Pensions in the Public Sector

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Chapter 10
Determining the Cost of Public Pension Plans

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The choice of actuarial assumptions is often an esoteric process commanding little interest beyond the pension plan sponsor. Nevertheless, experience has shown that changes in pension actuarial assumptions can become a political issue because of their impact on pension funding and consequent implications for governmental budgets. In this chapter, I discuss methods of determining and reasons for changing the many key actuarial assumptions used in public (and private) pension plans.[1] Actuarial assumptions are essential in projecting the long-term cost of defined benefit pensions. In addition, actuarial assumptions are frequently used in defined contribution plans to project annuities to individuals, but these assumptions are only of incidental importance in the funding of defined contribution plans. I speak not only to plan actuaries and fiduciaries but also to anyone concerned with understanding how actuarial assumptions can drive financial outcomes in the public sector.

The strong macroeconomy has made the selection of actuarial assumptions relatively easy in the last decade. In fact, the question in setting assumptions has often been how far to go in reducing a pension plan's annual contribution requirements, since reducing contributions could put the plan at risk if conditions worsen. Some plans have set very conservative assumptions to avoid an increase in future contributions except in very unusual conditions. Other plans have been less conservative, so they will have to increase contributions if conditions worsen even moderately. In the latter case, adverse economic conditions could produce required contribution level increases that might result in overall redesign of plan benefits.

Actuarial Assumptions in Pension Plans

Actuarial assumptions are used to predict the amount and timing of contributions to the pension fund and benefits paid from the fund. As used by professional actuaries, these assumptions are classified into two groups: *economic* or *demographic*. The economic assumptions include investment return and inflation and are largely unrelated to any specific pension plan. By contrast the demographic assumptions which include retirement and mortality rates are usually unique to each specific plan's provisions and the demographics of the specific group of plan participants.

Actuarial assumptions are typically changed through a two-step process. First, the actuary studies the validity of the existing actuarial assumptions for the pension plan. This study concludes with a report to the plan's governing body, recommending assumptions that should be used in the future. Second, the governing body acts on the actuarial assumptions. The assumptions adopted by the governing body are then used by the actuary in determining the liabilities of the pension plan.

Table 1 shows a typical set of economic and demographic assumptions for a defined benefit pension plan. Demographic assumptions are those used to project how and when participants will leave active participation in the plan and how long benefits will be paid after retirement. The three main economic assumptions pertain to inflation, investment return, and salary growth.

Many of the assumptions interact with each other. For example, as will be illustrated below, a 1 percent increase in all of the economic assumptions for a fully indexed plan will result in little change in the present value of benefits. In the past, actuaries have often used implicit assumptions that combine one or more of these offsetting factors. For example, an actuary might use a lower-than-expected investment return in lieu of an explicit salary scale. However, modern computers permit and the actuarial profession strongly advises that each economic and demographic assumption be explicit.

The projection of contributions and benefits for a hypothetical plan that pays a benefit equal to 50 percent of final salary at age 65 is presented as an example. No benefits are paid to participants leaving before age 65 and all remaining participants are assumed to retire at age 65. The retirement benefit is indexed to inflation after retirement.

In this example, the employee is enrolled in the pension plan at age 30 with a salary of $10,000. For this hypothetical plan, the actuarial demographic assumptions predict that 90 percent of enrollees leave the system before age 65, so only 10 percent are expected to retire at age 65. Annuity payments will be made as long as the retired worker is alive. The actuary applies a mortality table to determine the probability that the retiree will be alive in any future year. In the present case, the actuary predicts that 60 per-

TABLE 1. Types of Actuarial Assumptions for Typical Governmental Pension Plan

Economic	*Demographic*
Inflation	Death of
Investment return	Active participant
Salary growth	Disabled participant
General	Retired participant
Individual	Survivor
	Retirement with eligibility for full benefits
	Retirement with eligibility for reduced benefits
	Disability
	Termination with vested benefits
	Termination before vesting

Source: Author's tabulation.

cent of annuitants will survive from age 65 to age 80 and receive a payment at age 80.

The economic assumptions are then used to determine the workers' projected amount and present value of her benefit. Salary growth assumptions predict that the individual's salary will be $30,000 at age 65 so the benefit will be $15,000 (50 percent of final salary). Projections of inflation after retirement predict that the $15,000 at age 65 will have grown to a $20,000 benefit at age 80. Finally the benefits are discounted to the current age, using the expected fund investment return, to determine the present value of the benefit. If, for instance, the discount rate is 8 percent, the fund will need $426 today to pay the benefit at age 80. A full calculation will include benefits paid at other ages and for other terminations.

Economic Assumptions

The three economic assumptions used in the pension valuation—inflation, general salary growth, and investment return—are related and must be considered as a set. Table 2 shows the five-year average of the economic factors from 1951 through 1996. As would be expected, general salary growth and Treasury Bond returns, the least risky investment, followed inflation fairly closely for most of the period. One exception is that the return on Treasury Bonds has been substantially greater than inflation in the 1980s and 1990s. A second is that salary growth was substantially higher than inflation in the 1950s and 1960s.

