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THE FORECAST VALUATION METHOD FOR PENSION PLANS

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ABSTRACT

The forecast valuation method is not a new concept for pension actuaries, but the author wanted to document the method so that it might be approved by the Internal Revenue Service as an acceptable actuarial valuation method for pension plans. This paper describes the method, the formulas used under the method, the assumptions used, and the way these assumptions might be chosen. Finally, to illustrate how the approach might work in practice, the paper describes a case study—the ABC Corporation.

BACKGROUND TO THE DEVELOPMENT OF THE FORECAST VALUATION METHOD

As pensions have become a larger part of the total compensation package for employees, management has shown increasing concern over plan costs and how these costs are determined. In the past, rising investment expectations made plan improvements possible without change at the level of contributions simply by changing the actuarial assumptions (the interest assumption in particular). Of course, the ultimate cost of a pension plan is not affected by revising the assumptions, but management often has been able to make plan improvements and still keep its current accrual cost constant by using this device. This trend probably will not continue. Management, therefore, is becoming more interested in long-range financial planning for pension plan costs. In addition, the prospect of continuing inflation raises the question of how to fund for the plans with current dollars or future dollars and still maintain equity among different generations of stockholders. The forecast valuation method is a means to develop future valuation results so that management can better project its long-range pension costs and set up an appropriate funding policy.

The forecast valuation method is not a new concept to pension actuaries. Its underlying actuarial mathematics are simple. The technique, however, has not been documented in the *Transactions*. Now, with pension legislation prescribing minimum funding criteria, it is hoped that the concept will be recognized as providing an acceptable valuation method.

What Is the Forecast Valuation Method?

The forecast valuation method is a computer-based pension valuation system designed not only to produce valuation results for the current year but to "forecast" results for several years into the future. Instead of producing just a "snapshot" of the results, the forecast valuation method tries to portray a "motion picture." The specific types of cost calculations produced for the future are left to the discretion of the individual actuary, but, as a minimum, the payroll of the work force and the benefit disbursements in each year are produced, so that pension fund balances and cash flow are generated for the future. The primary purpose of the forecast valuation method is to set the contribution level required to fund for some objective at a future date. This objective, or bench-mark liability, may be the entry age actuarial liability, accrued benefit liability, liability for vested benefits, or some other appropriate objective. Once the desired objective is determined, the forecast valuation method makes it possible to set the level percentage of payroll contribution necessary to achieve the goal.

To set the bench-mark liability and the appropriate contribution level, the first valuation should be based on realistic assumptions. Contribution levels would also be calculated, based on alternative sets of assumptions, to provide an appropriate measure of the margin for contingencies. With the most probable assumptions, there is a 50 per cent chance that actual experience will result in a lower contribution level than that calculated and a 50 per cent chance that it will be greater. To protect against the latter, it may be desirable to add a margin or extra charge to the realistic rates. The size of the increase would be determined by the supplementary calculations.

HOW THE FORECAST VALUATION METHOD WORKS

The forecast valuation method relies upon basic actuarial mathematics. Commutation functions have been a great time-saving technique in the past, but modern computers make it possible to achieve great flexibility by no longer using them. The return to basic actuarial mathematics is one reason for using the forecast valuation method—results and actuarial techniques must be communicated to and understood by management. There are three types of calculations that must be made in the forecast valuation method: development of expected future population and payroll figures; development of expected future benefit disbursements; and development of future cost figures. Two important factors not present in the traditional actuarial valuations are assumptions about the size of the future work force and the characteristics of new entrants.

Development of Population and Payroll Figures

When data involving the size and characteristics of the employee group are developed, it is necessary to determine, for each year in the future, the number of active employees remaining active, dying, terminating, becoming disabled, and retiring. In addition, it is necessary to keep track of the number of inactives by category (retired, disabled, vested) and their beneficiaries. The numbers will, of course, depend on the assumptions made, and management should assist the actuary in deciding on an appropriate set of assumptions. For example, management may think that turnover will be about 10 per cent of the work force each year, with heaviest turnover among younger and short-service people. Unless some sort of experience study is conducted, the actuary may have to juggle age and/or service-related turnover tables to meet the criteria.

A multiple decrement service table could be developed for each individual, based on his current age.

$$l_x^{(T)} = \text{Number of active employees at age } x\ ;$$

$$d_x^{(m)} = l_x^{(T)} q_x^{(m)} = \text{Number of deaths at age } x\ ;$$

$$d_x^{(w)} = l_x^{(T)} q_x^{(w)} = \text{Number of terminations at age } x\ ;$$

$$d_x^{(i)} = l_x^{(T)} q_x^{(i)} = \text{Number of disabilities at age } x\ ;$$

$$d_x^{(r)} = l_x^{(T)} q_x^{(r)} = \text{Number of retirements at age } x\ ;$$

$$l_{x+1}^{(T)} = l_x^{(T)} - d_x^{(m)} - d_x^{(w)} - d_x^{(i)} - d_x^{(r)}\ ,$$

where $q_x^{(m)}$, $q_x^{(w)}$, $q_x^{(i)}$, and $q_x^{(r)}$ are the probabilities of dying, terminating, becoming disabled, and retiring, respectively, derived from an associated single decrement table.

Determination of the probabilities should be based on the particular case being valued. Any number of approaches can be used. One approach would be to assume that all decrements occur halfway through the year. Given that $q_x'^{(m)}$, $q_x'^{(w)}$, $q_x'^{(i)}$, and $q_x'^{(r)}$ are rates from the associated single decrement tables, probabilities could be developed in the following manner.

The probability of leaving active status at age x is

$$q_x^{(T)} = 1 - [(1 - q_x'^{(m)})(1 - q_x'^{(w)})(1 - q_x'^{(i)})(1 - q_x'^{(r)})]\ .$$

Developing central rates of decrement, for example, for mortality,

$$m_x^{(m)} = \frac{q_x'^{(m)}}{1 - \frac{1}{2} q_x'^{(m)}}\ .$$

To obtain the probability of dying while in active employment at age x, $q_x^{(T)}$ is prorated by the ratio of the central rate for mortality at age x to the central rate for all decrements at age x:

$$q_x^{(m)} = q_x^{(T)} \frac{m_x^{(m)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)} + m_x^{(r)}}.$$

Similarly, probabilities are derived for $q_x^{(w)}$, $q_x^{(i)}$, and $q_x^{(r)}$.

Practically speaking, at any given point an employee would be considered either a retirement or a termination, but not really both, so the above formulas would reduce to

$$q_x^{(m)} = q_x^{(T)} \frac{m_x^{(m)}}{m_x^{(m)} + m_x^{(w)/(r)} + m_x^{(i)} \ldots},$$

where $q_x^{(w)/(r)}$ and $m_x^{(w)/(r)}$ would represent either the probability of retiring (if eligible according to plan terms) or terminating at age x. Approaches reflecting different timing of the decrements are discussed in Appendix I. Aside from the consideration of when the decrements occur, realistic turnover should be used which would usually be based on select and ultimate tables. Table 1 is a simplified individual service table for a person entering the plan at age 50, assuming that all decrements occur halfway through the year, based on the following rates from the associated single decrement tables:

Age	$q_x'^{(m)}$	$q_x'^{(w)}$	$q_x'^{(i)}$	$q_x'^{(r)}$
50	.005501	.040500	.012000	.....
51	.006106	.038000	.012400	.....
52	.006744	.036000	.012800	.....
53	.007418	.034500	.013300	.....
54	.008124	.033000	.013900	.....
55	.008866	.....	.014600	.010000
56	.009577	.....	.015500	.025000
57	.010313	.....	.016600	.050000
58	.011113	.....	.017900	.200000
59	.012091	.....	.019500	.500000
60	.013216	.....	.020500	1.000000

Once service tables are generated for each individual, the results are totaled to see what happens to the employee group over time. Of course, if an arbitrary radix was chosen, the individual results would have to be adjusted before totaling to take into account the fact that we are dealing with only one person. For example, in Table 1 our work would be simplified if we had started with a radix of 1.000000 at age 50, so that individual

results could readily be added together. Table 2 shows how such totals might look at present, based on the current closed group of active employees projected for the next ten years.

The traditional actuarial valuation is based on the closed group of currently active and retired employees. While it is interesting to see how this group declines over the years, for realistic forecast purposes new entrants for each future year must be considered. It is the ability to include new people that primarily distinguishes the forecast valuation method from traditional methods. To process new entrants, we need to know how

TABLE 1

INDIVIDUAL SERVICE TABLE

Age	$l_x^{(T)}$	$d_x^{(m)}$	$d_x^{(w)}$	$d_x^{(i)}$	$d_x^{(r)}$
50	1,000,000	5,357	40,147	11,725	.....
51	942,771	5,613	35,495	11,343	.....
52	890,230	5,858	31,737	11,152	.....
53	841,483	6,094	28,731	10,958	.....
54	795,700	6,313	25,970	10,833	.....
55	752,584	6,591	.....	10,885	7,438
56	727,670	6,829	.....	11,085	17,964
57	691,792	6,898	.....	11,139	34,127
58	639,628	6,340	.....	10,248	126,082
59	496,958	4,463	.....	7,224	244,583
60	240,688	1,574	.....	2,451	236,663
61	0	.....	.....	.....	.....

TABLE 2

PROJECTION OF ACTIVE EMPLOYEES

(Assuming No Future New Entrants)

Year	Active Employees	Deaths	Terminations	Disabilities	Retirements
1974	5,000	9	706	18	34
1975	4,233	9	462	18	44
1976	3,700	9	328	17	45
1977	3,301	9	243	17	42
1978	2,990	9	181	17	54
1979	2,729	8	137	17	61
1980	2,506	8	110	16	59
1981	2,313	8	88	16	52
1982	2,149	7	72	16	64
1983	1,990	7	58	15	63

many will come into the plan and their characteristics. Any assumptions about the growth (or decline) of the work force can be used because, once the desired size of the work force is known, we can obtain the required number of new entrants simply by subtracting the number of active members of the plan on the valuation date from the number of employees expected in the work force. The characteristics of the new entrants would have to be determined in advance, but, with a profile developed at any given time, new entrants can be processed through the appropriate service table in the same manner as actives. The end result might look something like Table 3, assuming that the population remains stable for the next ten years.

TABLE 3

PROJECTION OF EMPLOYEES

(Assuming Active Population Remains Constant)

Year	Active Employees	Deaths	Terminations	Disabilities	Retirements
1974	5,000	9	706	18	34
1975	5,000	9	642	19	44
1976	5,000	10	608	19	45
1977	5,000	10	587	19	42
1978	5,000	10	569	20	54
1979	5,000	10	550	20	61
1980	5,000	9	541	20	59
1981	5,000	9	531	20	52
1982	5,000	9	522	19	64
1983	5,000	9	515	19	63

After or coincident with the development of the service table, the next step is to generate a table of salary-scale functions from the underlying salary increase assumptions:

$$S_{x+1} = S_x(1 + j_x) ,$$

where S_x is the salary-scale function at age x and j_x is the rate of salary increase from age x to age $x + 1$.

On the basis of the salary-scale functions and the employee's current rate of pay, it is possible to generate the individual's estimated rate of pay for each year:

$$ES_y = AS_x \frac{S_y}{S_x} ,$$

where ES_y is estimated salary at age y, AS_x is actual salary at age x, and S_y and S_x are salary-scale functions. Given ES_y as the estimated rate of

pay at age y for this individual, and assuming that he remains an active employee, the expected salary actually paid to him, PE_y, is

$$PE_y = ES_y \frac{l_y^{(T)}}{l_x^{(T)}} .$$

We now have an estimate of the amount that will actually be paid to the individual in each year. The only further item we need is the present value of his projected earnings that will be used in cost calculations.

$$PVFE_{x+s} = \sum_{t=s}^{\infty} v^{t-s} PE_{x+t} ,$$

where $PVFE_{x+s}$ is the present value at duration s of future earnings payable on or after age $x + s$. Earnings are assumed payable at the beginning of the year because costs usually are calculated based on the rate of pay at the valuation date rather than on earnings paid throughout the year.

To obtain totals at each future year for the current active group of employees, it is a simple matter to sum PE_{x+s} for all employees, where x represents the age on the current valuation date and s represents the duration. Similarly, the summation of $PVFE_{x+s}$ for all employees gives the present value of future earnings for the entire group at each future point in time.

The final calculation (if necessary) is to determine the employee contributions under a contributory pension plan, on the basis of the salary in each year.

Development of Benefit Disbursements

After we know what will happen to an individual during his working lifetime, we need to examine the plan provisions to see if and when he will be entitled to benefits. Examining each decrement, $d_x^{(n)}$, we must determine whether, under the particular pension plan provisions, the individual is entitled to any benefit if he leaves the group as a result of cause n and, if so, how much the benefit is and in what form it is payable. It is necessary to know the eligibility requirements for each possible benefit payable under the pension plan. The forecast valuation method allows the eligibilities to change in future years to anticipate expected (or known) plan changes. Benefits may be in the form of a lump sum, as is the case with some death benefits; refund of employee contributions; or purchase of benefits under a deposit administration contract with an insurance company. They also may be in the form of immediate income benefits payable under one of several optional forms of payment. The form

of payment requires the flexibility to allow the amount of the benefit to change at one or more ages in the future; to continue benefits to a surviving contingent annuitant; to pay benefits under a certain and continuous form whereby payments may continue for a period of time after the employee's death; or to allow future cost-of-living increases to benefit recipients. Once the decrement and the amount of benefit payable at each age as a result of that decrement are known, the appropriate mortality table is used to determine the actual benefit disbursements in each year.

For a person now aged x, a set of generalized formulas for determining the disbursement under an income benefit at duration s from a decrement occurring at age $x + t$ ($s \geq t$) would be

For straight life annuities:

$$BPO_{x+t,\,s-t} = \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t}(1 - k) \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} \qquad \text{if } s = t$$

$$= \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t} \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} \qquad \text{if } s > t\,,$$

where

$BPO_{x+t,\,s-t}$ = Benefit disbursement at duration s, from decrement at age $x + t$;

BEN_{x+t} = Amount of benefit payable as result of decrement occurring at age $x + t$;

k = Time during year when decrement occurred ($0 \leq k \leq 1$);

r = Time during year when benefit payable at age $x + t$ is paid ($0 \leq r \leq 1$ and $r \geq k$ if $s = t$);

$l^{(m)}_x$ = Number of people at age x, based on mortality (m) (not part of multiple decrement table).

For contingent annuities:

$$BPO_{x+t,\,s-t} = \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t}(1 - k)\left[f_1 \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} + f_2 \frac{l^{(m)}_{y+s+r}}{l^{(m)}_{y+t+k}}\right.$$

$$\left. - (f_1 + f_2 - 1) \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} \frac{l^{(m)}_{y+s+r}}{l^{(m)}_{y+t+k}}\right] \qquad \text{if } s = t$$

$$= \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t}\left[f_1 \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{y+t+k}} + f_2 \frac{l^{(m)}_{y+s+r}}{l^{(m)}_{y+t+k}}\right.$$

$$\left. - (f_1 + f_2 - 1) \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} \frac{l^{(m)}_{y+s+r}}{l^{(m)}_{y+t+k}}\right] \qquad \text{if } s > t\,,$$

where

f_1 = Proportion of benefit employee receives;
f_2 = Proportion of benefit contingent annuitant receives;
y = Age of contingent annuitant at time of decrement.

