Revisiting Pension Actuarial Science:
A Five-Part Series

Part 1
Fair Value of the Liability – The Contractual Benefit Obligation

James J. Rizzo, ASA, MAAA
Krzysztof M. Ostaszewski, Ph.D., FSA, CFA, CERA, MAAA
Piotr Krekora, PhD, ASA, MAAA

Abstract for the Series

The current financial model put forth as the market value of public sector pension benefit liabilities is simply the expected cash flows of the accumulated benefit obligation, as defined for current private sector financial reporting, discounted using a risk-free yield curve. This model is in serious need of an overhaul. It fails to faithfully represent the fair value of a currently accrued public sector pension benefit liability in three important ways:

1. Its use of the accumulated benefit obligation cash flows fails to accurately represent the terms of the employment contract which gives rise to the obligation being valued – a violation of labor economics principles.

2. Its use of expected cash flows as if they were fixed fails to recognize the risk premium load, which a fair exit price would include for the potential for adverse cash flow experience – a violation of actuarial finance and pricing principles.

3. Its use of risk-free discount rates fails to adequately reflect the observable and not-so-observable inputs from market participants' behavior – a violation of financial engineering principles.

Parts 1 through 3 in this series propose solutions to these three flaws.

Part 4, "The Residual Benefit Liability," presents an alternate approach to obtaining the fair value of the public sector employer's pension benefit liability. It approaches the task by modeling the real world operation of the pension fund, rather than approaching the task from the perspective of a theoretical construct. This alternate approach dares to model the long-term agency operation of the plan rather than ignoring it in favor of a pass-through approach. The current model ignores the effectiveness (even the existence) of the pension fund itself, while the alternate approach attempts to model the plan's operation in practice over time in order to determine the employer's residual asset or liability.

In spite of these three improvements and the alternate model, we believe the fair value of public sector post-employment benefit liabilities has little to no usefulness in most venues. There are legitimate roles which the market or fair value might play in valuing an individual member's personal wealth, a minor role in the context of certain discussions concerning risk measurement and risk management, and a major role in the context of plan terminations and freezes.

However, for purposes of advance funding, taxpayers, financial reporting, lenders and rating agencies, comparability, and the major part of risk measurement and analysis, the decision-usefulness of market or fair value is negligible, possibly even misleading. Other existing models and methods are far more suitable for these purposes, including conventional actuarial approaches and others that are less conventional or popular, but which should be considered in the actuarial toolbox and have higher decision utility.

Part 5 in this series, "Consider the Measurement Purpose," addresses various purposes for measuring a public sector pension liability and which measures have the most practical usefulness.

Series Outline

Introduction to the Series

A. Measurement Attribute Terminology
B. Improve the Current Model
C. Measure the Employer's Liability
D. Consider the Measurement Purpose

Part 1: Fair Value of the Liability – The Contractual Benefit Obligation

A. Benefit Contract Terms
B. Current Private Sector Treatments
C. Contractual Benefit Obligation (CBO) for Pensions
D. Case Study Plan
E. Contractual Benefit Obligation (CBO) for OPEBs

Part 2: Fair Value of the Liability – Risk-Adjusted CBO Cash Flows

A. Longevity Risks
B. Risk Premium for Error Around the Mean
C. Mortality Tables and Life Expectancy
D. Risk Premium for Error in the Mean
E. Risk Premium for Retirement Rate Risks
F. Summary of Risk-Adjusted Pension Cash Flows
G. Risk-Adjusted OPEB Cash Flows

Part 3: Fair Value of the Liability – A Market-Related Discount Rate

A. Modigliani-Miller Friction
B. Return to Fair Value Definitions
C. Single Premium Group Annuity Market
D. High Quality Corporate Bond Settlement Rates
E. Liquidity Risk
F. Low Percentile in Capital Asset Pricing Model
G. Possible Resolution

Part 4: Fair Value of the Liability – The Residual Benefit Liability

A. Modeling the Real World
B. Pension Fund is Not a Pass Through
C. Modeling Residual Assets and Liabilities

Part 5: Measuring the Liability – Consider the Measurement Purpose

A. Advance Funding
B. Taxpayers
C. Financial Reporting
D. Lenders and Rating Agencies
E. Comparability
F. Risk Measurement and Analysis
G. Personal Wealth
H. Plan Terminations and Freezes

Fair Value of the Liability – The Contractual Benefit Obligation

An understanding of the terms of a financial instrument, in all its complexities, is fundamental to its fair valuation. Financial engineering and pricing require a careful analysis of the specific terms of the financial contract and the amounts, conditions, likelihood and timing of payments due in the future. Financial instruments often have complex contract provisions. These must be identified and considered carefully in developing and applying the pricing model. Certainly, risk margins must be built in, but it all starts with the pricing imperative to model the contract terms themselves as closely as possible.

