MEASURE OF ACTUARIAL SOUNDNESS IN A PENSION PLAN OF THE RAILROAD RETIREMENT TYPE

ABRAHAM M. NIESSEN

INTRODUCTION

THE railroad retirement plan is intended to be self-supporting and as it now stands is financed by means of level rate contributions shared equally by employees and employers. All service creditable under the plan is essentially treated alike, regardless of when it was rendered. In theory, the determination of cost can be made without considering the problem of unfunded liabilities. The only thing that really matters is whether the actual rate of contributions is sufficiently close to the actuarially determined cost figure. In practice, however, the method of valuation used brings out figures of unfunded accrued liabilities which roughly conform with the "entry-age normal cost" approach described in Treasury Regulations 118. The magnitude of the unfunded liabilities so determined has been frequently taken as a measure of the degree of actuarial soundness—or, to put it more properly, the degree of actuarial unsoundness—of the railroad retirement system. It is not altogether clear that such a yardstick of soundness is proper for a plan financed in the same manner as railroad retirement. This paper proposes to discuss the various criteria of actuarial soundness, especially as they apply to the railroad retirement system, and to suggest another measure of the financial condition of the system as of any valuation date.

Aside from general considerations, the railroad retirement plan is now faced with a specific problem which arose as a result of the financial co-ordination with OASI introduced by the 1951 amendments. There is no doubt that this coordination affected the unfunded liabilities remaining with the railroad retirement system proper, but how the effect is to be determined is still very much an open question. Several alternative approaches seemed feasible. The actuary's report on the fifth valuation developed one approach, while the statement of the Actuarial Advisory Committee clearly implies something else. To add to the complications, still other opinions have been expressed by actuaries intimately familiar with railroad retirement problems. It is, of course, true that the calculated over-all costs for railroad retirement will remain the same regardless of how one views the effect of coordination with OASI on the unfunded liabilities. However, since a good deal of significance is generally attached

to such unfunded liability figures, it is important that these figures, when quoted, be both theoretically defensible and readily understandable. This paper proposes to go into this unique problem at some length. It is hoped that the discussion, if any, will elicit fresh views and opinions which will help to clarify the basic theoretical and practical issues involved.

DEFINITION OF TERMS

Since certain actuarial terms are not always used in the same sense, it may be advisable to specify the meaning in which such terms will be used in this paper.

Contributions—Payments into the plan made by employers and employees. At present the combined contribution rate for railroad retirement is $12\frac{1}{2}$ percent on the first $300 of monthly earnings.

Prior Service—Service rendered before the effective date of the plan. In the case of railroad retirement, prior service means service before 1937.

Past Service—Service rendered before the valuation date. Thus, past service includes all prior service, as well as service rendered after the effective date of the plan but before the date as of which the valuation is made.

Present Members—All individuals on the plan's benefit rolls and all non-retired employees who entered service before the valuation date, whether or not then in active service.

New Entrants—Employees who will come in for the first time after the valuation date.

Cost—Actuarially determined percentage ratio of the present value of future benefits to the present value of future taxable payrolls, both taken for present and future members combined. Thus, cost will be expressed in terms of level percentages of future payrolls.

Normal Rate—Cost of benefits to new entrants expressed as a level percentage of their own payrolls. For a group of new entrants coming in at the same age, the normal rate is calculated as of their entry age. For a population of new entrants coming in at various ages, the normal rate is calculated as of the point of entry considering a distribution of entry ages which is assumed to be typical.

Net Cost—Cost of benefits with respect to all present and future members expressed as a percentage of future payrolls after taking credit for the funds on hand. The net cost may also make allowance for the effect of coordination with another plan.

Accrued Liability—As of any valuation date, the accrued liability is the excess of the present value of future benefits to present members over the present value of their future contributions at the normal rate appropriate for their ages of original entry. A variation of this definition is to assume contributions at the normal rate appropriate for a typical age distribution of new entrants. Under the alternative definition, the accrued liability may be described as the excess of the present value of future benefits with respect to both present members and new entrants over the present value of all contributions in perpetuity at the normal rate appropriate for new entrants.

