Accrual Measures of Pension-Related Compensation and Wealth of State and Local Government Workers

David G. Lenze

Bureau of Economic Analysis
U.S. Department of Commerce
Washington, D.C. 20230
Phone: (202) 606-9292
Fax: (202) 606-5322
E-mail: David.Lenze@bea.gov

WP2009-03
April 2009

Accrual measures of pension-related compensation and wealth of state and local government workers

Abstract

This paper develops a simple method to convert the published normal costs and actuarial liabilities of state and local government retirement systems to the economic accruals and liabilities needed to estimate the compensation and property income components of the National Income and Product Accounts (NIPA). It also standardizes the measures using a common discount rate. The method is applied to data for the years 2000 to 2006 to generate a set of national and state estimates. Using a 6% discount rate, the accrued liability of state and local government retirement systems is about 8% lower than the actuarial liability and benefit accruals are about 38% higher than normal costs. Adopting accrual accounting for state and local government pension plans will have a large effect on the NIPA, adding $93 billion (or about 0.8%) to its measure of personal income in 2006.

Accrual measures of pension-related compensation and wealth of state and local government workers[1]

Introduction

Although most parts of the U.S. National Income and Product Accounts are kept on an accrual basis, the income and outlay account is kept on a cash basis because of data limitations. An important component of the income of workers is that portion of their compensation which is saved in defined benefit (DB) pension funds. Currently employers contribute 2.7% of employee compensation to such pension funds on a cash accounting basis.[2] In recent years, a decline in the value of equities, low interest rates, and the continued growth in the liabilities of pension funds have raised concerns about the financial soundness of DB pension funds. In response, many pension plan sponsors contributed large lump sums to the funds, imparting some unusual volatility to compensation measured on a cash basis, and distorting comparisons in current labor costs across industries and regions.

This paper investigates whether national income accounts can measure the household sector's pension compensation and wealth on an accrual basis using publicly available financial and actuarial reports of the pension funds. In particular, this paper looks at the pension funds for employees of state and local governments.[3] These pension

[1] I would like to thank Marshall Reinsdorf, Ron Gebhardtsbauer, and Ann Dunbar for helpful discussions, and Bruce Baker, Sean Puckett, Karla Allen, Michelle Grier, Jonas Wilson, Devin McIntosh, and Evan Lin for data assistance; however, any errors in this paper are my sole responsibility. An earlier version of this paper was prepared for the 30th General Conference of the International Association for Research in Income and Wealth, August 25, 2008, Portoroz, Slovenia.

[2] See the U.S. Bureau of Labor Statistics News Release "Employer costs for employee compensation—March 2008" Table 1.

[3] Some pension plans also provide for retiree health care benefits and until recently did not report contributions and benefits for health care separately from cash pension benefits. In this paper we make adjustments as necessary to exclude retiree health care benefits.

funds are not only a large proportion of all funds in the U.S.,[4] they continue to be the primary type of pension fund for state and local government workers.[5]

State and local government retirement systems differ from private pension plans in several important dimensions.

(1) Employees often contribute a large share of their salaries to state and local plans in addition to the amounts employers contribute whereas in the private sector employee contributions are rare.[6]

(2) State and local plans are exempt from most of the regulations (including the Employee Retirement Income Security Act (ERISA)) that private plans are subject to. Some state and local plans (e.g. the Pre-1996 Fund in the Indiana State Teachers' Retirement System) are unfunded and financed on a pay-as-you-go basis. Pay-as-you-go financing is prohibited by ERISA.

(3) Some state and local employees do not participate in the federal Old Age, Survivors' and Disability Insurance (financed by a 6.2% tax on covered earnings) and so their contributions to defined benefit and defined contribution retirement funds are larger than for those who do participate.[7]

---

[4] Employer contributions to state and local government employee retirement systems were $60.6 billion in fiscal year 2005, according to a U.S. Census Bureau survey (http://www.census.gov/govs/retire/2006ret01.html) while employer contributions to private defined benefit pension plans were $89.8 billion in 2005 according to the *Private Pension Plan Bulletin* published by the U.S. Department of Labor.

[5] In the first quarter of 2008, contributions to defined benefit pension plans were 6.7% of state and local government employees' compensation. Contributions to defined contribution plans were an additional 0.8% of compensation. See the U.S. Bureau of Labor Statistics News Release "Employer costs for employee compensation—March 2008."

[6] Of course, *all* contributions to the pension fund are out of employee compensation, the distinction between employee and employer contributions arises in a national accounting framework because employee contributions are deductions from amounts recorded in NIPA as wages and salaries; employer contributions are not and must be separately estimated.

[7] "Approximately one-fourth of all employees of state and local government do not participate in Social Security, including nearly one-half of all public school teachers and most or substantially all public employees in Alaska, Colorado, Louisiana, Maine, Massachusetts, Ohio, and Nevada" (Brainard 2006 p.7).

(4) Some state and local plans have automatic cost of living adjustments to pension benefits. This is rare in the private sector (Bodie 1990a).

(5) In the regulatory filings of private plans, the main measure of liability is based on benefits accrued as of the valuation date and ignores projected salary increases. Valuations of public plans, on the other hand, usually take into account expected salary increases associated with promotions, inflation, and productivity growth.

(6) State and local plans, unlike private sector plans, are not insured by the Pension Benefit Guaranty Corporation.

(7) Accounting standards differ. Private plans generally follow the standards set by the Financial Accounting Standards Board (FASB) while public plans follow the Government Accounting Standards Board (GASB).

(8) Data sources differ. Under ERISA, most private plans are required to report detailed accounting and actuarial information on Form 5500. State and local plans are exempt from those reporting requirements but do provide some information in response to a Census Bureau survey of government employee retirement systems.[8]

Because the pension concepts and terminology of accountants and actuaries are not familiar to all economists, this paper begins with a presentation of formulae for pension accruals and liabilities and then compares them with the normal cost and actuarial liability measures of actuaries and the annual required contribution concept of accountants. The paper next presents cash estimates of defined benefit (DB) pension compensation and wealth for the years 2000-06 and compares them to the actuarial estimates. Then the paper considers two important adjustments needed to convert these actuarial estimates into accrual estimates using a common discount rate. After making

these adjustments a very different picture emerges of household income and saving behavior.

In addition to improving the National Income and Product Accounts, the accrual measures should be useful in other contexts such as evaluating to what extent there is a compensating wage differential for state and local government workers corresponding to their pension benefit accruals (Ehrenberg 1980) and improving surveys of worker compensation.

[8] The Census Bureau has recently expanded its survey to collect actuarial data about the retirement systems.

I. The Accrual of Pension Benefits

Most of the issues pertinent to this paper can be illustrated with a model of a simple pension plan. In this model, a worker vests immediately upon hire, there are no breaks in service, benefits begin at age r, administrative costs are zero, there are no special provisions for early retirement, and there are no cost of living adjustments to benefits after retirement. B is the *accrued retirement benefit* to be paid each period (year). B is some function of covered salary W^*, length of covered service s, and a multiplier k. The accrued retirement benefit as of the worker's current age ($h+s$, where h is the age when he was hired) is given by[9]

$$B(h+s) = ksW^*(h+s), \quad h+s < r. \tag{1}$$

The expected present value of future benefits, as of the retirement age r, for an employee with $r-h$ years of service is

$$L(r) = \int_r^{\infty} B(r)S(r,a)e^{-i(a-r)}da. \tag{2}$$

where i is a discount rate and $S(r,a)$ is a survival rate, the probability that a retiree will survive from age r to age a and collect his pension benefit.[10] $L(r)$ is a liability of the plan to the employee.

$B(r)$ is given as of age r. Therefore it can be pulled outside the integral in Eq. (2) and the liability written as

$$L(r) = B(r)A(r), \tag{3}$$

[9] This model is based on Barnow and Ehrenberg (1979).

[10] In this model we consider only mortality risk. Defined benefit pension plans also typically have provisions for disability and survivorship benefits as well as provisions for workers who leave after vesting but before they are eligible to begin receiving retirement benefits. See Winklevoss (1993) for a treatment of these risks.

(4) $$A(r) = \int_r^{\infty} S(r,a)e^{-i(a-r)}da$$

where $A(r)$ is an annuity factor, the present value as of the retirement age r, of a lifetime annuity of \$1 per period. The annuity factor is the product of a survival probability and a discount rate.

The expected present value of an employee's accrued retirement benefit at any time $h+s$ prior to retirement is the expected present value of future benefits as of the retirement age adjusted for the probability that the worker may die prior to retirement age (and therefore receive no pension) and discounted to time $h+s$. This is given by

(5) $$L(h+s) = B(h+s)A(r)S(h+s,r)e^{i(h+s-r)},$$

where $S(h+s,r)$ is the probability that he will survive from age $h+s$ to r.

Our interest is in the worker's accrual of future benefits for an additional period of service to his employer. This is found by taking the partial derivative of Eq. (5) with respect to s:

(6) $$\frac{\partial L}{\partial s} = \left(\frac{1}{s} + \frac{\partial W^*/W^*}{\partial s} + \frac{\partial S/S}{\partial s} + i \right) L.$$

The first two terms on the right hand side represent the accrual of additional pension benefits because of another year of service. When an active employee works an additional year the expected present value of his pension grows not just because he has accumulated another year of service (as indicated by the first term), but also because the salary on which his benefit is calculated is now higher (as indicated by the second term).

The third and fourth terms on the right hand side of Eq. (6) represent amounts that accrue whether or not the participant in the pension plan provides another year of service; they accrue to both active and terminated employees. The third term represents the

change in a participant's survival probability given that he has lived another period. This will be positive because the survival probability is calculated over a shorter time span. For example, the probability of living an additional 5 years is higher than the probability of living an additional 6 years, $\partial S/\partial s > 0$. Lastly, the fourth term represents the unwinding of the time discount, that is, future pension benefits are discounted one less period.

The investment income on the accumulated assets is expected to cover the increase in L due to the unwinding of the time discount. Transfers between those who died during the year (and thus lost their future pension benefits) and those who survived are expected to cover the increase in L due to the change in the survival probability.

We define a *benefit accrual function* representing the pension *benefit accruals* of an active worker for another year of service as

$$C(h+s) = \left(\frac{1}{s} + \frac{\partial W^*/W^*}{\partial s} \right) L(h+s). \tag{7}$$

C is that part of the worker's current compensation which is saved in a pension fund.

It will be convenient to assume that wages grow exponentially at the rate of g per year:

$$W(h+s) = W(h)e^{gs} \tag{8}$$

and that pension benefits are based on an average salary. The following expression is general enough to include the more common averages typically specified by plans in the U.S. state and local government sector

$$W^*(h+s) = \frac{1}{n}\int_{s-n}^{s} W(h)e^{gt}dt = \left(e^{gs} - e^{g(s-n)}\right)\frac{W(h)}{gn}, \quad s \geq n > 0. \tag{9}$$

When $n = s$ the accrued retirement benefit is based on the average salary earned over the worker's entire career with the employer. In the limit, as n approaches 0 the accrued retirement benefit will be based on the worker's current salary. Many plans specify $n = 3$ or $n = 5$ (Brainard 2006 p.7).

Table 1 presents estimates of the accrual of pension benefits and the plan's liability by age assuming that W^* is based on a career average salary. In addition, it is assumed that the worker is hired at age 25 at an annual salary of $25,000. He works 40 years, retiring at age 65. His salary increases exponentially at an annual rate of .05, present values are calculated assuming a discount rate of .06. The pension plan pays 1% per year of service. Mortality is based on the male RP-2000 mortality tables for employees and healthy annuitants prepared by the Society of Actuaries. Under these assumptions, the worker accrues a benefit of $239 (or 0.96% of salary) at age 26. The accrual of benefits rises exponentially until it reaches 10.88% of salary at age 65. Even so, the accrual rates are quite modest, as a percentage of salary, for most of his career. At age 40 they are only 2.24% and even as late as age 50 they are only 4.14% of salary. The employer's cumulative liability also rises very slowly and even as late as age 60, it is not much more than one-half of the retirement age liability (53.37%).

