A Pension Rosetta Stone:
Reconciling Actuarial Science and Pension Accounting With Economic Values

Sound and Workable Pension Actuarial, Accounting, and Funding Approaches for Those Interested in the Health of Public and Private DB Plans

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Acknowledgments

No cross-discipline synthesis such as this essay happens without patient teachers, and I am blessed to have had the best. Professors Steve Ross and Roger Ibbotson introduced me to discount rate and present value theory and to the notion of a market value or economic balance sheet (specifically), and to financial economics (more generally), first when I was a student at Yale in the mid-1980s, and then when I worked with them (and also with Larry Siegel and Paul Kaplan) as manager of Ibbotson Associates during the balance of that decade.

My wonderful actuary colleagues at Towers Perrin, where I worked in the early 1990s, started the process of teaching me actuarial science, and patiently tolerated my frequent (and poorly disguised) challenges to some of their methods as I made comparisons between what I was learning from them and what I had learned at Yale and at Ibbotson Associates. It was during this time that this essay had its genesis, some 18 years ago (and started taking written form in about 1991 under a working title of "Feathers and Bricks"). These highly professional actuaries include, among many others, a number who themselves were on a quest to understand the relationship between economic and actuarial values: Rowland Davis, Greg Hansen, Gordon Enderle, and Emily Kessler all come to mind; but I am especially grateful to Colin Carlton and Matt Sloan, who have in recent years extended themselves generously and given me many insightful and useful criticisms and suggestions for this work. I am particularly grateful for Colin's admonition to "be bold" in this effort.

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MBW

[1] "I am still learning." Usually attributed to Michaelangelo.

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Chapter 1: Achieving Long-Term Health for Pension Plans

There are at least three perspectives from which one might view accounting and actuarial reporting for pension plans. There is the perspective of actuaries, originally informed by an intent to provide contributions sufficient to securely fund the plan but who now also must operate in the context of the regulations supporting ERISA and the Pension Protection Act (PPA) and within limitations imposed by accounting rules and tax laws. Then, there is the perspective of accountants, a discipline focused on accurately reporting income within the framework of generally accepted accounting principles, taxing rules of the IRS and other jurisdictions and perhaps international accounting rules as well. A third perspective is that of the financial economist, the perspective that I will describe here using an approach called "economic accounting." While I am neither a pension actuary nor a pension accountant, I have put sincere effort over many years into understanding those fields and how their views of the pension plan differ—both from each other and from those of economists.[2] From my perspective, the underlying economic values of the benefit promises, properly measured in monetary terms, are the unseen influence controlling all other actuarial and accounting values and it is only through understanding this underlying "engine" that the plan's costs and risks can be effectively managed.

Today, sadly, many sponsors believe these costs and risks to be so high that, without better management tools, the defined-benefit plan will probably disappear as an institution. Sponsors find pension accounting to be so confusing, with so many different actuarial, regulatory, accounting and tax methods involved in every plan, that they, as lay persons, believe they have no hope of understanding the true financial situation of any plan that they study.

I will show that with an economic approach, this plethora of methods boils down to just one method, that could (with the regulators' support) be used for all purposes—accounting, funding, reporting, and tax, and for all of the principal financial statements, the balance sheet, the income statement, and the statement of cash flows.

[2] Despite my best efforts, I am quite confident that I will have made sufficient actuarial and accounting gaffes here to entertain those who are more properly trained; I hope that I'll be forgiven those errors as an unavoidable side product of this sort of cross-discipline effort. Please write and point them out to me so that I can repair them in subsequent drafts.

With such a method, pension finance becomes suddenly much more understandable; no, that isn't a strong enough statement: It becomes *completely sensible*. Normal cost and contribution calculations become as easy to understand as mortgage payments. The role of the accrued liability as a benefit security yardstick crystallizes into clarity, and meaningful estimates of the present value of future contributions, as well as the present value of future normal costs, become available. Liabilities, P&L expense, and cash contributions are all made consistent with each other and all of these are stated in genuine monetary terms.

With these results, pension plans can be managed as they should be managed—in a clear-eyed, hard-headed manner. After all, pension finance deserves the best tools we can provide—it is about money, and extremely big money at that.

Economic accounting, a term fully interchangeable with "market value accounting," focuses on tracking changes in the market value of a firm, of a project, or of any other accounting unit. It is a "natural" or "common sense" form of accounting that peers into an entity to show its true wealth or financial condition.[3]

My intent is to focus the lens of economic accounting on the typical final pay defined-benefit pension plan and to suggest improvements to todays benefit finance techniques. These pension plans involve long-dated future obligations. I will argue that it is difficult, impossible really, to properly manage or account for these obligations if the analysis isn't fully informed by modern portfolio theory and the field of financial economics, all of which are designed to reflect actual market valuations. This paper will demonstrate that, by using an approach governed by market values, costs as well as risks can be controlled to any desired level. In fact, I hope to demonstrate that only the economic accounting described here will disclose the true pension liability and meaningful measures of both periodic expenses and required contributions.

I ask that readers read this treatise with an eye to testing current accounting and actuarial regulations and practices against this purely economic and monetary, and therefore "real," view—and not the other way 'round. After all, the point of economic accounting is to examine the underlying realities revealed by market values. It makes sense to test conventional actuarial and accounting practices against reality, but one is pushing his car uphill with a rope if he

[3] See Ross, et al (2005, p. 412, et seq.), for a corporate finance textbook discussion of market value balance sheets.

presumes to test reality against the conventional actuarial and accounting practices used for pension plans.

The discussion will apply equally to plans sponsored by public or corporate employers; differences in practices between these types of plans need not and should not exist. A single set of principles guides pension finance, regardless of the form of entity sponsoring the plan. (Although corporate plans report "pension expense" on their P&Ls, while public plans do not, I will refer to pension expense regularly without pointing out this difference.)

While the remarks contained herein are grounded in the U.S. regulatory context, I purposefully ignore those rules for purposes of discourse, as they reflect conventional practices of one sort or another rather than economic principles, and it is useful to step back and think about how the rules *should* be framed, rather than how they are now framed, as if one started with a clean sheet. U.S. regulations have hardened into institutional stone some of the conventional pension finance practices most in need of an economic makeover. The economic principles of pension finance are generic, universal, and quickly adaptable to any regulatory or jurisdictional environment. And though I focus my examples on a final pay defined-benefit plan (because, that being the simplest form, the principles are clearest) most or all of the logic can be applied to final-average and career-average pay plans, Taft-Hartley plans, cash-balance plans, and any other plans where the sponsor has flexibility either in funding level or degree of matching of assets to liabilities (therefore, excluding defined-contribution plans).

The Relationship Between Economic and Conventional Accounting

Real estate transactions provide an example of the distinction between economic and conventional accounting that is familiar to all. Real estate is normally carried on the conventional accounting balance sheet at "book value," or cost, and is not marked to market as the actual or true value of the property changes over time. Changes in market value therefore don't appear on the income statement until and unless a recognition event (such as a sale) occurs.

By contrast, in economic accounting a balance-sheet entry reflects the best estimate of current market value and is updated every period. In this way, economic accounting more accurately reflects what has really happened to wealth.

Much of the focus of economic accounting is, quite naturally, on the balance sheet; it is the natural place to track wealth. But because all financial statements are relatively direct transforms of one another, we can also think about economic income statements (the P&L) and economic cash flow statements (the annual change in value of real estate would be a gain or a loss on the P&L). In fact, *every* measure in conventional pension accounting and actuarial work (the valuation of the liabilities, pension expenses, contributions, normal costs, discount rates, required rates of return, etc.) has an economic progenitor, a true measure that a sponsor can look to when trying to understand what is *really* going on, "under the hood" of its plan.

Why Do We Need This Third, Economic Perspective?

In fairness to the accounting and actuarial professions, most of the differences between conventional and economic actuarial and accounting practices reflect principles originally designed for good and proper purposes: to protect readers of financial statements and beneficiaries of pension plans against misleading, manipulative, or fraudulent entries, and to protect against insufficient funding. The expressed bias in accounting is toward recognizing hard transactions, where money is actually exchanged in an arm's length transaction, over possibly more accurate—but also possibly more easily manipulated—book entries, figures that must inherently result from estimation (as would the year-by-year valuations needed for the real estate example above). Of course both professions aspire to the greatest possible accuracy, and both best practices and rules do allow many entries to be shown at market, particularly either where temptation to manipulate market value estimations are minimal or where technology for making reasonably accurate market value estimates is well known, making such estimates easily verifiable.

Pension accounting and actuarial practice is perhaps just such a specially amenable environment for economic approaches; in fact I would argue that accounting standards for pensions *should* be made to reflect economic realities, as the methods for estimating the most critical of the uncertain values involved are reasonably precise. There is little danger of misunderstanding or manipulating the most important book entries *if* the numbers are calculated consistently with first principles from the field of financial economics.

Unfortunately, we can't make the parallel claim that today's *conventional* pension accounting and actuarial standards have little chance of misunderstanding or even manipulation, as apparent contradictions of such a claim are too common to be denied with a straight face. Widespread deficits among plans, along with growing deficits of the Pension Benefit Guaranty Corporation mock any assertion that current ERISA practices ensure full funding. So the good intent of the accountants and actuaries, to build a system providing objective, useful information and sufficient funding, has been to that extent defeated. I might expect resistance to this assertion, but for even further proof compare liability valuations from actuarial (funding; DOL) approaches to those from accounting (GAAP, FASB; GASB) approaches: they are best characterized by their difference, not their similarity—both can't be right if the "law of one price" is remotely correct.[4] Unfortunately, neither is correct in any meaningful economic sense. And human nature being what it is, judgmental decisions inherent in conventional approaches have yielded too often to moral hazard in the pressure of the moment, again contributing to widespread and relatively deep underfunding of pension benefits.

One example that would be humorous (but for the fact that it highlights the cynicism sometimes accompanying conventional approaches to actuarial work and the lack of lay understanding of the judgment actually afforded to actuaries in conventional actuarial

[4] It has been suggested to me by reviewers that many people interested in maintaining the actuarial status quo will greet my references to the law of one price, to discount rate theory, and other economic first principles with disdain and that they may attempt to minimize their significance as mere assertions or conjectures, without proof; or that they will assert that even if true they are not applicable (this latter in particular is to be anticipated with respect to the usefulness of economic principles as applied to public plans). The suggestion has been that I provide more backup on these points in an attempt to persuade.

Of course free and open debate is the entitlement of all, and in general is good for the advancement of knowledge. However, if such objections are in reality to be expected, they would not be in the nature of debate but rather in the spirit of a willful choice to avoid otherwise easily available knowledge. The literature of financial economics is a large literature, and stands on its own, and its principles are reflected in the everyday behavior of markets. The burden to demonstrate why it is not applicable is not on those that, like me, merely refer to its foundation principles, but rather it is on those that would quibble with the entire science, seeming to refuse to acknowledge that the science even exists. This seems an unlikely characteristic for an actuary, given the characteristics of intellect and education that are required even to enter the profession; it seems more likely that I would encounter people who are accustomed to learning new knowledge.

The principles used here are basic and universal. One may as well dispute the laws of gravity as the law of one price or the principle that the discount rate for a risk-free stream of payments is the risk-free rate or that public bodies must face the same financing costs as are presented to the rest of the market (corrected for tax advantages, of course). All of these ideas are demonstrated every moment of the day and night in whatever of the global markets are open at that moment. I invite and urge all who have an interest in knowing the best financing technology to study the survey textbooks from financial economics, perhaps starting with corporate finance. My own personal favorite is Ross, et al (2005), but there are many others.

approaches) appeared in the *New York Times* on May 16, 2008. The New York state legislature, presuming that any appropriately credentialed actuary could and would provide one and only one estimate of the cost of benefit increases—an estimate both proper and fair—was reported to have relied repeatedly on a particular consulting actuary working for a number of New York City employee unions for advice on the cost of benefit modifications. "We assume he comes up with the right number," said one legislator (this was not the plan's own actuary).

But the consulting actuary himself, when interviewed, rather than taking the more usual tack of defending the science behind his methods, the reasonableness of his assumptions, and the accuracy of his report, instead candidly acknowledged that he routinely skewed his projections to favor the unions' desire for higher benefits. My job is "a step above voodoo," he was quoted as saying.

Yes, we trust our actuaries and believe that they are the arbiters of good and true information, but yes also, there is room for moral hazard, particularly in the manner in which expected returns and contributions are traded off against each other in the traditional funding method, where there exist no real road markers to guide the judgmental decision path. This is no surprise—good and true actuaries know this danger. The case reported by the *New York Times* is remarkable only for the consulting actuary's frank acknowledgment of his motivations; the same thing happens in smaller and larger ways all too often. Perhaps the actuarial community has allowed the public to believe that their numbers have monetary meaning, but the broad judgment implicit in the funding methods is inconsistent with any such claim. Wouldn't it be a good thing, though, if valuations did have monetary meaning?

In fact, many failed plans taken over by the PBGC had happily claimed they were much more substantially funded than they were, on the basis of numbers generated under full actuarial supervision and apparently calculated consistently with regulations, by actuaries from the largest and most respected firms. Yet the fact remains that these plans were woefully underfunded; after all, they failed (and I understand anecdotally that subsequent PBGC analysis has shown many or most of them to have been severely underfunded on more realistic assumptions). With this observation, the cynicism of the New York actuary doesn't seem so isolated.

The problem is sufficiently substantial to have received congressional attention, although the resulting legislation, the PPA, is tentative and incomplete. Although the PPA addresses some of these funding issues, holes big enough for trucks to go through—nay, supertankers!—have already been burrowed into its protections, where effective lobbyists teamed up on a Congress having no advisors to help them understand the underlying economic facts. Moreover, PPA assistance is directed only at corporate DB plans—public employee DB plans have had no Congressional support in reforming their accounting.

It is easy to see that management decisions will be made poorly if informed only by conventional actuarial and accounting data. For example:

- If you as a sponsor value a proposed benefit increase at the artificially high discount rate used for accounting purposes, you will be awarding that benefit increase as if benefits were "on sale" for cents on the dollar, at a deep discount to what it is really going to cost you.
- Taking the concept to its logical (!) conclusion, a number of public plans in the late 1990s and early 2000s "sold benefits," allowing employees to buy additional years of service in order to increase their benefits, typically at an 8-percent or higher discount rate.
- Many or most public plans agreed to benefit increases in the late 1990s and early 2000s because their actuarial report said they were "in surplus"—never mind that (a) these "surpluses" had been grossly mismeasured and overstated relative to economic reality, and in many cases were really negative rather than positive, and (b) the "surpluses" were not true surpluses at all, but only surpluses with respect to the small accrued liability measure, not the present value of benefits, and ongoing normal costs would have consumed them in any event. What were the sponsors thinking? These apparent surpluses were the upside returns from holding equities that were supposed to "pay for the plan," covering ongoing normal costs. But instead were used to justify making the plan more expensive. Good intentions are turned on their heads; this is completely backwards.
- Corporate and public plans have often traded future pension benefits (tomorrow's cash-flow problem) for today's salary demands, but have done so with neither the

> ability nor true intent to make the contributions required to pay for them—leaving employees with unfulfilled promises and future shareholders and taxpayers holding the bag.

The "required rate of return" assumption, which confounds two concepts that shouldn't be mixed (contributions and investment returns; see Chapter 7), still heavily influences investment policy, encouraging high percentages of equities and other risky assets. But a pension plan (being at heart an annuity provider) is akin to an insurance company and should probably be run much more conservatively, with fewer rather than more equities and other risky assets.

The various normal cost methods usually assign costs designed to accrue only to a total liability that is grossly understated by the use of an erroneously high discount rate, thus ensuring understatement of both pension expense and contributions (Chapters 2 and 4).

These dysfunctional practices still dominate, and there is not yet a complete appreciation of how fully the risks of sponsoring a pension plan can be controlled when viewed through an economic lens (Chapter 6). There is much yet to be done if actuarial and accounting output is truly going to be useful and reflective of reality.

Even in the U.K., where the liability is now reported on a mark-to-market basis on the balance sheet by virtue of FRS 17, there was only partial reform and mark-to-market methods *were not* adopted for the other financial statements. The liability is still discounted at another rate (the expected return on assets) when calculating normal costs for *contributions* (statement of cash flows) and for *pension expense* (P&L); the expected return assumption is still used for asset returns in pension expense.

Some of the constructs of economic accounting for which I advocate are unlikely to go fully "on-book" in the near future, particularly "full economic liability" and its related normal cost, discussed below. But the portion of full economic liability that is greater than the accrued liability is the source of all future accruals (it is definitionally the present value of future normal cost), and thus very important to understanding the future cost experience of the sponsor. The *FEL* feeds the growth of the accrued benefit security liability, and there is no question that this full liability measure offers important conceptual improvements on current practice. It should, at

some point in the future, be on-book and it should immediately be in full use for management purposes. The more users become accustomed to seeing this relationship, the more comfortable they will be with referring to the *FEL* in managerial decisions. That objective is enough for now, with respect to the *FEL*. The remaining constructs and approaches of economic accounting are all excellent candidates for immediate usage.

My aspiration for this essay is to show how financial economics can better inform all of the questions that face interested parties making decisions about plans, resulting in plans that are much more understandable—thus supporting better management decisions, more affordable pension plans, and more secure benefits. I hope to inspire actuaries and accountants to join in efforts to reform both the regulatory frameworks and the notions of best actuarial practice.

But to do that we have to review and rebuild the actuarial valuation and accounting process from the ground up, taking care to keep it consistent with an economic viewpoint and the purposes that the process is intended to serve. I begin with a brief historical review.

How Will This Treatise Differ From Others on Similar Topics?

This treatise will be new and different in a number of important and valuable ways from others that have been written espousing a financial economics view of the pension plan.

- It uses economic or market value accounting, mentioned above, a modern technique that dramatically aids our ability to sort out the issues involved in understanding the evolution of the pension liability over time. This enables us to capture the "flows" of new liabilities from future new employees than can be expected to arrive into the plan in the future.

- It identifies and describes the "full economic liability" and shows how the accrued liability is subsidiary to it, and conceptually no different than any other accrual accounting item, an artificial spreading of a point-in-time cost over multiple periods analogous to a car payment or to straight line and double declining balance accrual methods.

- It shows that the only economic importance of the accrued liability is if it is agreed that it is the amount legally owed and required to be funded; I call it the "benefit security liability."

- It will go beyond the assessment of the liability with a proper discount rate, which many (including myself) have written about previously, to also fully describe economic pension expense and economic contributions.[5]

- It will demonstrate the dramatic reductions in accounting risk that happen as soon as one views the pension plan through the lens of economic accounting and invests the assets in a liability hedging portfolio.

- Unlike some others it does not take a hard "all bonds, all the time" approach to pension investing, an overly restrictive interpretation of the Miller-Modigliani indifference propositions.

Historic Context: The Actuaries' Contribution to the Existence of Pensions

The precise history is better detailed elsewhere, but actuarial approaches to managing pensions were developed the better part of a century ago, well before the revolution in corporate and economic finance, perhaps best epitomized by Sharpe (1964). Those approaches were developed around the premise that a "funding pattern" or "funding method" (what I would instead call a "contribution policy") could be developed to provide a reserve fund ("funding contributions") to securely support a promised liability payout stream to pensioners. The idea was that contributions, along with a given expected return from the investment of contributed assets, would be accumulated to secure the plan's benefits.

This was innovative in its time; without this invention we would not have had the benefits of DB plans. We owe their existence to the insightful actuaries who first figured out how to make them possible, despite the limited financing and investment management technologies of

[5] Three large and influential pieces on this topic, for example, are representative of the literature, and none of them have spent more than passing comment about the nature of economic pension expense and economic contributions. Their dominant emphasis has been the liability. Joint American Academy of Actuaries and Society of Actuaries Task Force on Financial Economics and the Actuarial Model (2006)(U.S. actuaries); Exley, *et al* (1997)(writing for U.K. actuaries); Blake, et al (2008) (writing for U.K. accountants).

that day. Actuaries then (and now) saw their primary role as overseers of this path to covering retirement obligations.

In this context, the fact that future benefit payments had a present value constituting a "liability" was at most only a side thought, and of little consequence to the program. A prominent textbook reflects this sentiment and describes the funding, or actuarial, liability (while noting in passing the many liability measures in use for different purposes):

> A variety of liability measures are associated with pension plans, each one having a specified purpose. Some liabilities represent the financial obligations of the plan, either on a plan termination or ongoing basis, while *others just represent mathematical byproducts of various actuarial cost methods used for funding pension plans. Although the latter are not liabilities in the true sense of the word, they are referred to as actuarial liabilities* to distinguish them from the term liability as used in the fields of finance and accounting (Winklevoss 1977, p. 68; emphasis mine).

The important work to be done by the actuary was to balance contribution policies and investment returns to insure the payment of future benefits, not to determine the true present value of those future benefit promises—mere "mathematical byproducts."

As time passed, it came to happen that constituents often requested a liability value, first for reference and over time for use in formal accounting reports. This "liability" was compared to the assets—common sense suggests that the assets should be at least as large as the liability.[6]

But the liability thus calculated never provided a measure that could be used to compare monetary assets or liabilities on an apples-for-apples basis. The discount rate used to generate the present value of this liability was the expected return on the asset portfolio, and we know today,

[6] I'm skipping over much of this history, best detailed elsewhere. A good deal, even most, of this activity was done through insurance companies who offered a variety of different products such as individual policy pension trusts (IPPT), deferred annuity (DA) contracts, deposit administration groups (also DA), and investment participation groups (IPG). The earlier of these were bundled packages covering all related pension services. But the "opportunity" to reduce costs by investing more aggressively resulted in both an unbundling of the services and in the bundled services becoming more liberal in their investment policies, starting the push on the limits of risk that we see in today's expected returns. But discount rates were still relatively conservative into the mid 1970s. Smoothing reached its heyday in the 1960s.

from modern portfolio theory, something that wasn't known then: that this discount rate understates the true value of the liability unless assets are invested in a manner specifically designed to match the financial characteristics of the liability. So this stated liability tends to give a very misleading and unduly optimistic picture of economically true funded status. Ever-growing regulatory influences, forcing the addition of one new liability measure after another, each for its own accounting or other purpose and each with its own construction rules, have added confusion to the mix.

Today there is increasing agreement among many actuaries (occasionally grudging, perhaps, but increasing nonetheless!), that this original, asset-oriented approach to setting the discount rate does not appropriately determine the value of a meaningful liability. But at the earlier time when conventional actuarial methods were developed, the relationships between expected returns, risk-free rates, costs of capital, and market-related risk were not even remotely hinted at in the economic or actuarial literature. But in the context of its time, the expected asset return seemed reasonable, even sophisticated. Techniques such as smoothing seemed to be reasonable measures for risk control and amortization seemed a sensible thing to do.

Today many of those earlier methods have hardened into regulatory stone or habitual practice, and it is difficult or even frustrating to advocate improvements. In fact, as the debate over discount rates progressed over the past decade or two, the strong feelings and emotions that were often exhibited signaled the actuarial community's initial spirited willingness to defend those conventional approaches against arguments crossing over from financial economics. Much of this initial opposition seems to have morphed into an acknowledgment that changes are needed, as the strength of the economic principles involved in pensions has come into clearer focus during these discussions.

ERISA's passage in 1974 represented many needed reforms, though ill-timed inasmuch as the field of financial economics was so new that few of its lessons made their way into law.

Whatever the explanation, the fact is that the lessons of modern portfolio theory—while widely adopted and under continuous improvement in all other disciplines where they are relevant, during the four and a half decades since Sharpe (1964) was published—have not yet been fully incorporated into actuarial science or pension accounting. Public employee pension

plans still universally use the "wrong" discount rate (from an economic perspective; never mind that they may be universally right in the context of the Actuarial Standards of Practice, which still have yet to be updated). Moreover, at least as of the time of this writing, the official publications of the Government Accounting Standards Board (GASB) reflect strong resistance to change, although informally it is clear that they are carefully following the discussion and it would not be at all surprising if a change to a more economically oriented position were to happen soon.

Accounting approaches supporting GAAP books inexplicably have motivations different from benefit payment solvency concerns of actuaries. This results in the imposition of practices yet more different from those imposed on actuaries by sponsors' accountants and generates some of the additional—and too often contradictory—liability "measures" to which I have alluded. It is sufficient to know that these additional accountants' liability measures aren't consistent either with actuarial (funding) measures and practices *or* with economics (consider, for example, that the discount rate for the accounting is based on corporate credit rates, and for the actuary's funding approach, it is based on the expected asset returns; but the risk-free rate curve is what economists tell us to use).

Corporate plans are somewhat better in terms of contribution practices, but only by virtue of the PPA; however, the PPA doesn't completely enforce the correct discount rate either, even though its high-quality corporate credit rate is a significant improvement over the expected return on assets. Pension expense is also not computed in market value terms.

The Financial Accounting Standards Board (FASB) is, in fact, engaged in a serious review of accounting standards for pensions, with an apparent intent to make them more economically sensible.

Many thoughtful actuaries today regret that the term "liability" became associated with the present value of "funding plans," measured using expected asset returns as the discount rate; they know that true present values can't be varied or managed by the simple expedient of artificially choosing different discount rates. In that connection, the argument is sometimes made that we can "save" the original measure of the actuarial liability by stating it as "a present value determined at *X* percent," where *X* percent is the expected return on assets. But this makes the

statement of valuation *conditional*, and the condition explicitly contradicts the "law of one price" (the principle that there is just one correct discount rate and one value today for each cash flow). It adds nothing to the strength of the pension system, but merely defends the old methodology.

This can be articulated another way, by recognizing that, although a present value calculated at the wrong discount rate *appears* to be stated in dollars (the mathematics do provide a present value result, no matter what rate is used!), it isn't. A present value calculation only gives an answer that is *actually* stated in units of dollars if the discount rate is a proper market rate for the market risks in the cash flows being discounted. Otherwise, the valuation is in some other unit of value measurement: *oranges* rather than *apples*. Let's call this new unit "sasquatches," by contrast to "dollars" (sorry; I'm writing from the forested mountains of the Pacific Northwest!). Sasquatches might be interesting for some purposes, but tell us nothing about value in actual monetary terms, and thus are of little help to the accounting system or to the desire to see plans satisfactorily funded with real money. Benefits must be paid in real money, so funding should be in real money also. If told that I have 100 dollars of assets set against 100 sasquatches of liabilities, I cannot know if I'm underfunded, overfunded or neutral.

Whether we are discussing actuarial or accounting approaches, properly constructed *economic* approaches to measuring pension values will satisfy the perceived needs of both actuarial funding needs and accountant's reporting needs, and reconnect them to a common platform meaningful in terms of dollars, not sasquatches. It will facilitate better labor-management discussions and decisions about benefit levels and about funding levels.

The best way to provide responsible funding patterns is with a contribution policy such as the one described in Chapters 4 and 5, which is based on the true market value of an appropriately chosen and measured "benefit security liability." Such a contribution policy is tightly tied to properly constructed normal cost and to its associated accrued liability, and feeds the accounting system consistent data for all principal accounting statements—all based on an *economic* appreciation of the present value of liabilities.

The Perspectives of Sponsors

I am aware that many friends and colleagues in the plan sponsor community strongly believe that mark-to-market accounting is a bad thing, and have stated that if it is adopted they will terminate their defined-benefit pension plans. Their argument is that mark-to-market accounting will make their plans too risky and too costly to be viable, increasing the pressure to shut it down. Representatives of employees are also cautious, not wanting to "increase the liability" for fear of unhappy reactions from employers and legislators.

But I argue the contrary point—that most elements of economic accounting are in fact a *good* thing, for sponsors as well as for employees and other constituents. The argument is simple but, I think, powerful—first, that economic accounting does a much better job of supporting good management decisions than does conventional accounting, and second, that plans don't have to be too risky nor too costly when managed with the aid of good information. *See* Waring (2005) and (2009); Waring and Siegel (2006).

Plans won't be more risky or more costly on a mark-to-market basis: plans *already carry* all of the risk and cost that would *appear* to come from mark-to-market accounting. That risk and cost is only *hidden* (to a smaller degree than most realize) by conventional accounting and actuarial approaches, so that today's bad experience *doesn't show up* in the very near term. But this cost and risk doesn't go away, either, and in the intermediate and longer term it is still completely there. Nor will the true liability be higher than it really is, in a mark-to-market framework—it is what it is, and today's lower valuations are understatements of what it really is. *A given level of benefits costs what it costs*, regardless of the reporting method (some methods may obscure this, but it will be true over time under all methods). The real cost control lever is the market value today of the benefit package, as determined solely by benefit policy, and not the accounting treatment. I'll examine this concept further, below.

To insist on using measures that don't reveal the pension plan's financial reality is like assuming that you remain healthier by not ever seeing the doctor. It's a nice thought, but it just isn't so.

Exposing actual risks and costs to daylight doesn't make them greater or smaller. Costs and risks *can* be controlled—by informed *management and/or labor decisions* about benefit policy in particular, investment policy secondarily, and with some further help from economically sound accounting and reporting policies. *But good management decisions can't be made without good information.*

So the irony is that pension plans probably *can't* be properly managed or properly funded in today's conventional and artificial accounting and actuarial environment. Risk, cost, and funding can only be managed successfully if the true monetary value of liabilities, costs, and contributions are known, and this requires the use of economic accounting. In today's accounting and actuarial environment, much of what we need for good management decisions is obscured, distorted (Sasquatches!), or otherwise hidden from use.

So, regardless of whether formal accounting does or does not become more economically based, there is little excuse for not *managing* the plan on its economics. Doing so will lead to better benefit policies, better contribution policies, better investment policies, and better reporting policies—the four cornerstones of strong plan management—and that means fewer pension-related reporting issues and fewer pension-funding problems.

In the meantime, the world is changing—it seems likely that mark-to-market is going to be a fact (the PPA already moves us closer to this, for corporate funding purposes at least). Where would we like this to take us? Can we manage plans better, thus helping to preserve and even expand them? How do we safely transition without losing plans?

Can we view this change as what it really is, an opportunity to manage plans better going forward, and not as the problem itself?

Chapter 2: Measuring Meaningful Present Values—Discount Rate Topics

It is important to use the correct discount rate to equate value today with value tomorrow, and there exists substantial technology dealing with the "time value of money." This technology goes well beyond discount rate math, which itself is simple. The correct discount rate is equally important when valuing future corporate free cash flows during a hostile corporate acquisition attempt as when valuing future pension benefit payments in a DB plan. A discount rate for an asset that is not matched to the market-related risks of that asset, found in its stream of cash flows being discounted, presents an arbitrage opportunity—one that will restore the price to a level where the discount rate again equates value today with value tomorrow, assuming an open market. Where there is not an open market, as in pension plans, the arbitrage may persist for some time, and either management or labor will have an advantage over the other until the error in the discount rate is corrected or the load becomes too heavy and the disadvantaged party is heavily damaged and perhaps even defaults. Where the discount rate is too high, the advantage goes to labor at the expense of management, and vice versa.

There can be only one "right" price for anything today, including cash flows expected to occur in the future. The "law of one price" can't be suspended—not for the liability, and not for any other financial entity.[7]

When a liability is discounted at the wrong rate, its resulting "value" is expressed no longer in actual dollars, but in terms of some other unit of trade—sasquatches, perhaps, as suggested in Chapter 1. Sasquatches are not dollars, not being expressed in genuine monetary terms.

Best practices for estimating a discount rate, well-established in finance practice and informed by modern portfolio theory,[8] refer to the cost of borrowing money or using capital, a cost that *reflects all fully diversified, "market-related" risks (beta risks) in the cash flows being*

[7] Of course in practice the "law of one price" is more like the "law of one bid-ask spread," but that doesn't diminish the point.

[8] For a general discussion of discount rate theory and practice see Ross, *et al* (2005; p. 19 et seq.), who refer to the relationship between the discount rate and the market risks in the cash flows being discounted as "the standalone principle." Most any other quality introductory corporate finance text should have comparable material. There is an incredibly deep and involved literature on this topic, going well beyond what is covered here, as I merely scratch the surface at the most practical levels.

discounted (non-beta, diversifiable risks aren't usually considered, and usually shouldn't be). In our case the sponsor implicitly borrows a portion of current pay from the employees, with a promise to later pay it back in the form of pension benefits. A portion of today's total compensation will be paid tomorrow—it is a form of deferred compensation, with a rate of interest (an expected return) that is fair, and in proportion to the market risk taken by the employee-lenders. Ideally this should be *no* risk.

There are two perspectives to keep in mind when discussing discount rates for pension plans, similar but subtly different. The first provides general ideas about how to set and use discount rates and the general logic of discounting all types of cash flows in a manner best-suited to estimating their present market value. It centers on identifying and then matching market-related risks in those cash flows. It lays a foundation for an understanding of the consequences of a plan not being fully funded; a discussion (involving credit risk of the sponsor) that we cannot finish until late in the next chapter. For the most part this will lead us to look at bond-like risks when valuing pension plans, although we'll mention some other possibilities.

The second perspective is merely a specific application of the more general first perspective. It is most important to us in considering funding decisions. As a result of historical defaults, public policy focused on removing this possibility by requiring full funding. If we want to know the amount necessary to fund future benefits without risk of default, then we determine the present value of future benefits *as if* their market-related risks include no chance of default—i.e., by discounting using a risk-free rate curve. We use the *aspiration* that the transaction be risk-free rather than the *reality* that the liability might, at the moment, be underfunded and thereby exposed to risk, to tell us how much is needed in the fund in order to assure security of benefits. It would be faulty, and circular, logic for this benefit security purpose to use as a funding target a liability measured "small" because of the default risk premium added in to represent the chance of default through underfunding.

This is why we say that the correct discount rate for finding the funding target measure of the liability is the risk-free rate; selecting the discount rate for funding purposes really is just that simple. If the goal is security of benefits, then isn't a *secure* benefit a *risk-free* benefit?

But the more general theory is important, inasmuch as actual market values do matter. Practitioners should be facile in using market-related discount rates, as that knowledge is often useful. If the market value of the liability is less than that determined with a risk-free rate, that information would be valuable to know. This will most often be a result of credit risk, which we'll hold for full development until the next chapter.

The Liability-Matching Portfolio

Many finance textbooks discuss how to estimate the discount rate for specific cash flows by estimating their "beta," or market-related risk. One excellent way to think about this is to use the expected return of the best available *hedging portfolio* (a portfolio that is as closely matched in beta, or market-related, risks as is possible—that is, a liability-matching asset portfolio). Inherently, a hedging portfolio has the same beta, or market-related risk characteristics, as the thing that it is hedging.

Today, in many contexts we increase precision by thinking of beta in a multi-factor or multi-beta manner, rather than just as a single, equity beta. This allows us to describe the hedging portfolio as the sum of many separate market beta components, but the concept is otherwise unchanged. This approach is robust for finding discount rates for cash flows having virtually any type of market risks to them.

For pension plans, the betas in the liability that can be hedged—and that thus do affect the proper discount rate—are relatively simple, being dominantly interest rate risk factors such as real interest rate risk (at multiple annual horizons), inflation risk, yield curve twist risk, and perhaps credit risk. But the liability may also have equity-like risk factors, particularly in the far distant future accruals, those which aren't yet sufficiently mature to require current funding. If we narrow our focus not to the entire "full economic liability," the *FEL*, but to the portion representing retired and current employees, we are dealing for the most part with bond-like risks rather than equity-like risks.

Because this portion of the liability often contains a good deal of inflation protection, at least during the employee's working life and in many plans also during retirement, it resembles a real rate bond more than it does a nominal bond. So we want to build an appropriate mixture of

real rate government bonds and nominal government bonds into our "liability model," so as to represent it accurately. It is this rate—a low rate relative to conventional "expected return on assets" rates—that is the proper discount rate for taking the present value of risk-free future benefit payments.[9] In turn, it is this low rate that employees and pensioners earn on deferred compensation—if their risk is low, their return should be low; there are no "special deals" in the financial markets.

Today we often quote a discount rate as a single number, but in fact there is a full yield curve (or curves, for real rates and inflation) to refer to, with a different point on the curve relevant to each future year's forecast benefit payments. Although the yield curve can be expressed as an effective average discount rate (a single rate that, if applied to all the forecast cash flows, gives the same present value as the sum of all points on the full yield curve), it is important to use the full curve for proper work.

Other factors, in addition to real interest rates and inflation, may have small roles in the discount rate for the market value of the liability, particularly the sponsor's credit risk (which won't affect the benefit security measure; see the following chapter). Others have less significant impact and will be left for further research.[10]

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[9] Because most DB plans today aim to provide a benefit based on final pay, where wage inflation is relatively highly related to CPI inflation, the benefits are to that extent real. If in addition there were to be full inflation indexing of benefits, post retirement, then the stream would be *completely* real. One would use the real interest rate spot curve, which is quite low, to discount the estimated future cash flows if inflation growth were not included in the cash flows, and the real interest rate curve plus expected inflation if inflation were included.

During the very high interest period of the 1970s and in fact up almost to the 1990s, commonly used discount rates were often *lower* than market rates and overstated the value of the liability, encouraging funding *greater* than actually required. I have heard it argued that this assisted plans in getting off to a good start as the decade of the 1980s began.

See Waring (2004a) for a fully generalized roadmap for determining the mixture of nominal and inflation-protected government bonds needed for a particular plan with less than a full COLA policy; see Siegel and Waring (2004) for a parallel explanation in a simplified, no-equities setting. As a result the latter is perhaps in a more accessibly written form.

[10] From time to time it has been argued that the effect of the real growth rate of wages on future benefit payment cash flows might be hedged by equities (not moment by moment, but with some strongly positive correlation that would nonetheless be valuable over time). If correct, this suggests that we should separate out and discount the portions of the cash flows attributable solely to real wage growth, the portion in excess of CPI inflation, at a market related rate that includes some portion of the equity risk premium. This possibility deserves further empirical research by financial economists. However, even if correct the valuation "size" of this portion of real wage growth is small relative to the balance of the accrued liability; it may be larger with respect to the *FEL*.

Sponsors holding equities (or other risky assets *not* hedging the liability) introduce some amount of additional funding ratio risk, which in turn increases pension default risk and supports a default risk premium or default put option value even on an otherwise fully funded plan. Again, this is a small factor for healthy sponsors that can easily make contributions to cover investment shortfalls, but of larger concern for less healthy sponsors who might not be able to do so.