Unfunded Accrued Liability—Accrued liability less funds on hand on the valuation date.

Deficit for Present Members—This is a new term which is defined as the excess of the present value of future benefits to present members as reduced by funds on hand over the present value of their future contributions at the actual rate (the actual rate for railroad retirement is $12\frac{1}{2}$ percent).

Actuarial Deficit—The excess of the present value of all future benefits as reduced by funds on hand over the present value of all future contributions.

ANALYSIS OF UNFUNDED ACCRUED LIABILITY

The net cost of railroad retirement benefits can be calculated without any reference to unfunded liabilities. However, the cost figures developed by the present value method permit the calculation of the unfunded accrued liability in a simple single step. Alternatively, the net cost can be developed after the unfunded accrued liability has been obtained. How the calculations are arranged is illustrated in Table 1.

TABLE 1

METHOD OF DEVELOPING NET COSTS USED IN THE VALUATIONS
OF THE RAILROAD RETIREMENT SYSTEM

Item	Cost Figures
a. Present value of future benefits to present members (dollars)	B'
b. Normal rate for new entrants (percentage of payroll)	$r''\%$
c. Present value of 1 percent of future payrolls (dollars)	
(1) For present members	P'
(2) For new entrants	P''
d. Funds on hand	F

Calculation of net costs:

Method I

e. Present value of all future benefits—in dollars—$(B' + r''P'')$ .... B

f. Net cost as a percentage of payroll $\left(\dfrac{B-F}{P'+P''}\right)$ .... $r\%$

Method II

g. Unfunded accrued liability (dollars)—$(B' - F - r''P')$. L

h. Unfunded accrued liability as a percentage of payroll $\left(\dfrac{L}{P'+P''}\right)$ .... $r_0\%$

i. Net cost $(r'' + r_0)\%$ .... $r\%$

That item *i* of Table 1 is identical with item *f* can be shown as follows:

$$r'' + r_0 = r'' + \frac{L}{P'+P''} = \frac{r''\,(P'+P'') + B' - F - r''P'}{P'+P''}$$

$$= \frac{B' + r''P'' - F}{P'+P''} = \frac{B-F}{P'+P''} = r.$$

It can therefore be seen that the development of the unfunded accrued liability is not necessary in a calculation of this type. If such a liability figure is brought out, it is done for other purposes, and the question arises whether this kind of a figure is appropriate for the purposes for which it is commonly used. Before this question is answered, it may be advisable to analyze the unfunded accrued liability as defined in item g of Table 1 in some greater detail.

First, let it be noted that the normal rate used here is for new entrants, not for active employees according to their original age at entry. To this extent, the unfunded accrued liability will not be exactly applicable to the existing force. However, since age distributions of new entrants are fairly stable, the difference between the two normal rates is very small and, consequently, the "error" in the unfunded accrued liability is for all intents and purposes negligible. With this qualification in mind, we are now in a position to enumerate some of the more important properties of the unfunded accrued liability.

(1) The unfunded accrued liability is a rough approximation to the unfunded past service liability, but always remains larger. This follows from general reasoning, but it might be interesting to give a simple algebraic proof.

Consider a present employee age $x + t$ who entered service at age x. Assume that the normal retirement age is y and that the retirement benefit is proportionate to the length of service. For the sake of simplicity, we shall assume death as the only decrement before retirement, flat earnings of S dollars a year, and a benefit formula which provides a flat percentage of the average earnings per year of service. We thus have:

Total benefit at retirement $= kS(y - x)$ $\qquad (a)$

Past service benefit $= kSt$ $\qquad (b)$

Future service benefit $= kS(y - x - t)$ $\qquad (c)$

Normal rate $= \dfrac{kS(y - x)N_y}{S(N_x - N_y)}$ $\qquad (d)$

Present value of future service benefits $= \dfrac{kS(y - x - t)N_y}{D_{x+t}}$ $\qquad (e)$

