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The Future of Public Employee Retirement Systems

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Chapter 3

The Case for Marking Public Plan Liabilities to Market

Jeremy Gold and Gordon Latter

Career employees of US state and local governments such as teachers, civil servants, police, firefighters, and sanitation workers are usually covered by defined benefit (DB) public pension plans. The financial positions of such pensions are typically reported in documents called Comprehensive Annual Financial Reports (CAFRs). Public pension plan CAFRs usually include extensive data about plan assets, cash flows, expenses, investment policy, and performance. This information is helpful to watchdogs and other parties interested in monitoring the financial integrity of pools of assets that can run into hundreds of billions of dollars.

Information about public plan liabilities, however, is far more difficult to obtain. A typical CAFR will disclose the actuarial methods and assumptions used in the liability calculations, including plan provisions, data on participant ages, projections on salaries and service, and actuarial methods. The measure of the actuarial liabilities is highly dependent upon the methods and assumptions chosen by the plan actuary, or contained in local statutes and regulations. Actuarial assumptions are typically consistent with Actuarial Standards of Practice (ASOPs), especially ASOP No. 4 and ASOP No. 27 (for economic assumptions), and ASOP No. 35 (for demographic assumptions). The economic assumptions (expected returns on invested assets, future inflation, and salary increases) are designed to facilitate a long-range budgeting process and are not intended to reflect current market conditions. The actuarial liabilities developed in accordance with these long range projections are not well-linked to economic values and leave several important pension financial questions unanswered.

This chapter focuses on three such questions of particular importance to public pension plan valuation:

1) Will future taxpayers be paying for services provided to current and previous generations of taxpayers, or might the opposite be true?
2) How can we compare the funding level and benefit security of one public pension plan with plans in other US jurisdictions?

3) What is the market value of benefits earned by public employees in any given year, and what does this tell us about their total compensation?

As a preview of our arguments below, we propose that a useful approach can be modeled after the CAFR for the New York City Employees' Retirement System (NYCERS) for the 2007 fiscal year (New York City Employees' Retirement System & New York City Public Employee's Group Life Insurance Plan 2007: 149). Developed by Robert C. North, Jr., Chief Actuary of the New York City Office of the Actuary, the report includes supplementary information not generally available. For instance, the analysis provides several measures of plan assets and liabilities. For reasons discussed below, we identify the Market Value of the Accumulated Benefit Obligation (MVABO) shown in the rightmost column as the Market Value of Liabilities (MVL) for the plan. The same report shows several measures of the plan's funded ratio, defined as assets divided by liabilities. We suggest that the 'North Ratio' or the market value of assets (MVA) divided by the MVABO, is the most useful measure of the plan's financial status. This ratio helps us to answer the three questions shown above.

The remainder of the chapter discusses the importance and relevance of the Market Value of Liabilities. Next we examine the ordinary disclosures of several public pension plans and make rough estimates of their MVLs. We then consider the implications of MVL disclosure and conclude with some thoughts for policymakers.

Market value of pension liabilities

In 2006, the Society of Actuaries and the American Academy of Actuaries identified three defined benefit pension liability measures (Enderle et al. 2006):

1. Market liability is determined by reference to a portfolio of traded securities that matches the benefit stream in amount, timing, and probability of payment.
2. Solvency liability is determined by reference to a portfolio of default-free securities that matches the benefit stream in amount and timing.
3. Budget liability is the traditional actuarial accrued liability used to develop a schedule of contributions to be made to the plan over time.

The budget liability depends on choices made by the plan with respect to the actuarial funding method to be used and upon assumptions made in accordance with ASOP. Budget liabilities are not marked to market and do not address our three pension finance questions.

Focusing on the other two measures, the market liability equals the solvency liability if payment is certain. In many jurisdictions, pension payments are highly protected by the taxing power of the government sponsor and collateralized by the plan assets. Although the main purpose of pension funding in the private sector is to provide collateral, Peskin (2001) observes that the primary rationale for public sector funding is to assure intergenerational equity—that is, that each generation of taxpayers pays for the public services it consumes contemporaneously. In practice, while there are jurisdictions in which benefits may not be perfectly secure, in what follows we deem the MVL to be well-measured assuming that the probability of payment is nearly certain. Robert North's use of Treasury securities to measure New York City's public pension MVL is consistent with this approach.[1]

The Employment Relationship and the Role of the Pension Plan. Economists distinguish principals from agents. Principals are those with 'skin in the game'; it is their pocketbooks that will be more or less full as a result of the economic activity in question. Agents are those whose decisions affect the welfare of the principals. In the public plan arena, the principals include taxpayers, plan participants (employees, retirees, and beneficiaries), and lenders. Many agents are involved, including elected officials, plan trustees, plan administrators and their staffs, investment officers, asset managers, rating agencies, consultants, and actuaries.

Governments hire employees to provide services to taxpayers and other residents. These employees are compensated by taxpayers in (at least) two ways: current cash compensation (salaries), and promises of future cash (pensions). To avoid either burdening or subsidizing future taxpayers, current taxpayers should generally expect to finance the cost of today's services today, even if a deferred component of public employee total compensation may not be paid out for decades.

A public pension plan is like a reservoir: it allows taxpayers to pay today for benefits that will support retirees tomorrow. Unlike water held in reserve, however, pension assets may be expected to earn investment returns over time. Because of these returns and the risks associated with them, a generationally neutral taxpayer/employee compensation system requires sophisticated financial analysis. How much is tomorrow's promise worth today? Who bears what risks along the way? The balance of this section answers these questions using the tools of financial economics.

Financial Economics and Traditional Actuarial Pension Practice. Financial economists and actuaries use quantitative methods to estimate the value today of money to be paid in the future. Although the root process, discounted cash flow, is common to both disciplines, the analysis of risk and who bears it can be quite different. The differences between actuarial and

financial techniques have been discussed in the actuarial literature at least since Bühlmann (1987).[2]

The actuarial process is designed to develop a budget for the inflow of cash into the pension plan such that money will be available to meet benefit promises as they come due. The process depends on regular budget updates which smoothly adjust incoming cash flows to take account of emerging demographic and financial experience. By contrast, financial economists emphasize market values and are interested in measuring the pension contracts that link employees and taxpayers over time. The three questions we pose typify the concerns of financial economists.

Value When Employment Ends. Employees acquire pension wealth in accordance with the formulas embedded in their DB pension plans. When employment ends, the vested plan participant owns an annuity whose value reflects the probability that the recipient will be alive at each payment date, including ancillary benefits that may entitle his beneficiary to receive payments after the former employee's death. In the public sector, in contrast to the private, it is common for future benefits to include post-employment cost-of-living increases.

In practice, survival probabilities may be difficult to estimate and the annuity might be hard to value for any given individual, but the law of large numbers allows accurate estimates to be made for annuitant cohorts. The asset pricing models favored by financial economists (e.g., the Capital Asset Pricing Model) imply that the expected cohort cash flows may be valued using rates of return on fixed income securities (the yield curve). Assuming that pension default is unlikely, we can determine the value of benefits that are not inflation protected using the Treasury yield curve, and the value of inflation-indexed benefits using the Treasury Inflation-Protected Securities (TIPS) curve. Practical concerns may refine these measures when default is possible or when, as is frequently the case, inflation protection is limited.

Nominal market rates are currently almost certainly no greater than 5 percent annually and real rates are below 2 percent. This is importantly different from nominal rates used by public pension plan actuaries which are, and have been for many years, in the neighborhood of 8 percent.