All other terms are defined as for the life annuity calculation.

For certain and continuous annuities:

$$BPO_{x+t,\,s-t} = \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t}(1-k) \qquad \text{if } s = t$$

$$= \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t} \qquad \text{if } s > t \text{ and } s - t < N,$$

$$BPO_{x+t,\,s-t} = \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t}\left(f_1 + f_2 \frac{l^{(m)}_{x+s+N}}{l^{(m)}_{x+t+k}}\right) \qquad \text{if } s - t = N$$

$$= \frac{d^{(n)}_{x+t}}{l^{(T)}_x} BEN_{x+t} \frac{l^{(m)}_{x+s+r}}{l^{(m)}_{x+t+k}} \qquad \text{if } s - t > N,$$

where

N = Duration of the certain period;
f_1 = That part of the year's payment payable under the certain portion;
f_2 = That part payable under the continuous life portion.

All other terms are defined as for the life annuity calculation.

The above formulas are also appropriate for inactive lives; we need only set $d^{(n)}_{x+t} = l^{(T)}_x$.

Under each of the formulas the mortality table could, of course, vary according to the type of benefit payable (especially disability). To obtain total results for an individual after taking into account the probability of leaving the group due to the operation of a decrement, the calculation is

$$TBPO_s = \sum_{t=0}^{s} BPO_{x+t,\,s-t},$$

where s represents duration from age x and $TBPO_s$ is total payout at duration s.

The next step, an intermediate one in determining plan costs, is to develop the present value of these benefit disbursements. The calculation is similar to that used for the present value of earnings:

$$PVFB_{x+s} = \sum_{t=s}^{\infty} v^{t-s+r} TBPO_t,$$

where $PVFB_{x+s}$ represents the present value at duration s of benefits payable on or after age $x + s$ and r is the time during the year when benefit disbursements are assumed to occur.

By summing up the results for the current active group of employees, using the following formula, we obtain a forecast of total future disbursements:

$$TBEN_s = TBPO_s \text{ summed for all employees,}$$

where $TBEN_s$ is total benefit payout at duration s and s is duration from current valuation date.

Similarly, the present value of these disbursements at each future point in time is

$TPVB_s = PVFB_{x+s}$ summed for all employees, with x representing age on current valuation date,

or

$$TPVB_s = \sum_{t=s}^{\infty} v^{t-s+r} TBEN_t ,$$

where $TPVB_s$ is the present value of benefits to be paid at duration s or later and r represents the time during the year when the benefit is payable.

One significant advantage of the forecast valuation method is that each benefit can be valued separately, so it is easy to see the incidence of costs for the various benefits. For example, it may be desired to put in a benefit at a given long-range cost that will not be a drain on the fund for the next ten years. Such a benefit might be increased eligibility for the vested benefit (because payments will not begin until age 65) rather than subsidy of the early retirement factors, which would cause more people to go out receiving immediate income benefits.

Development of Costs

When the forecast valuation method is used, the contribution strategy often requires finding a level percentage of payroll contribution that will generate a large enough fund in a given number of years to equal some bench-mark liability (for example, entry age level actuarial liability, actuarial liability for accrued benefits, or the actuarial liability for vested benefits). However, it may be desirable to determine traditional actuarial valuation cost figures at the same time.

Under the aggregate valuation method, two possible costs could be determined, both based on the formula

Normal cost percentage

$$= \frac{\text{Present value of future benefits minus assets}}{\text{Present value of future earnings}}.$$

The traditional approach would base both the present value of future benefits and the present value of future earnings on the closed group of currently active and inactive employees. A different answer probably would be generated if these two present-value figures took into account the benefits and earnings of future entrants to the work force. The difference between these two approaches and the answers produced are shown in the case study of the ABC Corporation discussed later. Using as examples Tables 4 and 5 from the case study and assuming a new plan, the differences can readily be illustrated. Basing the normal cost percentage on the closed group of currently active and inactive employees from Table 4, we obtain

$$\text{Normal cost percentage} = \frac{166{,}465{,}000}{985{,}893{,}000} = 16.88 \text{ per cent}.$$

However, from Table 5, based on thirty years of new entrants, we obtain

$$\text{Normal cost percentage} = \frac{240{,}835{,}000}{2{,}158{,}895{,}000} = 11.16 \text{ per cent}.$$

The reason for the big difference, of course, is the significant cost of supplying past-service benefits. In one case the costs are being spread over the earnings of the group when the plan was instituted; in the other, the service costs are being spread as a percentage of payroll over the earnings of the currently active group and all future entrants for thirty years. Appendix II describes methods that can be used to determine entry age or accrued benefit normal costs and actuarial liabilities.

For purposes of this paper, I have concentrated any development of traditional valuation cost figures on the projected benefit cost method, except when calculating liabilities for accrued or vested benefits. Because calculations of accrued or vested liabilities are subject to interpretation, I have made the simplifying assumption in the case study discussed later that vested benefits commence at age 65 if the individual is not eligible for early retirement and commence immediately if he is eligible for early retirement.

USE OF ASSUMPTIONS IN THE FORECAST VALUATION METHOD

When the forecast valuation method is used, it is important to make each assumption realistic for the basic study. One obvious reason for using the technique is to obtain a veiw of the incidence and magnitude of

long-range costs of the pension plan. Therefore, it is imperative that assumptions not be designed to be offsetting. For example, a conservative interest assumption might offset a small salary increase assumption, but this would not give management a true picture so that it could determine whether to pay for the plan with current dollars or future dollars.

Mortality

As in a traditional actuarial valuation, the mortality assumption can be made to vary for males and females and for active and retired employees. The forecast valuation method also makes it possible to build in future improvements in mortality.

Interest

In traditional actuarial valuations, the interest assumption associated with active statuses may be different from that for inactive statuses, but that is usually the extent of the variation. With the forecast valuation method, however, it is possible to vary the interest assumption by calendar year to anticipate future changes in the yield of the underlying fund. When generating entry age normal costs and actuarial liabilities, it also is possible to duplicate the rates earned in prior years to try to equalize the pension costs over different generations of stockholders. For contributory plans it is possible to have the interest rate credited on employee contributions vary by calendar year—not necessarily in the same way as the valuation interest rate.

Turnover

If, as described, the forecast valuation develops an individual service table for each employee, it is possible to use a turnover assumption determined on a select and ultimate basis. Usually such a table is based on the experience of the company for which the valuation is being performed, because there do not seem to be any such refined tables in the actuarial literature. If the use of the forecast valuation method becomes more extensive or if assumptions, in general, become more sophisticated, tables based on the age and service of the employee could be developed reflecting the industry, location, and other factors that might relate to the turnover in the labor force. In the development of a turnover table, all ages should be considered; that is, the table need not be adjusted to reflect vesting provisions of the plan because vesting is valued as a separate benefit.

Salary Increase

To estimate future pay, separate assumptions may be made to reflect merit or promotional increases and to provide for inflation and produc-

tivity. The underlying merit increase for the salary increase assumption could be based on a select and ultimate table, if there was enough experience for such a table to be developed. Because a service table is generated for each individual, not only can we have a select and ultimate merit increase table, but we also can have a table in which the inflation factor of the salary increase varies by calendar year. Today the ability to judge accurately the cost of continuing inflation is particularly important in assisting management to decide how to fund its plan.

Retirement Ages

Retirement rates should be select and ultimate, if for no other reason than to be certain that they apply only to people who really are eligible to retire, an eligibility usually dependent on age and length of service. It should not be possible to both terminate and retire from the work force during the same year. In the discussion of the service table it was stated that a decision had to be made about when the retirement decrements occur. They could be assumed to be spread equally throughout the year or concentrated at year-end points, depending on the particular plan. It is more important, however, in making the most use of the forecast valuation method, to assume retirement at more than one age to determine the effect on the incidence and magnitude of costs of any early retirement utilization under the plan.

New Entrants

An important new assumption under the forecast valuation method is that concerning the size and characteristics of the work force that will enter the pension plan in the future. This assumption also probably is the hardest to make. Assumptions on the size of the work force can make a substantial difference in the long-range dollar costs of a pension plan, depending on whether it is assumed that the work force will grow or decline in the future and at what rate. It also is necessary to picture accurately the characteristics of people who will enter the work force.

Disability

An assumption as to the rate of disablement among active employees probably should be made, even if no disability benefits are payable under the plan. Disability should not be considered a decrement over which a person has any control; therefore, it is an influence on whether he remains an active participant. However, a reasonable assumption of no disability can be made if there are continued benefit accruals during the period of disability. If an individual is entitled to a disability benefit, then an assumption must be made of the type of mortality he will experience in

the disabled state. This could come from a select and ultimate table, or it could come from the same mortality table that operates on all other inactive employees.

Postretirement Increases

More and more companies are granting increases in benefits to currently retired employees, so that this is an additional assumption that must be considered. Although a company may not want to fund for this benefit in advance, it should be able to obtain some idea of the probable disbursements and the costs of continuing the policy in the future.

WHEN SHOULD THE FORECAST VALUATION METHOD BE USED?

The forecast valuation method would appear to be most appropriate for relatively large groups, primarily because the year-by-year forecast of benefit disbursements presumes that the average assumptions chosen will nearly approximate actual year-by-year experience. Even given a large enough group, the question arises of when to use the forecast valuation method rather than the traditional actuarial valuation.

The forecast valuation method basically is used to set the proper funding strategy. For example, management might want to have the liability for all accrued benefits (i.e., plan termination liability) fully funded after twenty years. Based on results of the forecast valuation, which used a set of realistic assumptions, it is easy to develop the required contribution level as a percent of payroll. Because it is highly unlikely that the realistic assumptions will be borne out by future experience, a loading for future contingencies might be added. This loading could be determined by making several forecast valuations using different sets of assumptions. With the results of the other valuations, an appropriate margin, if any, could then be determined, based on management's and the actuary's confidence in the realistic assumptions.

The important thing to remember is that communication with management is essential. When managers have the results given to them for study, they should, with proper guidance, be better able to comprehend the basis of their pension plan costs and thus be in a good position to determine how they want to fund for their pension plan. Below are some examples showing where the forecast valuation method could be used to allow management to solve a long-range problem related to funding its pension plan.

1. Company A participates in a multiemployer plan in a declining industry. The determination of the current contributions is based on the assumption of a stable active work force in the future. Therefore, the company is particularly

interested in the impact on its future contributions if the number of active employees who are part of the multiemployer plan continues to decline.

2. Company B relies heavily on government contracts; current contracts expire in ten years. How well funded will the plan be at the end of that time if management follows its current contribution strategy? What strategy would it have to follow if all individuals entitled to receive benefits had those benefits fully funded and if the plan is terminated ten years from now?

3. Company C is in a large surplus basis using the entry age method of funding. Its management wants to know under what interest assumption it would not have to make further contributions and when, under the current interest assumption, it would have to resume contributions.

4. Company D has regularly bargained with the union for increases in the plan. Management wants to know the annual level contribution required to fund for the benefits in advance, given an assumed amount of increase due to bargaining.

5. Company E has great plans for expansion, which require hiring older, more experienced employees. What will happen to its pension costs, and what is an appropriate funding strategy, if its work force increases 10 per cent per year?

6. A municipality is interested in what is likely to happen to its pension plan if the current level of contributions and benefit provisions are continued into the future. Taxpayers have complained about the excessive benefits and costs that may arise, and the municipality wants to be in a position to answer the charges.

In all the above situations, the ability to include new entrants in future calculations is essential to produce a sound funding strategy. This is relatively easy to accomplish under the forecast valuation method, but under the traditional actuarial methods no allowance is made for the inclusion of new entrants.

In today's economy it is also important to be able to judge the effects of inflation on the magnitude and incidence of pension plan costs. To have available a dollar estimate of costs thirty years from now might influence management's decision on whether to pay for the plan as a percentage of pay or to pay more later in "cheaper" dollars. Caution should be exercised when showing dollar costs in the future because the uninitiated are not used to seeing the effects of inflation on dollar costs. Therefore, it is always wise to express costs in terms of some base, such as payroll.

The forecast valuation method also is well suited to valuing anticipated plan changes. It is possible not only to show the incidence of the costs of any changes, but also to value such benefits as early retirement, vesting, disability, and spouse's benefits that previously had been valued only on

an approximate basis. Under early retirement, one can value complicated eligibility conditions as well as the factor of increasing utilization depending on how an early retirement subsidy is handled. Similarly, one can value other ancillary benefits according to their eligibility conditions. For vesting, the turnover decrement could be adjusted when a person becomes eligible for vesting. As discussed previously, the turnover assumption is no longer adjusted arbitrarily to account for vesting because the benefit is valued independently of the other benefits.

When utilized within the constraints of the assumptions, the forecast valuation method allows the actuary and management to analyze fully the pension plan—seeing how benefits fit together so that any changes in the plan may be valued over the long- rather than only the short-range future.

Although this paper, including the case study, concentrates on developing liabilities under the forecast valuation method, equally as much care should be taken in developing the asset side. On the basis of the anticipated cash flow, the actuary, with the aid of the investment manager, should be able to project the composition of the portfolio with the respective rates of return. Then, using a set of assumptions, as simple or sophisticated as management wishes to make them, the fund return can be established and the corresponding size of the fund developed. Such assumptions might include (*a*) the desired relationship of the common stock, preferred stock, bonds, and commercial paper in the fund; (*b*) how the relationship would be maintained; (*c*) the rate of return on each piece; (*d*) realized and unrealized gains on each piece; and (*e*) allocation of new contributions. In the following case study, I have used only one basic set of assumptions for developing the fund.

The forecast valuation method is more costly than a traditional actuarial valuation, but it can establish a contribution pattern that could be used for at least three years before it has to be reworked. As a by-product, the forecast method could be used to establish the traditional valuation results for purposes of *Accounting Principles Board Opinion No. 8* if the accountants were not willing to accept as the accrual cost the contribution management decided upon as a result of the forecast.

CASE STUDY—THE ABC CORPORATION

This case study depicts how the forecast valuation method might be used for a hypothetical company, the ABC Corporation. The ABC Corporation, which has a pension plan (with benefits as summarized in Exhibit 1), has experienced in recent years a slowing of its growth rate, resulting in a large number of retirees and substantial current dollar out-

lays each year. The company wants to know where its costs are going and what kind of funding strategy it should follow. Management knows little about actuarial mathematics, and it wants further insight into the causes of cost increases and decreases.