Present value of future contributions at the

$\qquad$ normal rate $= \dfrac{kS(y - x)N_y}{S(N_x - N_y)} \times \dfrac{S(N_{x+t} - N_y)}{D_{x+t}}$ $\quad (f)$

To prove that (e) is greater than (f), it is sufficient to show that

$$\frac{N_x - N_y}{y - x} > \frac{N_{x+t} - N_y}{y - x - t}.$$

But this is so because each side of the inequality is the average of a number of D_{y-j} terms where the expression on the left contains more terms than the one on the right. The D_{y-j} terms ($j = 1, 2, \ldots$) form a steadily increasing series as j increases, and for a series of that type the more terms are added on the larger end the larger will the average of the terms be.

It is therefore apparent that the offset taken for future contributions of present employees at the normal rate is less than the value of their future benefits which in turn means that the accrued liability contains some liabilities on account of future service benefits. This, of course, makes it larger than the past service liability.

(2) The unfunded accrued liability is independent of the actual rate of future contributions. For the railroad retirement system, the actual contributions are much in excess of the normal rate and to this extent credit for future contributions at the normal rate is highly unrealistic.

(3) Interest charges on the unfunded accrued liability expressed in terms of a percentage of total future payrolls are inversely proportional to the size of such payrolls. This feature brings out the dependence of the railroad retirement system on contributions of new entrants in excess of the normal rate. Take, for instance, the situation which existed on the date of the fourth valuation of the railroad retirement system, December 31, 1947.

(a) Unfunded accrued liability............................. $7,383 million
(b) Assumed annual payroll............................... 4,600 million
(c) Portion of total cost required to pay interest on the unfunded accrued liability ($.03a \div 1.015b$)..................... 4.74 percent

It is evident that if an annual payroll of, say, $5 billion had been assumed, the interest charges on the accrued liability would have amounted to only 4.36 percent of payroll; on the other hand, for a payroll assumption of, say, $3.5 billion, the corresponding figure would have come to 6.23 percent. These examples clearly indicate how important it is to make sure that the estimates of future taxable payrolls are not unduly optimistic.

(4) If the actual experience is strictly in accordance with valuation assumptions and the actual contribution rate is the same as the actuarially computed net costs, the unfunded accrued liability will remain stable. In practice, however, this is rarely, if ever, the case.

(5) Had provision been made for amortization of the unfunded accrued liability, the system would begin operating on normal rate contributions after funding had been completed.

ACTUARIAL SOUNDNESS

The question that now comes up for discussion is of what practical significance is the unfunded accrued liability in the case of the railroad

retirement system. This is related to the question of what is a proper criterion of actuarial soundness, since in the last analysis it is actuarial soundness that people are most interested in. The first thing to keep in mind is that standards of actuarial soundness considered proper for private pension plans are not equally applicable to a government program like railroad retirement. One might argue that since railroad retirement benefits are guaranteed by the government, the question of actuarial soundness is not pertinent at all. This, however, would be going too far, since throughout the legislative history of the Railroad Retirement Act the intent was expressed that the system be on what was considered a sound actuarial basis and self-supporting. In this connection, it might be interesting to review certain authoritative opinions which have recently been expressed on the subject.

At a special forum of the American Statistical Association held in December 1952 in Chicago, three prominent members of this Society (D. C. Bronson, G. B. Buck, and R. M. Peterson) were invited to present their views on actuarial soundness in pension plans. The opinions expressed ranged from the very strict requirement (Bronson) that upon termination of the plan assets should match liabilities based on past service (with an acknowledged amortization period for initial unfunded liabilities) to the very liberal criterion (Buck) that the present and contingent liabilities of the plan be balanced by the amount of present and contingent assets, both actuarially computed as of the valuation date.[1] Mr. Peterson thought that actuarial soundness cannot be defined in a manner applicable to all pension plans, but must be related to the pension plan's objectives and consequent liabilities. One of the most interesting features of the discussion was the lack of agreement among the speakers on such a fundamental actuarial concept. As Mr. Peterson brought out