Value During the Employment Career. The pension wealth of an employee still working clearly cannot be lower than the value of the benefit promise assuming that the employee quits today. This 'walk-away' or exit value is identified as the Vested Benefit Obligation (VBO) by private-sector actuaries and accountants. A somewhat larger number is the Accumulated Benefit Obligation (ABO) which augments the VBO by taking into account the probability that an employee will become eligible for early retirement subsidies or other ancillary rights that will increase the value of the benefits already earned. Neither the VBO nor the ABO attaches any value to

benefits based on future service and future pay increases. A measure that does take into account future salary (but not future service) is called the Projected Benefit Obligation (PBO). All three measures take into account plan-specified post-retirement cost-of-living increases when these are contractually 'owned' by the employee.

Consider a public sector employee who is eligible to retire immediately. He/she is advised that if he/she retires today, he/she will receive an annuity of $20,000 annually for life based on his/her current service and work history. If he/she works another year, the benefit will be recomputed as, say $22,000, giving him/her credit for an additional year of service and for his/her then-higher salary. Note that he/she has no economic interest in the benefit that might be calculated based upon today's service and tomorrow's salary. That benefit would reflect a PBO value for pension wealth today. The employee compares, instead, his/her accrued benefit today (a $20,000 annuity beginning now) versus his/her accrued benefit next year (a $22,000 annuity beginning then).

Because the ABO and the VBO are often close in value, we do not declare one the preferred measure of pension wealth. We do, however, reject the PBO as a pension wealth measure (Gold 2005).

What is the Value of the Benefit Earned Each Year? The present value of accrued benefits at market rates may be followed from time $t-1$ to time t, assuming that new benefits (ΔAB_t, with market value $MV\Delta AB_t$) are earned at year end and benefits (P_t) are paid during the year:

$$MVL_{t-1}(1+\tilde{r}) + MV\Delta AB_t - P_t(1+\tilde{r}/2) = MVL_t$$

where $\tilde{r}$ is the total liability rate of return.[3] The $MV\Delta AB_t$ may be computed by the plan's actuary who identifies the changes from $t-1$ to t in the accrued benefits of active employees and discounts the associated cash flows, applying the same yield curve used to develop MVL_t from AB_t. When an actuary reports the MVL, we can estimate the $MV\Delta AB_t$ as follows:[4]

$$MV\Delta AB_t = MVL_t - MVL_{t-1}(1+\tilde{r}) + P_t(1+\tilde{r}/2)$$

The $MV\Delta AB_t$ is an important economic datum, whether computed for the retirement system or for individual employees. It is the pension wealth newly acquired by today's employees and it is properly viewed as the cost incurred by today's taxpayers.[5]

What is the Value of the Pension Promise to Taxpayers? Because the plan owes what the participant holds as pension wealth, we can tentatively conclude that the MVL is equal to the MVABO.[6] But this measure has not been widely accepted, with many actuaries arguing that the Actuarial Accrued Liability (AAL, measured using expected rates of return on plan assets) computed as part of the plan's budgeting process is the best measure

of plan liabilities. The Governmental Accounting Standards Board (GASB 1994*a*, 1994*b*) which governs reporting in this area agrees. In the private sector, the Financial Accounting Standards Board (FASB 1985) tells businesses to report the PBO as a balance sheet liability.

We defend the MVABO as the most economically relevant measure of taxpayer obligations and compare it to the MVA to assess the financial state of public DB plans. Let us consider arguments that the MVABO is too high or too low a number. Some say MVABO is too high because it uses a nearly risk-free discount rate, while the plan invests in risky assets expected to exceed the risk-free rate over time. Those who make this argument often accompany it with the assertion that the plan will be around for a long time and is virtually certain to meet all of its obligations when due (Almeida, Kenneally, and Madland 2009). In effect, this argument says that riskless benefit promises funded by risky assets can be measured at the expected rate of return on those risky assets. This arbitrage-defying argument implicitly says that $100 worth of risky assets is more valuable today than $100 worth of risk-free assets (Bader and Gold 2005). It fails to account for the risk borne by future taxpayers who must make good on the benefit promises even if the risky assets fail to perform (Gold 2003).

The MVL cannot be less than the MVABO, since public pensions are subject to the ordinary rules of the financial markets and cannot magically promise benefits below the value that the capital markets assign to similar, default-free securities. Some contend that the MVABO is too low because it fails to recognize future pay increases, strong (often state constitutionally guaranteed) prohibitions of benefit reductions including benefits not yet earned, and valuable options held by employees. As it is typically calculated, the MVABO may underestimate the value of some options, but it also values some options that are not yet vested such as the right to retire early and receive a particularly valuable early retirement benefit. While these issues can cut both ways, in concept the MVABO should include and properly measure all options. With the caveat that the MVABO is imperfect, we accept it as the best practical measure of the MVL for public pension plans.

In the private sector, arguments are often made against recognizing future pay increases in today's benefit liabilities (Bodie 1990; Gold 2005; Sohn 2006). The proposition is that benefits based on future pay increases are not included, just as future pay increases are not. There is no current obligation to pay more in the future than the economic value that the employee will render in the future. In the public sector, this argument can be challenged because benefits and pay are negotiated between agents of the employees (union representatives) and of the taxpayers (elected officials). In the private sector, a company that overpays its workers will not

be able to compete for customers and capital. Forces that might make this true in the public sector (where taxpayers consume services and provide capital) are not obvious and may not exist.

Disclosure of the market value of benefit promises and the incremental value associated with each year of employment (the MVΔAB) is a necessary component in the development of negotiating discipline.

Summary: How Market Values Help Policymakers. To sum up, we have argued future taxpayers will have to pay for future benefit promises as these are earned, plus the MVL, less the MVA (i.e., Question 1 from above). If the MVs are equal (i.e., the North Ratio is 100%), future taxpayers will pay for future benefit accruals as these are earned; none of the services they consume will be subsidized by earlier taxpayers nor will they be called upon to pay for benefits already earned. Equality of MVL and MVA defines a system that is fair to future taxpayers. If the plan is in deficit (MVA less than MVL, North Ratio below 100%), taxpayers to date have underpaid; if the plan is in surplus, the opposite is true.

We also have addressed how public plan funding levels and benefit security can be compared across jurisdictions (i.e., Question 2 from above). Specifically, a comparison of North Ratios will indicate which jurisdiction has been better funded by current and prior taxpayers. A system with a higher North Ratio has paid for more of its earned benefits than a system with a lower ratio. Any system with a North Ratio greater than 100 percent may be said to be protecting its participants and treating its future taxpayers well. Although it is unlikely that taxpayers will choose their residences on the basis of public plan financial status, areas with very low funding ratios are likely to face higher taxes in the future. Information about future taxes may affect home prices today.

And finally, the MVΔAB$_t$ is the market value of benefits being earned by public employees in year t (i.e., Question 3 from above). In recent years, the combination of an aging workforce and low market discount rates (and still high actuarial rates) implies that the MVΔAB$_t$ is generally much higher than the actuarially required contribution reported in actuarial reports and CAFRs.

Estimating the market value of liabilities for public pension plans

Despite the importance and usefulness of the MVL and MVΔAB measures, these values are rarely calculated and almost never disclosed by public plans in the United States. Decisionmakers with responsibility for plan activities, including plan trustees, administrators, and elected officials, do not usually ask their actuaries to calculate market values, and financial analysts working

for rating agencies and bond investors do not have the necessary tools and information to make independent assessments even if they were inclined to do so. Part of the problem is that precise measurement of the MVL and the MVΔAB can only be done by actuaries working with reliable plan data, appropriate computer software, and detailed descriptions of the benefits being earned.

In this section, we seek to estimate the MVLs for four arbitrarily selected public pensions located in the Southeast (SE), Northwest (NW), Northeast (NE) and Midwest (MW), using publicly-available information contained in the CAFRs. Table 3-1 summarizes the relevant data extracted from the four CAFRs.