Risk-Free Rate vs. the Expected Return on Assets: Pension Finance Choices

Despite the relative clarity of the technology for determining the right discount rate, the actuarial community has traditionally used a discount rate taken from the expected return of the pension asset portfolio (and in turn taken from the "required rate of return" found during development of contribution or funding policy). This leads to the serious probability of surprisingly large contributions for the sponsor and/or increased chance of default faced by the plan participants.

For our discussion, let's consider as a highly simplified example a fictional company having a single employee who is retiring today. Her "retirement" benefit is a simple, single payment—she is to be paid $100,000 cash (nominal) in 20 years, if (but only if) she survives that long, and this obligation is to be fully funded and thus secure from the possibility of default.

What are the funding options to which the parties might agree? The company could take the present value of this payment at the then-current 4.5 percent zero-coupon 20-year nominal government bond yield, and invest the resulting present value of $41,464 in just such a bond. This bond investment would perfectly and risklessly hedge, or "match," the liability obligation, because its market-related risks—horizon, and nominal rate—are identical (its beta, or "duration," relative to nominal rate changes is 20 years, identical to that of the liability, making the liability the equivalent of a 20-year zero-coupon bond). On the appointed day there *will* be $100,000 waiting, without risk from unmatched market realizations.

Because the market-related risks are identical, the yield provides the correct discount rate for the liability, just as it does for the bond; their values are the same because their risks and returns are the same. Note that there are no other market-related risk factors to potentially ruin this hedge (other than failure of the government to pay its debts).

But there is another risk factor, one that *isn't* correlated to the markets, and so doesn't change the discount rate. It is the possibility of her death before the payment becomes due, thereby obviating the obligation. That risk factor isn't hedgeable by purchasing any instrument in

the markets, so isn't relevant to the discount rate.[11] Such "idiosyncratic" or "diversifiable" risk isn't rewarded by the markets, upon the theory that it can be made to "go away" through diversification and therefore needs no compensation. Because diversifiable risk isn't rewarded, it therefore also doesn't affect the discount rate.

But it can affect the value of the liability nonetheless. The amount reserved could be reduced, or *decremented* (not discounted) for the probability that the employee won't live long enough to be paid. However, for a single life rather than a group it is unlikely the retiree would agree to this diminution of her security: if the company was to set aside only that decremented amount, and she does in fact live to collect, she would want the whole obligation to be secure.

For larger groups, however, mortality risk can be pooled across the group. With pooling, the risk that a decremented valuation won't provide sufficient funding to satisfy the obligation declines as the pool gets larger, a wonderful and practical application of the "law of large numbers" that will be familiar to most readers. Our hypothetical employee might, for example, feel sufficiently secured by her employer's purchase of a properly managed life annuity from an insurer providing life annuities to many thousands of people (or from a DB plan!) to be willing to accept a decremented funding "deal," giving the employer the immediate savings of the decrement (she might still have some reservations, as she would in such a case be exposed to the smaller but nonetheless very real credit risk of the insurer).

So the yield on a hedging portfolio is one method to estimate the discount rate and, where the obligation is intended to be risk-free, this gives us a risk-free bond discount rate. It also suggests that investment policy would start with a risk-free bond portfolio.

On the other hand, the employer might notice that equities have a higher expected return than do bonds, perhaps when invested in a portfolio consisting of 65-percent stocks and 35-percent bonds and having a blended expected return of, let's say, 6.37 percent. The company may note that, if it discounts the obligation at this rate, only $29,569 of its $100,000 obligation need be set aside, an amount nearly $12,000 less than required in the bond example. Hmmm; this

[11] There are fledgling efforts to create a secondary market in mortality risk, thus securitizing it and potentially creating a market-priced cost of that risk—a beta for mortality risk, if you will.

is tempting! Would it be OK to use the expected return of this part-equity portfolio as the discount rate for the liability?

Expected Return on Assets vs Cost of Capital or "Hedging Portfolio" Expected Return

Today's U.S. standard practice for virtually all public employee and industry-wide, multi-employer (Taft-Hartley) DB plans is to use just such an approach for sourcing the discount rate for the liability.[12] The rationale is: "if we can earn that much on the assets, those returns (together with planned contributions) will pay for the liability and all will be good, right?"

Well, no, all won't necessarily be good, despite the widespread prevalence of the practice in pension actuarial work. Why? When a portfolio is invested in risky equities to pay a liability that is riskless, there is a substantial danger that the portfolio will underperform the liability and leave the liability underfunded, thereby increasing the possibility of default. The betas or market-related risks are not matched, the liability is not hedged, and the returns will likely go in different directions and if so may leave the plan in the hole. So there is no basis for using portfolio expected return as the liability discount rate.

In fact, equities and other risky assets have a higher expected return precisely *because* they have a greater risk of disappointment than risk-free assets. It is axiomatic that, in the markets, you expect a higher return when you take on more risk. "Higher risk" means you might end up worse off, even *much* worse off, than if you had invested in the risk-free asset.

[12] It is a principle of financial economics that the values for the discount rate, the cost of capital, and the expected return of an asset, a liability (or any other given set of cash flows) are identical, and are governed by the market-related risk in those cash flows. As a result, the terms can be used interchangeably. This observation is important to understanding what a proper discount rate really is and where it comes from.

Figure 1

Growth of a dollar over time: Liability-matched risk-free government bonds vs. typical pension investment policy mix, with 65-percent equity. Linear scale.

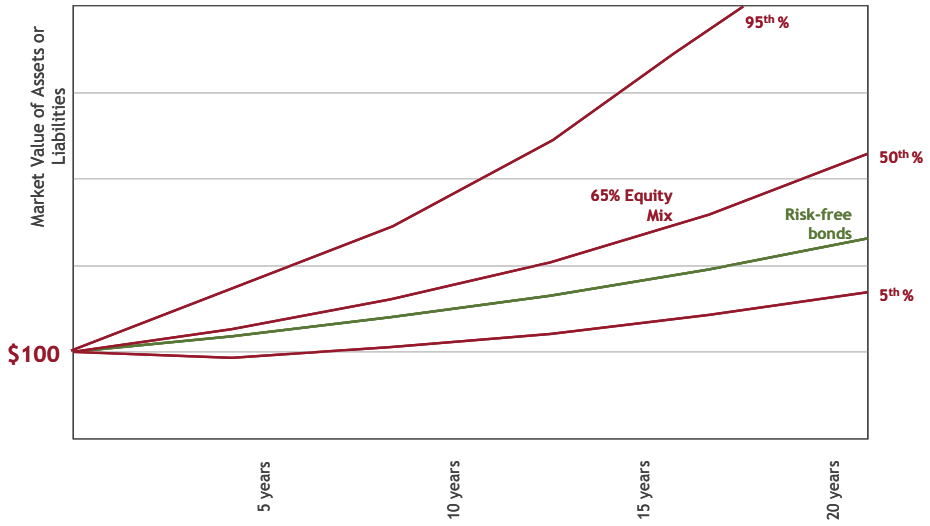


Figure 1 reflects this trade-off by plotting growth expectations (or distributions) of two portfolios over a 20-year period, one consisting of equities and other risky assets and the other being a liability matching bond portfolio such as would fully hedge a pension liability, and so is riskless in that sense. This form of graph is sometimes called a "tulip" chart because of its characteristic shape; it has become a standard tool of economists for representing potential deviations from market expectations since its introduction by Ibbotson and Sinquefield in their famous article on forecasting market returns (1976) (these diagrams are often shown with a logarithmic *y* axis, to linearize the rate of growth, and when drawn that way the resemblance to an actual tulip flower is stronger; here I use a linear axis to more clearly show the ending wealth effects).

Both portfolios in the example are plotted from the same valuation starting point; the growth of the hedged, risk-free portfolio appears as a steady but slow rise over time, with no

volatility not directly offset and matched by liability volatility.[13] Thus, the distribution for the risk-free portfolio is no distribution at all—the single line incorporates all percentiles.

Median returns for the 65 percent to 35 percent mixed equity and bond portfolio ("median" serving as a loose proxy for expected or mean return) are in fact a good deal higher than for those of the bond portfolio, as we anticipated. But notice the wide dispersion of potential realized returns indicated by the fifth and 95th percentile lines. The lower portion of the distribution gives us a good sense for risk: It illustrates the *significant probability that the mixed asset portfolio will in fact underperform a risk-free, fully hedged bond portfolio—which means that it will underperform the liability as well*. That probability is high and significant. But for scaling, we can see visually that it is less than 50 percent from inception to any other later point in time.

This comparison of two possible portfolios represents a "fair" trade-off of risk for return; therefore markets price the worth of a dollar in the mixed equity portfolio, despite its higher expected return, *exactly* the same as the worth of a dollar in the bond portfolio with its more certain, but lower, expected return. In the terminology of economists, the expected returns of the two portfolios have a "certainty equivalence," meaning that they are the same when adjusted for market risk, a "fair trade." The mixed equity portfolio's returns are higher only in *expectation*, not necessarily in *realization*—the realized returns are highly volatile and will necessarily be drawn from the broad distributions illustrated. As such they will often disappoint expectations and put the liability in danger of default. To the market as a whole, it all balances out and both investments are fully held.

In considering whether any equity portfolio, including the example given, provides a basis for discounting the liability, compare the market-related risks. Here we note that those in the equity portfolio do not resemble those of the risk-free liability. There is thus no natural hedge between the two; holding equities in a portfolio detracts from the security of the risk-free liabilities in a way that wouldn't occur if the portfolio were invested in liability-matching bonds.

[13] While there will be actual volatility of the bonds taken by themselves (asset only), when the bonds are examined in concert with the liability there is no risk if they are liability-matching bonds; i.e., there is no *surplus* risk. I'll take the liberty of showing the growth line for these bonds as a straight line, without its asset-only volatility, in order to present the relative true risk in the way we would see it in a pension application, i.e., with no surplus risk.

While the mixed equity portfolio *might* represent an acceptable investment policy for a risk-free liability, it is not a basis for establishing the discount rate of a liability. *The discount rate for the liability and the investment policy for the assets are two different matters*. The discount rate is endogenous to, and a function of, the natural risks in the liability cash flows. Investment policy, on the other hand, is largely a "risk-return decision," that is, a decision of how to balance the higher expected returns of risky assets against their higher risks. Provided that the sponsor can comfortably cover investment losses by making greater contributions, it can choose an investment policy from a very broad choice of risk exposure over and above holding the hedging portfolio. However, the least-risk investment policy will always be to hold the same hedging portfolio as the one that establishes the correct discount rate.

"But the Pension Plan is a Long-Term Investor . . . ."

The result does not change because the pension plan is a "long-term investor." Too often I've heard actuaries or plan sponsors justify aggressive investment policies having high percentages of equities and equity-like assets, by saying "A pension plan is a long-term investor, and a long-term investor *gets* the expected return over the long term." A refrain is usually added, delivered with a knowing look, that "after all, risk goes away with time."

Both claims are patently false: What an investor "gets" is not the expected return but rather a *realized* return drawn from a distribution wider than the one year standard deviation by approximately the square root of the number of years—which would be a multiple of five if "long-term" means 25 years! Notice that the graphs in Figure 1 gradually widen as the time period lengthens. Rather than going away, risk to wealth actually *accumulates* over time.[14] For an example, the 1980s and 1990s were two decades where realized returns were well *above* the expected return, consistently in the top portion of our graph. If that good luck can happen over such an extended term, we could just as easily have two decades of *under*performance. Indeed,

[14] There is a similar graph, but showing the distribution of cumulative compound annual *returns* rather than of portfolio values. It is sometimes called a "trumpet" diagram. It appears to show risk going away with time, but it is misleading because it portrays extreme (best and worst case) returns in *annualized* form: the top and bottom lines analogous to those in Figure 1 get closer together rather than farther apart because as a result of this focus on returns rather than wealth. In other words, while the dispersion of annualized rates of return grows smaller for longer periods, the dispersion of ending wealth values arising out of those returns nonetheless grows larger for longer periods. In fact, these two types of charts are merely mathematical transforms of one another, the underlying distribution and return process assumptions being identical. Unfortunately, the return version seems to be the only one with which many people are familiar, and it has been broadly misinterpreted.

we have experienced very long periods of flat or down performance in U.S. equity markets, including the decade we are about to finish, a longer period starting in 1929 and covering the bigger portion of two decades, and another starting in 1966 and lasting about as long, at least in real terms. Even long-term investors can have disappointing results; that possibility is what risk *is*.

So we see that being a long-term investor is only modestly important to the aggressiveness of investment policy—indeed, it would have no importance but for a few modest real-world violations of our assumptions of independence of returns.[15]

Proposition 1

> *Long-term investors don't "get" the expected return, but rather they get a highly random and uncertain draw from what can be a very wide distribution of possible realized returns.*

Proposition 2

> *Risk to portfolio wealth from random and uncertain investment returns doesn't go away with time, but accumulates, increasing in proportion to the square root of the length of time.*

Yet today's common practice still presumes that an investor will "get" the expected return of the equities and other risky assets in the portfolio, which is the underlying rationale for the use of that return as the discount rate. The error lies in planning to receive with certainty that which is, in reality, highly uncertain. This is a theme that will be repeated, in this chapter and in Chapters 4 and 7, as it is an implicit core belief woven solidly into much of conventional actuarial practice and is at the root of many inconsistencies between conventional and economic approaches. We will have to rid ourselves of it completely in order to move forward.

Back to Our Example

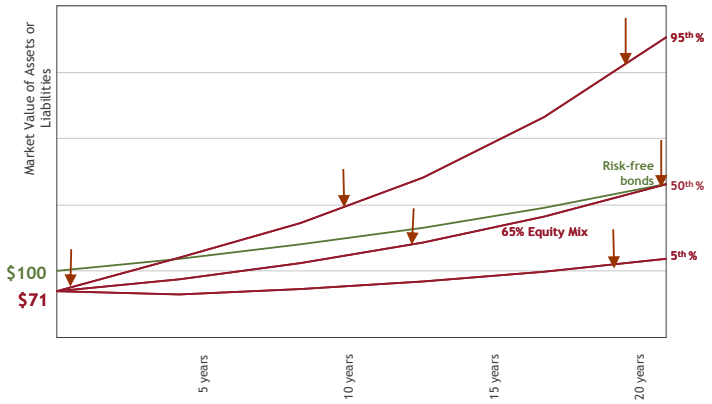
Figure 2 shows some practical implications of using the expected returns of the mixed equity portfolio to provide the discount rate. If the higher discount rate is used, the liability's

[15] See Campbell and Viceira (2002, 2005), who demonstrate that there may be very real, although quite modest, serial correlation and thus some modest diminishment of risk over quite long horizons (a reduction in annualized standard deviation from 18 percent to 14 percent after 25 years). These effects are not sufficient to contradict the general point of this argument, however.

value goes down—and thus the required portfolio's value goes down, along with the contributions needed to build it up—on this logic, it appears to require only about 71 percent of the value that it would require if the liability-matching long bond portfolio were used to set the discount rate, instead. And yes, if we start with that lower value (in our simplified example $29,569) and grow the mixed asset portfolio from that point at the expected return, we will indeed be able to satisfy the full $100,000 obligation at the end of our 20-year period—*if, but only if, we actually do earn the expected return, or better*.

Figure 2

Same as Figure 1, but with the initial investment in equities reduced so that the 20 year expected ending value of the 65-percent equity mix is the same as that of the risk-free bond portfolio.



But that is a big "if." We will be underfunded with respect to the obligation if the cumulative return is below expectations over any elapsed period of time and now, because we have funded the obligation with less money, the likelihood of that failure has gone up significantly, as shown by the graph. The possibility of having insufficient funds to pay the liability is now up to 50 percent over the whole planning period, from the much lower value shown in the prior figure. This isn't yet the full story: *the probability of default is much higher than 50 percent* from inception *to all points prior to the end of the planning period* during the life of the obligation. This is a dramatically different scenario than before we reduced the funding level, when the probability of default was much less than 50 percent.

Under this scenario, sasquatches rather than dollars are funding the liability. There is no longer anything like a fair risk-return trade-off between the two strategies being compared. In actual practice, the probability that the employer will be unpleasantly surprised to find that he must make large contributions during this period (to make up for investment losses), has now gone up substantially.[16]

Another way of saying this, is that DB plans are set up today so as to understate the true pension cost to the sponsor—by about one-third or more for public plans and around 15 percent (or even much higher) for private plans (high-quality corporate discount rate), and that this risk is felt whenever the markets perform lower than expected (not lower than bonds, but lower than expected for equities!). It's no wonder that sponsors feel DB plans are too risky, with too many negative surprises.[17]

By this point in our discussion, the folly of using the expected return on assets as the discount rate must be clear. Not only do typical high-equity asset portfolios not hedge the readily hedgeable aspects of the liability, but the practice also invites the contribution of so little initial funding that the path-dependent probability that there will be a need for additional "surprise" contributions from the sponsor will generally exceed 50 percent, in actual practice perhaps much greater. For both reasons, the liability is not securely funded and the sponsor is subject to the frequent torment of unexpected contributions.

The market-related discount rate for a riskless liability is, quite naturally, the risk-free rate. The discount rate should not be derived either from assets or from the optimism of the

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[16] Paradoxically, if the cumulative return does exceed expectation, it is likely under today's practice that benefit levels will be negotiated upwards rather than the employer getting a cost reduction (even though economically speaking there is no real call option to the employees for this purpose until the *FEL* is fully funded; see Appendix 1; also see "when is a plan fully in surplus?" in the investment policy chapter). So while an employer is told that it has to invest in equities to help pay for the plan, if the returns do come in higher than expected, it is likely to give away all or a part of the gain. Yet the employer takes the loss on the downside by itself (especially in non-contributory plans). By itself, this asymmetry should persuade sponsors to abandon heavy equity and risky asset positions and the expected return approach.

[17] One commenting actuary wryly suggests that, if we only want to require funding to some fraction of the true liability (which is the implicit effect of using the expected return on assets for the discount rate), we should just require funding to, say, 70 percent of the liability determined using the proper market-related discount rate. This would be a more transparent approach, but his point (intentionally) highlights the fact that under-funding itself is being affirmatively sponsored—and thus beggars the question. Is not the goal to securely fund benefits?

accountants or actuaries servicing the plan, nor from pressure to hit corporate earnings targets or to balance government budgets.

The Discount Rate is in Fact the Same on Both Sides of the Full Economic Balance Sheet, but That Doesn't Mean That the Liability Changes with Changes in Investment Policy

A point must be carefully made here: in more general finance applications, theorists agree that the left hand (asset) side of the balance sheet has the same weighted average cost of capital (WACC) as does the right hand side (liabilities plus equity). So the expected return of the assets, a synonym for their discount rate or for their WACC, is also the discount rate of the right-hand side.

But in this more general application *it is already assumed that both sides of the balance sheet are in balance and stated in proper current dollars*. Thus if one increases the aggressiveness of the left hand, asset side investments in order to generate a higher expected return, *it wouldn't change the present value of either the left hand side or the right hand side* (both sides would still be in balance, and in the original values). It *does* however raise the *expected* future level of payoff of the left side and therefore also the expected future value of the right hand side, but it also adds risk that the *realized* payoff may be less than if the portfolio had been invested less aggressively. And if less, then it affects both sides.

No one would argue that an individual investing his available funds in equities is wealthier *at that moment* than if invested instead in bonds. So why is the argument tolerated, that a pension liability is smaller when the assets are invested in equities than it would be if the assets were invested in bonds? It is the same argument, indefensible in either case. (I'm still waiting for the bank to reduce my house payments because I have equities in my brokerage portfolio). Let's state this as an indifference proposition:

Proposition 3

> *You cannot change the present value of future benefit payments—the liability, or any subsidiary measure of it—through investment policy decisions.*[18]

As a practical matter, the balance sheet of a pension plan trust can't easily be examined in full, because it is seldom shown in its complete economic form reflecting the complete economic posture of the trust. If written out completely, including the expected value of liability default (*EVLD*), a term representing the value of the possibility of employer default on the pension promise that we will define more completely in a later section (and all those other option entries back and forth among the sponsor, the participants, and the PBGC; see Appendix 1), the WACC on the left-hand or asset side is indeed going to be equal to the WACC on the right-hand liability side. But the *ABO*, or whatever is the "accrued benefit security measure" of the liability (again, a term that will be developed more carefully later) will have the same valuation *regardless of the investment policy for the assets*.

It is the valuation of the implicit options that will change—distributing the risk of shortfall and the benefits of surplus amongst the various parties (see Appendix 1). Increased investment aggressiveness may increase the possibility of an underfunded default, and thus the *EVLD*, decreasing the netted out *market* value of the liability after deducting the *EVLD* from the risk-free version. But this doesn't change the size of the liability that needs to be funded in order to provide full security of benefits, the funding target or benefit security measure of the accrued liability measured at the risk-free rate (more on this in the next chapter).

Thus, increasing the aggressiveness of the investments never justifies a reduction of funding requirements: If anything, it should *increase* the funding requirement above full funding, in order to reduce the risk to benefits imparted by the possibility of disappointing returns and the effect of that on the *EVLD* (as it does under Dutch DB plan regulations).

[18] Finance people will recognize that most of the propositions that I state in this essay are conditional on the usual perfect capital market assumptions and other useful simplifying assumptions in the same manner as are other equivalence propositions. They are likewise robust to that first order. Also, the PBGC guarantee may offset some of the *EVLD* on behalf of the participants, but this isn't really a benefit to the employer.

GASB's White Paper

GASB has circulated a white paper (2006) in which it argues that governmental accounting has needs different from corporate accounting. While in many or perhaps even most contexts this generality no doubt has merit, the paper extended it to include DB pension funding and finance, arguing that public employee pension plans need not abandon the expected return method of setting the discount rate in favor of market-related discount rates. Actually, this really didn't rise to the level of an "argument," being more an unsupported assertion, conclusory in nature.

This assertion surprises me, as other public body financing costs and methods have only trivial differences from those in the private sector. States and municipalities receive competitive rates on their investments and pay competitive rates for their borrowing (aside from the adjustment effect of specific tax breaks). The laws of gravity of benefit finance or any other form of finance don't change with the identity of the borrower. If governments face market discount rates wherever they borrow or lend, why would borrowing from pensioners—which after all is what pension finance is all about—be any different?

Turn the rock over and look at it from the other side: The discount rate is equivalently the rate of return on the liability. If pensioners only get low, risk-free rates of return on risk-free, deferred-compensation benefits in a private sector plan, why should they get more in a publicly sponsored plan? Seriously; we cannot gloss over this point.

While accounting methods are different, and while public bodies don't think about their balance sheets and P&Ls in exactly the same way that corporations do, they nonetheless work with and manage assets and liabilities and tax bases, and in other ways are economic entities. And, presumably, they strive to deliver services in a manner that maximizes taxpayer value and provides appropriate stewardship of resources and accountability through full information sharing. And the white paper's emphasis on inter-period equity between generations of taxpayers

is completely aligned with the need to provide equity between generations of shareholders, although the solutions they seem to advocate accomplish quite the opposite.[19] The similarities between the private and public sectors are more than sufficient for our purpose here: how best to fund, report, and manage pension plans.

The GASB white paper's claimed goals are to serve transparency and accountability in public body accounting. But these goals can only be met by moving pension accounting to mark-to-market, rather than by avoiding it, by embracing the idea of reporting and managing on the basis of valuations stated in genuine monetary terms.

[19] Oddly enough, there is an argument advanced by actuaries defending the expected return as the discount rate that suggests that its use is required in order to provide intergenerational equity—that otherwise the passive future generation will reap the rewards of the high-returning portfolio put in place by the wise current generation. This is the argument being defended in the GASB white paper, implicitly. This argument is completely backwards—as wrong as it is possible to be—and is discussed more completely in Chapter 7.

Chapter 3: The Full Economic Liability—The Starting Point for Economic Pension Accounting

If we designed an accounting and actuarial system, starting with a clean sheet of paper, intending that it reflect what was really going on in a plan at all times—stated in genuine monetary terms—it would be an economic accounting system. We could borrow terminology and general concepts from conventional accounting and actuarial practice, where not inconsistent with this goal, but we would implement these concepts so as to accurately reflect market values. What we would not do is adopt the multitudes of different methods, bases, and other actuarial arcania that clutter conventional approaches and blind the eye to economic realities.[20]

The Liability is Inherently an Economic Entity

The beating heart of all pension liability analysis is the forecast of the stream of future benefit payments that will be made to employees, survivors, and other participants, *i.e.*, forecasted benefit payment cash flows (duly decremented for life, continued employment,[21] and other appropriate probabilities). These cash flows make the liability just a complex bond; *i.e.*, an economic entity not conceptually different from many other assets routinely traded in the markets.

The fact that the liability is essentially economic in nature was recognized as early as 37 years ago, in 1972 by Jack Treynor; and again by Treynor, Reagan, and Priest (1975, page 56), Mulvey (1989), and Michaud (1989). The term has been more widely used recently; see Ryan and Fabozzi (2002) for a current example. I have been using it continuously in work with dozens of large plan sponsors and in client work, speeches, and articles on this topic since about 1991.

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[20] As an example, both actuaries and non-actuaries might find morbid amusement in reading a very serious effort by a very serious actuary to sort out these actuarial and regulatory concepts—none of which have any apparent tie to actual economic value; Segal (2002). As a bonus for looking up this reference, the reader will find another excellent summary of the problem by Jeremy Gold.

[21] Decrementing for the probability that an employee will continue to be employed in a given future year is standard practice in the United States today. However, if there is ever a push to set up DB plans that offer portability of benefits, such decrementing would need to be abandoned. It is inconsistent with providing a fund that could be transported to a new plan to secure already-earned benefits. This would substantially increase pension costs to employers, and simultaneously increase total retirement benefits to employees; employers would lose the retention benefit of the plan. This is unlikely to be encouraged voluntarily by plan sponsors, although one can readily see the benefits to employees.

The writers just cited are mostly economists; but the principle does not lack for support from leading actuaries as well: Two prominent former colleagues have advocated a mark-to-market "economic" measure of an accrued liability (the accumulated benefit obligation, or *ABO*), for financial risk management purposes (Davis and Sloan 1993). Another well-known actuary/investment policy specialist, Howard Winklevoss, used the term "economic liability" as the "true" liability in his text (1993, at page 68), referring also to an accrued liability (but didn't use a market discount rate (see p. 228)). Additionally, over the last decade or so, both Jeremy Gold and Lawrence Bader have written and spoken much on parallel topics, often as co-authors, and have argued for adoption of economic valuation principles within the actuarial community. They have shown courage in ongoing efforts to persuade their brethren, who haven't always been eager to hear the case that they make.[22] There have been other consistent efforts to consider incorporation of economic insights into actuarial practice in recent years by the principal actuarial professional organizations in the United States, and by parallel organizations in other countries (as one example, the Joint American Academy of Actuaries and Society of Actuaries Task Force on Financial Economics and the Actuarial Model recently published "The Pension Actuary's Guide to Financial Economics" (2006)).

Because the liability is just a stream of future cash flows—for all practical purposes a bond—like a bond, its value is economic in all of its essentials.[23] This implies that when estimating cash flows ("coupons"), estimates of all input variables must be *best estimates* of mean or statistically expected outcomes, rather than estimates that are biased to be "conservative," that fail to incorporate recently awarded benefits, or that are otherwise distorted in ways that are sometimes utilized in conventional actuarial and accounting practice.[24] I say this

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[22] A good selection of these excellent pieces are collected at http://users.erols.com/jeremygold/papers.html. In particular, the reader's attention is called to Bader and Gold (2003), an article that has been pivotal for many within the actuarial community. The Society of Actuaries has also collected a substantial literature on the topic, see http://www.soa.org/professional-interests/pension/researchthinking-ahead/pen-finance-resources.aspx.

[23] And yes, I am aware that the pension liability is more complex than the simple bond that we usually mentally model. Jeremy Gold points out, with attribution to Lawrence Bader, that most actual bonds are far from plain vanilla also, with early call and many other complex provisions.

[24] In pure economic accounting one wouldn't exclude the unvested benefits, for example, but would weight benefits by the *probability* of vesting, with a decrement. We wouldn't over- or under-forecast wage increases so as to be "conservative." We wouldn't "amortize" newly granted benefits. There are other omissions in conventional practice that wouldn't be duplicated. The point is that all promised benefits would be considered, using best estimates of returns, growth rates, and other parameters, and appropriately adjusted with best estimate decrement tables reflecting the probability of occurrence (uncertainties about market rates of return are treated a bit differently, by applying discount rates that are appropriate to the type of risk).

in passing, but the idea is central to much that is wrong with current practices. The only estimates useful for the future value of a pension variable are unbiased best estimates and the only useful present value is one discounted at market-appropriate discount rates and thus interpretable in genuine monetary terms.

A Newly Formed Pension Plan

On the date that a sponsor signs paperwork committing to a brand new pension plan, the organization has committed to paying benefits far out into the future (benefit payment cash flows), not just for current employees but also for future employees. The employer has changed the composition of expected future labor costs indefinitely into the future, and the pension component can readily be identified and parsed out. The present value of this broad set of future benefit payment cash flows, each weighted by the best estimate of the probability of payment, is what I call the "full economic liability," or *FEL*. (I'll often use the more formal notation, $ePVFBP$, with subscripts appropriate to the portion of the liability being referred to, as a reminder that these are *economic* present values of future benefit payments.)

Note that I use the term "liability" and "economic liability" interchangeably, and with generality of meaning allowed economists but denied perhaps to lawyers. This liability isn't necessarily debt enforceable in court, but the present value of expected future spending—it doesn't matter to the value of the company whether these planned payments are compelled by force of law or merely by business judgment; the simple fact is, that if we've made plans to make such payments they affect the value of the organization and can be reflected in a market value balance sheet. For a defined benefit pension, it is the present value of probabilistically weighted expected future benefit payments, which is likely to be higher than the mere *legal* obligation (where the latter is usually measured with the limiting assumption that the plan is being immediately terminated with no further new accruals).

This assertion, that it is the *FEL* measured across an "open group" (i.e., inclusive of future employees) that is ultimately the most important measure of the liability—rather than the less-inclusive accrual measures of the liability in the nature of conventional accounting's *ABO* and *PBO*—rubs against the grain for many seasoned actuaries and accountants. They are

accustomed to looking only at valuation of cash flows owed or accrued to *identified* past and present employees, those to whom there is already a legal obligation.

But I can show that the perspective it offers has benefits for plan management: For the most part, any discomfort lies with including unidentified future employees whom we can fairly estimate *may* be hired, although their employment is not certain. Fair enough. But new employees do "arrive" into the pension plan, year by year, and after arrival each will have a chance at a full working life of accruing normal costs. Next year's anticipated new hires, for example, are the closest new group in line to arrive, but they represent all future hires for this point: The present value of future benefit payments and of future normal costs associated with them is the same as that for this year's first year people, just reduced by one year's interest because, on average, their benefits will come one year later. Future employees are not materially different in their effect on our planning today merely because we do not know yet who they are.

The point is that we can't accurately portray the present value of future normal costs, if we fail to consider new employees coming on in future years. When evaluating benefit level changes, this is information that a sponsor really ought to have. Doing so is also correct from the perspective of valuing the company (a perspective different from the more common one of securing payment of current benefit promises, which I'll address later). For that purpose, one must understand the present values of *all* future revenues and of *all* future consumption of all factors of production, i.e., *all* expenses. Whether the revenue payors (customers) or the factor provider payees (suppliers of materials or in this case, labor) are identified yet *today* is of no importance—we value the company on the net present value of forecasts of all relevant cash flows.

Pension-related cash flows are just another labor cost, and from a corporate valuation perspective, labor costs are no different than any other costs: When evaluating the true total pension liability we can't limit our view to only those costs that will be paid to or through identified employees or to those that have already become legally binding obligations.

Let me offer some comfort to those put off by the added size of the incremental *FEL*, by noting that a good portion, and in some cases all, of it may be *offset* by the sponsor's option to terminate benefits (Appendix 1; also, later in this chapter). But the value of that termination

option is greater or lesser depending on many factors, including the competitive labor environment, the health of the industry, and the sponsor's credit quality.

So the *FEL* does have utility for management and ties out to the firm's market value. Wise management teams would benefit from regularly studying this value, and it may often be in their interest to disclose it, as for example, during bargaining.

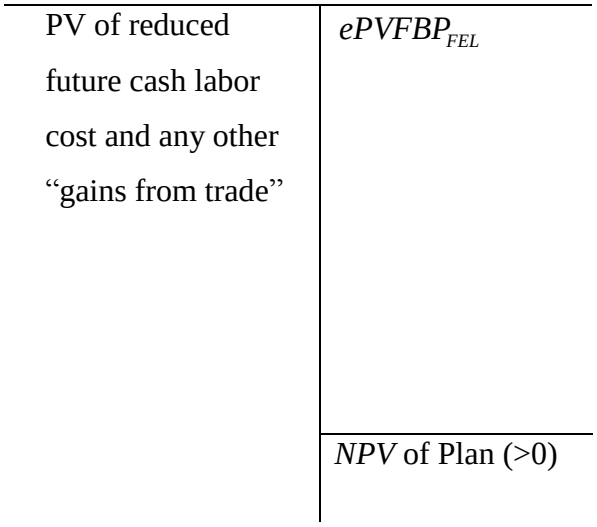
At the same time, it is not a value that must necessarily be stated on-book, although doing so would be a good thing, and perhaps will happen down the road (*way* down the road, no doubt!). In fact, today any attempt to put onto the books liabilities owed to future, unidentified employees would raise questions relative to a number of accounting principles, and wouldn't even be consistent with how other real but intangible values are and are not booked in other parts of the balance sheet today.

But the presence of those liabilities is consistent with corporate finance valuation practices, whether or not on the books. In fact, there are many cash flows out in the far distant future for every corporation, all difficult to estimate, all subject to change, and yet all are considered every time the organization gets valued—every time its stock trades or a merger or acquisition is proposed—and this happens despite the fact that many or all of these values aren't on the books. For now, that same fate is acceptable for the incremental *FEL*, but like those other off-book values it should still be known to, and used by, management.

Regardless, the liability entry appearing on the *economic* balance sheet at the moment a plan is signed (or benefits are increased) is the present value of these future benefit payments, the $ePVFBP_{FEL}$. It offsets an entry on the asset side, also created by the initiation of the plan (the present value of reduced cash compensation and perhaps increased labor productivity, etc.).

Figure 3

Incremental economic T-account entries (on the sponsor's balance sheet) at the moment of starting a new pension plan.



It should be safe to assume that there is some positive *NPV* generated by the institution of this plan, as otherwise it shouldn't be put in place; I've indicated this with the notation that the net of this transaction is greater than zero, a "gain from trade."[25]

Because many or most plans today are usually required to be funded through a separate trust (in the United States), I can usefully subdivide this into two accounts—the entries on the main balance sheet, plus a separate pension plan trust balance sheet. The balancing entry from this subsidiary account, in this case a trust NPV of zero, shows up on the liability side of the main balance sheet by custom:

[25] This may reflect an improvement in the employer's ability to attract, retain and motivate employees, or one derived from delivering what employees perceive as a compensation package having a higher value than its cost to the employer, or from the ability of a DB pension plan to use the insurance principle to reduce retirement costs (not really available to individuals except through insurance company annuities, which involve substantial credit risk today), or from the ability through a DB plan to establish tax effective savings greater than possible through DC plans or IRAs. From all sources, there should be a consumer surplus or gain from trade (equivalently an entrepreneurial gain) if as a result of starting the plan both labor and management believe that they are better off.

Figure 4

Incremental economic T-account entries at the moment of starting a new pension plan; with the liability in a trust separate from the sponsor.

=0

PV of reduced cash labor costs and any other gains from trade	$ePVFC_{FEL}$	$ePVFC_{FEL}$	$ePVFBP_{FEL}$
	Pension plan trust (NPV=0)		NPV (=0)
	NPV (>0)		

Note that the plan trust is fully funded, in a manner of speaking, immediately upon adoption: The economic present value of future contributions ($ePVFC_{FEL}$) shows up on both the main and pension plan balance sheets, indicating the "debt" that funds the liability. This sponsor debt is the sole funding asset, with whatever credit risk it might have—until and unless contributions are actually made to the trust, it is an *unsecured* obligation. And this same value is now owed by the sponsor and shows as a debit on one balance sheet with a matching credit on the other.

The observation that this debt is unsecured is important to discussions of credit risk, default and termination options, and—equivalently—of discount rates. We'll come back to it.

There are Multiple Correct Measures of the *Accrued* Portion of the Liability, but Just One "Parent" Measure, the FEL

While many practitioners and theorists recognize that the liability itself is economic, very little work has been done on the different ways to measure the liability, on how these different measures relate to each other, or on developing economic versions of pension expense and contributions. To realize its objectives, this paper must fill these gaps. We need the complete system in order to understand pension risk control and cost control.

Today, discussion of the economic liability usually starts by trying to identify the *one* economic measure. Commentators typically advocate for the *ABO* (or more rarely, the *PBO*), and sometimes the termination liability, as their candidate for *The* economic liability. All of these are accrued liabilities, and so by definition leave something off the table, still unaccrued.

I'm going to take a somewhat different approach. I am arguing that there is just one true measure of the *total* liability, the *FEL*, but that there are also an infinite number of possible measures of an *accrued* subsidiary portion of that liability, the portion usually shown on the books. Each measure of the accrued liability is supported by its own paired normal cost method, a topic that we'll explore deeply below. In this way we encompass not only all accrued obligations, but also all obligations known or fairly anticipated, but not yet accrued.

Proposition 4

> *There is only one full and proper measure of the present value of the liability; that measure is the full economic liability.*

Truly understanding any subsidiary *accrued* liability necessarily starts with the largest: the full economic measure. The full economic measure flows into the accrued liability differently depending on which of many possible accrual methods is used to charge it off to costs (normal costs). I will demonstrate this in Chapter 4, in the process discussing much about what the economic liability is and how it works.

We'll also learn in Chapter 4 that contributions and pension expense and normal costs are really the same thing, at heart. We'll learn there that we can completely coordinate our

expensing, contribution, and benefit security measures by sticking with one and only one normal cost method and thus one associated subsidiary accrued liability definition, used consistently for all of these purposes—one determined on an economically sound basis. And we'll learn that you can't reduce pension costs or contributions in a time value of money sense by making them smaller through one "method" or the other; the only way is by reducing the benefit promise.