Table 1 is for an individual worker. An employer will typically have many employees with different age and years of service characteristics. The accrual rate for an employer based on *all* his employees will be some average of the rates for the individual workers. Over time as the average age of the workforce changes (e.g. from a relatively young workforce in the early 1970s as baby boomers began their careers to a relatively mature workforce as those baby boomers contemplate retirement) the accrual rate for the

plan will also change. The change for the plan however is unlikely to be as sharp as that observed for an individual. For example, the average age of active employees in the Alaska Public Employees Retirement System (APERS) was 38 in 1972 and 45 in 2006 (according to the System's actuarial valuation reports for those years).

Table 2 presents an alternative set of estimates assuming that W* equals the worker's salary in his final year of employment. All other assumptions are identical to those used in Table 1. This provides a much higher accrued retirement benefit $B(r)$ at age 65: $73,891 versus only $31,945. Accruals start at 0.98% of salary at age 26 and rise very steeply to about 25.17% at age 65. Again, most of the accrual is in the last five years of employment; the age 60 liability is only 48.87% of the liability at retirement.

The pension liability derived here is also known as the accumulated benefit obligation or ABO. It corresponds to the legal obligation of the plan to employees should the plan be terminated. Some economists (Lazear 1979, Ippolito 1985, and Lazear and Moore 1988) advocate the use of an alternative liability, known as the projected benefit obligation or PBO. The choice between ABO and PBO is important because the difference between their liabilities can be very large (among other reasons). It is therefore lamentable that in three decades of research economists have not yet reached a consensus on which is the correct view (Wilcox 2006).[11]

[11] For the PBO, the years of service a worker has provided his employer are valued using the expected path of his salary until his retirement (including future promotions, inflation, and productivity gains) rather than his salary history up to his current age as for the ABO. See also Bodie (1990b).

II. Actuarial Perspective

In the previous section we derived formulae for the accrual of future pension benefits and showed that the benefit accrual function can rise steeply with length of service. Actuaries have developed several funding methods which smooth this rise by requiring higher employer contributions to a pension fund early in a worker's career and lower contributions at the end of his career than accrual accounting would require. Hence an *actuarial* liability, representing the expected present value of benefits *allocated* to date, is higher than an *accrued* liability and comes into equality with the accrued liability only at retirement.

In addition, the funding methods used by state & local governments in the US value the years of service already provided by the worker's expected final average salary. This salary takes into account expectations about future promotions, inflation, and economy-wide productivity gains (i.e. it is a PBO concept).

Actuaries distinguish two types of pension costs: normal costs and supplemental costs. Normal cost is the expected present value of the accrued retirement benefit allocated to a particular year. The sum of expected discounted normal costs from age of hire to retirement age must equal the accrued retirement benefit. In practice, the experience of the pension plan will usually deviate from expectations. In addition, plan provisions and assumptions may change over time so that normal costs do not cumulate to the retirement age liability. Supplemental costs are those costs required to balance cumulative normal costs with the retirement age liability.

In general, the normal cost in period $h+s$ can be represented by

$$N_j(h+s) = b_j(h+s)S(h+s,r)A(r)e^{i(h+s-r)} \tag{10}$$

where b is the *benefit allocation function* and the subscript j indexes actuarial funding methods. We will discuss three funding methods: projected unit credit, entry age, and aggregate. The expected present value of normal costs that have been allocated from age of hire to the worker's current age is the actuarial liability at age $h+s$. Denoting the actuarial liability by Λ (to distinguish it from the accrued liability L):

$$\Lambda_j(h+s) = \int_h^{h+s} N_j(a)\left(\frac{1}{S(a,h+s)}\right)e^{i(h+s-a)}da \tag{11}$$

where the inverse of the survival function takes into account transfers between workers who die and workers who survive.

Projected Unit Credit Method. The projected unit credit method defines the benefit allocation function as a constant percentage of each year's salary

$$b_{puc}(h+s) = \phi W(h+s) \tag{12}$$

where

$$\phi = \frac{B(r)}{\int_h^r W(a)da}. \tag{13}$$

The numerator in the ratio is the accrued retirement benefit as of age r and the denominator is the cumulative salary from the age of hire to retirement age.

Combining these definitions with Eq. (10) gives the normal cost for the projected unit credit method

$$N_{puc}(h+s) = \phi W(h+s)S(h+s,r)A(r)e^{i(h+s-r)}. \tag{14}$$

The actuarial liability for the projected unit credit method can be easily shown to equal the retirement age liability to the worker by plugging Eq. (14) into Eq. (11) and

evaluating at $h+s=r$. The exponential terms will cancel as will the survival functions and the salary integrals leaving

(15) $$\Lambda_{puc}(r) = B(r)A(r) = L(r).$$

That is, at retirement age the actuarial and accrued liabilities are equal.

For the numerical example considered above which assumed an accrued retirement benefit based on the career average salary, ϕ=1.03%. Normal cost rises from 0.88% of salary at age 26 to 9.92% at age 65 (Table 1). If instead the accrued retirement benefit is based on the salary in the final year of employment, ϕ=2.37% and normal cost rises from 2.03% initially to 22.95% at age 65 (Table 2).

Entry Age Method. In the entry age funding method normal costs are set equal to a constant percentage, τ, of a worker's salary over his career. Since *at entry age* h the sum of the expected present value of future normal costs equals the expected present value of future benefits *at entry age* h

(16) $$\int_h^r N_{ea}(a)S(h,a)e^{i(h-a)}da = B(r)A(r)S(h,r)e^{i(h-r)}$$

τ can be found by setting a portion of the expected present value of a worker's lifetime salary stream equal to the expected present value of future benefits

(17) $$\tau\int_h^r W(a)S(h,a)e^{i(h-a)}da = B(r)A(r)S(h,r)e^{i(h-r)}$$

(18) $$\tau = \frac{B(r)A(r)S(h,r)e^{i(h-r)}}{\int_h^r W(a)S(h,a)e^{i(h-a)}da}.$$

Then the normal cost at age $h+s$ is simply this constant times the salary at that age

(19) $$N_{ea}(h+s) = \tau W(h+s).$$

For the numerical example considered above which assumed an accrued retirement benefit based on the career average salary, τ =3.38%. That is, normal cost is a constant 3.38% of salary (Table 1). If instead the retirement benefit is based on the salary in the final year of employment, τ =7.81% (Table 2).

Aggregate Method. In the aggregate funding method the expected present value of the accrued retirement benefit (given by Eq. 5) less accumulated assets, $X(h+s)$, is divided by the expected present value of future salaries to obtain a "normal cost" rate. The "normal cost" rate is multiplied by the salary for a given year to obtain the "normal cost" for that year

$$N_{agg}(h+s) = \left(\frac{B(r)A(r)S(h+s,r)e^{i(h+s-r)} - X(h+s)}{\int_{h+s}^{r} W(a)S(h+s,a)e^{i(h+s-a)}da} \right) W(h+s). \tag{20}$$

Although actuaries call this a normal cost, it is a fundamentally different concept from the normal cost of the projected unit credit and the entry age methods. First, the aggregate method does not recognize an unfunded liability. Instead, supplemental costs arising from actuarial losses (deviations of experience from assumptions) or past failures to adequately contribute to the pension fund are amortized over the future career of a worker, combined with the pension cost for an additional year of service, and deemed to be the normal cost. Second, N_{agg} is defined in terms of the value of accumulated assets and so will be sensitive to swings in asset prices. Third, in order to dampen the effect of volatile asset prices on N_{agg} it is common practice to use an actuarial value of assets (for example, a five-year average of the market value of assets) for $X(h+s)$ rather than the market value of assets.

III. Accounting Perspective

There are 3 GASB Accounting statements pertinent to our work. Statements 25, 27, and 50 require that the comprehensive annual financial report of state and local government pension plans include supplementary information consisting of two schedules: a Schedule of Funding Progress and a Schedule of Employer Contributions. The first consists of the actuarial liability, actuarial value of assets, unfunded liability, and covered payroll. The second consists of the annual required contribution (ARC) and the percentage contributed. The annual required contribution is defined as the normal cost plus an amount to amortize the unfunded liability in no more than 30 years.

In the next section of the paper we will begin an empirical study of state and local government retirement systems in the United States. Section IV consists of a brief presentation of the current unsatisfactory cash estimates of income and expenses for state and local government retirement systems. In Section V we will present actuarial estimates. At present, the cash and actuarial estimates are the only information available to a national income accountant who needs accrual estimates. Section VI will present an illustrative conversion of publicly available actuarial estimates into accrual estimates.

IV. Cash Estimates

A cash accounting statement of income and expenses for participants in state and local government-administered public-employee retirement systems is presented in Table 3. The estimates are from a Census Bureau survey of these plans. Since fiscal years for most state and local governments end on June 30, we converted the Census estimates to calendar years by a simple average of adjacent years.

State and local government retirement systems earned about $145 billion on their investments in 2000 (line 3 plus 10). Declining equity prices and low interest rates substantially reduced financial returns for these systems in the following two years. They sustained investment losses of $77.9 billion in 2001 (line 10) and $69.6 billion in 2002. As a consequence, employer contributions[12] rose sharply in subsequent years (line 2). From an average of $40.1 billion per year in 2000-02, employer contributions rose 69% to $67.8 billion in 2006. Relative to payroll, employer contributions rose from 8.00% in 2000 to 10.84% in 2006 (line 14).

[12] Among state and local government retirement systems in the US it is common for a portion of the contributions made to pension funds to be deducted from salaries (the employee's contribution) and a portion (the employer's contribution) to be paid over and above the employee's salary. Employee contributions increased 26% 2000-05 while employer contributions increased 57%.

V. Actuarial Estimates

The actuarial estimates in this section are based on a sample of 124 of the largest state and local government retirement systems, representing 91% of the membership in all systems as reported in the 2002 Census Bureau census of state and local government-administered public-employee retirement systems.[13] Some smaller systems were included to the sample in order that it might account for at least 75% of membership in almost every state. Aggregate amounts reported in the tables below are sums and averages of the sampled systems weighted by membership to represent the entire population.

Ninety-eight of the sampled retirement systems published an actuarial liability based on the entry age funding method, 21 used the projected unit credit method, 2 used the frozen initial liability (aka frozen entry age) method, 2 used the aggregate method and 1 used the frozen attained age.

Some retirement systems recently switched their funding method to the entry age method. We extrapolated the new entry age liability back to 2000 using Eq. (21).

$$\Lambda_t = \Lambda_{t-1} + N_t + i(\Lambda_{t-1} + N_t) - B_t - \tfrac{1}{2} iB_t \tag{21}$$

where Λ is the actuarial liability of the retirement system, N is its normal cost, B is benefits paid, and i is the discount rate. This equation requires an estimate of entry age normal cost for the earlier years. Since normal cost rates are relatively stable over time unless large changes are made to plan provisions or actuarial or economic assumptions,

[13] Membership is a count of active and inactive members and all beneficiaries receiving periodic payments (retired on age, service, or disability as well as survivors of deceased members), but not lump sum recipients. The actuarial data were collected by BEA primarily from the comprehensive annual financial reports and actuarial valuation reports of the systems. The fiscal year data in these reports were converted to calendar years by averaging, taking into account differences in system fiscal years. For more details see the data appendix.

we assumed that the new entry age normal cost rate (normal cost divided by covered payroll) was a reasonable approximation of the normal cost rate in earlier years as well. Multiplying it by covered payroll provided an estimate of N while an estimate of B was obtained from the financial reports of the systems.[14]

Table 4 presents summary actuarial measures of income and saving for 2000-06 (it combines estimates of actuarial liabilities and normal costs calculated using different funding methods). It should be compared to the cash measures presented above in Table 3.[15] In the measurement of actuarial income, employer's normal cost is used rather than the employer contributions used in the measurement of cash income. Employer's normal cost was $41.0 billion in 2000 and rose to $51.7 billion in 2006 (line 1) about 8.3% of covered payroll in both years (line 17). This contrasts with the sharp rise in employer cash contributions from 8.0% in 2000 to 10.8% in 2006 in response to very low returns on assets (Table 3).