We rely on the MVL information provided in the NYCERS CAFR to derive a crude estimate of the value of benefits newly earned by its members, namely, the MVΔAB. CAFRs commonly disclose the AAL. We make two adjustments to convert the reported AAL into an estimated MVL. The first adjustment from AAL to ABO (based on actuarial assumptions) requires a change in accrual pattern. The second adjustment converts the ABO to MVL; this requires a change to market observed discount and inflation rates.

The first adjustment requires converting the AAL to an ABO. Because the ABO and AAL are identical for former employees, we need to adjust the accrual pattern for active employees only. The majority of public pension plans calculate the active AAL using the Entry Age Normal (EAN) actuarial method.[7]The EAN AAL equals the present value of future benefits (PVFB) less the present value of future employer normal costs (PVFNC) less the future employee contributions (PVFEC):[8] AAL = PVFB − PVFNC where present value is computed using the actuarial discount rate (expected rate of return on plan assets).

Consider a 50-year-old employee who has worked for 20 years and is expected to work an additional 10 years. Assuming a simple plan design where the annual accrual is $1,000 (payable at retirement), this employee would have accrued an annual benefit of $20,000 payable at age 60; the projected annual pension at retirement will be $30,000. Typical actuarial assumptions would value this annuity at $300,000[9] at age 60. Discounting this figure at 8 percent for 10 years, and assuming no pre-retirement decrements (mortality, early retirement, etc), the PVFB is $138,958.

Under the EAN method, normal cost is the level annual contribution at entry (e.g., age 30) that will accumulate to the present value of $300,000 at retirement. Level annual contributions of $2,648 accumulate with 8 percent interest to $300,000 over 30 years. The present value of future normal costs from now (age 50) until retirement (age 60) is $17,770.[10] Plugging these figures into the above formula yields: AAL = $138, 958 − $17, 770 = $121, 188. Our 50-year old has accrued an annual benefit of $20,000

TABLE 3-1 Summary of data from four public pension plans' Comprehensive Annual Financial Reports (CAFRs: $mm for aggregate financial values)

Location of plan[a]	*SE*	*NW*	*NE*	*MW*
Actuarial accrued liability (AAL)				
Active member contributions	$58	$1,104	$1,794	$2,616
Retirees and beneficiaries	55,534	8,667	5,676	12,217
Active (employer portion)	55,386	3,073	4,160	5,492
Total AAL	$110,978	$12,844	$11,630	$20,325
Actuarial asset value (AAV)	$117,160	$8,443	$8,888	$14,858
Funded ratio (AAV/AAL)	106%	66%	76%	73%
Market value of assets (MVA)	$116,340	$8,591	$9,972	$13,784
Active demographic data				
Annual payroll	$25,148	$1,513	$1,821	$2,859
Number of actives (000)	665	34	52	74
Average annual salary (000)	$38	$45	$35	$39
Average age	44	45	n/a	n/a
Average service	10	9	n/a	n/a
Key plan provisions				
Retirement age[b]	59	60	60	60
Post-retirement COLA[c]	3.00%	CPI	CPI	1.5%
Key assumptions:				
Investment return	7.75%	8.25%	7.50%	7.50%
Salary increase[d]	5.50%	4.50%	5.50%	4.50%
Inflation assumption	n/a	3.50%	4.00%	4.00%

[a] Locations refer to Southeast (SE), Northwest (NW), Northeast (NE) and Midwest (MW). Some retirement systems comprise several plans, making data collection and judgment difficult.

[b] The approximate age at which the full accrued benefit is payable as a life annuity has a large impact on the factors used to convert the EAN AAL to an estimated ABO. The retirement age drives the 'years to retirement' employed in Adjustment 1. The retirement age differs markedly between different types of employees (e.g., uniformed, clerical, teachers, administrators, etc.).

[c] Cost of living adjustments after retirement. The consumer price index (CPI) may be used as an automatic annual benefit increase factor. In the southeast, the plan specifies an annual 3 percent increase independent of the CPI; in the mid west, the benefit is increased by the lesser of 1.5 percent or the CPI; for all practical purposes this may be treated as a straight 1.5 percent annual increase.

[d] Our conversion factors are highly dependent on the assumed rate of salary increase. Most plans assume greater salary increases at younger ages (when employee growth contributes to individual productivity) and report a single compound growth rate which, over an entire career, produces the same expected final salary. But our conversion looks at mid to late career active employees whose future expected increases are smaller. In the southeast, for example, we reduced the compound 6.25 percent to 5.5 percent based on additional information contained in the CAFR.

Source: Authors' computations, see text.

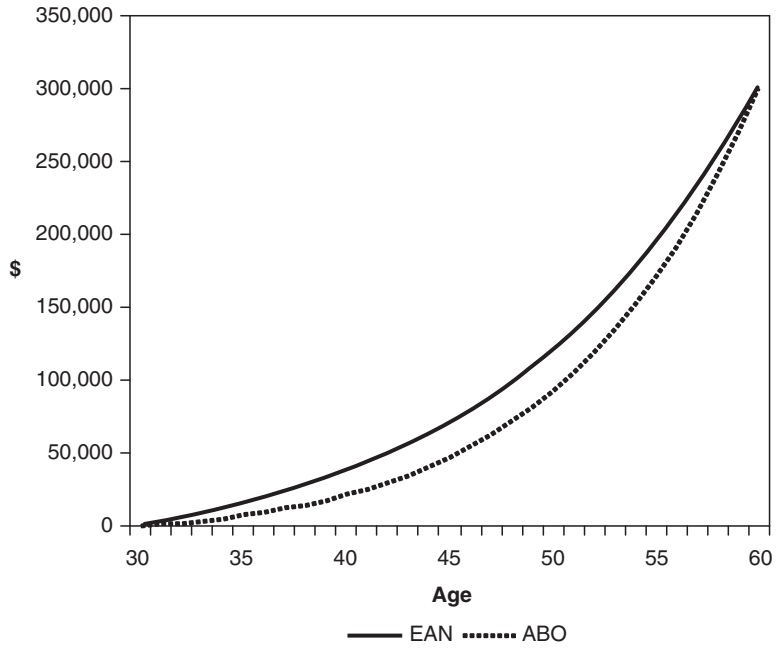

Figure 3-1 Comparison of Entry Age Normal (EAN) liabilities to Accrued Benefit Obligation (ABO) liabilities. Assumed salary scale: 0 percent. *Note*: Formula: 1 percent * final salary * years of service. *Source*: Authors' computations; see text.

payable at age 60. Multiplying by our age 60 annuity factor and discounting for 10 years at 8 percent, we calculate the actuarially valued ABO as $92,639.

Figure 3-1 displays the EAN AAL and the ABO year by year from entry age 30 until retirement at age 60. For our 50-year-old with 10 years left to retirement, the ABO is estimated to be 76 percent (92,639/121,188) of the EAN AAL. Table 3-2 provides sample conversion factors at various ages for our (flat dollar) plan.[11]

Most public plans, however, compute pensions as a percentage of final average pay. For such plans, the entry age normal cost is expressed as a percentage of each year's pay. Table 3-3 calculates sample conversion factors where the actuary has assumed a 5 percent salary increase at every age.[12] For our 50-year-old, with 10 years left to retirement, the ABO is estimated to be 54 percent (56,872/104,917) of the EAN AAL. We see (Table 3-4) that conversion factors decrease as the salary assumption increases. Figure 3-2 displays the EAN AAL and the ABO year by year from entry age 30 until retirement at age 60 with an assumed 5 percent salary increase.