Building a Pension Budget Identity

Here is a useful first draft pension budget identity: As of the first day of sponsoring the plan (at time zero), it must be true that the present value of all expected future benefit payments (benefit payment cash out-flows) is equal to the present value of all future contributions that will be made to fund those cash flows.

$$ePVFBP_{FEL\ t=0} \equiv ePVFC_{FEL\ t=0} \qquad (1)$$

The present value of benefits awarded must equal the present value of contributions needed to support those benefits. They are in effect two sides of the same coin. I'll keep adding to this first draft pension budget identity, considering contributions (funding), normal costs, etc., until I make it fully general.

Credit Risk and the Discount Rate

So far I've assumed that there is no credit risk, that the sponsor will be willing and able to assure the payment of benefits. Let's relax that assumption and discuss the effect of the sponsor's credit risk on the discount rate. After all, so far the only funding asset that we've provided in our examples is the sponsor's promise to pay; obviously there is risk in that promise.

As we will see, it is unnecessary for a sponsor to fully fund the entire *FEL*, and in practice it is useful to have a purposefully chosen but smaller on-book liability, an "accrued benefit security liability," which I've mentioned in prior subsections and which I'll develop in full detail in the next chapter, to use as a metric for funding purposes.

The portion of the liability (of the *FEL*) that isn't yet accrued is readily subject to employer termination: It is easy for a sponsor to decide to stop the accrual of benefits for new

hires (a "soft freeze"), and in many cases the sponsor can terminate the plan's accrual of new benefits even for existing employees (a "hard freeze"). Even the values already accrued into the on-book liability can be defaulted upon in bankruptcy if not fully funded. While the precise value to employers of this ability to terminate future accruals cannot be calculated easily, it is substantial and for many plans offsets much of the value of the not-yet-accrued portion of the *FEL*.

Economically, there is little difference between a default on an accrued benefit and a termination of the expectation of future accruals. In either case, the sponsor can be said to be exercising a default put option, "putting" the benefits back to the beneficiaries.[26]

Initially, before funding the accrued benefit security subsidiary measure of the liability with hard assets placed into the trust, the accrued liability's benefit payments have the credit risk of the sponsor, *i.e.*, the discount rate has a credit premium component and the liability will be worth just that much less because of the higher total discount rate, including the termination option. With increased funding of the trust, credit risks decline and so does the credit risk premium; and with *full* funding, there will be no further credit risk component. The benefit is secure and safe when fully funded and only the risk-free rate components of the discount rate remain, giving the liability a higher value appropriate to that level of security. Referring back to the discussion in the discount rate chapter, we can state this as a proposition:

Proposition 5

> *The market-related discount rate for any cash flow streams that are expected to be riskless is the risk-free rate. This is the correct discount rate to use for determining the benefit security or funding target measure of the accrued liability, which in turn is used for determining the normal cost component of required contributions.*

We can easily determine the *market value* of the accrued benefit security measure of the liability and with it the market value of this credit risk by adding the sponsor's credit risk premium to the risk-free discount rate. We use this higher rate to recalculate the present value of only the unfunded portion of the accrued liability. The reduced value of that portion, subtracted

[26] See Appendix I, a brief description of implicit options in pension plans.

from the risk-free measure of that same portion, is the value lost as a result of the combination of the underfunding and the sponsor's credit risk. This amount can be substantial where the underfunding is significant and the sponsor's credit is weak.

Proposition 6

> *The market-related discount rate for any cash flow streams that are* not *expected to be riskless includes risk premiums over and above the risk-free rate, as is appropriate to represent the market-related risks in those cash flows. This is the approach to use for determining the market value of any portion of the pension liability (other than the funding target measure of the accrued liability, for which one uses a risk-free rate). It is useful to separate such a market value into two components, one being a market value without credit risk, and the other being the reduction in market value related to the presence of credit risk.*

The participants' benefit promise is worth less than face value to them by this amount, representing the value of the default option.[27] This is a useful bit of information—one can imagine that union representatives at United Airlines, in perfect hindsight, might wish they had asked for such a figure during their salary and benefit negotiations in the years before its bankruptcy.

I like to refer to this difference, the value of the termination or default option, as the "expected value of liability default" in order to highlight the fact that participants lose value when the accrued benefit security liability isn't fully funded.[28] It is the price paid today for enduring the probability of a default at some future time. We'll refer to it at two levels, with

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[27] Which portions of the liability of an underfunded plan should be discounted at the lower rate and which at the higher, that for recent hires or for long time hires? This is really a "priority of creditors" legal question amongst pension claimants. One logical approach would be to give those benefits first accrued the higher priority and security and thus the lower discount rate, but other arguable approaches can be readily imagined.

[28] Public plans have no PBGC backup, but it is often said that they are able to pay any level of benefits despite low funding levels, owing to the sponsors' powers of taxation. Perhaps this is true in many cases, although the assertion seems arrogant and irresponsible on its face. Regardless, there are limits to the size of the liability that taxpayers might be willing to secure: consider the successful taxation rebellion of Howard Jarvis in California and its well-made point that taxpayers won't willingly pay just any bill. The recent bankruptcy of the city of Vallejo, Calif., puts a point on this discussion. So it may be that the specific characteristics of the termination or default option are different for public plans than for corporate plans, but there is a default option nonetheless.
For ordinary levels of economic underfunding, the credit risk premium can be estimated by looking at the traded credit yield spread or, if the debt is recent, the credit risk premium on debt issued by the public body being evaluated. Remember, however, that for funding purposes for either public or corporate plans, we want to measure the benefit security accrued liability at a risk-free rate, not at a market rate that includes the negative value of the default option.

respect only to *eAL*, the economic accrued benefit security liability, $EVLD_{eAL}$, and also with respect to the *FEL*, the $EVLD_{FEL}$. For current employees, the version of most interest is the $EVLD_{eAL}$, but the full $EVLD_{FEL}$ is necessary in order to balance the economic balance sheet.

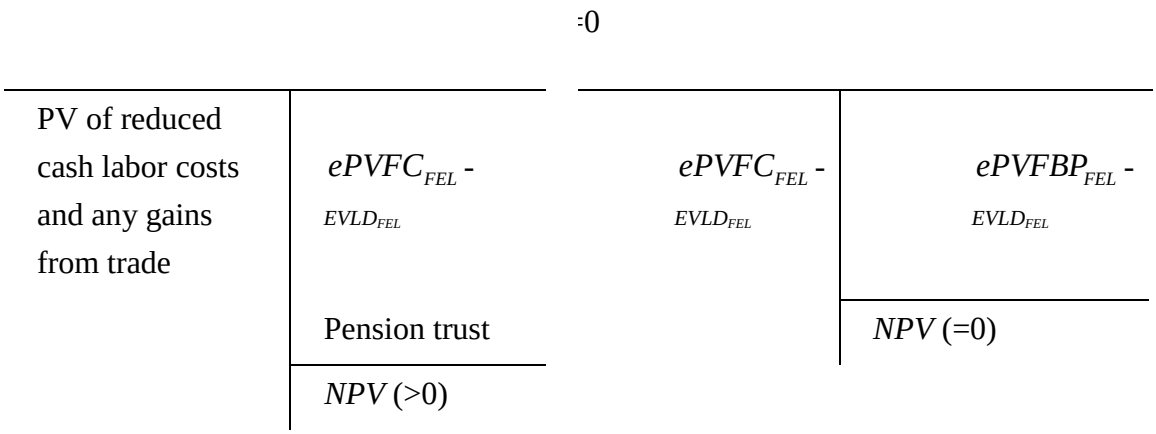
The bottom line is that net market value of the pension liability, whether the *FEL* or just the accrued portion, *eAL*, will be less than the calculated value by the amount of the appropriate *EVLD*, reflecting the presence of credit risk.

Protection is available: any portion of the liability that *is* fully funded is not subject to diminution by virtue of credit risk and usually is not subject to the exercise of the termination option.

Our example fund is still funded only with the employer's promise to pay. The $EVLD_{FEL}$ can be shown as a contra-item reducing the value of the original benefit promise (the $ePVFBP_{FEL}$ and the two debit and credit entries representing the sponsors promise to make contributions, the $ePVFC_{FEL}$).

Figure 5

Incremental economic T-account entries at the moment of starting a new pension plan; revealing the *EVLD* reducing the value of the $ePVFBP_{FEL}$ (*EVLD* in small font with negative sign, to indicate a contra-item); the *ePVFC* entries then also must include the *EVLD*:



We now have a realistic picture of the pension plan and its sponsor, before the on-book accrued liability begins to be accrued, and before funding begins.

Chapter 4: Using Accrual Accounting to Spread the *FEL* Over Time—"Normal Costs" and the Accrued Liability

So far we've developed the full economic liability and so know something about the target that must ultimately be funded. Let's work from this strong starting point and develop economic versions of the smaller measures of the liability that are already familiar, measures that are in fact subsidiary to, but which flow out of and over time become consistent with, the *FEL*.

Before digging into accrual accounting and the accrued liability, let's think of normal cost not in the usual way we think of it—in the context of accruing liabilities—but in the context of the full economic liability, the *FEL* that shows up on the economic balance sheet when a new plan starts up.

Full Economic Normal Cost

For pure economic accounting purposes, at the moment the plan is adopted (or at any time benefits are changed) a new commitment to pay benefits in the future is made. This commitment has value and should be viewed as a new liability on the firm's economic balance sheet (there is a corresponding asset entry; see Figure 3). To reflect conventional terminology, I'll call this the "economic normal cost" for the full economic liability, or eNC_{FEL}, reflecting the full value of the newly created[29] (or changed) aggregate $ePVFBP_{FEL}$. This is the change in value on the market value balance sheet associated with that benefit grant decision in favor of the employee population; this cost item is a completely new entry, entered immediately.

Over time, as there are *changes* in the benefit promise affecting the *FEL*, from whatever source, those changes would be the only economic cost items in those years, and again their impact is reported immediately. There will be no further normal costs related to the original decision. This reflects the focus of economic accounting—to keep track of the firm's market

[29] The terms "service cost" and "normal cost" are generally synonyms, and refer to the period accrual meant to represent this period's cost of the pension benefit itself (as opposed to financing costs, investment returns, supplemental costs, etc., the panoply of costs taken together being called "pension expense"). For notation, I've consistently referred to this cost as *eNC, o*r in its conventional (not economic) form simply *NC*, so as to save the notation *SC* for supplemental costs: The cost of newly awarded benefits related to *prior* service, as opposed to those related to *current* service, as well as changes in the liability related to improved estimates, are categorized in conventional practice as supplemental costs rather than as normal costs.

value—and once the decision to pay a set of future cash flows is made, the impact on the firm of that commitment is also recorded. Some later decision or later revision of estimates may change it again, but if so that change will generate its own new income, expense, and balance sheet effects.

This calls to mind a related contrast in practices, one that adds to our intuition about economic accounting: In conventional accounting, at the end of each period the income and expense accounts are entered onto the balance sheet, the books are closed, and a new "net worth" is reported without reference to any actual changes in the market worth of the company; this net worth is a "book" value only, not a market value. This is the accountant's progression, in any event.

On the other hand, the *economist* will start by evaluating the market value balance sheet, determining a market value for the assets, the liabilities, and the net worth first, and then deriving the income statement through a comparison with the prior year's balance sheet (what were the changes in value?). It seems a backwards process—until one appreciates that it is tied to real market values, not just "book" values. In economic accounting, the balance sheet isn't a residual of other entries, but the market value checksum against which all expense and revenue items must tie out. So when we note that there is a new balance sheet entry for the $ePVFBP_{FEL}$, we know that there must also be an entry on the economic P&L for eNC_{FEL}.

Enter the Matching Principle and Accrual Accounting

The reader may at first consider rejecting the economic accounting notion that the entire economic liability is immediately chargeable as an expense, because he or she knows that this is inconsistent with *conventional* accounting and actuarial practice. And that is true, it is inconsistent with conventional practice, but in conventional practice only a portion of the liability is accrued onto the books each period, intentionally. Where is the remainder? The remainder doesn't disappear. That is the reason for making this point: In economic accounting we want to acknowledge and track the existence of the entire *FEL*, both the accrued and unaccrued portions, and if it has sprung into existence with the initiation of a new plan, then in an economic sense it must also be expensed.

There is also a role for more conventional types of accrual, and during the course of this chapter we discuss other types of normal costs and their associated subsidiary accrued liabilities. The more interesting question is: Where do these periodic normal costs and their associated accrued liabilities come from, and how are they connected to the *FEL*?

The answers are suggested by the practice of accrual accounting. In conventional accounting we have this pesky "matching principle," having as its motivation a desire to improve the quality of the income statement's periodic profit and loss values by spreading large expenses that happen at a single point in time over the periods in which the items are used (with similar handling for lumpy revenues). In this instance, the matching principle strongly encourages allocating or spreading the full cost of the pension plan, the *FEL*,[30] which would otherwise be costed out immediately (as discussed for *eNC*) over many periods, charging it out slowly over time as the employees who will benefit from the plan deliver their individual labors.

As these costs are charged each period, they are recorded and accumulated in an "accrued liability" account. This liability continues each period to accrue and grow with new costs. (Symmetrically, as benefits are paid, the accrued liability reduces.)

It is only because of the matching principle that we use accrual accounting to get the measures of the liability with which most of us are more familiar, rather than more complete measures. Buying into the logic of the accrual process, we interpret the accrued liability as a measure which has—in some vague sense—been "earned." But, it is by no means the entire liability—even the conventional approach recognizes a "present value of benefits" that represents the sum of the accrued and unaccrued benefits for past and present employees.

It is these periodically accrued costs that are referred to in the jargon of actuarial science and pension accounting as "normal costs." Normal cost is the charge in this period of a part of the total known cost in order to comply with the matching principle's requirement that the total be spread over the years benefiting from the labor with which it is associated. The accrued liability which it generates is its associated running total, plus periodic interest. Normal cost is

[30] The matching principle is a very subtle form of "smoothing," spreading economic effects into years when they don't actually happen. "We should recognize in any case that accrual accounting is a fiction whose whole purpose is to smooth the data," Bernstein (2004).

not solely a P&L item, as cash contributions are also a direct function of normal cost; they show up on the statement of cash flows rather than in the P&L. As a cash item, normal cost has a benefit security function, as well as P&L and balance sheet functions.

Economic accounting, focused as it is on the economic balance sheet and the worth of the enterprise, doesn't normally worry about trying to improve the usefulness of the income statement by spreading balance sheet entries over time in a matching principle sense. But, in a later section we will find an economic justification for keeping track of a subsidiary accrued liability, a justification related to the credit risk of the plan sponsor and the security of benefits for the employees. For that purpose, we'll need to identify this subsidiary liability's associated normal cost and periodic charges, just as if we were motivated instead by the matching principle.

Normal Costs and the Retirees, Active Employees and Future Employees

It is helpful to break the population into three groups before discussing normal costs in greater detail, as these groups have very different accrual needs:

- **Group I: Retirees and Inactives:** The narrowest subset of future benefit payment cash flow forecasts is for future benefit payments to former employees already retired and to other inactive employees with vested benefits that have left service of the employer but will not begin receiving benefits until a future date ("terminated vesteds") or beneficiaries of deceased or retired employees. In this essay I simplify in order to avoid needless complication that is otherwise obvious to the trained reader and that can be readily remedied, and refer to all as "retirees," and call the aggregate present value of this portion of the liability the economic "retiree benefit obligation," informally the *eRBO*; more formally the $ePVFBP_{RBO}$.

  Retirees' benefits will have already been charged as normal costs and accrued to the liability during active employment in past years (as their portion of the accrued liability slowly works its way back off-book as benefit payments are paid out, discharging the obligation). There are no normal cost issues to discuss with respect to retirees.

- **Group II: Current Employees, or "Actives":** Next in order (and all of these conventional measures are additive, incrementally, until we get back to the full economic liability) is the present value of benefit payments forecast to be made for *current* employees. It is with respect to these current employees that we find the most important inputs to normal cost and the accrued liability. I'll come back to this in a full section to follow, but first let's look at the final group:

- **Group III: Future Employees? The *FEL*:** If we also cumulatively consider the benefit payments to be paid in the more distant future for future employees when they ultimately are hired, enjoy a full working life, and then retire, we now are working with the full economic liability, the aggregate $ePVFBP_{FEL}$.

  However, no rationale argues for assigning normal costs to the current period, for benefits on behalf of employees who are not yet identified or on the payroll. Nor is there any motivation to make contributions funding such obligations, for benefit security or for any other purpose. So we won't consider any allocations of current normal cost related to this category.

The interesting questions all relate to current employees, including newly hired employees just moving over the event horizon from the "future employee" category.

Normal Costs: Allocating Pension Costs to Current Employees

Returning now to consider cost allocations for current employees, we focus on how normal costs accrue, one individual at a time, i.e., "individual" methods. (There are also "aggregate methods" that calculate normal cost for the entire employee population in one swoop, but there is no need to reprise them here. When we need the aggregate of all normal costs, we'll just sum the individual costs.)

Let's first review how an individual employee *i*'s personal full economic liability, $ePVFBP_i$, is calculated: First, we predict the employee's date of retirement and estimate his or her benefits under the plan. Then we compute the present value of a life annuity in the amount of

those benefits beginning at that time (including decrements for the probability that the retired employee will be alive to collect the benefit each year).

Second, we recall that this "present" value is not *today's* present value, but the present value on the date of future retirement. So we look at it from today and think of it as a future value, and then discount it to find today's present value, a straightforward calculation (in actual practice, it is decremented both for the probability that the employee lives sufficiently long to remain eligible for retirement and that the employee continues to be employed by, and accruing benefits from, the plan sponsor).

While the proper calculation—with the probability decrements incorporated—usually requires some specialized software or at least some specialized probability tables, the simplest version of analogous problems, but without decrements, can be done on a pocket calculator having PV, PMT, and FV financial functions. More complex versions can be evaluated using a fairly simple spreadsheet. Conceptually, normal cost and accrued liability concepts are just that easy. They are simply time value of money calculations—annuities, future values, payments and present values. In my examples and discussion, I gloss over and in most cases ignore entirely decrements for life and continued employment probabilities so that we can focus on finance issues: the time value of money issues, including risk and return issues.[31]

[31] I believe pension management problems come largely from misunderstandings of the "pure finance" of pension plans, discounting and present value issues related to the time value of money, rather than from problems with demographic issues such as decrementing for life, continued employment, and other probabilities affecting the amount and likelihood that the sponsor will actually have to pay out benefits. By avoiding the modest additional complexity of incorporating these decrements, we are able to use completely standard NPV, payment, and FV financial concepts when discussing the valuations and when doing many of the computations for some of our later examples. Hopefully, this will allow us to more readily see the intuition that pension finance is no more difficult at heart than paying a mortgage or setting aside money to grow for a future goal: finance tasks that are widely understood.

My decision to avoid decrements here doesn't change the intuition conveyed by the results. Decrements are applied period by period for each individual, and they are independent of choice of normal cost method or of discount rate and other pure finance concerns. Therefore the combination of any decrements appropriate in a particular period constitute a mathematical constant, a fractional multiple which changes present values and thus normal costs by an equal proportion across all examples at every point in time. This leaves the relative advantages and disadvantages in our comparisons of normal cost methods the same, whether or not we include decrements.

Decrements, however, are important and real, and can't be left out of the actuarial work itself. They would, if used, substantially reduce the present values and the normal costs shown in our later examples. In fact, the probability that many employees will leave before earning benefits or will die prior to their life expectancy makes DB plans much more affordable for sponsors than a plan that didn't count on this fact (as for a plan with full portability).

To carry the analogy forward, normal cost is the same as a periodic payment (the PMT function on a calculator) required to be made if we were going to *pay off* this obligation as we would a mortgage. We would enter on the financial calculator a discount rate,[32] the number of periods that the employee will work, and value today of the employee's $ePVFBP_i$ as the PV (with zero for the FV). Then we would hit the PMT button to see what payment—normal cost—is required to pay off this "debt" by the end of that period of time. Hand-held calculators will calculate a level payment, consistent with the payment terms that most of us are accustomed to from financing cars, homes, and other substantial consumer and commercial goods. Here is an example: If the amount required to provide the employee's annuity, at time of retirement, is $300,000 (FV), its present value today, 30 years earlier at 4 percent, is $92,496 (PV). We can pay off this $92,496 PV "loan" over 30 years at 4 percent interest with annual payments at the end of each year of $5,349; "normal cost."

Instead of thinking about this as paying off a loan, we can think of it as building up a savings account to provide for a known future obligation, accumulating regular deposits (payments) into it over time sufficient to build up to the FV amount that will be needed. For pensions, we want to make payments that will accumulate, with interest, to the present value of the benefits at the time of the employee's future retirement, a future value with respect to today. The payments, again, will be made over the period during which the employee is expected to work before retiring. On the financial calculator, we would input the future value of $300,000 as FV, zero for the present value, PV, and finally 30 periods and 4 percent interest. The "payment" that comes out of the calculator would be the same as in the "loan payoff" approach, $5,349 (again, normal cost). Either approach is equivalent to the other during the accumulation period; the latter approach will also decumulate the balance during the retirement or payout stage.

One can imagine a running principal "balance" being kept for each employee's account, in either way of thinking about it. In the first example, we build a declining principal balance as normal costs (payments) effectively pay off the "loan" by the date of retirement. In the second example, accumulating these payments with interest, an increasing principal balance builds to provide the funds needed to finance the employee's retirement annuity at the end of his or her

[32] In actual applications, best practice uses the full spot curve rather than a single discount rate, but this description serves to illustrate the point.

working life, then declines slowly to zero as benefit payments are made during the retirement period.

This latter accumulating balance is what we mean when we refer to the "accrued liability," the portion of the employee's $ePVFBP_i$ that is now accrued and on-book. Because the accrued amount is just a lesser-included *portion* of the $ePVFBP_i$ for that employee, and must tie out to it by time of retirement, I refer to it as a "subsidiary" measure within the full $ePVFBP_i$.

Hopefully analogies to loan payments, savings accounts, and principal balances remove the mystery (to non actuaries) of the otherwise opaque terms "normal cost," "service cost," and "accrued liability."

One point that should be made here is that this partial liability, while perhaps a liability in a narrow legal sense (it is associated with some sense of being "owed" for benefit security purposes), has a different economic character than "The" liability, the *FEL*. It is just an accounting device to establish the "track" of setting aside money to pay off a future debt, a steadily increasing measuring point to use to see if we are doing OK towards our goal. We are driving from Los Angeles to New York City; New York City is the obligation, or liability, but by day six we should be in Memphis, if we are to be "on track." It is not our goal in the fullness of the word. The concern I have is that language is important; when we call it an "accrued liability" it does sort of invite an interpretation by those not fully familiar with the concept that it represents what is owed in total, but it is something considerably less inclusive than that.

Normal cost "payments" can be either *notional* or *monetary*. Normal cost is only notional (book entries without monetary movement) when used to form pension expense in the P&L, which is accumulated (accrued) into the on-book liability on the balance sheet. (This is the sense used in the prior paragraph.)

But normal cost is monetary when used to determine either the actual amount "owed" to employees at any point in time, as an accrued benefit, or when to determine the required contribution. Both happen simultaneously—an accrued liability is being built up, and contributions should be building up as well, and if the benefits represented by that accrued liability (however defined) are to be secure, those contributions with their investment earnings

should total to at least the amount of the accrued liability. Both the money in the fund and the accruing liability target should track pretty close together, and in an idealized world, identically.

So far I've only described level payments. Actuaries are, however, far more creative than handheld financial calculators. They can and sometimes do calculate normal cost on a level payment basis but more typically calculate payment size to vary over time in one of many possible patterns.

For most non-actuaries, the intuition gets lost at this point: payment patterns other than level payments are not often experienced when financing a car, a house, or any business transaction (it is fair to say that most normal cost methods have no analog in conventional financing whatsoever[33]). Further, because in today's practice a given plan might use *many* different normal costs or payment patterns—for liability reporting, contribution calculations, income statement reporting, tax, and other purposes (with some called service cost instead of normal cost, suggesting a substantive difference that really isn't there) it is understandable that non-actuaries become hopelessly lost. And because there can be different interest rates and return assumptions for each of these, in practice none being the correct rate, there is little chance that anyone can understand the true financial condition of any plan.

By staying with economic versions of all accounting variables involved, which automatically means that we use a market-determined discount rate, we take one big step towards sorting out the confusion. We complete the journey by demonstrating the rationale for choosing one and only one normal cost or payment pattern method for each plan, as I do later in this paper, and using it consistently for pension expense, for the liability calculation, and for contributions.

Digging Deeper: Other Normal Cost "Payment" Methods

Three commonly used normal cost allocation or payment methods are computed in sort of a "backwards" manner, not by computing a payment and then accruing it to a new liability value, but by computing the accrued liability present value at the beginning and end of the period

[33] There are analogs in insurance accounting, but again those have an actuarial origination and also have no analogs in conventional financing practice.

strictly from benefit formulas, and inferring that the change in that value was partly from interest and partly from a "payment," i.e., normal cost. These methods are said to be "benefit prorated." For the *ABO* accrued liability, for example, normal cost is computed by evaluating the non-interest portion of the increase in present value of the accrued liability this period, which will have gotten larger based on the usual benefit formula (say, 1.5 percent of final salary times years of service) because the employee now has one more year of service. For the *ABO*, it is assumed when making these comparisons that at retirement the employee still earns his current salary, so any salary increase that period will also contribute a bit to normal cost. This method has very low payments in early years for each employee, and very high payments in later years.

For the *PBO*, normal cost is determined in almost the same way, but using a forecast for the employee's final salary rather than today's. As a result it has somewhat higher payments than the *ABO* in early years of an employee's tenure (and lower, later).

The actuaries' *PVB*, or present value of benefits (sometimes called the *EBO*, or expected benefit obligation) is the next logical method, reflecting both forecast total years of service and forecast final salary; if done with a market-determined discount rate, this would be our example employee's full individual $ePVFBP_i$. The aggregate accrued liability across all current and retired employees is thus the same in spirit as our aggregate $ePVFBP_{RBO\ +\ active}$ (i.e., on an economic basis, it is the *FEL* but without future employees).

The normal cost method associated with the *PVB*, initial funding, is also the fastest method of accruing normal costs or making payments, inasmuch as it is equivalent to paying off the "debt" immediately on initial hire, by contributing an amount that would fund the retirement annuity on the long distant future retirement date (only literally true if PVB is determined using the correct market-related discount rate, $ePVFBP_i$, which is rarely the case). So the normal cost for this method is parallel to the full economic normal cost method, but again without future employees. When used for contributions, this normal cost method is referred to as "initial funding."

The level payment method mentioned earlier, the only one commonly seen in ordinary financing applications, is one of many "other" individual methods. Actuaries refer to it as a "cost prorate constant dollar" method.

Another payment plan deserves consideration as a candidate for a "one-size-fits-all" method. It calculates normal cost "payments" as *growing* payments, in this case growing at the same rate as salary, so it has the budgeting advantage that normal cost is always a constant proportion of salary. This method appeals to those who think, as many do, that one earns a pension benefit as a more or less constant proportional part of one's overall pay package. Moreover, when cost is expressed as an economically meaningful percentage of payroll, sponsors and employees both have good and easy-to-interpret information about whether the cost—and thus the level of benefits—is reasonable as a component of total compensation, so it is easy to think about benefit budgeting in this form. Actuaries call this a "cost prorate constant percent" method, and it is usually also what is meant by the more cryptic term "entry age normal." In practice this normal cost method is widely used, but it is seldom (never?) calculated on a market value basis, thereby failing to provide economically meaningful information. I advocate here for the economic version, not the conventional.[34]

There are many more normal cost methods, with many different "shapes" to the size of the payments over time. In principle there are an *infinite* number of them, and a great many are in use (the Winklevoss actuarial textbook formally defines 27 normal costs methods; 1993).

We see then that normal cost is just an accrual method of making "payments" to spread or amortize the reasonably well understood present value of each employee's future retirement annuity, $ePVFBP_i$, over the many future periods of his or her time of employment. And as we charge these notional normal costs to the P&L, we also accrue them to the on-book liability.

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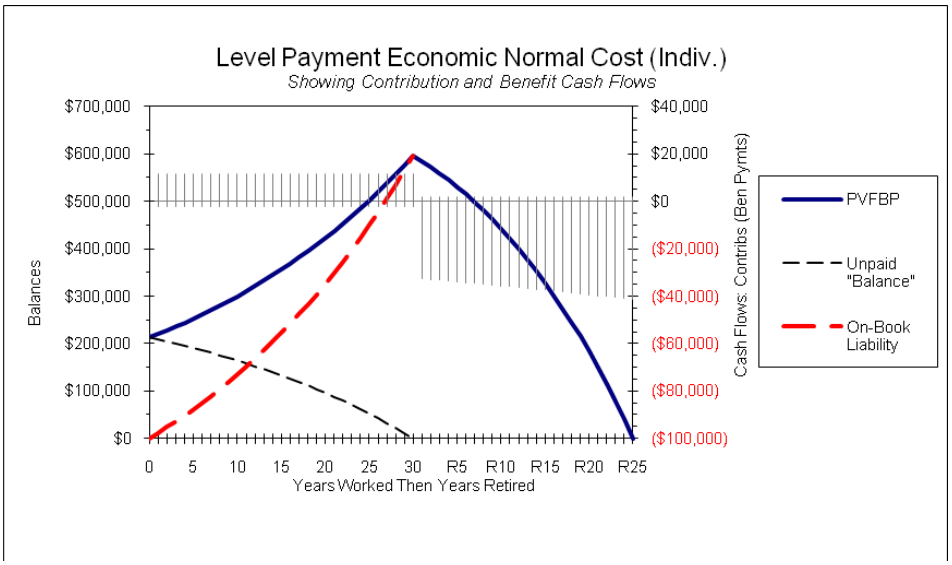
[34] Because we are not decrementing for death and continued employment probabilities and have the luxury of assuming constant discount and salary growth rates, we can calculate here normal cost as a constant proportion of salary in closed form, using a standard but seldom encountered annuity payment formula for a growing periodic payment amount. The normal cost or contribution (payment) made at the end of the first period of employment, assuming an unrealistically flat spot rate curve and a constant rate of salary growth, is $PVFBP_{i\,0}\ \ d-g\ \ 1+d\ ^{T}\ /\ \ 1+d\ ^{T}-\ 1+g\ ^{T}$, d being the appropriate discount rate or cost of capital (I understand that actuaries use d to represent a quite different variable, the value today of interest paid one year out), g the salary growth rate, T the time from hiring until retirement, and the parenthetical subscript 0 indicating the time of initial employment. Each succeeding period's normal cost grows by g. Note that it is a direct function of each employee's $ePVFBP_i$, reinforcing my point that it is the economic liability that controls all subsidiary pension accounting measures.

This economic accrued liability would then be the correct size, taken one employee at a time, to tie out to that employee's individual future $ePVFBP_i$ at time of retirement, the value then of his or her retirement annuity. And if a contribution in the amount of this same normal cost is made every period, it builds an asset reserve that would, if invested in a liability-matching form, exactly secure this accrual. At heart, these are just time value of money problems, so long as we do our valuations on a basis comparable to that used when financing anything else, i.e., with market-determined rates.

Relating Normal Costs to Accrued and Total Liabilities, Over Time

It is useful to visualize how these normal cost and present value relationships relate to each other. Figure 6 shows the path of the $ePVFBP_i$, the individual economic or total liability for a newly hired employee, age 35, who is expected to retiree at 65 and then live *exactly* 25 more years (thus conveniently honoring our desire not to use life probability decrements). Today he makes $40,000 per year. His salary will grow solely at the rate of inflation, 2.0 percent (no merit or advancement), and the weighted average real interest rate across the spot curve is 1.5 percent. His single-life benefit is fully vested, and will be 1.5 percent per year of service, plus a COLA expected to cover one-half of actual inflation.

Figure 6



Take a moment to examine this graph, as it contains a very full picture of what really happens in a pension plan, viewed one employee at a time. Look first at the right hand side of the graph, showing slowly growing benefit payment cash outflows (thin lines pointing straight down, with their scale on the right axis), and a heavy upper line showing the declining present value of future benefit payments during this individual's retirement period, ultimately going to zero as he receives his last payment (scaled on the left axis). The high point of the heavy upper line is the value of the life annuity for this retiree as of the date of retirement, the sum needed at that point in time in order to provide security for those retirement benefits. This is the amount of money that needs to be accumulated during the employee's working life; it is the target that normal costs are designed to accrue as both an on-book liability and a matching monetary reserve.

We can discount this future value back in time to today's date (computing the present value of a future value) by using a proper discount rate (it should go without saying, and would in any other than a pension context). It amounts to a substantial value immediately upon hiring—it doesn't start at nothing and grow from there. This is the beginning *FEL* with respect to this individual, his or her $ePVFBP_i$ as of today (and in fact we can say for any given individual, the $ePVFBP_i$ is also that individual's FEL_i). This is a very real and very serious number, and constitutes the true total economic liability associated with this individual employee (it is recognized by the actuarial community as this employee's "*PVB"* or *"PVFB,"* although they do not calculate it using market discount rates and so it is not an economically valuable number). The heavy upper line traces its value at each point in time from initial employment until death. This initial value is fully equivalent to a debt that must be paid off before retirement.

How can we "make payments" to provide for this obligation, thinking either of today's $ePVFBP_i$ as a debt or thinking of the higher "savings account" value that must be accumulated by time of retirement? We could immediately make a contribution in the amount of today's $ePVFBP_i$, as in the "initial funding" method, and just "pay off" the loan. Doing so would make this discussion very easy, but would be considered painful for most sponsors. If that were done, the amount would, if invested in the liability-matching asset, naturally grow to cover the higher value needed at that future time, and if done consistently across the employee base this approach

would provide an exceptional level of benefit security (assuming, always, a proper economic discount rate).

Or the employer could, as discussed earlier, make contributions and charge expense based on some normal cost accrual method, our "payment." Figure 6 shows a series of level payments as thin lines pointing *up* on the left side of the graph during the pre-retirement employment period, with the upward direction suggesting money being paid *in* to the trust (the benefit payments paid *out* are lines pointed downward). The thin, quick-dashed line illustrates how the initial liability can be seen to be paid down by these notional payments as if it were a loan balance, while the thicker, slow-dashed line represents the accumulation of regular payments with interest, as if for a savings account (the on-book accrued liability) then growing and eventually equaling in size the cost of the annuity at time of retirement, then shrinking identically with *PVFB* until the annuity expires on the carefully planned demise of our exemplary employee.

The benefits would be perfectly secured if notional normal costs used to accrue the liability were matched by monetary contributions, and if those were invested to match the liability, i.e., in some mixture of long bonds. (If invested more aggressively, the result might be either greater or lesser, depending on the luck of the markets, but I'll address investment policy and the means by which contributions adapt to high and low returns more thoroughly below.)

Figure 7

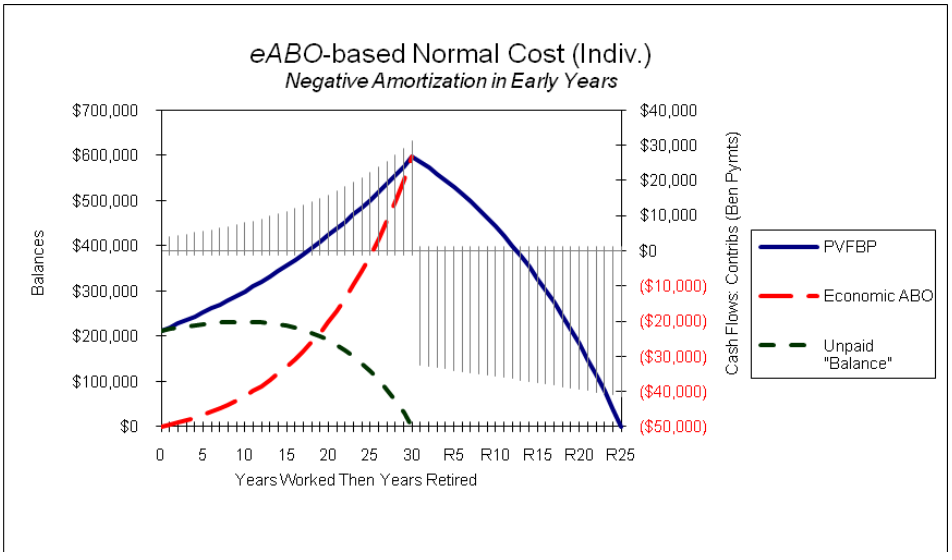


Figure 7 is the same as Figure 6 on the right hand side, representing the retirement period. But the left hand side shows an *eABO* accrued liability, and the normal costs are those associated with the *eABO,* rather than the level payments of the prior figure. The interesting feature of this method is that normal cost payments in the early years are small—so small that all of the interest is not even covered in the "loan payment" version, causing negative amortization as revealed by the slight upwards path of the unpaid balance. The "principal" of the debt doesn't begin to seriously decrease until halfway through the employee's working life. So, while the amounts contributed do slowly accumulate with the accumulation of interest over the early years (the "savings account" version) as they are being made, the weakness of this funding method is nonetheless clear.