While equity returns are partially driven by inflation, the relationship of investment returns to inflation is less consistent than with the other factors. With the exception of the 1970s, equity returns were much higher than the other factors throughout the period. A pension actuary must consider the likely relationship between economic assumptions in selecting any given as-

TABLE 2. Economic Factors 1951 to 1996 (%)

Five-year period ending	*CPI (W)*	*Salary growth*	*Treasury bonds*	*Stocks*
1956	0.9	4.1	2.9	21.5
1961	1.9	3.2	3.9	14.4
1966	1.6	3.7	4.3	6.5
1971	4.6	5.2	6.0	8.9
1976	7.1	6.6	7.6	7.7
1981	9.9	7.8	10.2	8.9
1986	3.8	3.6	11.3	20.0
1991	4.4	3.1	8.7	16.1
1996	2.9	2.8	7.2	15.8

Source: Society of Actuaries (1998).

sumption. It would be unrealistic, for instance, to couple a salary growth assumption of 4 percent with an inflation assumption of 6 percent since that would assume a 2 percent loss in real income each year in the future. While there have been isolated years in which the average person has absorbed a real income loss, the historic trend, as shown in Table 2, has been an increase in real income.

The economic assumptions are also tied closely to each other in their effect on actuarial valuations. Increases of the same percentage in all three assumptions at least partially offset each other. In a system that fully indexes benefits to inflation, a change in all three would result in little change in the liabilities. The degree to which equal changes in the three economic assumptions offset each other in determining the actuarial present values depends on the degree to which benefits are tied to salary growth before retirement and inflation after retirement. Many government plans are fully or partially tied to salary growth before retirement and inflation after retirement.

A 1982 analysis examined the indexing of the Federal Retirement Systems, where prior to 1980 the program had benefits calculated as a percentage of final salary and fully indexed to inflation after retirement (Hustead and Hustead 1982). Table 3 shows that an increase of 1 percent in each economic factor would have had minimal impact on the normal cost of the pre-1980 military retirement system.[2] An increase of 1 percent in all three sets of assumptions would have had minimal impact on the liabilities of the military retirement system. There would be a somewhat greater effect on the federal Civil Service Retirement System (CSRS) normal cost since benefits are tied to the average salary in the three years before retirement rather than final pay. In a system with no indexing after retirement, only about half of the investment return would be offset by an equivalent increase in the salary assumption. Table 3 shows the results for the pre-1980 military retirement

TABLE 3. Effect of Economic Assumptions on Military and Civil Service Retirement System Normal Cost

	Change in normal cost resulting from a 1 percent increase in annual rate		
Economic factor	*Military Retirement System System*	*Civil service Retirement System*	*Plan with no COLAs*
Inflation	17%	12%	0%
General salary growth	12%	11%	11%
Investment return	(28%)	(25%)	(25%)
Total	1%	(2%)	(13%)

Source: Hustead and Hustead (1982).

system and CSRS. A comparison to a plan without automatic COLA protection was added by the author. The normal cost in the CSRS system falls by 2 percent, and in the unindexed system by 13 percent, when all assumptions are increased by 1 percent.

Inflation assumptions. Since the mid-1980s, the selection of the inflation assumption has been relatively easy because inflation in the United States has been at a fairly consistent level of 3 to 4 percent during that period. During the 1990s actuaries assumed inflation returns of 4 or 5 percent, reflecting their general conservatism. The CSRS Board of Actuaries currently assumes an inflation rate of 4 percent and the average rate among governmental pension plans was 5 percent (Samet et al. 1996).

Experience studies measure inflation using one of the national consumer price indices published by the Bureau of Labor Statistics, which include the CPI for all urban consumers (CPI-U) and the CPI for urban wage earners and clerical workers (CPI-W). The two indices track each other very closely so the difference in using one or the other is very minor. The December 1998 CPI-W was 160.7 compared to 163.9 for the CPI-U, a difference of 3.2 percent in inflation from the base period of 1982–84. The CPI-W is preferred for pension plan purposes since that is the index used to determine COLAs for Social Security benefits.

Investment return. The most critical, and often controversial, assumption is the assumed investment return (see Table 4). In the 1960s and 1970s, governmental pension funds were largely invested in bonds with average returns increasing from around 4 percent in the early 1960s to 8 percent in the mid 1970s. In response to this change in asset mix, actuaries gradually increased investment return assumptions from the 3–4 percent range in the early 1960s to the 6–7 percent range by the early 1980s.

During the 1980s and 1990s, investment returns of governmental funds increased sharply as a result of the high rates of return in the equity mar-

TABLE 4. Investment Mix of Public Pension Plans

	1960	*1970*	*1991–93*
Bonds	88.1%	68.1%	41.0%
Equities	2.2	12.0	44.0
Mortgages	6.5	12.6	4.5
Other	3.2	7.3	10.5

Source: Bleakney (1972) and Samet et al. (1996).

kets and the increasing move into that market in response to those high rates of return. Fund investment returns averaged well into the double digits throughout the period. For example the Pennsylvania SERS fund averaged a 13.3 percent investment return from 1981 through 1997 (HayGroup 1998).

