Accrual Measures of Pension-Related Compensation and Wealth of U.S. Households

David G. Lenze

U.S. Department of Commerce
Bureau of Economic Analysis

Washington, D.C.

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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 (measured as 2.7% of compensation in the first quarter of 2008 using cash accounting)[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

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[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 contributions to defined benefit and defined contribution retirement funds are larger than for those who do participate.[7]

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[4] Total contributions (both employee and government) to state and local government employee retirement systems were $97.2 billion in fiscal year 2006, according to a U.S. Census Bureau survey (http://www.census.gov/govs/retire/2006ret01.html) while total contributions to private defined benefit pension plans were $92.7 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.

[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 1990).

(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 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 2000-05 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]

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

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

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

where

(3) $$B(r) = k(r-h)W^*(r),$$

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

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[9] The dependence of this model on Barnow and Ehrenberg (1979) should be obvious.

[10] In this model we will consider only mortality risk. Defined benefit pension plans also typically have provisions for disability and survivorship benefits as well as provisions for benefits for workers who leave

(4) $$L(r) = B(r)A(r)\,,$$

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

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

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

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. (6) with respect to s:

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

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).

after vesting but before they are eligible to begin receiving retirement benefits. See Winklevoss (1993) for a treatment of these risks.

The third and fourth terms on the right hand side of Eq. (7) 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 will define a *benefit accrual function* representing the pension *benefit accruals* of an active worker for another year of service as

$$C(h+s) = \left(\frac{1}{s} + \frac{\partial W^* / W^*}{\partial s} \right) L(h+s) . \tag{8}$$

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:

$$W(h+s) = W(h) e^{gs} \tag{9}$$

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

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

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 1989-91 life table for males published by the U.S. National Center for Health Statistics. Under these assumptions, the worker accrues a benefit of $170 (or 0.68% of salary) in the first year of service. The accrual of benefits rises exponentially until it reaches 8.99% of salary at age 64. Even so, the amounts accrued are quite modest, as a percentage of salary, for most of his career. At age 40 they are only 1.73% and even as late as age 50 they are only 3.27% of salary. The employer's cumulative liability also rises very slowly and even as late as age 60, it is only one-half of the retirement age liability.

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 currently as 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 0.78% of salary in the first year and rise very steeply to more than 30% in the final year of employment. Again, most of the accrual is in the last five years of employment; the age 60 liability is only 46% 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.

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. An important implication of the actuarial perspective is that the years of service already provided are valued taking into account expectations about the worker's future salary path, including expectations about future promotions, inflation, and economy-wide productivity gains.

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

$$N(h+s) = b^{j}(h+s)S(h+s,r)A(r)e^{i(h+s-r)} \tag{11}$$

where b is the *benefit allocation function* and the superscript 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):

(12) $$\Lambda^j(h+s) = \int_h^{h+s} N^j(a)\left(\frac{1}{S(a,h+s)}\right)e^{i(h+s-a)}da$$

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

(13) $$b^{puc}(h+s) = \phi W(h+s)$$

where

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

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. (11) gives the normal cost for the projected unit credit method

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

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. (15) into Eq. (12) and evaluating for $h+s=r$. The exponential terms will cancel as will the survival functions and the salary integrals leaving

(16) $$\Lambda^{puc}(r) = B(r)A(r) = L(r)\,.$$

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 0.68% of salary initially to 8.99% at age 64. It turns out that the actuarial liability equals the accrued liability at every age in this case (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 1.57% initially to 20.95% at age 64 (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 the sum of expected present value of future normal costs *at entry age* h equals the expected present value of future benefits *at entry age* h

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

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

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

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

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

(20) $$N^{ea}(h+s) = \tau W(h+s)\,.$$

For the numerical example considered above which assumed an accrued retirement benefit based on the career average salary, τ =2.73%. That is, normal cost is a constant 2.73% of salary (Table 1). If instead the retirement benefit is based on the salary in the final year of employment, τ =6.31% (Table 2).

Aggregate Method. In the aggregate funding method the expected present value of the accrued retirement benefit (given by Eq. 6) 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

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

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 $X(h+s)$ 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 a 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 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 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 averaging.

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 about $40 billion per year in 2000-02, employer contributions rose more than 50% to $62 billion in 2005.

[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.

V. Actuarial estimates

The preliminary actuarial estimates in this section are based on a sample of 58 of the largest state and local government retirement systems, representing approximately 57% of all membership in these systems.[13] Data collection continues and the estimates will be updated with estimates for approximately 120 systems that account for more than 90% of national assets and more than 75% of assets in each state. Aggregate amounts reported in the tables below are sums and averages of the sampled systems weighted by membership to represent the entire population.