---

[1] Mr. Buck drew a distinction between actuarial soundness and financial strength by pointing out that a plan can be actuarially sound and still be financially weak and possibly headed for financial difficulty. He also stressed the importance of reserves even for Government plans which can fall back on taxing powers. In Mr. Buck's own words: "To me, an actuarially sound retirement system should be financially reliable also and should be a system under which the new employee entering under its provisions should have set aside currently, as his compensation is paid, contributions to a trust fund or an insurance company, which with the interest accumulations thereon will produce a reserve to pay his pension by the time he retires, so that no further payments will be needed on his account to assure the payment of his allowance for life. This procedure will guarantee the payment of any pension proposed on account of his service as he renders it and he will not have to depend on a friendly group of taxpayers in the future or a friendly group of future stockholders to pay his pension. Under the reserve plan the employer is equally protected. He knows what his obligations are. He is not building up expenses to force him out of his competitive market in the future, and he is charging the proper amount to the cost of doing business today."

in his remarks, the Federal old-age and survivors insurance program would be actuarially sound by Mr. Buck's definition, but unsound by Mr. Bronson's. The remark applies with equal force to the railroad retirement system if one disregards the fact that the actuarially computed net cost (13.41 percent of payroll as of December 31, 1950) is higher than the actual rate of contributions (12.5 percent). It will be shown that under neither of the definitions mentioned above is the unfunded accrued liability a proper measure of actuarial soundness.

Mr. Bronson's criterion is satisfied when the past service liability is balanced by funds on hand or by specific provisions made for its amortization over not too long a period of time. This is the closed end approach which is derived from the concept of reserves in individual insurance contracts. For a large pension plan which starts with heavy prior service liabilities, this criterion is very severe indeed. To carry this soundness requirement to a logical conclusion, both OASI and railroad retirement would have to start with higher rates of contributions and then lower them significantly after the past service liability becomes fully funded. This might have been theoretically desirable but impossible to put into practice. In fact, both systems adopted lower rates of contributions in the early years with provision for gradual increases later on. But the amortization of the unfunded accrued liability as here defined goes even further, since, as stated in the preceding section, such an amount is larger than the unfunded past service liability. It is, therefore, clear that the acceptance of the unfunded accrued liability as a measure of actuarial soundness for the railroad retirement system is somewhat unrealistic even from the point of view of the most severe criterion. While it may be argued that the distinction between accrued and past service liabilities as defined in this paper will not escape the technician, the fact remains that the layman interested in the plan will generally not be able to distinguish between the two. It would therefore appear that the showing of the unfunded accrued liability without explanation as to what it actually means does not help the layman to get a clear picture of the financial condition of the railroad retirement system.

Under Mr. Buck's criterion, a plan is actuarially sound if future obligations are balanced by present and potential assets. Two interpretations are possible: (i) that only present members are to be considered, and (ii) that new entrants are also to be included. Mr. Peterson, when commenting that under Mr. Buck's criterion the old-age and survivors insurance system is actuarially sound, undoubtedly had the second interpretation in mind. This is probably what Mr. Buck actually meant. It can be assumed that Mr. Buck would not be satisfied with his general

criterion of soundness if there were other signs of danger. Such a "stop, look, and listen" sign would be a situation where theoretical soundness is achieved in large measure by taking credit for employee contributions by new entrants at the normal rate or in excess of it. It is in this respect that the unfunded accrued liability can offer some guidance. But, for an analysis of that type, it is sufficient to compare the normal rate with the net cost, and, as stated before, net costs can be calculated without explicitly knowing what the unfunded accrued liability is.

