SOME PRACTICAL ASPECTS OF THE CALCULATION OF
EMPLOYER CONTRIBUTIONS UNDER GROUP ANNUI-
TIES OF THE DEPOSIT ADMINISTRATION TYPE

RAYMOND F. HOUSEMAN

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RICHARD P. PETERSON:

Mr. Houseman in his paper gives some practical aspects of various
methods of funding and undoubtedly desired discussions reflecting dif-
ferent approaches on some of the more important points. The following
comments confined to six main points may be appropriate.

1. *Funding in general.* In certain cases it may be desirable to consider
funding as commencing when benefits might best be considered as starting
to accrue. Although vesting provisions might influence the time of fund-
ing, it is certainly possible to consider the commencement of funding as
independent of the benefit formula. This is most apparent where benefits
are not directly related to service. In most cases it would seem preferable
to use the most appropriate group of employees (generally all employees)
and apply all suitable assumptions, including rates of withdrawal and
salary increase scales (if appropriate), rather than guess at a waiting pe-
riod to eliminate some employees from the calculation. There is no more
risk attached to discounting for withdrawals than there is in using a wait-
ing period to cheapen the funding based on a set of assumptions which
ignores withdrawals.

2. *Entry Age Normal Method.* Mr. Houseman's paper takes the tradi-
tional approach of using actual entry ages of each employee. Instead of
considering deviations from this as approximations, it might be desirable
to consider an assumed entry age as proper. However, rather than using
the minimum age (for inclusion in funding) for normal cost purposes it
would seem preferable to use a higher average age to take account of those
who actually enter at a higher age. It is true that any understatement in
first year normal cost is reflected in a higher initial accrued liability (and
conversely) but what is much more important is the effect of any under-
statement for those who enter in years after the first.

It seems desirable to attempt to determine a normal cost which will
remain level in future years if all actuarial assumptions are realized and
the group remains stable in size (benefit size for participating group of
nonretired employees). When an understatement of average future entry
age is made, future normal costs will tend to increase. In any year that the

actual weighted average entry age of new participants is different than initially assumed, there is in effect an actuarial gain or loss from such difference. The effect of entry age assumed is more important in regard to future normal costs than is past experience and its bearing on first year figures. It is only necessary to choose an average entry age so that for new entrants the difference between the present value of their benefits and the present value of their normal costs is minimized.

There seems to be some difficulty in the paper in the definition of unfunded accrued liability since it isn't clear what has happened to the retired life fund. The retired life fund should be deducted if all benefits are considered.

3. *Premium.* This word seems to have undesirable connotations when used to describe cost estimates made for the purpose of helping an employer decide how much to put in his deposit fund at any time. The result of such calculations is not a premium charged at a certain time by the insurance company and the word does not properly describe the flexibility generally allowed in amount of employer contributions.

4. *Unit Credit Method.* Another possibility in using this method on flat amount pension formulas is to assume the unit amount to be purchased each year based on an average entry age is the same for all employees. This, of course, gives an initial accrued liability which is not necessarily the same as conventionally calculated unit credit past service liability. Gains and losses can be conveniently reflected in the normal cost by using a frozen initial liability form (spread funding of gains and losses) of the unit credit method.

5. *Aggregate Cost Method.* Mr. Houseman has mentioned an interesting point that sometimes occurs under this method. That is, "discounting" for withdrawals may call for heavier funding than without such "discount." Under the aggregate method the use of a waiting period may lead to materially lower initial funding. But this is not always true, particularly if a high age eligibility is used.

As shown in Mr. Trowbridge's paper (*TSA* IV), it is appropriate to use the entry age normal method when an accrued liability figure is desired under the aggregate method. The aggregate method is in a sense a special type of entry age normal cost method where each payment toward the accrued liability is automatically determined by the average temporary annuity. The aggregate cost approaches the normal cost of the entry age normal cost method if gains and losses are spread in that method. Because the aggregate method does not separate the cost into two components of normal cost and accrued liability, the ease of flexibility in funding the accrued liability is lost.

6. *Contributory cases.* It is true that the cost of before retirement death

and withdrawal benefits arising from employee contributions can be conveniently expressed as a function of employee contributions and hence is independent of pension benefits. However, on a modified cash refund after retirement benefit the ratio of employee contributions to benefits cannot be ignored if theoretical accuracy is desired. Adjustments can be made on an approximate basis. It is interesting to note that there are several methods of funding death and withdrawal benefits. It may be desirable to consider funding these by the same normal cost method as that used for pension benefits, *i.e.*, unit credit or level premium.