Actuarial interest income (line 2) is computed using the assumed investment rate of return from actuarial valuation reports and the actuarial liability. The weighted average interest rate is very stable at about 8% (line 19) while the actuarial liability rises from $2.2 trillion in 2000 to $3.3 trillion in 2006 (line 9).[16] Together they yield interest income which rises steadily from $178 billion in 2000 to $262 billion in 2006. Again

[14] Details about other adjustments that were made to the data for individual retirement systems are provided in the appendix.

[15] Note that under cash accounting DB pension plans are in the household sector, so pension assets are part of household wealth and the operations of the plans are an activity of households. Therefore the administrative and investment expenses of the plans are included in household income (and household consumption). Under accrual accounting, the plans are in the sector of the employer (state and local government) and so the administrative and investment expenses are not part of household income nor household consumption.

[16] The investment rate of return assumption compares favorably with actual experience in the recent past. Earnings have averaged 8.5% of assets over the period 1994-2006 using data from the Census Bureau survey of these systems.

there is a sharp contrast with cash property income (dividends and interest), which declined in 2001 and 2002.

Table 4, Line 11 also shows that over this period assets have been about 2 to 16% lower than the actuarial accrued liability, with the smallest unfunded liability occurring in 2000 before the effects of the unfavorable investment returns were felt and the largest unfunded liability occurring in 2002 as employers began increasing their contributions.[17]

Table 5 presents the annual required contribution (ARC), a measure required by GASB. Employers contributed about 90% of the required amount in 2000, but even with the sharp rise in the contributions subsequently, the percent of ARC contributed fell continuously to 81% in 2005 before rising to 83% in 2006.[18]

Lastly, Table 6 presents the distribution of the actuarial liability between active members (lines 1 and 3) and retirees and beneficiaries (line 2). The middle panel displays the distribution as percentage shares. The retiree and beneficiary share rose from 44.85% in 2000 to 50.58% in 2005. (These estimates are based on a smaller sample than the estimates in Tables 4 and 5; thirty-two of the retirement systems in the sample did not report the solvency test results on which Table 6 is based.)

[17] The unfunded liability should be interpreted carefully because of the relationship between a retirement system and its sponsoring government. The size of a retirement system's unfunded liability depends on how and where the sponsoring government wishes to record its liabilities. For instance, by issuing pension obligation bonds and contributing the proceeds to the fiduciary fund for its retirement systems, the state of Illinois increased the assets of the systems and reduced their unfunded liabilities. The liability represented by the bonds was recorded on the statement of net assets of the sponsoring (primary) government. Although this maneuver appears to improve the finances of the retirement systems there has been no net change for the state government in its entirety.

[18] GASB requires that the unfunded liability be amortized over a period not longer than 30 years. In practice the periods and methods used by retirement systems vary considerably making comparisons between ARCs of different retirement systems difficult.

VI. Accrual Estimates

In this section we illustrate the conversion of the actuarial estimates of the previous section to standardized accrual estimates.[19] The standardization entails two steps. First, the actuarial estimates are converted to accrual estimates. Second, accrual estimates are standardized to reflect a common discount rate assumption.

A precise conversion would require complete information about all members in a given retirement system and complete details about the provisions of its pension plan. Without such information we fall back on an approximation based on the simple pension model of Section I. The approximation, of course, is sensitive to the assumptions used. We selected parameters to be representative of average active and retired members of a state and local government retirement system: The representative worker was hired at age 27 and retired at age 57, having worked 30 years.[20] His starting salary was $25,000 per year and grew at the exponential annual rate of 0.04. Present values are calculated assuming an 8% discount rate. Benefits are equal to 2% of the average salary in the final five years of employment times the number of years of service.[21] Given these (base case) assumptions, ϕ=3.18%, τ=9.22%, W(45)=$51,361, and B(57)=$45,138.

Conversion of Actuarial Liabilities to Accrued Liabilities. Table 7 shows benefit accruals relative to normal costs for a particular worker by age for the projected unit credit and entry age actuarial funding methods. At age 45 benefit accruals for this

[19] See also Gold and Latter (2008) for another attempt to develop more relevant measures of pension liabilities.

[20] See the 2006 actuarial valuation report for the Alaska Public Employees' Retirement System (PERS). Excluding police and firemen, the average active worker is age 45 and has 9 years of service. The average retiree retired at age 57 with 15 years of service. The averages for active police and firemen are 41 (age) and 10 (years of service) while the averages for police and firemen at the time of retirement are 52 (age) and 19 (years of service). The Alaska PERS is one of the few retirement systems that publishes this type of data.

worker are 10% below projected unit credit normal costs and 11% above entry age normal costs. The accrued liability is 82% of the projected unit credit actuarial liability and 50% of the entry age liability. Note that by age 57 all liabilities are equal.

We assume that actuarial measures can be converted to accrual measures using the age of the average active member which is taken to be 45. The conversion of normal costs and actuarial liabilities is sensitive to the assumption made about the average age of active members and W^* but not to the discount rate.

The effect of a change in the average age is seen by comparing the conversion factors for various ages in Table 7. For instance, the average age of active policemen and firemen is usually lower than that of other workers. In the Alaska system the average age of policemen and firemen is 41, four years younger than other members. The entry age normal cost conversion factor for age 41 in Table 7 is 0.75 and 1.11 for age 45.

The sensitivity of the conversion factors to variations in the other parameters is summarized in Table 8. The conversion factors under the final year salary assumption (Case 2) are the same as in the base case (average of final five years). However, under the career average salary assumption, the conversion factors are much larger (Case 3). The normal cost conversion factors (at age 45) are 1.11 for the projected unit credit method and 1.36 for the entry age method while the liability conversion factors are 1.00 (projected unit credit) and 0.62 (entry age).

Changing the multiplier k from .02 to .01 (Case 6) or to .03 (Case 7) has no effect on the age 45 conversion factors.[22] Nor do changing the initial salary assumption

[21] The Teacher Retirement System of Texas and the Florida Retirement System are examples of systems that use the average of the five highest years of earnings.

[22] Brainard (2006 p.7) reports that the median multiplier for employees who participate in OASDI is .0185 while the median multiplier for those do not participate is .0220.

from $25,000 to $50,000 (Case 10) or to $12,500 (Case 11) or replacing the male mortality table with the female mortality table (Case 14). Changing the salary growth rate g (Cases 8 and 9) can have a noticeable effect on the conversion factors (especially the entry age normal cost conversion factors at age 45).

Changing the discount rate i from 8% to either 7% (Case 3) or 9% (Case 4) generally has very little effect, except for the entry age normal cost conversion factors).

Cases 12 and 13 alter the career path from age 27 to 57 in the base case to age 32-62 (later hire) in case 12 and age 22-52 (earlier hire) in case 13. In all three cases we keep the age-wage path equal so that at 45, for example, the wage equals $51,361 regardless of the year of hire. These cases illustrate that simply knowing the average age of employees is insufficient; one needs to know the average years of service as well. In the base case at age 45, years of service is 18, in the later hire case years of service equals 13, and in the earlier hire case years of service equals 23. If instead we compared conversion factors for the three career paths at 18 years of service, they would be identical.

Lastly, it should be noted that in making the conversion, it is necessary to adjust only the actuarial liability for active employees; the actuarial liabilities for inactive employees who have terminated or for beneficiaries equal the accrued liabilities under all funding methods.

Discount Rate Assumption. Bader and Gold (2003), Wilcox (2006 pp.253-6), Novy-Marx and Rauh (2008) and others have criticized current actuarial practice that uses an investment rate of return to discount future pension liabilities of state and local government retirement systems.

For funding purposes, Wilcox recommends that liabilities should be discounted using the risk free nominal yield curve, or if that is not possible, a single risk-free rate. He assumes that taxpayers will bail out an insolvent plan. Historically, state and local pension plans, unlike private plans, have always paid their pension obligations in full, even when bondholders of bankrupt state and local governments have sustained losses.

The Pension Benefit Guaranty Corporation has developed formulae for changing the discount rate assumption embedded in an accrued liability. The "termination" formula for the accrued liability to retired participants is

(22) $$\rho_R = e^{-.0538(i^* - i)}$$

and the formula for the liability to active and terminated participants is

(23) $$\rho_A = e^{-.1502(i^* - i)}$$

where i is the discount rate on which the liability was originally calculated and i^* is the desired discount rate.

Having converted the actuarial liabilities to accrued liabilities as described in the previous section, and relying on Eq. (7) which shows that benefit accruals are proportional to accrued liabilities, we can use the same discount rate conversion formulae for benefit accruals and for accrued liabilities. The discount rate conversions can have a very large effect on the estimates. For instance, when converting from the typical 8% discount rate assumed by actuaries to a 5% risk free market rate, ρ_A equals 1.6 and ρ_R equals 1.2.

Results using the market yield on 20-year Treasury securities are presented in Table 9. They depict very different saving behavior than the cash and actuarial estimates. Benefit accruals in 2000 were $58.8 billion (line 1), 49% higher than employer cash

contributions and 43% higher than normal cost.[23] Benefit accruals grew at a compound rate of 5.2% from 2000-06. As a percentage of covered payroll, benefit accruals were 12% to 14% in 2000-06 (line 17). This contrasts with normal cost which was approximately 8.3% of covered payroll and employer cash contributions which were 7% to 11% of payroll.

Imputed interest in 2000 was $112.8 billion (line 2), substantially more than the $83.1 billion cash estimate of property income but less than the $178.3 billion imputed interest on the actuarial liability. Imputed interest on the accrued liability grew at a 5.9% compound rate 2000-06.

Accrued household saving in DB pension plans rose slowly over this period at a 2.4% rate, or from $96.9 to $111.7 billion per year (line 5). This contrasts with large decelerations and accelerations in saving when measured on a cash basis and a growing level of annual saving when measured on an actuarial basis (from $144.6 billion in 2000 to $186.2 billion in 2006).

The accrued liability was $2.02 trillion in 2000 (line 9). This was less than the $2.16 trillion assets held by the retirement systems (line 8). However, the $141 billion surplus in 2000 became an $80 billion deficit in 2001 (line 10). Subsequently, the deficit grew to $444 billion in 2003 but by 2006 it had fallen to $152 billion.

Table 10 presents a similar set of estimates but uses a constant 6% discount rate, the same rate as used by the private sector on their Form 5500 filings. Because the discount rate is consistently higher than the market rate used in Table 9, the accrued

[23] As an example of the conversion of normal costs to benefit accruals, consider the case of the California Public Employees Retirement System which used the entry age funding method and an 8.25% discount rate in its June 30, 2000 valuation. Employer's normal cost was $2.78 billion. The entry-age conversion factor

liability is lower. In fact, by 2006 state and local government retirement systems had returned to a surplus ($78.8 billion) in the aggregate (line 10). The constant discount rate smoothes some of the swings over time in Table 9. For instance, benefit accruals as a percentage of covered payroll range from 11.34% to 11.96% in Table 10 versus a range of 11.91% to 13.78% in Table 9.