An understanding of the voluntary exchange transaction that occurs between employer and employee (i.e., the terms of the instrument) is fundamental to the fair valuation of public sector pension benefit liabilities. That is the specific contract which we are to price, in developing and applying a financial and actuarial model for valuing public pension benefit liabilities. Again, it all starts with the pricing imperative to closely model the contract terms themselves. No more; no less. As we will see below, the current model's use of the accumulated benefit obligation (ABO) misses the mark on this important point.

Generally speaking, in exchange for an employee's creditable service for a given period of time (e.g., a year), the employer agrees to compensate the employee. All under the terms of the exchange transaction between the employer and employee:

- Some of this compensation is paid immediately by the employer to the employee.
- Some is paid by another party under a separate agreement between the employer and the other party.
- Some is paid immediately by the employer to another party, which in turn provides benefits or payments to the employee later or provides insurance coverage during that period.
- Some compensation is deferred and paid by the employer to the employee at a later date.

The contract may be implicit or explicit. For fair value, what must be valued is the part of that exchange, which represents the employer's future obligation for benefit earned to date.

Some payments made by the employer to the employee may not even be as compensation for prior services rendered pursuant to the contract. Such payments might, more appropriately, be considered unilateral payments to maintain goodwill, encourage future employment longevity, or for political reasons. These may be paid immediately or may be deferred or transferred to another party for later payment. Deferred payment promises of these types, once embedded in the contract (even if not specifically negotiated but granted unilaterally), become part of an employee's or retiree's contract rights and must be valued along with the more usual type of deferred payment promises as part of the contractual benefit obligation (CBO).

A. Benefit Contract Terms

The actuary's job is to identify the amounts, conditions, likelihood and timing of those deferred benefit payments arising out of the voluntary exchange transaction between employee and employer. True to the principles of pricing financial instruments under fair value models, we must model the contract terms carefully.

A complicating feature of valuing pension liabilities (as compared to typical financial instruments' static contract terms) is the dynamic nature of the pension payoff promises as they accrue over time. If a financial option can be exercised at a later date, the total amount of payment (expected or risk-adjusted) must be factored into the pricing process. Pension benefit amounts and rights accrue over time in accordance with the contract. The terms of the pension contract automatically and dynamically change the amount, conditions, likelihood and timing of payment as each year of creditable service is rendered. So the amount, conditions, likelihood and timing of payments must be factored into the pension pricing model at a measurement date. These factors must be determined based on what has been earned by the employee under the terms of the contract as of the measurement date, not based on what might be earned by the employee in the future conditioned on future employment.

This is an important fair value pricing principle often ignored in the name of other worthy goals not associated with fair value pricing.

B. Current Private Sector Treatments

Current Private Sector Accounting

As previously mentioned, the currently accepted model for the market value of the public sector pension liability appears to be the expected ABO discounted using at risk-free yield curve.

The Financial Accounting Standards Board (FASB) issued Statement of Financial Accounting Standards (SFAS) No. 87 (Employer's Accounting for Pensions) in December 1985. That accounting standard defined three types of benefit measures for disclosure, the projected benefit obligation (PBO), the accumulated benefit obligation (ABO) and the vested benefit obligation (VBO).

FASB does not describe the PBO, ABO or VBO as fair value. There are reasons unique to the history and perspective of the FASB and its purposes that gave rise to terminology and measurement attributes for pension valuations that are not equivalent to market value or fair value of the pension benefit liability. While the accounting standard does discuss fair value of plan assets, it does not refer to fair value of plan liabilities. It deliberately does not use a fair value attribute model. This may change in the future, but that appears unlikely. FASB makes an exception for corporate pension liabilities and describes its own model for such calculation without attempting to fold its model into an attribute framework.

Standards setters often make exceptions to their conceptual framework, and pensions are an oft-excepted liability. Strict uncompromising ideologues find no place in standards setting because real world situations seldom conform to simple, unified theories.

None of FASB's three benefit obligation measures is consistent with fair value and the employment contract principles in terms of the benefits valued. In addition, FASB's benefit obligation measures are not consistent with current fair value principles in terms of non-investment risk premiums. Finally, they are not entirely consistent with current fair value models in terms of the discount rates used, including other margins.

The rhetorical linkage of fair value of all assets and liabilities sounds like a worthy goal in conversation, but many believe that certain assets and liabilities should not have a fair value measurement attribute. The accounting profession through its standards-setting bodies has legitimate reasons for mixed attribute models. PBO, ABO and VBO may have some similarities to fair value, but they are not fair value.