Management has available for the current year only the following essential results from the annual actuarial valuation:

Normal cost on January 1, 1974	$ 3,231,000
Actuarial liability as of December 31, 1973	109,820,000
Fund as of December 31, 1973	69,236,000
Unfunded actuarial liability as of December 31, 1973	40,584,000
Recommended contribution for 1974	5,487,000

The valuation was performed using the individual entry age normal approach, and the contribution was determined as normal cost plus thirty-year amortization of the unfunded actuarial liability. The actuarial as-

EXHIBIT 1

DESCRIPTION OF BENEFITS

Normal retirement:	
Eligibility	Age 65 with 10 years of service
Benefit	1½% of final 5-year average earnings for each year of service *less* 1⅔% of the primary social security benefit for each year of service up to 30
Early retirement:	
Eligibility	Age 55 with 10 years of service
Benefit	Same as for normal retirement but based on service to date of early retirement and reduced ½% for each month early retirement date precedes normal retirement date
Vesting:	
Eligibility	Age 50 with 15 years of service
Benefit	Same as for normal retirement but based on service to termination and payment deferred to age 65
Disability:	
Eligibility	Eligible from date employed
Benefit	Continued accruals under the plan based on earnings at date of disability with benefit payable at 65
Preretirement death benefits	None
Postretirement death benefits	None

sumptions used in the valuation are shown in Exhibit 2. The actuary finds the assumptions as a whole conservative. He is not convinced that assumptions being used will continue to be valid. In particular, he believes that, in light of continuing inflation, both salary and interest assumptions are too low. He prefers somewhat more realistic assumptions that, perhaps, would reflect a different incidence of costs.

It is decided to use the forecast valuation method. Table 4 shows the

EXHIBIT 2

ASSUMPTIONS

Mortality: 1971 Group Annuity Table with projection—sample rates:

Age	Male	Female
20.....	.000524	.000439
30.....	.000842	.000615
40.....	.001700	.001089
50.....	.005501	.002674
60.....	.013216	.008124
70.....	.036284	.018935

Interest: 4%

Turnover: Sample rates:

Age	Male	Female
20.....	.086	.117
25.....	.066	.086
30.....	.052	.066
35.....	.041	.052
40.....	.000	.000

Salary increase: Rates of increase for selected ages:

Age	Male	Female
20.....	.0562	.0098
30.....	.0376	.0102
40.....	.0344	.0092
50.....	.0281	.0094
60.....	.0000	.0000

Social security: Social Security Act, based on amendments through January 1, 1974, with no anticipated future increases in either the social security taxable wage base or the consumer price index.

TABLE 4

FORECAST OF VALUATION RESULTS FOR ABC CORPORATION'S CURRENT PENSION PLAN

(Using Actuarial Assumptions Shown in Exhibit 2 and Assuming No Future New Entrants; 000 Omitted from Dollar Figures)

YEAR	NUMBER OF EMPLOYEES		EARNINGS	PRESENT VALUE OF FUTURE EARNINGS	BENEFIT PAYMENTS	PRESENT VALUE OF FUTURE BENEFITS	ENTRY AGE NORMAL COST		ACTUARIAL LIABILITY
	Active	Retired					Dollars	% of Pay	
1974.....	5,244	1,838	$60,715	$985,893	$6,054	$166,465	$3,231	5.32%	$109,820
1975.....	4,933	1,805	59,094	962,185	6,069	166,950	3,168	5.36	111,399
1976.....	4,652	1,770	57,877	939,215	5,936	167,438	3,134	5.41	112,961
1977.....	4,401	1,734	56,607	916,592	5,925	168,083	3,092	5.46	114,686
1978.....	4,178	1,700	55,580	894,384	5,822	168,765	3,069	5.51	116,446
1979.....	3,963	1,667	54,679	872,253	5,772	169,577	3,047	5.57	118,359
1984.....	3,118	1,494	51,193	762,115	5,526	174,786	3,001	5.86	129,489
1989.....	2,612	1,280	50,068	641,463	5,130	182,975	3,030	6.05	144,829
1994.....	2,259	1,092	48,095	501,553	5,584	193,812	2,930	6.09	164,370
1999.....	1,916	943	43,179	348,269	6,573	203,219	2,590	6.00	183,288
2004.....	1,525	869	34,667	196,410	8,292	208,018	2,022	5.83	197,273

basic results produced by the new approach, using current actuarial assumptions. The first line produces the same basic results as the traditional valuation, but it is now possible to see the underlying benefit disbursements used as a basis for the costs. The traditional actuarial valuation results are misleading, however, because management knows that the work force will not remain a closed group. The results are updated, assuming that the size of the work force remains constant for the next thirty years. Table 5 shows these updated results. On the basis of the same actuarial assumptions as before, but with the introduction of an assumption about new entrants, the progress of pension plan costs in the future may readily be seen. The projection shows that because of the many current retirees the disbursements from the fund actually will decrease during the next several years. Table 5 shows further how the fund would have progressed in the next thirty years in comparison with the entry age liability, the liability for vested benefits, and the liability for accrued benefits, assuming that contributions remained at amortization of the unfunded actuarial liability over the thirty years from 1974 through 2004. The funding passes the liability for vested benefits in 1977, passes the liability for accrued benefits in 1979, and, as expected, is fully funded on an entry age basis in 2004.

Having shown management the basic picture of where costs are going, the actuary next wishes to make the assumptions realistic. He would like to see what effect, if any, the realistic assumptions have on the incidence or size of costs, bearing in mind that the present assumptions, when viewed together, produce little in the way of gains or losses. In the past, whenever the Social Security Act was changed, there was an immediate gain to the plan; now it is decided to anticipate these gains. The new set of assumptions (shown in Exhibit 3) reveals that interest rates definitely are higher than previously assumed; that salary increases are greater; that the vested benefit and early retirement provision should be valued as separate benefits, not lumped together in the retirement benefit; and that social security benefits will increase in the future. Table 6 reflects the new results. The outlays from the fund will be significantly larger than is shown in Table 5 because of the increase in the salary scale and because disbursements will occur sooner because of the early retirement utilization. For 1974 the normal cost and actuarial liability are substantially lower, primarily because future increases in social security benefits have been anticipated. The 1974 recommended contribution decreases from $5,487,000 to $3,678,000 as a result of the changes in assumptions. However, both management and the actuary agree that assumptions must be able to stand alone and that these figures better represent what will

TABLE 5

FORECAST OF VALUATION RESULTS FOR ABC CORPORATION'S CURRENT PENSION PLAN

(Using Actuarial Assumptions Shown in Exhibit 2 and Assuming Active Population Remains Constant; 000 Omitted from Dollar Figures)

YEAR	NO. ACTIVE	NO. RETIRED	EARNINGS	PRESENT VALUE OF FUTURE EARNINGS	BENEFIT PAYMENTS	PRESENT VALUE OF FUTURE BENEFITS	NORMAL COST		ACTUARIAL LIABILITY	FUND	CONTRIBUTION		LIABILITY FOR ACCRUED BENEFITS	LIABILITY FOR VESTED BENEFITS
							Dollars	% of Pay			Dollars	% of Pay		
1974	5,244	1,838	$ 60,715	$2,158,895	$6,054	$240,835	$3,231	5.32%	$109,820	$ 69,236	$ 5,487	9.04%	$ 90,649	$ 82,931
1975	5,244	1,805	61,777	2,182,107	6,069	244,295	3,307	5.35	111,399	71,539	5,564	9.01	88,821	81,358
1976	5,244	1,770	63,209	2,205,144	5,936	247,878	3,413	5.40	113,105	73,997	5,669	8.97	88,006	79,929
1977	5,244	1,734	64,558	2,227,612	5,925	251,739	3,512	5.44	115,125	76,800	5,769	8.94	87,429	78,968
1978	5,244	1,700	66,189	2,249,576	5,822	255,767	3,631	5.49	117,340	79,829	5,887	8.89	86,944	77,667
1979	5,244	1,667	67,885	2,270,723	5,772	260,060	3,761	5.54	119,873	83,208	6,017	8.86	86,788	77,435
1984	5,244	1,494	78,611	2,358,645	5,526	284,872	4,560	5.80	137,120	105,224	6,817	8.67	90,722	76,862
1989	5,244	1,280	92,450	2,398,590	5,130	316,912	5,550	6.00	164,853	138,758	7,806	8.44	107,105	86,483
1994	5,244	1,092	107,891	2,364,023	5,584	356,769	6,629	6.14	205,384	186,348	8,886	8.24	138,494	115,703
1999	5,244	943	125,452	2,231,506	6,573	401,482	7,840	6.25	257,188	246,740	10,097	8.05	184,383	163,748
2004	5,244	883	147,365	1,963,949	8,555	449,103	9,374	6.36	320,807	320,807	9,374	6.36	244,729	219,806

happen than those used for the traditional valuation. Even though there might be room for further adjustment, it is decided to use these results to set the proper funding strategy.

Although management is comfortable with its current contribution policies, it would like to know whether the contributions have been too high considering the company's long-range objective of a fully funded liability for accrued benefits. Working from Table 6, using current philosophy, company contributions would go from 6.06 per cent of payroll

EXHIBIT 3

REVISED ASSUMPTIONS

Mortality: No change
Interest: 6%
Turnover: Sample rates:

AGE	COMPLETED SERVICE			
	0	2	4	Salaried
20.....	.320	.224	.200	.170
25.....	.287	.207	.182	.159
30.....	.256	.167	.130	.096
35.....	.238	.144	.099	.047
40.....	.171	.115	.076	.023
45.....	.076	.057	.039	.016
50.....	0	0	0	0

Salary increase: Rates of increase for selected ages:

Age	Male	Female
20.....	.0879	.0401
30.....	.0688	.0405
40.....	.0655	.0395
50.....	.0590	.0397
60.....	.0300	.0300

Retirement: Selected rates:

Age.....	55	60	62	65
Rate.....	.050	.578	.333	1.000

Social security: Social Security Act, based on amendments through January 1, 1974, with assumed future annual increases of 5% in taxable wage base and 3% in consumer price index.

TABLE 6

FORECAST OF VALUATION RESULTS FOR ABC CORPORATION'S CURRENT PENSION PLAN

(Using Actuarial Assumptions Revised according to Exhibit 3 and Assuming Active Population Remains Constant; 000 Omitted from Dollar Figures)

YEAR	EARNINGS	PRESENT VALUE OF FUTURE EARNINGS	BENEFIT PAYMENTS	PRESENT VALUE OF FUTURE BENEFITS	ENTRY AGE NORMAL COST		ACTUARIAL LIABILITY	FUND	CONTRIBUTION		LIABILITY FOR ACCRUED BENEFITS	LIABILITY FOR VESTED BENEFITS
					Dollars	% of Pay			Dollars	% of Pay		
1974.....	$ 60,715	$1,976,185	$ 6,054	$163,768	$2,029	3.34%	$ 93,293	$ 69,236	$3,678	6.06%	$ 72,739	$ 68,888
1975.....	62,510	2,030,398	6,234	167,361	2,095	3.35	94,809	71,056	3,744	5.99	71,840	67,997
1976.....	65,024	2,085,960	6,235	170,984	2,196	3.38	96,299	72,869	3,845	5.91	71,112	66,880
1977.....	67,751	2,142,192	6,286	174,824	2,304	3.40	97,985	74,897	3,953	5.83	70,423	65,963
1978.....	70,824	2,198,907	6,260	178,841	2,424	3.42	99,833	77,107	4,073	5.75	69,737	64,800
1979.....	74,258	2,255,767	6,205	183,127	2,568	3.46	101,948	79,606	4,217	5.68	69,199	64,286
1984.....	95,460	2,530,137	5,795	209,910	3,436	3.60	118,471	98,425	5,085	5.33	70,879	63,720
1989.....	121,752	2,758,366	5,895	247,453	4,441	3.65	147,837	130,863	6,090	5.00	84,198	73,180
1994.....	153,773	2,894,405	6,643	295,672	5,605	3.64	191,448	178,585	7,254	4.72	110,146	99,369
1999.....	191,391	2,871,075	8,501	354,130	6,898	3.60	251,086	243,724	8,547	4.47	157,657	148,964
2004.....	231,615	2,609,544	13,447	415,534	8,110	3.50	321,609	321,609	8,110	3.50	219,650	210,033

in 1974 to 3.50 per cent in 2004. To fully fund the liability for accrued benefits by 1994 would require a level contribution of 3.40 per cent of payroll from 1974 through 1994. In comparison, a contribution of normal cost plus interest on the unfunded actuarial liability would go from 5.85 per cent of payroll in 1974 to 4.09 per cent in 1994. By adopting a 3.42 per cent of payroll contribution, the ABC Corporation could have its liability for accrued benefits fully funded by 1994 and still be below the interest-only contribution. However, maintaining that level of funding for the ten years from 1994 to 2004 would require a contribution of 5.30 per cent of payroll.

Management of the ABC Corporation wants to liberalize vesting, basing it on ten years of service, and add a 50 per cent postretirement spouse's benefit (i.e., if the retiree dies, the spouse is entitled to 50 per cent of the retiree's pension).

If funds are available to fund accrued benefits by 1994 with a contribution below 6 per cent of payroll, the employer wants to subsidize early retirement somewhat by cutting the early retirement factors in half. Table 7 shows the net effect of the first two changes (vesting and the postretirement spouse's benefit). The required contribution is now 3.83 per cent of pay for the next twenty years and 5.87 per cent for the following ten years, well below the contribution based on thirty-year amortization of the unfunded actuarial liability (6.97 per cent in 1974). Table 7 is based upon the same set of actuarial assumptions used previously, except that the turnover has been adjusted in the tenth year to reflect the higher rate as a result of earlier vesting.