It is believed that the "deficit for present members," as previously defined, would offer a more realistic measure of the excess financial bur-

TABLE 2

UNFUNDED ACCRUED LIABILITY AND DEFICIT FOR PRESENT MEM-
BERS OF THE RAILROAD RETIREMENT SYSTEM AS OF DECEM-
BER 31, 1950, EXCLUDING THE EFFECT OF FINANCIAL INTER-
CHANGE WITH OASI

(Dollar Figures in Millions)

Item	Cost
a. Present value of future benefits to present members.	$17,002
b. Funds on hand.	$ 2,369
c. Present value of 1 percent of future payrolls for present members.	$ 543
d. Normal rate.	7.66%
e. Actual rate.	12.50%
f. Unfunded accrued liability ($a - b - c \times 100d$).	$10,474
g. Deficit for present members ($a - b - c \times 100e$).	$ 7,845
h. Present value of 1 percent of future payroll for new entrants.	$ 1,149
i. Present value of new entrants' contributions in excess of the normal rate [$100(e - d) \times h$].	$ 5,561
j. Actuarial deficit ($g - i$).	$ 2,284
k. Additional rate of contributions required to offset the actuarial deficit [$j \div (c + h)$]%.	1.35%
l. Net cost exclusive of administrative expenses ($e + k$)	13.85%

dens which are put on the shoulders of new entrants. In the computation of such a deficit, credit is taken for contributions of present members at the actual, not normal, rate. Since for the railroad retirement system the actual rate is significantly higher than the normal, the deficit for present members will of necessity be much smaller than the unfunded accrued liability. How the two compare under conditions of the fifth actuarial valuation[2] is shown in Table 2. The difference between the two figures is $2.6 billion. It is not contended that a smaller unfunded accrued liability emerged as a result of the new approach. All that is suggested is that in

[2] Report of the Actuary of the Railroad Retirement Board, by Joseph Musher, published in the 1952 Annual Report of the Board.

the case of the railroad retirement plan and other plans like it, the "deficit for present members" is from a practical point of view a more meaningful figure than the unfunded accrued liability.

It is recognized that in order to derive the net cost from the normal rate and deficit for present members, it would be necessary to go through certain computational steps which seem artificial. These steps are shown in items h to l of Table 2 merely for the sake of illustration. It is, of course, much simpler to calculate net costs in the manner indicated by items a to f of Table 1 where unfunded liabilities or deficits are not brought in at all. The point is that a cost calculation by means of the deficit for present members can be done, and its artificiality is perhaps a minor handicap once it is conceded that such an approach will give the layman a better understanding of the true meaning of the cost figures.

It is also freely conceded that "deficit for present members" is not as precise a term as "unfunded accrued liability." But it has the important advantage that it is specifically suited to the actual conditions of the railroad retirement system, something that Mr. Peterson considers essential in analyzing the financial condition of any particular pension plan. As things now stand, there is no reasonable expectation that provision will be made for the amortization of past service liabilities or that differential contribution rates will be introduced for various groups of employees. Why then base an analysis of the financial condition on unfunded accrued liabilities which have no particular relevance under existing circumstances? What we are really after is to point out the dangers of discounting the excess contributions of future generations of employees. The deficit for present members gives a quantitative answer to this very question.

To sum up this part of the discussion, the paper suggests that consideration be given to the merits of quoting "deficits for present members" and "actuarial deficits" as defined instead of—or, at least, in addition to—figures of "unfunded accrued liabilities." This, admittedly, will be of no particular value to the technician, but it may be of great assistance to the layman.

A SPECIAL PROBLEM

A special problem of great interest arose in connection with the fifth actuarial valuation of assets and liabilities under the Railroad Retirement Act as amended in 1951. The railroad retirement plan is now coordinated with the old-age and survivors insurance system in several respects, the most important of which is a scheme of reinsurance applicable to a portion of the benefits payable under the Railroad Retirement Act. In essence,

the railroad retirement system is obligated to pay old-age and survivors insurance taxes on railroad payrolls according to social security rates, and, in return, old-age and survivors insurance is to reimburse railroad retirement to the extent of the additional benefits OASI would have to pay on the basis of railroad earnings had such earnings been credited under the Social Security Act on a par with regular social security wages. In addition, the Social Security Administration is to give direct credit for railroad employment to individuals whose railroad service totals less than the 10 years needed to qualify for a railroad retirement benefit. The financial interchange is made retroactive to January 1, 1937. How the reimbursements for additional benefits are calculated will perhaps be best illustrated by citing three examples.