Cost of Living Adjustments. Although most state and local pension plans provide automatic cost of living adjustments (COLA) to retirement benefits, none were fully indexed and most had a cap of 3% per year or less. As indicated in Table 11, 93 of the systems in our sample provide automatic COLAs while 31 did not.[24] Of those with automatic COLAs, 34 were independent of the rate of inflation. For instance, the Florida Retirement System increases retirement benefits 3% per year regardless of the rate of inflation and the COLA in the Wisconsin Retirement System is dependent on the actual rate of return on assets exceeding the assumed rate of return (among other things). Of the 58 systems with COLAs dependent on the rate of inflation, 36 are capped at 3% per year or less (often with carryover provisions from years when inflation exceeds 3% to years when it is less than 3%). Four systems do not have a cap, but their COLAs are only a percentage of the inflation rate. For instance, the Teachers' Pension and Annuity Fund of New Jersey provides a COLA equal to 60% of the change in the CPI with no cap.[25]

In practice, then, even when a retirement plan has an automatic COLA dependent on the rate of inflation, the cap is usually so low that it is highly likely to be binding

---

for benefit accruals at age 45 from Table 7 is 1.11 and ρ_A =1.34 to convert to a 6.30% market discount rate. Benefit accruals are therefore $4.13 billion, 49% higher than normal costs.

[24] However, many systems without automatic COLAs provide occasional ad hoc COLAs.

[25] This summary glosses over many of the exceedingly complex and varied COLA provisions in state and local pensions plans. For instance, many plans do not compound COLAs. Other plans limit COLAs to

always and the maximum cost of living adjustment always made. It will be convenient to assume that all COLAs in state and local government retirement plans are similar to Florida's constant annual increase. It can be easily shown that if this is the case, the conversion factors in Table 7 that convert normal costs and actuarial liabilities to accrual measures are unchanged. If the retirement benefit increases at a constant rate of π then the expression for the annuity factor given in Eq. (4) can be written as

$$A(r) = \int_r^{\infty} S(r,a) e^{(\pi - i)(a-r)} da \,. \tag{24}$$

This raises the liability given by Eq. (5) and benefit accruals given by Eq. (7) in the same proportion it raises the actuarial liability given by Eq. (11) and normal costs given by Eq. (10). In other words, the ratio of the accrued liability to the actuarial liability and the ratio of benefit accruals to normal costs are unchanged.

State Estimates. Table 12 presents estimates of benefit accruals by state.[26] These estimates are based on the constant 6% discount rate assumption. There is substantial variation across states in these accruals as a percentage of covered payroll (Table 13). At the low end in 2006 are Rhode Island (4.7%) and Massachusetts (5.0%). At the high end are the District of Columbia (26.4%) and Nevada (24.9%).

---

only a portion of the retirement benefit (for instance, the first $12,000 or excluding the amount based on employee contributions).

[26] In converting the actuarial estimates to accrual estimates we used the same set of (base case) assumptions for all retirement systems. Although it might be worthwhile to use system-specific assumptions, particularly regarding average age and years of service of active workers, the gain must be balanced against the cost of collecting the relevant data, which in many cases is not even published. The gain is likely to be greatest for retirement systems for police and firemen. Even so, they are a relatively small subset of the population.

Comparisons across states are complicated because sometimes covered payroll includes and sometimes excludes DROP payments.[27] For instance DROP payments grew rapidly in Alabama from 2000 to 2006. In addition, the revisions actuaries make to their actuarial assumptions on the basis of the experience studies they conduct every five years can have substantial effects on employer normal cost rates. Colorado is an example of this. The effects of such changes in Table 13 are usually spread over two years because fiscal years usually do not correspond to calendar years. The normal cost rate in Oregon dropped sharply in 2004 when that state froze the money match provision in its retirement plan.

There is even greater variation in benefit accruals relative to current cash estimates. In 2006, the benefit accruals and cash contributions in Idaho were approximately equal. In contrast, benefit accruals in New Jersey are more than 18 times as much as the current cash estimates ($2.19 billion versus $119 million).

[27] Under a deferred retirement option plan (DROP) an employee eligible for retirement (1) stops accruing future retirement benefits, (2) directs that his retirement benefits be paid into a trust fund where they earn a specified rate of interest, and (3) continues to work for the same employer.

VII. Conclusions

The need for accrual measures of pension compensation and wealth has long been recognized.[28] One difficulty is that state and local government pension plans in the U.S. generally do not publish the accrual measures needed for national income accounts and the measures they do publish are not based on a consistent set of funding methods and assumptions.

This paper developed a simple method to convert published normal costs and actuarial liabilities to the economic accruals and liabilities needed for national income accounts using a common discount rate. The method was applied to data for the years 2000 to 2006 to generate a set of national and state estimates. Not surprisingly, the accrual estimates are quite different from the currently published cash estimates.

Estimates of benefit accruals and liabilities based on a market discount rate could be higher or lower than published normal costs and actuarial liabilities for three reasons. (1) The discount rate used by actuaries is usually substantially above the market discount rate as represented by the yield on risk free treasury securities, making actuarial estimates smaller than accrual estimates. (2) The actuarial funding methods used by state and local governments in the U.S. are variations of the projected benefit obligation (PBO) which takes into account salary increases expected in the future. In contrast, the accrual

[28] "It is difficult to carry out economic analysis based primarily on accrual concepts in a world where activity is reported on a cash basis. Particularly in the pension area, the personal income and saving statistics produced by the National Income and Product Accounts differ substantially from the concepts used in most economic analyses. In the corporate sector, cash accounting tends to distort the measurement of pension commitments and thereby corporate profits. Accounts based on cash also fail to recognize the relationship between the federal government and the household and business sectors created by the Pension Benefit Guaranty Corporation insurance. Finally, tax expenditure estimates based solely on a cash flow analysis do not provide an accurate measure of the benefits of the tax-favored treatment of pensions.

"The time is right for improving the data on pensions. Great strides have been made in the area of cross-sectional surveys of individuals; these improvements should permit better estimates of the extent to which employees reduce their other saving in response to guaranteed pension benefits. Comparable

measure proposed in this paper is an accumulated benefit obligation (ABO) which ignores future salary increases. This difference would tend to make the actuarial estimates larger than the accrual estimates. (3) As shown in Section II, actuarial funding methods smooth the rise in benefit accruals which occurs over a worker's career. All else equal, this makes the accrued liability lower than the actuarial liability except at the age of retirement when they are equal. On the other hand, it makes benefit accruals lower than normal costs in the early years of a career and higher than normal costs at the end of a career.

The net effect in the aggregate of all these factors in 2006 is that the accrued liability (assuming a 6% discount rate) is about 8% lower than the actuarial liability and benefit accruals are about 38% higher than normal costs.

In addition to national estimates, estimates were prepared for states, across which there is substantial variation. For instance, benefit accruals ranged from 18% above employer's normal cost in New York in 2006 to 61% above in Minnesota, New Hampshire, and Pennsylvania. Benefit accruals ranged from 5% of covered payroll in Connecticut to 25% in Nevada (and 11% nationally).

Adopting accrual accounting for employer contributions to DB pension plans will have a large effect on NIPA measures of compensation and personal income receipts on assets. We estimate that pension benefit accruals in 2000 are 47% higher than the NIPA cash estimate and 9% higher in 2006. The dividends and interest income of state and local government retirement plans is attributed to households and recorded in personal income receipts on assets in the NIPA. The accrual estimate of this income is 41%

---

improvements are needed at the macro level; revising our national accounts to make use of available data should be given high priority" (Munnell and Yohn 1992).

higher than the NIPA cash estimate in 2000 and 91% higher in 2006. Together the two accrual estimates would add $54 billion (or 0.6%) to total personal income in 2000 and $93 billion (0.8%) in 2006.

Among other things, the accrual estimates are dependent on a set of assumptions such as the age and years of service of the representative employee. Sensitivity simulations altering the other assumptions generally did not have large consequences for the estimates of benefit accruals and liabilities.

The accrual estimates are also dependent on the quality of the actuarial data published by the retirement systems and the consistency with which different retirement systems apply a given actuarial funding method. Although estimates for many systems are based on complete information from 2000 to the present, estimates for other systems are based on a single year of primary data which we extrapolated back to 2000 assuming a constant normal cost rate. Even over the short six year period considered in this paper, there has been some improvement in the availability and quality of the underlying actuarial data. For example, some systems which use the aggregate actuarial funding method have begun publishing entry age normal costs and liabilities.

Appendix: Notes on Data Collection

General. Some of the data used in this paper (actuarial liability, covered payroll, annual required contribution, investment rate of return, employer's normal cost, and the distribution of the actuarial liability between active and retired members, cost of living adjustments) were collected directly from the Comprehensive Annual Financial Reports (CAFR) and Actuarial Valuation Reports (AVR) of the retirement systems. Usually actuarial valuations are performed every year but some systems perform them every other year.

The actuarial valuation dates for most retirement systems is June 30th; a common alternative valuation date is December 31st. A few systems use other valuation dates. Fiscal year data were converted to calendar years using a weighted average of adjacent years, the weights depending on the system's fiscal year. (Fiscal year data from the Census Bureau survey were converted to calendar years assuming that all systems used a June 30th fiscal year.)

Normal Cost. By design, normal cost is rather stable from year to year unless plan provisions, economic assumptions (e.g. interest, inflation, and wage rates), or actuarial assumptions (termination, retirement, mortality, and disability rates), are substantially changed. Therefore it was felt reasonable to extrapolate normal cost to a common 2000-06 sample period for all systems (when actual data were missing) by holding the normal cost rate constant and multiplying it by covered payroll.

The actuarial valuation reports we examined typically use payroll and other data as of the valuation date to calculate a normal cost rate for a future fiscal year. For instance, the June 30, 2007 AVR for the Vermont State Employees' Retirement System

reports the calculations of a normal cost rate for the 2010 fiscal year. As a general rule, we used the normal cost rate calculated using data as of the valuation date as an estimate of the normal cost rate for the year ending on that valuation date. In the Vermont example, we used the normal cost rate calculated for fiscal year 2010 as an estimate of the normal cost rate for the year ending June 30, 2007. This is correct (for an individual) when the entry age funding method is used because the normal cost rate is the same for every year of that individual's career. For the system, the rate will not be identical every year because the composition of active members changes, but the rate will nevertheless usually be very stable. Even for the projected unit credit method this general rule should be approximately correct. This means that we can multiply the normal cost rate by the covered payroll for the year ending on the valuation date to estimate normal cost for that year.

For the systems that did not use either the entry age or the projected unit credit funding methods, we made adjustments and assumptions such as:

- Wisconsin's official actuarial method is the frozen initial liability but it also publishes some entry age estimates in its valuation report. In this paper we used the published entry age liability and normal cost and calculated an unfunded "actuarial accrued liability" (AAL) as the difference between the entry age liability and the actuarial value of assets. We then amortized the "unfunded actuarial accrued liability" (UAAL) over 30 years using a constant dollar amortization payment and added the amortization payment to the entry age normal cost to obtain an entry age annual required contribution (ARC).