FASB's PBO applies expected future pay increases for pay-related pension plans. This is clearly not consistent with the fundamental principle of measuring the amounts, conditions, likelihood and timing of payment earned under the terms of the employment contract at the date of measurement. It may be consistent with FASB's objectives, but it is not consistent with a fair value of the contract. Under the contract, a pay-related pension benefit formula provides an earned right only to the formula factors through the measurement date. Future pay would be used only for future measurement dates to determine the proper contractual amounts earned at those later dates. Fair value of the pension benefit liabilities requires the determination of the contractual benefits earned at the measurement date, and no more.

FASB's ABO recognizes only the earnings to the measurement date and, therefore, is more in line with valuing the contractual benefits than the PBO. However, the ABO (and PBO) includes three features that are inconsistent with the employment contract being valued and, thus, inconsistent with a fair value of the pension benefit obligation.

1. ABO and PBO include the value of future increases in the employee's vested percentage that might occur after the measurement date. This, too, is inconsistent with a fair value of the contractual benefit obligation -- another overstatement (slight though it may be) of the terms of the labor contract in place. At the measurement date, an employee who has not rendered enough qualifying service under the terms of the contract has earned no rights to deferred compensation for retirement on account of those prior years of service. That is the way the contract works. At future measurement dates, upon reaching the years of service required for vesting, there is a sudden jump in the exit liability owed by the employer for future retirement benefits, enough to make up for all prior years of service. Then each measurement date thereafter, the progression is naturally much smoother. That is how the contract works, the voluntary exchange transaction between the employee and the employer has punctuated discontinuities, which should not disturb a faithful application of financial engineering principles to price the contractual benefits. A nonvested employee has no contractual retirement benefits

until he or she works enough years to earn the nonforfeitable right to the retirement benefit.

2. ABO and PBO load the benefit obligation for active employees with expected benefits, "accrued" ratably as of the measurement date, for duty and nonduty disabilities that might occur in the future, even though the disability has not occurred as of the measurement date[1]. This is a natural feature of the traditional unit credit cost method of funding (projected and unprojected), which was borrowed for private sector accounting purposes such as PBO, ABO, VBO and for private sector funding purposes such as current liability and funding target. This might be appropriate for funding benefits under a traditional unit credit cost method (Pension Research Committee, 1991). It might also be appropriate in the minds of those accountants preferring a more linear progression or other smoothing to avoid discontinuities in the benefit incidence, but a fair value of the benefit contract terms knows of no such technique. This treatment of future ancillary benefits is not appropriate to a fair value of the benefits actually earned to date under the terms of the contract. An employee does not earn a nonforfeitable disability right until he or she is disabled under the terms of the contract.

   Employment contracts usually call for coverage under a group life insurance policy. There is no claim on benefits unless and until the employee dies. The current year's compensation (including the group term premium for the year) makes sufficient provision for one-year term costs to account for that possibility. But, if the event does not occur, there is no exit obligation to value. Each day he works, he has the right to "coverage" for benefits payable in the case of death.

   Indeed, all those who had become disabled prior to the measurement date, and therefore are receiving or entitled to future disability pensions, have a contractual benefit promise that must be valued. The same feature of FASB's ABO also applies to duty and nonduty death benefits. Again, if as of the measurement date an employee has not become disabled or died from duty and nonduty causes, then there is no disability or death benefit earned as of the measurement date (except what may attach itself to a vested deferred retirement benefit earned). Even the Internal Revenue Code Section 411(d)(6) does not attach future ancillary benefit rights to the current accrued retirement benefit for private sector plans at any given measurement date.

   The fair value of the pension benefit earned for the coming year should include a one-year term cost for duty and nonduty disability and death benefits. Including a level funding type of cost in the valuation to account for disability and death benefits that might arise in the future (after the measurement date) is not consistent with the contract and compensation terms of the current exchange.

[1] Statement of Financial Accounting Standards No. 87, Paragraphs 17 and 42b, and Footnote 10.

3. ABO and PBO load the benefit obligation with the value of future early retirement subsidies which employees might earn in the future[2], even though they may not have yet achieved sufficient service to earn a right to such subsidies at the measurement date. Again, this is not consistent with the terms of the contract and what the employee has actually earned as of the measurement date. Certainly, if an employee has earned (as of the measurement date) enough creditable service to satisfy the service requirement for a subsidized early retirement, then he has indeed earned the subsidy right and it has attached itself to his then-current accrued retirement benefit. However, if the employee has not earned (as of the measurement date) sufficient service to satisfy the service requirement for a subsidized early retirement, then the fair value of his contractual benefit obligation should not yet include any early retirement subsidy.