Forty-five of the retirement systems used the entry age funding method, ten used the projected unit credit method, two used the aggregate method and one used the frozen initial liability method (aka frozen entry age method).[14] A new GASB standard stipulates that retirement systems that use the aggregate method for funding purposes must use the entry age method for financial reporting purposes. However, since GASB does not require the publication of an entry age normal cost, we made an estimate of it by subtracting the entry age unfunded actuarial liability in the numerator of Eq. (21). 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.

[13] This is a count of active and inactive members and all beneficiaries receiving periodic payments, but not lump sum recipients. The number of lump sum recipients is very erratic. The 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 was converted to calendar years by averaging. For more details see the data appendix.

[14] The Wisconsin Retirement System uses the frozen initial liability method. However it also reports an entry age liability and normal cost in its actuarial valuation report and so we will use those measures in this study. Several systems changed their funding method since 2000.

By design, normal costs are relatively stable over time unless large changes are made to plan provisions or actuarial and economic assumptions. On the basis of this property, we calculated the normal cost rate for the most recent year (normal cost divided by covered payroll) and used it for earlier years as well. Then we used Eq. (22) to extrapolate the published entry age actuarial liability back to 2000.

$$\Lambda_t = \Lambda_{t-1} + N_t + i(\Lambda_{t-1} + N_t) - B_t - \tfrac{1}{2} i B_t \quad (22)$$

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 used in the actuarial valuation reports of the system.

Table 4 presents summary actuarial measures of income and saving for 2000-05. It should be compared to the cash measures presented above in Table 3. 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 $41.5 billion in 2000 and rose to $46.4 billion in 2005 (line 1) declining slightly relative to covered payroll. This contrasts with the sharp rise in employer contributions in 2003 in response reaction to very low investment earnings.

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 $2.4 trillion in 2000 to $3.2 trillion in 2005 (line 10).[15] Together they yield interest income which rises steadily from $196 billion in 2000 to $258 billion in 2005. Again there is a sharp contrast with cash investment income, which declines in 2001 and 2002.

Table 4, Line 12 also shows that over this period assets have been about 10-19% 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.

Table 5 is the Schedule of Employer Contributions, another table required by GASB. It presents the annual required contribution (ARC). Employers contributed just a little less than required in 2000, but even with the sharp rise in the contributions subsequently, the percent of ARC contributed has fallen continuously to 82% in 2005.

Lastly, Table 6 presents the distribution of the actuarial liability between active members (lines 1 and 3) and retirees and beneficiaries (line 2). The lower panel displays the distribution as percentage shares. The retiree and beneficiary share rose from 46% in 2000 to 51% in 2005.

[15] 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.

VI. Accrual estimates

In this section we illustrate the conversion of the actuarial estimates of the previous section to standardized accrual estimates. 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. Parameters have been selected to be representative of an average state and local government retirement system. The worker is hired at age 27 and retires at age 57, having worked 30 years. His starting salary is $25,000 per year and grows at the exponential annual rate of 0.04. Present values are calculated assuming a 7.9% discount rate. Benefits are equal to 1% of the average salary in the final five years of employment times the number of years of service. Given these (base case) assumptions ϕ=1.59%, τ=3.64%, W(45)=$51,361, and B(57)=$22,569. In future work, these assumptions will be refined to better approximate the retirement plans and worker characteristics.[16]

Conversion of Actuarial Liabilities to Accrued Liability. 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 worker are 14% above projected unit credit normal costs and 52% above entry age

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

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 65 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 8 is 0.99 and 1.52 for age 45. In future work, it may be important to collect average age data for the retirement systems.

The sensitivity of the conversion factors to variations in the other parameters is summarized in Table 8. At age 45 the conversion factors under the final year salary assumption are the same as in the base case. However, under the career average salary assumption, the conversion factors are much larger. The normal cost conversion factors are 1.37 for the projected unit credit method and 1.83 for the entry age method while the liability conversion factors are 1.00 (projected unit credit) and 0.61 (entry age).

Changing the multiplier k from .01 to .02 has no effect on the age 45 conversion factors.[17] Changing the salary growth rate g from .04 to .05 has little effect on the projected unit credit conversion factors, and a slightly larger effect on the entry age conversion factors.

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[17] 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.

During 2000-05 the range of discount rates used by government employee retirement systems ranged from 7.00% to 8.75%. Changing the discount rate *i* from 7.90% to either 7.50 or 8.75 also has very little effect.

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 who are receiving retirement benefits equal the accrued liabilities under all funding methods.[18]

Discount rate assumption. Bader and Gold (2003), Wilcox (2006 pp.253-6), 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, such as the 5.17% recommended by the Technical Panel on Assumptions and Methods (2007).