- The State Teachers Retirement System of Vermont and the Vermont State Employees' Retirement System adopted the entry age funding method in their June 30, 2006 valuation reports. Formerly they used the frozen initial liability method. We used the entry age normal cost rate from the 2006 report for all earlier years.
- South Dakota and North Carolina Local Governmental use the frozen initial liability. They do not publish an entry age AAL. We treated their published actuarial data as if they were entry age because there is no information to do otherwise.
- The Tennessee Consolidated Retirement System (consisting of two plans: the State employees, Teachers, & Higher Education Employees Pension Plan (SETHEEPP) and the Political Subdivisions Pension Plan (PSPP)) began publishing an entry age AAL in its FY2008 CAFR. Previously it published a frozen initial liability AAL. We estimated a normal cost for the system for 2007 as a weighted average of the published normal cost rates for State and Higher Education participants and for Teacher participants (a normal cost for PSPP participants was not published). The weights were estimated from the data in the schedule of active members by salary. We assumed that the normal cost rate for earlier years was equal to the 2007 rate. We then estimated an entry age AAL for earlier years using Eq. (21).
- The New York City (NYC) Police, Fire, Teachers', and Employees' retirement systems use the frozen initial liability funding method but they also publish a "market value accumulated benefit obligation." This is the accrued liability that

we are attempting to estimate. Unfortunately the NYC systems do not also publish benefit accruals. We roughly calculated these accruals using Eq. (21) and other data published in the NYC CAFRS, namely the duration of the accrued liability and the discount rate. Eq. (21) assumes that the discount rate is constant over time. Since the discount rate used by NYC changes over time, we first use the duration measure to standardize the liability for two adjacent years on a common discount rate. Duration (D) for a pension liability (L) is defined as $D \equiv -\left(\frac{L_t - L_{t-1}}{L_{t-1}}\right) \Big/ \left(\frac{(1+r_t)-(1+r_{t-1})}{1+r_{t-1}}\right)$ where r is the discount rate (e.g. for a five percent discount rate, r=.05). To solve for L_{t-1} when D, L_t, r_t, and r_{t-1} are given, $L_{t-1} = -L_t \Big/ \left(\frac{D(r_t - r_{t-1})}{1+r_{t-1}} - 1\right)$. For example, in 2005 L=$55.4 billion, r=0.042, D=12.7 years. In 2006 L=$49.8 billion, r=.054, and D=11.7. Two estimates of accruals (A) are possible. First we can standardize L on r=.054 in which case L_{t-1}=48.4 and A=1.7. Alternatively, we can standardize on r=.042 in which case L_t=57.5 and A=2.7. Averaging the two estimates yields A=2.2. Even so, a time series of accruals estimated in this fashion is quite variable. Therefore, we use an average of accruals relative to payroll (generally over 2000-05—data for 2006 were unavailable) for each year in that interval.

- The District of Columbia Police, Fire, and Teachers systems use the aggregate funding method. They also began publishing an entry age AAL as of October 1, 2006. We roughly calculated an entry age normal cost rate by subtracting the entry age UAAL from the present value of future employer normal costs (the

published amount based on the aggregate method) and dividing the result by the present value of future payroll. Then using Eq. (21) we calculated an entry age AAL for 2000-2005. Using these estimates of entry age normal cost and entry age AAL, we calculated an entry age ARC, assuming a level dollar amortization payment.

- The Employees' Retirement System and the Police and Fire Retirement System (both in the NY State and Local Retirement System) began publishing an entry age AAL as of April 1, 2005 although they continue to use the aggregate method for funding. Using the entry age AAL as of April 1, 2007, we calculated a rough estimate of the entry age normal cost by subtracting the entry age unfunded actuarial liability in the numerator of Eq. (20). By removing supplemental costs, this adjustment yields a measure comparable to the normal cost concept used by the projected unit credit and entry age methods. This measure allocates over time the expected present value of future liabilities in proportion to the expected present value of future salaries. The entry age normal cost rate for 2007, obtained by dividing normal cost by covered payroll, was used for all earlier years. Then using Eq. (21) the entry age AAL for 2007 was extrapolated back to 2000. Using these estimates of entry age normal cost and entry age AAL, we calculated an entry age ARC, assuming a level dollar amortization payment. Similar procedures were used for the Teachers' Retirement System of the City of New York which began publishing an entry age liability in 2006.
- The Parochial Employees' Retirement System uses the frozen attained age funding method for its Plan A (designed for employers who do not participate in

Social Security) and the aggregate funding method for Plan B (a much smaller plan for employers who do participate in Social Security—Covered payroll for Plan A is more than 7 times greater than Plan B's payroll.) The actuarial liability for the frozen attained age method is the same as for the projected unit credit method. However, the "normal cost" for the frozen attained age method implicitly includes the supplemental cost of actuarial gains and losses. Fortunately, the system's valuation provides a detailed accounting of changes in the normal cost rate. We used that information to remove the effects of actuarial gains and losses on the published normal cost rate. If we had the detailed accounting of changes from the date the initial liability was frozen (December 31, 1989) we would then have an exact projected unit credit normal cost rate. Since we have an accounting only from 1999 onwards there is some unknown level of actuarial gains and losses built into the estimate. So although the level is inaccurate to some extent, year to year changes in the estimate will be correct. For many purposes the annual changes are more important. A complication is that the system does not publish the projected unit credit liability in its actuarial valuation report. Instead, an entry age liability is published in the System's annual financial report. We then calculated an annual required contribution by adding an amortization payment to our normal cost estimate. The amortization payment was calculated as a level amount for a 30 year period using the system's investment rate of return. We calculated the percent contributed by counting ad valorem tax revenue and revenue sharing along with the employer contribution.

Several adjustments were necessary to enforce consistency between the normal cost data collected for the various retirement systems:

- The Government Accounting Standards Board requires that covered payroll for the system be published in a Schedule of Funding Progress. In most cases, this is the payroll used in this paper to calculate normal cost. Some retirement systems (e.g. Florida Retirement System and Teachers' Retirement System of Alabama) include DROP salaries in covered payroll, but not in the payroll used to calculate normal cost. In the case of the Teachers' Retirement System of Alabama, covered payroll was 12.5% higher than the valuation payroll in 2005. For these systems, we used valuation payroll rather than covered payroll to estimate normal cost.
- Sometimes administrative expenses are included in the published normal cost rate (e.g. Florida Retirement System); other times they are omitted (e.g. Teachers' Retirement System of Alabama); and in some cases it is not known (e.g. Kansas Public Employees Retirement System). Where necessary we adjust normal cost to exclude administrative costs.
- Sometimes death benefits and term life insurance are omitted from the published normal cost rate (e.g. Teachers' Retirement System of Alabama). We adjusted it to include those costs. The Texas Municipal Retirement System has an optional supplemental death benefits (term life insurance) plan. We included the cost of this plan in the employer's normal cost.
- Some systems (e.g. Teacher's Retirement System of Oklahoma) include the cost of medical benefits in normal cost. We removed that cost when it could be identified.

- Some systems (e.g. Kansas Public Employees Retirement System, Oklahoma Public Employees Retirement System) include interest in the normal cost rate because the employer contribution is not due until some time after the valuation date. We excluded these interest payments.
- Some systems (e.g. California Teachers' Retirement System) do not publish *employer's* normal cost or *employer's* normal cost rate. They publish a *total* normal cost and a member contribution rate. The statutorily set member and employer contribution rates will only by chance equal the normal cost rate. How the difference between the normal cost rate and the statutory rates will be paid is unspecified. We arbitrarily defined the employer's normal cost rate as the total rate less the statutory members' rate.
- Some systems (e.g. Ohio Police and Fire Pension Fund) exclude from normal cost those contributions to the retirement fund that were not made by the employer or the members. In the case of the Ohio Police and Fire Pension Fund there are state "subsidies" that are omitted from the published normal cost. We added these subsidies to normal cost.
- Some systems (e.g. State Teachers Retirement System of Ohio) include in the covered payroll published in the Schedule of Funding Progress the salaries paid to members who participate only in a defined contribution plan. We estimated normal cost by multiplying the normal cost rate by a valuation payroll which excluded such salaries.

- Some systems (e.g. Alaska Teachers' Retirement System beginning with the June 30, 2006 valuation date) use an annualized payroll rather than a fiscal year payroll.
- In some systems (e.g. Employees' Retirement System of Georgia) the employer pays the employee contribution. This is known as "pick-up." We assumed that QCEW wages do not reflect this employer pick-up and treated the pick-up as another component of the employer normal cost.

Solvency Test. Missing observations were replaced by interpolations when possible. When the missing observations were at the beginning or the end of the time series we used the rate of change in adjacent years to extrapolate.

Annual Required Contribution. This was not available for FY 2006 for the NYC retirement systems. We assume it would be the same as FY 2005 so that I could calculate a calendar year 2005 estimate. The FY 2001 and 2002 ARC for the Teachers' Pension and Annuity Fund of New Jersey were reported as being zero. That is not credible so we replaced that with an interpolated amount. The West Virginia PERS did not publish an ARC. We estimated one assuming a level dollar amortization over 30 years.

Covered Payroll, Actuarial Value of Assets, and Actuarial Accrued Liability. There are very long lags in the publication of data for the NYC retirement systems. We extrapolated some data to 2006 using the growth rate in the previous year.

Membership. Membership data are from the Census Bureau. We did not evaluate them in detail, but several obvious problems were fixed in DC (both the Teachers and the Police & Fire), West Virginia (both PERS and Teachers). Census

combined membership data for Employees' Retirement System and Police and Fire Retirement System (both part of the NY State and Local Retirement System). We separated the membership using data published in the CAFRs.

Liability for Retirees and Beneficiaries. The distribution of the actuarial liability between (1) active member contributions, (2) retirees and beneficiaries, and (3) active members (employer financed portion) is often reported as part of a solvency test. For those systems which did not publish this information in any year we assumed that the distribution was identical to the average for those systems which did report. Some systems (e.g. the Alaska Public Employees Retirement System) combined their pension and retiree health care liabilities in the solvency test.

Administrative Expenses. Administrative expenses were collected from CAFRs. Missing values were replaced by using an average ratio of administrative expenses to actuarial assets for other years multiplied by actuarial assets in the missing year. No administrative expenses for any year were available for the Connecticut State Teachers' Retirement System. In this case we used the average administrative expense ratio for all systems.

References

Bader, Lawrence N. and Jeremy Gold. 2003. Reinventing pension and actuarial science. *The Pension Forum* 15 (No. 1, January) 1-13.

Barnow, Burt S. and Ronald G. Ehrenberg. 1979. The costs of defined benefit pension plans and firm adjustments. *The Quarterly Journal of Economics* 93 (No.4, November) 523-540.

Bodie, Zvi. 1990a. Pensions as retirement income insurance. *Journal of Economic Literature* 28 (No. 1, March) 28-49

Bodie, Zvi. 1990b. The ABO, the PBO, and pension investment policy. *Financial Analysts Journal* 46 (No. 5, September/October) 27-34

Brainard, Keith. 2006. *Public Fund Survey Summary of Findings for FY 2005*. National Association of State Retirement Administrators.

Ehrenberg, Ronald G. 1980. Retirement system characteristics and compensating wage differentials in the public sector. *Industrial and Labor Relations Review* 33 (No. 4 July) 470-483.

Gold, Jeremy and Gordon Latter. 2008. The Case for marking public pension plan liabilities to market. Pension Research Council Working Paper WP2008-20.

Ippolito, Richard A. 1985. The labor contract and true economic pension liabilities. *The American Economic Review* 75 (No. 5 December) 1031-1043.

Lazear, Edward P. 1979. Why is there mandatory retirement? *Journal of Political Economy* 87 (No. 6 December) 1261-1284.

Lazear, Edward P. and Robert L. Moore. 1988. Pensions and turnover. In *Pensions in the U.S. Economy*, edited by Zvi Bodie, John B. Shoven, and David A. Wise. Chicago: University of Chicago Press.

Munnell, Alicia H. and Mauricio Soto. 2007. *State and local pensions are different from private plans.* Center for Retirement Research at Boston College.

Munnell, Alicia H. and Frederick O. Yohn. 1992. "What is the impact of pensions on saving?" In *Pensions and the Economy: Sources, Uses, and Limitations of Data*, edited by Zvi Bodie and Alicia H. Munnell. Philadelphia: University of Pennsylvania Press.

Novy-Marx, Robert and Joshua D. Rauh. 2008. The intergenerational transfer of public pension promises. National Bureau of Economic Research Working Paper 14343.

Technical Panel on Assumptions and Methods (2007). *Report to the Social Security Advisory Board*. Washington, D.C.