Comparing Normal Cost Methods

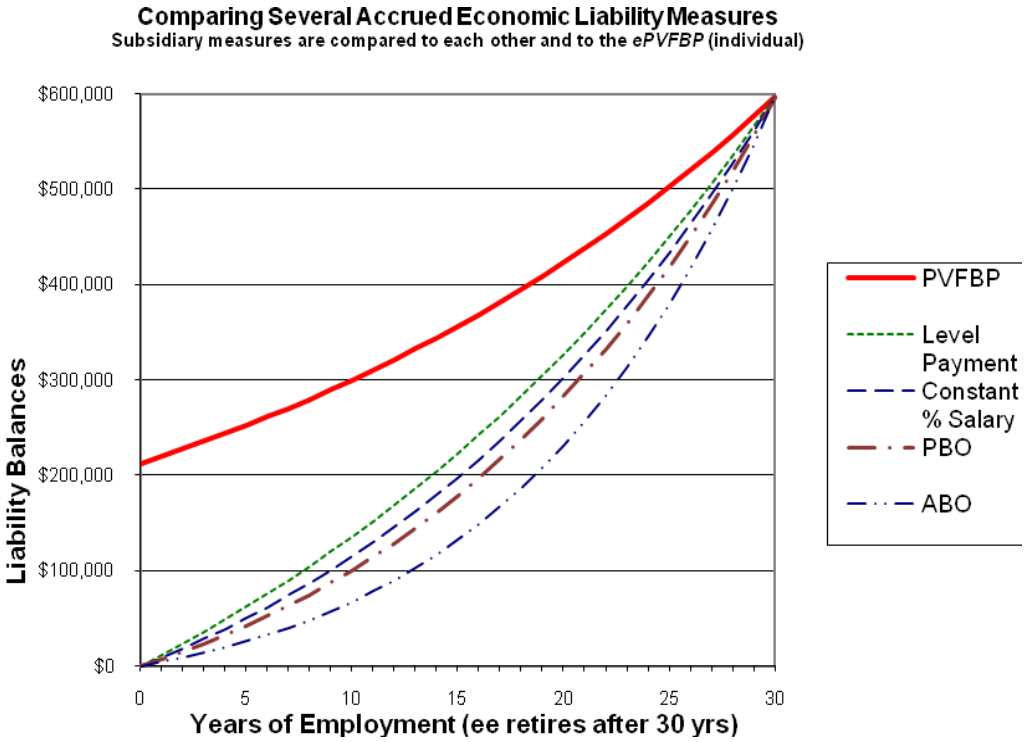
As said, there are an infinite number of normal cost paths by which to pay off this obligation over time, with some weighting their payments later and some earlier. The graphs provided illustrate three such paths: initial funding, level payment funding, and *eABO* funding, perhaps framing a fair range for discussion of practically useful methods. Clearly, among these three methods there must be some middle ground where "fair" benefit security is provided at a "fair" cost to the employer.[35]

Figure 8 tells a sobering story. Selection of normal cost method makes a big difference: This figure compares these three on-book accrued economic liability measures, plus two others, on one graph, giving us a representative handful from the many possible different common normal cost methods. Note that at about year 22, the highest accrued liability (excluding the $ePVFBP_i$) is about 33 percent greater than the lowest, and that at about year 12 the highest is larger by a factor of nearly two! At 15 years, their coverage of the $ePVFBP_i$ ranges from about one-third to two-thirds. Those ratios translate directly and linearly to the size of the retirement benefit that could be funded if the employer were to terminate the plan. Inasmuch as the average

[35] It will be clear from the discussion of investment policy that some cushion of additional assets over and above the benefit security liability might be a part of "fairness" whenever the assets are invested other than perfectly matched to the liability. The cushion would protect the benefits when market returns were below those of the liability-matching asset portfolio.

tenure of employees in the aggregate is likely to be in these middle ranges, differences in the level of benefit security provided by different normal costs methods are quite large.

Figure 8



Proposition 7

> *Contribution policy doesn't control costs, but it does affect benefit security; slower, later contributions leave open the possibility of a greater employee loss in the event of sponsor default.*

It makes an even bigger difference if one uses a non-market discount rate. Not only does the present value of the $PVFBP_i$ go down with the much higher rate, as a first order effect, but also the periodic "payment" on that new lower liability, normal cost, goes down by a much greater proportion as a second order effect: It presumes that the higher expected rate of return on

the assets will in fact be earned on the accumulations.[36] It is sort of a "double whammy" of apparent cost reduction, and only actually "getting" these higher expected returns, a very uncertain endeavor, would make this work out and prevent a very real economic shortfall.

Notice that any particular payment method, or normal cost, will accrue a subsidiary liability that is unique to it. So when we specify either a particular normal cost method (or a particular form of accrued liability), we are automatically specifying its associated liability (or normal cost method); they are always joined in associated pairs.

Normal Costs and Contributions: Funding Target Measures of the Liability

Noting that normal cost for P&L is only notional, but is calculated *as if* it were a payment designed to amortize the liability, one might assume that the actual payments on the plan, the funding contributions, would also be based on that identical normal cost figured with the same method. After all, if they were based on that cost, the on-book accrued liability would always be fully funded as already described herein.

However, in today's corporate practice, the normal cost method used for computing contributions (funding) is always different from the normal cost method used to determine the pension cost to be charged to the P&L (accounting). Even the discount rate and interest rate used in those two methods will be different in many cases. This is a result of different statutory and regulatory requirements for the two tasks. But shouldn't normal cost be the same for both funding and accounting in a sensible world? If this point is agreed, as I think it must be, which of the many possible normal cost methods should be used?

I mentioned earlier that there is no natural analog in economic accounting to the matching principle of conventional accounting, with its motivation of improving the representation of periodic income in the P&L. But, I also mentioned that there may be a different motivation for accruing an on-book liability using a normal cost method. That motivation would be to establish and maintain an economically sensible funding target measure of the liability, a liability measure that, if funded, provides a pre-determined and agreed level of xx.

[36] I understand that under certain aggregate normal cost methods in use by actuaries, the effect described does not appear to happen. This reveals a strong fault in the financial sensibility of such a method.

I have mentioned the notion of a benefit security or funding target measure of the accrued liability many times in earlier sections, but without fully explaining what I meant by the term. This is a good place to do so. In fact, a liability measure establishing a meaningful funding target and benefit security level, in monetary terms, is the only subsidiary measure of the *FEL* that I have identified that has an economically meaningful interpretation: It specifies a *dollar* value designed to accomplish a *dollar*-denominated funding objective. And if contributions are made in the same manner in which the accrued liability is formed, then that dollar denominated objective can be met. This is important, and bears discussion.

Remember what has been described above, that the normal cost that accrues to the on-book liability is just an allocated cost, spreading each employee's $PVFBP_i$ (which *is* an economically meaningful value) across time. In and of themselves, there is absolutely nothing "economic" about any cost allocation method across time, and this is certainly true for all of these methods. Level payment, constant percent of payroll (entry age normal), *ABO*, *PBO*, whatever, none of them are inherently economic, and they are all economically indistinguishable (see discussion around my Figure 8), just as double declining balance and straight line depreciation methods for tangible assets are neither economic in nature, nor economically distinguishable from one another, but are simply competing methods of spreading the cost (which *is* economic) of an asset over time.[37]

It is only when we choose to use an allocation measure to mean something monetary to someone that it becomes economic. If we agree that an employee is "owed" a legal obligation based on the *ABO* (more or less today's U.S. standard), then the *ABO* becomes an economically meaningful term.[38] And if we believe that all parts of labor compensation should be delivered as nearly risklessly as can be arranged, as is public policy in the United States, then the *ABO* also

[37] There will usually be taxation differences between depreciation methods, but this is very much a second order effect given that it is just a timing difference. If taxes are reduced early through double-declining balance depreciation, all that is saved is the after tax earnings on the early tax savings, not the tax savings themselves.

[38] One cannot lean too heavily on the *ABO* as a "standard." First of all, there are several versions of it, the "termination liability," etc., and more tellingly the *ABO* that might show on the balance sheet will in many or all cases be quite different than the one used for the funding target. Clearly current practice "doesn't get it," which leaves the door open to discuss what the socially agreeable measure of the legal liability to employees *should* be, and then to match it with an identical funding target. Then, and only then, do we get a rationale system that protects benefits.

becomes a funding target, another monetary use of the measure and another reason to treat it as an economically meaningful term.

But I mention the *ABO* at the risk of implying that it is *inherently* economic, which in reviewing this discussion it clearly is not. It is only economic in nature because it has been imbedded in law and practice as the basis for the debt claimable as owed to employees, and at best its tie to the funding target in current practice is worse than weak. Were we to make this decision based on what we know today, we might well choose a different measure than the *ABO*, as it has a normal cost ("payment") that is so small in early years that it doesn't even amortize the "debt" represented by the then-current *PVFBP* for current employees (not even when computed on an economic basis), making it a particularly unusual method of making periodic "payments" not seen in any other routine financing situation (See Figure 7, above, displaying the *eABO*. For the conventional *ABO*, the problems are far worse because of the overstated discount rate.)

So in the interest of full generality, I refer to the subsidiary liability that simultaneously represents the accrual of the legal obligation to the employees and of the funding target for the pension plan as the "benefit security liability."

I expect the actuarial community in particular to embrace this justification, as it harkens back to the original actuarial intent of working to insure that benefits will be paid. Further, it is a motivation that makes sense, a good step toward persuading accounting and sponsor interests to also align themselves with this worthy funding purpose in an effort to effectuate supportive legislation and regulation.

Proposition 8

> *The only economically meaningful measure of the liability, other than the full economic liability, is the measure of that portion of the liability that is expected to be funded by the sponsor in order to provide an agreed "adequate" level of benefit security and a legally enforceable liability to the employee. This is the accrued benefit security liability or funding target liability, and it is associated with a particular normal cost accrual method. It is subsidiary to (a lesser-included portion of) the FEL* (or, for an individual method, the $PVFBP_i$).

There is no one "right" benefit security or funding target measure, out of the many possible normal cost and associated accrued liabilities. Therefore the specific normal cost method to be used, with its associated accrued liability, must be agreed upon in some form. This might be either a "social agreement" imposed by governmental legislation or regulation (as the *ABO* is, loosely, today), or better, an actual agreement negotiated on a case-by-case basis between labor and management. In the past, the analog to this "agreement" has often been set by regulations, but given the many opportunities to subvert its full funding purpose that are found in traditional practices embraced by those regulations, the rules have not successfully protected the security of benefits.

As with any other accrual accounting method, there is some degree of subjectivity necessarily involved in this decision: just what portion of a full retirement benefit should be secured at which times, over the course of an employee's working life? What normal cost method will accomplish it? By acknowledging the benefit security purpose, policymakers and labor-management negotiators can use their judgment to decide which level of benefits should be secured and which should not. Once made, the decision is the basis for a normal costing method for funding and in turn, of an economically meaningful subsidiary liability.

Not all parts of this decision are difficult. No one would disagree that retirees' benefits, $ePVFBP_{RBO}$, should be fully funded rather than still remaining in the process of being accrued to full funding (and with real dollars rather than sasquatches, not the case today). With equal certainty, the portion of the *FEL* measuring the pension value associated with future employees not yet on the payroll should probably *never* be funded.

As to current employees, most sponsors and even most employees would agree that funding the full value of the aggregate $ePVFBP_{active}$ (initial funding) is not required in order to provide a "fair" level of benefit security; doing so would be overly generous to employees and burdensome to employers. At the other extreme, few would agree that the *eABO*, a punishing walk-away liability, is sufficient to be fair, and even less so the conventional *ABO* with its high

discount rates that virtually assure that a "fully funded" plan is in fact substantially underfunded.[39]

There are many choices between these extremes. My favorite accrues benefits as a constant proportion of salary. It has its downside, in that it accrues much more slowly than equal payment or initial funding (but more quickly than either *eABO* or *ePBO*) methods. It might be the right compromise for many.

No treatise can decide which normal cost method should be used and what level of benefits will thus be protected. That is either a political decision—a policy task for regulators (and one on which the various regulators should coordinate their efforts)—or it is a contract decision to be negotiated in the course of labor-management discussions.

Lower payouts might be agreed for employees that leave employment voluntarily (walk-away benefits).[40] But this again is a policy or contract decision. Regardless, such an agreement doesn't really require use of another measure of the liability in the books, except perhaps as a footnote: it's a fair assumption that walk-away benefits would be fully funded if the benefit security measure of the liability is fully funded.

Once chosen, we have a normal cost method and an associated accrued liability to use as a funding target. Giving primacy to the economic importance of benefit security and thus to the accumulation of hard money to fund the benefits, this normal cost method should be used to

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[39] I have been surprised to learn during discussions of this monograph with others that in fact there are some who advocate the *eABO* as the "right" benefit security measure of the accrued liability. Or more correctly, perhaps, they argue that it is a measure of an accrued benefit that has economic significance—because it can be pulled directly from the benefit contract (so much percent of final pay for each year of service). In my view, this is a post-hoc justification, not a real economic justification, as the present value of that liability at time of future retirement ($PVFBP_i$) is instantly estimable on hire; the benefit accrual per the contract is merely one more way to spread the cost over time. Note that it is incredibly stingy; Figure 7 shows that if we were to think of the $PVFBP_i$ at time of hire as a "debt" to be paid off through the normal cost, the *eABO* method would not even cover the interest; the upward curvature displays the effect of this negative amortization. I find it impossible to justify the *eABO* as a healthy choice for a benefit security liability. Its chief advantage is simply one of inertia; it is in place today, although not in economic form. It deserves re-thinking.

[40] The *ABO* seems to have support as a book liability because it is all an employee is entitled to today, if he or she leaves employment. The real benefit security concern, however, arises when the *employer* equivalently walks away (terminating or defaulting the plan), not the employee. Most would agree that the *ABO* (or even the *eABO*) would probably be insufficient to provide a fair level of benefit security in the event of sponsor default or termination. The obligation to walk-aways will never be higher than the benefit security measure, but by agreement it can be lower.

determine contributions, and it follows naturally that it should also be used for determining pension expense in the P&L and in turn for establishing the accrued funding target liability; it is a matched set, mutually supportive.

Doing so preserves the accounting objective that all financial statements should "articulate," meaning in this case that entries on the balance sheet, the income statement, and the cash flow statement should all be based on the same normal costs. No purpose is served by allowing different methods for calculating contributions and expense as happens in current practice—other than to allow the cash position and the P&L to be "managed" separately, an opportunity that has proven opportune to moral hazard.

Whether we are calculating monetary contributions for the cash flow statement or notional expense for the P&L, and that in turn accumulates as the accrued liability on the balance sheet, "economic normal cost" means the same thing: an amount that, if paid, provides sufficient funds by time of retirement to provide for the retirement annuity. Determined consistently with market values, economic normal costs and their associated accrued liabilities are simply a time value of money problem of how to amortize an obligation (modified consistently in application by the probability decrements we mentioned earlier). If the normal cost used for contributions and for the P&L is the same, the assets and the accruing liability will always be synchronized, at least so long as the assets are invested in the same risk-free rate assets that form the basis for the proper discount rate of the risk-free liability. A later chapter will address what happens when the assets aren't invested in this way.

The Balance Sheet With Accruals of an Economic Measure of a Periodic Normal Cost

I can present our time-period zero economic balance sheet for the pension trust, distinguishing between portions of the *FEL* that have already accrued on-book and those that will accrue through future normal costs, as follows:

Figure 9

The full economic liability can be divided between on-book and off-book portions.

ıst, t=0

$ePVFC_{FEL}$ -$EVLD_{FEL}$	+Retirees: accrued and on-book ($ePVFBP_{RBO}$) +Current ee's: • Accrued and on-book $ePVFBP_{eAL}$ • To be accrued $ePVFNC_{eAL}$ +Future ee's, off-book (beginning to accrue only on arrival, then placed in the lines next above): . $ePVFBP_{future} = ePVFNC_{future}$
$= ePVFBP_{FEL}$ -$EVLD_{FEL}$	
NPV (=0)	

In the first category, the portion that is already accrued, is the clearly on-book *RBO*, and the aggregate accrued portion of the active lives, $ePVFBP_{eAL}$. In the second, yet-to-be-accrued category are future normal costs arising from all current employees and from future employees (the present value of the *FEL*'s future normal costs). This suggests an aggregate equality that must hold true at any point in time, *t*:[41]

$$ePVFBP_{FEL\ t} = ePVFBP_{eAL\ t} + ePVFNC_{FEL\ t} \qquad (2)$$

[41] A related observation is that this plan, and all others like it, is really only *partially* funded. We often say that we have a "fully funded pension system," but in reality the intention is that it be only partially funded, just to the level of a funding target measure of the accrued portion of the liability, with the balance of the *FEL* being covered, off-book, on a *pay-as-you-go* basis (PAYGo). In practice any economically under-funded plans are, to the extent of their shortfall, PAYGo even with respect to portions of labor and services that have already been performed.

Updating the beginning period pension budget identity

These observations and our generalized concept of normal cost give us a third leg of the startup pension budget identity that I started to develop in equation (1): By necessity, at time zero for the plan (*ab initio*, before accrual of any benefits and before contributions, benefit payments, earnings on assets, etc), the present value of all expected future normal costs must be equal to the present value of all expected future benefit payments, and thus also to the present value of all future contributions (for economic values):

$$\underbrace{ePVFBP_{FEL\ t=0}}_{\text{balance sheet}} \equiv \underbrace{ePVFNC_{FEL\ t=0}}_{\text{income statement}} \equiv \underbrace{ePVFC_{FEL\ t=0}}_{\text{cash flow statement}} . \qquad (3)$$

Each term of this pension budget identity is associated with one of the three principal reports of an accounting system, which I've noted with appropriate labels.

There is no escape from the true economics. The way to control true costs and total contributions over time is with management of the benefit formula, which determines the $PVFBP_{FEL}$, not with management of the accounting.[42] The *FEL* ultimately governs the long-term cost experience, not the periodic costing method.

Proposition 9

> *Controlling benefit policy, which creates and controls the size of the $PVFBP_{FEL}$, is the only way to control pension costs (both contributions and expense).*

Attempts to reduce current accruals of normal costs by selecting a slow accrual, small-liability method such as the *ABO* (or for that matter, through any other deferral of recognition of costs such as amortization, or any other accounting manipulation) will at some point cross over and begin delivering a *higher* cost per year than other methods (see the steeper slope of the accruing liability on the prior figure, in late years).

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[42] The point that normal cost is determined by the benefits is at some level obvious, and has been stated before many times, recently by Exley, *et al* (1997). However, prior discussions haven't observed that the precise magnitude of the present value of future normal cost is the not-yet-accrued portion of the *FEL*. The role of future hires in pension cost seems usually to be ignored, as if employees appear by magic, without having been expected.

Any effort to reduce costs today, other than by reducing benefit levels, results in higher costs later, and *with interest*.

Proposition 10

> *Measures of the pension plan made using conventional accounting methods will always follow measures made using economic accounting, even if with a lag. "The accounting will always follow the economics, sooner or later."*

There can be no genuine gain to the sponsor from using distorted accounting over any appreciable period of time—not lower expense, nor lower contributions, nor lower liabilities.

Further to the primacy of the *FEL*, a sponsor shouldn't make *benefit policy* decisions based solely on a subsidiary measure, such as the on-book accrued portion of the full economic liability—even if that subsidiary liability is expressed in proper economic terms. The true cost of a benefit change from the perspective of the sponsor is the change in value of the aggregate *FEL*, the sum of the on-book and off-book measures that will sooner or later come on the books—not the change in one of the on-book measures taken by itself. A benefit increase raises the $ePVFNC_i$ and the $ePVFBP_i$ for all current employees, but it also raises the $ePVFNC_{future}$=$ePVFBP_{future}$ with respect to all future employees. And for employers anticipating that they will be sponsoring the plan indefinitely, this is important information.

When we get to equation (20), in part II, I will add the remaining details to this pension budget identity so that it becomes completely general at times other than *ab initio*. It will still remain consistent with the essential intuition of this relationship, as shown here.

Future Employees Become Current Employees

I have focused on the current employees. But each period, as new employees are hired and come on board, *future* employees become *current* employees. With this metamorphosis, the present value of future benefit payments for new employees, equivalently thought of as the present value of future normal costs for new employees, slowly and steadily shifts on-book.

This is another demonstration of the need to look to the *FEL* if we want a full understanding of the nature of the pension liability and its costs to the employer. Because the *FEL* incorporates the present value of fairly expected liabilities associated with future employees, it provides the source for the flow of future employees into the actual current population. Year by year, those new arrivals show up in normal cost and in the accrued on-book liability. The instant of employment is merely the inflexion point, before which no part of the e*PVFNC* for these future employees can accrue on-book, but the economic liability is there even before that point; the new employees are not surprises.

For any active plan, the ongoing accrual of benefits from off-book status to on-book status does not stop until there are no future employees to earn benefits under the plan, meaning either business contraction/failure or termination of benefits for new employees.

For those who argue that the *eABO* or the *ePBO* or some such other subsidiary measure is "the" economic liability, that fact is difficult to argue away. However, if we agree to recognize the *FEL* as the "master" economic liability and simultaneously agree that a subsidiary measure is needed as a reasonable funding target, then we will have made very useful progress.

Summary of Normal Cost Discussion

I hope by now to have driven home the point that, while there is a single overarching value of the liability that should be taken as important by any plan sponsor—the full economic liability or *FEL*—there is also room for a legitimate subsidiary accrued (and on-book) liability, one that is economically meaningful because of its use as a funding target for benefit security purposes. After all, this is about dollars, not sasquatches. The normal cost that would generate this funding target liability would then also have a meaningful and useful economic interpretation as the core of the contribution needed each period in order to build up that funding target liability—contributions are also about dollars. And if this normal cost is good enough to generate the contribution payment, then it is also an appropriate basis for computing pension expense.

We don't need the confusing plethora of normal costs and liabilities that we have today, and which ensure that no one understands the true financial posture of the plan. Although plan

managers and employee representatives would benefit immediately from having economic accounting data on the plan, it would also be very helpful if the DOL, IRS, and PBGC, and FASB and GASB coordinated their approaches, all insisting on the same economically interpretable accounting.

So the prescription for all interested parties is to choose a level of benefit security that can be agreed, and then express it in terms of an economic normal cost method and an associated accrual liability. This accrued liability can be thought of as a benefit security measure and as a funding target. There are an infinite number of normal cost methods (and their associated accrued liabilities, inasmuch as they come in matched pairs). Pick one that is perceived as "fair" to all, and stick with it.

Beyond this, there also are implications for management with respect to controlling the cost and benefit security levels of the plan: The first is to consider carefully how large a benefit should be promised, because it is determinative of the size of the *FEL*. This is a benefit policy decision, and the *FEL* completely determines the present value of future normal costs as well as that of future contributions. A second deals with the contribution policy and benefit security question that we have been summarizing: Which normal cost method will be used? Will the sponsor fund the plan speedily (providing solid benefit security) or slowly (less benefit security)? Of course, a "slow" normal cost accrual method in the early years of employment ensures a painfully fast accrual rate in the later years.

Chapter 5: Paying for the Plan—Contributions and Pension Expense

In the previous section, I set up the approach to economic accounting in a general manner and developed economically sensible approaches for establishing periodic normal costs, in order to establish an agreed benefit security measure of the liability. I then made an argument that contributions should come from those same normal costs. Now I am prepared to move on with the remaining details of economic accounting for pensions, specifying pension expense and contributions.

Up to this point, I've assumed that the plan is at time zero and has just been initiated. Let's now assume the passage of one year and use normal cost and supplemental cost concepts to flesh out the economic accounting approach. I'll introduce, in order, economic versions of pension expense, contributions, benefit payments, and investment earnings, making a complete accounting system.

Other Components of Pension Expense

What today is referred to as "pension expense" contains components other than normal costs, although normal costs do provide the baseline onto which other items are appended in order to generate this item. I'll make the case a bit later that use of the term "pension expense" to lump all these components together into a single net figure represents poor practice, and understanding the components will promote understanding of the argument. For now, however, we'll go with the conventional grouping.

Supplemental costs, from the liabilities: **"**Things happen" to the worth of a pension plan's assets and liabilities and these "things" create income and expense effects. The asset side is easy to track—the things that happen are portfolio returns and various fees and costs, that show up in the custodian's report. But "things" are more complex to track for the liabilities: Perhaps the forecasts (decrements) for rates of retirement or rates of early departure, or for rates of deaths of beneficiaries (mortality risk), or for some other projected occurrences turn out to be off by a bit. Or perhaps estimates of future wage growth relative to inflation or employee population growth change. These estimate changes also change the forecasts for future benefit payment cash flows

to retirees from what they had been at the prior year end, thereby changing the value of the liability. And a change in the liability must in turn be reflected in income or expense.

The market-determined present value of such changes happening in any given year is an economic version of the conventional accounting or actuarial term "supplemental costs," which we'll notate as *SC* (not to be confused with service costs, for which we are using the near-synonym, "normal cost"). Supplemental costs are one component of economic pension expense.

I've referred to them in prior articles as "liability alphas" or "liability residual returns," as these risks are not market-related and thereby not hedgeable (see Waring 2004c), and thus analogous to alphas found on the asset side (uncorrelated residual returns, those not explained by beta returns).

In *expectation*, the supplemental costs, or liability alphas, are (or should be, if the forecasts are statistically unbiased) zero. Therefore the present value of future supplemental cost is also zero, so I will not dwell on them. Despite having a zero mean expectation, volatility arises from the possibility of estimation error. So in *realization*, they will rarely be as expected; there will be a distribution of realized values related to the error terms in the estimates. These risks can't be eliminated, but they can be managed downward. In practice, they often seem to trend positive (higher costs), suggesting unjustified optimism in decrement forecasts.

Supplemental costs are sometimes referred to as "accumulated gains and losses," (AG&L). But by whatever name, in actuarial practice these terms not only includes the forecast errors in demographic characteristics that I have been referring to, but also include amortizations of prior service costs, benefit level changes, and gains or losses of investment returns relative to the expected return assumption, all of which in an economic context should have already hit either the liability or the asset values (and the income statement) as soon as they happened. While supplemental costs from fairly estimated realization errors have no other proper path for entering onto the income statement, that isn't true for the others; for this reason in my discussion the term "supplemental costs," unless the context is clear that it means otherwise, is restricted to demographic surprises. (An economic approach would use actual realized returns on the asset portfolio and wouldn't accumulate return differentials as if they were errors; they are just returns,

and should go into an economic determination of pension expense directly, rather than through the AG&L. I address this topic in depth, below.)

Interest rate costs: Changes in value from the accrual of interest rates on the accrued liability during the year are also treated as a pension expense item. Following conventional practice, we'll just call this interest cost: The passage of the year makes all future cash flows one year nearer and thus the present value is one year's worth of interest more valuable. *Changes* in the present value of future benefits from *changes* in interest rates, *i.e.*, capital gains and losses, are also expensed directly in an economic or market value context. (Both of these components of the total return are more properly booked as *financing* costs, but current practice treats them as part of pension expense—which we'll also do, for the time being.)

Economic Pension Expense

In this simplified system—so far, without contributions or investment earnings—*full economic* pension expense, ePE_{FEL}, based on the aggregate *FEL*, is just the difference between the $ePVFBP_{FEL}$ at time *t* (in this special first case *t*=1) and at prior period end, time *t*-1 (which only in this special first case is time *t=0*).[43]

$$ePE_{FEL\ t-1,t} = ePVFBP_{FEL\ t} - ePVFBP_{FEL\ t-1} \qquad (4)$$

I can illustrate more of the dynamics by showing how the $ePVFBP_{FEL(t-1)}$ changes into $ePVFBP_{FEL(t)}$; i.e., how the liability changes from one period to the next. It changes as a function of interest cost, plus capital gains or losses from any interest rate changes (to a first approximation, duration *D* times change in discount rates, Δd), plus any surprise valuation changes from re-estimating the benefit payment cash flows or revising the benefit levels (economic supplemental costs, eSC, the liability's residual return). As discussed above, the normal cost component of full economic pension expense will be equal to the *FEL* at time zero. It is expected to be zero at all later times, in that it was all fully charged immediately upon plan formation.

[43] Benefit payments, discussed below, can be safely left out of this equation if we assume that they are made at time *t*, at the end of the period, and that our time *t-1* beginning value reflects them as having already been paid for the prior period. I'll discuss them more, later.

So, for the next period, time *t*, the aggregate *FEL* will have changed:

$$
\begin{aligned}
ePVFBP_{FEL\ t} &= \underbrace{ePVFBP_{FEL\ t\text{-}1}}_{\text{beginning value}} \\
&+ \underbrace{eNC_{FEL}}_{\text{normal cost=0}} + \underbrace{eSC_{FEL\ t-1,t}}_{\text{estimation changes}} \\
&+ \underbrace{\underbrace{d_{FEL\ t-1}\, ePVFBP_{FEL\ t\text{-}1}}_{\text{interest cost}} - \underbrace{\Delta d_{FEL\ t-1,t}\, D_{FEL} ePVFBP_{FEL\ t-1}}_{\text{capital gains or losses from interest rate changes}}}_{\text{the "total return" of the liability}}
\end{aligned}
\tag{5}
$$

After one year the ending *FEL* (in this as-of-yet unfunded plan) is just the starting *FEL* increased by the effects of interest rates and of capital gains or losses on the liability, plus or minus whatever demographic gains and losses or benefit changes may have been experienced in the supplemental cost category. We get our starting version of the conventional definition of pension expense by subtracting the value of the liability in year *t-1* from the value in year *t*, per equation (4):

$$
\begin{aligned}
ePE_{FEL\ t-1,t} &= \underbrace{eNC_{FEL}}_{=0} + eSC_{FEL\ t-1,t} \\
&+ d_{FEL\ t-1}\, ePVFBP_{FEL\ t-1} - \Delta d_{FEL\ t-1,t}\, D_{FEL\ t-1}\, ePVFBP_{FEL\ t-1}
\end{aligned}
\tag{6}
$$

FEL pension expense is just normal cost, which has an expectancy of zero absent benefit changes (careful—true only for an *FEL* basis!), plus supplemental costs, which also, properly done, have an expectancy of zero (for all measures), plus the "total return" on the liability, i.e., interest costs plus capital losses or gains. If these zero expectancies all are realized, the liability simply continues accumulating interest until it has grown large enough to fund the retirement liability.

We can establish a version of economic pension expense that parallels the matching principle's task, ePE_{eAL}, and only accrue eNC_{eAL} into the accrued liability (rather than expensing the full eNC_{FEL}): Let's define the on-book pension expense as the change from *t-1* to *t* in the generalized economic version of the accrued liability used for benefit security purposes, the *eAL* (by keeping it general, the relationship will apply for any agreed measure for the accrued liability

and associated normal cost method—level payment, constant proportion of pay, *ABO*, or whatever).

$$ePE_{eAL\ t-1,t} = ePVFBP_{eAL\ t} - ePVFBP_{eAL\ t-1} \tag{7}$$

The difference between the *FEL* and the *eAL* means that there is a part of the *FEL* that stays off-book, equal to their difference. The off-book portion is that part of the *FEL* whose charge to the books remains deferred, i.e., the present value of future normal costs:

$$ePVFBP_{FEL\ t} = ePVFBP_{eAL\ t} + ePVFNC_{eAL\ t} \tag{8}$$

The on-book portion of pension expense can be developed in more detail, in a manner parallel to that for *FEL* pension expense, above, getting:

$$\begin{aligned} ePE_{eAL\ t-1,t} &= eNC_{eAL\ t-1,t} + eSC_{eAL\ t-1,t} \\ &\quad + d_{eAL\ t-1}\, ePVFBP_{eAL\ t-1} - \Delta d_{eAL\ t-1,t}\, D_{eAL\ t-1}\, ePVFBP_{eAL\ t-1} \end{aligned} \tag{9}$$

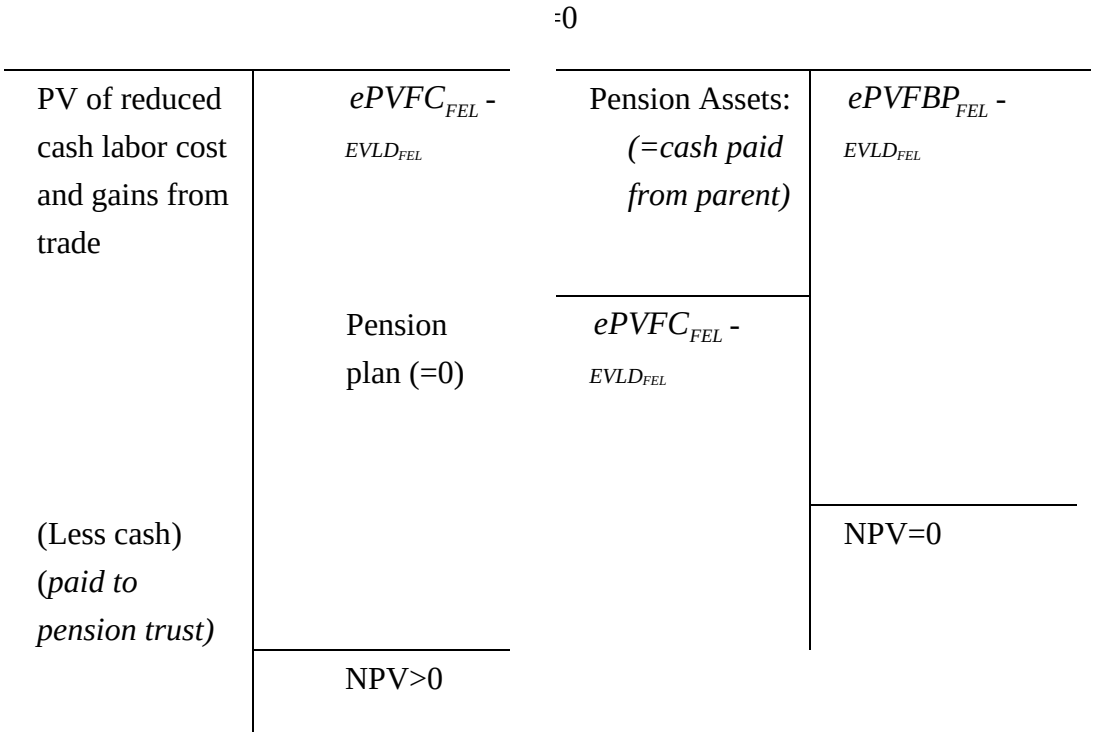
This is just a portion of economic pension expense: another portion—the returns of the asset portfolio—will be described shortly. But this portion, reflected in equation (9), is accrued on the books to the on-book liability; asset returns are not.

Contributions to the Asset Pool, and the Sponsor's Credit/Default Option

Now bringing contributions into the mix, note that cash contributions reduce both present value of future contributions, *ePVFC,* and the liability's exposure to the sponsor's default or credit risk. At the moment of making a contribution, the value of the total plan $EVLD_{FEL}$ goes *down* in a manner directly related to the extent of that new funding, and the portion related to the accrued liability, $EVLD_{eAL}$, goes to zero as the funding ratio for the accrued liability reaches unity.

Figure 10

Economic T-account entries at the moment of starting a new pension plan; showing a cash contribution providing pension assets to the trust.



If the cash contribution were equal to the economic accrued liability, *eAL*, there would still be a remaining present value for future contributions, representing the as yet off-book and not-yet-accrued portion of the *FEL*, the present value of future normal costs.

Investment Returns on Contributed Assets

If we have assets, they will generate returns for the trust. These returns can be viewed as income, a helpfully offsetting component of total pension expense in its conventional treatment. Our *FEL* and *eAL* versions of economic pension expense (and all other versions) have a new and additional monetary component: the actual total rate of return realized on the assets, multiplied by pension assets, to give us a dollar change of value. This monetary return reduces costs, so is negative, $-r_{t-1,t}\, PA_{t-1}$. It is often seen as an offset to interest expense (I think that *PA*, for pension assets, *shouldn't* need the little *e* to remind us that we are only dealing with economic or

market values, so I won't bother to use it; But I know that I'm being too generous, as we still see widespread use of asset smoothing despite the obviousness to all that smoothed assets don't reflect reality). Let's include these returns in our next, more complete form for expressing pension expense, first for the *FEL*, where after the initial startup, the ongoing normal cost is zero, and then for our generalized accrued portion of the liability where we have an actual charge for normal cost accruing each period:

$$\begin{aligned} ePE_{FEL\ t-1,t} &= \underbrace{eNC_{FEL\ t-1,t}}_{=0} + eSC_{FEL\ t-1,t} \\ &+ d_{FEL\ t-1}\, ePVFBP_{FEL\ t-1} - \Delta d_{FEL\ t-1,t}\, D_{FEL} ePVFBP_{FEL\ t-1} \\ &- r_{t-1,t}\, PA_{t-1} \end{aligned} \tag{10}$$

$$\begin{aligned} ePE_{eAL\ t-1,t} &= eNC_{eAL\ t-1,t} + eSC_{eAL\ t-1,t} \\ &+ d_{eAL\ t-1}\, ePVFBP_{eAL\ t-1} - \Delta d_{eAL\ t-1,t}\, D_{eAL} ePVFBP_{eAL\ t-1} \\ &- r_{t-1,t}\, PA_{t-1} \end{aligned} \tag{11}$$

This full definition finishes the developmental version found in equations (6) and (9) above (there are no amortizing entries in economic accounting). Equation (10), referring to the *FEL*, fully reflects all changes in value as they happen and is more representative of true or full economic pension expense. Equation (11) is the pension expense related to the on-book accrued liability. Each expression of expense gives insight, but serves different purposes.

Benefit Payments

Now we add benefit payments into the mix. Benefit payments simultaneously reduce the value of pension assets and the value of the remaining accrued liability owed (and also the *FEL*) by equal amounts. They thus have no net effect on economic measures of pension expense (or on economically determined contributions, as we will see in a following section). They *will* affect the balance sheet valuations for the absolute level of assets and liabilities, so whenever we consider change in liability or change in assets from one period to the next, where absolute size is relevant we should consider including them.

<u>Economically Determined</u> Contributions: How Big Are They?

If I explained to anyone having basic mathematical literacy, say my brother's teenage daughter (or any other non-pension expert I might encounter at a family or community gathering), that a particular pension plan had a liability of $10 and assets worth $6, and then asked what contribution should be required, she would quickly say that it should simply be $4, the amount required to make the plan fully funded, *i.e.*, the contribution should be the liabilities less the pension assets:

$$C_t = L_t - PA_t . \qquad (12)$$

I might go on to explain that it is a bit more complicated than what I had already told her, that there are *several* alternative measures of this liability, just one of which is the originally mentioned $10; there are others measured at $7, $8.50, and $12, and maybe more. I am confident that by this point I will have completely confused my young friend.

But if I then told her that the measure that is the highest, at $12, includes $2 that really hasn't yet been earned by the employees in the plan; that the measures that are low, $7 and $8.50, are calculated in ways that distort their value so that they aren't really stated in units of dollars; but that the $10 measure of the liability was not only correctly stated in dollars but also represented the amount agreed by the parties to be owed to the employees in the pension plan to secure their benefits, then I think that she would again confidently use $10 as the correct measure, and again tell me that $4 is owed. My readers will know that the highest measure from the examples above is the *FEL*, the two lowest are conventional accounting and funding measures, while the $10 version is our generic economic accrued liability $ePVFBP_{eAL}$.

The point is that economic contribution calculations are pretty easy, and just reflect common sense. If we know the funding target measure of the liability, we check to see if we are funded to that level, and if not we make a rectifying contribution.