There are many other aspects of funding methods which can benefit from further treatment, such as handling of gains and losses, effect of change of benefit formula, methods of approximating costs of partial vesting, funding requirements of various union agreements, etc. All of us working in the pension field certainly appreciate the efforts of those who challenge our thoughts by presentation of papers of this kind.

CLARK T. FOSTER:

I should like to make two comments, the first concerning one of the author's conclusions and the other concerning an additional consideration which frequently arises in determining contributions under a deposit administration plan.

The statement is made that the aggregate method is probably the most convenient to use in the calculation of a premium for a deposit administration group annuity. It seems to us that the choice of funding method is dictated primarily by the type of plan. For example, costs of a plan providing an annual pension accrual proportionate to current earnings are most conveniently determined by the unit credit funding method. Use of the aggregate method in such a case would involve a salary scale which would otherwise be quite unnecessary.

While the aggregate method may be convenient in many cases, it does have one disadvantage in the lack of flexibility in determining contributions. Since no past service liability is established as such, the annual contribution is a fixed amount. Under other methods of funding, a corporation has considerable flexibility in being able to make a past service contribution of any amount from about $2\frac{1}{2}\%$ to 10% of the initial liability.

An advantage usually claimed for a deposit administration type of contract is the opportunity for a corporation to base its contributions on whatever assumptions appear to be reasonable. A corporation which is willing to take a chance on unfavorable experience in future years may base its contributions on the most realistic assumptions. It is usual, for example, to estimate the employee turnover experience and to limit contributions to whatever amount is estimated to be necessary for employees

surviving in the service of the employer. In many cases, however, it is equally advantageous to assume favorable experience with respect to funds which have been taken from the deposit account for the purchase of annuities. It may be expected that mortality, interest and expense experience will be more favorable than guaranteed by the insurance company in its rates for the purchase of benefits at retirement.

The insurance company obviously expects to earn more on its investments than is guaranteed in its rates, and, in fact, one of the usual sales arguments is that such excess interest earnings will be returned to the employer in the form of dividends. Similarly, it is expected that the insurance company's expenses will be considerably less than the loading included in the premiums. Mortality, too, may be more favorable than assumed in the premium rates, particularly in certain groups where retirement is not compulsory and most employees delay retirement until their health has commenced to decline.

It is natural for an employer who wishes his contributions to remain level from year to year to anticipate such experience through the use of more realistic assumptions than are involved in the insurance company's rates. Use of such assumptions, however, causes complications as to gains and losses from actuarial experience. Despite the fact that experience may be favorable right from the effective date, it normally takes a few years for dividends to be generated. As a result, although investment earnings may be as high as the employer has estimated, and although mortality experience may be in line with his assumptions, apparent losses will develop until this favorable experience is reflected in dividends.

On the other hand, it is possible for apparent gains to develop under certain circumstances. In a young group of employees including only a few employees eligible to retire during the first few years, it is possible that the expenses charged to the fund at the time these few annuities are purchased would represent a very small percentage of the total amount in the fund. If, therefore, contributions had originally included a loading of, say, 5% to cover expenses on a pay-as-you-go basis, an analysis on a *net* reserve basis during the early years might show a fairly large surplus which would ultimately be necessary to cover the expense loading included in the insurance company's premiums for future retirements.

ROBERT F. LINK:

Mr. Houseman has provided a valuable reference on funding methods and calculation methods for the insurance company actuary who is involved in deposit administration problems. I wish that such a reference had been in existence about four years ago when I looked at a deposit administration plan for the first time. It would seem that perhaps his paper

has a broader application, extending to trusteed plans as well as insurance company plans.

There is, perhaps, some danger in using this paper as a reference, unless one is extremely alert to the implications of some of the devices that Mr. Houseman suggests. I do not imply that the suggestions are bad; I do imply that they can be embarrassing if adopted without a clear idea of their effect. In the passage entitled "Waiting Period, Nearest Ages and Durations," it is suggested that the exclusion of certain employees results in an understatement of cost. Having just finished reading Mr. Trowbridge's paper, I wonder a little bit why the exclusion of some employees should result in an understatement. If the Equation of Maturity were satisfied, the normal cost plus interest on past service cost should be the same, regardless of the particular funding method or choice of exclusion.

Many of us have, of course, observed the lower costs which emerge in practice where an exclusion is used. I suggest that this lower cost is due to one of two factors: either (a) the group is an immature group or (b) our actuarial assumptions include turnover rates which are much too low in the early years. If the former is the case, the group should be warned that rising costs can be expected.