Furthermore, he recommends that the pension fund should be invested in a portfolio of bonds which generates a cash flow corresponding to the need for cash as pension obligations become due.

State and local government retirement systems do not hold such a portfolio. In 2005, for instance, 60% of their assets were in equities, 29% in fixed income assets, and 11% in other assets (Brainard 2006). In addition, as documented in Table 4, their assets

[18] The New York City Employees' Retirement System is one of the largest public retirement systems in the U.S. and is perhaps the only large system which publishes an accrued liability (or Accumulated Benefit Obligation). This makes it possible to check the accuracy of the proposed conversion methodology. As of June 30, 2005, 56.8% of the actuarial liability was for current retirees (computed from data in the 2007 Comprehensive Annual Financial Report p.142). The entry age actuarial liability was $44.9 billion (p.149). Converting this liability using the age 45 conversion factor of 0.50 in Table 7 yields an accrued liability of $35.2 billion. This is only 3.6% less than the $36.5 billion accrued liability reported on p.149.

have been consistently less than their actuarial liabilities. From the perspective of the members of the retirement system, whose incomes we are trying to measure, a discount rate higher than the risk free rate is appropriate to reflect the risk these practices pose. The rate at which state and local governments can borrow for a general obligation unsecured loan (adjusted for tax distortions) would be the upper bound on this rate. The discount rates for 2000-05 selected for this paper are presented in Table 9.[19]

Reinsdorf (2008) presents adjustment factors for changing the discount rate assumption embedded in an accrued liability. His general purpose adjustment multiplier for the accrued liability to retired participants is

$$\rho_R = 0.94^{100(i^*-i)} \tag{23}$$

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

$$\rho_A = \rho_R[(1+i)/(1+i^*)]^{r-50} \tag{24}$$

where i is the discount rate on which the liability was originally calculated, i^* is the desired discount rate and r is the average retirement age (which we have been assuming is 57).

Nominal discount rate. Having converted the actuarial liabilities to accrued liabilities as described in the previous section, and relying on Eq. (8) which shows that benefit accruals are proportional to accrued liabilities, we can use the same adjustment factors for benefit accruals and for accrued liabilities. Results are in Table 10. They depict very different saving behavior than the cash and actuarial estimates.

Benefit accruals in 2000 were $71.3 billion, 80% higher than employer cash contributions and 72% higher than normal cost. Benefit accruals grew at a compound

[19] Table 9 presents calendar year values. Values corresponding to the fiscal years of the retirement systems

rate of 6.4% from 2000-05. As a percentage of covered payroll, benefit accruals were 14-16% in 2000-05. This contrasts with a normal cost rate of about 7,7-8.2% and actual cash contributions of 7.2-10.4%.

Imputed interest in 2000 was $141 billion, substantially more than the $83 billion cash estimate of dividends, interest, and rents but less than the $196 billion imputed interest on the actuarial liability. It grew at a 2.5% compound rate.

Accrued saving in DB pension plans is very stable over this period, about $133 billion per year. 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 $163 billion in 2000 to $185 billion in 2005).

The accrued liability was $2.04 trillion in 2000, much less than the $2.16 trillion assets held by the retirement systems. However, the $125 billion surplus in 2000 became a $70 billion deficit in 2001. The deficit has grown subsequently to $445 billion in 2005, reflecting a 9.6% compound growth rate of liabilities and a 5.2% growth rate of assets.

Real discount rate. As noted in the introduction, many retirement systems in the state and local government sector provide cost of living adjustments to retiree benefits.[20] In this case the proper discount rate is the real risk free rate adjusted for the riskiness of the system's asset portfolio. Using Treasury Inflation-Protected Securities data, the Technical Panel on Assumptions and Methods (2007) estimated expected inflation to be

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were used in the conversion.

[20] "Approximately two-thirds of the plans in the survey provide some form of automatic COLA" Brainard (2006 p.6).

2.5%.[21] Table 11 repeats the results of Table 10 except that they are based on a discount rate 2.5 percentage points lower.

The estimates in Table 11 should be regarded as upper bounds; those retirement plans which provide cost of living adjustments, typically do not provide complete inflation protection, rather they cap the adjustments at some level. Future data collection should aim at determining what inflation protection is provided.

In any case, it is interesting to note that when using a real discount rate the state and local sector was in deficit even in 2000. Since then the unfunded liability has grown to $1.26 trillion in 2005, or about 31% of the accrued liability. Benefit accruals in 2005 were $134 billion, more than double actual employer contributions ($62 billion).

[21] The median inflation assumption used by state and local government retirement systems in 2005 was 3.5% (Brainard 2006 p.7).