Table 8 shows the disbursements, normal cost, and actuarial liability in each future year of the three benefits provided for the current active employees. When subsidized early retirement is valued, it is interesting to note what happens to these benefits. Table 9 shows the combined impact of all these plan changes, on the basis of the retirement assumptions shown in Exhibit 4. To fully fund for accrued benefits by 1994 requires a contribution of only 4.65 per cent of payroll, but from 1994 to 2004 this would rise to 7.17 per cent of payroll. This compares with 8.26 per cent of payroll in 1974 and 4.56 per cent in 2004, which would have been the contribution rates based on thirty-year amortization of the unfunded actuarial liability. Even more interesting from the actuary's point of view is a comparison between Table 10 and Table 8. This shows how each of the three benefits is affected by the subsidized early retirement, which means not only an increase in early retirement benefits but an increase in the utilization of early retirement. The normal cost and the actuarial liability for vesting remain about the same. The cost of the retirement

TABLE 7

FORECAST OF VALUATION RESULTS FOR ABC CORPORATION'S PENSION PLAN WITH REVISED VESTING PROVISIONS AND A POSTRETIREMENT SPOUSE'S DEATH BENEFIT

(Using Actuarial Assumptions Revised according to Exhibit 3 and Assuming Active Population Remains Constant; 000 Omitted from Dollar Figures)

Year	Earnings	Present Value of Future Earnings	Benefit Payments	Present Value of Future Benefits	Entry Age Normal Cost		Actuarial Liability	Fund	Contribution		Liability for Accrued Benefits	Liability for Vested Benefits
					Dollars	% of Pay			Dollars	% of Pay		
1974.....	$ 60,715	$1,969,539	$ 6,054	$176,657	$2,276	3.75%	$ 97,760	$ 69,236	$4,231	6.97%	$ 72,739	$ 72,484
1975.....	62,490	2,023,352	6,235	181,024	2,349	3.76	99,806	71,643	4,304	6.89	72,272	72,005
1976.....	64,982	2,078,513	6,239	185,466	2,461	3.79	101,864	74,083	4,416	6.80	71,831	71,505
1977.....	67,668	2,134,343	6,294	190,170	2,581	3.81	104,162	76,787	4,536	6.70	71,540	71,145
1978.....	70,703	2,190,674	6,273	195,100	2,715	3.84	106,668	79,722	4,670	6.61	71,189	70,707
1979.....	74,093	2,247,168	6,225	200,348	2,875	3.88	109,487	82,997	4,830	6.52	70,960	70,512
1984.....	95,149	2,520,046	5,866	232,742	3,844	4.04	130,395	106,627	5,799	6.09	74,471	74,326
1989.....	121,440	2,746,735	6,058	277,414	4,970	4.09	165,909	145,783	6,925	5.70	90,969	90,829
1994.....	153,497	2,880,660	6,973	334,503	6,275	4.09	217,835	202,583	8,230	5.36	121,570	121,443
1999.....	191,331	2,853,982	9,105	403,626	7,731	4.04	288,296	279,567	9,686	5.06	175,032	174,897
2004.....	232,267	2,585,710	14,425	477,514	9,115	3.92	372,507	372,507	9,115	3.92	247,195	247,042

TABLE 8

FORECAST OF VALUATION RESULTS FOR CURRENT ACTIVE EMPLOYEES AND NEW ENTRANTS, BY TYPE OF BENEFIT, UNDER ABC CORPORATION'S PENSION PLAN WITH REVISED VESTING PROVISIONS AND A POSTRETIREMENT SPOUSE'S DEATH BENEFIT

(Using Actuarial Assumptions Revised according to Exhibit 3 and Assuming Active Population Remains Constant)

YEAR	BENEFITS FOR CURRENT ACTIVE EMPLOYEES (000 OMITTED)								
	Vested Benefits			Retirement Benefit			Postretirement Spouse's Death Benefit		
	Benefit Payments	Normal Cost	Actuarial Liability	Benefit Payments	Normal Cost	Actuarial Liability	Benefit Payments	Normal Cost	Actuarial Liability
1974	$ 0	$ 61	$ 352	$ 0	$1,970	$ 35,648	$ 0	$ 244	$ 4,085
1975	0	60	438	341	2,035	39,876	1	253	4,589
1976	0	62	528	512	2,134	44,074	4	266	5,132
1977	0	62	625	740	2,239	48,454	8	280	5,718
1978	0	64	729	898	2,356	52,973	13	295	6,350
1979	0	66	840	1,035	2,496	57,724	20	313	7,030
1984	0	78	1,543	1,664	3,342	86,598	71	424	11,302
1989	0	91	2,563	2,868	4,328	126,141	164	551	17,346
1994	11	106	4,003	4,657	5,472	176,920	324	596	25,556
1999	58	121	5,880	7,335	6,753	240,409	584	858	36,333
2004	177	126	8,069	12,695	7,980	312,118	1,007	1,009	49,871

TABLE 9

FORECAST OF VALUATION RESULTS FOR ABC CORPORATION'S PENSION PLAN WITH REVISED VESTING AND EARLY RETIREMENT PROVISIONS AND A POSTRETIREMENT SPOUSE'S DEATH BENEFIT

(Using Actuarial Assumptions Revised according to Exhibit 4 and Assuming Active Population Remains Constant; 000 Omitted from Dollar Figures)

Year	Earnings	Present Value of Future Earnings	Benefit Payments	Present Value of Future Benefits	Entry Age Normal Cost		Actuarial Liability	Fund	Contribution		Liability for Accrued Benefits	Liability for Vested Benefits
					Dollars	% of Pay			Dollars	% of Pay		
1974.....	$ 60,715	$1,961,287	$ 6,054	$195,160	$ 2,652	4.37%	$103,747	$ 69,236	$ 5,017	8.26%	$ 75,212	$ 74,957
1975.....	62,470	2,014,606	6,271	200,636	2,736	4.38	106,551	72,477	5,101	8.17	75,070	74,804
1976.....	64,938	2,069,263	6,304	206,218	2,865	4.41	109,387	75,775	5,230	8.05	74,599	74,273
1977.....	67,613	2,124,584	6,386	212,100	3,004	4.44	112,496	79,375	5,369	7.94	74,345	73,950
1978.....	70,651	2,180,388	6,391	218,252	3,161	4.47	115,855	83,254	5,526	7.82	74,384	73,902
1979.....	74,015	2,236,321	6,371	224,767	3,346	4.52	119,577	87,527	5,711	7.72	74,498	74,050
1984.....	94,913	2,506,242	6,180	264,253	4,463	4.70	145,866	117,109	6,828	7.19	81,985	81,840
1989.....	121,098	2,729,994	6,602	317,296	5,767	4.76	188,410	164,060	8,133	6.72	102,501	102,360
1994.....	153,013	2,860,541	7,855	384,056	7,276	4.76	249,344	230,891	9,641	6.30	140,091	139,964
1999.....	190,332	2,831,065	10,637	463,599	8,932	4.69	330,561	320,000	11,298	5.94	209,423	209,287
2004.....	231,412	2,561,191	16,838	546,985	10,558	4.56	425,969	425,969	10,558	4.56	293,631	293,476

benefit increases, but not as much as might be anticipated, because the subsidized early retirement factors and greater utilization are offset by lower final average earnings and fewer years of credit. Finally, the cost of the postretirement spouse's benefit does not increase in the same proportion as the retirement benefit, reflecting the smaller dollar benefits payable and the longer period over which the death benefit is deferred.

The net result of all these calculations is that the ABC Corporation has decided to adopt all plan changes, contributing 5.50 per cent of payroll to fully fund the liability for accrued benefits by 1994. This contribution rate will also keep the accrued benefit fully funded through 2004. Management's final concern is to add, if appropriate, some margin of safety. The ABC Corporation left its contribution at 5.50 per cent because, with an offset-type plan, the company would achieve a savings if

EXHIBIT 4

REVISED RETIREMENT ASSUMPTIONS

Selected rates:

Age	55	60	62	65
Rate	.100	.533	.333	1.000

Congress increases social security benefits. Moreover, management feels that a 6 per cent investment return is on the conservative side in today's marketplace.

The final step is to prepare the necessary material to support this accrual cost in order to satisfy the Internal Revenue Service for tax purposes and the auditors for statement purposes.

Conclusion

There is probably general agreement that, if a plan is fully funded on the entry age normal basis, the assets are more than enough to pay the pension obligations on a termination basis. Many people believe it probably is sufficient for a plan to be fully funded for all accrued benefits. The entry age method determines normal costs as a level percentage of payroll, while the accrued benefit method tends to produce normal costs that increase over time as a per cent of payroll. Until such time as a plan's assets are more than the liability for accrued benefits, a cost method that produces normal costs as a level percentage of payroll is preferable to one that produces costs that increase as a percentage of payroll. On the other hand, once a plan's assets are equal to its liability for

TABLE 10

FORECAST OF VALUATION RESULTS FOR CURRENT ACTIVE EMPLOYEES AND NEW ENTRANTS, BY TYPE OF BENEFIT, UNDER ABC CORPORATION'S PENSION PLAN WITH REVISED VESTING AND EARLY RETIREMENT PROVISIONS AND A POSTRETIREMENT SPOUSE'S DEATH BENEFIT

(Using Actuarial Assumptions Revised according to Exhibit 4 and Assuming Active Population Remains Constant)

YEAR	BENEFITS FOR CURRENT ACTIVE EMPLOYEES (000 Omitted)								
	Vested Benefits			Retirement Benefit			Postretirement Spouse's Death Benefit		
	Benefit Payments	Normal Cost	Actuarial Liability	Benefit Payments	Normal Cost	Actuarial Liability	Benefit Payments	Normal Cost	Actuarial Liability
1974	$ 0	$ 62	$ 357	$ 0	$2,311	$ 41,098	$ 0	$ 280	$ 4,616
1975	0	61	444	378	2,385	46,014	1	290	5,190
1976	0	62	535	577	2,498	50,913	4	304	5,808
1977	0	63	633	831	2,621	56,023	8	320	6,475
1978	0	64	737	1,015	2,758	61,307	14	338	7,195
1979	0	66	849	1,179	2,921	66,864	22	359	7,970
1984	0	78	1,556	1,971	3,901	100,512	79	484	12,845
1989	0	91	2,580	3,392	5,048	146,229	184	628	19,741
1994	11	106	4,025	5,495	6,376	204,855	368	794	29,108
1999	58	120	5,906	8,783	7,838	277,601	668	974	41,378
2004	177	125	8,099	14,957	9,284	358,672	1,157	1,149	56,753

accrued benefits, the normal cost produced under the accrued benefit cost method might be preferable if it does not fluctuate too wildly. The forecast valuation method is a means to get the best out of both methods, by paying a percentage of payroll each year until the assets of the plan equal the liability for accrued benefits or other bench-mark liability and then paying a smaller percentage of payroll cost to keep the plan fully funded on a projected basis—that is, an established bench mark to be met ten or more years in the future.

This kind of funding strategy can be followed only if the appropriate liabilities can be projected several years into the future, so that the appropriate level percentage of payroll contribution can be established. It is the author's opinion that the forecast valuation method is an appropriate technique for setting funding strategy, provided, of course, that the bench-mark liability is enough to provide security for all employees covered by the pension plan.

APPENDIX I

SERVICE TABLE CALCULATIONS

CASE A

All decrements except retirement occur halfway through the year; retirements occur at the end of the year.

$$q_x^{(T)} = 1 - [(1 - q_x'^{(m)})(1 - q_x'^{(w)})(1 - q_x'^{(i)})(1 - q_x'^{(r)})],$$

where $q_x'^{(r)}$ is the probability that a person will retire at age $x + 1$ (i.e., the end of the year in which he was aged x at the beginning of the year). It is assumed that $q_x'^{(r)}$ applies after all the other decrements. We know that

$$m_x^{(m)} = \frac{q_x'^{(m)}}{1 - \frac{1}{2}q_x'^{(m)}},$$

$$m_x^{(w)} = \frac{q_x'^{(w)}}{1 - \frac{1}{2}q_x'^{(w)}},$$

$$m_x^{(i)} = \frac{q_x'^{(i)}}{1 - \frac{1}{2}q_x'^{(i)}};$$

therefore,

$$q_x^{(m)} = \left(1 - \frac{1 - q_x^{(T)}}{1 - q_x'^{(r)}}\right) \frac{m_x^{(m)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}},$$

$$q_x^{(w)} = \left(1 - \frac{1 - q_x^{(T)}}{1 - q_x'^{(r)}}\right) \frac{m_x^{(w)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}},$$

$$q_x^{(i)} = \left(1 - \frac{1 - q_x^{(T)}}{1 - q_x'^{(r)}}\right) \frac{m_x^{(i)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}},$$

$$q_x^{(r)} = \frac{1 - q_x^{(T)}}{1 - q_x^{(r)}} q_x'^{(r)}.$$

CASE B

All decrements except retirement occur halfway through the year; retirements occur at the beginning of the year.

$$q_x^{(r)} = 1 - [(1 - q_x'^{(r)})(1 - q_x'^{(m)})(1 - q_x'^{(w)})(1 - q_x'^{(r)})],$$

where $q_x'^{(r)}$ is the probability that a person aged x will retire immediately. Central rates of decrement are defined as in Case A. Then

$$q_x^{(r)} = q_x'^{(r)},$$

$$q_x^{(m)} = [q_x^{(T)} - q_x^{(r)}] \frac{m_x^{(m)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}},$$

$$q_x^{(w)} = [q_x^{(T)} - q_x^{(r)}] \frac{m_x^{(w)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}},$$

$$q_x^{(i)} = [q_x^{(T)} - q_x^{(r)}] \frac{m_x^{(i)}}{m_x^{(m)} + m_x^{(w)} + m_x^{(i)}}.$$

APPENDIX II

TRADITIONAL VALUATION COST CALCULATIONS

INDIVIDUAL ENTRY AGE NORMAL

To generate entry age cost calculations, it is necessary to generate the service table "backwards" from the employee's current age to his entry age into the plan and to generate the benefit disbursements that might have been made due to decrements that occurred before the current valuation date. For example, if there are assumed retirement decrements occurring between ages 55 and 65 and the employee is currently aged 60, it is necessary to generate the benefit disbursements that might have been made according to the retirement assumptions being used. Another way of looking at it is to try to estimate how many people actually retired

between ages 55 and 60 and the benefits they are receiving. Once the items are known for each age from entry into the plan, it is a relatively simple matter to get the normal cost and actuarial liability for each individual.

The first step is to obtain a normal cost factor (NCF) for the individual as follows:

$$NCF = \frac{PVFB'_e}{PVFE_e},$$

where $PVFB'_e$ is the present value of all benefits as viewed from entry age, that is, benefits that might have been payable due to decrements before the valuation date as well as those occurring after the valuation date. Then the normal cost at age $e + s$ is

$$NC_{e+s} = NCF \; PE_{e+s}.$$

Then the present value of future normal costs at age $e + s$ is

$$PVFNC_{e+s} = \sum_{t=s}^{\infty} v^{t-s} NC_{e+t},$$

where it is assumed that normal cost is payable at the beginning of the year. The actuarial liability at any age $x + t$ is then

$$AL_{x+t} = PVFB_{x+t} - PVFNC_{x+t}.$$

The normal cost and actuarial liability can be determined for each benefit separately or for all benefits combined, depending on the present value of benefits used in the calculation.

The above formulas are used to calculate the normal cost as a level percentage of payroll. To calculate normal cost as a level dollar amount, the formulas could have been exactly the same if, when the present value of earnings was determined, PE_y had been calculated as $l_x^{(T)}/l_y^{(T)}$.

ACCRUED BENEFIT

When the attempt is made to obtain a normal cost and actuarial liability under an accrued benefit cost method, the determination is not nearly as easy as it is under the projected benefit cost method. The concept is not difficult to comprehend, but it is much more time-consuming to obtain results with the same flexibility in the choice of assumptions as we had under the projected benefit cost method. Aside from the possible problem of trying to allocate benefit accruals each year under a final pay plan, there is also the problem with a multiple retirement age assumption of obtaining the present value of the benefit accrued for each year. Because we want to avoid the use of commutation functions, we first have

to determine the benefit accrual in each year; then, using that benefit, we have to follow the individual through his service table to find out when the benefit would be payable and, thereby, determine the present value of that benefit accrual. This would determine the normal cost; the actuarial liability would be determined under the same procedure, except that the total accrued benefit would be used rather than the benefit accrual for the year in question.