Taking the longer perspective, there had been a gradual increase in the investment assumptions over the last thirty years in response to improved investment returns. However, actuaries and the governing boards are conservative and, by the late 1990s, seldom adopted rates greater than 8.5 percent. Ninety percent of the plans studied in SOA (1998) used investment returns of 7 percent to 8.5 percent and the average assumption was 8 percent. Only 13 of the 183 plans used an investment return of 8.75 or 9 percent and none used an assumption greater than 9 percent. The result for most governmental pension funds has been a continual series of large gains from investment return which have, in turn, resulted in both continuing improvement in the percent of liabilities funded by assets and continuing decreases in the employer contributions. For example, from 1980 through 1997, the Pennsylvania SERS contribution declined from 18.0 to 6.7 percent of payroll, and the assets grew from 34 to 107 percent of liabilities (HayGroup 1998).

Most government retirement systems receive an annual report on investment returns from their investment advisors. In that case, the actuary can simply refer to these results in analyzing the historic rate of return. The actuary does need to make sure that the measurement period and method for calculating the rates of return are consistent with the analysis of other assumptions and the use of the rates in the actuarial valuation. This might require, for example, that the actuary convert fiscal year rates of return to calendar year rates of return.

In the absence of an investment advisors report, the actuary needs to adopt a consistent and reasonable rate of measuring investment return. One classic method is to divide the investment return during the year by the average of (1) the value of the fund at the beginning of the year adjusted for new contributions and benefits and (2) the value of the fund at the end of the year less the investment return during the year.

Salary growth. Salary growth is composed of two elements. One is the rate of general increase that applies to all employees and the other is the addi-

tional increase associated with any given individual moving through his career with the employer. For example, in a given year, a federal employee might be promoted from a salary of $69,924 at General Schedule 14, Step 4, to a salary of $77,265 at General Schedule 15, Step 2. At the beginning of the next year, the salary for all pay levels might increase 3 percent so the employee is then earning $79,582. The total increase in salary for the individual over the year has been 13.8 percent of which 3 percent is from general increases that apply to all employees and the remaining 10.8 percent is associated with the individual.

These general and individual salary increase elements should be measured separately. The rate of general salary increase can be measured by analysis of the pay practice of the employer. In the case of a public sector employer such as the federal government that pays according to a specific schedule, the general increase is equal to the increase in salary rates in that schedule. If the increase varies by grade and step, then the general increase is determined by weighting the average increase by the number of plan participants at each pay level.

Lacking specific pay schedules, as is generally true in the private sector and increasingly common in the public sector, the actuary can compare the average salary for all employees at the beginning of the year to the average at the end of the year. The result can be taken directly as the general salary increase if there has not been a significant change in the size or composition of the workforce. If there has been, however, the actuary must control for such a change.

Measurement of the individual element of salary growth begins by comparing the end and beginning of year salaries for all employees who participated in the plan throughout the year. The individual salary growth is then the total salary growth less the general salary growth. The calculation of salary growth is usually performed by service and/or age since individual increases are usually substantially greater in the early part of the career as the individuals are promoted to their final position.

A typical individual scale runs from over 4 percent per year early in the career to less than 1 percent later in the career. Combined with a typical general salary increase assumption of 4 percent, the total annual salary increase assumption ranges from 8 percent to 5 percent as age increases.

Economic Factors for Pension Plans

Table 5 compares the economic assumptions used to determine the cost of governmental and private sector pension plans. It can be seen that the public plan economic assumptions reflect a more conservative basis for selecting assumptions: higher inflation and general salary growth assumptions are

TABLE 5. Economic Assumptions Used by Pension Plans

Assumption	*State*	*Federal CSRS*	*Private*	*Social security*
Inflation (%)	5	4	N/A	3.5
Investment return (%)	8	7	9	6.3
Salary growth (%)	6.5	6.4 (4.25 general, 2.15 average individual)	5.0	4.4 (general only)

Sources: Samet et al. (1996), OPM (1998), *Pension Forum* (1997), Board of Trustees (1998).

conservative in that they require higher outlays. An assumed lower investment return is conservative in that it increases the present value of future payments.

The 5 percent average inflation rate for governmental plans is much higher than the 3.7 percent average rate in the last fifteen years and, in fact, is higher than the rate in all but one year since 1981. Actuaries for governmental pension plans are gradually lowering the inflation rate but few are below the 4 percent CSRS assumptions or as low as the 3.5 percent social security inflation rate. Private plan actuaries seldom select an explicit inflation assumption because few private plans have automatic retirement cost-of-living adjustments (COLAs). Most large private sector plans do apply ad hoc COLAs every three to five years but, even if these regularly recur, IRS does not permit the actuary to prefund the COLAs before they occur.

The average 8 percent governmental pension plan investment assumption is also conservative in that it is significantly lower than the experience of most plans and of the general market return since 1980. The average private sector investment assumption of 9 percent is closer to actual long-term investment returns but still well below fund returns over the last two decades. The 7 percent investment return rate for CSRS and 6.3 percent for Social Security are relatively low because the only investment available for those funds is Treasury backed securities.

The total state salary scale assumption of 6.5 percent is the same as the federal CSRS assumption. However, if inflation is 5 percent, the average individual salary growth would only be 1.5 percent compared to 2.15 percent for the federal CSRS. This suggests that the total salary growth assumption is less conservative than the other economic assumptions. The private sector salary growth assumption is lower than that of the government plans but it may not include individual salary growth. The social security assumption of 4.4 percent is for general increases only so it is in the neighborhood of the governmental plan assumptions.