VII. Conclusions

The need for accrual measures of pension compensation and wealth has long been recognized.[22] 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 considered a simple method to convert normal costs and actuarial liabilities to the economic accruals and liabilities needed for national income accounts and compared the resulting estimates to currently published cash estimates.

[22] "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 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).

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) 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 was converted to calendar year 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 2000-05 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.

Several adjustments were necessary to enforce consistency between the 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, I 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 and 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.

Liability for retirees and beneficiaries. The distribution of the actuarial liability between active member contributions, retirees and beneficiaries, and 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.

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 Sate Teachers' Retirement System. In this case we used the average administrative expense ratio for all systems.

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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)
25	170	0.68	0	0	170	0.68	0	0	681	2.73	0	0
26	190	0.72	181	0.06	190	0.72	181	0.06	716	2.73	725	0.24
27	212	0.77	395	0.13	213	0.77	395	0.13	753	2.73	1,533	0.50
28	238	0.82	646	0.21	238	0.82	646	0.21	792	2.73	2,432	0.79
29	266	0.87	940	0.31	266	0.87	940	0.31	832	2.73	3,430	1.12
30	297	0.93	1,283	0.42	297	0.93	1,283	0.42	875	2.73	4,534	1.48
31	332	0.98	1,681	0.55	333	0.99	1,681	0.55	920	2.73	5,756	1.88
32	371	1.05	2,143	0.70	372	1.05	2,143	0.70	967	2.73	7,104	2.32
33	415	1.11	2,677	0.87	416	1.12	2,677	0.87	1,017	2.73	8,589	2.80
34	465	1.19	3,292	1.07	466	1.19	3,292	1.07	1,069	2.73	10,224	3.34
35	520	1.26	4,000	1.31	521	1.26	4,000	1.31	1,124	2.73	12,020	3.92
36	582	1.34	4,813	1.57	583	1.35	4,813	1.57	1,181	2.73	13,993	4.57
37	651	1.43	5,746	1.88	653	1.43	5,746	1.88	1,242	2.73	16,156	5.27
38	729	1.52	6,813	2.22	731	1.53	6,813	2.22	1,305	2.73	18,526	6.05
39	816	1.62	8,034	2.62	818	1.63	8,034	2.62	1,372	2.73	21,119	6.89
40	913	1.73	9,429	3.08	916	1.73	9,429	3.08	1,443	2.73	23,955	7.82
41	1,022	1.84	11,019	3.60	1,026	1.84	11,019	3.60	1,517	2.73	27,054	8.83
42	1,145	1.96	12,832	4.19	1,149	1.96	12,832	4.19	1,594	2.73	30,437	9.93
43	1,282	2.08	14,897	4.86	1,287	2.09	14,897	4.86	1,676	2.73	34,130	11.14
44	1,436	2.22	17,248	5.63	1,442	2.23	17,248	5.63	1,762	2.73	38,159	12.46
45	1,609	2.37	19,923	6.50	1,616	2.38	19,923	6.50	1,852	2.73	42,556	13.89
46	1,803	2.52	22,968	7.50	1,812	2.54	22,968	7.50	1,947	2.73	47,354	15.46
47	2,022	2.69	26,432	8.63	2,031	2.70	26,432	8.63	2,047	2.73	52,591	17.17
48	2,268	2.87	30,375	9.91	2,279	2.89	30,375	9.91	2,152	2.73	58,306	19.03
49	2,545	3.07	34,860	11.38	2,558	3.08	34,860	11.38	2,263	2.73	64,544	21.07
50	2,857	3.27	39,963	13.04	2,872	3.29	39,963	13.04	2,379	2.73	71,351	23.29
51	3,208	3.50	45,773	14.94	3,226	3.52	45,773	14.94	2,501	2.73	78,786	25.72
52	3,606	3.74	52,389	17.10	3,626	3.76	52,389	17.10	2,629	2.73	86,911	28.37
53	4,055	4.00	59,931	19.56	4,078	4.02	59,931	19.56	2,764	2.73	95,800	31.27
54	4,563	4.28	68,536	22.37	4,591	4.31	68,536	22.37	2,905	2.73	105,533	34.45
55	5,139	4.59	78,360	25.58	5,172	4.62	78,360	25.58	3,054	2.73	116,199	37.93
56	5,794	4.92	89,589	29.24	5,831	4.95	89,589	29.24	3,211	2.73	127,901	41.75
57	6,537	5.28	102,437	33.44	6,581	5.31	102,437	33.44	3,375	2.73	140,753	45.94
58	7,385	5.67	117,161	38.24	7,435	5.71	117,161	38.24	3,549	2.73	154,895	50.56
59	8,352	6.10	134,071	43.76	8,410	6.15	134,071	43.76	3,730	2.73	170,492	55.65
60	9,459	6.58	153,525	50.11	9,527	6.62	153,525	50.11	3,922	2.73	187,727	61.28
61	10,728	7.09	175,934	57.43	10,807	7.15	175,934	57.43	4,123	2.73	206,790	67.50
62	12,184	7.66	201,777	65.86	12,276	7.72	201,777	65.86	4,334	2.73	227,896	74.39
63	13,858	8.29	231,640	75.61	13,965	8.36	231,640	75.61	4,556	2.73	251,310	82.03
64	15,789	8.99	266,218	86.90	15,913	9.06	266,218	86.90	4,790	2.73	277,342	90.53
