	0.0
	(3.5)	(19.3)	(9.5)	(0.0)	(16.9)	(1.6)	(3.4)	(18.7)	(0.1)	(1.6)	(23.9)	(4.6)	(0.0)	(14.5)	(0.0)

Notes: All figures are in percent. Figures in parentheses are standard deviations, except for the chance of falling below 75% of current liabilities, where they indicate the same probability under the ratio of the fair market value relative to current liabilities based on the 4-year average treasury yield. Funding ratio refers to the ratio of actuarial assets to current liabilities evaluated at the model's rules.

Table 5
Contributions when Funding Problems May Arise

	Baseline model		Model (2)		Model (3)		Model (4)		Model (5)	
	Funding ratio below 90%	Funding ratio above 90%	Funding ratio below 90%	Funding ratio above 90%	Funding ratio below 90%	Funding ratio above 90%	Funding ratio below 90%	Funding ratio above 90%	Funding ratio below 90%	Funding ratio above 90%
1952-2002	5.9	1.7	6.8	1.5	6.4	1.7	4.6	2.1	9.1	1.5
1980-2002	5.4	1.2	0.0	0.0	6.4	1.3	4.2	1.3	0.0	0.0
	Recession	Non-recession	Recession	Non-recession	Recession	Non-recession	Recession	Non-recession	Recession	Non-recession
1952-2002	2.2	2.8	2.5	1.8	1.7	3.2	2.6	2.2	3.4	1.8
1980-2002	2.0	3.4	0.0	0.0	0.7	3.8	1.8	1.6	0.0	0.0

Note: All figures are in percent.

Table 6
Summary Results of Monte Carlo Experiment

Model	Contribution relative to salary	Contribution rel. to salary if funding ratio is less than 90%	Contribution rel. to salary if funding ratio is more than 90%	Average funding ratio	Probability of funding ratio of less than 75%
Baseline	7.8 (7.2)	12.9	2.5	91.3 (21.4)	22.3
Model (2)	8.0 (5.0)	10.5	3.7	85.6 (12.2)	19.4
Model (3)	4.4 (5.8)	10.9	1.2	108.8 (34.1)	16.1
Model (4)	8.1 (6.7)	12.5	4.9	96.5 (23.7)	18.2
Model (5)	5.0 (4.9)	10.4	2.5	101.2 (25.1)	14.9

Notes: All figures are in percent. Model (2) incorporates an alternative discount rate, model (3) includes alternative assumptions for the level and rate of return of equities, model (4) requires contributions up to a limit of 120% of current liabilities, and model (5) incorporates all three changes simultaneously. Funding ratio denotes the ratio of actuarial assets to current liabilities evaluated at the model's rules. Figures in parentheses are standard deviations.

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