TABLE 3-2 Factors used to convert Entry Age Normal (EAN) Accrued Actuarial Liabilities (AAL) to Accumulated Benefit Obligation (ABO). Assumed salary scale: 0 percent

Age	*PVFB*	*Salary*	*Normal Cost*	*PVFNC*	*EAN Accrued Actuarial Liability*	*Accrued Benefit Payable at age 60*	*ABO*	*Conversion Factor (%)*
30	29,813	100,000	2,648	29,813	0	0	0	
35	43,805	100,000	2,648	28,269	15,536	5,000	7,301	47
40	64,364	100,000	2,648	26,001	38,364	10,000	21,455	56
41	69,514	100,000	2,648	25,433	44,081	11,000	25,488	58
42	75,075	100,000	2,648	24,819	50,256	12,000	30,030	60
43	81,081	100,000	2,648	24,156	56,924	13,000	35,135	62
44	87,567	100,000	2,648	23,440	64,127	14,000	40,865	64
45	94,573	100,000	2,648	22,667	71,905	15,000	47,286	66
46	102,138	100,000	2,648	21,833	80,306	16,000	54,474	68
47	110,309	100,000	2,648	20,931	89,378	17,000	62,509	70
48	119,134	100,000	2,648	19,957	99,177	18,000	71,480	72
49	128,665	100,000	2,648	18,906	109,759	19,000	81,488	74
50	138,958	100,000	2,648	17,770	121,188	20,000	92,639	76
51	150,075	100,000	2,648	16,543	133,531	21,000	105,052	79
52	162,081	100,000	2,648	15,218	146,862	22,000	118,859	81
53	175,047	100,000	2,648	13,788	161,259	23,000	134,203	83
54	189,051	100,000	2,648	12,242	176,808	24,000	151,241	86
55	204,175	100,000	2,648	10,574	193,601	25,000	170,146	88
56	220,509	100,000	2,648	8,771	211,738	26,000	191,108	90
57	238,150	100,000	2,648	6,825	231,325	27,000	214,335	93
58	257,202	100,000	2,648	4,722	252,479	28,000	240,055	95
59	277,778	100,000	2,648	2,452	275,326	29,000	268,519	98
60	300,000	100,000	2,648	0	300,000	30,000	300,000	100

Notes: Formula: 1 percent * final salary * years of service. This table develops for one employee, hired at age 30, retired at age 60, benefits begin at age 65, with salary increasing 5 percent annually throughout his career, the entry age normal liability accrual (EAN AAL) and the ABO. The ratio (conversion factor) may be applied to a published EAN AAL to derive an ABO. To do so, however, for all the active employees in a plan, one must judge how the range (30 to 60) should be modified and which row (age) is representative of the active employee population. If, for example, the full range were deemed appropriate and the liability-weighted average employee were deemed to be age 53, the conversion factor would be 65 percent.

Source: Authors' computations, see text.

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TABLE 3-3 Factors used to convert Entry Age Normal (EAN) liabilities to Accumulated Benefit Obligation (ABO) liabilities. Assumed salary scale: 5 percent

Age	*PVFB*	*Salary*	*Normal Cost*	*PVFNC*	*EAN Accrued Actuarial Liability*	*Accrued Benefit Payable at age 60*	*ABO*	*Conversion Factor (%)*
30	29,813	23,138	1,493	29,813	0	0	0	
35	43,805	29,530	1,906	33,717	10,088	1,477	2,156	21
40	64,364	37,689	2,432	36,666	27,698	3,769	8,086	29
41	69,514	39,573	2,554	37,046	32,468	4,353	10,087	31
42	75,075	41,552	2,681	37,328	37,747	4,986	12,478	33
43	81,081	43,630	2,815	37,499	43,582	5,672	15,329	35
44	87,567	45,811	2,956	37,542	50,025	6,414	18,721	37
45	94,573	48,102	3,104	37,442	57,131	7,215	22,745	40
46	102,138	50,507	3,259	37,178	64,961	8,081	27,513	42
47	110,309	53,032	3,422	36,730	73,580	9,015	33,150	45
48	119,134	55,684	3,593	36,075	83,059	10,023	39,803	48
49	128,665	58,468	3,773	35,188	93,477	11,109	47,644	51
50	138,958	61,391	3,962	34,041	104,917	12,278	56,872	54
51	150,075	64,461	4,160	32,605	117,470	13,537	67,718	58
52	162,081	67,684	4,368	30,845	131,235	14,890	80,449	61
53	175,047	71,068	4,586	28,727	146,320	16,346	95,375	65

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54	189,051	74,622	4,815	26,210	162,841	17,909	112,858	69
55	204,175	78,353	5,056	23,250	180,925	19,588	133,314	74
56	220,509	82,270	5,309	19,802	200,707	21,390	157,225	78
57	238,150	86,384	5,574	15,811	222,338	23,324	185,150	83
58	257,202	90,703	5,853	11,223	245,979	25,397	217,737	89
59	277,778	95,238	6,146	5,975	271,803	27,619	255,732	94
60	300,000	100,000	6,453	0	300,000	30,000	300,000	100

Notes: Formula: 1 percent * final salary * years of service.

This table develops for one employee, hired at age 30, retired at age 60, benefits begin at age 65, with salary increasing 5 percent annually throughout his career, the entry age normal liability accrual (EAN AAL) and the ABO. The ratio (conversion factor) may be applied to a published EAN AAL to derive an ABO. To do so, however, for all the active employees in a plan, one must judge how the range (30 to 60) should be modified and which row (age) is representative of the active employee population. If, for example, the full range were deemed appropriate and the liability-weighted average employee were deemed to be age 53, the conversion factor would be 65 percent.

Source: Authors' computations, see text.

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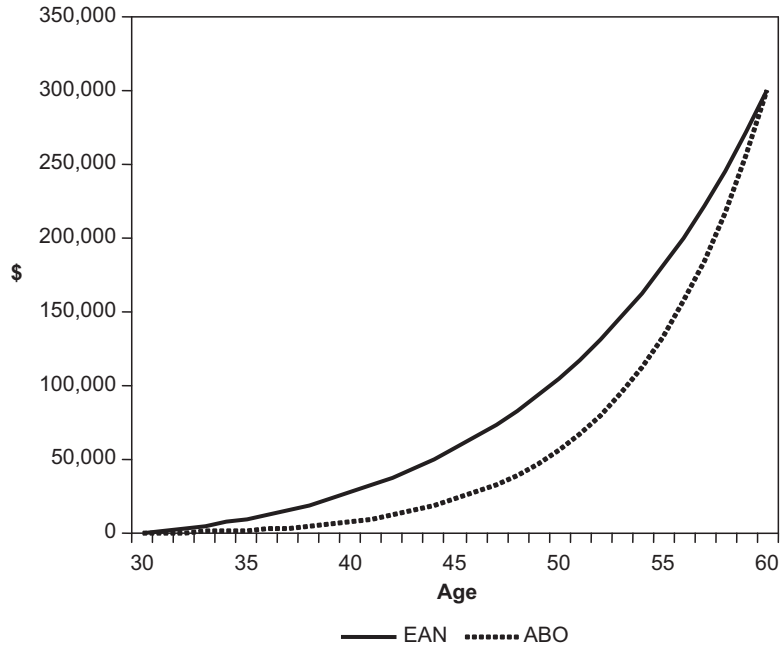

Figure 3-2 Comparison of Entry Age Normal (EAN) liabilities to Accrued Benefit Obligation (ABO) liabilities. Assumed salary scale: 5 percent. *Note*: Formula: 1 percent * final salary * years of service. *Source*: Authors' computations; see text.