65	0	0.00	306,362	100.00	0	0.00	306,362	100.00	0	0.00	306,362	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)
25	195	0.78	0	0	393	1.57	0	0	1,576	6.31	0	0
26	228	0.87	185	0.03	440	1.67	418	0.06	1,657	6.31	1,677	0.24
27	267	0.96	415	0.06	492	1.78	913	0.13	1,742	6.31	3,546	0.50
28	311	1.07	695	0.10	550	1.89	1,494	0.21	1,831	6.31	5,626	0.79
29	362	1.19	1,037	0.15	615	2.01	2,174	0.31	1,925	6.31	7,933	1.12
30	422	1.31	1,450	0.20	688	2.14	2,967	0.42	2,024	6.31	10,488	1.48
31	490	1.45	1,946	0.27	769	2.28	3,889	0.55	2,128	6.31	13,313	1.88
32	568	1.60	2,540	0.36	861	2.43	4,957	0.70	2,237	6.31	16,431	2.32
33	659	1.77	3,248	0.46	963	2.58	6,191	0.87	2,352	6.31	19,867	2.80
34	762	1.94	4,088	0.58	1,077	2.75	7,614	1.07	2,472	6.31	23,648	3.34
35	882	2.14	5,083	0.72	1,206	2.92	9,252	1.31	2,599	6.31	27,803	3.92
36	1,019	2.35	6,257	0.88	1,349	3.11	11,133	1.57	2,732	6.31	32,366	4.57
37	1,176	2.58	7,641	1.08	1,510	3.32	13,290	1.88	2,872	6.31	37,369	5.27
38	1,357	2.83	9,266	1.31	1,691	3.53	15,759	2.22	3,020	6.31	42,850	6.05
39	1,564	3.11	11,172	1.58	1,893	3.76	18,584	2.62	3,174	6.31	48,850	6.89
40	1,801	3.40	13,402	1.89	2,119	4.00	21,809	3.08	3,337	6.31	55,409	7.82
41	2,073	3.73	16,008	2.26	2,373	4.27	25,488	3.60	3,508	6.31	62,576	8.83
42	2,385	4.08	19,049	2.69	2,658	4.54	29,681	4.19	3,688	6.31	70,402	9.94
43	2,742	4.46	22,593	3.19	2,977	4.84	34,457	4.86	3,877	6.31	78,943	11.14
44	3,152	4.88	26,719	3.77	3,335	5.16	39,895	5.63	4,076	6.31	88,264	12.46
45	3,622	5.33	31,518	4.45	3,738	5.50	46,083	6.50	4,285	6.31	98,433	13.89
46	4,160	5.82	37,098	5.24	4,190	5.87	53,126	7.50	4,505	6.31	109,532	15.46
47	4,778	6.36	43,583	6.15	4,699	6.26	61,139	8.63	4,736	6.31	121,644	17.17
48	5,487	6.95	51,117	7.21	5,271	6.68	70,258	9.91	4,978	6.31	134,865	19.03
49	6,301	7.59	59,863	8.45	5,916	7.13	80,633	11.38	5,234	6.31	149,292	21.07
50	7,236	8.29	70,013	9.88	6,642	7.61	92,437	13.04	5,502	6.31	165,038	23.29
51	8,310	9.06	81,797	11.54	7,462	8.13	105,874	14.94	5,784	6.31	182,235	25.72
52	9,546	9.90	95,476	13.47	8,387	8.70	121,177	17.10	6,081	6.31	201,028	28.37
53	10,969	10.82	111,367	15.72	9,434	9.31	138,624	19.56	6,392	6.31	221,589	31.27
54	12,608	11.83	129,832	18.32	10,619	9.96	158,526	22.37	6,720	6.31	244,101	34.45
55	14,500	12.94	151,300	21.35	11,962	10.68	181,250	25.58	7,065	6.31	268,773	37.93
56	16,685	14.17	176,278	24.88	13,487	11.45	207,223	29.24	7,427	6.31	295,839	41.75
57	19,214	15.52	205,360	28.98	15,221	12.29	236,939	33.44	7,808	6.31	325,566	45.94
58	22,145	17.01	239,267	33.76	17,197	13.21	270,998	38.24	8,208	6.31	358,278	50.56
59	25,549	18.67	278,864	39.35	19,454	14.22	310,111	43.76	8,629	6.31	394,355	55.65
60	29,508	20.51	325,175	45.89	22,036	15.32	355,108	50.11	9,071	6.31	434,218	61.28
61	34,118	22.56	379,394	53.54	24,996	16.53	406,941	57.43	9,536	6.31	478,312	67.50
62	39,495	24.84	442,934	62.51	28,394	17.86	466,718	65.86	10,025	6.31	527,132	74.39
63	45,781	27.39	517,520	73.03	32,302	19.33	535,790	75.61	10,539	6.31	581,290	82.03
64	53,147	30.25	605,235	85.41	36,808	20.95	615,773	86.90	11,079	6.31	641,502	90.53
65	0	0.00	708,625	100.00	0	0.00	708,625	100.00	0	0.00	708,625	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
1 Income	122.6	109.5	112.2	134.1	147.5	154.7
2 Employer contributions to DB pension plans	39.5	38.8	42.5	53.6	60.4	61.8
3 Dividends, Interest, and rental income (gross of investment expenses)	83.1	70.6	69.7	80.5	87.1	92.8
4 Less: Expenses and benefits net of employee contributions	80.6	90.1	100.2	110.3	119.6	128.9
5 Investment and administrative expenses	6.0	7.5	7.7	7.8	9.1	10.1
6 Benefits and Withdrawals	100.4	109.6	120.7	132.4	141.7	151.1
7 Employee contributions	25.7	27.0	28.2	29.8	31.2	32.4
8 Equals: Net saving in DB plans	42.0	19.3	12.0	23.8	27.9	25.8
9 Change in DB pension plan assets	125.8	-5.3	7.2	168.7	249.8	200.8
10 Net gain or loss on investments	61.8	-77.9	-69.6	113.6	201.8	187.7
11 Other	22.0	53.2	64.8	31.3	20.2	-12.7
Memo:						
12 Assets	2,163.1	2,157.8	2,165.0	2,333.7	2,583.5	2,784.3
13 Ratio, Employee contributions to Employer + Employee contributions	0.39	0.41	0.40	0.36	0.34	0.34
14 Employer contributions as a percent of covered payroll	7.52	7.22	7.71	9.48	10.38	10.25
15 Memo: Employer contributions, NIPA Table 6.11D, Line	39.6	38.8	41.8	56.1	55.4	61.0