Demographic Assumptions

Compilation and analysis of demographic data is a complex process and must be performed very carefully to avoid incorrect selection or application of assumptions. The analysis and interpretation of plan experience must be consistent with demographic rates applied in the pension valuation. For example, if retirement rates in the pension valuation are applied only to those eligible for full retirement at the beginning of the year, then the experience rate should be all retirements divided by those eligible at the beginning of the year. In the past, actuaries set assumptions under the general professional guidelines that require actuarial findings to be based on the actuary's best estimate. The Academy of Actuaries is developing an Actuarial Standard of Practice on Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations that will offer specific guidance on measuring and setting demographic assumptions for pension plans.

The actuary usually begins the study of demographic assumptions by comparing actual-to-expected ratios for each assumption. For example, the actuary might find that there were 1,200 actual retirements during the experience study period compared to 1,000 expected using the actuarial assumptions. This would be an actual-to-expected ratio of 120 percent (100 percent times 1,200/1,000). This actual-to-expected analysis is a good measure of the overall applicability of the assumptions but can mask differences by age and service. For example, if a plan permits retirement any time after age 60, a simple actuarial assumption might predict that all individuals retire in the year following age 62. An alternative set of assumptions would be that one-fifth of participants retire at each age from 60 to 64. If the actual average retirement age is 62.5 the actual-to-expected ratios would show that either set was reasonable but the two different sets of assumptions could produce significantly different liabilities.

While one aggregate ratio can mask significant differences by age and service, too great a disaggregation can produce results that fail to reveal any overall pattern. Few pension plans are large enough to permit analysis of all demographic rates at every age and service combination but the larger systems usually have enough experience to provide significant results by at least five-year age and service groupings.

Retirement. Retirement rates are measured by dividing the number of participants who retire during the year by the number eligible for that retirement benefit. The rates of retirement are usually unique to the plan provisions and demographics, and most plans can develop credible rates from their own experience. In the absence of sufficient experience the plan actuary can use large plans such as CSRS and statewide plans as a guide to establishing retirement rates.

In general, the retirement rate in the first year of eligibility for unreduced retirement benefits is between a fourth and a half of eligible participants if eligibility is before age 60. The rate then usually drops to 20 percent or less a year with an upturn after age 60 and a spike at age 62 when participants first become eligible for social security.

Different retirement rates should be established for each group of participants with differing retirement conditions. For example, if the general retirement requirement is age 60 but law enforcement officers can retire at age 50, the actuary should establish separate rates for the law enforcement officers. The actuary should select different rates for those eligible for reduced and unreduced benefits.

Retirement rates are much lower among those eligible for reduced than for full benefits, even if the reduction is less than a full actuarial reduction of 4 to 6 percent a year. For example, the number of CSRS retirements doubled after a 1 percent per year reduction was removed in 1966 (U.S. Civil Service Commission 1969).

Determination of the rate of retirement in the first year of eligibility presents a technical problem. The usual practice in determining demographic rates is to divide the number who leave during the year by the number of eligible participants at the beginning of the year. But, if 55 is the first age of retirement eligibility there will be retirements among participants age 54 at the beginning of the year since all of these will become eligible for benefits during the year. One approach is to add a half year of exposure for those who become eligible during the year. The key consideration is that the determination of the rates in the experience study and the application in the valuation have to be consistent.

Disability. Disability rates also vary widely because of differences in plan benefits, eligibility conditions, and demographics. The SOA study found that disability rates for statewide plans are generally based on plan experience. Smaller plans often used published tables with an adjustment to fit the plan's own overall experience. Published tables that are often used are those of the CSRS, social security, and railroad retirement systems. The 1994 CSRS disability rates increase from one per thousand at age 22 to one per hundred at age 61.

Participants who are eligible for either disability or full retirement benefits present another technical problem. If the benefits do not differ, the actuary will often count the disability cases as nondisability retirements in determining the full retirement rates. Disability rates will then stop in the year before full retirement eligibility to simplify both the analysis and the application of disability rates.

Mortality. As with disability, mortality experience for a specific plan, at least before retirement, is usually too sparse to determine tables based to-

tally on the plan's experience. Actuaries often compare actual-to-expected rates on the most widely used mortality tables at the time and select the table that most closely fits each plan's experience.

Most plans use mortality tables produced by the Society of Actuaries (Samet, et al. 1996). These include the tables produced from group annuity mortality experience. The latest tables produced from the group annuity mortality experience are the 1971 and 1983 Group Annuity Mortality (1971 GAM and 1983 GAM) tables and the 1994 Group Annuity Reserving table. An alternative series is the set of tables developed from uninsured pensioner experience. These are the 1984 and 1994 Uninsured Pensioner tables.[3]

The most common table in use for governmental pension plans in the early 1990s, according to the SOA study, was the 1971 Group Annuity Mortality table, usually with projection to years after 1971. One method of implicitly reflecting mortality improvement is to set back the mortality rates by, for instance, assuming a 65-year-old male in the future will have the same mortality as a 60-year-old when the mortality table was developed. The 1983 GAM table was used by a large number of plans in the SOA study and is probably now the most popular table among large state plans.