1. A man worked continuously for 30 years in railroad employment to the time of his retirement at age 65 on January 1, 1953. His creditable railroad earnings were always at the rate of $300 a month and he had no social security employment whatsoever. His railroad retirement annuity is $165.60. Had his railroad service been credited under the Social Security Act, he would have been entitled to an old-age benefit of $85. This $85 is therefore the amount that OASI is required to pay railroad retirement for each month during which the retired employee does not earn more than $75 in either railroad or social security employment. The work clause would, of course, not apply after the man attains age 75. Additional reimbursements would be required if the man's wife would have been eligible for a wife's benefit under the Social Security Act. In the usual case, such additional reimbursement would be $42.50 a month.

2. Suppose the same man takes a job covered under the Social Security Act beginning with January 1953, and works continuously to the end of 1954 making $200 a month. Effective January 1, 1955, he becomes entitled to an old-age benefit of $55 a month (assuming that a recomputation was later applied for). Social Security would not be required to pay railroad retirement anything for the 24 months in 1953 and 1954, since the man earned more than $75 in each of such months. For January 1955 and thereafter, OASI would have to reimburse railroad retirement only to the extent of $30, since this is the difference between the $85 which would have been payable on the basis of railroad and social security earnings combined and the $55 which will be payable on the basis of social security wages alone.

3. The man of example 2 dies in January 1955, leaving a widow age 65. Under the formulas of the Social Security Act, she would have been entitled to a monthly benefit of $63.80. Actually, she will be receiving a benefit in the same amount from the Railroad Retirement Board. The amount of reimbursement from old-age and survivors insurance will be the full $63.80, since simultaneous survivor benefits from both systems are not permitted. In this case, the additional benefit is the full benefit computed according to social security formulas on the basis of railroad and social security earnings combined.

The beneficiaries themselves are not involved in these transactions; the financial interchange takes place between the two trust funds. For this reason, the most recent actuarial valuation for the railroad retirement system had virtually to be made in three separate parts:

A. Valuation for benefits payable under the Railroad Retirement Act without regard to coordination with social security.
B. Valuation for benefits which would have been payable to railroad retirement beneficiaries on the basis of railroad and social security earnings combined, according to the formulas of the Social Security Act.
C. Valuation for old-age benefits which will be payable by social security directly to railroad annuitants and their dependents on the basis of social security employment alone.

The excess of B over C represents the potential assets anticipated from reimbursements. Against those, it was necessary to set up liabilities consisting of future taxes on railroad payrolls at social security rates and a lump-sum settlement representing the net effect of financial interchange transactions attributable to the years 1937–50. It is in this connection that difficulties arose in the derivation of unfunded accrued liabilities.

Since the problem will be discussed here from a theoretical rather than a practical viewpoint, the development will proceed by means of algebraic symbols, not figures actually computed in the course of the valuation. The pertinent items are presented in Table 3 below:

TABLE 3

SELECTED COST ITEMS ENTERING INTO THE CALCULATION OF LEVEL COSTS FOR THE RAILROAD RETIREMENT PLAN AS AMENDED IN 1951

(Present Value Dollar Amounts for Present Members, Percentages of Payroll for New Entrants)

Item	Present Members	New Entrants
1. Benefits payable under the Railroad Retirement Act...	B_1	$r_1\%$
2. Benefits to railroad beneficiaries which would have been payable under the Social Security Act on the basis of railroad and social security employment combined........................	B_2	$r_2\%$
3. Portion of item 2 directly payable by OASI on on the basis of social security employment alone	B_3	$r_3\%$
4. Amount due OASI as a lump-sum settlement for the years 1937–50.............................	S	....
5. Taxes due OASI on future creditable railroad payrolls....................................	T	$t\%$
6. Funds on hand..	F	....