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

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
1 Employer's normal cost (net of administrative expense)	41.5	43.4	45.0	45.7	45.3	46.4
2 *Plus:* Imputed interest on actuarial liability, net of investment expense (See note	195.6	205.5	216.8	229.4	242.2	257.7
3 *Plus:* Investment and administrative expenses	6.0	7.5	7.7	7.8	9.1	10.1
4 *Equals:* Actuarial income	243.1	256.4	269.5	282.9	296.5	314.2
5 *Less:* Benefits, withdrawals, & other expenses net of employee contributions	80.6	90.1	100.2	110.3	119.6	128.9
6 *Equals:* Actuarial saving in DB pension plans	162.5	166.2	169.3	172.6	176.9	185.3
7 Change in DB pension plan assets	125.8	-5.3	7.2	168.7	249.8	200.8
8 Other than actuarial saving	-36.7	-171.6	-162.1	-3.9	72.9	15.5
Memo items						
9 Assets	2,163.1	2,157.8	2,165.0	2,333.7	2,583.5	2,784.3
10 Actuarial liability	2,412.9	2,533.4	2,675.1	2,845.5	3,020.0	3,210.5
11 Unfunded Accrued Liability	249.7	375.6	510.1	511.8	436.5	426.1
12 Funded Ratio (%)	89.65	85.17	80.93	82.01	85.55	86.73
13 Unfunded Accrued Liability as a percentage of covered payroll	47.54	69.89	92.51	90.51	75.07	70.65
14 Covered payroll	525.3	537.4	551.4	565.5	581.4	603.2
15 Active Membership (millions)	13.9	14.0	14.2	14.2	14.2	14.3
16 Total Membership (millions)	23.1	23.0	23.4	24.1	24.6	25.0
17 Employer's normal cost per active member (dollars)	2,980	3,093	3,171	3,218	3,190	3,232
18 Employer's normal cost as a percent of covered payroll	7.90	8.08	8.16	8.09	7.78	7.69
19 Investment rate of return assumption (%)	8.11	8.11	8.11	8.06	8.02	8.03

Notes:

(1) Actuarial estimates are based on a preliminary sample of 58 systems accounting for 59% of the market value of assets of all systems. Final estimates will be based on 121 systems accounting for more than 90% of all assets.