Wilcox, David W. 2006. Reforming the defined-benefit pension system. *Brookings Papers on Economic Activity* 1 (Spring) 235-304.

Winklevoss, Howard E. 1993. *Pension Mathematics with Numerical Illustrations.* 2nd ed. Philadelphia: University of Pennsylvania Press

Table 1. Benefit accruals, normal costs, and liabilities, career average salary assumption

	Accrued Benefit				Projected Unit Credit				Entry Age			
Age	Accrual	% of Salary	Liability	% of L(r)	Normal Cost	% of Salary	Actuarial Liability	% of L(r)	Normal Cost	% of Salary	Actuarial Liability	% of L(r)
26	239	0.96	233	0.07	220	0.88	233	0.07	844	3.38	896	0.27
27	267	1.02	508	0.15	245	0.93	508	0.15	887	3.38	1,894	0.57
28	298	1.08	831	0.25	274	0.99	831	0.25	932	3.38	3,003	0.91
29	333	1.15	1,208	0.37	306	1.05	1,208	0.37	980	3.38	4,231	1.28
30	372	1.22	1,646	0.50	342	1.12	1,646	0.50	1,031	3.38	5,589	1.69
31	415	1.29	2,153	0.65	381	1.19	2,153	0.65	1,083	3.38	7,089	2.14
32	464	1.37	2,740	0.83	426	1.26	2,740	0.83	1,139	3.38	8,742	2.64
33	518	1.46	3,417	1.03	476	1.34	3,417	1.03	1,197	3.38	10,560	3.19
34	579	1.55	4,196	1.27	531	1.42	4,196	1.27	1,259	3.38	12,559	3.80
35	647	1.65	5,090	1.54	594	1.51	5,090	1.54	1,323	3.38	14,752	4.46
36	723	1.75	6,114	1.85	663	1.61	6,114	1.85	1,391	3.38	17,155	5.19
37	807	1.86	7,285	2.20	741	1.71	7,285	2.20	1,462	3.38	19,787	5.98
38	902	1.98	8,623	2.61	828	1.82	8,623	2.61	1,537	3.38	22,665	6.85
39	1,008	2.10	10,149	3.07	925	1.93	10,149	3.07	1,616	3.38	25,809	7.80
40	1,126	2.24	11,886	3.59	1,034	2.05	11,886	3.59	1,699	3.38	29,241	8.84
41	1,259	2.38	13,864	4.19	1,155	2.18	13,864	4.19	1,786	3.38	32,983	9.97
42	1,407	2.53	16,111	4.87	1,291	2.32	16,111	4.87	1,878	3.38	37,062	11.21
43	1,573	2.69	18,664	5.64	1,443	2.47	18,664	5.64	1,974	3.38	41,504	12.55
44	1,758	2.86	21,560	6.52	1,612	2.62	21,560	6.52	2,075	3.38	46,339	14.01
45	1,965	3.04	24,845	7.51	1,803	2.79	24,845	7.51	2,182	3.38	51,598	15.60
46	2,197	3.23	28,567	8.64	2,015	2.97	28,567	8.64	2,294	3.38	57,317	17.33
47	2,457	3.44	32,783	9.91	2,253	3.15	32,783	9.91	2,411	3.38	63,532	19.21
48	2,748	3.66	37,555	11.36	2,519	3.35	37,555	11.36	2,535	3.38	70,283	21.25
49	3,073	3.89	42,955	12.99	2,818	3.57	42,955	12.99	2,665	3.38	77,612	23.47
50	3,438	4.14	49,062	14.84	3,152	3.80	49,063	14.84	2,801	3.38	85,570	25.88
51	3,847	4.41	55,968	16.92	3,526	4.04	55,968	16.92	2,945	3.38	94,204	28.49
52	4,305	4.69	63,773	19.28	3,945	4.30	63,773	19.28	3,096	3.38	103,570	31.32
53	4,818	5.00	72,594	21.95	4,414	4.58	72,594	21.95	3,255	3.38	113,728	34.39
54	5,393	5.32	82,561	24.97	4,940	4.87	82,561	24.97	3,422	3.38	124,745	37.72
55	6,039	5.67	93,823	28.37	5,530	5.19	93,823	28.37	3,597	3.38	136,692	41.33
56	6,763	6.04	106,551	32.22	6,192	5.53	106,552	32.22	3,781	3.38	149,655	45.25
57	7,577	6.43	120,943	36.57	6,935	5.89	120,943	36.57	3,975	3.38	163,725	49.51
58	8,492	6.86	137,220	41.49	7,770	6.27	137,219	41.49	4,179	3.38	179,000	54.13
59	9,521	7.31	155,638	47.06	8,708	6.69	155,638	47.06	4,393	3.38	195,598	59.15
60	10,681	7.80	176,490	53.37	9,763	7.13	176,490	53.37	4,619	3.38	213,639	64.60
61	11,987	8.33	200,110	60.51	10,952	7.61	200,111	60.51	4,855	3.38	233,263	70.54
62	13,460	8.90	226,879	68.61	12,292	8.13	226,879	68.60	5,104	3.38	254,612	76.99
63	15,123	9.51	257,229	77.78	13,803	8.68	257,228	77.78	5,366	3.38	277,852	84.02
64	17,001	10.17	291,652	88.19	15,508	9.28	291,652	88.19	5,641	3.38	303,155	91.67
65	19,123	10.88	330,703	100.00	17,434	9.92	330,704	100.00	5,930	3.38	330,704	100.00

Table 2. Benefit accruals, normal costs, and liabilities, final year salary assumption

	Accrued Benefit				Projected Unit Credit				Entry Age			
Age	Accrual	% of Salary	Liability	% of L(r)	Normal Cost	% of Salary	Actuarial Liability	% of L(r)	Normal Cost	% of Salary	Actuarial Liability	% of L(r)
26	245	0.98	239	0.03	508	2.03	540	0.07	1,952	7.81	2,073	0.27
27	281	1.07	534	0.07	567	2.16	1,176	0.15	2,052	7.81	4,382	0.57
28	321	1.16	895	0.12	633	2.29	1,922	0.25	2,157	7.81	6,945	0.91
29	367	1.27	1,332	0.17	707	2.44	2,793	0.37	2,267	7.81	9,787	1.28
30	420	1.38	1,860	0.24	790	2.59	3,806	0.50	2,384	7.81	12,929	1.69
31	481	1.50	2,493	0.33	882	2.75	4,981	0.65	2,506	7.81	16,397	2.14
32	550	1.63	3,248	0.42	985	2.92	6,339	0.83	2,634	7.81	20,220	2.64
33	629	1.77	4,146	0.54	1,101	3.10	7,904	1.03	2,769	7.81	24,426	3.19
34	719	1.93	5,210	0.68	1,229	3.30	9,705	1.27	2,911	7.81	29,049	3.80
35	822	2.10	6,468	0.85	1,373	3.50	11,772	1.54	3,061	7.81	34,121	4.46
36	939	2.28	7,948	1.04	1,534	3.72	14,141	1.85	3,218	7.81	39,681	5.19
37	1,074	2.48	9,688	1.27	1,714	3.96	16,850	2.20	3,383	7.81	45,768	5.98
38	1,227	2.69	11,727	1.53	1,915	4.20	19,945	2.61	3,556	7.81	52,425	6.85
39	1,402	2.93	14,112	1.84	2,140	4.47	23,474	3.07	3,738	7.81	59,697	7.80
40	1,601	3.18	16,896	2.21	2,391	4.75	27,494	3.59	3,930	7.81	67,635	8.84
41	1,829	3.46	20,141	2.63	2,672	5.05	32,067	4.19	4,132	7.81	76,291	9.97
42	2,089	3.75	23,917	3.13	2,986	5.37	37,266	4.87	4,343	7.81	85,726	11.21
43	2,385	4.08	28,305	3.70	3,337	5.70	43,170	5.64	4,566	7.81	96,000	12.55
44	2,723	4.43	33,399	4.37	3,730	6.07	49,869	6.52	4,800	7.81	107,183	14.01
45	3,109	4.81	39,304	5.14	4,169	6.45	57,467	7.51	5,046	7.81	119,349	15.60
46	3,549	5.22	46,142	6.03	4,661	6.86	66,077	8.64	5,305	7.81	132,576	17.33
47	4,051	5.67	54,054	7.07	5,212	7.29	75,828	9.91	5,577	7.81	146,951	19.21
48	4,624	6.16	63,200	8.26	5,828	7.76	86,866	11.36	5,863	7.81	162,566	21.25
49	5,278	6.68	73,763	9.64	6,517	8.25	99,356	12.99	6,164	7.81	179,520	23.47
50	6,023	7.26	85,954	11.24	7,290	8.78	113,484	14.84	6,480	7.81	197,926	25.88
51	6,874	7.88	100,016	13.08	8,155	9.35	129,456	16.92	6,812	7.81	217,897	28.49
52	7,845	8.55	116,224	15.19	9,124	9.95	147,510	19.28	7,161	7.81	239,561	31.32
53	8,953	9.28	134,897	17.64	10,210	10.59	167,912	21.95	7,528	7.81	263,057	34.39
54	10,216	10.08	156,400	20.45	11,427	11.27	190,966	24.97	7,914	7.81	288,538	37.72
55	11,659	10.94	181,155	23.68	12,792	12.00	217,015	28.37	8,320	7.81	316,173	41.33
56	13,307	11.88	209,653	27.41	14,322	12.78	246,459	32.22	8,747	7.81	346,158	45.25
57	15,190	12.90	242,460	31.70	16,041	13.62	279,746	36.57	9,195	7.81	378,700	49.51
58	17,342	14.01	280,231	36.64	17,971	14.51	317,393	41.49	9,666	7.81	414,034	54.13
59	19,804	15.21	323,724	42.32	20,141	15.47	359,997	47.06	10,162	7.81	452,425	59.15
60	22,622	16.53	373,818	48.87	22,583	16.50	408,227	53.37	10,683	7.81	494,154	64.60
61	25,849	17.97	431,530	56.41	25,332	17.61	462,864	60.51	11,231	7.81	539,544	70.54
62	29,548	19.54	498,035	65.11	28,431	18.80	524,778	68.60	11,807	7.81	588,927	76.99
63	33,788	21.25	574,691	75.13	31,926	20.08	594,977	77.78	12,412	7.81	642,681	84.02
64	38,652	23.12	663,056	86.68	35,870	21.46	674,601	88.19	13,048	7.81	701,208	91.67
65	44,233	25.17	764,927	100.00	40,325	22.95	764,929	100.00	13,717	7.81	764,929	100.00

Table 3. Cash accounting statement of income and expenses for participants in state and local government-administered public-employee DB pension plans

Flows are measured for years ending on December 31; stocks are measured as of December 31.
Billions of dollars (or percent, as noted)

		2000	2001	2002	2003	2004	2005	2006
1	Income	122.6	109.5	110.6	128.6	141.0	147.8	161.2
2	Employer contributions to DB pension plans	39.5	38.8	42.1	53.1	59.8	60.9	67.8
3	Property income (gross of investment and administrative expenses)[1]	83.1	70.6	68.5	75.5	81.3	86.9	93.4
4	*Less:* Expenses and benefits net of employee contributions	80.6	90.1	99.3	108.8	118.3	127.4	140.0
5	Investment and administrative expenses	6.0	7.5	7.6	7.6	9.0	10.0	12.5
6	Benefits and Withdrawals	100.4	109.6	119.6	130.5	140.1	149.0	160.5
7	Employee contributions	25.7	27.0	27.9	29.4	30.8	31.6	33.0
8	*Equals:* Net household saving in DB plans	42.0	19.3	11.3	19.8	22.7	20.4	21.2
9	Change in DB pension plan assets	125.8	-5.3	-10.9	158.1	253.8	198.2	359.9
10	Net gain or loss on investments	61.8	-77.9	-69.6	113.6	201.8	187.7	288.0
11	Other	22.0	53.2	47.4	24.7	29.2	-9.9	50.7
	Memo:							
12	Assets (market value)	2,163.1	2,157.8	2,146.9	2,305.0	2,558.8	2,757.0	3,116.9
13	Ratio, Employee contributions to Employer + Employee contributions	0.39	0.41	0.40	0.36	0.34	0.34	0.33
14	Employer contributions as a percent of covered payroll	8.00	7.44	7.75	9.53	10.42	10.22	10.84
15	Employer contributions, NIPA Table 6.11D, Line 30	39.6	38.8	41.8	56.1	55.4	61.9	65.3
16	Property income of state & local DB pension funds in personal income	85.1	70.6	69.6	77.5	82.1	87.4	95.5

Sources: Based on a tabulation of the data in the "Individual Unit File" from the Census Bureau surveys of state and local government administered public-employee retirement systems; BEA's National Income and Product Accounts; and covered payroll data collected as described in the text.