Recent legislation requires some of the valuations performed by private sector actuaries to be based on a standard table. The standard table is the 1983 GAM table today and will be a table promulgated by the secretary of the treasury after 1999. Many private sector plan actuaries have adopted the 1983 GAM for all purposes rather than to use different mortality tables for different valuations. Public sector plans are not subject to this standard so, while the 1983 GAM plan is popular, it will not become as dominant as in the private sector. For mortality, as for other assumptions, public sector plans only have to conform to the Governmental Accounting Standards Board (GASB) and professional requirements that the mortality tables used in the plan reasonably reflect the mortality of the group.

An important consideration connected with adoption of a new mortality table is the relationship with the mortality table used for determining optional benefits, such as lump sum or joint and survivor benefits, under the plan. If the interest and mortality basis used to determine the optional benefits is different from the valuation assumptions, the selection of an option will increase or decrease the cost of the plan.

The mortality table used to determine optional benefits (the actuarial-equivalence table) often does not automatically change with the adoption of a new table for actuarial valuation purposes. However, even where the tie is not automatic it is good practice to eventually move to the same table for both purposes. Otherwise, there could be significant actuarial gains or losses for both the plan and the participants. If, for example, the retiree were permitted to take a partial or full lump sum benefit, in lieu of the regular re-

tirement benefit, use of an outdated mortality table to determine the lump sum would result in lower lump sum payments than the actuarial equivalent in the plan.

Other terminations. A termination occurs when an active employee leaves the plan. The above decrements dealt with instances in which the terminating employee became entitled to an immediate benefit. Other terminations are those who are not entitled to an immediate annuity. These could be vested, entitled to a later annuity, or not entitled to any annuity. Terminations of participants not eligible for immediate benefits are high in the first year of employment and drop with each year that the participant remains with the employer. As a result, many larger plans vary assumed termination rates by service although others vary the rates by age as a surrogate for service. Some plans, such as CSRS, vary the rates by both age and service. The CSRS termination rates for males vary from 9 percent a year at the earliest age and service to less than 1 percent for the older age and service combinations. The average termination rate is around 7 percent for employees under age 45 in the SOA study. However, the rate varies widely by age, sex, and plan.

As with retirement, the termination rate must be carefully and consistently calculated in the first year after employment since the exposure at the beginning of the year is zero. Termination rates end when the participant becomes eligible for immediate retirement benefits.

Other assumptions. In addition to the primary demographic assumptions there are often other assumptions needed to accurately project all of the benefits of the retirement system. For example, a subsidized survivor benefit would require assumptions about the percentage and characteristics of retirees who elect the subsidized benefits. If joint and survivor options are determined using the actuary's valuation mortality and interest then the actuary does not need to project the number of optional elections. In that case, the present value of a joint and survivor benefit would be the same as for a straight life annuity and the plan would not be adversely or favorably affected by any option selected by the new annuitant.

There should be different sets of demographic assumptions for participants entitled to different benefit levels under the plan. For example, law enforcement officers usually are able to retire at earlier ages than under the general rules so their retirement, disability, and other termination rates are much different than for the general participant population.

Other assumptions include an allowance for administrative expenses to the extent that these are paid by the plan. Administrative expenses for investments are typically netted from the investment return and should be considered in comparing plan investment return with national indices of investment performance.

When and How Are Actuarial Assumptions Changed?

It is important to know who selects the actuarial assumptions. In the public sector actuarial assumptions are typically set at the time of the first valuation of the retirement system based on national data or assumptions for similar plans since the governmental plan in question does not yet have experience to be evaluated. The assumptions are then reviewed periodically with the results, including any recommendation for change in assumptions, reported to the plan sponsor. The review of assumptions is commonly made every three to five years. The actuary reviews the results to determine whether changes in the assumptions should be recommended. The effects of proposed assumption changes in demographic assumptions are then compared to the results without the change to determine the extent to which the validity of the results would be improved by adoption of the recommended changes.

Different plan sponsors will approach the selection of assumptions from different viewpoints depending on the financial circumstances of the plan and budgetary considerations. An actuary will accept assumptions that vary from his or her recommended assumptions as long as the assumptions are within a reasonable range. For example, an actuary might recommend an investment return assumption of 8.5 percent but accept a rate as low as 8 percent or as high as 9 percent if preferred by the plan sponsor.

Actuarial assumptions for private sector pension plans are, at least formally, set by the actuary. The actuary must assure the Internal Revenue Service, through filing of Form 5500, Schedule B, that "in my opinion each assumption, used in combination, represents my best estimate of anticipated experience under the plan" (IRS 1997). In practice, the private sector plan sponsor often exerts a good deal of influence on the assumptions. In the public sector, the formal authority for selection of assumptions varies widely depending on the governance and history of the fund. In many cases (for instance, the Pennsylvania state retirement systems), the assumptions are formally set by the governing board. In other cases (e.g., the federal retirement systems) the assumptions are set by the actuary or a Board of Actuaries.