FASB's VBO has none of these failings. It uses only the earnings to the measurement date and recognizes the extent vested as of the measurement date. It does not include any liabilities for disabilities and deaths not yet occurred at the measurement date, and it does not include the value of early retirement subsidies unless the employees eligible for early retirement subsidies at the measurement date. This makes VBO more consistent with labor economics than ABO or PBO. However, it still has a remaining flaw that disqualifies it.

All three of FASB's measures of the obligation (VBO, ABO and PBO) ignore or override the employment contract in the issue of certain complex accrual patterns, such as formulas which are backloaded, or are the greater of two formulas, or which limit the service credits[3]. As one such example of a backloaded pattern, consider an employer-employee contract that states that the employee's retirement benefit formula is 2 percent of final average pay for each of the first 20 years of service plus 3 percent of final average pay for years in excess of 20, and consider an employee who has 21 years at the current measurement date and will retire at 35 years. FASB's measurement rules require the benefit to accrue linearly from zero to 35 years. For the current measurement date, all three of FASB's benefit obligation measurements require the employee's benefit for service to date to be valued at 51 percent of average pay (21/35 times 85 percent). However, under the actual terms of the employer-employee contract, the employee has earned a retirement right to 43 percent of average pay (20 times 2 percent plus one times 3 percent). The 43 percent answer represents the contractual benefit obligation of the employer, and should be used to measure the fair value of the pension obligation.

These characteristics of VBO, ABO and PBO, which fail the test of contractual benefits, are a part of FASB's measurement model because of a desire to attribute costs to all years of service in a smoothed ratable fashion. FASB did not want discontinuities in its reporting model.

Financial engineering, however, regularly deals with punctuated liabilities over time and discontinuities in the liability progressions. Such discontinuities should not disturb those who calculate or use a fair valuation of the contractual benefit obligation. It is what it is. An alternate approach (such as VBO, ABO or PBO) may be entirely appropriate for other purposes. A

[2] Statement of Financial Accounting Standards No. 87, Paragraph 42 and Footnote 9.

[3] Statement of Financial Accounting Standards No. 87, Paragraphs 40, 42, and Footnote 8. See also A Guide to Implementation of Statement 87 on Employer's Accounting for Pensions, Q&A 45.

standards-setting body may choose to adopt a different measurement attribute identical to current private sector financial reporting. If so, it should not be called fair value (or market value). It is something else.

The current model of the market value of pension liabilities is simply the expected ABO discounted using a risk-free yield curve. A corrected or improved model for fair value of the liability is based on the contractual benefit obligation, not an artificially smoothed pattern.

Current Private Sector Funding

At least the current liability and funding target of the Internal Revenue Code use only the earnings to the measurement date and do not require this linear override, valuing the benefits just as they accrue per the contract formula. However, they do apply the traditional unit credit funding features of recognizing the future possibility of duty and nonduty-connected disability and death in the calculation, and they ignore vesting. It is a traditional, unprojected unit credit cost method using the accrued benefits.

Notice that the proponents of the current model for market value of liability disclosures have latched onto private sector concepts of accounting and funding for identifying the benefits to value. However, these concepts do not value the contractual benefits earned to date under the voluntary exchange transaction, which occurs between employer and employee, and thus, should not be part of a fair value model. We should follow the labor economics principles more closely.

C. Contractual Benefit Obligation (CBO) for Pensions

Staying true to financial engineering and pricing principles requires using the contractual obligation to determine what benefits to value. We must not rely on other worthy goals, being reminded that we are pricing the fair value of the contractual benefit obligation here. That is the proper exit liability to value. That is the starting point for the process. This means that the CBO calculations must involve the following features and processes.

1. Those members who are currently in pay status, as of the measurement date, regardless of reason (including in-service duty and nonduty disability and death), should be valued according to the benefit amount and form applicable. This is nothing new.

2. The CBO as of a given measurement date should have zero values for active employees who have not yet (as of such measurement date) earned a nonforfeitable (vested) right to a retirement benefit. For contributory plans with refund features, however, the fair value of the liability for such employees is no less than the accumulated employee contributions as of the measurement date together with any interest credited.

3. For employees with a nonforfeitable vested interest who do not yet have sufficient service to have earned, as of the measurement date, a right to a subsidized early retirement benefit, the value of the CBO is determined by modeling their

decrements until final retirement age, as the contractually accrued and vested retirement benefit calculated as of the measurement date payable at the later of the date for commencement of vested deferred benefits (again, based solely on service at the measurement date in applying the eligibility conditions) or the date of decrement.