Note:

(1) Property income is dividends, interest, and rent.

Table 4. Actuarial measures of income and saving of households in state and local government-administered public-employee retirement systems[1]

Flows are measured for years ending on December 31; stocks are measured as of December 31.

Billions of dollars (or percent, as noted)

		2000	2001	2002	2003	2004	2005	2006
1	Employer's normal cost (net of administrative expense)	41.0	43.9	46.1	46.9	47.4	49.0	51.7
2	*Plus:* Imputed interest on actuarial liability[2]	178.3	192.3	205.7	218.3	231.2	245.7	261.9
3	*Equals:* Actuarial household income	219.3	236.2	251.7	265.2	278.6	294.7	313.6
4	*Less:* Benefits net of employee contributions	74.7	82.7	91.6	101.1	109.3	117.4	127.5
5	*Equals:* Actuarial household saving in DB pension plans	144.6	153.6	160.1	164.1	169.2	177.3	186.2
6	Change in DB pension plan assets	125.8	-5.3	-10.9	158.1	253.8	198.2	359.9
7	Increase in funded portion of actuarial liability	-18.8	-158.9	-170.9	-6.0	84.5	20.9	173.8
	Memo:							
8	Assets (market value)	2,163.1	2,157.8	2,146.9	2,305.0	2,558.8	2,757.0	3,116.9
9	Actuarial liability	2,218.1	2,393.3	2,560.7	2,730.6	2,902.4	3,088.3	3,296.3
10	Unfunded actuarial liability	55.0	235.5	413.8	425.6	343.6	331.2	179.3
11	Funded ratio (%)	97.52	90.16	83.84	84.41	88.16	89.27	94.56
12	Covered payroll	493.6	521.6	542.7	556.9	573.3	596.0	625.7
13	Unfunded actuarial liability as a percentage of covered payroll	11.13	45.16	76.25	76.43	59.94	55.58	28.66
14	Active membership (millions)	13.5	13.8	14.1	14.1	14.1	14.2	14.4
15	Total membership (millions)	22.4	23.2	23.9	24.3	24.8	25.4	26.1
16	Employer's normal cost per active member (dollars)	3,034	3,171	3,276	3,334	3,362	3,440	3,582
17	Employer's normal cost as a percent of covered payroll	8.31	8.42	8.49	8.43	8.27	8.22	8.26
18	Investment rate of return assumption (%)	8.04	8.04	8.03	7.99	7.96	7.95	7.95

Notes:

(1) Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

(2) Using investment rate of return assumed by retirement systems.

Table 5. Annual required contribution

Flows are measured for years ending on December 31.

Billions of dollars

		2000	2001	2002	2003	2004	2005	2006
1	Annual required contribution (ARC)	36.9	38.5	42.5	51.2	61.9	69.4	75.7
2	Percent contributed	90.01	87.46	82.84	81.74	81.71	81.19	83.01
	Memo:							
3	Employer's normal cost (net of administrative expense)	41.0	43.9	46.1	46.9	47.4	49.0	51.7
4	Ratio, normal cost to ARC	1.11	1.14	1.08	0.92	0.77	0.71	0.68
5	Employer contributions, NIPA Table 6.11D, Line 30	39.6	38.8	41.8	56.1	55.4	61.9	65.3
6	Ratio, NIPA employer contributions to ARC	1.07	1.01	0.98	1.10	0.90	0.89	0.86

Note:

Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

Table 6. Solvency test (as of December 31)[1,2]

	2000	2001	2002	2003	2004	2005	2006
	Billions of dollars						
1 Active Member Contributions	331.9	348.0	364.7	376.5	394.3	412.8	433.6
2 Retirees & Beneficiaries	994.9	1083.6	1184.1	1301.3	1429.8	1547.0	1667.1
3 Active Members (Employer Financed Portion)	891.3	961.7	1012.0	1052.8	1078.3	1128.5	1195.5
	Percent of Actuarial Liability						
4 Active Member Contributions	14.96	14.54	14.24	13.79	13.58	13.37	13.15
5 Retirees & Beneficiaries	44.85	45.28	46.24	47.66	49.26	50.09	50.58
6 Active Members (Employer Financed Portion)	40.18	40.18	39.52	38.56	37.15	36.54	36.27
	Billions of dollars						
7 Actuarial liability	2,218.09	2,393.33	2,560.74	2,730.64	2,902.43	3,088.26	3,296.25

Notes:

(1) Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

(2) 32 systems did not report solvency test data. Some systems combined the retiree health liability with the pension liability.

Table 7. Accruals and liabilities as a percentage of normal costs and actuarial liabilities, by age and actuarial funding method.

(Final Year Salary Assumption)

	Projected Unit Credit		Entry Age	
Age	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability
28	0.70	0.63	0.22	0.20
29	0.70	0.63	0.23	0.20
30	0.70	0.63	0.25	0.21
31	0.70	0.63	0.28	0.22
32	0.71	0.64	0.30	0.23
33	0.72	0.65	0.34	0.25
34	0.74	0.67	0.37	0.26
35	0.75	0.68	0.41	0.28
36	0.77	0.69	0.45	0.30
37	0.78	0.71	0.50	0.31
38	0.80	0.72	0.55	0.33
39	0.81	0.73	0.61	0.35
40	0.83	0.75	0.67	0.38
41	0.84	0.76	0.75	0.40
42	0.86	0.77	0.82	0.42
43	0.87	0.79	0.91	0.45
44	0.89	0.80	1.00	0.47
45	0.90	0.82	1.11	0.50
46	0.92	0.83	1.22	0.53
47	0.94	0.85	1.35	0.56
48	0.95	0.86	1.49	0.60
49	0.97	0.88	1.65	0.63
50	0.99	0.89	1.82	0.67
51	1.00	0.91	2.01	0.71
52	1.02	0.92	2.22	0.75
53	1.04	0.94	2.45	0.80
54	1.06	0.95	2.71	0.84
55	1.07	0.97	2.99	0.89
56	1.09	0.98	3.30	0.94
57	1.11	1.00	3.65	1.00

Table 8. Sensitivity of conversion factors at various ages to variations in model parameters

	Age 35				Age 45				Age 55			
	Projected Unit Credit		Entry Age		Projected Unit Credit		Entry Age		Projected Unit Credit		Entry Age	
Case	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability
1) Base Case	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
Base case parameters except for:												
2) W* = Final year	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
3) W* = Career average	1.11	1.00	0.60	0.41	1.11	1.00	1.36	0.62	1.11	1.00	3.09	0.92
4) i=.07	0.75	0.68	0.43	0.30	0.90	0.82	1.04	0.52	1.06	0.97	2.54	0.90
5) i=.09	0.76	0.68	0.40	0.26	0.91	0.82	1.19	0.48	1.08	0.97	3.54	0.89
6) k=.01	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
7) k=.03	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
8) g=.05	0.70	0.63	0.36	0.24	0.87	0.79	1.01	0.47	1.07	0.96	2.82	0.88
9) g=.03	0.82	0.74	0.47	0.32	0.94	0.85	1.22	0.55	1.07	0.97	3.18	0.91
10) W(h) = 50,000	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
11) W(h) = 12,500	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.99	0.89
12) 30-year career, from age 32-62	0.70	0.63	0.25	0.21	0.83	0.75	0.67	0.37	0.99	0.89	1.83	0.67
13) 30-year career, from age 22-52	0.83	0.75	0.67	0.38	0.99	0.89	1.81	0.67	…	…	…	…
14) Female RP-2000 Mortality Table	0.75	0.68	0.41	0.28	0.90	0.82	1.11	0.50	1.07	0.97	2.97	0.89

Note: The base case assumes that W* = average of final five years, i = .08, k = .02, g = .04, W(h)=$25,000, a thirty year career from age 27 to 57, and uses the male RP-2000 mortality tables.

Table 9. Accrual measures of income and saving of households in state and local government-administered public-employee retirement systems [Market discount rate]

Flows are measured for years ending on December 31; stocks are measured as of December 31.

Billions of dollars (or as noted)

	2000	2001	2002	2003	2004	2005	2006
1 Benefit accruals (net of administrative expense)	58.8	64.9	74.8	76.3	77.2	79.9	79.7
2 *Plus:* Imputed interest on accrued liability	112.8	130.0	126.0	138.3	145.2	146.0	159.5
3 *Equals:* Accrued household income	171.6	194.9	200.8	214.6	222.4	225.9	239.2
4 *Less:* Benefits net of employee contributions	74.7	82.7	91.6	101.1	109.3	117.4	127.5
5 *Equals:* Accrued household saving in DB pension plans	96.9	112.3	109.2	113.5	113.1	108.5	111.7
6 Change in DB pension plan assets	125.8	-5.3	-10.9	158.1	253.8	198.2	359.9
7 Increase in funded portion of accrued liability	28.9	-117.6	-120.1	44.6	140.7	89.7	248.2
Memo:							
8 Assets (market value)	2,163.1	2,157.8	2,146.9	2,305.0	2,558.8	2,757.0	3,116.9
9 Accrued liability	2,021.9	2,238.2	2,567.1	2,749.1	2,951.7	3,173.8	3,269.1
10 Unfunded Accrued Liability	-141.3	80.4	420.1	444.0	392.9	416.8	152.2
11 Funded Ratio (%)	106.99	96.41	83.63	83.85	86.69	86.87	95.34
12 Covered payroll	493.6	521.6	542.7	556.9	573.3	596.0	625.7
13 Unfunded Accrued Liability as a percentage of covered payroll	-28.62	15.42	77.42	79.74	68.53	69.94	24.32
14 Active Membership (millions)	13.5	13.8	14.1	14.1	14.1	14.2	14.4
15 Total Membership (millions)	22.4	23.2	23.9	24.3	24.8	25.4	26.1
16 Benefit accruals per active member (dollars)	4,348	4,687	5,320	5,420	5,475	5,607	5,518
17 Benefit accruals as a percent of covered payroll	11.91	12.44	13.78	13.71	13.46	13.41	12.73
18 Discount rate (%)	5.58	5.81	4.91	5.03	4.92	4.60	4.88

Note:

Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

Table 10. Accrual measures of income and saving of households in state and local government-administered public-employee retirement systems [6% discount rate]

Flows are measured for years ending on December 31; stocks are measured as of December 31.
Billions of dollars (or as noted)