Mr. Houseman's paper also suggests that the overstatement resulting from using withdrawal rates tends to be offset by the use of an exclusion and the failure to project increases in salary. Pension funding is a field where offsets, if tested, seem to be pretty disappointing. I would suggest that the understatement resulting from not using withdrawal rates is trivial when any significant exclusion is used. On the other hand, the effect of either an exclusion or of omitting salary scales may be of vital importance in determining the level of costs.

Occasionally circumstances arise which require an estimate on two bases, one using all lives with turnover and salary scale, the other using a limited group, no turnover and no salary scale. The two cost estimates, purporting to be for the same plan, may be so different that grey hairs result from choosing which to use, unless one has some clear set of actuarial principles to go by.

Mr. Houseman suggests (on page 236) that the use of too low an entry age under the entry age normal cost method will toss additional liability into the accrued liability. Perhaps in the initial year of a calculation this is all right; however, if the same low entry age is used for new entrants, losses will emerge annually due to the introduction of an initial accrued liability for new entrants. It should be a general principle of pension funding that the entry age used in entry age normal cost methods should bear some realistic relationship to the basis of selection of the lives with respect to whom the funding calculation is performed.

WILLIAM C. WIRTH:

Mr. Houseman's paper is a valuable addition to the field of pension literature. The coming of age recently of the deposit administration type of contract as a major pension item for insurance companies found few references available regarding the actuarial problems of this type of plan. Perhaps the most complete reference was the Treasury Department's *Bulletin on Section 23 (p)*. However, this Bulletin was published in 1945 and is somewhat confusing and incomplete in its discussions of such things as special past service bases and methods of accounting for experience gains and losses.

This lack of information, combined with the necessity of interpreting the Treasury Department's rules and regulations, undoubtedly led to many different lines of reasoning on such points as what funding method to use, what factors and assumptions are suitable, whether the use of a waiting period is advisable, and how to account for experience gains and losses. There are also without doubt many variations in office calculation methods. Mr. Houseman has presented his ideas very ably and it is to be hoped that other ideas and methods will be presented in the course of the discussion of his paper.

For my part, I should like to confine my discussion to the funding method known as the frozen initial liability method; why, in my opinion, this is the best method for many deposit administration plans; how first year calculation procedures may be modified so that the methods will be consistent with renewal year methods; and some calculating short cuts that can be made in applying this funding method.

Why Use the Frozen Initial Liability Method

The frozen initial liability funding method, as it is commonly applied, is simply a modification of the entry age normal method which spreads experience gains and losses over future normal cost premiums. It is this spreading characteristic which makes the method so advantageous since the problem of what to do with gains and losses appears to be eliminated. This gain and loss problem, which exists under certain other funding methods, is the subject of some of the Treasury Department's most confusing rules.

I have heard some actuaries argue that a breakdown of gains and losses by cause is a valuable part of their actuarial service to clients, but personally, it is my feeling that such a breakdown is ordinarily unnecessary. Experience has shown that a fairly large gain or loss can develop due to chance fluctuations and it seems to me that it is far easier to explain the small effect these fluctuations have on normal cost premiums under the

frozen initial liability method than it is to explain to the employer that his fund has suffered a loss equal perhaps to his entire past service contribution in the previous year or to explain the complications that a large gain makes in his tax deduction picture. In an insurance company there is also the added difficulty of explaining the relationship between large losses in the active life fund and any dividends or rate credits that may have been paid.

First Year Methods

In Mr. Houseman's paper he states that under the frozen initial liability method the first year normal cost premium and the initial accrued liability are determined in the same manner as in the entry age normal method, and the office calculation method outlined in his appendix follows this procedure. However, in calculating the normal cost as the sum of individual normal premiums which differ for various employees depending on their expected benefits and entry ages, an inconsistency develops between this method and the method used in renewal years where the normal cost is the sum of normal premiums which are equal (in amount or in percentage of earnings) for each employee. This inconsistency can be remedied by summing the estimated benefits and the number of employees by entry age groups and by multiplying these totals by the appropriate $\theta_{x:\overline{y-x}|}$ and $\ddot{a}_{x:\overline{y-x}|}$ factors to give the entry age present values of benefits and of \$1 per year of service per employee. By defining the normal premium per employee as the quotient of the benefit entry age present values divided by the \$1 entry age present values a method consistent with renewal frozen initial liability calculations is developed. The accrued liability is found in the usual manner by subtracting the present value of these equal normal premiums from the present value of benefits as of attained ages. Similar methods can be used to develop normal premiums as an equal percentage of each employee's earnings.