Based on the data in Table 3-1 and the factors in Table 3-4, the analyst uses judgment and experience to choose a conversion factor. Although many considerations could influence the choice of a conversion factor, the most important is the number of years left until retirement. We estimate the liability-weighted average number of years to retirement after reviewing each of our four plan provisions, actuarial assumptions, and summary member data disclosed in the respective CAFRs. Applying this approach to our four public plans we develop the relationship of the AAL to the ABO shown in Table 3-5. Although the NE plan's CAFR did not provide an average age (an important element in our estimate of years to retirement), it did disclose an ABO-like value in accordance with FAS No. 35 (FASB 1980). For the other three plans, we assume a 65 percent conversion factor. If the plan provisions and demographics in combination with the actuarial assumptions differ significantly from the four samples provided here, the conversion factor will be different.[13]

The second adjustment converts the ABO to the MVL. Latter (2007) reports that the average actuarial discount rate for the two largest plans

TABLE 3-4 Converting Entry Age Normal (EAN) liabilities to Accumulated Benefit Obligation (ABO) liabilities: various salary assumptions

Years to Ret Age	*Salary Scale Assumption (%)*			
	0	4.50	**5.00**	5.50
25	47	23	**21**	20
20	56	31	**29**	28
15	66	42	**40**	38
10	76	56	**54**	53
5	88	75	**74**	73
0	100	100	**100**	100

Notes: Formula: 1 percent * final salary * years of service. Conversion factors are shown based on years to retirement and various assumed salary increases. Factors based on 5 percent (bold) come from Table 3-3.

Source: Authors' computations, see text.

in each of the 50 United States is 8 percent. Figure 3-3 shows that this assumed return is significantly higher than the Treasury spot curve at March 31, 2008.

Actuaries who perform valuations for public plans can readily develop the cash flows that underlie the ABO. Because these underlying cash flows are not presented in CAFRs, we rely on a hypothetical set of cash flows that approximate the ABO term structure for large public plans—ignoring post-retirement increases for cost of living. We adjust these cash flows for cost-of-living provisions and then value them twice: using the plan actuary's assumptions, and market assumptions. The ratio of these values for the hypothetical population is then applied to the ABOs developed in the first adjustment. For technical reasons, we make these calculations separately for retired and active populations.

TABLE 3-5 First adjustment: converting the Actuarial Accrued Liability (AAL) to Accumulated Benefit Obligation (ABO)

Location of plan	*SE*	*NW*	*NE*	*MW*
1. Active AAL	$55,444	$4,177	$5,954	$8,108
2. Conversion factor	65%	65%	n/a	65%
3. Active ABO [(1)*(2)]	$36,039	$2,715	$3,873	$5,270
4. Retired and beneficiaries	55,534	8,667	5,676	12,217
Total ABO [(3)+(4)]	$91,574	$11,383	$9,549	$17,488

Notes: See Table 3-1. Factor of 65 percent based on Table 3-4 with about seven liability-weighted years to retirement.

Source: Authors' computations, see text.

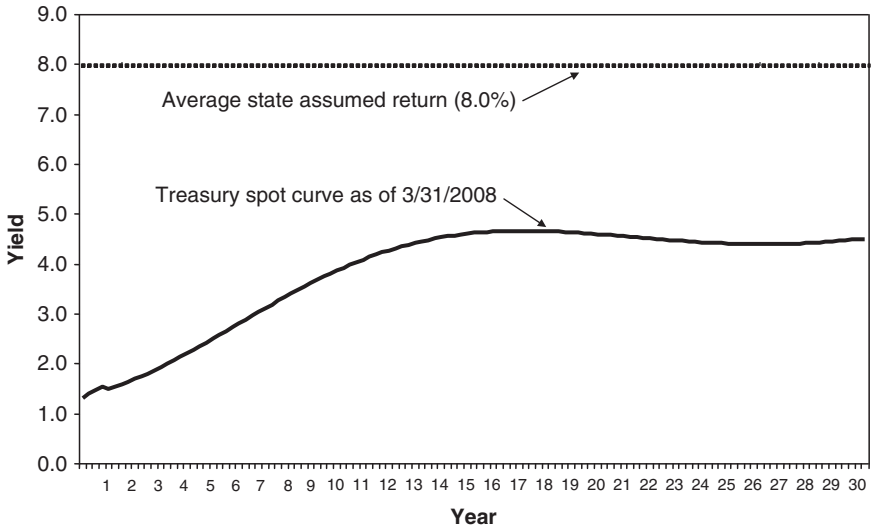

Figure 3-3 Nominal interest rates: actuarial versus market. *Source*: Authors' computations; see text.

The SE plan specifies that benefits will increase 3 percent annually after retirement regardless of the actual inflation rate. The actuarial valuation already embeds these increases and we need only adjust for the difference between the nominal actuarial discount rate (7.75%) and the Treasury spot curve. As shown in Table 3-6, our hypothetical population liabilities increase by factors of 1.3366 (retirees) and 1.9506 (actives). We apply these to the retiree and active ABOs brought forward from Table 3-5 to estimate an MVL of $144,528 million.

The MW plan provides post-retirement benefit increases equal to the lesser of CPI and 1.5 percent. In theory, a capped CPI formula requires an option model. This would be especially true if the cap were, say, 4 percent and would be likely to apply in some years and not in others. As a practical matter, the 1.5 percent cap is likely to apply in every year and thus we proceed as if the MW plan, like the SE plan, specified a fixed benefit increase rate. We use our hypothetical population to derive factors of 1.3142 (retirees) and 1.8613 (actives). Our MVL is estimated to be $25,864 million.

Because many public plans provide a cost-of-living adjustment (COLA), we need to adjust for the difference between actuarial and market real returns. Latter (2007) reports that the average inflation assumption for the two largest plans in each of the 50 United States is 3.5 percent. Figure 3-4 shows that this average assumed real return of 4.35 percent

TABLE 3-6 Second adjustment: converting the Accumulated Benefit Obligation (ABO) to a Market Value Liability (MVL)

Location of plan	*SE*	*NW*	*NE*	*MW*
Plan economic assumptions				
Nominal discount rate	7.75%	8.25%	7.50%	7.50%
Inflation (COLA) assumption	n/a	3.50%	4.00%	n/a
Real discount rate	n/a	4.59%	3.37%	n/a
PV of hypothetical plan Retirees:				
1. Plan nominal discount rate	$72,200	$69,834	$73,435	$73,435
2. Treasury yield curve	96,505	96,505	96,505	96,505
3. Plan real discount rate	#N/A	90,936	100,444	#N/A
4. TIPS yield curve	119,568	119,568	119,568	119,568
5. Adjustment factor (2/1 or 4/3)	1.3366	1.3149	1.1904	1.3142
PV of hypothetical plan Actives:				
1. Plan nominal discount rate	$86,008	$78,447	$90,135	$90,135
2. Treasury yield curve	167,770	167,770	167,770	167,770
3. Plan real discount rate	#N/A	127,657	162,672	#N/A
4. TIPS yield curve	266,675	266,675	266,675	266,675
5. Adjustment factor (2/1 or 4/3)	1.9506	2.0890	1.6393	1.8613
Conversion of ABO to MVL				
1. Retiree ABO	$55,534	$8,667	$5,676	$12,217
2. Adjustment factor	1.3366	1.3149	1.1904	1.3142
3. Retiree MVL [(1)*(2)]	74,229	11,396	6,757	16,055
4. Active ABO	36,039	2,715	3,873	5,270
5. Adjustment factor	1.9506	2.0890	1.6393	1.8613
6. Active MVL [(4)*(5)]	70,299	5,672	6,349	9,809
7. Total MVL [(3)+(6)]	$144,528	$17,067	$13,106	$25,864

Note: See Table 3-1.

Source: Authors' computations, see text.

(1.08/1.035 – 1) is significantly higher than the TIPS spot curve at March 31, 2008. Figure 3-5 compares the Treasury Spot curve (from Figure 3-3) to the TIPS curve (from Figure 3-4) as of March 31, 2008. The inflation curve represents the difference between these two curves.