If the decrements are a function of service, future service should be assumed for the purpose of decrement probabilities, but not for the purpose of benefit eligibilities, amounts or subsidies. The value of any death benefit associated with vested deferred retirement benefits should also be included (not to be confused with duty or nonduty active employee death benefits). Again, for contributory plans with refund features, the fair value of the CBO for such employees is no less than the accumulated employee contributions as of the measurement date together with any interest credited.

4. For employees who do have sufficient service to have earned, as of the measurement date, a right to a subsidized early retirement benefit (but not necessarily the age), the value of the CBO is typically determined by:

    a. modeling their decrements until their earliest early retirement age (associated with the service earned as of the measurement date), as the retirement benefit contractually accrued as of the measurement date payable at an assumed early retirement commencement date together with the early retirement reduction associated with such age, the number of years for early retirement reduction being based upon the terms of the plan and the service earned as of the measurement date; and
    b. modeling their retirement decrements after the earliest early retirement age (associated with the service earned as of the measurement date) until normal retirement age, as the retirement benefit contractually accrued as of the measurement date but reduced for early retirement at and payable at the time of decrement,
    c. modeling their retirement decrements after normal retirement age until final retirement age, as the retirement benefit contractually accrued as of the measurement date, payable at the time of decrement.

5. One-year term normal costs for duty and nonduty during-employment disability and death benefits provided by the plan should be added to the value of retirement benefits accruing during the coming year to obtain the total normal cost for the year.

Revising the benefits valued (to be the contractual benefits) is the first of three improvements to the current model of market value of liabilities, which are presented herein. The other two are risk adjustments to the contractual cash flows discussed in Part 2, "Risk-Adjusted CBO Cash Flows," and a discount rate that reflects market prices discussed in Part 3, "A Market-Related Discount Rate," in the series.

D. Case Study Plan

The contractual benefit obligation is more faithful to the economics principles of labor contracts. To illustrate the difference between the CBO and ABO, consider a case study plan.

Figures 1 and 2 below present the plan provisions and actuarial assumptions relevant to this comparison.

Figure 1

Summary of Case Study Plan Provisions	
Normal (unreduced) Retirement Date (NRD) Eligibility	Age 60 with five years of service, or 30 years of service regardless of age. No DROP provisions.
Normal (unreduced) Retirement Date (NRD) Benefit	2 percent of final average pay for each of the first 20 years plus 3 percent of final average pay for each year in excess of 20.
Early (reduced) Retirement Eligibility	Age 50 with 15 years of service
Early (reduced) Retirement Reduction	3 percent for each year by which actual retirement precedes NRD
Vesting Eligibility	Five-year cliff vesting
Vesting Benefit	Accrued benefit payable at NRD, or a refund of contributions with interest
Nonduty Disability Eligibility	10 years of service
Nonduty Disability Benefit	The greater of accrued benefit or 25 percent of pay, payable immediately
Duty Disability Eligibility	From date of hire.
Duty Disability Benefit	The greater of accrued benefit or 42 percent of pay, payable immediately.
Nonduty Death Eligibility	10 years of service
Nonduty Death Benefit	Accrued benefit payable immediately to beneficiary.
Duty Death Eligibility	From date of hire.
Duty Death Benefit	The greater of accrued benefit or 50 percent of pay, payable immediately to beneficiary
Cost of Living Increase	Increase in consumer price index, not to exceed 3 percent per year

Figure 2

Summary of Relevant Valuation Information	
Discount Rate	2.82 percent, the single discount rate equivalent to the Treasury STRIPS yield curve observed on Dec. 31, 2008.
Mortality Table	1994 Group Annuity Mortality Table for pre- and post-retirement for valuations.
Retirement Rates	24 percent at age 50, then, 7 percent, 7 percent, 7 percent, 11 percent, 11 percent, 11 percent, 11 percent, 8 percent, 8 percent, then 60 percent at age 60, then 30 percent for each year through age 69, then 100 percent at age 70; also 100 percent at 35 years of service regardless of age
Turnover and Disability Rates	Based on a recent experience study
Market Value of Plan Assets at 12/31/2008	$380,717,255
Price Inflation	3.0 percent per year compounded annually
Salary Increases	Service-based, from 14 percent to 4 percent annual increases

Figures 3 and 4 present comparisons of the ABO and CBO values for our case study plan. For this comparison, the mortality table used was 1994 GAM (males and female) and 2.82 percent for the discount rate. This discount rate represents the single discount rate producing a present value of the CBO expected cash flows which is equal to the their present value when using the full U.S. Treasury STRIPS yield curve (yields above 30 years equal to the yield for 30 years) as of Dec. 31, 2008.