Modifying equation (12) to reflect this decision, the "natural" or economic required contribution is simply the ending period deficit relative to the funding target measure of the liability (positive values only; if overfunded, no contribution is made nor withdrawal taken):

$$eC_{eAL\ t} = ePVFBP_{eAL\ t} - PA_t \ . \tag{13}$$

Note that my sign convention treats a contribution as having a *positive* sign in the usual case, implying that we are looking at it from the perspective of the pension trust, and thus a negative sign from the perspective of the sponsor. (I won't repeat hereafter the notation indicating that contributions are only made when there is a deficit, not a surplus, as the reader does not need the reminder.)

I can express equation (13) in a form parallel to that I used to develop pension expense, *i.e.*, in terms of beginning period values plus changes during the year, rather than in terms of ending period values (I assume that all costs and benefit payments happen at period end, to avoid dealing with mid-period issues).

$$\begin{aligned} eC_{eAL\ t} &= \underbrace{ePVFBP_{eAL\ t-1} - PA_{t-1}}_{\text{starting deficit}} \\ &+ \underbrace{eNC_{eAL\ t-1,t} \pm eSC_{eAL\ t-1,t}}_{\text{liability changes during the year}} \\ &+ \underbrace{d_{eAL\ t-1} - \Delta d_{eAL\ t-1,t} D_{eAL\ t-1}\ \ ePVFBP_{eAL\ t-1} - r_{t-1,t} \cdot PA_{t-1}}_{\text{net returns on liability and assets}} \end{aligned} \tag{14}$$

Stated in words, equation (14) says that the economic contribution based on the on-book accrued liability is the starting *AL* deficit at the beginning of the period, plus pension expense. (Any benefit payments during the period would simultaneously reduce both the assets and the liabilities, and so cancel out in the contribution calculation; therefore I don't show them.)

This equation demonstrates the tight functional connection between economically determined pension expense and its companion economically required contribution, a connection alluded to often in the normal cost discussion earlier: If there is no starting economic deficit, then in that very neat world *contributions and pension expense both have the very same value*. The

normal cost "core" is always the same, as are interest costs, supplemental costs, and investment returns. The total is identical.

This mathematical description of the contribution (equation (14)) sounds in many ways like an actuary's description of the contribution calculation for a corporate plan and for many public employee plans. And it should, as the words used are much the same. But there are big underlying differences, the biggest being the economist's much clearer focus on referencing the calculations to market valuations or their equivalents, the absence of amortizations of returns, prior service costs, and newly awarded benefits in the economic versions, and attention to an investment policy starting point that matches assets to the liabilities.

But additional meaningful differences also exist. The actuary will almost certainly use a different liability reference measure and associated normal cost method for the stated liability and for the contribution calculation, thereby making a significant difference. He or she will very likely use a different discount rate for the stated liability and for the contribution calculation as well, which means working with very different deficits and thus very different implied contributions. He or she will almost certainly amortize the deficit over time. And there will be other differences as well. And the actuary's contribution might at the end of the day be a tiny fraction of that suggested by the economist—despite use of much common language and much very similar looking math.

The natural and very real link between contributions and normal costs that necessarily exists, and that reveals itself when examining the plan in consistent economic, market value, dollar-denominated dimensions, is broken in the conventional actuarial and accounting approach. And that isn't surprising: after all of this gratuitous complexity, the contribution is now only tenuously related to a proper funding basis.

My brother's teenage daughter got it right the first time—the sponsor's contribution should be equal to the ending deficit—and she got it right the second time, that that deficit should be the one measured relative to a dollar-denominated funding target measure of the liability. And she would be completely baffled if an actuary then sat down with her, no matter how patiently, to explain his version of the contribution, a version that asserts that a small fraction of her $4 contribution could in fact be sufficient. Out of deference and trust she would

not challenge him bluntly, but she would go away silently wondering what exactly he was trying to say and how the fractional contribution suggested by him would take care of the shortfall.

How has it happened that anyone with the most ordinary mathematical literacy has more useful insight into pension funding than is found in conventional funding approaches?

Chapter 6: Managing Pension Funding Risks—Investment Policy

The Impact of Investment Policy on Contributions and on Pension Expense

A pension plan experiences investment risk from both sides of the balance sheet. The liability, on the right hand side, has a value that fluctuates with the discount rate, which itself is a composite of rates from different points along the spot rate curve. The assets can be subjected to those same interest rate exposures, forming a natural hedge between the liability side and the asset side and removing all investment-related risk from the plan; perhaps in addition to this hedging portfolio the sponsor may choose to have some exposure to equities and other equity-like risky assets. This is called "surplus optimization" (discussed in a later section of this chapter), and is the preferred practical approach for determining pension investment policy from an economic perspective. While an argument can be made for a simpler approach, that of merely maximizing present value from pension operations, plan sponsors seem universally intent on holding a significant risky asset portfolio. So long as that is the case, then surplus optimization is the better tool.[44]

Or the assets can be invested as they are in conventional practice today, guided by the conventional actuarial and accounting perspective, in a mix of shorter-term bonds and equities and equity-like assets, leaving little natural hedging between asset and liability sides of the balance sheet and adding risk to the plan's surplus or deficit from *both* sides.

Investment policy is about determining the market-related risks that a portfolio should be exposed to as its default position, the notion being that market-related risks are rewarded with an expectation—but not a certainty—of returns greater than the riskless rate. Today's investment specialists tend to identify market risks as a list, or vector, of "factors," sometimes called "beta

[44] In general, it is fair to say that a pure view of finance theory would suggest that present value maximization (shareholder value maximization) rather than utility maximization is the preferred objective function for a corporation (and an analogous conclusion for public bodies). But for a variety of reasons most corporations and public bodies choose to use utility maximization when investing pension assets. Within reason, this causes no harm (the term "indifference" in the Miller-Modigliani indifference propositions means just that), but there are knock-on effects that aren't favorable; see, for example the leverage discussion of Robert Merton discussed in a later chapter. On the other hand, there are in fact some opportunities to add value. Campbell and Viceira (2006) discuss many of the factors that persuade sponsors to hold equities, some of which are consistent with present value maximization (certain skillful active management opportunities, for just one example). But many others are consistent with utility maximization, if just the utility of the agents making the decisions.

factors" or just "beta" (in the latter case the jargon is singular but nonetheless incorporates multi-factor views). Beta factors catalogue relevant moving parts from the *market* that might affect (be correlated with) one or both sides of the balance sheet. For pension plans, these factors certainly include real and nominal risk-free rates (the exposure betas are equivalently described as "durations") and, for most plans, the list also includes a factor representing each asset class in which the plan has already invested or that is under consideration for investment.[45]

If investment policy for the asset portfolio holds the same market-related risk factor weightings as does the liability, then it fully hedges the liability, effectively immunizing the surplus or deficit of the plan from market risk. This is the liability-matching portfolio discussed in the discount rate section and at several places in the normal cost and contribution discussions, above.

This *fully hedged* investment policy is an ideal starting candidate when considering what investment policy to actually adopt. Not only does it remove investment risk from the surplus (deficit) of the plan, but *it also virtually eliminates investment risk from pension expense and required contributions* (next subsection) in economic accounting, and as I have discussed elsewhere, this beneficial effect will follow over into any conventional version of the accounting as well.

Once this starting point is set, the sponsor can consider also holding exposures to equities and other risky assets, for the possibility that upside realizations from good markets might help the plan by reducing pension expense and contribution requirements as good future returns are realized (a hopeful possibility, balanced by the risk that bad realizations will increase expense and contributions). If we are to judge by the way they behave, most plan sponsors today are willing to assume this very real risk.

Through the magic of derivatives and their ability to separate beta returns from risk-free rate returns, we can maintain this liability-matching portfolio even while holding a substantial exposure to equities and other risky assets not related to the liability-matching portfolio. In other

[45] While a duration is a beta in the sense that it represents the change in price with respect to the change in a variable, in this case the interest rate, it is non-linear and thus the second and higher moments (convexity, etc.) are important.

words, we can maintain the ultimate "surplus-optimal" two-fund portfolio—the liability-matching risk-free asset portfolio plus the risky asset portfolio.[46]

Show Me The Money: A Demonstration of Risk Control

I can show this opportunity for risk control most clearly by reorganizing and rewriting equation (11), the *eAL* version of pension expense. I decompose asset returns into that part that represents the same market-related risk factors as are in the liability (which for the most part are interest rates, *d*, and their related capital gains, $-\Delta d_{eAL\ t-1,t}\ D_{eAL\ t-1}$) to represent the hedging portfolio, and a remaining portion from those "other" exposures in the portfolio, which we can think of as the risky assets unrelated to the hedging portfolio. I represent this latter risk premium with the term, μ. "Other" will primarily be equity risk premium returns, but also other risky asset excess return exposures such as credit, equity, or other beta factor risks (in idealized theory, μ is the risk premium return on the world market portfolio of risky assets).

Reorganizing the equation to group these two types of asset returns separately (using an overly simple single duration notation in place of a more complete set of interest rate-related beta factors) results in the equation set forth below. With this parsing of asset returns, we see that the returns of the hedging portfolio nicely cancel all the returns of the liability, regardless of what they are. These returns, by themselves, all have volatility; but when the returns cancel each other out, volatility risk naturally cancels out as well. That portion of the plan's risk has been *eliminated*, leaving only returns of the risky asset portfolio and the possibility of non-zero supplemental costs to cause variances in pension expense from the basic cost, economic normal cost.[47] While these relationships are correct in both expected and realized form, let's concentrate on realizations, acknowledging that the investment returns including interest and capital gains are all volatile values:

[46] Waring and Whitney (2009) show the identity between a liability-hedging two-fund approach and surplus optimization, giving a useful means of articulating and thinking about the surplus optimization task.

[47] There are more complete and implementable versions of surplus return, as well as surplus risk, summarized and developed in Waring (2004b) and Waring and Whitney (2009), articles that are focused more toward investment professionals than is this exposition. There, I decompose returns in standard terms, their risk-free component, their beta or factor components, and their alphas. The risk-free component of returns won't be an equal offset for under-funded plans, as might be suggested by the version here; the difference will be in the short term rate of return with respect to the deficit. The sponsor always pays interest on the deficit, knowingly or not.

$$
\begin{aligned}
ePE_{eAL\ t-1,t} &= \underbrace{eNC_{eAL\ t-1,t} \pm eSC_{eAL\ t-1,t}}_{\text{plan costs}} \\
&+ \underbrace{d_{eAL\ t-1}\, ePVFBP_{eAL\ t-1}}_{\text{liability income returns}} - \underbrace{\Delta d_{eAL(-1,t)}\, D_{eAL}\, ePVFBP_{eAL(-1)}}_{\text{liability capital gains returns}} \\
&- \underbrace{\underbrace{d_{PA(-1)}\, PA_{(-1)}}_{\text{asset income returns}} + \underbrace{\Delta d_{PA(-1,t)}\, D_{PA}\, PA_{(-1)}}_{\text{asset capital gains returns}}}_{\text{Liability-matching asset portfolio}} \\
&- \underbrace{\mu_{PA(-1,t)}\, PA_{(-1)}}_{\substack{\text{Risky asset portfolio} \\ \text{risk premiums}}}
\end{aligned}
\tag{15}
$$

But these volatile values are all equally present in both positive and negative forms, and cancel out! Pension expense for the fully hedged plan reduces to normal costs (relatively predictable and of very low risk), unhedgeable supplemental costs with zero expected value and (hopefully) very modest risk levels, and the risky asset returns (with the risk that goes with them):

$$
ePE_{eAL\ t-1,t} = eNC_{eAL\ t-1,t} \pm eSC_{eAL\ t-1,t} - \mu_{PA\ t-1,t}\, PA_{t-1} \tag{16}
$$

Equivalently, we can show that contribution risk also simplifies in an exactly parallel manner. Starting with equation (14):

$$
\begin{aligned}
eC_{eAL\ t} &= ePVFBP_{eAL\ t-1} - PA_{t-1} \\
&+ eNC_{eAL\ t-1,t} \pm eSC_{eAL\ t-1,t} \\
&+ \underbrace{d_{eAL\ t-1}\, ePVFBP_{eAL\ t-1}}_{\text{liability income returns}} - \underbrace{\Delta d_{eAL(-1,t)}\, D_{eAL}\, ePVFBP_{eAL(-1)}}_{\text{liability capital gains returns}} \\
&- \underbrace{\underbrace{d_{PA(-1)}\, PA_{(-1)}}_{\text{asset income returns}} + \underbrace{\Delta d_{PA(-1,t)}\, D_{PA}\, PA_{(-1)}}_{\text{asset capital gains returns}}}_{\text{Liability-matching asset portfolio}} \\
&- \underbrace{\mu_{PA(-1,t)}\, PA_{(-1)}}_{\substack{\text{Risky asset portfolio} \\ \text{risk premiums}}}
\end{aligned}
\tag{17}
$$

$$eC_{eAL\ t} = BeginningDeficit_{eAL\ t-1} + eNC_{eAL\ t-1,t} \pm eSC_{eAL\ t-1,t} - \underbrace{\mu_{PA\ t-1,t}\, PA_{t-1}}_{\text{Risky asset portfolio risk premiums}} \quad (18)$$

Inasmuch as the contribution is identical to pension expense, other than for the beginning deficit in the contribution calculation, returns—and their corresponding risks—can be controlled almost as completely as the sponsor desires: by hedging the liability first, then controlling the amount of exposure to the market portfolio of risky assets. The only risks not controllable through investment policy are the estimation errors involved in the supplemental costs, *SC*.

The bottom line is that if we optimize our pension asset portfolio to maximize expected surplus utility (using the return and risk of the assets less the return of the liability, weighted by the A/L ratio), *we simultaneously and automatically also optimize our portfolio with respect to future pension expense and contribution levels and risks.*[48] This point is worthy of emphasis: Pension funding risks, pension expense risks, and pension contribution risks are *all* the same thing and are controlled in the same way—through investment policy—as they are all transforms of the same risk (surplus risk).

Proposition 11

> *Through investment policy we can control—eliminate or reduce—the risk to the key economic pension metrics—to pension expense, to contributions, and to the surplus: first by matching the assets to the liability, and second by taking no more than a considered degree of risk with additional holdings of equities or other risky assets (other than actuarial forecasting risks for non-market variables).*

[48] Two comments on liability growth and returns: First, it is easy to confuse the *growth rate* of the accrued liability (which includes newly accrued normal costs and ongoing contributions and benefit payments, and which grows at different rates depending on the *AL* measure used and the maturity of the plan), with the *return* of the liability. The expected return of any measure of the liability is best estimated as the discount rate of the liability-matching asset portfolio: The realized return of the liability is the realized return of that liability-matching portfolio. You can't hedge the accrued liability's overall growth rate, only its discount rate.
Second, if the perpetually expected growth in benefit payments (population growth, wage inflation, real wage growth, retiree COLAs, etc) were to exceed the discount rate, the perpetuity value of the *FEL* goes to infinity; it "departs." Since this can't happen, what this really means is that the benefit payments can't grow at rates approaching or exceeding the discount rate for appreciable periods of time without bankrupting the plan and its sponsor (particularly absent the imminent exercise of the sponsor's option to reduce or eliminate future accruals of benefits).

Given that most pension plans today do not use the first step, hedging the liability, they take on excess risk to plan surplus and thus also to contributions and pension expense. The surplus asset allocation approach to investment policy (which does hedge the liability) generates remarkably less contribution, liability, and pension expense risk than today's plans typically endure, and most of the remaining risk can be dialed up or down by changing one's tolerance for holding the risky asset portfolio.[49] Properly done, surplus optimization is the tool of choice for developing this happy two-fund investment policy.

The well-advised plan sponsor is in charge of how much market risk it takes on, if any; therefore it is "in control" of its risk, both to economic contribution and economic pension expense experiences, as well as to the accrued liability. Any investment risk experienced has been taken on intentionally for the purpose of seeking excess returns, and presumably with the full understanding that those returns might come in at disappointing levels; bad returns from well-chosen risks cannot be considered as unfair "surprises."

Surprises in the supplemental cost category should be modest if good work is continuously being done on the quality of the actuarial estimates underlying the cash flow projections. But some level of risk cannot be avoided and even with the best actuarial estimates—made such that the long-term average error approaches zero (a difficult task)—there would still be realized error terms every year. There are no available investments that might hedge these errors. For large groups of employees, the variance of the error term for the true (but unknown) mean life expectancy is small, growing more so as the plans get ever larger (thanks to the "law of large numbers"). Even so, today we have significant and persistent error underestimating some of these means, a non-zero bias to what should be a mean-zero estimation. There are other, hopefully more modest, risks in other decrement estimates, but most should be close to mean zero over time and of relatively small variance.[50]

These observations dramatically revise the conventional wisdom that pension plans are "too risky" despite any risk control efforts exercised by the sponsor. They seem too risky only because no effort is made to hedge the liability while, at the same time, sponsors are encouraged

[49] See Wallace (2006) for a parallel and relevant observation in a different context.

[50] This analysis stands so long as these demographic variables aren't in the market or correlated to the market. If a market were to develop in, say, mortality risk, however, it is conceivable that a non-zero beta for mortality might develop.

to hold large exposures to risky assets—so of course they are risky! On the other hand, sponsors that understand these relationships can be in complete control, neither too risky nor too costly, but rather just as planned, plus or minus some amount attributed to actuarial forecasting errors.

If We Control Economic Risk to the Surplus, We Have Controlled the Accounting Risks to the Plan

Proposition 10, above, says that the accounting will always follow the economics, i.e., that while we can manipulate accounting variables in many ways, the long-term experience—of the size of required contributions and of normal costs—will always be controlled by the *FEL, regardless of what the normal cost method is for reporting them*. You can defer a contribution or an expense, but do so only with compound interest, inasmuch as the time value of the money involved does not change regardless of what we choose to show in the books.

There is an important corollary to that observation, appropriate now that we have considered risk introduced or hedged via investment policy decisions, which is a key theses of this exposition: If through a well-designed investment policy we control economic surplus (deficit) risk, hedging out all interest rate and other liability risks with the liability-matching portfolio, and taking only such market risk in the risky asset portfolio as we are intentionally willing to tolerate in the search for higher returns, then we have controlled the biggest part of both economic pension expense risk and economic contribution risk. The only risks left unhedged are those generated by actuarial estimate surprises showing up in supplemental costs, which can't be managed through investment policy. And if we have accomplished this risk control with the economic accounting, then we must have also controlled the conventional accounting.

This critically important observation is really a corollary to Proposition 10:

Proposition 12

> *If through well-designed investment policies we have controlled the market-related risks to pension expense, contributions, and surplus in the economic accounting, then (by virtue of* Proposition 10) *it must also be true that we have controlled those same risks in the conventional accounting.*

The accounting won't show volatility that never did exist, and we can take most of that risk which might exist away; if anything, the accounting system will cosmetically *reduce* the actual economic risk, not increase it (although only briefly).

There will be a lag in time, but the accounting always follows the economics, sooner or later. The best practice is to control *economic* risk, leaving little risk to be processed by the accounting system.

Why Hold Any Equities, or More Generally, Any Exposure at All to The Risky Asset Portfolio?

It should go without saying that pension investment policy should take advantage of the major hedging opportunity revealed to us by surplus optimization, and hedge the liability's interest rate risks (and any other identified factor risks between the assets and the liabilities) to the maximum extent practically possible, using a liability-matching portfolio (more specifically, the hedging portfolio should dollar-duration match the real interest rate risk and the inflation risk found in the liability; Waring 2004b).

The second decision, how much equity-like risk to take, is the classic risk tolerance question faced by all investors: how much risk of bad returns am I willing to take in order to seek higher expected returns? The amount of equity and equity-related risk taken in the plan should be intentional and fully informed, no greater than will leave the sponsor still feeling "in control."

Why take on any amount of equity risk?[51] The answer is clear here, from the perspective of future contributions. To the extent that some risky assets are held, the *expected* value of the portfolio at the end of future years (but not the present value) will be larger. If the hoped-for realizations *do* happen, and the portfolio does become larger in line with this expectation, then cash contributions can be reduced below the normal cost.

[51] Fisher Black (1980) and Irwin Tepper (1981) have argued that the sponsor should simply hold an all-bond portfolio with no additional risky assets. Their arguments are a research interest of this author, and may be contradicted by some of the implications of this exposition. I anticipate writing a paper on this topic at some point, to finish a 2005 working paper.

But this is not a riskless effort: A *happy* result occurs *when, and only when,* equities achieve a realized excess return above the liability return (for an economically measured liability, the risk-free rate). So there is a corresponding *unhappy* possibility—that there will be an *increasing* effect on contributions in years when equities *don't* win that race.

Proposition 13

> *Investment policy doesn't "pay for the plan" until and unless there are favorable investment realizations; if those realizations are unfavorable, the plan will require higher contributions rather than lower.*

Over most long periods of time, equities "probably" will win (see the "tulip" chart, Figure 6); so the bet might be worthwhile—but it isn't a certain bet over either short periods or long periods. It is *expected* to win, but only in the statistical sense of the term: in realization it may or may not do so. That trade-off is what risk *is*, for a pension plan investment policy, and it is the standard risk-return trade-off of the markets.

I suspect that sponsors, if fully cognizant of the risk of holding equities and of the fact that accounting risk flows directly from economic risk, will choose to "dial down" the amount of risky assets that they hold, even if they choose to fully hedge their interest rate risk. But this is their decision, not mine: I can demonstrate good basic investment finance principles for controlling risk, but the amount of risk that feels "in control" is a matter for each sponsor to decide.

Nonetheless, a case can be made for holding equities, even in the face of the famous Miller-Modigliani indifference propositions. For a complete, well-articulated and even-handed discussion of this latter point, see Campbell and Viceira (2006b).

Evaluating an Organization's Tolerance for Risk

This discussion will seem most-directed at corporate DB plans, but the general logic applies equally to public plans. Even though public plans aren't accustomed to considering their market-related risks relative to the stability and volatility of their load on the tax base, the

relationships exist and are loosely parallel to those between corporations and their shareholders. Risk control is important.

While a good portion of the risk tolerance decision involves a certain visceral willingness to entertain risk and the chance of loss in searching for higher returns, that visceral sense must always be normalized against the ability to pay for any loss that occurs. Today, however, this doesn't appear to take place, as evidenced by the remarkable consistency in degree of aggressiveness across all plans (nearly all pension plans hold, more or less, 75 percent equities and other risky assets, reflecting little variation in apparent risk tolerance).

The following examples of such a normalization are inspired directly from a wonderful article by Nobel laureate Robert C. Merton (2006), in which he explores some of the consequences of failing to show the assets and the liabilities separately on the balance sheet. One such consequence is that the company's exposure to risk in the pension assets is often unclear, leading to overexposure to those risks relative to a particular organization's ability to absorb losses when they occur. In the course of clarifying this risk, he makes the point that a sponsor whose pension liability is small relative to its overall balance sheet, can on average afford to take more risk than a sponsor whose plan is a large part of its economic balance sheet.

Take a look first at Figure 11, showing an economic balance sheet stripped to the essentials. In it, pension assets (PA) are shown separately from book liability, rather than being netted out (for reasons I'll discuss in a later subsection of this chapter). Figure 11 uses a conventional de-leveraging calculation to back market-related risk, or beta, of the operating assets (OA) out from the beta of the equity, here with an average value of 1.00. It shows us that the true beta of the operating assets is .18.

Figure 11

Integrated balance sheet: With pension assets and liabilities not netted

	$	*Beta*		*$*	*Beta*
OA	100	**0.18**	Corp. Debt	45	0.00
PA	50	0.65	P. Liab	55	0.00
			S/H Eq	50	1.00
Totals:	*150*	*0.33*		*150*	*0.33*

Such an investment policy may be bold, but it is entirely common. The beta of the pension assets is .65, representing a 65-percent exposure to equities and other risky assets and a typical—even conservative—investment policy relative to virtually all U.S. pension plans today.

What would happen if this plan were much smaller, relative to the size of the overall balance sheet (i.e., if the organization could support it with a much smaller part of its wealth)? In Figure 12, I hold constant the operating assets, the corporate debt, the shareholder equity, the proportion of equity and equity-like assets in the fund, and size of the deficit, but reduce the pension liability from $55 to $20. *As a result, the beta of shareholder equity drops from 1.00 to a much calmer .55*. This dramatic result is due entirely to the fact that the pension plan is much smaller, proportionally, to the equity risk of the pension assets; now adding proportionally less risk to shareholder equity.

Figure 12

Risk tolerance may be higher for sponsors with relatively smaller liabilities

	$	*Beta*		*$*	*Beta*
OA	100	0.18	Corp. Debt	45	0.00
PA	15	0.65	P. Liab	20	0.00
			S/H Eq	50	**0.55**
Totals:	*115*	*0.24*		*115*	*0.24*

What this suggests perhaps is that the company represented in Figure 11, given the large size of its pension plan relative to the size of the organization, should seriously reconsider the degree of its aggressiveness in its pension asset investment policy. The pension assets are half as big as the operating assets, so they represent a large part of the company. And their beta of .65 is more than three times the beta of the operating assets. Is this really the way that this company wants to use its risk budget, with its knock-on effect on leverage and the equity cost of capital?

All this beta talk may seem ethereal, but I can make it more concrete. The example company's own fortunes are usually correlated with those of the market as a whole (meaning, with all its fellow companies): What are the consequences to our company of, for example, a recession—which causes both individual businesses and markets as a whole to be down, with not only disappointing results but also, usually, with stressful cash positions? Now the company is in effect doubled up in market risk, with its own profits and cash positions down, and with pension

assets down and the plan in need of larger contributions. In the first example above, a return of minus 30 percent on the 65 percent equity PA portfolio, not unimaginable, would also be a minus 30 percent loss of shareholder equity, an amount that couldn't readily be made up—even if cash positions were at normal levels. But in the second case it would be only 9 percent, still an unpleasant loss, especially when cash is tight, but much more readily absorbed than the first.

Where the pension plan is substantial relative to the size of the sponsor, its portfolio aggressiveness should be scaled back considerably, for a given risk tolerance. And for two companies with pension plans that are the same relative size, the company with less free cash flow should have less aggressive investment policies than the richer one. These are just normalizations, the starting point even before adjusting for visceral risk tastes. The key to risk tolerance is: can we (the sponsor) make up investment losses without undue stress?

Eventually, risk taken in the pension assets relative to the liability acts on the plan as "surplus risk." Surplus risk means that the surplus or deficit is volatile, and in this case we're concerned that surpluses might get smaller or that deficits might get larger.

And since investment returns directly affect both contributions and pension expense, surplus risk shows up in every one of the three principal financial statements. How much of this risk can the sponsor handle?

And this isn't just a concern of the sponsor. If the accrued benefit security liability becomes underfunded (or more underfunded) as a result of negative realizations, the $EVLD_{eAL}$ moves more into the money: there is a greater exposure to the possibility of sponsor default on the unfunded portion of that liability. Healthy sponsors can readily make up small losses, but unhealthy sponsors have a tough time with any loss.

If a plan is in surplus, that surplus provides two benefits. The first is that it might obviate the necessity of some amount of future contributions that the employer would otherwise have to make as benefits accrue. The other is that it gives a bit of a cushion for the possibility of unpleasant investment realizations. It is for this latter reason that Dutch plans are required to have some amount of surplus before being allowed to take on any surplus risk.

There are formal tools that can be adapted to analyze this, what I have dubbed "surplus tulips." For an example of a tulip for a sponsor with an aggressive investment policy and a small surplus, see Waring (2008), exhibit 3.14. One can see that the larger the surplus or the more conservative the policy, the lower is the risk to the security of benefits.

Technologies for Developing Pension Plan Investment Policy

This article focuses on actuarial and accounting issues in pension management, and not on details of the technology for building pension investment policies. Nevertheless I would be remiss if I failed to include at least a general discussion of the topic. There are two points to be made here. The first is that the technologies currently in use—asset-liability studies—are completely inadequate to the task. The second is a discussion of the alternative technologies that are available and better-suited to the task.

Traditional actuarial asset-liability studies: There are many different approaches to building the big *Monte Carlo* actuarial asset-liability study programs that have dominated the development of investment policies for 20 or so years. But a fair description of most is that they first conduct an ordinary asset-only optimization across the asset classes.

Next, several mixes, each with different levels of aggressiveness, are chosen for further study from this asset-only frontier. In this second stage of the study, those chosen mixes are then processed through the *Monte Carlo* actuarial model, and output is developed showing the distribution of possible outcomes over approximately the next 10 years for pension expense, contributions, and surplus. The programming behind these models is elaborate and complex. Most are touted as "having an actuary in the box," meaning that full actuarial analyses are automated each period, the software making critical decisions that then are fed into the model as the starting point for the next period. The outcomes are driven by all conceivable input variables, including decrements for non-financial eventualities; there are *Monte Carlo* distributions for each. In fact, these models are often indescribably complex, with *Monte Carlo* distributions piled on *Monte Carlo* distributions, and minimal control over the interrelating correlations that should, or should not be, acting between them. They are proudly touted as being "stochastic" models, and that is true; but this is not really an unusual feature. So is the ordinary mean-variance Markowitz model; any model that deals with risky outcomes can be said to be stochastic.

These are not asset-liability studies, but asset studies followed by liability studies. A better job can be done with much simpler technology having much better genetics, such as surplus optimization (or even present value maximization).

One retort to this description is a claim that a given provider now incorporates the liability right into the asset phase, and uses the same interest rate changes, etc., on both sides of the balance sheet while doing so. Yet these models still end up recommending a partial allocation to a short duration bond portfolio, unless the client seems open to a long bond and the model is tweaked to give the desired result. There are too many errors and variations to detail here, but experience tells me that if you give me a couple of hours with the developers of any of these "stochastic" and "Monte Carlo" models, I will be disappointed to find a long list of problems with their methodology.

If you accept just two ideas; first, that the accounting must follow the economics, and second, that only beta, or market-related, risk in the problem is important to a determination of investment policy (which is, after all, entirely and only about beta), then these huge models are not only unnecessarily complex, but worse, are in error. There is little point in including any of the decrements, for example; there is little if any market-related risk in any of them, and if through the plethora of *Monte Carlo* distributions it should happen that some particular asset holdings reduce the risk from these decrements, that would patently be a false result and evidence of a flaw in the program, most likely in correlations controls, if any (there is only the weakest and most transient basis for asserting true forward-looking correlations between decrements and markets). And of course if the decrements are used, great care must be taken to assure that they will not have spurious correlations to any other variable.

And there is no point in trying to model the many and varied ways in which accounting treats the numbers differently from their underlying economic progenitors, *as the accounting must follow the economics*. Modeling the details of conventional accounting (artificially high discount rates, smoothing, amortizations, etc., as discussed in Chapter 9) makes the model appear to have an incredibly detailed grip on reality, but in fact it just compounds the complexity of the problem, and needlessly so. There is a principle of parsimony, which suggests that a model be no more complex than the minimum possible: The models that I have had exposure to don't

remotely seem parsimonious and one has to be highly skeptical that the models are in fact written in a manner that will always run true over periods of time to the economic pension budget identities developed elsewhere in this monograph.

As I've shown elsewhere here, you can't change the market or economic present value of future contributions, the present value of future normal costs, or the present value of the liability through changes in investment policy. Yet, routinely, these asset-liability studies purport to show graphs of distributions for these variables that leave a very definite impression—or even have an explicit claim—that they have done just that.

The proof of the inadequacy of these models lies in their outcomes. When taking a liability into consideration, you would expect a result that hedged that liability, suggesting holdings of matching long bonds. They don't; instead these models generate pension investment policies holding perhaps only 30 percent of their assets in bonds—and short bonds at that (typically using Barclays (nee Lehman Brothers) Aggregate Index bond benchmarks having only about a four-year duration)—meaning that interest rate risks in the assets were dramatically mismatched to the very long duration liabilities. This mismatch not only evidences that the models fail in the most straightforward of their tasks, but also provides a partial, though substantial, explanation of why pension plans are in such bad shape today: *Of course* there would be massive damage to the plan's deficit in a declining rate environment, as the liability goes up in value dramatically while the assets—with their relatively short durations—barely follow at all, and with parallel experience logged in the economic expense and contribution accounts.

In addition, these models generate very high allocations to equities and equity-like risky assets, averaging around 70 percent or more, which adds much liability-relative (or surplus) risk, which in turn is equivalently risk to contributions and expense. This policy is great in rising markets—it was during the rising markets of the 1980s and 1990s that this trend really set in—but is very dangerous in falling markets.

The true motivation for holding high proportions of equities, however, is even more damning of conventional non-economic accounting practice: public plans and multi-employer Taft-Hartley plans (and formerly, corporate) pension plans use the higher expected returns of such portfolios as discount rates, dramatically understating their liabilities and their

contributions, and corporate plans use them as inputs into the pension expense calculation (discussed elsewhere herein) as well, giving a first-effect reduction to book expense. This is not a creditable reason for adopting an aggressive investment policy and the risks unnecessarily taken on have repeatedly exacted their tolls.

That is exactly what happened in 2001-02 and again in 2008-09—both interest-rate markets and equity markets moved adversely to pensions, simultaneously. The interest-rate moves that happened weren't particularly abnormal by historic standards, and even the dramatically bad equity markets of 2008-09 are fully precedented. But plans having these unhedged, high-equity investment policies developed with conventional asset-liability technologies had their wheels fall off. The underlying economics overwhelmed what bit of risk control was given by the accounting system, with the result that most plans today are well-under-funded—in large part as a consequence of this poor technology.

The fact is that, because the risk in the economic accounting (and thus the GAAP accounting) is a direct function of the growth rate and the volatility of the pension surplus (as shown above, risk and return for contributions and for pension expense is identical to risk and return of the surplus) none of the complexity of these big models is needed. Surplus optimization technologies handle the problem perfectly, without complexity, and in ways completely consistent with investment theory from the field of financial economics (more below on this subject).

I confess to personal guilt, having used and promoted one of these big asset-liability models in the early 1990s. My excuse is shared by many: The flaws are difficult to see unless one looks first at the larger problem through the lens of economic accounting; if one hasn't considered that the accounting might not be "real," it seems to make sense to optimize on accounting variables. But the bottom line is that the tremendous expense and complexity of these models is wasted, they accomplish nothing, and what they do appear to accomplish is both wrong and often harmful.

Today's technologies for developing pension plan investment policy: There are better technologies available that *do* take the liability into account, and which are consistent with best practices from the investment management side of the financial economists' world. Earlier in this

chapter I advocated "surplus optimization," an adaptation of Markowitz optimization made to include the liability. It was first written about by Leibowitz (1987), and later by others including Sharpe (initially in 1990 but he continues to write on related topics of investment policy in current times (2006)). I also have written about this subject extensively, making surplus optimization operational for pension plans, and in these articles I provide other references to the substantial literature of the topic (Waring 2004b, 2004c, 2004d, 2008, 2009; Waring and Whitney 2009). It is thought by many practitioners to be the best *practical* way, today, for developing investment policy in the presence of a liability. Others advocate a still simpler method, maximization of present value, but sponsors seem determined to use some form of utility maximization approach, perhaps with good reason.

A simple articulation of surplus optimization parallels the classic articulation of the Tobin (or Sharpe) two-fund theorem taught in all first-year investment courses: An investor with a liability should hold two portfolios, or "funds," one that matches or "hedges" the market-related risks in the liability (mostly real interest rate and inflation risks) and one that holds exposures to the world market portfolio of risky assets (equities and such). The latter portfolio is larger or smaller depending on the investor's tolerance for investment risk. (see Waring and Whitney 2009). This is straightforward and easy to communicate to the various constituencies of a plan and it is a remarkably good summary of a well-engineered investment policy.

Surplus optimization, using as the liability the economic version of the accrued benefit security liability, is the *minimum* standard I would suggest to use when developing investment policy. It accomplishes that task quite well, giving results that not only pass the "smell test" but are vastly improved over those from traditional asset-only and asset-liability technologies. Importantly, surplus optimization is readily tractable in the mathematic sense; the problem, once stated, is directly solvable. It controls periodic volatility in all of the important pension accounting variables to any degree desired (market risk is removed with the hedging portfolio and only added back through the size of the risky asset portfolio, a risk tolerance decision); this leaves only decrement forecasting errors (supplemental costs) as contributors to risk in economic pension expense, contributions, and surplus (the accounting risk then will also be controlled). Lastly, it is unambiguously consistent with ERISA's sole benefit rule (for corporate plans) and general trust law (for public plans).

But even more advanced technologies exist, though all of them suffer a diminishment of mathematical convenience and/or tractability relative to surplus optimization against the accrued liability, some more than others. And while the biggest improvement comes merely from moving from traditional methods such as the asset-liability study described above, to surplus optimization relative to accrued liability, each offers incremental advantages over surplus optimization against the accrued liability—so we may see more of them in the future.

First, we could refer to a measure of liability more complete than the accrued and on-book economic benefit security measure, perhaps the economic *PVFBP* for current and retired employees or perhaps the full economic liability, $PVFBP_{FEL}$. This becomes more complex for the *FEL* version, because of difficulties involved in estimating the present value of future normal costs for future hires, and in both cases because of the difficulties in estimating the value of the sponsor's termination/default option and the other options involved (the *EVLD* representing the termination or default option, plus the other options shown in Appendix 1). The benefit flows from using investment policy to control risk/return relationships for the whole plan, not just for the on-book accrued liability. Mathematically, we lose some tractability because options don't process in standard mean-variance optimizations so another more complex mathematical optimization technology is required.

We can go further, even *beyond* the pension plan, and consider how assets create risk in the context of the entire organization, referring to the so-called "augmented balance sheet."[52] Think of conducting a surplus optimization including not only pension assets and liabilities but all assets and liabilities of the organization as well. The surplus risk being managed would then not be the surplus risk of the pension plan, but the surplus risk of the entire organization, i.e., the growth rate and volatility of shareholder equity for a corporation or the growth rate and volatility of the demand on the tax base for a public body.

The academic literature on this latter topic moves well beyond simple mean-variance Markowitz-style optimization, and tends to be written in terms of pure utility theory. These approaches were originally pioneered by Robert Merton, who referred to his work as an "intertemporal capital asset pricing model." There is some advantage in modeling prices over

[52] See Treynor (1972), (1976).

time rather than using a single period model (1973). There are many variants (and a huge literature; see Campbell and Viceira 2002 for an encyclopedic review and a masterful synthesis). It is sometimes called a "consumption capital asset pricing model" and in this form is applicable to pensions, where it works directly from intertemporal benefit payments (consumption) rather than from their present values (as we do in mean-variance optimization).