The NW and NE plans provide for full CPI indexing after retirement. Table 3-6 shows assumed nominal discount rates of 8.25 percent and 7.5 percent and inflation rates of 3.5 percent and 4 percent for these plans. We use our hypothetical populations to estimate the impact of replacing these actuarial assumptions with market rates of discount and inflation. Benefits that will grow at the full CPI may be estimated by discounting non-inflated cash flows using real rates of return. We compute the values of the retiree cash flows by discounting at the actuarially assumed real rates

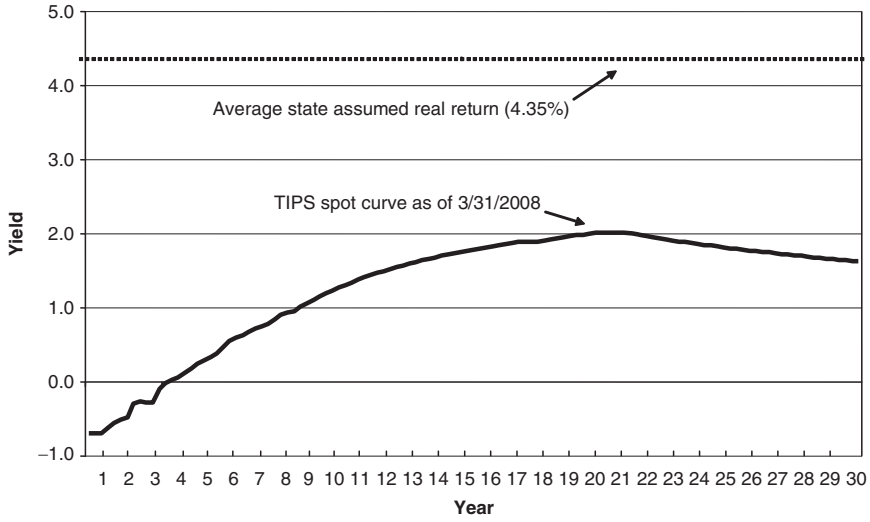

Figure 3-4 Real interest rates: actuarial versus market. *Source*: Authors' computations; see text.

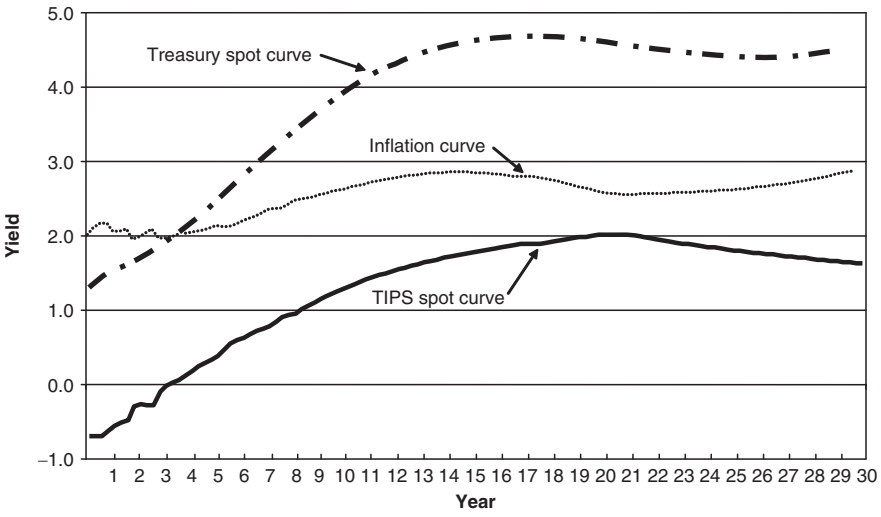

Figure 3-5 Treasury interest rates, real and break-even inflation rates (as of 3/31/2008). *Source*: Authors' computations; see text.

TABLE 3-7 Comparison of funded status: Actuarial vs. Market

Location of plan	*SE*	*NW*	*NE*	*MW*
Actuarial Accrued Liability (AAL)	110,978	12,844	11,630	20,325
Actuarial Asset Value (AAV)	117,160	8,443	8,888	14,858
Funded status	106%	66%	76%	73%
Market Value of Liability (MVL)	144,528	17,067	13,106	25,864
Market Value of Assets (MVA)	116,340	8,591	9,972	13,784
Funded status	80%	50%	76%	53%

Note: See Table 3-1.

Source: Authors' computations, see text.

(4.59% for the NW and 3.37% for the NE) and then repeat the calculation using the market's real rates found in the TIPs curve. We take the ratio of the market value to the actuarial values (119,568/90,936 = 1.3149 and 119,568/100,444 = 1.1904 respectively) and, in the last panel of Table 3-6, we apply these to the retiree ABOs determined in the first adjustment.

For active lives, the ABO benefits are indexed only after the employee retires. During the period between now and benefit commencement, we need to discount benefits at nominal rates. Real rates are used thereafter. This calculation leads to multipliers for the active members of the NW and NE plans of 2.0890 and 1.6393, respectively. The multipliers are higher for actives than for retirees primarily because the benefits will be paid for longer periods, thereby growing more with inflation. For both actives and retirees, the NW plan multipliers are higher than those for the NE because the NE actuary has been much more conservative (and thus closer to the market).

In the final panel of Table 3-6, we apply all of our respective multipliers to the active and retired lives ABOs determined by the first adjustment producing our final estimate of MVL on line 7. Table 3-7 compares the actuarial funded status to our crude mark to market funded status. In this market environment (Figures 3-3 and 3-4), one would anticipate lower market funded ratios after applying the adjustments. Indeed, in three cases (SE, NW, and MW) the market funded status is lower than the actuarial funded status. The funded status for the NE plan is unchanged since the actuarial economic assumptions are relatively conservative and the MVA is higher than the AAV.

$$MV\Delta AB_t = MVL_t - MVL_{t-1}(1+\tilde{r}) + P_t(1+\tilde{r}/2)$$

and applying it to the detailed MVL information provided in the NYCERS CAFR, we can now obtain a rough estimate of the benefits newly earned by its members, or the MVΔAB. At time t-1, the market value, duration, and

implied market interest rate are $55.4 billion, 12.7 years, and 4.2 percent, respectively. At time t, the market value, duration and implied market interest rate are $49.8 billion, 11.7 years and 5.4 percent, respectively. From the CAFR we see the annual pension payments are $3.0 billion. From this information we estimate a liability return ($\tilde{r}$) of −9.5 percent. Plugging these figures into our formula results in ($bn):

$$\text{MV}\Delta\text{AB} = 49.8\text{–}55.4 * (1 - .095) + 3.0 * (1 - .095/2) = 2.5$$

Discussion

Many in the public plan community argue that differences between the private (corporate) sector and the public sector are sufficient to exempt public plans from the market discipline that constrains corporate plans. This view has been also espoused by the Governmental Accounting Standards Board (GASB 2006) which contrasts the valuation (and investor) focus of private sector accounting with the accountability (for the use of resources) focus applicable to public financial reporting. This and other distinctions justify financial reporting in the public sector different from that in private enterprise. When it comes to pensions, GASB (2006: 8) says:

> The longer term view of operations of government is consistent with focusing on trends in operations, rather than on short-term fluctuations, such as in fair values of certain assets and liabilities. Immediate recognition of changes in fair values of assets set aside in employee benefit plans is appropriate accountability reporting in the employee benefit plans that hold those assets. However, it is not appropriate for government employers to immediately recognize those fair value changes or changes in accrued actuarial liabilities resulting from a change in benefit plan terms. These short-term fluctuations could produce a measurement of the period's employee benefit costs, which are included in cost of services, that may be less decision-useful for governmental financial report users.