Thus, for a life annuity form of income benefit payout,

$$NC_z = BEN_z\left\{\sum_{t=0}^{\infty}\frac{d_{z+t}^{(m)}}{l_x^{(T)}}\left[v^{r+t}(1-k)\frac{l_{z+t+r}^{(m)}}{l_{z+t+k}^{(m)}}+\sum_{s=t+1}^{\infty}v^{s+r}\frac{l_{z+s+r}^{(m)}}{l_{z+t+k}^{(m)}}\right]\right\},$$

where BEN_z is the benefit accrual during the year between age z and $z+1$, r is the time of the year the benefit is assumed payable, and k is the time during the year when decrements occur.

$$AL_z = TBEN_z\left\{\sum_{t=0}^{\infty}\frac{d_{z+t}^{(m)}}{l_x^{(T)}}\left[v^{r+t}(1-k)\frac{l_{z+t+r}^{(m)}}{l_{z+t+k}^{(m)}}+\sum_{s=t+1}^{\infty}v^{s+r}\frac{l_{z+s+r}^{(m)}}{l_{z+t+k}^{(m)}}\right]\right\},$$

where $TBEN_x$ is the total benefit accrual at age x.

DISCUSSION OF PRECEDING PAPER

A. J. C. SMITH:

I have been much involved during the last two or three years in developing applications for actuarial forecasting techniques, and it is a pleasure to read—and there was a certain fascination in reading—a paper on the work of another actuary who has been involved in similar study.

David Howe and I presented a paper entitled "The Practical Application of Cash Flow Techniques to Pension Plans" to the Canadian Institute of Actuaries in March, 1974. Mr. Fleischer's approach has a number of things in common with ours. I was particularly aware of this when reading his comments on the uses of the forecast valuation method. He states that its principal purpose is to set proper funding strategy and that it will contribute to the communication with management so necessary to the consulting actuary. There are, however, differences between us. Mr. Fleischer's paper discusses the application of the technique to the customary actuarial valuation process and, consequently, applies it within the bounds of the profession. I feel that its most valuable application is its use to extend the actuary's role in the development of the business plans of his clients. It is true that, "operating within the constraints of the assumptions, the forecast method allows the actuary and management to fully analyze the pension plan," but the greatest advantage of the method is that it enables the actuary and management to complete an analysis that transcends the constraints of the assumptions.

In the past few years a great deal has been said and written about the future, speculating about it and preparing for it. Our attention has been caught by the increased rate of change in society and the rapidity with which the future is upon us. In this environment it is vital to try to reduce the risks in forecasting. Dr. Samuel Johnson warned us of the dangers of wishful thinking: "The future not yet being experienced is pliant and ductile in our thinking and will be imperceptibly molded by what we wish it to be rather than what in reality it may become." Psychologists writing about forecasting have discussed the tendency of the mind to adhere to the single future possibility that appears most probable or perhaps most desirable, while rejecting the more difficult alternative of contemplating a variety of future possibilities. If forecasting is the heart of actuarial science and the actuary is to be the

prophet in the field of financing employee benefits, we must have techniques that minimize the risks in prediction. And this is where the approaches explored in the paper should have their application. By quantification we can increase objectivity; by examining a variety of alternatives we can reduce the dangers of basing decisions only on the most likely eventuality; and by simulation we can communicate results in a way that creates understanding.

In his paper Mr. Fleischer stresses the need for "realistic assumptions" and seems to use this expression variously to describe the assumptions that are "most likely," "most likely with a consistent margin for conservatism," and "comparably placed in the distributions of possible assumptions." However, he is writing of the accepted role of the actuary and applying his cash-flow techniques to the traditional actuarial valuation. By doing so, he may somewhat improve the valuation process, although in its many forms the regular actuarial valuation seems to me to have the flexibility to respond to most of the demands that are placed upon it, but he misses the possibility of much broader application.

With respect to many of the assumptions involved in making an actuarial valuation or forecast, the client's input is at least as valuable as the actuary's. If, after extensive consultation with the client, a variety of sets of assumptions are discovered that are linked to the possible developments in the client's business, a number of desirable things become possible:

1. A study can be made which produces financial results with respect to the client's employee benefit program that are based on the assumptions used in his overall business planning and are in consequence most useful and comprehensible to him.
2. A variety of results can be produced that are based on assumptions and variations in assumptions in which the client is interested; the practical effect and consequently the significance of particular variations can be established.
3. The client's understanding of the results of the study is increased because of his involvement in the setting of the assumptions and the insight this gives him not only into the effect of changes in assumptions but into the actuarial calculation process.
4. The actuary can demonstrate the practical nature of his service to the client, enhancing the actuarial profession's reputation for providing a worthwhile service and helping to bury some of the old legends about actuaries in ivory towers.

ROBERT J. SCHNITZER:

Mr. Fleischer's paper is an important addition to the body of actuarial literature, in that it represents the first detailed description of a relatively new technique for pension cost determination. The paper should serve

as a springboard for further discussion and analysis by pension actuaries, so that projection valuation methods will become widely understood and generally accepted by actuaries and clients alike.

My purposes in writing this discussion are to reemphasize the strong points of forecast valuation techniques, to describe some alternatives in the design of a projection system which our firm has employed, and to point out an important area where additional thought and research are needed in the development of projection techniques.

Advantages of a Projection Valuation Method

There are two major attributes of a forecast, or projection, valuation method which seem to me to favor its use above traditional actuarial cost methods: (1) it provides a great deal more information about the expected course of plan funding in years following the valuation date, and (2) it provides the means for making an explicit assumption about future new entrants to a plan (or the lack thereof).

Through the use of a forecast technique, the actuary can provide his client and the client's investment advisers with cash-flow information that would be invaluable to those advisers in setting investment strategy and to the plan sponsor in budgeting future expenses. By showing on a year-by-year basis both the liability for vested benefits and the plan's assets, the accountants for the plan sponsor would have a better grasp of the information they need for footnotes to annual statements. Similarly, a year-by-year comparison of plan assets with the liabilities for accrued benefits on a plan termination basis shows the plan sponsor how the benefit-security ratio progresses under a given schedule of contributions.

A section of the conference committee joint explanation of the Employee Retirement Income Security Act is worth repeating here, since it appears to require plan fiduciaries to obtain the information which a cash-flow projection provides:

> Under the labor provisions of the substitute, each plan is to provide a procedure for establishing a funding policy and method to carry out the plan objectives. This procedure is to enable the plan fiduciaries to determine the plan's short- and long-run financial needs and communicate these requirements to the appropriate persons. For example, with a retirement plan it is expected that under this procedure the persons who manage the plan will determine whether the plan has a short-run need for liquidity (e.g., to pay benefits) or whether liquidity is a long-run goal and investment growth is a more current need. This in turn is to be communicated to the persons responsible for investments, so that investment policy can be appropriately coordinated with plan needs.

The other advantage of projection valuation methods—the ability to include future new entrants—is an important feature for valuing plans whose participant groups are not stable. The implicit assumption inherent in traditional cost methods is either that there are no future new entrants or that future new entrants will have the same characteristics as prior years' entrants. This implicit assumption could be widely different from the expected experience under the plan and could produce substantial actuarial gains or losses. At a time when actuaries are required to choose assumptions that represent their best estimates of anticipated experience, it seems incumbent upon us to develop techniques that permit a best estimate regarding future participant group growth rates.

Alternatives in System Design

The forecast valuation system that Mr. Fleischer describes is exceedingly complex, although the underlying logic of each part is fairly simple. The system that our firm has developed is not quite as sophisticated as Mr. Fleischer's, and I thought it would be helpful to describe briefly our approach so that actuaries who are considering the development of their own systems could start at a somewhat simpler level.

Our first step is to rearrange the census data provided by the client into various files, with employees grouped according to the characteristics described below:

1. Actives, by sex, age, and continuous service to valuation date.
2. Retirees, by sex, age, and form of annuity.
3. Beneficiaries under term-certain annuities, by remaining years of benefits.
4. Vested terminees, by sex and age.
5. Disabled employees, by sex and age.

The first program in the system creates these summary files and computes accrued and vested liabilities as of the valuation date.

The second program is the heart of the system, since it projects the plan population for as many years as are desired. In our system all decrements are assumed to occur at the end of the year, but this can easily be adjusted to midyear occurrences if it is preferred. Using tables of mortality, disablement, and termination (including retirement) rates, each category of employee or former employee is followed from the beginning of the year to the end of the year:

1. Actives at the beginning of the year can die, can become disabled, or can terminate with or without vested benefits, or can retire; fractional amounts of people, benefits, and liabilities are put into appropriate cells of the corresponding year-end files for retirees, vested terminees, or disabled lives. If the

plan has a surviving spouse's pension, a death can create an entry in the retiree file. If there are returns of employee contributions upon death or non-vested terminations, there is an entry created in a file of lump-sum payouts. The remaining actives are put into the active file as of the end of the year.

2. Retirees can either die or survive. The type of entry that is created in the event of death depends on the form of annuity.
3. Vested terminees and disabled lives can either die, retire, or survive to the next year end. We have assumed that all retirees elect the plan's normal form of annuity.
4. Beneficiaries under term-certain annuities have their benefit period reduced one year.

For each category, present values of accrued and vested benefits are computed using commutation functions. This is not as flexible as the approach Mr. Fleischer uses, but we felt that additional accuracy not only might be specious but would require considerably more computer time and expense.

When all the decrements from the active lives have been computed, it is then possible to determine the number of new entrants to be created. For example, if you have assumed a 5 per cent growth rate, and you start the year with 10,000 employees and end up with 9,200, then you need to add 1,300 new participants ($1.05 \times 10{,}000 - 9{,}200$). We add these additional employees to the active file in accordance with a pattern which distributes them into predetermined age and sex categories. They are assigned a salary equal to the average salary for the age-sex cell into which they are placed.

The third phase of the system merely creates a summary file, containing information for each year as to numbers of people in each category, actives' salaries and employee contributions, benefits paid to retirees and beneficiaries, and liabilities for vested and accrued benefits.

In the fourth program we use a table of investment return rates to discount future benefits, salaries, and accrued liabilities and to determine the level percentage of payroll needed to fund the accrued liability by a given year end. Exhibits I and II are examples of the output of this program. Since the plan being valued has no disability provision, we eliminated the column for disabled lives from Exhibit I.

The fifth, and final, program uses a table either of contribution rates (fractions of payroll) or of dollar amounts of contributions to project the fund and to compare assets and liabilities year by year. The cash-flow information which is such an important aspect of this system is produced at this stage. Exhibits III and IV are sample output from this program.

EXHIBIT I

FORECAST OF PARTICIPANTS, PAYROLL, BENEFITS, AND ACCRUED LIABILITY

Year	Active Participants	Retirees and Beneficiaries	Vested Terminees	Total	Annual Payroll	Benefits Paid in Year	Accrued Liability End of Year
1975...	1,971	89	12	2,072	35,685,236	242,836	6,698,050
1976...	2,109	105	30	2,244	39,981,520	292,596	7,770,168
1977...	2,256	110	53	2,419	44,669,651	314,021	9,449,405
1978...	2,414	119	76	2,609	49,778,078	424,319	11,483,448
1979...	2,583	127	103	2,813	55,517,415	479,716	14,281,755
1980...	2,764	135	136	3,035	61,973,164	662,203	16,239,838
1981...	2,958	140	171	3,269	68,991,083	727,753	18,579,564
1982...	3,165	154	208	3,527	76,793,112	811,707	21,196,187
1983...	3,387	164	252	3,803	85,578,906	906,143	24,105,299
1984...	3,624	177	295	4,096	95,237,561	1,051,304	27,452,154
1985...	3,878	197	336	4,411	106,280,025	1,215,009	31,574,290
1986...	4,149	217	380	4,746	118,450,533	1,445,227	35,620,387
1987...	4,439	233	429	5,101	132,356,541	1,623,738	40,251,525
1988...	4,749	251	481	5,481	148,045,693	1,824,211	45,344,956
1989...	5,082	271	536	5,889	165,707,268	2,087,063	51,003,108
1990...	5,438	297	593	6,328	185,806,267	2,377,589	57,668,609
1991...	5,818	321	654	6,793	208,180,600	2,739,040	64,664,519
1992...	6,226	345	720	7,291	233,898,410	3,019,482	73,789,036
1993...	6,662	372	788	7,822	262,925,260	3,513,071	82,495,409
1994...	7,128	404	862	8,394	295,542,145	4,060,252	92,182,033

EXHIBIT II

CALCULATION OF FUNDING LEVEL

Year N	Present Value as of January 1, 1975				Cost as Level Percentage of Pay‡
	Benefits and Liabilities*	Assets	Funding Deficiency	Future Payroll†	
1975.....	6,554,878	3,781,000	2,773,878	35,685,236	7.77%
1976.....	7,419,607	3,781,000	3,638,607	73,403,651	4.96
1977.....	8,709,655	3,781,000	4,928,655	113,159,481	4.36
1978.....	10,217,903	3,781,000	6,436,903	154,954,116	4.15
1979.....	12,163,320	3,781,000	8,382,320	198,929,108	4.21
1980.....	13,420,439	3,781,000	9,639,439	245,239,062	3.93
1981.....	14,826,982	3,781,000	11,045,982	293,875,053	3.76
1982.....	16,293,814	3,781,000	12,512,814	344,946,858	3.63
1983.....	17,815,389	3,781,000	14,034,389	398,640,122	3.52
1984.....	19,481,293	3,781,000	15,700,293	455,011,088	3.45
1985.....	21,444,348	3,781,000	17,663,348	514,357,299	3.43
1986.....	23,253,428	3,781,000	19,472,428	576,755,562	3.38
1987.....	25,206,782	3,781,000	21,425,782	642,532,708	3.33
1988.....	27,222,470	3,781,000	23,441,470	711,942,306	3.29
1989.....	29,345,152	3,781,000	25,564,152	785,234,791	3.26
1990.....	31,728,377	3,781,000	27,947,377	862,765,254	3.24
1991.....	34,089,143	3,781,000	30,308,143	944,714,774	3.21
1992.....	37,016,164	3,781,000	33,235,164	1,031,576,321	3.22
1993.....	39,626,389	3,781,000	35,845,389	1,123,690,553	3.19
1994.....	42,407,362	3,781,000	38,626,362	1,221,371,077	3.16

* Discounted value as of valuation date of benefits to be paid through year N, plus discounted value of accrued liability at end of year N.

† Discounted value as of valuation date of payroll in years from valuation date through year N.

‡ Percentage of pay to be contributed in years through year N to pay benefits and accumulate assets to equal accrued liability at end of year N.