(2) There is some inconsistency in the treatment of administrative expenses in employer's normal cost and in the investment rate of return which must be resolved.

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

Table 5. Schedule of Employer Contributions
Flows are measured for years ending on December 31.
Billions of dollars

	2000	2001	2002	2003	2004	2005
1 Annual Required Contribution (ARC)	33.1	34.0	37.5	47.2	59.4	67.5
2 Percent Contributed	98.01	93.80	89.84	88.01	84.98	82.21
Memo:						
3 Normal cost	41.5	43.4	45.0	45.7	45.3	46.4
4 Ratio, normal cost to ARC	1.25	1.28	1.20	0.97	0.76	0.69
5 NIPA employer contributions	39.6	38.8	41.8	56.1	55.4	61.0
6 Ratio, NIPA employer contributions to ARC	1.20	1.14	1.12	1.19	0.93	0.90

Note:
(1) Actuarial estimates are based on a preliminary sample of 58 systems accounting for 59% of the market value of assets of all systems.
Final estimates will be based on 121 systems accounting for more than 90% of all assets.

Table 6. Solvency Test (as of December 31)

	2000	2001	2002	2003	2004	2005
			Billions of dollars			
1 Active Member Contributions	351.7	362.5	372.0	384.6	402.3	420.1
2 Retirees & Beneficiaries	1116.4	1186.0	1280.8	1404.4	1530.9	1649.2
3 Active Members (Employer Financed Portion)	944.8	984.8	1022.3	1056.5	1086.8	1141.2
			Percent of Actuarial Liability			
4 Active Member Contributions	14.58	14.31	13.91	13.52	13.32	13.08
5 Retirees & Beneficiaries	46.27	46.82	47.88	49.35	50.69	51.37
6 Active Members (Employer Financed Portion)	39.16	38.87	38.22	37.13	35.99	35.55

Note:

(1) The precent distribution of AAL between active member contributions, retirees and beneficiaries, active member (employer financed portion) is based on a preliminary sample of 58 systems, 13 of which did not report data for any year. Some systems combined the retiree health liability with the pension liability. The dollar distribution is estimated using this percent distribution and the AAL from the Schedule of Funding Progress.

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
27	0.71	…	0.22	…
28	0.72	0.63	0.24	0.19
29	0.74	0.63	0.27	0.20
30	0.75	0.63	0.29	0.21
31	0.77	0.63	0.33	0.22
32	0.80	0.64	0.37	0.23
33	0.82	0.66	0.41	0.25
34	0.85	0.67	0.46	0.26
35	0.88	0.68	0.51	0.28
36	0.90	0.69	0.58	0.29
37	0.93	0.71	0.64	0.31
38	0.95	0.72	0.72	0.33
39	0.98	0.73	0.80	0.35
40	1.01	0.75	0.89	0.37
41	1.03	0.76	0.99	0.40
42	1.06	0.77	1.10	0.42
43	1.08	0.79	1.23	0.44
44	1.11	0.80	1.36	0.47
45	1.14	0.82	1.52	0.50
46	1.16	0.83	1.69	0.53
47	1.19	0.85	1.88	0.56
48	1.22	0.86	2.09	0.60
49	1.24	0.88	2.32	0.63
50	1.27	0.89	2.58	0.67
51	1.29	0.91	2.87	0.71
52	1.32	0.92	3.19	0.75
53	1.35	0.94	3.55	0.79
54	1.38	0.95	3.95	0.84
55	1.40	0.97	4.40	0.89
56	1.43	0.98	4.90	0.94
57	…	1.00	…	1.00

Table 8. Sensitivity of Conversion Factors at Age 45 to variations in model parameters

	Projected Unit Credit		Entry Age	
	Normal Cost	Actuarial Liability	Normal Cost	Actuarial Liability
Base Case	1.14	0.82	1.52	0.50
W* = Final year	1.14	0.82	1.52	0.50
W* = Career average	1.37	1.00	1.83	0.61
W(h) = $12,500	1.14	0.82	1.52	0.50
W(h) = $50,000	1.14	0.82	1.52	0.50
i = .075	1.13	0.82	1.47	0.51
i = .0875	1.15	0.82	1.62	0.48
k = .02	1.14	0.82	1.52	0.50
g = .05	1.13	0.79	1.42	0.46

Note: The base case assumes that W* = average of final five years, i = .079, k = .01, and g = .04.