While in theory the arguments for these broader views may be interesting and even compelling, the mathematics of solving the problems have not kept up with the mathematics of describing them; they are for the most part intractable, although having cracks here and there in their armor. Someday, these even-better methods may be available to us, but for today we make huge headway if we simply move to mean variance surplus optimization.

Note that any larger measure used re-introduces variability back into the on-book pension expense, contribution, and surplus figures. But that would still be the right answer: The *point* of the larger approaches, after all, is that an increase in pension expense, for example, is made up elsewhere in the form of a bigger reduction in some other expense or an increase in some other item of income.

A workable approach to taking advantage of some of the insights from these approaches, however, is to optimize pension assets against accrued on-book liabilities as suggested initially in this section, and then to modify the result, "bending" the policy towards or away from bigger market risks that the sponsor faces in its overall organization. If an organization is heavily exposed to the energy sector in one part of its asset structure, as are airlines and energy companies, for example, it might underweight energy in its pension asset portfolio. See, e.g., Merton (2003).

Certainly the final investment policy decision should reflect the term structure of the liability and perhaps also of the assets, inasmuch as short-term bonds are not riskless for investors with long-term obligations and even equities differ in their characteristics over long rather than short terms, Campbell and Viceira (2006a).

These larger optimization views are sensible approaches from an economist's perspective. But the first, smallest view of surplus optimization, referencing the accrued liability,

is the one seen most unambiguously consistent with the sole benefit rule. Perhaps they are all consistent: What is good for sponsors is also often good for participants.

My expectation is that, for now, only a few organizations will want to move to either of the larger and more inclusive approaches, preferring the comfort of managing the surplus of pension assets against accrued on-book liability. Merely to accomplish that worthy move away from older technologies, will require a consistent recommendation from actuaries, investment managers, and consultants. Make no mistake—it is not the ultimate answer to investment policy, but it is leagues better than what we've done in the past and it is practical *today*.

When is a Plan Truly "in Surplus"

We often say today that when a plan has more assets than the *ABO* (or than another conventional accrued liability reference measure, *AL*, which might be in use instead), that it is "in surplus." But from this t-account, and from the rest of our discussion, one can see that just because a plan is in surplus relative to its funding target measure of the liability, does not mean that the plan really is "in surplus" in any complete or general sense. There are two reasons, the first being that conventional measures understate the true size of the accrued liability by using a discount rate that is too high, stating the liability in sasquatches rather than dollars. A $7 stated liability is probably really a $10 liability in most plans.

The second reason that such a plan is not in true surplus, even if the reference accrued liability is an economically correct measure, becomes apparent only when one realizes that accrued liability is a subsidiary liability within the greater *FEL*. Unless the plan is so fortunate as to be funded in excess of the *FEL*, it is not in true surplus: the continuing accrual of normal costs, slowly moving the off-book portion of the liability into the on-book accrued liability, will over time consume any funding level above the current funding target but below the *FEL*. Only when fully funded to the *FEL* might a sponsor *expect* to make no further contributions; in that case such a surplus might be fair game for the employer and employees to argue over and divide up in some way, including claims for benefit increases. If an aggressive but risky investment policy has helped move the assets ahead of liability accruals, then the sponsor is rewarded by a reduction in the size of required contributions until the ongoing accrual of new normal costs, generating new on-book liabilities, uses up that surplus.

Proposition 14

> *A plan is not in true surplus when the assets are merely greater than the economic accrued liability, but only when the assets on hand are greater than the full economic liability. The difference between the economic accrued liability and the FEL is the present value of future normal costs, and any surplus over the accrued liability is simply pre-funding for those future accruals.*

This is an important qualifier to the term, being "in surplus." Perhaps we should habitually use more precise terminology to describe these funds, perhaps "pre-funded future normal costs," to avoid the implication that the plan is completely funded in a general sense—which is how the term "in surplus" is usually understood by plan constituents and sponsors alike, today.

This is important because sponsors today often agree to employee demands to increase benefits when plans are "in surplus" to their accrued liability. A sponsor that understands that its plan is not in surplus with respect to the *FEL*, only to the accrued liability (and probably an understated version of it) might make a different choice.[53]

Managing the Present Value of Future Contributions Through Investment Policy

Some pension advisors advocate that their clients can reduce the present value of future contributions (*PVFC*, or if economically determined, *ePVFC*) through well chosen investment policy.

But recall that pension assets plus present value of future contributions, on one side of the balance sheet, equals the liability on the other side. If *PVFC* changes as a result of investment policy, something else would also have to change as a result of this change in investment policy, or the balance sheet will no longer balance. Change cannot be to the liability, as it is determined by the benefits promised and a market-determined, not asset-determined, discount rate. And it won't be to pension assets—regardless of how assets are invested, the portfolio has the same present value (a dollar's worth of stocks is worth the same today as a dollar's worth of bonds).

[53] See Appendix I, describing some of the implicit options in pension plans.

And while I didn't mention the various implicit options, a more aggressive investment policy will also not change the *PVFC* through them.

We can state this as an indifference proposition. Since the same logic would apply to any effort to change the present value of future normal costs by changing investment policy, we'll state it as applicable to both:

Proposition 15

> *You cannot change the present value of future contributions or of future normal costs through investment policy decisions.*

You *can* aspire to improve the *PVFC* at some time in the *future* (the future present value?!) through investment policy (ditto for normal costs), but that change depends upon investment realizations, which may be up or down, as realized. With more aggressive investment policy the expected level of contributions and expense does go down, but the present value remains unchanged because of the increased possibility that contributions and risk may go up as well.

Chapter 7: A Retirement Party for the "Required Rate of Return"

The "required rate of return" was the key technology allowing the first retirement plans to be built, paying for far distant benefits with current contributions. It is a concept at the heart of the "funding method."

The required rate of return is developed by balancing two opposing necessities: trying to *reduce* the planned level of *contributions* needed to support the agreed benefit payments, by assuming *higher returns* on the invested assets over an arbitrary but lengthy period of time.

Mechanically, the process is iterative. The number of variations in use reflects the amazing creativity of the actuarial profession, but the description set forth in the following paragraph should suffice to represent them all for purposes of this paper.

Benefits are projected, usually for a closed group. Contribution rates are experimentally adjusted up and down while the rate of return is simultaneously adjusted down or up, with the goal of finding a combination of contribution plan and rate of return such that the present value of future contributions equates to the present value of future benefit payments (all discounted at that rate of return). The actuary's adjustment of contribution rates *downward* necessitates that the required rate of return be adjusted *upward*, and vice versa.[54] Both must be in "reasonable" balance for a solution to "look right."

When this balancing act is finished, both a contribution policy and a required rate of return have been established. (This is not intended to be a pejorative description, and I understand that many actuaries in fact are not seeking a particular contribution level at all when conducting this exercise. Nonetheless, the process itself does provide that temptation.)

As an accident of the process, "present value" of the future benefit payments is created, but one using the "required" rate of return itself. It is in this sense that the *actuarial liability* is only a "mathematical byproduct" of figuring out how to fund the plan (see full quote in Chapter 1).

[54] Once again, I understand that for certain aggregate methods the two will appear to move together, a patent violation of financial common sense that should cause immediate discontinuation of the use of such a method.

Depending on specifics of the particular method, the required rate of return is either exactly or approximately an "internal rate of return," or IRR, a concept from discount math well known to financial economists. But an IRR doesn't take investment volatility, or risk, into account. Its use in this application assumes that the planned investment returns will actually occur. But those exact returns will not occur—investments in risky asset portfolios sufficiently aggressive to generate the required rate of return numbers that we see today will have a high degree of volatility, and will behave more or less as displayed in the "tulip" charts shown elsewhere in this essay: they can and will surprise us, either pleasantly or unpleasantly, over time. What does this mean for the plan?

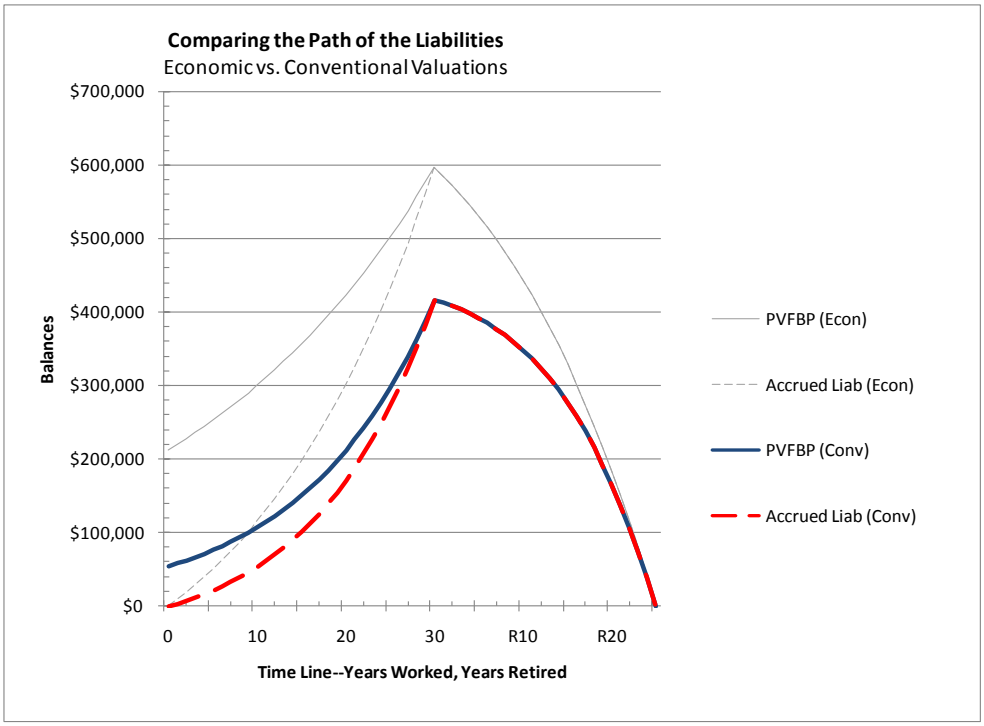
Visualizing the Required Rate of Return

Let's go back to the funding charts that I developed in Chapter 4. When I look at these charts, showing how economic normal costs created using a market-based liability create an accrued liability that grows to cover the retirement annuity, I can almost hear one of my actuary friends leaning over my shoulder and challenging me by saying, "These charts don't *prove* that we need to use the risk-free rate curve for our discount rate; I can draw graphs that look just like these do, using the higher required rate of return as the discount rate."

Yes, this is true; he can, at least almost. Let's do it and take a look. To set down a baseline for comparison, Figure 13 shows a diagram similar to Figure 6 and Figure 7 from Chapter 4, although the curves for the market value accrued liability and for the $PVFBP_i$ are for a normal cost method based on a constant percent of pay (such as was used in Figure 8). These curves are softened, "grayed-out" to de-emphasize them and put them in the background, so that we can highlight my friend's version on the same chart.

To do this, I've added new, lower curves for the path of the same liability but computed at a higher discount rate—7 percent—such as might be associated with required rate of return,

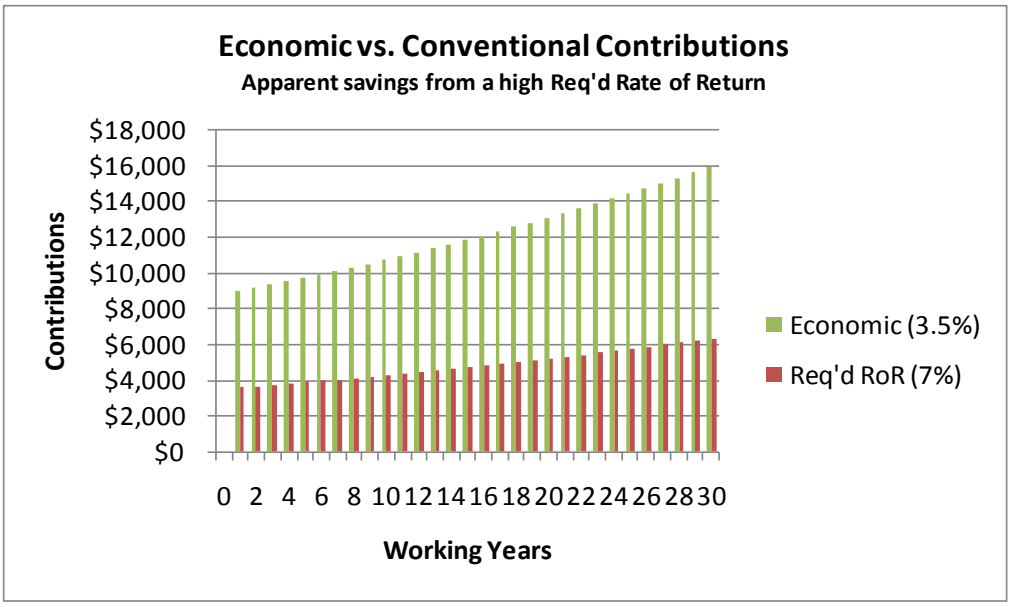
Figure 13



rather than 3.5 percent, as is used for the higher risk-free curve. Notice that the $PVFBP_i$ line is now much lower on the graph as a result, and thus much smaller in stated value.

It would clutter the graph to show the cash flows in the same picture, as I did earlier, so I show them separately in Figure 14. The forecast cash flow lines for *contributions are all much shorter* using the higher discount rate, indicating much lower contributions. The cash flows for benefit payments (not shown) would be identical in either case—they are controlled by the benefit formula and don't change with the discount rate.

Figure 14



This is the contribution level vs. discount rate trade-off that is at the heart of the actuarial "funding method," described just above. A higher discount rate, with a lower apparent liability representing the same ultimate benefit payment obligation, suggests smaller required contributions. So, the graph *looks* workable; all benefits are paid. Why criticize this picture?

I discussed in Chapter 2 that we take on significant surplus risk when we invest in a portfolio of equities and other equity-like asset classes that are not hedged to the liability. Surplus risk means not only that the surplus or deficit of the plan is not stable, but also that the plan might get *less* expensive in terms of required contributions and pension expense, or that it might get *more* expensive.

It all depends on investment realizations over a period of time: For a portfolio discounted at the correct, liability-hedging discount rate, if the returns realized are equal to those of the liability-matching asset portfolio, the plan's contributions and expense will be as expected, and the accrued liability will always be perfectly covered by the accruing assets so that the surplus is stable. If realized returns are above that discount rate there will be excess assets, and contributions and expense can be reduced by that excess. *But if worse, then they'll be higher by*

the shortfall. In this case, where we are working from a liability discounted at the risk-free rate, the realized return "break-even point" is the relatively low risk-free rate.

But when using the high required rate of return of a risky asset portfolio as the discount rate, we are both discounting the liability at that higher expected return *and* we are planning lower contributions into the fund, a double whammy. This makes the realized return break-even point higher than before: Now, the realized returns have to be at or better—not than the risk-free rate, but rather the higher expected return assumption—in order for contributions and expense to work out as expected; or lower (compare Figure 2 to Figure 1, for a complementary picture). *If realized returns for any period of time do not cumulate to this geometrically annualized expected rate of return, then contributions and expense need to be higher than planned in order to make up the shortfall.* So, absent any other considerations, we've raised the hurdle rate for success.

Demonstrating the Lack of Benefit Security Caused by Using the Required Rate of Return

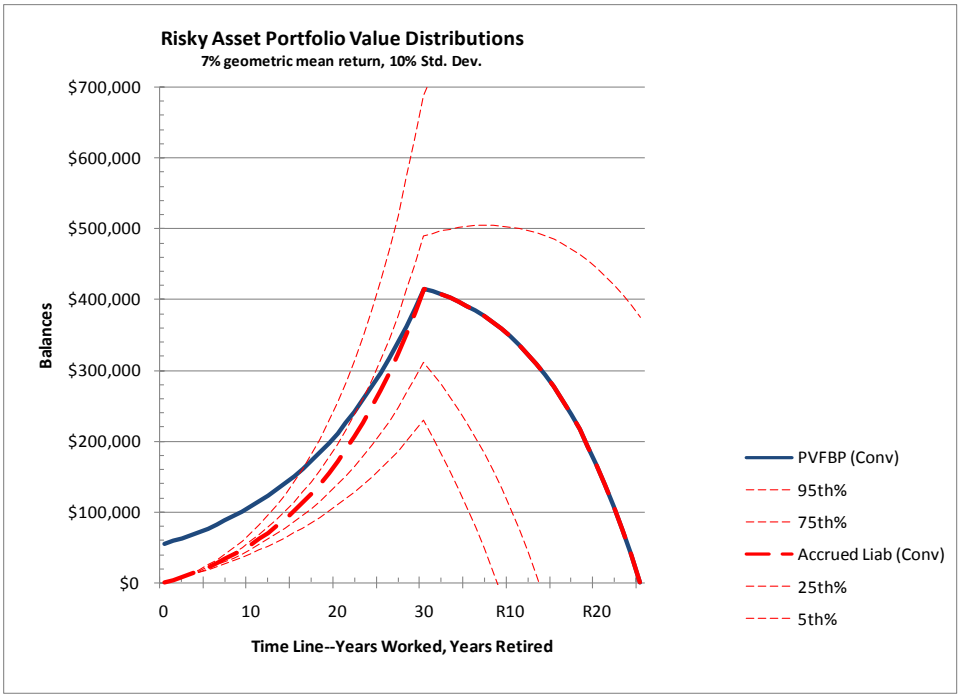
Unfortunately, Figure 13 shows neither this uncertainty in the asset portfolio nor how it relates to the accruing liability. We need to know how the portfolio might diverge from the accruing liability. Figure 15[55] superimposes, over the path of the accrued liability, a special form of "tulip" chart showing the distribution of asset values over time as they grow with volatile asset returns, assuming that only the lower planned contributions are made. In its usual presentation, a tulip chart shows the growth of a single dollar from time zero, with no cash flows in or out. But here, we have contribution cash flows coming in every period during the accumulation phase, and benefit payments going out during the retirement or decumulation phase. So we have to show percentile lines, as in a tulip chart, to represent the variability in the value of a portfolio *with cash flows*.

The accruing liability remains as a single solid line, with no appreciable variability (there will be some wiggling, from supplemental costs). But when risk is included, the accumulating

[55] This is a particularly difficult tulip distribution chart to create, because of the cash inflows and outflows from contributions and benefit payments, a more complex assignment than creating a tulip distribution around the growth of an initial dollar as is the usual case when using the Ibbotson-Sinquefield approach to simulating distributions of the growth of a dollar. Dr. Duane Whitney provided the expertise for its calculations, adapting Kaplan's (2009) method, and deserves the credit for making this display possible; to my knowledge it hasn't been done elsewhere. But it has application for many real life investment situations, other than pension plans. Individual investors save over time and then spend over time, while investing in risky assets, and their expected experience could also be modeled in this manner.

assets show a wide and diverging distribution of possible values over time, dramatically shown by the 5th, 25th, 75th, and 95th percentile lines (the surplus standard deviation for this chart is 10 percent, low relative to the 14 percent or so that I often see for conventional unhedged investment policies).

Figure 15



If there is an extended period of poor returns, represented by the 5th and 25th percentile lines, this retiree's benefit payments would be halted for lack of funding well before the end of his 25-year retirement (just over half way through, at the 25th percentile). There would be a very large deficit, and both the sponsor and the employee will be facing the risk of default.

In an economically tidy world, a deficit in any period is supposed to be made up through a higher contribution that same period. If that were to happen in every period where there was a deficit, then the asset portfolio would again be made always to be at least equal to the accruing liability, and after periods of strong realizations the asset portfolio would lie above the accruing liability. The sponsor would "feel" the accumulating volatility of the assets not just as an unpleasant deficit when the market trended the wrong direction, but also as a surprise demand for an extra contribution and as a surprise hit to pension expense.

How big might those surprises be? I can "size" them for the reader this way: If the fund is always "topped up" to equal the accruing liability in every period when it ends in deficit, then at the end of any given year in which there is no prior surplus, the exposure to a surprise contribution is determined by our standard deviation (here 10 percent) applied to the accumulated value of the asset portfolio. That is, a $20,000 to $40,000 surprise contribution at a one standard deviation probability (16th percentile; it would be roughly twice as large at the 5th percentile), each year during the middle 30 years of the time line when the asset portfolio is between $200,000 and $400,000 in value. This is "worst case" in some sense, as in years where prior realized returns were above expectations the excess would offset a following year's below-expectation return.[56] Weighed against this regular possibility of a $20,000 or even perhaps a $70,000 additional surprise contribution, is a constant $5,000 to $8,000 per year "saving" in the base contribution.

If the sponsor cannot or does not make up deficits from unhappy investment realizations in each year (or at least frequently), the security of benefits may be impaired.

But the bottom line is that the present value of future contributions is exactly the same regardless of investment policy or discount rate, on a risk-adjusted basis. It is just that contributions are higher, and certain, if we compute them using a risk-free rate, and they are lower, but with much more volatility when computed using a higher required rate of return. The present value of the volatile portion of contributions in the latter case is exactly equal to the difference in present value of the two basic contribution streams when adjusted for the implicit options. It works out; there is no free lunch.

When the volatility of returns is taken into account, the purported savings in contributions from using a high required rate of return are shown to be completely illusory; motion has been confused with forward progress.

[56] The trust is effectively long a combination of a bond and a one year call option on the equities, refreshed each period. The premium on a series of such positions is quite high. And the trust is also exposed to the sponsor's default option with respect to any portion of the liability that is unfunded.

Proposition 16

> *Adjusting the value of the accrued liability and of contributions downward based on the expected return or required rate of return assumption from the plan's investment policy—i.e., the traditional actuarial funding method—is a serious methodological and valuation error: It assumes with certainty that an uncertain investment return will in fact be realized, which implies that there is no risk to funding or to contribution and pension expense rates when in fact there is substantial risk to both. That risk is equivalent in value to the present value of the downward adjustment to contributions. The funding method only appears to reduce contributions, but in fact does not reduce the present value of future contributions whatsoever.*

The Required Rate of Return and Investment Policy

The actuarially required rate of return on pension assets has had a powerful moral sway on investment policy: provided with such an imposingly labeled number, sponsors hesitate to choose any investment policy having an expected return that doesn't achieve the same number. So it has effectively replaced any sense of risk tolerance that might otherwise come into play when sponsors select levels of aggressiveness or conservativeness for their investment policies.

The actuarially required rate of return thereby became the *de facto* minimum target level for the expected rate of return that *must* be achieved by the investment policy decision: An investment policy, say a 70-30 mix of equities and bonds spread across a number of asset classes and selected from the efficient frontier, is chosen if, and only if, its expected return is at least equal to the actuarially required rate of return.[57] Tolerance for risk is given lip service, but the real check is to see whether or not the rest of the pension herd is following the same lead: Looking over our shoulders, are other plan sponsors doing approximately the same thing?

[57] As an IRR, the required rate of return is a geometric, or compound, average. As mentioned, it is often used as a minimum expected return when working with efficient frontier graphs and other optimizer output. But optimizers work with arithmetic averages, which are higher than geometric averages by approximately half the variance (.50 percent for an investment policy with a 10 percent standard deviation). Optimizers require the geometric average because, for volatile investments, you must *target* the expected arithmetic average each period in order to have an expectation of *achieving* the geometric average over multiple periods.
So yet another error is introduced when the required rate of return is used in this way. Regrettably, the arithmetic equivalent of the required rates of return in common use today requires an asset mix even more aggressive than that already encouraged.

No wonder investment policy is so remarkably uniform across pension plans—the demand for returns implied by an imposing-sounding "required rate of return" is allowed to overpower the sponsor's sense of risk tolerance. This occurs perhaps with the aid and support of the sponsor's actuary, who has become convinced that a more aggressive investment policy is a safe way to reduce contributions, and believes it to be in the best interest of the plan. In effect, when deciding the "reasonableness" of the discount rate while weighing different contribution policies, the actuary him- or herself has taken over the risk tolerance decision from the sponsor. I would observe that this decision is the proper domain of the sponsor, not the actuary.[58]

Is Actuarial Confidence in High Expected Returns Well Placed?

The rationale most often heard justifying more aggressive investment policies with higher expected returns is that "pension plans are long horizon investors, and 'you get' the expected return over the long horizon." This was discussed in Chapter 2: the key problem is that mere length of term doesn't by any stretch of imagination allow one to plan on "getting" the expected return; risk to wealth accumulates with time, it doesn't diminish.

An ingenious variant on this argument is that "because the sponsor will get the expected return," it would create a "generational inequity" to charge that wise sponsor's taxpayers today with a cost that doesn't take the high expected return into account. To do so would unfairly give future generations of taxpayers the benefit of those high returns and reduced contributions, rather than the current generation.[59]

But since you don't "get" expected returns, this generational inequity argument is completely backwards; the cart being literally before the horse. If in fact the expected return assumption *is* used, the inequity is against the *next* generation, in favor of today's generation. This is because today the sponsor will count, as if already received, equity returns that have a

[58] This chapter dramatically demonstrates the fallacy involved in the actuary's common assertion that C+I =E+B, or that contributions plus investment returns equals expenses plus benefits: It quietly assumes that investment returns are a constant. In fact, contributions are a variable function of first, the present value of future benefit payments (plus expenses), and second, investment earnings which in today's practice are quite volatile and make for variation around the contribution level that is a pure function of benefits in an asset-liability matched plan.

[59] There is a sense in which this argument applies to corporations as well, although the better view is to note that the share price, in theory, immediately reflects any underfunding of the pension plan thus preventing generational shifting.

very real chance of not actually being realized, and if that occurs then tomorrow's generation must pay the shortfall.

Proposition 17

> *There is indeed a generational inequity involved in using expected return assumption to compute contributions: Its use is an inequity against the future generation, who may well have to make up for lower contributions being made by today's generation on the strength of expected returns that have a very real possibility of not being realized.*

The irony in this discussion is that, if contributions are made responsibly, not allowing the plan to go into deficit, then there is no savings to be divided between generations, equitably or inequitably, as discussed a few paragraphs above.

Presenting the Gold Watch

We know that, historically, using the required rate of return—which until very recent decades was determined by the expected return of a *bond* portfolio—did little harm; the bond portfolio was a "poor man's approximation" of a liability-matching asset portfolio and so a good thing. I suspect that this didn't happen by chance, but represented the good judgment, fiscal rectitude, and informed instincts of early pension actuaries.

But over the last few decades the dynamic has trended to increase the proportion of equities and other risky assets in the portfolio so as to increase the expected return assumption, so as to increase the discount rate, so as to reduce the "actuarial value" of the liability, so as (finally!) to reduce required contributions. Therefore the moral *force* of the "required rate of return," as used in the funding method in recent times, has fostered and encouraged a certain moral *hazard* inappropriate for any fiduciary with responsibility over a pension plan. To paraphrase the familiar bumper sticker, "Risk Happens." The poor market returns of recent periods have shown this methodology to be a major contributor to the current pension funding crisis, a fact that by itself should be causing considerable (and responsible) introspection by the actuarial profession.

The correct way to calculate contributions is not to trade them off against required rates of return, but to calculate them as payments required to amortize the future life annuity represented by the benefit promise, using a risk-free rate curve to discount benefit payments in each future period. There is no "balancing act;" there is no role for judgment in balancing required rates of returns against contribution levels. Expected returns go up with risk, so if we want the risk-free version, we use the risk-free rate; it is the same, on a risk equivalent basis.

And the correct way to determine investment policy isn't to invest aggressively in hope of achieving an uncertain but high "required" rate of return, but rather to choose a "surplus optimal" investment policy generating a *utility maximizing* expected rate of return *taking risk into account*. This has the natural follow-on effect of controlling risk to the rate of contributions as well as to pension expense.

By changing funding method to the risk-free method, *contribution policy* becomes only a minor actor in the play and contribution level is basically determined by benefit policy. Only the *timing* of contributions, not their size (measured as the *PVFNC,* calculated by using market determined discount rates) is left to be controlled by the choice of normal cost method and its associated accrued liability. A "slower" normal cost method means smaller contributions earlier and larger ones later; as a result it also means less secure benefits for the typical workforce.

We can still agree that the search for higher expected returns has as its purpose the desire to reduce contributions. But you reduce them *after*, not *before*, the fact of good returns happening, hopefully by experiencing high realized returns and building a surplus relative to the accrued liability, then consuming it in the form of reduced contributions. This is the right way to enjoy an aggressive investment policy. The result is the same, but the incentives and the measurements are much more appropriate.

It is regrettable but true. There is no longer a place for the concept of "funding method" or "required rate of return" in pension finance; they are artifacts, relics from pre-modern portfolio theory actuarial practice. It is time for them to be retired to the place of honor they deserve for their historic role in making pension plans originally possible. Without them we couldn't have the institution of the DB plan at all. The DB plan is an exceptionally good means

for spreading a portion of one's working life income over into one's retired life, and we owe this invention to the funding method and the required rate of return.

But today we know more about finance and have better tools, so it is time to retire the old ones, with gratitude. The discount rate is an observation, taken from the market, and not an assumption.

Proposition 18

> *The actuarial "funding method" and the "required rate of return" are not designed to do the task that they are asked to do today—developing contribution policy in the presence of risky investments in the pension asset portfolio. They have no mechanism for trading off the risks of such investments against their returns, including the follow-on effects of those returns on the pension surplus or deficit, on contributions, on pension expense, and on benefit security. Their role in pension actuarial and accounting work, and in developing contribution policy, normal costs, liability valuations, pension expense, investment policy, and other tasks has been replaced by more modern methods based on market-related discount rates and the idea of maximizing surplus utility—methods that do take investment risk into account. The use of the funding method and of the required rate of return should be discontinued for all these purposes.*

This retirement is a bit too late and some damage has been done to the accounts, but we don't want to mention these things at the party. Let's remember instead all the good that the required rate of return did for us in its prime working years.

Postscript

Words have power, and are usually used to a purpose. I note with interest that if we choose to use the word "required" from the phrase "required rate of return" in its full ordinary sense—that of demanding something as being necessary or essential—the only rates of return we have the power to literally "require" are rates on the risk-free rate curve. Maybe those wise old actuaries who dreamed up the original funding method and who used it with long bond rates of return really did have the prescience to anticipate modern portfolio theory.

But if so, use of the term as it has come to be used recently, referring to returns on risky asset portfolios, does not pay just homage to their insights.

Chapter 8: The Fully Generalized Pension Budget Identity

Earlier, I gave the following form for the pension budget identity at time zero. It is only completely accurate at the moment of starting the plan, *t=0*, which was, after all, the context within which it was developed:

$$\underbrace{ePVFBP_{FEL\ t=0}}_{\text{balance sheet}} \equiv \underbrace{ePVFNC_{FEL\ t=0}}_{\text{income statement}} \equiv \underbrace{ePVFC_{FEL\ t=0}}_{\text{cash flow statement}} \qquad (3)$$

The budget identity is mostly about levels, or "stocks." We have since discussed all of the "flows" that connect these stocks from one period to the next: periodically accrued normal costs, various types of supplemental costs, benefit payments, interest costs, contributions, and earnings on pension assets.

Now I want to develop a more general form of this pension budget identity, incorporating this subsidiary accrued liability.[60] The first step will give a form that will be true at any point in time, *t*, where the plan is fully funded, *i.e.*, where it has pension assets on hand exactly equal to some subsidiary measure of the liability (let's again say the generalized accrued liability that we have chosen as an economically meaningful benefit security funding target, *eAL)*. In this restricted case, the present value of the full economic liability, *FEL*, is equal to the *eAL* plus the present value of future normal costs, or equivalently, to the *eAL* plus the present value of future contributions *if* the *eAL* is fully funded. Using the short form notations *FEL* and *AL* in place of the full present value of future benefit payments notation:

$$FEL_t \equiv eAL_t + ePVFNC_{eAL\ t} \equiv eAL_t + ePVFC_{eAL\ t} \qquad (19)$$

I can make this more fully general, applicable to *any* level of assets on hand, by adding an *eAL* surplus (deficit), $S_{eAL\ t} = PA_t - eAL_t$. Because the assets are greater than the accrued liability, the surplus relative to the accrued liability displaces some portion of the *ePVFC*.

[60] I won't take the final step of including the *EVLD* in these identities, consistent with my intention to minimize discussion of the various options in the plan, but all three financial statements in equation (3) would be offset by an equal amount if I did. There is a benefit to this omission: By not including it, we're making an implicit assumption that the sponsor is able to support the plan for the long term, and is happy to do so. That's not a bad assumption for those of us who would like to be advising healthy plans for the long term.

Modifying equation (19) to show this more general example:

$$FEL_t \equiv eAL_t + ePVFNC_{eAL\,t} \equiv eAL_t + ePVFC_{eAL\,t} + S_{eAL\,t} \qquad (20)$$

The $ePVFC_{eAL}$ can be viewed like a "plug" that varies so that, when combined with the surplus (deficit), it balances this equation (unlike the more usual use of the term "plug," however, this value can be independently calculated). This illustrates my earlier point that a plan that is "in surplus" relative to the subsidiary liability *eAL* is not in true surplus; it will still need to make future contributions. As normal costs accrue, flowing from the $ePVFNC_{eAL}$ to the *eAL* (and as benefit payments get made, reducing both the *eAL* and the pension assets), the surplus will be consumed absent further contributions. Such "surplus assets" aren't surplus at all, rather they secure future accruals not yet charged but clearly foreseen. And if the surplus is negative—a deficit—then the $ePVFC_{eAL}$ is greater than the $ePVFNC_{eAL}$ meaning that normal costs weren't paid in prior years or that a bad loss resulted from risk taken in the asset portfolio. Either way, the sponsor now has to make up this arrears.

Only if its assets are so large as to exceed the *FEL* is a plan truly in surplus; then there truly is no *expectation* that future contributions will be needed (although the path dependent nature of investment returns may result in contributions being required if there is a risky asset portfolio in the investment policy).

Many practitioners are particularly interested in the on-book accrued liability, *eAL*, which can be defined in this context by the simple expedient of rearranging terms:

$$eAL_t \equiv FEL_t - ePVFNC_{eAL\,t} \equiv FEL_t - ePVFC_{eAL\,t} + S_{eAL\,t} \qquad (21)$$

This form of pension budget identity defines the *eAL* as a portion of the full economic liability, though a very specific portion. Either the present value of future normal costs or the combined present value of future contributions (the latter with any surplus or deficit) will fully describe the difference (see equation (8), for another parallel parsing).

This is very valuable information: what sponsor or actuary wouldn't want to understand the $ePVFNC_{eAL\,t}$ and the $ePVFC_{eAL\,t}$, the present value of future normal costs and contributions

associated with its plan? While the *FEL* has no prior use in the practice of pension management, it clearly has a defining role for any sponsor interested in the size of its commitment in pension expense or contribution terms.

The Inviolability of the FEL

These relationships reinforce that the valuation of the plan—and by extension its normal cost and pension contribution items—all ultimately reconcile to one number: the full economic liability. Because I have used a generalized accrued liability to show this, it will be equally true for any economically determined measure of the accrued liability, with its associated normal cost method.

I have completed the argument here that economic versions of conventional accounting and actuarial values tie back to the *FEL*. Accepting that principle, it also follows that all *non*-economic, or conventional accounting and actuarial values, also must reconcile to the economic *FEL*—if not immediately, then sooner or later. The fact is that the full *FEL* describes the full value of the benefit package, delivered over time. An economically determined subsidiary accrued liability and its associated normal cost method accrue portions of the *FEL* onto the books, over time, on some agreed basis as a target for funding.

The present values of both normal costs and contribution are absolutely direct functions, first of the future benefit payment cash outflows defined by the benefit policy (the *FEL*), and second by the market-related discount rate. As a result, a sponsor can't "save" anything in present value terms by avoiding a normal cost or contribution today, regardless of the method used in that avoidance: Conventional calculated liability measures and normal costs, including the opportunities that they present for current period manipulation, might appear to reduce contributions or expense in the moment, *but they are never permanently avoided* (absent default and bankruptcy, but we accounted for these possibilities when discussing the *EVLD*, earlier).

The result is that, if contributions and expense are not paid or charged when they should be paid or charged on an economically sound basis, they are simply deferred—and with interest. Again, there is no pension finance free lunch.

Because the proper discount rate is set by the market and can't be managed by the sponsor, the one and only way to "manage" contribution and expense over the long term is to manage the size of the *FEL*—and it is managed by managing benefit policy. How big are the benefits, and when are they paid? This benefit policy decision is the single "dial" truly controlling the cost of the plan.

So I offer an accounting analogy to the first law of thermodynamics:

Proposition 19

> *Value, in the form of changes to the eAL, the $ePVFC_{eAL}$, or the $PVFNC_{eAL}$, is neither created nor destroyed by accounting treatments and manipulations, only by benefit policy.*

You can't fool Mother Nature—or economically defined pension budget identities.

Chapter 9: The Rosetta Stone—How Good Economic Measures Get Translated into the Actuarial and Accounting Measures We See in Practice

Most sponsor executives responsible for analyzing and managing pension plans, other than their actuaries and perhaps their accountants, view various conventional measures of the liability, of expense, and of contributions as if stated in an unintelligible foreign language, incapable of translation or full understanding. Yet I believe that persons of ordinary finance and monetary acumen who are reasonably comfortable with the time value of money, can understand economic versions of these measures even though conventional versions predominate in actual use. Can we show how to translate parallel concepts from the language of economic accounting into the language of actuarial and accounting convention?

Discount Rates Differences

The single biggest difference between conventional accounting and economic accounting lies in choice of discount rates.