EXHIBIT III

PROJECTION OF CONTRIBUTIONS AND ASSETS

Year	Annual Payroll	Contributions as Percentage of Payroll	Beginning-of-Year Assets	Plan Contribution	Benefit Payments	Investment Return*	End-of-Year Assets	Contributions minus Benefits
1975..	35,685,236	3.16%	3,781,000	1,128,560	242,836	287,289	4,954,013	885,724
1976..	39,981,520	3.16	4,954,013	1,264,432	292,596	364,329	6,290,178	971,836
1977..	44,669,651	3.16	6,290,178	1,412,696	314,021	452,752	7,841,605	1,098,675
1978..	49,778,078	3.16	7,841,605	1,574,252	424,319	552,222	9,543,760	1,149,933
1979..	55,517,415	3.16	9,543,760	1,755,760	479,716	663,580	11,483,384	1,276,044
1980..	61,973,164	3.16	11,483,384	1,959,926	662,203	786,733	13,567,840	1,297,723
1981..	68,991,083	3.16	13,567,840	2,181,871	727,753	923,150	15,945,108	1,454,118
1982..	76,793,112	3.16	15,945,108	2,428,613	811,707	1,078,072	18,640,086	1,616,906
1983..	85,578,906	3.16	18,640,086	2,706,467	906,143	1,253,609	21,694,019	1,800,324
1984..	95,237,561	3.16	21,694,019	3,011,926	1,051,304	1,450,818	25,105,459	1,960,622
1985..	106,280,025	3.16	25,105,459	3,361,148	1,215,009	1,671,546	28,923,144	2,146,139
1986..	118,450,533	3.16	28,923,144	3,746,045	1,445,227	1,916,795	33,140,757	2,300,818
1987..	132,356,541	3.16	33,140,757	4,185,829	1,623,738	2,190,883	37,893,731	2,562,091
1988..	148,045,693	3.16	37,893,731	4,682,004	1,824,211	2,499,818	43,251,342	2,857,793
1989..	165,707,268	3.16	43,251,342	5,240,559	2,087,063	2,846,902	49,251,740	3,153,496
1990..	185,806,267	3.16	49,251,740	5,876,198	2,377,589	3,236,349	55,986,698	3,498,609
1991..	208,180,600	3.16	55,986,698	6,583,795	2,739,040	3,672,058	63,503,511	3,844,755
1992..	233,898,410	3.16	63,503,511	7,397,131	3,019,482	4,163,454	72,044,614	4,377,649
1993..	262,925,260	3.16	72,044,614	8,315,117	3,513,071	4,716,192	81,562,852	4,802,046
1994..	295,542,145	3.16	81,562,852	9,346,639	4,060,252	5,332,762	92,182,001	5,286,387

* Including dividends, interest, and realized and unrealized appreciation.

EXHIBIT IV

COMPARISON OF ASSETS AND LIABILITIES

End of Year	Liability for:		Trust Assets	Unfunded Liability for:	
	Accrued Benefits	Vested Accrued Benefits		Accrued Benefits	Vested Accrued Benefits
1975...	6,698,050	5,833,775	4,954,013	1,744,037	879,762
1976...	7,770,168	6,861,095	6,290,178	1,479,990	570,917
1977...	9,449,405	8,388,330	7,841,605	1,607,800	546,725
1978...	11,483,448	10,040,243	9,543,760	1,939,688	496,483
1979...	14,281,755	12,682,215	11,483,384	2,798,371	1,198,831
1980...	16,239,838	14,462,803	13,567,840	2,671,998	894,963
1981...	18,579,564	16,625,055	15,945,108	2,634,456	679,947
1982...	21,196,187	19,130,618	18,640,086	2,556,101	490,532
1983...	24,105,299	21,757,885	21,694,019	2,411,280	63,866
1984...	27,452,154	24,897,471	25,105,459	2,346,695	− 207,988
1985...	31,574,290	28,740,194	28,923,144	2,651,146	− 182,950
1986...	35,620,387	32,513,270	33,140,757	2,479,630	− 627,487
1987...	40,251,525	36,856,888	37,893,731	2,357,794	−1,036,843
1988...	45,344,956	41,683,960	43,251,342	2,093,614	−1,567,382
1989...	51,003,108	47,012,668	49,251,740	1,751,368	−2,239,072
1990...	57,668,609	53,269,282	55,986,698	1,681,911	−2,717,416
1991...	64,664,519	59,832,342	63,503,511	1,161,008	−3,671,169
1992...	73,789,036	68,548,922	72,044,614	1,744,422	−3,495,692
1993...	82,495,409	76,901,217	81,562,852	932,557	−4,661,635
1994...	92,182,033	86,031,308	92,182,001	32	−6,150,693

Need for Additional Research

The one important area that Mr. Fleischer did not discuss, which is crucial to the use of projection methods as an ongoing valuation technique, is the procedure to be followed in valuations after the initial one. I do not have the answers as yet, but it is my hope that other actuaries have considered the problem and will share their thoughts with us.

The basic issue can be stated this way: If you have chosen a particular funding objective as of a date, say, twenty years hence, then, at valuation dates after the initial one, do you determine a new funding level based on the original target date, or do you establish a new funding level based on a target twenty years from the current valuation date? This is really a question of the treatment of actuarial gains and losses, and the answer must be governed in part by the requirements of ERISA. Certainly in the next few years there will be many refinements of the projection valuation methods, but it seems that the issues of ongoing valuation technique need to be addressed now.

R. K. KISCHUK:

Mr. Fleischer is to be congratulated on his thorough and excellent documentation of the forecast valuation method. This is certainly a very timely contribution to the actuarial literature, given the increasing complexity of the pension field, the increased flexibility in valuation techniques brought about by modern computers, and the growing sophistication of management with regard to pension matters.

The forecast valuation method, as presented in the paper, is most appropriate for relatively large groups. For smaller groups the year-by-year forecast of benefit disbursements would not bear a very close relationship to the actual benefit disbursement due to fluctuations in experience. This would be especially true in costing such ancillary benefits as disability, death, termination, and subsidized early retirement benefits. Another important barrier to the use of this method for smaller plans is the higher cost involved. This is especially true to the extent that alternate valuations are required in order to satisfy accounting and governmental requirements.

Yet smaller plans are often faced with situations where it would be preferable to evolve a sound funding strategy based upon projections involving new entrants and upon the attainment of a funding objective at a given point in time in the future. The author gives six examples of long-range problems relating to pension funding, which could easily be faced by plans which are much smaller than the relatively large groups for which the method is most appropriate.

In meeting the needs of the smaller plan, a simplified version of the forecast valuation method will often prove useful. This simplified method is similar to the method outlined in the paper, since it includes new entrants in the calculation and involves setting a funding strategy toward a bench-mark liability. However, the simplified method does differ in that it does not produce a forecast of year-by-year experience under the plan and it makes much freer use of approximations in setting the assumptions and valuing ancillary benefits.

The freer use of approximations is justified by the smaller size of the group. The use of exact methods would produce only small refinements in the results, relative to the cost of making the calculations. The actuary would have to determine the extent to which approximations would be used, based upon the size of the group and the purpose for which the calculations were being performed.

Similarly, the value of a year-by-year forecast of plan experience would be very limited in the case of most smaller plans. Actual plan experience will normally fluctuate a great deal from the predicted year-by-year results but may conform rather closely to the assumptions over longer periods of time.

The simplified version of the forecast valuation method is suitable for those groups that are of sufficient size that the plan experience would be expected to conform fairly closely to the assumptions over the period in question, disregarding year-by-year fluctuations. A margin for contingencies would be added to the final results to allow for adverse fluctuation in experience over the period as a whole.

A rough outline of the method is as follows. First, an appropriate period of time is selected for the study. The current participant group is then projected to the end of the forecast period, using the salary assumption; probabilities of remaining in the participant group for that length of time, or ${}_np_x^{(t)}$; and such other assumptions and approximations as may be appropriate. The number of active plan members at the end of the projection period can be subtracted from the number of employees expected in the work force at that time. The number and profile of new entrants during the forecast period can be obtained by working backward, using approximations according to the judgment of the actuary.

The total present value of future benefits and the total present value of future salaries may then be determined as of the beginning and end of the forecast period, including new entrants during the period. The liability for accrued benefits is also determined as of the end of the period, based on the expected work force, assuming that this is the bench-mark liability. Suitable approximations may be used in obtaining these num-

bers. The valuation techniques used will be basically those of the traditional actuarial valuation.

When these numbers have been obtained, some useful cost data can be developed. First, the level percentage of payroll needed to provide benefit payments during the forecast period may be obtained as follows:

$$P_1 = \frac{TPVB_0 - v^n TPVB_n}{TPVE_0 - v^n TPVE_n},$$

where

$TPVB_t$ = Total present value of benefits to be paid at duration t and later;

$TPVE_t$ = Total present value of earnings to be paid at duration t and later;

n = Length of the forecast period;

v^n = n-year discount factor at the valuation rate of interest.

The level additional percentage of payroll needed to fully fund the liability for accrued benefits by the end of the forecast period is obtained as follows:

$$P_2 = \frac{v^n TLAB_n}{TPVE_0 - v^n TPVE_n},$$

where $TLAB_n$ is the total liability for accrued benefits based on the expected work force at the end of the forecast period.

The level percentage of payroll equivalent of the initial fund value is calculated as follows:

$$P_3 = \frac{F_0}{TPVE_0 - v^n TPVE_n},$$

where F_0 is the balance of the pension fund at the beginning of the projection period.

The level percentage of payroll needed during the forecast period in order to attain the funding objective is, therefore, $P_1 + P_2 - P_3$. To this, a sufficient margin for contingencies should be added. New entrants beyond the forecast period are ignored for purposes of these calculations, since they do not affect the percent of payroll figures.

The simplified version of the forecast valuation method provides a short-cut method of obtaining the desired percentage of payroll costs. Approximations can be used to the extent desired, provided that the results are sufficiently qualified and an appropriate margin for contingencies is used. Still, in many cases, management will be looking only for a rough answer to a given question. By simplifying the calculations, the answer can be provided in a shorter time frame and with a minimum of cost.

PETER L. HUTCHINGS:

Mr. Fleischer's paper provides a convenient summary of the characteristics of this pension technique. Life insurance actuaries will recognize it as a close counterpart of a model office. The inclusion of calculations for alternative futures is especially interesting.

One possible use for the forecast technique is to produce calculations that show the impact of changes over time in interest or inflation rates. Since the net cash flow in any particular year is a by-product of the calculation, one can illustrate the impact of temporarily high interest (and also inflation) rates and contrast them with the much greater impact of permanently high interest and inflation rates.

Perhaps it would be appropriate to underscore the author's comments on the significance of the new-entrants assumption. The age and salary characteristics, as well as the number, of assumed entrants, can have a dramatic effect on costs. There is no explicit analogue for this assumption under other funding methods.

One must be very cautious about producing accrual rates which turn out to be heavily influenced by highly speculative and possibly unrealistic assumptions as to the number or youth of new entrants. Certainly, alternate futures should be calculated in any specific case to evaluate the sensitivity of the overall result to this particular assumption.

PATRICIA WATT:

Mr. Fleischer's paper is interesting and shows evidence of extensive experience with projection techniques. Cash-flow forecasts for pension plans, while they must be used cautiously, can be of great assistance to the client.

Comparison of Cash-Flow and Commutation Function Valuations

Our use of the cash-flow technique has given rise to the following observations relating to a comparison between the traditional commutation function valuation approach and the projection approach.

In the simple case of curtate annuities, the values determined under the cash-flow method are identical with the values produced by commutation functions. However, for less trivial applications, there were two principal sources of discrepancy: (*a*) rounding errors and (*b*) approximations to continuously paid benefits.

Rounding errors arise in those cases where the commutation function is based on components using a varying number of significant digits. In one case where, for example, a d_x was calculated as $q_x l_x^{(T)}$, and then rounded to the nearest integer, only one significant digit was preserved, and the liability calculated by the commutation function was 30 per cent

less than the liability calculated on a cash-flow basis, preserving as many significant digits as possible on the machine used.

Approximations to continuously paid or monthly paid benefits are another kind of problem. The error can be minimized, either by introducing $1 - k$ into the first-year benefits as Mr. Fleischer suggests or by introducing a $1 - k$ adjustment at the time of discounting for interest. This enables one to see the effect of different distributions of decrements on the cash flow and is usually within 2 or 3 per cent of the comparable liability calculated from continuous commutation functions.

Limitations of the Method

In our experience, cash-flow valuations work best for those functions of the form $B = \Sigma f(i)g(b)$, where the present value of benefits (B) can be expressed as the scalar product of a discount function vector, $f(i)$, and a benefit function vector, $g(b)$. Mention has already been made of the difficulty of approximating continuous functions and those payable monthly. Another difficult case is that in which there is a waiting period, such as nine months before commencement of benefit payments. In this case it is usually necessary to adjust the decrement used to reflect the joint probabilities of decrement and survival of the waiting period, since the occurrence of the decrement and the commencing of benefits require separate adjustments, and the approximation suggested above is not adequate. This has not, however, been a serious restriction on the use of projection techniques.

Uses of the Method

As a valuation technique, without the introduction of new entrants, projection valuation is a reliable and precise tool. It is exactly equivalent to techniques widely used throughout the United States and should present no problems with the Internal Revenue Service.

An important consideration is assisting the client in comprehending cash-flow figures. A large amount of information is generated by projection techniques, and the client often needs assistance in grasping the implications of the results. We have found that graphic presentation, where benefit payouts and fund accumulations are plotted year by year, is very helpful. Supplemented by the traditional balance sheet and income statement, the visual impact of a graphic presentation is considerable.

Projection techniques are useful for fast and accurate valuation of practically any benefit that can be designed. Multiple valuations and the ability to explore the impact of different interest rates, as well as the

ability to value from first principles any benefit for which a decrement can be determined, are significant advantages of the method.

Postretirement decrements can easily be introduced into the calculations, such as spouse remarriage or children's attaining age 18 (or 22). Assumptions about number and ages of children based on participant age and sex are also feasible. Cost-of-living and inflation assumptions can be readily incorporated. Asset valuations can incorporate reinvestment cash-flow and new-money interest rate assumptions, and varying rates of return can be predicted. Vested benefits can be readily valued, as can early retirement and disability benefits.

It is not necessary to calculate a full service table for each person in order to do a projected valuation. By the simple expedient of sorting participants by age at entry and sex, a single array of select and ultimate decrements and a single vector ${}_tp_x^{(T)}$ can be generated for each entry age. This represents a considerable saving in time and core-storage requirements. Also, l's and d's need not be generated, since the q's can be used directly. A column of ${}_tp_x^{(T)}$ can be calculated from the q's for the entry age, and then only the column of ${}_tp_x^{(T)}$ need be adjusted for each new attained age, by dividing by ${}_tp_x^{(T)}$ at the attained age, forcing the initial probability ${}_tp_x^{(T)}$ to be 1.0.

The only exception to this is in the case of decrements which are a function of duration from the present rather than of age and service. This is an infrequent case, but consider the problem of legislators, where it is known that withdrawal occurs only in alternate years, and further that withdrawal in years ending in 2 is exceptionally heavy due to reapportionment. For cases such as these, the decrements must be realized and ${}_tp_x^{(T)}$ regenerated for every member. On the other hand, consider the difficulty of performing such a valuation by means of commutation functions.