Figure 3, below, pulls the layers away a bit to reveal how the ABO and CBO progress through an employee's career, and how the ABO and CBO differ for employees with different service. Notice the two discontinuities that exist at five and 15 years. This treatment may not be appropriate for certain other purposes, but it entirely appropriate for calculation a fair value of the contractual pension benefit liability.

Figure 3

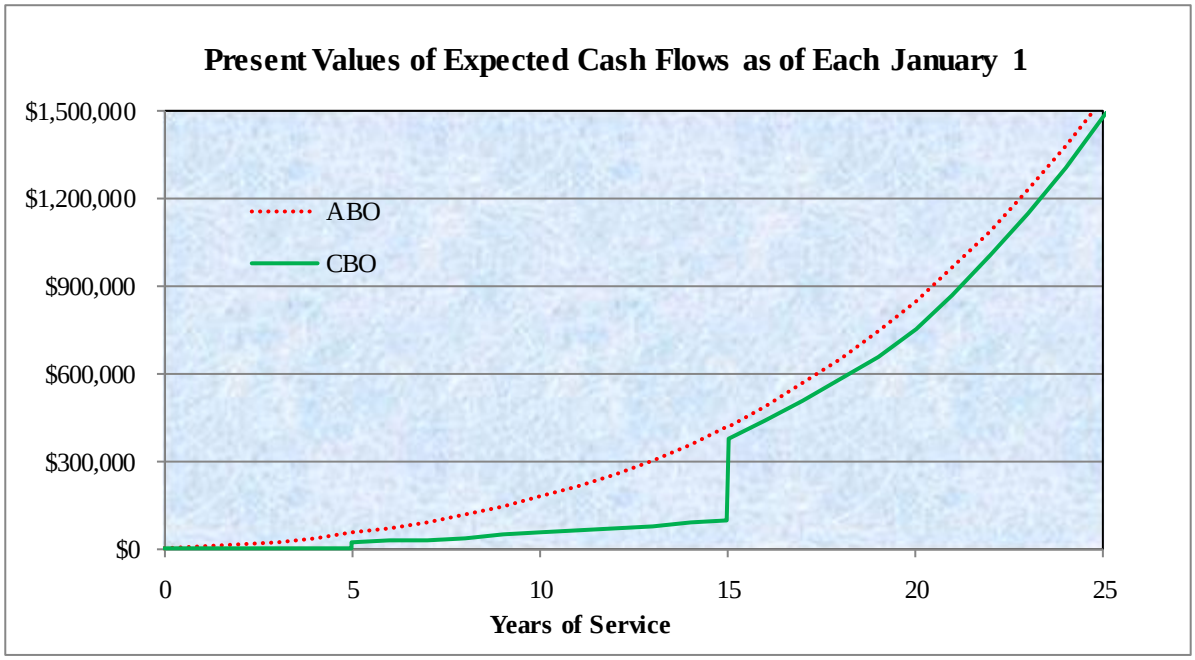
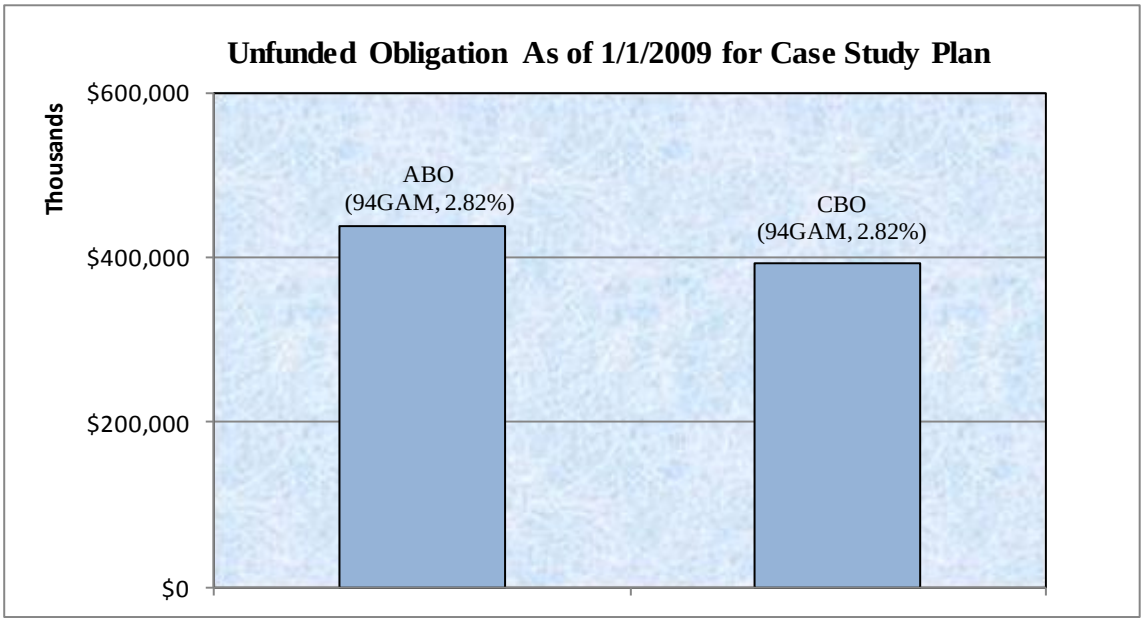


Figure 4



The total present value of ABO (and CBO, respectively) minus the market value of assets was calculated to derive the unfunded obligation as of Jan. 1, 2009.