It is broadly accepted by financial economists, and more recently by the actuarial and accounting communities, that the "right" discount rate for liability is a market-related discount rate and that for a secure benefit, the market-determined rate is the risk-free rate (as discussed already in Chapter 1). However, to my knowledge, actuarial and accounting practice has never used the risk-free rate or any other similar market-related rate to discount the primary measures of the pension liability.[61]

Public employee and multi-employer Taft-Hartley pension plans use the expected return on the *asset* portfolio—the wrong side of the balance sheet, for all purposes. Corporate plans, for purposes of calculating their pension expense and contribution values, also use expected return on the asset portfolio, although the PPA now forces many to use a high-quality corporate bond

[61] As pointed out earlier, the concept of market-related discount rates simply didn't exist when most actuarial or funding practices were developed; further many GAAP accounting measures use discount rates different from those that actuaries use for funding. Nonetheless, there are a few *non*-primary uses of a treasury-referenced discount rate: The "current liability," an ABO-like measure used as a trigger point for certain minimum funding contribution requirements, uses a smoothed treasury rate, but its effectiveness is diluted by its handling of certain credit balances from prior contributions. Lump sum payouts are determined using treasury rates. And the PBGC uses treasury rates to determine funding levels for purposes of setting its premiums. Even so, for most portions of the liability the real rate is more appropriate than the nominal rate.

rate to calculate contributions, similar to that used for purposes of establishing balance sheet accrued liability entries. While high-quality corporate credit rates are usually well below the expected return on the asset portfolios and so an improvement, they are usually a point or so higher than the proper long-term risk-free rate and, in the winter of 2008-09, were more than two points higher (the exact amount depends on credit spreads at the time). Either of these rates therefore tends to understate the true economic value of the accrued liability, although by different degrees.[62]

This illustrates the key issue in translating the "right" economic measures into conventional accounting measures: Before doing anything else, we need to re-compute the valuation of the liability measure of interest using the proper discount rate curve, and we might have to do it in different ways for different financial statements of the same sponsor!

We achieve a rough initial approximation of this translation by viewing valuation change as a combined function of the liability's duration and of the interest rate differential between the risk-free rate and the discount rate being used. At typical durations[63] of say 15, this will show approximately a 15-percent understatement for accrued liabilities based on the high-quality corporate credit discount rate used by corporations (a 1-percent credit spread, times 15 duration), and a roughly 45 percent understatement of the accrued liability measure based on the expected return of assets for public plans and multi-employer plans (a spread of the asset expected return of say 6.5 percent over risk-free rates of about 3.5 percent, or 3 percent times 15 duration). Public employee and multi-employer plans would therefore have about a 45-percent understatement error, for *both* reported liability and contribution calculations. (With such large

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[62] I have seen *healthy* sponsors react by stating that they are being "punished" by low market-determined discount rates, giving them a larger liability and greater required contributions despite their good behavior. But high discount rates are not rewards for good behavior—rather they are the market's punishment of expected *bad* behavior. The argument is exactly backwards: low discount rates are what is really "good," not high ones. Remember the alternate view: the discount rate is also the rate of interest being paid to the plan participants on their deferred earnings; when it is low, this borrowing is also at a low cost. Of course, if underfunded, the implicit rate actually charged is higher by the credit risk premium, and some have made the argument that employees will assess a higher credit risk premium than would commercial lenders (for lack of ability to diversify).

[63] In more precise work, instead of using single nominal durations we should use the dual durations (real interest rate and inflation) of Waring (2004), inspired by the multiple liability durations of Goodman and Marshall (1988), in place of conventional single-factor nominal duration. Or we might use a good multi-factor interest rate model: A three factor model might include my preferred first two factors, inflation and real interest rates, then add curve twist; other factors could be added if thought to be helpful. Fabozzi et al (2006) suggest more detailed liability models.

differences in rates, a duration-based approximation is quite rough because the effect of convexity grows large; accurate versions would be calculated plan-by-plan, using the actual forecast cash flows and the full spot curves.)

The net effect is that, currently, reported on-balance sheet accrued liability of conventional accounting is always understated relative to a market-related measure of the same liability measure, by perhaps 10 percent to 15 percent for corporations (if using historically typical credit spreads), and probably double that or more for public employee plans in the United States.

This isn't just a matter of the stated size of the liability, which is the usual way it is discussed: Because normal costs are a function of the liability, any normal cost based on a rate higher than the risk-free rate is also understated, meaning that normal cost components of both required contributions and pension expense are understated. In turn, this means that benefits are less secure than we think they are, and that sponsor income is overstated.

Multiple Inconsistent Normal Cost Measures

Because different regulatory environments use different normal cost methods, and thus, different associated accrued liabilities, normal cost measures are inconsistent as well. The biggest method differences are found in funding methods controlled under federal statutes by the DOL and IRS (and to some extent the PBGC) for corporate plans, and in accounting under FASB and GASB. This often means different normal cost methods and even different discount rates. The result is that neither method is likely to be an economically meaningful normal cost, i.e. one that, if funded, we can fairly expect to create an accrued liability that would provide solid benefit security (without a high likelihood of frequent and potentially large surprise contributions; see Chapter 7).

This result can't be blamed entirely on the regulators. There may be limitations on the normal cost method to be used, but bounds on discount rates are upper bounds, not lower bounds. There is little or no regulatory impediment to using a lower discount rate for both funding and accounting purposes. While the IRS, for example, can be expected to have reservations about lower discount rates with respect to corporate sponsors, it isn't impossible to

imagine this lobbying resistance to improved new legislation and regulation giving way, particularly in the face of a developing consensus from actuarial and accounting communities that an economic approach would serve all parties involved better than they have been served in the past (the discount rate was already reduced by the PPA, so we know it can be done). It is fair to remember that pension plan regulations were formed with full actuarial and accounting input, and that they heavily reflect the community's best advice of the time. The best advice of our current time is to implement changes that show market values.

Smoothing and Amortization, Generally

The motivation behind smoothing and amortization efforts is to make today's experience of costly pension effects "go away." This is misguided, in that risks and costs don't really go away as a result of smoothing and amortization efforts. And though I get resistance when I lump smoothing and amortization into the same bucket, the fact is that they are the same in their smoothing effect, even if perhaps different in motivation.

Asset values are a convenient place to demonstrate this—but the result is completely general to all smoothing and amortization efforts, on both sides of the balance sheet.

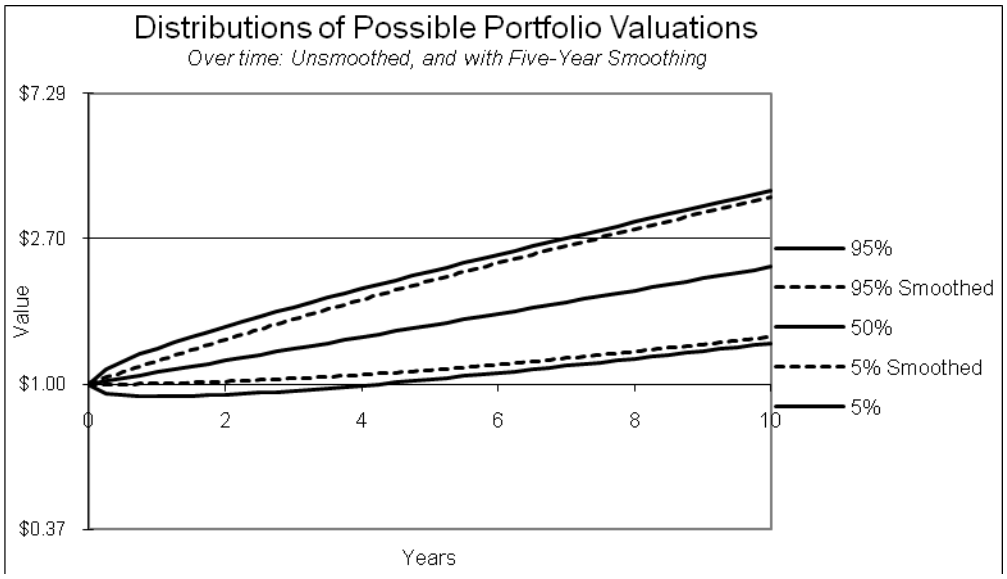
For example, many presume that five-year smoothing reduces risk by a factor of the square root of five, i.e., by more than half. Let's see if this is a fair characterization.

Presume that our exemplary plan has a 75-percent to 25-percent equity-fixed mix (in multiple asset classes), a typical investment policy for a U.S. DB plan, other than that it has an overlay completely hedging the liability. An overall expected return of 8.87 percent and a standard deviation of 10.94 (both arithmetic), would be fair for that policy. This expected return is consistent with an 8 percent geometric rate, for comparison to common expected return assumptions.

Figure 16 shows another Ibbotson-Sinquefield "tulip" chart (this time using a logarithmic vertical axis) describing the distribution of possible *realized* values for the ending value of a dollar of assets invested in this portfolio, over time.[64] The unbroken lines show the 5th, 50th and 95th percentiles of the distribution, without smoothing of any kind. At any point in time along the left to right dimension, one can read off values taken from the lognormal distribution of possible ending portfolio values. As can be seen, there is a good deal of variation in where the portfolio might end up—a result of the risk involved.

Figure 16

Does smoothing really get rid of risk?



What is the effect of smoothing on a time series having this high degree of variability? To answer this question, I also show on the chart a distribution of portfolio values with the same percentiles for the same assets, but with five-year smoothing. And if one inspects the first couple of years, the notion that five-year smoothing would cut risk by more than half looks to be about right; this short view is why so many think that smoothing is a powerful tool for risk control.

[64] Prepared for the author by colleague Dr. Duane Whitney; we were assisted by Greg Schlappich, ASA. For the unsmoothed lines, we used Paul Kaplan's improved method for calculating the Ibbotson and Sinquefield tulip charts (2009). We use assumptions that are standard in finance—that returns are lognormally distributed and independent, over time. There are modest violations of these assumptions in the empirical record, where we see some evidence of "fat tails," or kurtosis, and modest amounts of serial correlation or regression to the mean (Campbell and Viceira 2002, 2005, 2006a).

But by showing the effect of smoothing over not just a single period, but over longer periods of time, it is clear that the reduction in risk steadily gets smaller as time passes; risk increases, asymptotically approaching that of the natural, unsmoothed distribution. As the five-year "window" moves along year after year, a bigger and bigger portion of the risk from the first years is now incorporated in the distribution. And as time passes the five-year smoothing window, the prior years' actual return distributions are the natural unsmoothed distribution, and form the starting place for the smoothed period's distribution. Whatever smoothing appears to be happening is really only a recent appendage to the true long run path, whatever it might have been.

So over longer periods, true total risk accumulates and is experienced, despite smoothing: Notice that the fifth percentile of wealth is not much different for the smoothed measure than for the unsmoothed measure, over the entire right hand side of this chart, *i.e.*, after the passage of as little as three or four years. Thereafter, reduction in risk is only a very small percentage. Smoothing never makes risk go away—smoothing *defers* risk but it shows up later. That can be useful, I suppose, but doesn't change the underlying economic ground truth.

In an effort to hide volatility from interest rate changes, the on-book accrued liability is often also smoothed: For many purposes it is calculated with a "sticky" discount rate, one that is not adjusted regularly to market rates. Yet the end result will be the same: over time, the reported liability value will converge with the true values (which will reflect the considerable volatility of the interest rate markets) as the rate is adjusted to slowly follow the market rate. It must be so.

Amortizations have the effect of smoothing what is an immediate economic effect over long periods of time. There are a number of amortizations involved in any plan, including net losses or gains on the investments relative to the expected return assumption, that we'll discuss in the next section.

One such amortization is that of benefit increases related to prior service. If the accrued liability were to immediately go up by 20 percent, say, as a result of a benefit increase being applied to past service of the employees, the new portion of the liability would be "phased in" through amortization over a very long period of time (in reality, just "smoothing" of new benefits). This has the knock-on effect of phasing in over time what should be an immediate

increase in interest cost required to support the "true" accrued liability, further diminishing the security of promised benefits.[65]

There are also amortizations that result from use of non-articulating normal costs, such as pre-paid accrued expense. These wouldn't exist if we just used the same normal cost, hopefully an economic version, for all three financial statements: the accrued liability for the on-book balance sheet, pension expense for the income statement (P&L), and contributions for the statement of cash flows.

Perversely, smoothing and amortization end up *adding* risk, not reducing it:[66] You can't invest in smoothed assets—there is no such thing in the markets—so if you smooth either the assets or the liabilities you can't use hedging to reduce risk! With hedging, assets and liabilities can be made to move together so as to cancel out surplus risk, which as we have shown is the path to reducing expense risk and contribution risk. (There is no need to de-risk the liability separately, or the assets separately; the only need is to de-risk the surplus.)

The strong emotional attachment of the sponsor, accounting, and actuarial communities to various smoothing and amortization rules is one of the true paradoxes of the pension accounting discussion; the impact of smoothing is cosmetic and temporary, at best, and the impact of amortization can substantially diminish benefit security, a contradiction of the aspirations of the actuarial community to diligently protect security of benefits.

The best risk control comes from hedging the assets against the liabilities, not from trying to artificially dampen the reported valuations of assets and liabilities, separately.

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[65] In private conversation, Jeremy Gold points out that on the one hand, the benefit is amortized into the liability slowly over time, but that on the other hand, the benefit is immediately outright granted to the employees. If there is a logic that the cost should be borne over time, then it should be matched by a treatment that the new benefit is only earned over time if accounting symmetry is to be preserved (double-entry articulation).

[66] See Peter Bernstein's wonderfully erudite discussions of the ubiquity of smoothing efforts, including their tendencies to hide and distort reality, their contribution to poor decision making, and their inherent likelihood of adding risks in other less obvious ways (1997; 2004).

The Expected Return Assumption and Pension Expense

We have discussed the expected return assumption in its application as a discount rate, in chapter 2 and again when discussing the required rate of return in chapter 7. But there are also issues around the expected return assumption and the computation of pension expense that deserve specific discussion if one is going to be able to translate from economic pension expense to the conventional version.

I think it is clear to most that an economic version of pension expense reflects *actual* investment returns (review equation (11), above). But for conventional accounting purposes in practice today, the *expected* return on assets is used in place of the actual. So, conventionally stated pension expense is wrong virtually every period.

But the errors aren't forgotten: positive and negative dollar differences between what the portfolio's value would have been if the expected return had been realized, and its value based on the *actual* realization, are accumulated year after year and kept in the accumulated gains and losses account. They are recognized through amortization whenever their accumulation exceeds regulatory "corridor" boundaries (often over quite long periods of time).

So this methodology is just an unusual, and aggressive, means of smoothing *actual* asset returns; in the intermediate and longer term, pension expense isn't based on expected returns at all. Since it is just smoothing, not even a true amortization, the effect is not unlike that shown in Figure 16, above; it doesn't do much good over any intermediate or longer term. Even so, true volatility creeps into results as it does for any smoothing method—pension expense will be higher after periods of bad returns. If returns were truly mean-reverting by substantial amounts, smoothing might resemble reality—but they are not. As we have shown, risk accumulates with time, it doesn't diminish. It is quite ordinary to experience, for example, five- year periods of flat or down returns.

There is no free lunch. The *unhealthy* sponsor, trying to show accounting earnings or reduce losses, might be tempted to manipulate the expected return assumption merely as a matter of short-term survival, postponing investment losses to be dealt with in future years—years only dimly seen through the murk of the "corridor" and the amortization period—but that are off in

years to come, hopefully on someone else's watch. But few sponsor executives have been educated to the fact that, regardless of where the expected return assumption is set, high or low, the results over both intermediate and long terms will reflect actual portfolio returns. It is a total waste of effort for the healthy sponsor to "game" the expected return assumption, and it is a one-time act of desperation for an unhealthy sponsor.

To translate between economic measures of asset returns and conventional pension measures, apply the expected return assumption in place of the actual return when computing returns on the investment portfolio. Then, accumulate the return differences and amortize them over a very long period of time!

Pension Contributions

I noted earlier that the *economically* required contribution in a given period is just the period-ending deficit, if any, the difference between assets on hand and the accrued funding target liability. However, actual contribution methods—particularly those used for public plans but also DOL minimum[67] contribution rules, don't necessarily generate a legally required contribution anywhere near this size.

This isn't only because of the artificially high discount rate used to determine the accrued liability and its associated normal cost, which as we've already mentioned causes understatement of contributions.

It is also because, after whatever artificial reductions in deficit size are generated by these efforts, instead of requiring sponsors to pay that much-reduced deficit amount into the plan as an immediate contribution, we instead allow the sponsor to *amortize* the deficit, catching it up sometimes for a period as long as 15 or even 30 years. While the PPA reduced this to seven years for most corporations, many others are being given exceptions. And of course those are the plans that are most in need of greater contributions.

I like to remember that the accrued liability and the contributions funding it are themselves an amortization of the *ePVFBP*, a payment plan for paying it off over time. To

[67] In the United States, tax laws and regulations put an upper limit on contributions, and laws enforced by the Department of Labor (such as ERISA) put a lower limit on them.

amortize a deficit relative to that accrued liability—which is just a part of the *PVFBP*, which is a value that is already being amortized by the normal cost, after all—is thus an "amortization of an amortization," very creative perhaps but out of the ordinary for other comparable financing environments. That's a lot of amortization, and if we were honest with ourselves we might conclude it is not a practice that promotes the security of benefits. While making that point, it also fairly applies to amortizations of prior service after benefit changes and in fact all nondemographic conventional supplemental costs.

This is also where the infamous "credit balance" comes in. If contributions in prior years were in excess, above this minimum requirement—mind you, even if the sponsor is still behind on contributions and is in deficit—the prior years' 'excess contributions' (an amusing mischaracterization) can be used to reduce this year's minimum required contribution of hard cash. Given that this is a plan that is in deficit, prior "overpayments" of the planned *deficit* amortization (the second one of the double amortizations described above) aren't overpayments at all but are catch-ups on payments otherwise in arrears. They should be treated as good faith efforts to catch up at a rate faster than the slowest speed allowable, and shouldn't excuse a full contribution the next period. Rules should encourage deficits to be made up, not to be stretched out or manipulated.

"Amortizations" of newly awarded benefits related to prior service, as discussed in prior subsections, create yet another reason for the contribution to be calculated in a much less than economically reasonable manner.

At the end of the day, the minimum required contribution under these calculations can be vanishingly small or zero, even for plans that are nowhere near fully funded on a conventional actuarial basis, much less on an economic basis.

Many responsible (and solvent) sponsors, guided by the many equally responsible actuaries, regularly contribute more than this minimum; but other sponsors, also guided and aided by their actuaries, do not. Paradoxically, the rules that create this moral hazard make it available to exactly those sponsors who should not be allowed this opportunity—those not solvent enough to fully stand behind their benefit promises.

So Now That We've Translated, What Do We Have?

There is much more to the problem of translating economic accounting into conventional accounting than I have described here; the details and variations seem endless. But I believe that I've captured the differences which most substantially diminish security of benefits and impact financial statements.

Now we've seen how useful measures—measures that have meaningful interpretations in genuine monetary terms—can be translated into distorted measures lacking that important quality. And we've revealed the tremendous levels of creativity and ingenuity that have gone into making contributions so painless for sponsors as almost not to exist—but unfortunately, contributions do in fact need to exist in order to support benefits.

Imagine an alternative universe, one where the actuarial and accounting community were taking great pains to make sure that liabilities are stated in true dollars and that sufficient pension contributions are made to fully fund the pension and provide security of benefits. In such a universe, if I suggested a switch to a higher discount rate based on the expected return of the asset portfolio, ignoring its volatility of returns over time and amortizing over long periods both prior service and any beginning period deficit when calculating contributions, my suggestions would be received with derision and scorn.

But in this universe, today, that is exactly what we have.

I submit that no one understands these conventional actuarial and accounting measures of the pension plan—*including the professionals who create them and use them*. Of course I fully acknowledge that they do understand, in the most detailed manner possible, how it is that they have chosen to *characterize* these measures, the numerical process that they have gone through to generate their measures. But that characterization is just a narrative, *not an economically meaningful characterization*. It has no ready interpretation in genuine monetary value—in which, sooner or later, the benefits must be paid. These conventional measures can't be understood sufficiently well to make good plan management decisions—not about benefit policy, contribution policy, or investment policy. Sadly, the proof of that is found not only in the

arguments presented in this paper but also in the fact that few plans are fully funded on an economically sensible basis sufficient to secure a fair measure of accrued benefits.

But there is hope; we can do this work better with economically grounded approaches.

Chapter 10: Public Policy Suggestions—Accounting and Actuarial Standards

Generally, it is fair to say that sponsors and participants will be better off if plans are managed with good information—which is to say, with information that is economically meaningful. If we were to modify accounting rules to provide more meaningful and useful economic information, what changes should we make?

Should the FEL be a Required Report?

On the one hand, the "law of one price" (perhaps the most fundamental principle in financial economics) says that there is only *one* real liability; otherwise no-arbitrage conditions would be violated. I have made a strong case that this one real liability is the economic *FEL*, and that in turn we can calculate an economically meaningful subsidiary liability to use as a funding target and benefit security measure, on an agreed and economically sound basis that can be articulated to all constituents. So in an ideal world we might consider reporting the *FEL* on the balance sheet.

On the other hand, that thought is subject to a series of objections, some serious. The most serious of these is that the *FEL* is subject to very substantial estimation issues (related to estimating population levels, pay levels, and benefit formulas for far distant future employees). This raises a fair concern about opportunity for manipulation. This isn't a complete objection: its value can be estimated, if only loosely, and the fact that no other financial statement impact hangs on its value diminishes motivation to manipulate.

And let's agree that there is no good argument supporting its dual use as a funding target and benefit security measure, as there would never be a reason to fund benefits for future employees or to charge normal costs to pension expense on their behalf. So even if we showed *FEL* on the balance sheet, we would still need to show a smaller subsidiary accrued liability measure as a funding target (using its associated normal cost method). Again, this isn't really an objection: two economically consistent measures could be shown, and if shown they could be labeled and reconciled so that both made sense.

Lastly, reporting the *FEL* would distort the overall balance sheet as much as clarifying it, if we did not also estimate and report the value of all other off-book items, such as various options for plan termination that the sponsor implicitly holds, particularly $EVLD_{FEL}$ (options that offset much of the value of the *FEL* above the value of the accrued benefit security liability). Again, this isn't a real objection, but it would introduce additional estimation issues and (informative but difficult) reconciliation reporting if we were going to report a truly complete picture of the plan.

For those reasons, and perhaps more so because the *FEL* just simply does not meet the current "balance sheet model," (most future expenses are not shown on-book, even if they are reflected in the firm's market value) it seems likely we'll only require sponsors to report the subsidiary on-book accrued liability, at least for now. That may change in the future as the concepts of the *FEL* and $EVLD_{FEL}$ become more comfortable.

The *FEL* will not soon go on-book, but a decision to use a subsidiary accrual measure involving only current and past employees as "the" liability for book purposes is always equally a decision that the remainder of the *FEL* stays *off*-book—which does not mean that it goes away. This off-book amount is the present value of future normal cost, not just for current employees but also for future employees, a figure that I, as a manager, would be very interested in understanding, particularly when contemplating a benefit level change as a part of adjusting the total compensation package. The true measure of the *total* liability, as opposed to the funding target, always comes back to the *FEL*, regardless of whether or not it is stated.

Just One Accrued Liability, Please!

A prominent actuarial text lists 27 different normal costs, each presumably having its own associated accrued liability. There may be more; perhaps in practice far fewer see common use.

But the exact number doesn't really matter. What does matter is that there is typically more than one in use in every plan, for different purposes, and that none of those in use can be meaningfully understood in terms of actual dollars rather than sasquatches. Nor do the

constituents of these plans have any idea of the subtle differences in normal cost methods between the various accrued liability measures.

If there is no economically meaningful reason to use or report a subsidiary liability, other than as a benefit security funding target, then no interest is served by the continued use of multiple other inconsistent and non-economic accrued liability variations—for the actuary, the accountant, the IRS, the PBGC, the DOL, FASB, GASB, etc. *Everyone* would be better served if the rules were collapsed, forcing a single on-book accrued liability measure, even if not the same for all sponsors. It would be chosen because it is "right" for that particular set of constituencies. Then the nature of the normal cost method and the meaning of the agreed accrued liability associated with it would be on the table and fully understood by all.

Today, legal requirements and standards with respect to normal costs are quite different for funding and accounting, but that fact is not an objection to the proposition that they *should* be the same.

The only economically meaningful purpose provided by on-book accrued liability, is to frame the funding target so as to provide an agreed level of benefit security. Since that proposition has never before been argued to regulators in a complete economic context, we should use our influence as a group to develop better rules. One agency or organization at a time, the methods required by these regulators need to be brought up to a modern, sensible, and useful standard that insures benefit security in genuine monetary terms. Such a standard will serve the interests of all regulators, inasmuch as all they ask is that the numbers be consistent, accurate, transparent, and unmanipulated. An economic system delivers that goal better than the existing system.

Articulation Between Financial Statements

Once a normal cost method and its associated accrued liability have been chosen, presumably for the purposes of establishing an agreed level of benefit security, both pension expense and contributions are determined. It would serve the accounting requirement that entries "articulate" between different financial statements in parallel, if all plans used the same normal cost method for all purposes. New accruals to the liability each period (on the balance sheet)

would be tied to pension expense (on the P&L) and to cash contributions and benefit payments (on the statement of cash flows).[68] Today inconsistent values are often used, a practice heavily frowned upon and generally not allowed anywhere else in double-entry bookkeeping.

Pension Expense

In the Rosetta Stone section, above, I discussed problems with using an expected return assumption to represent returns of the asset portfolio when calculating pension expense. Clearly, the interest of accuracy in reporting suggests using actual realized returns rather than expected returns. The aggressive smoothing of pension asset returns through using the expected return assumption cannot be justified.

The expected return assumption produces unhealthy side effects beyond the fact that it is really just a smoothing mechanism. It encourages overly aggressive pension asset investment policies in a misguided effort to reduce deficits, pension expense, and contributions. And its use camouflages the very real need to hedge the liability's interest rate risks. Both of these side effects substantially add to pension funding risk.

Secondly, the normal cost component of pension expense should be the same normal cost used for accruing benefit security liability and for calculating required contributions. All of these need to be based on a market-related discount rate, as discussed in a prior subsection.

Third, the definition and presentation of what we now call "pension expense" (or "net periodic pension cost") would benefit from modification: returns of the asset portfolio and the charging of interest to the accrued liability are "pension *financing* revenues" and "pension *financing* expenses," and should be presented in their own "pension financing" group. Another group, "pension *benefit* expense," should include only normal costs and supplemental costs (from actuarial decrement forecasting errors, not realization errors from the expected return assumption, which shouldn't be used at all). Pension benefit expense and interest costs credit the liability and debit the expense account, separately stated. The return of the asset portfolio debits

[68] Some of these inconsistencies in articulation between financial statements were nicely pointed out many years ago by Good and Love (1990), pp. 41-42.

the pension asset account and credits the revenue account. The point is to separately state all elements of pension expense, rather than netting them out to a single pension expense figure.

If amortizations are to be allowed (see a following subsection), they should be in their own group and fully disclosed.

Contributions

Economic reforms for calculating contributions somewhat overlap those discussed for pension expense. Use the correct risk-free discount rate (curve). Use an appropriate normal cost method suitable for establishing an agreed measure of accrued benefit security liability, and use the same measure for all accounting purposes. If amortizations of new benefits (prior service) or of beginning period deficits are allowed, keep them short and modest and focused on the task of "catching up" in a business-like manner, because they seriously interfere with security of benefits. Require full disclosure as to what size the contribution would be without amortization. Credit balance rules should not allow evasion of this year's contribution on the basis of prior year contributions.

If thought socially necessary, a responsible transition program, designed to put sponsors on paths realistically likely to repair their funded status over a modest (maybe 10, maximum 15-year) time period, could be put into place. Any such program should be set up sensibly, with necessary benefit policy reviews and possibly enforced benefit reductions. It should require ongoing payment of full current normal costs and interest on the full accrued liability, plus substantial payments toward reducing the deficits on a regular (and monitored) basis.

The Discount Rate

Sponsor interests currently seem to be arguing for the adoption of a discount rate based on a high-quality corporate credit rate. At first blush, the higher credit risk-related discount rate gives sponsors what appears to be a lower liability, so its use is attractive to them.

I fear that this first blush attractiveness is mistaken, for all the reasons mentioned in Chapters 2 and 3, which don't need full repetition here.

The presence of this inappropriate component is capable of inciting other mischief not in the interest of benefit security. In the winter of 2008-09, spreads on high quality corporate bonds went to record levels, leaving many sponsors thrilled that their book liabilities went down, thereby offsetting substantial recent losses in their equity holdings. An investment banking sub-industry now sells products to "match" the liability including this credit risk component. But this hedges nothing other than the accounting distortion and does real harm as well, by putting risk on the asset side of the balance sheet to match and offset risk not really present on the liability side. Sponsors are being encouraged by this distortion of the books from economic reality to add risk where none existed before.

In the long term, management interests, as well as participant interests, are unconditionally better served by using the appropriate market-determined risk-free rate, which supports both good decision-making at all levels and strong security of benefits.

Smoothing and Amortizations?

It may be in the interests of sponsors, participants, and guarantee organizations alike to support limited smoothing and amortization treatments, to modify the method by which underlying economic reality is reported (and perhaps how contributions are made), in a manner that makes it easier for employers to sponsor the DB plan—but with a caveat: Liability value, contribution calculation, and pension expense value cannot be allowed to trend very far away from the underlying "ground truth," their economic values—if we want these plans to be (and to remain) healthy and secure in their benefits.

My general suggestion is to avoid asset or liability smoothing. But if smoothing must be done, smooth only the volatility in the net surplus, i.e., in the actual "surplus return," the annual change in economic surplus or deficit resulting from investment gains and losses (this can be reflected with articulating entries on the balance sheet and income statement, and if necessary in cash flows). By no means should smoothing happen on the liability alone or on the assets alone. In this way, hedging techniques and surplus optimization techniques are still clearly of use to the sponsor in controlling the amount of risk showing up in the surplus, so it is a superior approach to risk control, inducing better and more sensible behavior than separate smoothing (how do you hedge your assets to a smoothed liability?).

It has the natural follow-on result of taking volatility out of contributions and pension expense, which may or may not be desirable. If amortization is allowed, normal costs and interest costs for both contributions and expense should be figured on the "true" *eAL*, so that accruals don't get behind by any amount greater than the amount allowed to be smoothed out of surplus.

This is a slippery slope. If smoothing or amortization is allowed anywhere, it should be allowed only for modest time periods within safe differences from underlying economic values. Amortization periods longer than, say, three or so years seem destined to do more damage to benefit security than the good done by encouraging sponsor generosity.

If amortizations are to be allowed, correct economic values should be fully disclosed so as to provide full transparency. As an example, for the liability:

Accrued funding target liability, including newly awarded benefits:	$100
Less unamortized portion of newly awarded benefits (three-year):	$20
Accrued funding target liability:	$80

A similar approach should be used to disclose reductions from amortizations in figures shown for normal cost, pension expense, and contributions. Knowledge is power, and knowledge of that shortfall is likely to focus energy on reducing it in a reasonably prompt and purposeful manner.

No organization using any smoothing or amortization technique, including those suggested above, should deceive itself: smoothing hides risk for a bit, but over time economic truth reveals itself despite smoothing.

Truthfully, smoothing isn't at all necessary; there are better ways of controlling volatility of pension expense and contributions: if the investment policy principles suggested in this exposition are utilized, pension plans should be manageable with quite modest risk to surplus, to contributions, and to pension expense, even if never smoothed at all. Just by adopting investment policies informed by surplus optimization, sponsors can achieve results inherently less risky than those resulting from traditional methods, obviating much of the need for smoothing.

Should the Pension Trust be Off Balance Sheet?

Most of today's accounting standards use a legal "control" test to ascertain which assets and liabilities should be reported on, and which might be left off, the balance sheet. This is an economically sensible concept. In areas where standard legal control tests are misleading or uncertain, an alternative test is to determine which assets and liabilities expose an issuer to "risks and rewards" (Securities Exchange Commission, 2005). The pension trust is surely one such area.

As an economic fact, there is little question that the financially healthy sponsor bears the risks and rewards of pension assets, inasmuch as good returns reduce contributions and bad returns increase them. Likewise, capital losses from changes in interest rates and other risks in liability are the primary responsibility of the sponsor; if the assets haven't been hedged properly to the liabilities so that a diminution of surplus results, then that diminution must be made up in order to maintain benefit security. These realities, and the implication that the plan is in the control of the sponsor, however, contradict the legal control test implied by the ERISA sole benefit rule (requiring that the plan's assets be managed for the sole benefit of the participants).

I'm not by any means suggesting that we abandon the ERISA trust; it is good that assets in trust are immune from the sponsor's creditors. But the sole benefit rule has always been troublesome with respect to accounting and reporting policy as well as investment policy, particularly where the plan is reasonably well funded and the sponsor is healthy.[69]

While many of the risks and rewards do fall on the sponsor, many also fall on the participants, particularly when the plan is underfunded and the sponsor's creditworthiness is weak. Regardless, there is no harm to participants if assets and liabilities, rather than just their net, are shown on the sponsor's balance sheet. Doing so is a good thing for all and serves the interest of economic transparency, thereby allowing users of financial statements to more readily see the firm's overall capital structure. There is some significance to this, given that the order of

[69] The real purpose of the trust is to make sure that the assets dedicated to the plan are safe from other creditors. In a private conversation, Jeremy Gold suggests that the sole benefit rule be defined to mean simply that the goal is to assure that benefits promised in time become benefits delivered; he elaborates by suggesting that the sole benefit rule should not be interpreted to allow an effort to maximize the probability of being able to increase benefits or by extension any of the other "sole benefit" rationales that have been used to justify aggressive actuarial discount rate assumptions and aggressive investment policies. Food for thought.

magnitude of pension assets often makes them the most significant operating subsidiary of the sponsor. And depending on how the assets are invested, there can be significant swings in the net, or in the surplus, as happened in 2002 and again in 2008-09. In those years, interest rate declines severely damaged the financial health of plans whose assets were not matched to liabilities. Today's typically heavy equity allocations mean additional damage to the security of benefits.

Perhaps investment characteristics should be made more transparent as well: creditors and other users might otherwise think that the pension, if close to fully funded, is a nonissue. But with a poorly designed (and typical) investment policy, there can be very large swings in surplus, and where the plan is large relative to the operating assets this can mean a very large swing in the sponsor's overall value. Users of financial statements—and this includes those reports issued by public plans—may well be interested in knowing the underlying data and why those swings are happening.

Merton, with his usual elegance of insight, has also made the point that pension assets and liabilities should be included on the sponsor's balance sheet, separately stated.[70] He pictures it as a capital structure problem (2006), offering an example in the following general form: Suppose we have a company, showing its pension plan on a conventional basis, with pension assets and liabilities netted out. It has a $5 deficit. The conventional practice for computing the cost of capital for the operating assets is one that starts by observing the beta of the shareholder's equity, observed in the market, then "de-leveraging" it to find the beta of the operating assets. Armed with this beta, the cost of capital is immediately developed from the capital asset pricing model. Here, working with only a net figure for the pension, rather than separately stated assets and liabilities, we get an operating asset beta of .50.

[70] FAS 158, implemented just after Merton's paper was published, does partially meet the suggestions implicit in his argument.

Figure 17

Corporate balance sheet: Ordinary method to determine OA beta

	$	*Beta*		*$*	*Beta*
OA	100	**0.50**	Corp. Debt	45	0.00
			Pension (net)	5	0.00
			S/H Eq	50	1.00
Totals:	*100*	*0.50*		*100*	*0.50*

But we get a very different picture if we show the pension assets and the pension liabilities separately, rather than simply as net. Refer back to Figure 11, the same balance sheet but shown with the separate detail of pension assets and liability. Using that full detail, we see that the correct beta for operating assets is not .50, but rather it is only .18! Important points are easily missed when the balance sheet shows netted values.

While the very best analysts may be able to "see through" the obfuscation involved in showing just the net liability, it is an unnecessary obfuscation. It is more sensible to show the assets and the accrued on-book liability on the balance sheet.

Should we Change the Accounting and Actuarial Systems?

Many sponsors today have set their minds in opposition to mark-to-market accounting, but I argue that they should reconsider: sponsors, shareholders, taxpayers, and participants are all better off with better information. Better information will result in better benefit decisions and better investment policy decisions; further, transparency and clarity leads to less perceived risk, probably lowering the cost of capital for the firm. By use of economic accounting, both cost and risk are better controlled.

The impact of change would likely be quite modest on healthy plans: While their reported numbers will change, the changeover would almost certainly be a nonevent to their stock price: other accounting changes haven't changed stock prices (FAS 87; FAS 106). The changeover would improve sponsors' long-term ability to manage costs, as well as their ability to manage risks. As a result, they will likely modify their investment policies to better hedge their liabilities, as suggested above: this is a transparently healthy change.

It is the severely under-funded sponsor, with a struggling financial condition, that would feel the most immediate impact from a mark-to-market change: the economic realities of their plans' tenuous levels of benefit security will confront them clearly, immediately, and probably stressfully. In recent times this would certainly include plans in the automotive and airline industries as well as many other firms, as well as a large portion of the public employee plans. I am sympathetic to the constraints and difficulties presented by these distressed plans, and recognize that any overly aggressive transition might force the closure of plans otherwise still having a chance of success. There are many corporate and public plans in this potentially salvageable position; there are still more that have no chance of success, and sadly efforts to keep them on life support will ultimately cause even greater injury to their participants.

These troubled plans got into their current state in large part as a result of unhealthy accounting rules that have allowed the plans to be funded only with sasquatches, rather than dollars; the rules were then aided and abetted by both management and employee representatives wanting to hear happy news and unwilling to challenge the true status of funding. Maintenance of current accounting rules for the worst off of these plans will allow them to trend even further into deficit over the next few years, and then they will fail anyway, falling over of their own weight. And later failure will result in a larger loss of accrued benefits than would an earlier one. Tough decisions need to be made about which plans should be allowed to continue accruing benefits, and which ones have a legitimate hope of salvation through the "tough love" approaches suggested in Chapter 11.

Some plan to achieve full funding should be required of these strapped sponsors, as discussed above, including mileposts demonstrating responsible progress toward health. The idea is to exert strong pressure toward improved funding levels for accrued benefits, without undue pressure on organizations which cannot withstand it—but only for so long a period as the plan's true financial condition continues to improve. Exceptions should be overseen tightly so as not to allow further funded status deterioration, as measured by economically sound techniques.

Financing the PBGC

In Appendix I and elsewhere, I discuss various implicit options seen in pension plans. One of these is the sponsor option to default on any amount not fully funded. I've pointed out that, by intentionally understating funding requirements—using high discount rates for the liability, aggressive amortization, high expected return assumptions for normal costs for contribution calculations, etc.—a sponsor can intentionally economically underfund its plan. But the PBGC guarantees economic full funding (subject to some benefit limitations), operating as if it were an insurer.