Denoting again the present values of 1 percent of future taxable payrolls for present employees and future entrants by P' and P'' respectively, we can proceed to make level cost calculations as follows:

(a) Net cost without regard to financial interchanges with social security

$$\frac{B_1 + r_1 P'' - F}{P' + P''}$$

(b) Effect of financial interchange

$$\frac{(B_2 - B_3) - (S + T) - [t - (r_2 - r_3)]P}{P' + P''}$$

(c) Net cost considering the financial interchange

$$(a) - (b)$$

We now come to the problem of determining what is a proper unfunded liability which would allow for the effect of the financial interchange (reinsurance) with social security. If one could view the present railroad retirement program simply as a social security "offset" plan, there would be no difficulty whatsoever. The cost calculations would then concern themselves only with supplementary benefits and the unfunded accrued liability would be computed in the regular fashion. Social security benefits and taxes would then remain outside of the scope of the actuarial calculations. However, the actual situation is not that of an "offset" plan, since a single tax rate is charged for what might be called a combination of both the social security and supplementary railroad retirement benefits. In that way the railroad retirement system becomes involved in the financing of social security benefits which would have been payable to railroad workers on the basis of their railroad employment. Viewing the situation from the angle of actual total benefits, we have an unfunded accrued liability which is calculated in the ordinary way without regard to the reinsurance scheme. It is only when one begins to inquire into the cost of the "supplementary" benefits that a different approach toward the unfunded liabilities of the railroad retirement system becomes necessary. It is from such a point of view that different opinions have been expressed.

To illustrate the diversity of opinion, three different approaches will be presented. All of these attempt to adapt the traditional concept of unfunded accrued liabilities to the peculiar conditions of the present railroad retirement system. The discussion which follows will give a brief description of each of these approaches, with an analysis of the logic behind it.

In addition, a fourth approach will be shown, based on the concept of "deficit for present members" which was discussed earlier in the paper.

I. This method begins with developing cost figures for the supplementary benefits and disregards social security taxes which form a part of the reinsurance scheme. Keeping the notations of Table 3, and remembering that P' and P'' represent the present value of 1 percent of future payrolls for present employees and new entrants respectively, we have the following:

Present value of supplementary benefits to present members

$$B_1 - (B_2 - B_3) \tag{a}$$

Normal rate for supplementary benefits to new entrants

$$[r_1 - (r_2 - r_3)]\% \tag{b}$$

Unfunded accrued liability attributable to the supplementary benefits

$$[B_1 - (B_2 - B_3) - (F - S)] - [r_1 - (r_2 - r_3)]P' \tag{c}$$

Note that in item (c) the effective funds on hand are represented by $F - S$, since the assumption is made that for purposes of the theoretical discussion the lump-sum settlement of S dollars due OASI may be considered as having been transferred out of the Railroad Retirement Account.

This method seems to be based on the theory that only benefit cost figures may enter into the determination of unfunded accrued liabilities. The approach recognizes the reinsurance scheme by bringing out another unfunded accrued liability "shifted" to OASI which equals:

$$[(B_2 - B_3) - S] - (r_2 - r_3)P'. \tag{d}$$

The sum of the two unfunded accrued liabilities equals

$$B_1 - F - r_1 P' \tag{e}$$

which is the same as the single unfunded accrued liability computed without regard to the reinsurance scheme.