E. Contractual Benefit Obligation (CBO) for OPEBs

While this paper's primary focus is measuring the liabilities of public sector pension plans, the financial reporting treatment for other postemployment benefits (OPEBs) is and will likely be the same as for pensions. Although, standards-setting boards often make exceptions to the application of concepts and principles, it would be a serious error to build momentum for the proper model for fair value of public sector pension liabilities without regard to how that model might apply to public sector OPEBs.

Governmental entities' unfunded OPEB liabilities, as measured pursuant to GASB Statement No. 45, are often of the same order of magnitude as unfunded pensions. While having similarities to pensions, the nature of OPEBs and the nature of the employment contract for OPEBs (whether implicit or explicit) are different from pensions, while remaining at least as complex and illusory.

Some have specifically excluded OPEBs from the public and private discussions and limited them to pensions in the interest of narrowing the focus of the already wide-ranging topic of public sector pension finance. That may have been a reasonable approach for the past. However, the valuation of OPEB liabilities cannot be treated as an afterthought, added on to whatever becomes the accepted or standard model for pensions. We must begin to include OPEBs in the primary discussions. Having said all that, this paper focuses on pensions, but will include brief discussions of OPEBs at relevant points.

Contractually, in considering the voluntary exchange transaction between employee and employer, identifying that component of compensation earned to date which relates to OPEBs is challenging. Some employers have detailed plan provisions, documented and duly adopted. As actuaries are now valuing the OPEB obligations of many governmental employers for the first time, it is becoming clear to labor and management that precious little has been reduced to writing. Both FASB and GASB have embraced the concept of the "substantive plan," the plan as understood between employee and employer. GASB included language concerning moral and political obligations that may exist between the employer and the employee/retiree, which go beyond the terms of any collective bargaining agreement, statutory requirements, or written plan documents or booklets, which might exist.

Progress is being made in this area. However, when it comes to identifying what an employee has "earned" to date, the implicit and explicit contract terms are little help because they primarily cover the eligibility conditions, the benefit levels and contribution requirement once the employee actually retires. Furthermore, few employers provide vested deferred OPEB subsidies to those employees who terminate prior to reaching eligibility for early retirement pension benefits. Determining the CBO earned through a given measurement date may not be fully answerable.

A reasonable way to help determine what nonforfeitable right to future OPEBs an employee has actually earned, as of a given measurement date, is to ask these questions:

1. If the employee were to terminate employment (other than by death or disability) as of the measurement date, what right to future OPEBs would he have? That is not an irrelevant question for determining the contractual benefit obligation and its fair value as of a measurement date if we are to be true to the concept of "fair value" of the current contract obligation. It may indeed be an irrelevant question if we are determining another form of benefit measurement for other purposes, such for funding, accounting (under a mixed-attribute model), comparability or lenders and rating agencies. But the question may provide some real insight for determining the fair value of the current OPEB CBO.

2. Does the employer have the right to alter or amend the eligibility conditions, the benefit plan (vendors, copays, deductibles), or the future level of contributions required from retirees? Can the employer terminate the program unilaterally?

3. Since "fair value" imagines a market in which an employer discharges or settles the voluntary exchange obligation, which the employee had earned for service to the measurement date, how much of the total future obligation had really been earned under the terms of the voluntary exchange as of the date of measurement?

These questions have legal, accounting and funding answers, and they illustrate only one of the challenges (benefit accrual rights) that exist in attempting to contrive a logical measure of the current contractual right to an OPEB while maintaining faithfulness to fair value principles in financial engineering.

Furthermore, if an employer holds the unilateral right to cut back or terminate OPEBs or raise the contributions required from retirees, then we should question whether they really are part of the voluntary exchange transaction for prior service.

James J. Rizzo, ASA, MAAA, is senior consultant and actuary at Gabriel, Roeder, Smith & Company in Fort Lauderdale, Fla. and can be reached at *jim.rizzo@gabrielroeder.com*.