Whatever the formal arrangement, selection of the actuarial assumptions is usually best achieved as a joint effort of the actuary and the client. If the selection is formally made by the actuary, but the plan sponsor does not agree with the assumptions, the sponsor probably will dismiss the actuary. If the selection is formally made by the sponsor, but the actuary does not agree, the actuary has two choices. The first is to issue a qualified report stating that the actuary does not agree with the assumptions. The second is to resign from the case. Cases of a disagreement that leads to dismissal or resignation are rare.

Underlying Philosophy Regarding Assumptions

There are significant differences in the criteria for selection of actuarial assumptions in the public and private sector. Private sector plans sponsors often attempt to design the amount and timing of pension plan contributions to meet plan sponsor financial goals. For example, a private sector plan sponsor may have an unusually high surplus in a given year and want to maximize contributions in that year. The actuary will usually work with the sponsor to select assumptions within the actuary's range of reasonableness and legal constraints that will best fit the plan sponsor's financial goals.

The often conflicting goals of the private sector plan sponsor, auditors, and the IRS have resulted in a complex and arcane set of funding patterns in the private sector. The actuary for a private sector plan must produce a number of different actuarial valuations to meet all requirements. In addition to the traditional actuarial valuation that presents the actuary's best estimate of the plan funding levels a valuation is required to determine the net periodic pension cost for plan expense purposes, and another valuation to determine the funded status for the Pension Benefit Guaranty Corporation (PBGC). While actuaries for private sector plans attempt to keep assumptions as consistent as possible among the alternative valuations, there are unavoidable differences in assumptions. In particular, the discount rate used for accounting expense purposes, the investment return rate required for PBGC measures, and the actuary's recommended investment rate, usually differ. In 1998, for example, the PBGC rate was below 5 percent, the plan expense discount rate was typically around 7 percent and the long-range actuarial assumption was usually 8 percent or higher.

Government plans are not covered by the PBGC and government accounting rules permit a wide range of assumptions and funding methods. As a result, the actuary for a governmental plan only needs to perform one valuation with one set of assumptions for governmental pension plans. As with the private sector actuary's traditional approach, this is the public sector actuary's best estimate of plan costs and liabilities.

Whatever the formal arrangement, the selection of the assumptions for a public sector plan is usually an interactive process involving the actuary, the pension board, the treasurer and, often, political considerations as described elsewhere in this volume (Bryan this volume; Peskin this volume).

Timing of review of assumptions. The process of adopting new assumptions begins with an actuarial investigation of experience under the plan. The timing of this experience study is often specified in the governing legislation, as it is with the Pennsylvania and federal plans. If the frequency of experience studies is not formally specified in the governing legislation, it is the responsibility of the board and the actuary to determine when a new study

TABLE 6. Hypothetical Results from An Actuarial Review ($B)

Unfunded liability at beginning of year	$20.0 B
(Gains) and losses	
Change predicted by actuary	1.7
Gain due to investment return	(2.0)
Loss due to early retirements	1.1
Loss due to low mortality	0.3
Loss due to high salary increases	0.7
Other gains and losses	0.4
Subtotal gains and losses	0.5
Unfunded liability at end of year	$22.2 B

is needed. Both GASB and the Actuarial Standards Board provide guidance on the timing and content of an experience study (GASB 1994; ASB 1999). Whether formal or informal, experience studies are commonly performed every three to five years as they are with large private sector plans.

It is also considered to be good practice to review the continuing overall validity of the set of assumptions each year, through a gain-and-loss study usually presented as part of the annual actuarial valuation. These studies show the primary reasons for unexpected changes in the liabilities of the pension plan. For example, a gain-and-loss study might show the results in Table 6. An unusually large gain or loss or continuing high gains or losses attributable to a particular assumption, suggests that that assumption should be reviewed before the next scheduled experience study. Confirmation that the assumption was no longer valid could either trigger an early experience study or simply result in a change of the specific assumption without further action on assumptions.

The experience study. The findings of the actuarial study of assumptions are usually presented in an experience study which includes the results of the analysis and the actuary's recommended changes in assumptions, if any. Experience studies usually begin with a presentation of the review of assumptions. The presentation shows the actual-to-expected ratios and other important findings for each of the assumptions with an explanation of significant differences between actual experience and that expected using the current set of actuarial assumptions. The study then presents recommendations for changes in assumptions, if any. Studies should include an estimate of the financial effect of making the recommended change.

The recommendations are usually based on the analysis of experience. For example, the actuary might find that disability rates during the study period proved to be substantially lower than expected and recommend a reduction in those rates. However, the actuary must be careful to consider unusual circumstances that make the experience inappropriate as a basis for setting assumptions about the future. For example, the system might

have had an early retirement window open during the experience period that resulted in a high actual-to-expected ratio of retirees. In that case, the actuary should estimate the rates of retirement that would have occurred in the absence of the early retirement window in developing recommendations for long-term assumptions. Conversely, if the plan has adopted a window to begin after the experience study, the actuarial assumptions for retirement should be increased to predict higher retirements while the window is open and reduced to predict lower retirements in the year or two after the window is closed.

The actuary then presents the experience study to the governing body, which tends to focus on the economic assumptions since these are neither as esoteric nor as numerous as the demographic assumptions. Further, since the bulk of the time of the governing body is usually spent on establishing investment policy and selecting investment firms, the governors will be particularly interested in the investment return assumption.