But because underfunding is essentially voluntary, plan failure is not the same type of contingency as is insured against in other contexts. The PBGC's role then should not be to act as an insurer, which is only appropriate for truly random events such as fires and auto accidents: claims on the PBGC are solely a result of moral hazard. Instead, the remedy must be to prevent underfunding in the first place—via aggressive monitoring and enforcement that ensure adequate funding levels. The modest premiums now being charged would suffice had we been enforcing economic funding disciplines in the last few decades.[71] It isn't too late to start now, although many plans out there seem destined at this point to fail.

[71] PBGC "insurance," completely mispriced as it is, seems to create a special case of the classic "prisoner's dilemma," in that what is good for one sponsor may be bad for all others.

Chapter 11: Saving the Pension Plan

We now come to what may be the most important chapter in this essay. As I am finishing writing it in the winter of 2008-09, the U.S. pension crisis is deepening. Market events of 1998, 2002, and those of this winter delivered pension plans a body blow, in two parts. The data is not all out, but we know already that continuing interest rate declines have increased all liability measures (partially offset—at least temporarily—on the book liabilities by increased corporate credit spreads in early 2009), in turn deepening deficits, and that negative equity market returns further damaged the asset side, again deepening deficits. So, even though reports are not all in, we know that conventional, reported funded ratios are at all time lows. True, or economic, funded ratios are undoubtedly much worse. Houston, we have a problem . . . .

Even before this latest market period, corporate sponsors were already slowly terminating plans; one here, then one there, and tomorrow another one over there. Public funds haven't yet started closing, but a number have undergone revision sufficiently dramatic as to provide fair warning of high financing stress levels, and many more will surely follow (new benefit tiers, shifts to DC, etc.).

There is a strong momentum toward defined contribution plans for both corporate and, to a (fortunately) much lesser degree, public plans, even though these plans have proven themselves unsuccessful at accumulating significant retirement assets (median balances are widely reported as being well under $100,000; hardly a sound basis for providing retirement income).

It is not only pension plans that are hurting, but sponsors as well. Bad markets go hand-in-hand with tight cash positions, as revenues dry up for both corporate and public sponsors.

What can be done to save these plans?

An Action Plan: Something Has to be Done, but it Isn't Going to be Easy

One reason why boards overseeing public plans and committees and executives overseeing corporate plans have not embraced reforms of pension accounting policy, particularly the discount rate, is fear of consequences that may flow from disclosing the true size of the liability, and thus of the deficit. The fear is that legislators and corporate boards may well react

in anger and in frustration, and simply terminate their plans, if informed bluntly that contributions will have to be much higher than had been previously disclosed. This is not a desirable outcome, and its specter puts pressure on staff and actuaries to maintain the perception that "all is well," as the least difficult alternative. In fact, the resistance to accounting and actuarial modernization by many actuaries may well simply reflect this same desire, "holding the course" and asserting that "all is well" in the hope that favorable market reversals might bail out these poorly funded plans. I fear that this is the actuarial equivalent of football's "hail Mary" pass, throwing long for the chance of salvation through a last minute touchdown.

But all is *not* well, and failing to deal with the problem just ensures plan termination or failure at a later date. Today's large deficits will progressively get worse and worse, until plans ultimately fall over of their own weight: A plan that is only, say, 50-percent funded on an economic basis has only half the assets (relative to the accrued liability) working to try to cover the interest rate, and so it necessarily moves steadily further into the hole. Even if contributions sufficient to cover ongoing normal costs were to be made, the sponsor would have to make up a 50-percent interest shortfall with an additional contribution just to maintain the existing deficit—never mind reducing that deficit! Without intervention, the plan's ongoing continuation doesn't seem likely, because most sponsors in that position are now unable to pay such substantial contributions. But it seems that most plans in this position use every trick in the book (see the Rosetta chapter!) to avoid or minimize contributions, rather than to exaggerate them. This is not a positive situation.

Distressed plans are between Scylla and Charybdis, between a rock and a hard spot, between the devil and the deep blue sea (see Waring 2009). Saving these plans is going to be tough. It will require all involved to do everything they can to encourage thoughtful and considered evaluation of alternatives that will forestall arbitrary termination by the governing body. There are likely to be painful compromises for all before a long-term solution is found. Only large cash infusions and/or large adjustments to already-accrued benefits—both difficult in the extreme—will reduce such large deficits.

A strategy designed to face up to these difficulties has several elements, all directly confronting these difficult contribution-level and benefit-level decisions. But if it is implemented effectively, the plan just might be saved:

Accounting and Reporting Policy

Management and labor can sensibly negotiate these discussions only if armed with economic information. If they are armed only with conventional accounting or actuarial information, the economics of the situation will be distorted and informed decisions won't be possible. In most economic environments this distortion will understate the true cost of benefits, generating a tendency to agree on smaller (rather than larger) contributions and larger (rather than smaller) benefit packages, in a combination not sustainable absent heroically positive investment luck. If based on conventional approaches rather than economic approaches, the true value of benefit policy will be more to the advantage of one side than the other—and neither will realize this if not armed with the economic version.

In no other major factor of production is cost information available to both management and labor so badly misleading, as in pension benefits under today's conventional accounting. This situation is unacceptable from the perspective of either, and in the long term is bad for all: This is one place where the fact that a pension plan lasts for the long term *is* in fact important. A benefit promise must be sustainable by the employer for the long term, or the plan won't be successful.

This fact is always important, but of most importance when the plan is in extremis. Before anything else is done, the sponsor must accept the reality that good decisions cannot be made without good information (and conversely, that bad information implies bad decisions!). Then it must take action to obtain market-based information about the value of the liabilities and about necessary economically determined contributions (and for corporations, expense). This information must be available for management decision support, *regardless of whether or not the plan is legally required to report in this form*.

Management should insist that the plan's actuaries completely buy into these goals and will serve them *without reservation*. Otherwise, management will be faced with an ongoing

barrage of contradictory advice and information (some of it assuring them that if they just "hold the course," with high-equity allocations and only modest benefit and contribution changes, all will be OK "in the long run," and that their current level of contributions are "more than adequate"). It isn't so; this diversion must be dispensed with right up front. Management needs to have information that is stated in monetary values, not in sasquatches.

Next, figure out what accrual basis is being used for funding, and make sure that all involved understand it on an individual employee basis (where it is easiest to absorb) as well as what it means for the plan as a whole, in aggregate. Ask the actuary to prepare a graphic along the lines of Figure 6 or Figure 7, showing the present value of benefits on an economic basis for a theoretical new employee over time, using the current benefit schedule (although this can be shown appropriately decremented with their best unbiased estimates, to reduce present value to where it really is when considered in the aggregate, I suggest that many discussions be done as I have done here, without decrements, which will facilitate understanding even if the numbers are temporarily too high). I suggest doing this for an individual representative employee rather than for the aggregate, because it is simply easier to understand. Show a second line for the accrued liability using the discount rate that has been in use, as in Figure 13. If able, calculate and show the percentiles for asset accumulation, as done in Figure 15.

Ask the actuary to include several idealized accrual lines on the left hand, or accumulation, side of the chart, along the lines of those in my Figure 8, first showing one that uses a normal cost set as a constant percentage of pay over time and thus generating a pretty good "neutral" accrued liability to use as a reference. Then show another accrual line for the normal cost method that they are using to calculate actual contributions—show this normal cost method two ways and as if it were an accrual of assets: once with a risk-free discount rate/interest rate, and once with the discount rate and interest rate they are actually using in contribution calculations (this latter line will be much lower, showing how slow contributions accrue to cover the liability).

Lastly, plot (on a version of this chart that does include the decrements)—at a point on the timeline representing the tenure of the average employee—a dot showing the assets currently in trust for this imaginary participant (based on the proportion of this representative employee's

individual economic version of accrued liability to the aggregate of all employees' economic accrued liabilities). This chart will show dramatic underfunding below the economic accrual lines (and even more dramatic underfunding below the economic present value of benefits line).

Such charts and data are the starting point for a fair discussion (remember, they don't yet have the demographic decrement in them). Using them, one can discuss the normal cost method used for accruing benefits and contributions, and whether it would provide an agreeable degree of benefit security when fully funded. One can then discuss the true costs of the plan, stated fairly in terms of percentages of payroll or of dollars. And one can see the true level of underfunding, and perhaps start to form an impression on whether this underfunding can be made up, or not.

Only once this "grounding" discussion is thoroughly finished should one go back and start working with actual economic values for the aggregate plan, with demographic decrements included. Of course it will make sense to spend some educational time on these decrements during the transition.

Don't stop at using this information solely for management purposes, implement a transition to market value format for the official books, as well. Announce a plan to creditors and others to reduce your discount rate, based on the expected return on assets, by one half of one percent every year for six years or until you reach a market discount rate, whichever comes first. Immediately reduce any spread over the treasury curve based on high-quality corporate credit rates to 1.5 percent, or to wherever it had been before the recent spread increase, and then reduce it by one fourth of one percent until it is at market. The book liability valuation will come up to fair-market value in annual doses, rather than all at once. Because it is announced, it will be seen as a cosmetic change and will be unlikely to cause difficulty, though some financial ratio tests may require adjustment. Move to a single normal cost method for all purposes.

Contribution Policy and Benefit Policy

By viewing the plan from an economic perspective, we've learned that we can't change the cost of the plan via contribution policy. But we've also learned how to evaluate the true level

of contributions needed in order to pay for a given benefit policy. Preparatory to discussing benefit policy, let's look at what the current plan would cost if properly paid for.

Ask the actuary to determine for you the contribution level required to bring the plan, at current benefit levels, to fully funded status, *on a market value basis*, within 10 years. Ask for the full picture, including recently awarded benefits whose prior service component might for other purposes be separately amortized over a different time period and probably not with equal payments. Ten years is a long enough period but don't go beyond 15; things change too much over longer periods, and as we all know from negotiating home mortgages, there isn't much marginal reduction in the payment from an amortization horizon beyond about 15 years.

Divide this contribution into three pieces: First, the contribution required to provide for ongoing normal cost related to an agreeably secure level of benefits for current employees (my vote is for a normal cost determined as a constant percentage of pay, nevertheless understand the method used in the context of Figure 8). And regardless of the method, ask for the cost to be shown as a percentage of total payroll.

Second, if there is likely to be significant hiring of new employees during this 10-year period, either for replacement or as workforce growth, show how normal cost will change over the period as those new hires come on (and as some portion of current employees retire).

Thirdly, and most interestingly to discussions that will follow, compute and show separately the payment required to amortize the economic deficit, calculated on a level payment basis as if it were a loan you intend to pay off in that period (it is!). Keep the amortization period short, maybe three to five years, as you are amortizing a debt that was already amortized once and defaulted upon, in that normal costs themselves are an amortization of the *PVFBP*. Another way to put it is to observe that the deficit represents costs already incurred in prior periods, sunk costs that are owed and in default. (Contributions related to the deficit have been nicely spun in recent discussions by using the euphemism "legacy costs," a very neutral term free of implications of default—as if it were perfectly normal not to pay your labor!) Now, what is the creditworthiness of the sponsor? Can it make such payments? Better yet, is there any reasonable chance that this deficit, a very real debt, can be immediately paid off, perhaps with external financing?

Estimate the value of the plan's exposure to the sponsor's credit risk, relative to the economically underfunded accrued benefit security measure of the liability, the $EVLD_{eAL}$: Re-discount the deficit using the risk-free rate plus a premium for the sponsor's credit risk (if market information is available from the sponsor's other borrowings, use it). This new amount, reduced from the original by the "expected value of liability default," or $EVLD_{eAL}$, shows the market worth of the unfunded benefit promises—it is likely to be substantially less than what the beneficiaries expect to receive, but may frame the "limit of the possible." Can this new lesser amount be borrowed externally (at a reasonable cost) and contributed to the plan?[72] For many plans, this possibility is unlikely: such a loan may be unavailable or, if it is, management may see such debt as an unsurvivable hobbling of its financing flexibility.

But without a loan, there will be a shortfall. On whom will it fall? Will labor agree to renegotiate benefits already accrued? How will the accrued liability be made to balance with available assets, and who will make the required sacrifices, providing the required contributions of cash and/or agreeing to reductions of benefits?

The ongoing normal cost may or may not look sustainable, as a percent of current salary, but with the data I suggest above, all can see the cost in intuitive form.

Recognize that the normal cost method used has a high impact on how secure benefits will be in the event of default or termination, assuming there is no deficit. What portion of the benefit shall we fund in the interest of providing benefit security, and what normal cost method does this imply that we should use?

Then synthesize all this information—the deficit portion has to be paid, and the ongoing normal cost accrual needs to be paid. Is that realistic? How can it be made to be realistic?

What you are likely to see is that the biggest problem comes from the need to pay off the deficit in order to support benefits already credited to employees.

[72] Many "pension obligation bonds" (POBs) have been issued, particularly by public bodies, but at very high rates. Once again, the expected return assumption has sometimes been used to justify this: "While yes, the loan rate is high, we'll invest the money in equities and come out ahead!" While it is good for the solvency of the plan when the sponsor uses its credit to borrow a substantial deficit reducing contribution, reason should prevail here also. The evaluation of the interest rate on a POB must be made entirely independently of how the funds are to be invested.

Have an open conversation among all constituents about these results. The discussion will be invaluable to all in understanding the actual contribution load on the sponsor in this and subsequent years, for the level of benefits that labor has been told to expect. Are these contributions realistically achievable, or does something have to give way—and if so, what?

Coming to Grips With the Possibility of Renegotiating Benefit Policy

When a plan is in extremis, the pension plan is faced with two dangers from the sponsors' board or other governing body: insolvency and termination of the plan, at worst, or termination of the plan and a switch to DC, at best. From a retirement perspective, the second isn't much better than the first.

A sponsor that is in extremis, with a large overhanging plan deficit, may be functionally bankrupt already. In that event all old debts, including unfunded benefits, are in jeopardy and historically agreed benefit levels may simply be unsustainable. Ongoing employment itself—much less ongoing benefit accruals—may also be in jeopardy, depending on the nature of the organization.

If, after reviewing the true economic situation, you've concluded that the plan is truly in danger, consider the value of trying to save it by some combination of whatever additional contribution the sponsor is able to make and a significant downward adjustment to benefits. Even if benefits must be negotiated downward, a defined-benefit plan with a reduced benefit is still better than the alternatives. I often say that "the worst DB plan is better than the best DC plan," as DC plans haven't shown success at providing meaningful retirement income (Waring and Siegel 2007).

If to the advantage of the plan and its participants, then *preemptively* take on the task of negotiating and presenting a meaningful and hard-nosed rescue plan, including benefit modifications, *before* the governing body takes stronger action.

For a healthy organization, pension benefits are just one component of the necessarily hard-headed determination of a total compensation package that will serve the twin—but competing—goals of being sufficient to attract, retain, and motivate employees on the one hand, and of providing a competitive cost structure to the employer on the other. If total cost, and let's

focus on the pension portion, is too low to accomplish the first objective (employee-oriented needs) or too high to support the second (employer-oriented needs) then it must be adjusted to a point that works for both. Any other answer—one that is either too generous or too stingy—is unhealthy and unsustainable for *both* sponsor and participants.

It is not a welcome task to suggest that it might be in the best interest of labor to voluntarily reduce benefits. Emotions run high on these matters, understandably, and any reduction would be a large and very bitter pill for labor to swallow. Achieving agreement to reductions will require strong leadership on the part of employee representatives, supported by good economic information sufficient to convince employees that they must look at the problem in a hard-headed and objective manner and make the best of the bad situation.

Nobody wants to accept lower benefits, but if those involved in this discussion do decide that doing so is necessary to save the plan, adjustments can be made in many ways. One of the biggest economic cost control "dials," controlling the size of all measures of the liability, is the multiplier on pay times years of service. Today these are set at 2 percent and sometimes even higher (particularly in public employee plans; *i.e.*, on retirement the employee is paid a benefit of 2 percent times final average pay times his or her years of service; a $50,000 final average pay employee with 30 years of service would get a retirement income replacement ratio of 60 percent, or $30,000, per year). Another important benefit policy "dial" is inflation adjustment during retirement (cost of living allowances, or COLA), which can be very expensive—a practice of adjusting benefits for inflation every year could easily add 30 percent to the true cost of the plan. And benefits based on final pay or final average pay are much more expensive than benefits based on career average pay. There are many other features to look at, and they all have cost effects.

Clearly there are minefields for scriveners such as myself when suggesting that either labor or management might need to give up something; there is risk of offending *everyone*. Nobody in the workforce wants to take a cut in benefits. No sponsor wants to commit to an overly high cost of labor. And it is very difficult to pay large contributions to restore the health of under-funded plans, paying for yesterday's labor—paying for today's labor is hard enough, and somebody else should have paid for yesterday's!

But equally, it is usually true that no one on either side wants the plan to fail. The best protection, going forward, is a well-chosen economically determined funding target liability and its associated normal cost method, kept fully funded at all times. A benefit policy that will be successful and secure over the long term can only be negotiated with good, economically sensible, market-value-based information.

Discussions are already taking place between many well-resourced management and labor teams; the involved parties will tell us their compromise answers in due time. It is a fair bet that, to the extent these discussions are informed by economic cost analysis rather than by conventional accounting analysis, they will be more successful than existing plans at providing secure retirement benefits over the long haul.

Investment Policy

The sponsor should immediately move to adopt a surplus asset allocation approach for developing investment policy, including the holding of a liability-matching asset portfolio consisting primarily of long bonds or equivalent interest rate derivatives with long durations.

At the same time, the sponsor should begin to report plan health not with returns on assets discussed first, as is current practice, but with returns on the *surplus* discussed first. This is, after all, the best indicator of the plan's health. Asset returns swing wildly with interest rate changes, but so do liabilities. If the assets are set up to match and hedge liability, then the surplus will not swing at all. If this fact is not conveyed successfully to participants, much angst will appear when rates start going up and the bond portfolio starts falling. Therefore, the fall in liability value that coincides with it should be highlighted—which is why I suggest starting with surplus.

The presence of the new liability-matching asset portfolio will dramatically reduce risk to the plan's market valued or true surplus, starting immediately.

Careful thought should be given to what degree of risky asset exposure, with its attendant risk of loss, is acceptable for the fund to bear. Today's 70-percent and greater exposures to equities and equity-like risky assets are quite aggressive, and entail significant risk of loss that goes hand in hand with their significant chance of gain. But when a plan is in extremis and the

sponsor has demonstrated its lack of ability to make up overdue contributions by paying off the deficit, participants should take an increased role by voicing their preferences for this part of investment policy. Can an equity loss over a period of several years, making the deficit even worse, be tolerated? We all want the investments to help pay for the plan, but the more aggressive the investment policy the greater the possibility that it might instead make the plan more, rather than less, expensive. And it is quite unlikely that good investment returns alone will solve the underfunding problem.[73]

[73] See Gold (2006) for another writer's approach to transitioning plans to a more realistic and responsible accounting environment.

Chapter 12: Conclusion—Making Better Management Decisions and Managing Plans at Lower Risk

Our look at current pension accounting practices through the lens of economic accounting has borne valuable fruit. In practice, every one of today's conventional accounting measures—discount rate, liability value, normal cost, expense, contribution, required rate of return, etc.—can and often do stray quite far from their underlying, true, or economic values. This endangers the DB pension system, supporting misperceptions of the true cost of pension benefits, of artificially low contribution policies, of distorted earnings statements, and of understated liabilities. In the end, it's resulted in underfunded plans and has frustrated and confused both sponsors and participants. These variant values *add*, rather than reduce, risk and make it impossible for sponsors to meaningfully manage their plans.

Unfortunately, these practices also adversely affect benefit policy decisions, resulting in larger benefit awards and higher pension costs than expected—further endangering the DB pension system to the detriment of participants and employers alike.

By contrast, a complete economic accounting approach for pensions, such as that designed here, will provide meaningful and useful information for every one of these measures. And even if GAAP pension reporting is not put on a fully mark-to-market basis, having an economically correct second set of books would be an invaluable aid to enlightened management teams and employee groups.

Mark-to-Market Accounting is Not a Reason to Terminate the Plan

What we don't want to see is an increase in DB plan closures or terminations, justified by a move to mark-to-market accounting. That would be the worst possible result, but is exactly what happened to U.K. corporate plans as they went to a market, or economic, reporting system. However, their accounting move was an incomplete one, originally requiring a market-related discount rate only for reporting the accrued book liability under FRS 17, not making similar changes with respect to calculations of pension expense and contributions—which remained solidly conventional (there may have been more recent extensions to the other financial statements, but the damage has already been done there).

As a result, U.K. sponsors could not be given the message of this treatise: that they could consistently both reduce risk and control costs (to the surplus, to expense, and to contributions) by managing benefit policy and investment policy. Conventional risk control problems therefore remained pervasive, and tools for managing them were not fully updated. This essay shows that we in the United States need not be similarly handicapped—a move to mark-to-market gives abundant opportunity to control costs and risks of the plan.

Much of The Intuition is Already Out There

I'm a financial economist rather than an actuary. I've never formally studied actuarial science, although I've given it considerable thought and attention (perhaps it is sufficient to say that if I don't have a pretty solid lay understanding of actuarial science, then perhaps few non-actuaries do—a fact which, if true, speaks perhaps unkindly of the art).

I believe there is little or nothing in my basic description of economic pension accounting that will seem unfamiliar to those who have more formally studied actuarial science in fullness of detail, and I think that this would be true even for my versions of pension budget identities. There is a very real sense in which little new ground is broken here; I will be concerned for my thesis if actuaries reading this essay aren't frequently saying, "I already know that," as they read it. In fact, I expect that they will be "at home" with the overall framework used.

What *is* very different here is the clarity of focus on market values for *all* variables. As a result of that focus, management insights are dramatically different, dramatically more readily interpretable, and dramatically more useful.

Another way to say it is that the practices that cause difficulties in conventional pension accounting lie not with the basic way in which the solution to the pension finance problem is conceived. It is somewhere in the *application* of these practices that the puck gets lost, the single biggest problem being the discount rate. Other big problems include the use of multiple normal cost methods in the same plan, use of multiple discount rates none of which are correct in place of a single consistent rate based on the government bond yield curve, the liberal application of smoothing and amortization, as well as other more minor problems. These work in conjunction

with each other not only to disconnect every normal cost, liability, or contribution value from all others used in that plan, but from all monetary sense of reality as well.

It needn't be that way. Huge opportunities for risk control and cost control immediately open up, merely by insisting on the three biggest of the many needed reforms: first, that pension entries for the three financial statements all be computed on the same normal cost basis; second, that the discount rate be the market-determined risk-free rate in all three of those cases; and third, by discontinuing the use of smoothing and amortization (or at least fully disclosing both artificial and true values, making effects transparent, and keeping the period short). All unintentional investment risk can then be eliminated, leaving only consciously taken equity risk plus the inherent risks involved in actuarial decrement forecasting errors (this risk can also be managed to some degree by using the best estimate decrements, an effort already being made in many applications). What is the benefit of all this? Risk to the surplus, to pension expense, and to contributions can be nearly completely controlled, to any desirable level, the risk-control dial being the aggressiveness of investment policy.

Perhaps actuaries and accountants will find useful surprises here, tools usable by them to make their clients' plans run better and opportunities to add value through consulting offerings.

In closing, let me emphasize again that all of the practices I criticize here were adopted with good intent, trying to manage risks and costs with the best tools then available. But these are no longer the best tools, better ones are *now* available and have been for some time. The simple fact is that these outdated practices have made pension finance realities inaccessible to sponsors and have effectively prevented the adoption of clear-eyed and hard-headed benefit policies, contribution policies, and investment policies.

If long bonds (ideally duration-matching the liability) reduce risks to surplus, and thus also to pension expense and contributions, the question the actuarial profession needs to ask itself is *whether or not their recommendations*[74] *away from such a long bond portfolio over the last number of decades, toward more and more equities—chasing higher and higher required*

[74] Such a recommendation is *implied* on the actuarial side, when discussing high required rate of return and expected return assumptions, and it is *explicit* on the investment consulting side of the actuary's activity, when conducting asset-liability studies.

rates of returns and generating lower and lower contributions while taking more and more investment risk—isn't responsible for the current pension crisis? Acknowledging that the intentions were good, nonetheless did these shifts reduce contribution levels below that which is sufficient to prudently fund these plans, failing to take into account the downside risk of the equities?

It is my hope that many in the actuarial, accounting, and regulatory communities will be provoked to acknowledge substantial opportunity for them to support better pension management just by turning toward the use of sensible economic methods in their actuarial and accounting practices for pension plans. Doing so will help slowly restore a healthy DB pension institution, a result that should follow naturally from better-informed benefit, contribution, and investment policies.

Actuaries must recognize that they should enjoy a revered place as guardians of fiscal rectitude; the very word conjures sober truth-tellers dealing with financial constructs far too complex for others of lesser genius to fathom. It is a place of honor and respect, worthy of maintaining. At this point I fear that it is some need of *restoration.*

Perhaps the science of the pension actuary should be reviewed from top to bottom, excising financing practices inconsistent with best practices from the rest of the field finance. Perhaps it is insufficient to make surface level changes here or there, as some have done—patching bits of modern finance onto the existing structure of actuarial science. Actuarial science should perhaps be rebuilt from the ground up, discarding foundation stones such as the required rate of return and using modern portfolio theory and the knowledge base from the field of financial economics in its place; focusing on consistency between financial statements instead of differences, and on integrity in establishing payment plans (normal costs). There is opportunity for the mindset, the emphasis, the way that problems are approached, to evolve well beyond the craft's roots in the funding method, but it is all consistent with the notion of the actuary as sober truth-teller.

It bears repeating that, at the end of the day, pension plans can be successful only if managed in a clear-eyed, hard-headed manner, using good information. My ambition is to inspire all who deal with pensions, including particularly the actuarial and accounting communities, to insist that actuarial and accounting reports be provided on a sensible economic basis, and to likewise demand whatever regulatory changes are needed in order to implement that new basis.

In the meantime I hope that these professionals will recommend to their clients that plans be *managed* on a sound economic basis.

Appendix I: Implicit Options in the Pension Plan

I don't treat the several imbedded options in the pension plan in this exposition, other than in passing in this appendix. They are quite important in certain situations and deserve a fuller treatment. They are most important in underfunded plans and in plans where industry or other forces are putting pressure on the sponsor to terminate the plan. They are less important to a plan that is fully funded to an appropriate accrued liability funding target, where the sponsor's business is strong and it has no present intention to change or terminate the plan. Options are "stocks," rather than "flows," and can be worked into the various pension budget identities discussed in the text.[75]

Among these options are the sponsor's option to terminate new accruals (a "hard" or "soft freeze," depending on whether it affects just future new employees or also existing employees), a put that is held long by the sponsor on its balance sheet, and short by the trust on behalf of present and future employees and the PBGC. The termination option is "in the money" any time the assets (plus something more, from the general accounts, for healthy sponsors) are less than the *FEL*. If the sponsor is in difficulty itself to the point where it may not be able to make up for a deficit relative to the already accrued portion of the liability, the termination option is sometimes characterized as a *default* option. The termination "put" is held short by the participants and employees with respect to the remainder of the *FEL* above the value of available assets (which includes not only the assets in the pension trust but some part of any available worth of the sponsor). This option's value offsets much of the unfunded portion of the *FEL*, more so for less healthy sponsors than for healthy sponsors, and more so for sponsors seriously considering termination than for sponsors that intend to and are able to continue sponsoring the plan indefinitely.

The term $EVLD_{FEL}$ used in the text is intended to capture the value of this option; the subsidiary or nested term $EVLD_{eAL}$ refers only to the likelihood of termination or default on benefits already accrued, generally thought to be "owed" in a more tangible sense than those yet

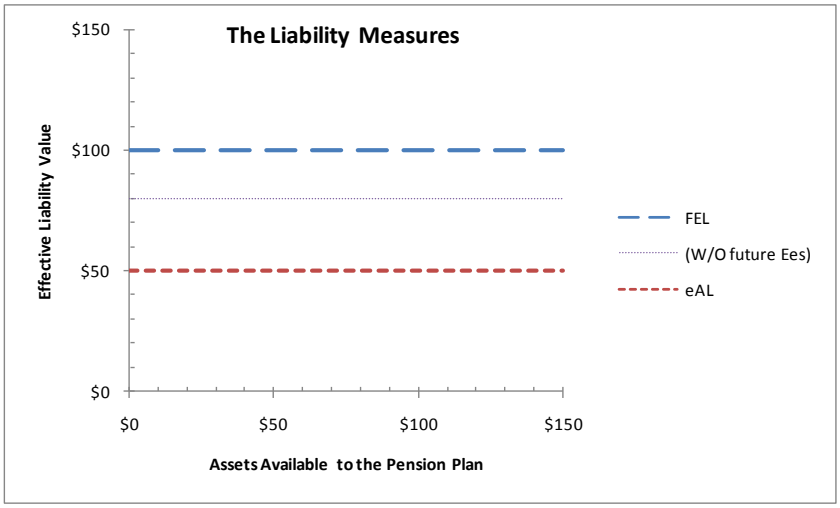
[75] Sharpe (1976) does a more detailed job of expositing these options. It is generally consistent with this discussion, but without the added insight that both the *FEL* and the *eAL* are key to the discussion and provide different strike prices for different of the options; he simply accepted the conventional "liability" (in most of his article in a highly artificial single period form) as the strike price.

to be accrued. But regardless of whether the *eAL* is "owed" in a stronger way than the rest of the *FEL*, if it is underfunded it is subject to defeat by this option just the same.

In payoff diagram terms, the liability's value is a straight and level line, as for the payoff diagram of a bond. In Figure 18, I show the *FEL* as the top line, and for reference I also include the *eAL*. (I also show a line representing the dividing point between the portion of the *FEL* representing past and current employees and the portion representing employees not yet hired, i.e., with the $PVFNC_{eAL}$ included, but not the $PVFNC_{future}$.)

Figure 18

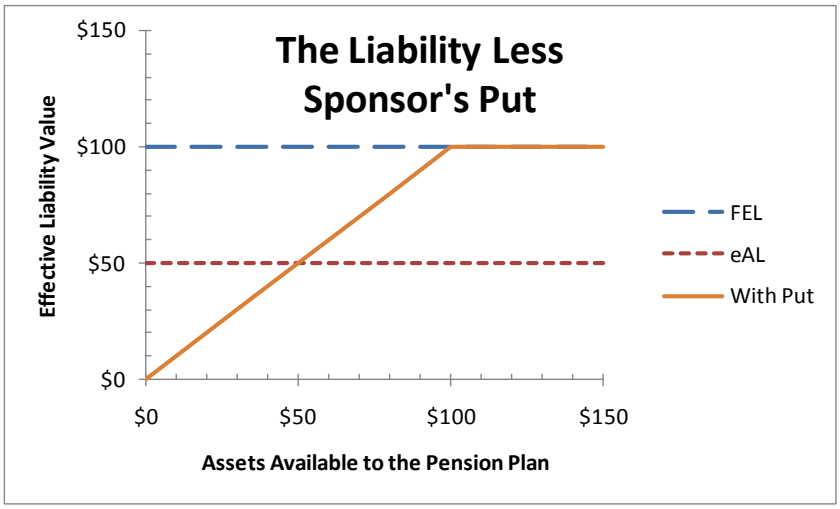
Payoff diagrams for three measures of the liability.



In Figure 19, the sponsor's termination or default put is then added to the liability line, giving a new combined line showing the modified value of the liabilities. If the available assets (those in the pension plan plus any the sponsor is likely to be willing to add) are less than the value of the *FEL*—and they virtually always are, and should be—the value of the *FEL* diminishes proportionately. If the funds are low enough, the value of the liability falls below even the *eAL*. At that point the benefits that have accrued are no longer secure; this is the position many plans are in today.

Figure 19

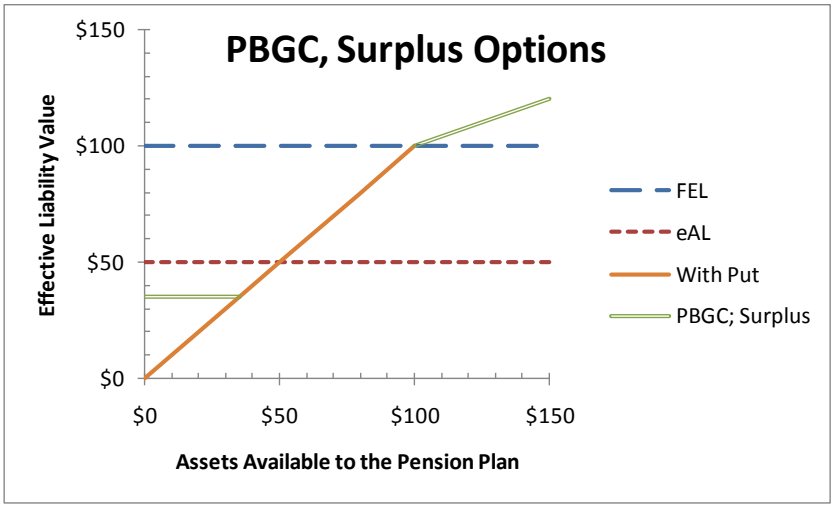
Payoff diagram for the liabilities after including employer's termination put option.



In turn, the PBGC (for corporate plans, not for public plans) is short the sponsor's termination or default put to the extent that the available assets are less than the lesser of a) the actual accrued liability, or b) the liability recomputed on the basis of the PBGC's benefit limits. The employee's protection from the PBGC makes them long this put. So in this area of the chart, shown on the lower left hand corner of Figure 20, while the sponsor itself can avoid the liability right down to zero if underfunded to that degree, the PBGC put offsets the sponsor's put on behalf of the participants, and when combined gives them a straight line payoff region again. This assumes the creditworthiness of the PBGC itself.

Figure 20

Payoff diagram for the liabilities, adding a) PBGC protection and b) a call option by employees on a portion of any true surplus.



The last option that I'll mention, and an interesting one, is the call option held short by the sponsor and long by the plan participants on any pension assets greater than the *FEL*, i.e., true economic overfunding. Owing to lack of clarity in the past about the role—even the existence—of the *FEL*, parties have behaved as if this call option is in the money whenever the plan is overfunded relative merely to the reported accrued liability. A study of the *FEL* and of the present value of future contributions reveals that this is an error, as the *ePVFC* will consume any surplus above the accrued liability (regardless of whether it is an economic or conventional accrual measure) and less than the *FEL*. But in a similar manner, the benefit of this true economic surplus is likely to be shared between the sponsor and the participants, so I've not shown the payoff (top right corner of Figure 20) with the full steepness that would indicate that all surplus was going to the participants.

So a payoff line that describes the value of the liability completely, combined with respect to the described options, consists of the two lower left and upper right segments with the double-inscribed line, and the angled solid line connecting them. (For public plans, the payoff line does not include the flat PBGC area on the lower left). This solid angled line is the region that well-managed plans should always be in.

No measure of the liability is any more secure than its funding level, and this is why I point out that the only economic importance of a subsidiary accrued liability *less* than the *FEL* is as an agreed funding target. It is important to expect sponsors to fully fund the accrued liability that is being used as an agreed funding target, and on a market value basis rather than on a conventional actuarial basis.

The public's interest in this is high, because the PBGC (for corporate plans) will likely end up providing for underfunded benefits, given how many plans are funded at a low level, suggesting that the PBGC call is "in the money" at a national level.

A related issue is that of investment policy. In any region of the payoff curve where the line angles up on a one-for-one basis, investment policy presents a standard, and fair, risk/return trade-off. But where it is not at such an angle, there is a special relationship between risk and return. For example, in the flat area at the lower left of the diagram, where the PBGC is subject to taking over the plan, neither the sponsor nor the participants have any downside to "throwing the dice" with a very aggressive investment policy. They can't lose, because of the PBGC guaranty, and they just might win, getting back to fully funded status or even better. This is a serious moral hazard issue, and points up another area that the PBGC should monitor and control: investment policy for plans in jeopardy of default. See Harrison and Sharpe (1982).

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Variables and Terms Used

AL; eAL: conventionally measured accrued liability, and the economically determined version.

ABO; eABO: conventionally measured accumulated benefit obligation (one type of accrued liability), and the economically determined version.

C; eC: conventionally determined contribution, and the economic version.

d: discount rate or cost of capital, economically determined, and Δd, the change in that rate.

D: duration.

Economic: In context, but usually used as a synonym to "market."

EVLD: economically determined expected value of liability default.

FEL: Full economic liability. A synonym for the present value of future benefit payments based on the full economic liability, $PVFBP_{FEL}$., described below. This is an aggregate measure, and as such is, where the context doesn't require otherwise, an open-group concept (inclusive of unidentified future employees). The *FEL* for an individual is the individual's $PVFBP_i$.

NC; eNC; eNC_{FEL}*;* eNC_{eAL}: conventionally determined normal cost, and three economically determined variants (generic; based on the *FEL*, and based on the *eAL*).

NPV; PV: net present value and present value. In this paper usually economic unless the context requires otherwise.

PA: economic value of pension assets.

PBGC: Pension Benefit Guaranty Commission.

PE; ePE; ePE_{FEL}*;* ePE_{eAL}: conventionally determined pension expense, and three economically determined variants (generic; based on the *FEL*, and based on the *eAL*).

PBO; ePBO: conventionally measured projected benefit obligation (one type of accrued liability), and the economically determined version.

PVB; PVFB: conventional terms meaning present value of benefits or equivalently, present value of future benefits. In this paper I use the more complete synonym, PVFBP (below).

PVFBP; ePVFBP; ePVFBP$_{FEL}$; ePVFBP$_i$; ePVFBP$_{future}$; ePVFBP$_{eAL}$: without the prefix "e", this is the present value of future benefit payments on a conventionally measured based; with the "e", it is an economic version. There are many variants, identified by subscripts. Without the subscript it is a generic.

PVFC; ePVFC; ePVFC$_{FEL}$; ePVFC$_{future}$; ePVFC$_{eAL}$: present value of future contributions.

PVFNC; ePVFNC; ePVFNC$_i$; ePVFNC$_{future}$; ePVFNC$_{eAl}$: present value of future normal costs.

P&L: profit and loss statement, or income statement.

r: total rate of return; also r_{PA}.

SC; eSC: supplemental costs (not service costs). Restricted in its economic form to demographic estimation estimates, excluding prior service costs, expected return errors, etc. See text.

μ_{PA}: return in excess of the return of the hedging portfolio; a risk premium. See Waring and Whitney (2009).

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