Table 9. Discount Rate Assumptions

2000	6.93
2001	6.36
2002	5.97
2003	5.31
2004	5.34
2005	4.94

Table 10. Accrual measures of income and saving of households in state-and-local government-administered public-employee retirement systems

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
1 Benefit accruals	71.3	78.6	86.9	93.0	93.1	97.2
2 *Plus:* Imputed interest on accrued liability (gross of investment expense)	141.1	141.7	147.7	146.1	158.3	159.5
3 *Plus:* Administrative expenses	1.9	1.9	2.0	2.0	2.2	2.3
4 *Equals:* Accrued income	214.4	222.2	236.6	241.1	253.6	259.0
5 *Less:* Benefits, withdrawals, & other expenses net of employee contributions	80.6	90.1	100.2	110.3	119.6	128.9
6 *Equals:* Accrued saving in DB pension plans	133.7	132.1	136.4	130.7	134.0	130.1
7 Change in DB pension plan assets	125.8	-5.3	7.2	168.7	249.8	200.8
8 Other than accrued saving	-7.9	-137.4	-129.2	37.9	115.8	70.7
Memo items						
9 Assets	2,163.1	2,157.8	2,165.0	2,333.7	2,583.5	2,784.3
10 Accrued liability	2,037.7	2,228.0	2,475.1	2,749.9	2,966.4	3,228.9
11 Unfunded Accrued Liability	-125.4	70.2	310.1	416.2	382.9	444.6
12 Funded Ratio (%)	106.15	96.85	87.47	84.86	87.09	86.23
13 Unfunded Accrued Liability as a percentage of covered payroll	-23.88	13.06	56.24	73.60	65.86	73.71
14 Covered payroll	525.3	537.4	551.4	565.5	581.4	603.2
15 Active Membership (millions)	13.9	14.0	14.2	14.2	14.2	14.3
16 Total Membership (millions)	23.1	23.0	23.4	24.1	24.6	25.0
17 Benefit accruals per active member (dollars)	5,120	5,604	6,126	6,541	6,564	6,780
18 Benefit accruals as a percent of covered payroll	13.57	14.63	15.76	16.44	16.02	16.12
19 Discount rate (%)	6.93	6.36	5.97	5.31	5.34	4.94

Note:

(1) Actuarial estimates are based on a preliminary sample of 58 systems accounting for 59% of the market value of assets of all systems.
Final estimates will be based on 121 systems accounting for more than 90% of all assets.

Table 11. Accrual measures of income and saving of households in state-and-local government-administered public-employee retirement systems–using real discount rates

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
1 Benefit accruals	98.2	108.4	119.9	128.4	128.6	134.3
2 *Plus:* Imputed interest on accrued liability (gross of investment expense)	113.2	107.9	107.7	97.0	105.3	98.6
3 *Plus:* Administrative expenses	1.9	1.9	2.0	2.0	2.2	2.3
4 *Equals:* Accrued income	213.3	218.2	229.6	227.4	236.2	235.3
5 *Less:* Benefits, withdrawals, & other expenses net of employee contributions	80.6	90.1	100.2	110.3	119.6	128.9
6 *Equals:* Accrued saving in DB pension plans	132.7	128.1	129.4	117.0	116.6	106.4
7 Change in DB pension plan assets	125.8	-5.3	7.2	168.7	249.8	200.8
8 Other than accrued saving	-6.9	-133.4	-122.2	51.6	133.3	94.5
Memo items						
9 Assets	2,163.1	2,157.8	2,165.0	2,333.7	2,583.5	2,784.3
10 Accrued liability	2,556.2	2,796.2	3,106.6	3,448.1	3,713.9	4,043.1
11 Unfunded Accrued Liability	393.1	638.4	941.6	1,114.4	1,130.4	1,258.7
12 Funded Ratio (%)	84.62	77.17	69.69	67.68	69.56	68.87
13 Unfunded Accrued Liability as a percentage of covered payroll	74.84	118.80	170.77	197.07	194.41	208.69
14 Covered payroll	525.3	537.4	551.4	565.5	581.4	603.2
15 Active Membership (millions)	13.9	14.0	14.2	14.2	14.2	14.3
16 Total Membership (millions)	23.1	23.0	23.4	24.1	24.6	25.0
17 Benefit accruals per active member (dollars)	7,054	7,726	8,453	9,033	9,066	9,367
18 Benefit accruals as a percent of covered payroll	18.70	20.17	21.75	22.71	22.12	22.27
19 Discount rate (%)	4.43	3.86	3.47	2.81	2.84	2.44

Note:

(1) Actuarial estimates are based on a preliminary sample of 58 systems accounting for 59% of the market value of assets of all systems.
Final estimates will be based on 121 systems accounting for more than 90% of all assets.