The actuary will make recommendations, and the governing body will consider those recommendations, in light of their overall financing strategy. If, for example, the governing body prefers that changes in cost in future years will likely be reductions rather than increases, the plan sponsor may select a lower investment return rate than a large private sector plan with the same investment history and philosophy. Plan sponsors who are less concerned with potential increases in costs will select assumptions that are closer to the actuary's best estimate. The general approach of governmental plan sponsors is to be somewhat conservative or very conservative in selecting assumptions. For example, in response to double-digit investment returns, the actuary for a plan with a current investment return assumption of 7.5 percent might recommend that the assumption be set at 8.5 percent. A somewhat conservative philosophy might result in an assumption of 8.25 percent but a very conservative plan sponsor might prefer 7.75 or 8 percent. It is likely that the actuary would agree with a very conservative approach, as long as the actuarial report explained that it was the basis for selection of the plan assumptions.

Often the governing body focuses on the projected effect of the change of assumptions as much as on the assumptions themselves. In recent years, with excess investment return driving down employer contributions, governing bodies will be most comfortable adopting a set of assumptions that result in a small reduction in the employer contribution. If the most likely set of assumptions results in a large reduction in contribution, the governing body will often select somewhat more conservative assumptions as a margin against unexpected adverse experience.

This description of the usual process does not, of course, apply to situations where the selection of assumptions becomes a high-profile political issue. The actuary is then sometimes torn between parties who want to re-

TABLE 7. Permitted Funding Methods of Pension Plans

	GASB no. 25	*FASAB*	*FASB no. 87*	*IRS*
Funding methods	Any accepted method (72% of plans in SOA are entry-age normal)	Aggregate entry age normal cost but others permitted if justified	Projected unit credit	Any of the accepted methods
Amortization of unfunded liability	No more than 30 years	None specified	Average working life	5 to 30 years depending on type
Limits on projected benefits	None	None	None	Limits on salaries and benefits
Assumption restrictions	Reasonable	Reasonable	Market interest for discount, others reasonable	Reasonable but investment return and mortality table specified for PBGC purposes

Sources: Samet et al. (1996), FASAB (1995), IRS (1997).

duce the rate as much as possible and others who want little or no reduction in rate. In those cases, any recommendations by the actuary could be viewed by at least one of the parties as political in nature even though such recommendations seldom are, and never should be, influenced by those considerations.

Level and Incidence of Funding

The actuary then applies the new assumptions in the next actuarial valuation to determine the present value of future benefits and to compare these to the value of the assets. This calculation establishes the overall financial status of the plan, but then further direction is needed to determine how the liabilities will be amortized. The amortization method is defined by the actuarial funding method and the length of the funding period.

A public plan sponsor must set and meet a funding policy that is designed to amortize all liabilities over a reasonable period. Until the issuance of GASB Statement Number 25 in 1994 there were no specific national guidelines for setting funding policy for public pension plans. However, over the years, taxpayers and governing bodies had become increasingly aware of the importance of sound financing. In states such as Pennsylvania, this resulted in establishment of an independent retirement commission charged with monitoring and reporting on the financing of all governmental plans under its jurisdiction. Other states, such as Georgia, legislated funding periods and methods for all governmental plans in the state. The guidance of the commissions, assisted by strong fund performance, has greatly improved the financial soundness of many governmental funds.

The FASB expense rules and IRS funding requirements place specific limitations on the range of funding required and permitted in the private sector. GASB No. 25, however, permits a range of funding policy (see Table 7). The typical governmental retirement plan had established specific funding requirements, through legislation or adoption of a requirement by the governing board, before 1996 when GASB No. 25 had to be applied. GASB No. 25 was designed to encompass the large majority of funding patterns among governmental pension plans. While GASB No. 25 only requires a report on the relative funding pattern, governmental plan sponsors hesitate to adopt or continue funding that is lower than the amount required to be reported by GASB No. 25.

As in the private sector, government plans typically smooth out gains and losses in investment income, commonly over five years. This has proved another level of conservatism in recent years as the large market gains in the 1980s and 1990s have been gradually brought into assets, and used to reduce contributions, over five years.

Inflation Protection

Pension plans are usually designed to achieve a benefit that produces a specific replacement ratio at retirement after a full career with the sponsoring employer. For example, a typical state retirement plan design might produce replacement income of 75 percent of salary, including social security, at age 65 with thirty years of service. Benefits for participants who die, become disabled, or retire early are often tied to the full retirement replacement ratio.

The protection against erosion of benefit value from inflation differs before and after retirement. Inflation before retirement for active plan participants is covered by tying the benefit to salary at or near retirement. Governmental plans typically use the high-three (61 percent) or high-five (20 percent) salary average (BLS 1994). Private sector salary related plans are somewhat less liberal with a large majority using the five-year averaging period (HayGroup 1998).

Inflation after retirement is often, but not always, covered by periodic increases in the retirement benefit commonly called cost-of-living allowances. Protection against inflation after retirement is quite different in the public and private sector. About half of governmental plans include automatic COLAs (BLS 1994). Only 12 percent of private sector plans provide automatic COLAs, but many do provide periodic ad hoc increases (HayGroup 1998; Mitchell et al. this volume).