We respect the distinction between valuation and accountability between the private and public sectors, but we disagree with how this difference is applied to public pension plans. The conclusion—that recognition of the value of changes in benefit terms is less decision-useful—is not supported by distinctions between private and public accounting objectives. The decision to modify plan terms cannot be well made in the absence of market values for the very benefit changes being considered. Some in the public plan community use the GASB's lack of recognition requirement to justify non-disclosure of MVL, annual MVΔAB, and MVΔAB attributable to plan amendments. While we agree that governments are not the same as corporations, we nonetheless view a public DB plan as a financial institution. In this sense, it has more in common with insurance companies

and private sector pension plans than with either a government or a corporation.

Insurance companies and DB plans make long-term promises in exchange for current cash. The long-term 'reservoir' aspect of these institutions implies that they have high ratios of assets on hand to benefits currently being paid. Many opponents of market disclosure for public plans use the long-term nature of the commitments to justify discounting future promises using the expected return on plan assets. Their long-term nature is also used to justify the amortization of liabilities created instantly (upon plan amendment) over long periods (usually as a constant percentage of payrolls assumed to rise perpetually). We believe that ignorance of the market values of current liabilities and reporting that defers recognition of significant increases in current liabilities attributable to plan amendments is no more justified for a government-sponsored DB plan, than it is for a corporate DB plan, than it is for an insurance company. The different nature of the sponsor does not port down to the plan nor does it reduce the decision-usefulness of market values (Gold 2003).

In recent years, many public plan actuaries have argued that the long-term nature of public pension plans allows risk-sharing across generations with benefits for all. This argument does not survive serious scrutiny. Especially suspect is the argument that returns from risky investing can be front-loaded for the benefit of today's taxpayers and public employees, without injury to future generations of taxpayers. If future taxpayers bear all the risks, why are they not entitled to all the rewards? If the current generation gets rewards without risks, should future taxpayers settle for rewards that are below those available to other market participants exposed to the same risks? Indeed, unfunded benefits conferred on today's employees come at the expense of tomorrow's taxpayers (Bader and Gold 2003).

We note that Cui, de Jong, and Ponds (2007) argue that risk-sharing across generations, although it cannot add value, can enhance generational welfare (utility). That analysis postulates fairly valued trades (intergenerational commitment contracts) between generations implemented by adjustment technologies that can be modeled as the trading of contingent claims across generations. Gains and losses on risky investments incurred by one generation can then be passed on to future generations in accordance with these commitments. History, however, suggests that each current generation tends to be more willing to pass on losses than gains, raising serious governance questions that remain to be addressed.

Actuarial opponents of the application of market economics to public plans argue that the MVL reflects a 'termination' concept, while the ongoing nature of public plans renders the MVL irrelevant. A distinction between corporate and public plans, they say, is that corporate plans terminate so the MVL measures an improbable event in the public sector.

We counter that the MVL measures accrued pension wealth (independent of plan termination), a standard concept in labor economics. Similarly, the MVΔAB measures changes in pension wealth, an important component of total employee compensation.

It is frequently argued that the MVL cannot be measured as well for public plans as for private sector plans, because the employment contracts are different. We acknowledge these contractual differences but note that failing to measure the MVL makes it difficult to make good decisions about public sector employment contracts and total compensation. The lack of information about market values leads to many of the very contract provisions that are then cited as the reason why market value cannot be reliably measured. Unfortunately, societal interests are not well served by such circular reasoning and argument.

Threats to the Existence of Public Pension Plans. Agents in the public pension arena argue that the disclosure of market-based information about plan liabilities might be used by opponents of DB plans to terminate these arrangements. As evidenced by proposals in California[14] and elsewhere, some in the political arena do oppose public DB plans, and they are likely to use information that reveals the financial cost and volatility of riskily invested DB plans in their efforts. Such opponents generally advocate defined contribution (DC) plans because such plans have a more certain, and usually lower, cost than current DB pensions. They also point to the private sector, saying that elements of FAS No. 87 reporting have led the corporate sector astray. Thus, the argument goes, reporting MVL will threaten the existence of public DB plans.

We agree that DC plans are less able than DB plans to provide lifetime income to retired civil service employees. Nonetheless, we argue that DB plans will be strengthened by pertinent market value information. In the financial security arena, market values are key to rational decisionmaking. Particularly under today's economic conditions, traditional actuarial methods and assumptions tend to understate the cost of DB plans. Under all economic conditions they understate the volatility. In the period from 1975–85, however, these same methods and assumptions substantially overstated benefit values and cost. Decisions should not be driven by the position that overstating costs for a decade or more may be balanced by understatement for some other period.

The lesson that should be taken from the MVL and MVΔAB is that it costs more to provide a given level of retirement income in times of low interest rates (real and nominal, as appropriate) than it does in times of high rates. A system supported by honest reporting of market values would recognize that more of today's total compensation needs to be set aside in low interest rate periods. While the converse, that less needs to be set aside when rates are high, may seem to be a welcome message when applicable, the bottom

line is that more of today's total compensation needs to be deferred if DB pension promises are to be paid for by those consuming the services today.

Those who favor DC plans seek to set aside smaller amounts in a fashion that is less risky to government employers (and thus future taxpayers), even if those plans eventually prove to be inadequate to protect retirees. It is critical to acknowledge that good pensions are more costly today than they were in the early 1980s. That is, pension funding must rise; risky investments do not produce free lunches (future taxpayers bear the risk); and benefits may have to be less generous than they have been to date. The pressure on DB plans is not a by-product of additional measurement and reporting. No economic sector can escape the hard rules of the capital markets. Trends around the world make this more true today than ever before. Alternatives to wasteful deployment of resources arise everywhere. The public plan sector with an estimated $3 trillion in assets and perhaps as much as $4 trillion in MVL is no exception. The economics that rules the other roughly $120 trillion of capital assets and financial institutions will prevail in the public pension arena.[15] Ignoring the market realities and hoping for the best might, in the short run, prolong the life of plans that may (in today's interest rate environment) be more generous than affordable. But those who wish to perpetuate and enjoy the benefits of DB pension plans should welcome the disclosure of these important numbers as part of a sustainable long term strategy.

Full identification and recognition of MVΔABs (combined with MVAs and MVLs that reveal existing funding shortfalls) might come as a shock to the system if released in today's interest rate environment. The consequences will not occur at one moment in time, however, and some adjustment period will be necessary (perhaps more than a decade). But the first response should be that pressure is increased on state and local governments to get their fiscal houses in order. This additional information should make it easier for elected officials to negotiate future total compensation that is more affordable and sustainable. Employees will be able to compare funding levels and benefit security between their plan and those in other jurisdictions. Employees with better funded plans can anticipate less pressure on their future benefits and wages than employees with poorly funded plans.

Pushback by Privately-Employed Taxpayers. Since 1950, public employment in the United States has grown relative to the private sector, and public sector workers' importance as voters has grown as well. This voting power is used skillfully by those who negotiate wages and benefits on their behalf, and it has become easy and routine for elected officials to grant benefit improvements especially when the costs are systematically understated. As a result, public employees today enjoy generally better pension benefits than their private sector counterparts, and the disparity is increasing even as,

in many areas, public employees' wages are catching or have caught up to private wages of those in similar positions (Brainard 2009; Clark, Craig, and Ahmed 2009). Many private-sector employees now have jobs comparable to those held by public employees (e.g., office workers, private carters, private school teachers).

Disclosure of the annual equivalent compensation cost (MVΔAB) will facilitate comparison of total compensation between sectors, and it may exert some countervailing pressure on public officials and strengthen the hand of those who represent taxpayers. Accordingly, the additional information we recommend may lead to better decisionmaking and a new balance of interests between taxpayers and public employees.