New-Entrants Considerations

In our experience the most important consideration with respect to the introduction of new entrants is their effect on the average age of the population. By manipulating the number and characteristics of the new entrants it is possible to make the normal cost descend almost to the level of one-year term costs for new entrants in any given year. This is so because the working population becomes successively more "dilute" with respect to persons collecting sizable benefits based on long service. I think Mr. Fleischer's paper would be significantly enhanced if he would describe the characteristics that are assumed for the new entrants and the resulting impact upon the active population. Since he assumes an

active group of constant size, the introduction of new entrants forces a stationary active population. The group of retired employees will then converge to a stationary population in $w - r$ years, where r is the earliest retirement age and w is the end of the postretirement mortality table. Therefore, after $w - r$ years, pension costs should be constant except for salary-scale influences, and the contributions plus interest earned from year to year should exactly meet benefit payments. The contributions are therefore a mature normal cost.

Introduction of new entrants into a nonstationary situation may give rise to a deceptively low contribution rate, because the most expensive benefits for the new entrants will have not been funded at the point at which a projection is terminated. Thus, if a projection is run for forty-six years (assuming no active lives under age 20 and retirement not later than age 65), until the youngest employee in the work force has retired, not all the benefits for the new entrants during this forty-six years show up in the projection, and consequently liabilities are understated. Contributions are also understated, of course, but the use of new entrants under these circumstances makes the entire calculation highly speculative. The attributes and liabilities of a known closed group of active and retired lives are being diluted and possibly distorted by the admixture of hypothetical lives.

Cost

The cash-flow technique would appear to be more costly, because of increased computer use; however, at least one consulting firm has done nothing but cash-flow valuations for several years and has developed procedures that make it practical from a cost standpoint for both large and small clients. These procedures make use of increased staff productivity because of intensive automation and simplified, modular programs which are easy to use and flexible.

There are a large number of so-called minicomputers on the market which are capable of running sizable cash-flow problems, at quite respectable speeds and at relatively low cost. We have run one which handles eight independent decrements, and values eighteen different benefits, in less than 32K of core. It can run a valuation of 4,000 lives in about two hours. On this basis, the machine cost is a nominal part of the valuation cost.

On balance, Mr. Fleischer's enthusiasm for projection valuation techniques and their applications to unique and challenging situations seems entirely justified. As the profession gains experience with the cash-flow method, I feel certain that it will come into wider use and that its advantages will be readily apparent to both clients and consultants.

PAUL H. JACKSON:

Mr. Fleischer is to be congratulated for setting forth in the *Transactions* some of the basic details of the forecast method, which was described in general terms by Mr. Bassett in his *Harvard Business Review* article. The forecast method is quite valuable in developing cash-flow figures over an extended period when used in connection with a so-called traditional valuation method. I doubt, however, whether this method should be used as the sole valuation approach, since the problems relating to tax deductions, legal minimums, and pension cost accounting would not appear to be resolved at this point.

The paper states that the traditional actuarial valuation is based on "the closed group of currently active and retired employees" and concludes accordingly that one of the assumptions in the traditional valuation is that there will be no new entrants. It is simply not true that, because the traditional actuarial valuation methods are based on the present group of active and retired employees, they necessarily incorporate an assumption that there will be no new entrants at all. Actually the assumption is that, regardless of the number of new entrants, they will have an age-at-hire distribution such that the normal cost, as a percentage of their pay, will match that of the basic valuation, so that on an ongoing basis the normal costs will remain stable as a percentage of payroll. In any case, an assumption as to the expected number of future new entrants is not an essential one under the traditional actuarial valuation methods, and it is simply inappropriate to imply that the traditional actuarial methods necessarily incorporate so unrealistic an assumption.

On the matter of retirement ages, the paper suggests that under the forecast valuation method retirement should be assumed to occur at more than one age in order to determine the effect on the incidence and magnitude of costs of the actual early retirement utilization as well as the likely costs of any amendments. This is certainly true, but the use of retirement rates at individual ages is not logically restricted to the forecast valuation method. In fact, such retirement rates on a select and ultimate service table basis have been used for many years with the traditional actuarial valuation methods.

The paper states that it should not be possible for any individual to both terminate and retire from the work force during the same year. This is merely a simplifying assumption that is not necessary. In the case of subsidized early retirement benefits that are available at plant shutdown only, or available only with the consent of the employer, it is in fact possible for a given individual to both terminate and retire in a given year.

The paper states the forecast valuation method is better suited to the valuation of plan changes. This follows from an assumption that, under the traditional valuation methods, (1) the turnover decrements are adjusted arbitrarily to account for vesting, (2) the eligibility and utilization of early retirement subsidies are handled by approximate methods, and (3) disability and spouse's benefits are valued on an approximate basis. Any of the refinements necessary to value these benefits on a forecast valuation method can also be applied under the traditional valuation methods, and, in the case of larger plans, in fact have been. Accordingly, these refinements are not characteristics of the forecast valuation method itself, and any advantages flowing from them should not be considered as an advantage of that method.

The traditional valuation methods develop normal costs that should apply generally whatever the number of new entrants may be. Under the forecast method, however, the past-service costs are spread over future payroll, so that the initial amortization payment for such past service will depend very heavily on the assumption as to new entrants. This problem is not unlike the one posed by the Pennsylvania statute requiring the funding of past-service liabilities for public school employee retirement systems over a thirty-year period as a level percentage of payroll on the assumption that the total payroll will increase 4 per cent per year. Messrs. Myers and Siegel have discussed the actuarial problems relating to this method in a paper presented to the Conference of Actuaries in Public Practice. To the extent that initial amortization requirements are diluted by an assumption of new entrants, there may be some question as to whether the minimum requirements under the pension reform act will have been met.

The new-entrants assumption in the particular case study set forth develops somewhat unusual results. Table 4 shows that there are 35 retired employees per 100 actives in 1974 and that, on the assumption of no future new entrants, this ratio would increase to 57 per 100 by the year 2004, patently an unrealistic result. On the other hand, Table 5 suggests that with level new entrants the ratio of 35 retired per 100 active in 1974 will decrease to 17 per 100 by the year 2004; on the surface at least, this seems no more plausible. Indeed, it is likely that there must have been a decline in the number of actives covered by this plan in recent years in order to develop the 35 per 100 retired ratio in 1974, so that the continuance of some further decline may not be unreasonable.

In the case study the new set of assumptions used for the forecast method are described as "realistic assumptions." This terminology clearly implies that any different assumption would be unrealistic. This

semantic legerdemain is akin to the use of colored adjectives, as in "I am firm, you are stubborn, he is obstinate." Clearly, realistic assumptions can be employed with any method and are not solely a property of the forecast method.

In his conclusion the author states that "there is probably general agreement that, if a plan is fully funded on the entry age normal basis, the assets are more than enough to pay the pension obligations on a termination basis." Where subsidized early retirement benefits are available over a broad range of ages, the liability for early retirement benefits computed on a termination basis can be considerably larger than the going-concern value developed for the actuarial valuation, and this may be sufficient to raise the level of total benefit liability above the level of assets. As a practical matter, termination of plan is not unlikely to occur at a time when the market value of assets is depressed or at a time when the group of active workers is overly mature or at a point in a time when the plan has been amended within ten years so that the funding has not been completed. Thus, at plan termination, even where contributions have been made on the entry age normal basis, it is not usually expected that excess assets will be on hand. Then, too, the pension reform act makes the plan sponsor liable for any deficiency in funding up to 30 per cent of his net worth, so that, if it ever was desirable to fund only for the unit credit value of accrued benefits, it must be much less desirable to do so now.

On balance, the forecast valuation method gives the actuary a very valuable and powerful tool with which to set forth the future financial impact of current decisions regarding funding methods, plan improvements, and the like. It seems unlikely that the forecast method will be acceptable in and of itself, either for demonstrating compliance with minimum contribution requirements under the pension reform act or for demonstrating tax deductibility of contributions under IRS maximum limits. These inherent limitations do not, however, diminish the usefulness of the method in setting forth year by year the actual dollar magnitude of the funding decisions to be made by the plan sponsor.

CLAUDE Y. PAQUIN:

One may attempt to determine the cost of pensions (1) upon the retired employee's death, (2) upon the employee's retirement, (3) upon the hiring of the employee, (4) upon the employee's birth, and (5) at various stages before, between, or beyond these various events. If this comment appears too preposterous and tongue-in-cheek, consider for a moment the difficulties of the United States Social Security Administra-

tion with what birth rates *will be* in the future and how they will affect the funding or financing of the various social security benefits. Immigration rates and the probability of benefit changes (liberalizations or curtailments) might also be taken into account.

I will concede that the only sure way of determining pension costs is to wait until the pensioner's death and see how much has actually been paid. This historical perspective is very accurate but not very practical or helpful. So one might move back in time and view costs from the date of retirement (terminal funding cost) or from the date of hiring. For those who believe that a pension is earned by a man's work, it does, of course, make sense to associate the employee's pension cost with his working lifetime by variously spreading the cost over this working lifetime. This the traditional actuarial cost methods have done, although the amount of flexibility in cost allocation between years and individuals has been considerable.

If providing pension (and other welfare) benefits is just a social cost, or a cost of doing business in the kind of society we have, it may make some sense to consider the pension costs of employees even before those employees are hired. Possibly, if one considers employees that may be employed twenty or more years hence, their pension costs will be considered even before their birth. I am, of course, not saying that the pensions will be prepaid or funded before the pensioners' birth, but the cost of these pensions will be considered that early in the "grand funding scheme."

The problem with actuarial science is that it knows no bounds. The distinction between actuarial assumption and conjecture has never firmly been made. What begins as a guess does not, through the operation of actuarial alchemy, transform itself into a nonspeculative entity. Certainly the author is entitled to considerable credit for developing and presenting his method. It is not his fault if "actuarial science knows no bounds." His method reflects ingenuity and hard work. The application of his method may produce very interesting results. Yet the piling of one assumption on top of another strains the fabric with which he clothes his results. Where the line is to be drawn beyond which actuarial results lose their credibility I cannot say: what I can say is that this method takes us yet another step away from credibility.

I would quarrel strongly with the author about the appellation "forecast valuation method" for the method he describes. A forecast is a prediction, and actuaries generally disclaim being able to foretell the future. Mutual life insurers go to great pains to explain that their dividend projections are not forecasts or estimates. Perhaps the method would

better be renamed the "projected work force valuation method" or the "projected population valuation method." The Society's Committee on Standard Notation and Nomenclature should take jurisdiction to prevent loosing upon the public yet another of the misleading nondescript terms with which the pension literature unfortunately abounds.

RICHARD G. SCHREITMUELLER:

Mr. Fleischer's paper is a valuable and timely addition to the actuarial literature. The paper sets forth much of the actuarial theory behind projections of assets, cash flow, and so on, which are of increasing interest as a result of the pension reform law. Also, in line with management's desire to explore more of the "what if" frontiers of funding assumptions and experience, the paper gives some excellent examples of specialized problems of this type for which projections can provide answers. Perhaps most important, in view of publicity being given to the use of projections as a recognized method for the formal valuation of pension plans, the paper sums up succinctly the reasons why the projection method is *not* suitable today for general use in valuing pension plans.

The explicit assumption of future new entrants into the covered group is rightly described in the paper as the feature that primarily distinguishes the forecast method from the traditional methods of valuing a pension plan. Thus we need only review what the paper says, and leaves unsaid, about new entrants to form an opinion about the validity of the forecast valuation method. The traditional valuation methods, based on the present participants only, are designed to develop contributions whose present value can reasonably be expected to equal the unfunded present value of benefits. Then, as new entrants come along, they too are brought into the calculations, and contributions are gradually adjusted to accommodate experience as to new entrants. The forecast method says, "Why wait? If we have a reasonable way to predict what the new-entrant experience is going to be, contributions can be adjusted for them from the outset." Well, do we actuaries know how to project new entrants, or do we not?

New Entrants: State of the Art in 1975

The paper's thirty-two pages give every indication of authorship by someone who knows whereof he writes with regard to projections, who has seen the good side and the bad. The lone paragraph discussing the nature and choice of assumptions as to new entrants reads as follows, with emphasis added:

An *important* new assumption under the forecast valuation method is that concerning the size and characteristics of the work force that will enter the pen-

sion plan in the future. This assumption also probably is the *hardest* to make. Assumptions on the size of the work force can make a *substantial* difference in the long-range dollar costs of a pension plan, depending on whether it is *decided* that the work force will grow or decline in the future and at what rate. It also is *necessary* to picture accurately the characteristics of people who will enter the work force.

Perhaps this paragraph overstates somewhat the sensitivity of the actuary's end results to the new-entrants assumptions used, but clearly the new-entrants assumption is deemed important. It is unfortunate that the paper does not mention any of the possible assumptions as to the number and characteristics of new entrants, or how such assumptions might be derived by the actuary, or the effect of varying the growth rate of the work force upward or downward from zero, or the effect of varying the new-entrants characteristics as to age, pay, and the like. As indicated in the paper, any assumptions about new entrants *can* be used.

The case study, for the ABC Corporation, contains an exhibit listing the actuarial assumptions, which is silent about the entire matter of new entrants. The assumptions as to the number of new entrants are implied in the results for the case, namely, the number of actives remains constant, so that the new entrants were somehow introduced as a balancing item after decrements for retirement, withdrawal, and so on. However, the characteristics of new entrants (and present actives) are somewhat mysterious; the number of retirees thirty years in the future is only a little higher after the new entrants are introduced into the calculations, so that the new entrants apparently were assumed to be on the young side. Also, the Table 6 ratio of the present value of future earnings to the covered payroll decreases by 65 per cent in the course of thirty years. Such a decrease could be expected if new entrants come in at the older ages, with fewer years and lower pay increases remaining before retirement, or if they come in at very young ages and so are subject to the churning effect of high turnover; apparently the latter assumption was made.

Why is the new-entrants assumption the hardest one to make? Predicting the size of the work force implies that the actuary has some notion of whether the organization will grow or shrink; how is he to know that, over any extended period of future time? He could rely on management's forecast of manpower, and early in the paper the principle is espoused that management should assist the actuary in setting assumptions. However, the plan sponsor is not entirely a disinterested party in the actuary's end results, and management seems ill equipped to project manpower needs many decades into the future. Similarly, economists, management

consultants, or other outside experts would appear to lack the ability to predict an organization's manpower needs over so long a time.

How many decades of projection are we working with in the forecast method? At least seven or eight, if we want to run the present participants out to the end of the mortality table. Of course, simplifying assumptions and techniques can be used to truncate the actual computations after thirty or forty years, if the active population is then assumed to be in some stationary or dynamic state of equilibrium. However, in my experience the introduction of new entrants in numbers that produce a predetermined rate of growth in the number of actives, and with characteristics that develop an "ultimate" pattern of actives within thirty years, often requires forcing in the new entrants in an arbitrary or inconsistent manner. It would be interesting to see the Table 6 forecast method results in the paper extended beyond thirty years, to the point required to complete the computations for the ABC Corporation.