Short Cuts

The above method may be modified in practice by assuming an average entry age for all employees (perhaps weighted in some manner), including those employees whose current age is less than the average entry age being used. A further approximation that gives fine results and saves a great deal of work is the use of a distribution chart showing 5-year age and service groupings of employees. Each combined age and service group contains many of the essential elements of a calculation; *i.e.*, the approximate entry age can be found, the benefit is often entirely a function of the entry age and, of course, the central attained age is available. Calculations based on such a method can be done very quickly and are an excellent estimate for proposal purposes.

RAYMOND F. HOUSEMAN:

I wish to express my appreciation to Messrs. Peterson, Foster, Link and Wirth for their discussion of my paper. It is helpful to have opinions expressed on a subject such as this, on which so little has been written and which has been to a great extent developed independently by different persons.

Mr. Peterson gives information on six points. In regard to his statement as to the retired life fund, I excluded retired lives entirely from the calculation, both as to present value of benefits and as to funds held.

Perhaps I should explain why I chose to use the term "normal premium." It is often necessary to explain the difference between the cost of a pension plan and an employer's annual contribution to the plan. If the term "normal cost" is used in connection with the latter item instead of "normal premium," it adds to the confusion by calling an item which you are attempting to explain is not a cost, "normal cost." Another reason for using the term "normal premium" instead of "normal cost" is that the former contains provision for future expenses and contingencies, as well as benefits, whereas the latter term as it is frequently used provides for benefits only.

Mr. Foster comments upon my statement that appears on page 240 to the effect that the aggregate method is probably the most convenient to use to calculate a premium for a deposit administration group annuity. My intention was to limit that statement to cover only the mechanics of calculation, noting that there is no need to determine entry ages or maintain individual employee records.

In regard to relating a benefit formula based upon a percentage of each year's current earnings to the unit credit method, we might go one step further and bring in the funding medium by stating that this combination is most convenient to use under a regular group annuity plan where the amount of annuity is actually purchased as it accrues. This combination of benefit formula and funding method is relatively unwieldy to use in connection with a deposit administration group annuity where no annuities are purchased until retirement, because the use of past earnings records in connection with premium calculations cannot easily be avoided.

If it is considered satisfactory to use the unit credit method of funding in connection with a benefit formula based upon a percentage of current earnings each year, I do not see why it would be necessary to use a salary scale if the aggregate method of funding were used instead. Either method of funding would reflect salary changes only to the date of valuation under such circumstances.

Mr. Link discusses the differences that result when a waiting period is used in lieu of withdrawal rates and a salary scale. I did not intend to imply that an understatement of cost results from the use of a waiting period, but to indicate that it could be used as an approximation to a more elaborate calculation involving withdrawal rates and salary scales. Whether an understatement or overstatement relative to a given set of withdrawal rates and salary scale results from the use of a waiting period in an individual case will depend upon the choice of waiting period.

Mr. Link is correct in stating that any such device should not be adopted without a clear idea as to its effect. This applies not only to the choice of a waiting period but also to the choice of withdrawal rates, salary scales, and other rates. However, because of the errors inherent in the withdrawal rates and salary increase index numbers, it would seem that a fairly substantial deviation in the results on the two bases could be considered allowable.

With respect to the use of the Equation of Maturity, referred to in Mr. Trowbridge's paper, as a check on the reasonableness of the normal premium, I doubt if it is possible to find an actual case where a stationary condition has been reached or ever will be reached in the future such that the Equation of Maturity will apply. However, because of the importance of obtaining a suitable figure for the normal premium, it might be considered worth while to calculate what the ultimate cost would be under a set of assumptions that will eventually lead to a stationary condition. An example of such a calculation appears in *RAIA* III, 37–41, "On the Status of Certain Current Pension Funds," by H. L. Rietz. Since such a calculation involves the assumptions as to the number, ages and salaries of new entrants, in addition to the usual ones of salary scales, withdrawal rates and retirement ages, none of which can be forecast accurately, it becomes difficult to decide just how valid the final figure is after it has been calculated.

Mr. Wirth's discussion outlines the reasons why some life insurance companies favor the frozen initial liability method for use with deposit administration group annuity plans.

He outlines an ingenious method of determining a first-year normal premium consistent with the method of determining subsequent years' premiums which lends itself quite readily to office methods of calculation.

His discussion forms an important addition to the paper.