Quality of Estimates. The estimation process described above adjusted first, for the pattern of accrual (AAL $\rightarrow$ ABO), and second, for the difference between actuarial assumptions and market observations of discount and inflation rates (ABO $\rightarrow$ MVL). Each of these adjustments depends on many moving parts, and the standard CAFR actuarial disclosures are not designed to facilitate such re-estimation. It is possible that our MVL estimates might be off as much as 20 percent, which is not a trivial matter. The most uncertain part of our process is the estimation of the AAL/ABO relationships illustrated in Figures 3-1 and 3-2 and the selection of the number of years to retirement which we use to choose our conversion factor (Table 3-4). We are more confident about the second adjustment where we are less dependent on the behind-the-curtain actuarial machinery. Despite our concerns over the reliability of our estimates, we believe that our analysis is likely to be more accurate than financial analyses that rely on, rather than penetrate, the dynamics of traditional actuarial methods.

Interest Rate Sensitivity. Economists often look at partial derivatives of decision measures to assess the impact of small changes in the inputs used to compute those measures. Actuaries often do a similar analysis that they call sensitivity testing. Interest rates are frequently the subject of such analyses. The funding ratios measured using common actuarial methods and assumptions look very stable. In the extreme case—aggregate funding—the funding ratio is always 100 percent. Funding ratios measured at market can be quite volatile, primarily because of asset/liability mismatches. Despite some caveats about the accuracy of our estimates, we are confident that our measures will be relatively robust. If, for example, TIPS rates change and we estimate retiree liabilities for a fully indexed plan, the re-estimated retiree MVL will be consistent and sensitivity will be reflected properly.

Market Value of Benefits Earned. For the year ended June 30, 2006, employers participating in NYCERS and its employees contributed less than $1.4 billion to that plan. Because the plan's AAL is virtually identical to

its AAV, no contributions are made with respect to unfunded past service costs and the entire $1.4 billion represents normal cost. In the same fiscal year, we have estimated the MVΔAB to be $2.5 billion. This is the value of future benefits newly acquired by active employees and it represents the normal cost using the traditional unit credit actuarial cost method combined with market rates of discount. In fiscal 2006, therefore, New York City contributed substantially less to the plan than the new pension wealth acquired by its employees. Accordingly, our approach implies that approximately $1 billion in value received by today's employees will be paid by future taxpayers. As of June 30, 2006, the NYCERS plan MVA and MVL were $37.3 billion and $49.8 billion respectively, representing a market deficit of $12.5 billion. None of this deficit is recognized in cost calculations under the traditional actuarial methods, and all of it, plus interest, will have to be paid for by future taxpayers. Future taxpayers are on the hook for both the existing $12.5 billion shortfall and the newly added $1 billion, and must pay either in cash or by taking uncompensated market risk (Gold 2003).

Conclusion

The market value of DB public pension plan liabilities, in conjunction with the available market value of plan assets, are measures that have the potential to shine light in an arena where employees, taxpayers, and lenders have not had access to the information needed to make independent assessments. To our knowledge, only the New York City plan actuary makes these computations and discloses the results to date. We propose that all public pension actuaries make these additional disclosures using reliable plan data, appropriate computer software, and detailed descriptions of the benefits being earned.

To illustrate this point, we arbitrarily selected four public plans to make the adjustments necessary to convert the disclosed budget liability or AAL into an estimated MVL. Our adjustments are rough, but they produce a much lower market funded status (versus actuarial) for three plans. Nonetheless, most public sector DB plans today report in accordance with GASB Nos. 25 and 27 (GASB 1994*a*, 1994*b*). A GASB white paper (GASB 2006) discusses the distinction between accounting for private enterprises (where the emphasis is on financial valuation) and accounting for public sector activities (where the emphasis is accountability and the husbandry of scarce resources). Although this distinction is important and appropriate, we believe that the actuarial values disclosed in accordance with GASB Nos. 25 and 27 do not serve accountability as well as they would if they were to include the MVL and the MVΔAB.

Advocates of the status quo argue that the MVL is a concept that appears in private sector accounting (the ABO defined by FAS No. 87) because private plans can terminate, whereas they assert that public plans have an 'infinite horizon.'[16] This misses the more general economic importance of the MVL as a measure of wealth held by employees and owed by taxpayers. It is this property of the MVL that makes it appropriate to all DB plans, to decision making about these plans, and to answering the three questions raised herein. Other status quo advocates contend that market-based calculations inject spurious volatility into funding ratios and plan costs. The volatility, however, is real. The cost of providing benefits when market interest rates are 4 percent is significantly greater than when rates are 12 percent.

This chapter advocates the calculation and disclosure of the market value of liabilities (MVL) and the annual equivalent compensation cost (MVΔAB) for public sector pension plans. Market-based information is critically important input for those who wish to make fiscally responsible decisions.

Notes

[1] Some have suggested that using a relevant swap curve instead of Treasury rates provides a better market measure of the liability. We take an agnostic view with respect to the technical advantages of one or the other measure and accept either as a useful way to estimate MVL.

[2] The theme has been carried forward by D'Arcy (1989) and Hardy (2005) and, into the pension arena, by Exley, Mehta, and Smith (1997), Bader and Gold (2003), and Enderle et al. (2006).

[3] Liability returns are computed analogously to asset returns (Leibowitz 1987) reflecting both the passage of time and changes in the beginning and ending discount rate curves.

[4] This is the Traditional Unit Credit (TUC) Normal Cost computed at market rates.

[5] Actuaries, elected officials, and other agents usually assert that the 'cost' of the plan is equal to the actuarially required contributions. Economists, and the markets they defer to, disagree.

[6] Earlier we used the term ABO to define the recognized accrual pattern (i.e., a liability that does not anticipate future service or pay increases). Henceforth, we use the term ABO to mean the value of such accrued benefits when discounted using the plan's actuarial assumptions. We use MVABO to mean the value discounted using market rates.

[7] Some states and localities (e.g., New York State) use the aggregate actuarial funding method to determine an annual contribution. Under this method the AAL is set equal to the actuarial value of plan assets (leading to the meaningless tautology that the plan is always fully funded). Attempting to estimate an EAN

AAL from the aggregate figures would require more in-depth analysis. Fortunately, GASB (2007) requires disclosure of the EAN AAL for all plans using the aggregate funding method.

[8] Although most public pension plans require employee contributions, we set the PVFEC to zero to simplify the exposition. This affects the sharing of cost between the employer and the employees but does not change the AAL.

[9] Using the RP2000 Combined Healthy Male mortality table and an assumed interest rate of 8 percent the non-indexed single life annuity value at age 60 equals 9.9238. We round to 10.0 to simplify the exercise: \$300, 000 = \$30, 000*10.0.

[10] This equals \$2,648 * 10-year annuity at 8 percent.

[11] The benefit payable at 60 under this plan is the same as under a plan specifying 1 percent of final salary for each year of service where the final pay is \$100,000 (i.e., 1%*100, 000*30 = \$30, 000).

[12] The model was built to produce the same \$30,000 pension, irrespective of salary increase assumption.

[13] In most jurisdictions separate plans are established for uniformed (or safety) employees. Such plans provide for much lower retirement ages. A common provision allows retirement at any age after 20 or 25 years of service. Many police and firefighters retire in their mid 40s.

[14] This refers to a 2005 California proposal reported by Delsey and Hill (2005), later dropped by Gov. Schwarzenegger (Gledhill 2005).

[15] The latest US only figure from the Federal Flow of Funds was \$61.984 trillion (Federal Reserve Board 2007). Non-US figures are assumed to be at least as great as the US figure.

[16] See Findlay (2008). But Revell (2008) reports an instance of a governmental plan sponsor declaring bankruptcy, citing unaffordable pension and health care costs for its employees. The seeming permanence of public plans is often cited as a reason to discount liabilities at rates reflecting expected returns on risky assets, but Kohn (2008) proposes that low-risk liabilities must be discounted with low-risk discount rates.

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