New Entrants: State of the Art in 1950

Mr. A. M. Niessen's paper entitled "Projections—How to Make Them and How to Use Them" (*TSA*, II, 235) makes interesting reading a quarter-century later in today's age of high-speed computers. As indicated by that paper and its discussions, in 1950 projections were a subject of keen interest for purposes of communicating pension costs to the layman, some actuaries advocated the use of projections as a basic valuation method, various alternatives and technical problems regarding new entrants were brought up, the difficulties of making a projection that is also a successful forecast were described, and actuaries were warned that they might be called the task if the projection were looked upon as a forecast. Lively though the discussion was, in those days no one went so far as to suggest that a projection involving new entrants was the same thing as a forecast.

Conclusions That Can Be Drawn

One might expect new-entrants assumptions to work their best for the federal social security system, in view of the nature of the covered group and the statistics available; however, recent decreases in birth rates have significantly affected the outlook for new entrants and long-range costs under the projection valuation methods used by social security. For the more typical private pension plan, the number and characteristics of new entrants will be affected by a broad range of external and internal changes, for example, in the organization itself, in demand for its output, in the caliber of its management, and in technology and natural resources. This

is why projections of new entrants which go more than a few years out seem highly conjectural and well outside the actuary's areas of expertise. Exceptions to this principle are possible for organizations that have a strong likelihood of long existence, enjoy a monopoly position in their field of endeavor, and seem to be relatively free of unpredictable forces of change. At first glance these criteria would seem to fit any government pension plan, and politicians may view favorably any methods for passing along pension funding costs to their successors in office. In this regard, actuaries located outside New York City may need to be reminded that the unlimited taxing power of a local government extends only to those who choose not to move elsewhere, and that erosion of the local tax base can produce the classic assessment spiral. In short, the actuary may be doing a real disservice to a local government if he uses a projection method to value its pension plan without the most careful consideration as to the method's appropriateness in the particular locale and time.

Actuarial error regarding the new entrants is in some ways analogous to gains and losses in assets valued at market; that is, the effect of fewer new entrants than expected is to increase the contributions as a percentage of payroll at a time when the plan sponsor is likely to be experiencing financial difficulty, and vice versa with respect to gains. An important distinction, however, is that error regarding new entrants may be the result of long-range forces that cannot reasonably be expected to reverse themselves over a few years in the same manner as asset fluctuations.

An actuarial valuation report disclosing data summaries, assumptions, and results as indicated in the case study for ABC Corporation would not appear to meet the professional standard that it permit objective appraisal by another actuary unfamiliar with the situation. Extension of this standard to the paper itself, if it is to serve as a basis for actuaries to accept unfamiliar projection methods for general use in valuing pension plans, would seem to require extensive disclosure and examples of the effect of the new-entrants assumption. Thus the paper does not appear to contain sufficient technical content or rationale to support general acceptance by actuaries of projection methods as legitimate members of the family of pension valuation methods, and it contains significant internal evidence to the contrary. Strong arguments against such use of projection methods can also be developed from general reasoning.

As indicated in the paper, projections for a decade or two, in which new entrants may be of little importance, can be highly useful in special circumstances as an adjunct to the regular valuation of a pension plan by one of the traditional methods not involving new entrants. Longer-range pro-

jections involving new entrants would seem useful primarily as a communications medium that the plan sponsor can understand; in such circumstances, the new-entrants assumption could, within limits and with proper disclosure, serve as a balancing item, so that cost estimates based on the projection would be consistent with the regular valuation. Such long-range projections are probably limited to large cases, as indicated in the paper, although this constraint appears to be primarily a matter of affordable costs for actuarial services rather than statistical validity based on large numbers.

(AUTHOR'S REVIEW OF DISCUSSION)

DONALD R. FLEISCHER:

I was pleased to see in all these discussions a substantial interest in forecasting techniques. Although, as might be expected, there are many divergent views on the forecast valuation method, the greatest controversy centers in the introduction of an assumption concerning new entrants.

Mr. Smith obviously has had a great deal of experience with forecasting techniques and is convinced of their value. Although I agree with him that the whole area of forecasting would be a good subject for a paper, my primary purpose in writing this paper was to describe a pension valuation method developed through the use of forecasting techniques. My hope was that it would be considered an acceptable valuation method under ERISA. As far as the valuation method is concerned, I was pleased to see that, when he indicated that it is essential to involve the client in the assumption-setting process, Mr. Smith was in agreement with my feelings on this matter.

I sincerely thank Mr. Schnitzer for his comments and support in the forecast valuation area. I completely agree that a practical approach for smaller plans would call for a system that is not quite so complicated. In this paper I described a very generalized model that could be modified or simplified for use by small plans. The approaches suggested by Mr. Schnitzer in regard to refining calculations are appropriate in most situations and certainly simplify calculations. One of his suggestions is to group the active employees by sex, age, and length of continuous service. I believe that for any pension plan that is integrated with social security another category is necessary—earnings. Unless provision is made for such a category (or some other type of approximation is made), workers with very low earnings will probably be included in a cell with those with very high earnings, and results will be understated.

In regard to Mr. Schnitzer's question on how to handle gains and losses under the forecast method, I think that this could be left to the discretion of the actuary, subject, of course, to ERISA requirements. If the funding is over the moving twenty-year date, it is not necessary to keep track of the gains or losses. This would be similar to the aggregate valuation method (where the unfunded past-service liability is spread over future salaries) and therefore might be acceptable under ERISA. Using a fixed date to achieve the bench-mark liability gives rise to gain and loss elements. The overall gain and loss for any year under the forecast method could be calculated as follows:

1. Calculate the difference between the actual fund and the expected fund. (If positive, it is a gain; if negative, a loss.)
2. Calculate the percentage of payroll contribution required to fund the bench-mark liability over the remaining period. Calculate the difference between the discounted value of future contributions at this rate and the discounted value of future contributions at the rate calculated in the prior valuation. (If positive, it is a loss; if negative, a gain.)
3. Add the results of steps 1 and 2. The result is to be amortized over fifteen years as required by ERISA.

Mr. Kischuk raises very valid points on how to apply the forecast method to smaller plans. He outlines a method that certainly appears to work, but I would like to see more elaboration on how the new entrants are determined. He states that "the number and profile of new entrants during the forecast period can be obtained by working backward, using approximations according to the judgment of the actuary." I would prefer a better-defined procedure (even with approximations), so that one actuary could readily see how another actuary had determined the new-entrants assumption. As discussed in my paper, and as is generally agreed, this assumption is crucial to the development of the method. I would like to thank Mr. Kischuk for developing the formulas used in generating percentage of payroll cost. In fact, these were the same formulas used in generating costs as a percentage of payroll for the ABC Corporation.

Mr. Hutchings reiterates the importance of the new-entrants assumption. I certainly agree on its importance and endorse his recommendation that the impact of alternative assumptions be fully investigated. He also states that one possible use for the forecast technique is to show the impact of changes in interest and in inflation rates over a period of time. From my own experience, such a demonstration is very enlightening not only to clients but also to actuaries.

Ms. Watt's comments and suggestions will be helpful to others in-

terested in applying projection techniques. Obviously, she has worked extensively with projection techniques, and the several refinements that she outlined will make the method I described more efficient in practice. I have just one remark with respect to her comments about the new-entrants assumption. Once an individual is introduced into the plan, whether as a currently active employee or as a new entrant, the projection for that individual should run until the end of his life. In terms of projecting for a given number of years, this should reflect only the number of years for which new entrants are introduced into the population. In the example Ms. Watt cited, if a projection is run for forty-six years (assuming no active lives under age 20), I would take that to mean that, when liabilities are calculated, new entrants are introduced only in the calculations for the next forty-six years, with all new entrants, including those introduced forty-six years from now, projected until the end of their lives.

From his remarks I would judge that Mr. Jackson obviously has misinterpreted my purpose in writing this paper. I meant to say not that the forecast method should be the *only* acceptable method but that I think it should be acceptable along with the other currently acceptable methods. He states, and I agree, that the issues of tax deduction, legal minimums, and pension cost accounting are not resolved at this point. That is exactly the main reason for which I wrote this paper. I had hoped that discussions such as Mr. Jackson's might suggest possible ways to have this method approved as a valid approach for valuing pension plans. Mr. Jackson does raise some valid points on which I may have been misleading in my paper. I will elaborate on these points, most of which relate to how the method operates and not to its acceptability.

In my statement that the traditional valuation is based on the closed group of currently active and retired employees, I did not mean to imply that there is no implicit assumption about new entrants in any valuation; I meant to say only that there is no explicit assumption about new entrants. Therefore, I suggested that perhaps the actuary should not rely on merely the implicit nature of the assumption but should perform his valuation on the basis of what he believes to be the future outlook of the pension plan. Under the entry-age valuation method, the implicit assumption is that the average entry age of future new "hires" will be the same as the average entry age of the current work force, thus keeping the normal cost constant as a percentage of payroll. But suppose that the actuary has reason to know that the company is in a declining industry and that any new "hires" will be fairly old, especially in comparison with the age at hire of the current group. Should not the actuary take this into account in his valuation?

Evidently Mr. Jackson believes that the paper suggests that many of the other assumptions I discussed could not be used under traditional methods. These assumptions can be used under the traditional methods, but generally they are not. However, it is no more difficult to use them under the forecast valuation method than under the traditional methods. In larger plans where more sophisticated assumptions may already be in use, the forecast method may offer no distinct advantage when assumptions are being set.

Funding past-service liabilities as a level percentage of payroll may raise some questions in relation to the minimum requirements of pension funding, but I think this method should be acceptable. In fact, ERISA to a limited extent addresses the problem of funding past-service costs as a level percentage of payroll. Section 1013(d) allows payment of unfunded liabilities as a level percentage of payroll for certain multiemployer plans, provided that (*a*) on January 1, 1974, contributions under the plan were based on a percentage of pay; (*b*) actuarial assumptions with respect to pay are reasonably related to past and projected experience; and (*c*) the rates of interest under the plan are determined on the basis of reasonable actuarial assumptions.

Mr. Jackson expressed some concern regarding the unusual results obtained under the new-entrants assumption. The ABC Corporation had experienced a decline for a period of years, during which time several people retired but few were hired. However, under new management, new products were developed, and for the past several years there was a strong resurgence that is reflected in the assumptions. I agree that the current ratio of retired to active lives is inordinately large, but that is the specific reason the ABC Corporation desired a long-range projection of its pension plan costs.

Designation of assumptions as "realistic" does not imply that any different assumptions would be completely unrealistic. In my terminology, "realistic" ties in with the pension reform act, which states that every actuary should choose assumptions that will produce his best estimate of anticipated experience under the plan. The assumptions that I chose were ones that were felt to be realistic for this case, and certainly another actuary might have other views on what is realistic and unrealistic.

Mr. Jackson states that funding on the entry-age basis may not be enough to cover termination liabilities. Although this may be true, my point was to say that the objective (being fully funded for entry-age liabilities) was probably too conservative. I agree that being fully funded for accrued benefits may be inadequate, but I think that some

point in between—that is, a bench-mark liability—should be the appropriate objective for a given pension plan.

I was sorry to note that Mr. Jackson does not think the method will be accepted by the IRS. I had hoped that he would set out in detail some of the reasons for his view and perhaps show ways to overcome the problem. I think that the method could be and should be acceptable, the only hurdle being that of a new-entrants assumption. Perhaps certain parameters on the new-entrants assumption combined with a comparison of results on another acceptable actuarial method could be used to demonstrate the appropriateness of the method for a particular plan. With this as background, perhaps the Society, with IRS agreement, could set appropriate parameters which, when combined with actuaries' certifications, would make the method acceptable on a general basis.

Mr. Paquin has gone to some length to say that it is inappropriate for an actuary to make an assumption about new entrants. I do not agree. There is, of course, some possibility of manipulating any assumption to achieve desired results, but I do not think that this in itself would render it an inappropriate assumption. Prudent care must always be taken in choosing the assumption. In any valuation method, an implicit assumption is made about new entrants in trying to develop costs from one year to the next. Obviously, if one knew exactly how new entrants would be hired in the future, one should reflect this fact in the valuation. Making no decision about new entrants is, in fact, a decision in itself.

Moreover, with government requiring that an enrolled actuary sign a statement to the effect that his assumptions are realistic, I do not think he would be unduly influenced by management to "play" with pension costs. Rather, on the basis of his estimates, which would incorporate past hiring practices as well as expected growth in both the industry and the company, he would be able to come up with a realistic assumption.

Mr. Paquin has a legitimate concern about actuarial terminology, and I certainly do not want to add to the confusion. However, I think the fact that the forecast valuation method introduces the concept of new entrants as a unique assumption in the actual valuation makes it distinct from other methods, and therefore it should have an appropriate nomenclature. I do not share Mr. Paquin's objections to the word "forecast." Perhaps the term "forecast valuation method" might not be the correct one insofar as the Committee on Standard Notation and Nomenclature is concerned, but I believe that if the expression "projected work-force valuation method" were to be used, it might be confused with the standard nomenclature of "projected benefit method."

My answer to Mr. Schreitmueller's question, "Do we actuaries know

how to project new entrants, or do we not?" is analogous to the question, "Do we actuaries know how to project investment return and salary increases, or do we not?" The choice of new entrants should depend on the industry and on the company as well as on the economy in general. Characteristics could be derived from hiring patterns in the past and projected hiring patterns in the future. This is analogous to the way we would choose assumptions about rates of turnover or salary within an employee group. Such assumptions are affected by the type of group, the industry, the economy, and other factors. In addition, choices of interest rate and salary-increase assumptions are affected by the economy and by outside influences. The investment return assumption that is chosen may differ significantly from that which is actually realized. For example, if it is felt that 6 per cent is an appropriate interest assumption, it may be that this rate will be earned by all pension plans in total. However, the rate of return for a particular employer could and probably would vary substantially from that assumption.

I do agree with Mr. Schreitmueller that any forecast valuation method must make full disclosure of the methods used and assumptions made with respect to new entrants. In retrospect, I wish I had been more complete in my description of the new-entrants assumptions, but in this regard the case study was fairly unique. The ABC Corporation had an inordinately large number of currently retired lives. The characteristics of the new entrants were assumed to be the same as those of new entrants hired over the past few years, and it was assumed that enough new entrants would be hired in each year to keep the work force stable. Mr. Schreitmueller is quite right. The average age of the new entrants turned out to be quite low, and there was very heavy turnover in the group.

In planning the forecast valuation method, we must realize that there are definite constraints and there are plans for which it may not be appropriate. For example, it may be inappropriate to apply it to the initial valuation of a new company, since there would be no reliable statistics on which to base new-entrants assumptions. Obviously the future is always an unknown quantity, but for established companies, such as utilities, it might be fairly safe to assume that they would stay in business and that in the future their work force would show a slight growth pattern.