Few plans in the private or public sector protect former participants with vested benefits from inflation between the end of participation in the plan and commencement of retirement benefits. The result can be a substantial loss in the real value of a vested benefit. For example, a $10,000 benefit vested at age 40 would only be worth $4,200 at age 62 if inflation was 4 percent a year.

Most plan sponsors who do not provide full automatic protection are deterred by the high cost of such protection. Sponsors of pension plans that do not provide full inflation protection are somewhat comforted by the fact that social security is fully protected from inflation before and after retirement. Table 8 illustrates the loss to inflation that can occur in a system that is not indexed if inflation is 4 percent a year.

One approach to protection against inflation after retirement has been for the retired participants to share in the investment return. A typical investment-sharing plan would allocate part or all of the earnings on assets earmarked for retirees to provide increases in retirement benefits. This type of allocation would proceed as follows:

Asset allocated for retiree liabilities	$1,000 million
Investment return	12%

TABLE 8. Replacement Ratios with No Indexing of Plan Benefits and Inflation at 4 Percent a Year

	Annual benefit in 1999 dollars	*Replacement ratio*
Final salary	$35,096	
Benefit at age 62	21,841	62%
Benefit at age 80	16,557	47%
Benefit at age 95	13,789	39%

Source: Author's calculations.

Actuarial assumption	8%
Allocated to COLA account	$40 million
(0.12–0.08) × $1,000 million	

Part or all of the earnings in excess of the actuarial assumption would be directed to a reserve account to be used to pay future COLAs.

Postretirement Medical Costs

Actuarial assumptions are also essential in the measurement of postretirement costs of medical plans (referred to as PRM costs). With the rising cost of medical care and the absence of prefunding, the annual cost of postretirement medical can approach or even exceed the cost of the pension plan. Many of the assumptions are the same as those used for the pension plan but some, such as salary growth, are not used in PRM valuations and others, such as medical inflation, are not used in the pension plan.

The economic assumptions used to determine PRM liabilities are the investment return and health care inflation. Investment return is the same as for the pension plan unless there are significant differences in the fund allocation. Health care inflation is used instead of general inflation because medical costs are driven by the health care segment of the economy where costs have increased much more rapidly than in the overall economy. Salary growth is not used because medical benefits are not affected by salary and usually not financed as a percent of salary.

Health care cost changes are measured by looking at both the governmental plans' experience and national changes in health care costs. One source for the national health care costs is the National Health Expenditure analysis produced by the Health Care Financing Administration of the federal government. Trends in health plan costs are determined by reviewing recent cost and premium experience of the plan. It is important to split the trend into experience among retirees under and over age 65 because of the sharp drop in plan costs when Medicare benefits begin at age 65.

Actuaries tend to place the greatest credibility on the last year or two of

health cost experience rather than a longer term analysis as is common for the pension economic factors. This much shorter time horizon is necessitated by the much more volatile trend in health care expenditures than in general inflation. For instance, the Federal Employees Health Benefits Plan (FEHBP) experience shows trends that range from –11.4 percent in 1986 to a 25.8 percent increase in 1988 (Hustead 1999).

The PRM valuation uses the demographic assumptions for the pension system since eligibility for PRM benefits is usually tied to pension plan eligibility. In many plans all participants eligible for unreduced retirement benefits are also eligible for PRM benefits. In other plans, the PRM benefit eligibility is more stringent than for the pension benefits. In those cases the retirement rates for both plans must recognize the effect of eligibility for PRM benefits. If, for example, employees can retire on full pension benefits at 55 but will not be eligible for full PRM benefits until age 60, the retirement rates below age 60 will be lower than expected based on pension benefits alone.

The PRM valuation requires additional demographic assumptions if, as is usually the case, dependents are also eligible for PRM benefits. The assumptions include the probability that the annuitant is married, the age of the spouse, and the number of children eligible for benefits.

Actuarial Assumptions: Future Challenges

The bull market of recent years, coupled with increasing investment in equities, has lead to a well-funded situation for many public systems similar to those in the private sector. This has, in turn, greatly reduced employer contributions for many of the public systems. The immediate challenge has been seen to be how to "spend" the unexpected savings. Pressures are to improve benefits for participants, use the money to fund PRM and other benefits, or to simply let the reductions lead to lower taxes. On the other hand, the concern is what might happen when and if the economy turns down. Fiscal conservatism leads many plan sponsors to let large margins build up against the downturn; for these plans, a sharp downturn will simply return contribution rates to their former level. For plans that have used the favorable results to increase benefits and/or reduce contributions, a sharp downturn could lead to the need to boost contributions.

Few governments have faced the potential cost of post-retirement medical benefits and many have not even calculated those costs. With continuing pressure for determination of the cost and at least recognition of the expense on the government financial statements, governments could well face the pressures that impacted on private sector PRM plans in the last decade. Those pressures often lead to curtailment or even termination of PRM bene-

fits to private sector employees. Those changes, in turn, have exacerbated the problem of lack of health insurance for over 40 million Americans.

Notes

1. Similar assumptions are used in funding and costing postretirement medical promises as well.

2. The normal cost of a pay-based retirement plan is the percent of career pay that, with interest, will pay the benefits of the new entrants to the retirement plan.

3. These tables can be obtained from the Society of Actuaries website <www.soa.org>.

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