	2000	2001	2002	2003	2004	2005	2006
1 Benefit accruals (net of administrative expense)	58.3	62.3	64.9	65.7	65.8	67.6	71.2
2 *Plus:* Imputed interest on accrued liability	120.5	130.6	140.1	149.7	159.6	170.8	182.3
3 *Equals:* Accrued household income	178.8	192.9	205.0	215.4	225.4	238.4	253.4
4 *Less:* Benefits net of employee contributions	74.7	82.7	91.6	101.1	109.3	117.4	127.5
5 *Equals:* Accrued household saving in DB pension plans	104.1	110.3	113.3	114.2	116.0	121.0	126.0
6 Change in DB pension plan assets	125.8	-5.3	-10.9	158.1	253.8	198.2	359.9
7 Increase in funded portion of accrued liability	21.7	-115.6	-124.2	43.9	137.7	77.2	234.0
Memo:							
8 Assets (market value)	2,163.1	2,157.8	2,146.9	2,305.0	2,558.8	2,757.0	3,116.9
9 Accrued liability	2,008.3	2,177.1	2,335.0	2,495.0	2,660.1	2,846.8	3,038.1
10 Unfunded Accrued Liability	-154.8	19.3	188.0	190.0	101.3	89.8	-78.8
11 Funded Ratio (%)	107.71	99.11	91.95	92.38	96.19	96.85	102.60
12 Covered payroll	493.6	521.6	542.7	556.9	573.3	596.0	625.7
13 Unfunded Accrued Liability as a percentage of covered payroll	-31.36	3.70	34.65	34.12	17.67	15.07	-12.60
14 Active Membership (millions)	13.5	13.8	14.1	14.1	14.1	14.2	14.4
15 Total Membership (millions)	22.4	23.2	23.9	24.3	24.8	25.4	26.1
16 Benefit accruals per active member (dollars)	4,313	4,500	4,615	4,665	4,664	4,743	4,928
17 Benefit accruals as a percent of covered payroll	11.81	11.94	11.96	11.80	11.47	11.34	11.37
18 Discount rate (%)	6.00	6.00	6.00	6.00	6.00	6.00	6.00

Note:

Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

Table 11. Cost of living adjustment (COLA) provisions in state and local government pension plans, 2006

	Number of Systems
No automatic COLA provisions; ad hoc adjustment occasionally granted	31
Automatic COLA provisions	93
Independent of inflation rate	34
Dependent on inflation rate	59
COLA capped at 2%	5
COLA capped at 2.5%	6
COLA capped at 3%	25
COLA capped at 3.5%	1
COLA capped at 4%	4
COLA capped at 5%	8
COLA capped at 6%	4
COLA capped at 9%	2
No cap	4

Table 12. Benefit accruals by state [6% discount rate]

For the year ending on December 31. Millions of dollars.

State	2000	2001	2002	2003	2004	2005	2006
Alabama	595.2	615.0	632.8	646.8	653.7	699.0	788.1
Alaska	124.7	128.3	132.1	124.4	130.0	133.5	127.7
Arizona	985.4	1,091.5	1,160.9	1,186.8	1,292.1	1,435.4	1,562.3
Arkansas	402.6	414.2	420.9	438.6	427.4	406.1	413.7
California	10,608.9	12,017.7	13,124.9	13,495.0	13,868.5	14,651.6	15,593.7
Colorado	740.9	884.1	950.6	963.9	970.8	766.0	748.1
Connecticut	388.1	399.3	341.5	284.2	289.7	350.7	437.2
Delaware	158.1	168.1	174.3	178.7	187.6	194.7	201.3
D.C.	159.3	161.8	170.1	175.4	182.1	189.9	190.0
Florida	3,723.2	3,839.9	3,923.4	3,888.9	3,913.9	4,114.3	4,315.6
Georgia	1,850.1	1,889.0	1,987.5	2,009.6	1,804.0	1,691.3	1,775.0
Hawaii	213.6	208.4	227.5	237.1	245.1	250.2	277.4
Idaho	242.3	237.3	224.7	222.1	223.5	240.1	263.5
Illinois	2,365.7	2,374.0	2,464.9	2,517.9	2,763.4	2,980.1	3,294.2
Indiana	617.7	651.7	645.2	623.7	649.2	702.0	740.0
Iowa	334.0	349.1	365.5	381.1	397.7	412.2	459.5
Kansas	244.0	253.4	265.9	276.8	283.2	311.9	323.7
Kentucky	538.9	589.8	617.7	625.4	639.0	585.5	541.1
Louisiana	541.0	565.2	602.4	625.2	628.3	623.3	646.3
Maine	140.1	147.7	154.0	157.7	162.3	167.2	172.6
Maryland	980.4	1,055.6	1,115.7	1,131.7	1,170.6	1,257.6	1,293.6
Massachusetts	738.0	694.0	755.4	731.5	758.5	829.0	886.3
Michigan	1,603.6	1,630.8	1,684.2	1,713.9	1,728.3	1,577.4	1,556.0
Minnesota	687.5	719.4	771.4	752.4	682.8	700.2	716.2
Mississippi	242.6	246.4	255.9	267.6	278.1	296.8	332.0
Missouri	1,371.4	1,398.1	1,478.1	1,519.0	1,535.7	1,585.4	1,641.3
Montana	85.7	92.3	96.6	97.9	99.4	102.4	108.1
Nebraska	86.8	93.9	91.6	96.2	92.3	83.8	95.1
Nevada	765.4	821.5	874.7	924.0	982.4	1,051.5	1,139.5
New Hampshire	118.5	127.8	137.7	147.7	154.3	160.5	166.3
New Jersey	1,680.0	1,778.0	1,870.0	1,959.1	2,054.7	2,153.1	2,193.9
New Mexico	306.5	337.8	368.9	398.8	432.2	468.1	508.0
New York	8,590.2	8,938.3	8,825.6	8,975.1	9,239.4	9,651.8	9,966.1
North Carolina	1,045.5	1,107.7	1,139.8	1,181.8	1,220.7	1,287.6	1,358.8
North Dakota	41.8	44.0	46.1	48.0	52.9	59.6	60.9
Ohio	1,801.0	1,909.1	1,954.1	1,948.4	2,006.9	2,038.0	1,984.8
Oklahoma	353.4	373.3	382.1	379.9	378.7	402.9	438.4
Oregon	896.5	1,166.6	1,194.2	1,171.8	456.2	313.1	404.4
Pennsylvania	2,129.6	2,321.3	2,388.2	2,437.5	2,417.1	2,425.5	2,564.1
Rhode Island	67.0	74.3	75.8	74.6	78.5	90.5	104.4
South Carolina	417.3	426.6	420.6	384.9	385.0	417.9	435.9
South Dakota	62.1	66.3	69.1	74.0	77.4	78.8	83.1
Tennessee	888.3	928.3	969.0	1,012.8	1,058.4	1,107.7	1,171.3
Texas	3,183.7	3,511.8	3,646.4	3,494.5	3,141.0	2,928.4	3,151.8
Utah	563.8	599.0	635.2	656.6	692.2	709.6	767.3
Vermont	75.9	79.7	82.3	84.6	88.9	94.1	101.4
Virginia	1,621.0	1,715.0	1,775.9	1,899.1	1,891.1	1,859.2	2,002.8
Washington	1,651.9	1,629.5	1,768.0	1,597.6	1,397.0	1,413.8	1,467.4
West Virginia	103.0	106.0	109.9	111.8	111.4	111.7	120.6
Wisconsin	1,076.9	1,227.7	1,228.2	1,267.6	1,284.5	1,307.1	1,347.9
Wyoming	79.7	85.6	87.7	91.6	96.5	102.7	114.1
Sum	58,288.9	62,291.4	64,885.3	65,691.4	65,754.4	67,571.2	71,152.9

Note: Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.

Table 13. Benefit accruals as a percent of covered payroll, by state [6% discount rate]
For the year ending on December 31.

State	2000	2001	2002	2003	2004	2005	2006
Alabama	8.4	8.4	8.2	8.0	7.8	7.7	8.2
Alaska	6.4	6.4	6.3	5.9	6.0	5.9	5.5
Arizona	13.1	13.4	13.3	13.2	13.7	14.4	14.5
Arkansas	14.7	14.5	14.2	14.1	12.9	11.7	11.4
California	14.8	15.4	15.8	15.8	16.0	16.3	16.4
Colorado	11.8	13.0	13.2	13.7	13.3	10.4	9.8
Connecticut	5.7	5.6	4.8	3.9	3.8	4.4	5.3
Delaware	11.4	11.4	11.4	11.4	11.5	11.1	10.8
D.C.	26.5	26.5	26.5	26.5	26.5	26.5	26.4
Florida	16.4	16.2	16.2	15.8	15.2	15.3	15.3
Georgia	13.5	13.4	13.4	13.3	11.9	10.7	10.5
Hawaii	9.1	8.1	8.3	8.3	8.3	8.0	8.2
Idaho	12.7	11.8	10.9	10.6	10.3	10.5	11.0
Illinois	10.4	9.9	9.9	9.9	10.6	11.0	11.8
Indiana	8.5	8.5	8.0	7.5	7.6	8.1	8.2
Iowa	7.2	7.3	7.3	7.4	7.5	7.4	7.9
Kansas	4.9	4.8	5.3	5.4	5.4	5.8	5.7
Kentucky	9.6	9.9	9.8	9.4	9.4	8.3	7.3
Louisiana	8.8	8.9	9.0	9.0	8.7	8.8	9.0
Maine	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Maryland	11.3	11.3	11.3	11.3	11.4	11.4	10.9
Massachusetts	5.0	4.4	4.8	4.6	4.6	4.8	5.0
Michigan	10.7	10.6	10.7	10.7	10.6	9.8	9.9
Minnesota	7.4	7.4	7.4	7.0	6.4	6.4	6.2
Mississippi	5.9	5.9	5.9	5.9	5.9	6.1	6.5
Missouri	14.4	13.9	14.2	14.2	13.9	13.8	13.6
Montana	6.1	6.3	6.4	6.3	6.3	6.3	6.4
Nebraska	6.7	6.8	6.2	6.2	5.8	5.1	5.5
Nevada	24.9	24.9	24.9	24.9	24.9	24.9	24.9
New Hampshire	7.7	7.7	7.7	7.7	7.7	7.6	7.6
New Jersey	9.5	9.5	9.5	9.5	9.5	9.5	9.2
New Mexico	9.2	9.6	10.0	10.4	10.7	11.1	11.4
New York	18.2	18.0	17.3	17.1	16.9	17.0	16.7
North Carolina	7.7	7.7	7.7	7.7	7.7	7.7	7.7
North Dakota	5.3	5.3	5.3	5.3	5.7	6.2	6.0
Ohio	8.3	8.3	8.1	7.9	7.9	7.8	7.4
Oklahoma	7.5	7.5	7.5	7.5	7.4	7.4	7.6
Oregon	14.3	18.5	18.5	18.5	6.7	4.6	5.5
Pennsylvania	11.8	12.6	12.6	12.7	12.1	11.6	11.6
Rhode Island	4.6	4.8	4.6	4.4	4.5	4.6	4.7
South Carolina	6.4	6.4	6.2	5.6	5.6	5.8	5.7
South Dakota	6.2	6.2	6.2	6.4	6.4	6.3	6.4
Tennessee	12.8	12.8	12.8	12.8	12.8	12.8	12.9
Texas	9.1	9.4	9.3	8.8	7.8	7.0	7.0
Utah	17.2	17.2	17.7	18.0	18.2	18.2	18.7
Vermont	8.7	8.7	8.5	8.4	8.5	8.5	8.8
Virginia	14.0	14.0	14.0	14.4	13.5	12.5	12.7
Washington	13.9	13.0	13.5	11.8	10.0	9.8	9.9
West Virginia	5.5	5.6	5.6	5.7	5.7	5.7	6.0
Wisconsin	10.6	11.3	11.1	11.0	10.8	10.9	10.9
Wyoming	8.1	8.1	8.1	8.1	8.1	8.1	8.1
All states plus D.C.	11.8	11.9	12.0	11.8	11.5	11.3	11.4

Note: Estimates are based on a sample of retirement systems, weighted by membership to represent the entire population, as described in the text.