Dr. Krzysztof M. Ostaszewski, FSA, CFA, CERA, MAAA, is actuarial program director and professor of mathematics at Illinois State University in Normal, Ill. and can be reached at *krzysio@ilstu.edu*.

Dr. Piotr Krekora, ASA, MAAA, is senior actuarial analyst at Gabriel, Roeder, Smith & Company in Fort Lauderdale, Fla. and can be reached at *piotr.krekora@gabrielroeder.com*.

Special Thanks and References for the Series

Special Thanks

We wish to express our gratitude to many friends and colleagues who assisted in various aspects of this series of papers. These include Stephen Gauthier (Government Finance Officers Association), Penelope Wardlow, Girard Miller (The PFM Group), Terry Mumford and Albert J. Lee (Ice Miller), members of National Association of Public Pension Attorneys, Sean McShea (Ryan Labs, Inc.), Robin Prunty (Standard & Poor's) and Karl Johnson (GASB).

References

Actuarial Standards Board, Actuarial Standard of Practice No. 27, *Selection of Economic Assumptions for Measuring Pension Obligations*, September 2007.

Bader, L. N., "Pension Deficits: An Unnecessary Evil," *Financial Analysts Journal*, 60 (3), May/June 2004, pp. 15-20.

Daniel Bauer, Matthias Borger and Jochen Russ, *Pricing Longevity Bonds Using Implied Survival Probabilities*, 2006 meeting of the American Risk and Insurance Association (ARIA), 2006.

Boaz, G.C., *Memorandum*, State of Tennessee Comptroller of the Treasury, Feb. 24, 2009.

Boivie, Ilana and Beth Almeida, *Pensionomics: Measuring the Economic Impact of State & Local Pension Plans*, National Institute on Retirement, February 2009.

Casualty Actuarial Society Task Force on Fair Value Liabilities, *White Paper on Fair Valuing Property/Casualty Insurance Liabilities*, Arlington, Va., 2000.

Casualty Actuarial Society, *Fair Value of P&C Liabilities: Practical Implications*, Arlington, Va., 2004.

Derman, Emanuel, *My Life as a Quant*, John Wiley & Sons, Inc.

Gabriel, Roeder, Smith & Co., "Valuing Public Pension Plans: Comparing Financial Economics with Conventional Approaches," *GRS Insight*, April 2008, pp. 1-4.

Gold, J., "Never Again: A Transition to a Secure Private Pension System," *The Journal of Portfolio Management*, Fall 2005, pp. 92-97.

Gold, J. and G. Latter, "The Case for Pension Plan Liabilities to Market," working paper, Aug. 11, 2008.

MacMinn, R., K. Ostaszewski, R. Thiagarajah, and F. Weber, "An Investigation of Select Birth Cohorts," in: *Living to 100 and Beyond*, Society of Actuaries Monograph, Schaumburg, Ill., January 2005.

MacMinn, R., K. Ostaszewski, R. Thiagarajah, and F. Weber, "Mortality improvement select birth cohorts and their effect on pricing of survivor bonds," in: *Re-Envisioning Retirement in the 21st Century*, Society of Actuaries Monograph, Schaumburg, Ill., June 2006.

Modigliani, F., and M. Miller (1958), "The Cost of Capital, Corporation Finance, and the Theory of Investment," *American Economic Review*, pp. 261-297.

Mueller, Dennis C. (1989), *Public Choice II*. Cambridge: Cambridge University Press.

Myers, Stewart C., "Capital Structure", *Journal of Economic Perspectives*, Spring 2001, pp. 81-102.

Pension Research Committee, "The Projected Unit Credit Cost Method," *The Pension Forum*, September 1991, pages 3-4.

Society of Actuaries, Report of the Society of Actuaries Mortality Improvement Survey Subcommittee, March 2003.

Society of Actuaries, *Pension Actuary's Guide to Financial Economics*, Schaumburg, Ill., 2006.

Society of Actuaries Group Annuity Valuation Table Task Force, *1994 Group Annuity Mortality Table and 1994 Group Annuity Reserving Table*, Transactions of the Society of Actuaries, January 1995, Vol. 47, pp. 865-919.

Society of Actuaries, Retirement Plans Experience Committee, *RP-2000 Mortality Tables*, July 2000.

SunGard, SunGard *Investment Plus*, Capital market assumptions updated as of Dec. 31, 2008.

Wilcox, D., Deputy Director in the Division of Research and Statistics at the Federal Reserve Board, Oral Comments at a Forum in Washington, D.C. on Sept. 4, 2008, sponsored by the Public Interest Committee of the American Academy of Actuaries.

Wilmott, Paul, *Derivatives: the theory and practice of financial engineering*, J. Wiley, 1998.