II. The logic behind this approach is that, from the point of view of the railroad retirement system, taxes to be paid into the OASI Trust Fund are cost items no different from costs of benefits. Potential assets will, of course, include benefit reimbursements expected from OASI. The basic cost figures then shape up as follows:

Effective normal rate including tax obligations and reimbursements under the reinsurance scheme

$$[r_1 + t - (r_2 - r_3)]\%\qquad\qquad(a)$$

Effective liabilities for present members on the same basis

$$B_1 + (S + T) - (B_2 - B_3)\qquad\qquad(b)$$

Unfunded accrued liability

$$[B_1 + (S + T) - (B_2 - B_3)] - [(r_1 + t) - (r_2 - r_3)]P' - F\qquad(c)$$

The normal rate so defined appears proper from the point of view of costs to the railroad retirement system, but it suffers from the difficulty of bringing in a cost item (premiums) which is independent of the cost of the supplementary benefits which is only $(r_1 - r_2 + r_3)\%$. To this extent, this approach departs from the theoretical basis of unfunded accrued liability. However, since new situations often require modifications of old concepts, it is very possible that this new definition of normal costs is quite proper under the circumstances.

It is interesting to note that the unfunded accrued liability computed under method II is less than that computed under method I by $tP' - T$, which, in terms of present values, is the excess of social security taxes on present employees at the equivalent level rate applicable to new entrants over taxes at the equivalent level rate applicable to present employees. That such an excess exists is due to the fact that social security tax rates are graded (3 percent for the years 1950–53; 4 percent for 1954–59; 5 percent for 1960–64; 6 percent for 1965–69; and $6\frac{1}{2}$ percent after 1969), so that present employee payrolls will be taxed mainly at the lower rates, while for new entrants exactly the opposite is true; had the rate been flat, the unfunded accrued liability would have been the same under both methods. The striking fact about methods I and II is that, although their logical bases differ so much, they would have produced the same results were it not for the technicality (from a theoretical, not practical, point of view) that the statutory social security tax rate is not flat but follows a step-up schedule. This would lead one to believe that the theoretical difference between the two approaches is more apparent than real.

III. This method is based on the premise that the net gain to the railroad retirement system resulting from the financial interchange with OASI is to be viewed as an asset on a par with funds on hand. The unfunded accrued liability is first computed on a gross basis without regard to the financial interchange and then a net amount is obtained by deduct-

ing the additional asset previously referred to. In symbols it works out as follows:

Gross unfunded accrued liability

$$B_1 - F - r_1 P' \qquad (a)$$

Present value of net gains from the financial interchange

$$[(B_2 - B_3) - (S + T)] - [t - (r_2 - r_3)]P'' \qquad (b)$$

Net unfunded accrued liability equals (a) minus (b).

This method was proposed with a good deal of reservation and only on the theory that for the railroad retirement system it is not necessary to retain the same meaning of certain concepts as for private plans. It was recognized that the net unfunded accrued liability as here defined contains much more than what would have been the figure applicable to the railroad retirement benefits in excess of social security amounts. Doubt was also expressed whether such an unfunded accrued liability figure could ever receive Treasury approval, if such approval were necessary for the railroad retirement plan. The method has the virtue of great simplicity and this is not to be overlooked when actuaries are trying to explain some of the highly technical terms which they use.

IV. This approach does not seek to adapt the concept of unfunded accrued liability to the present railroad retirement system. Instead, it goes back to the concept of "deficit for present members" which has been defined earlier. When coordination with OASI is considered, we have the following situation:

Present value of benefits to present members in excess of reimbursements expected from OASI

$$B_1 - (B_2 - B_3) \qquad (a)$$

Other liabilities with respect to present members, consisting of the lump-sum settlement in favor of OASI and the present value of future taxes at the social security rates,

$$S + T \qquad (b)$$

Present value of future contributions from present employees at the actual rate of 12.5 percent plus funds on hand

$$12.5\, P' + F \qquad (c)$$

Deficit for present members

$$[B_1 - (B_2 - B_3)] + (S + T) - (12.5\, P' + F) \qquad (d)$$

Since without coordination the comparable figure would have been

$$B_1 - (12.5\, P' + F), \qquad (e)$$

the conclusion is to be reached that the effect of the financial interchange is to reduce the deficit for present members by

$$(B_2 - B_3) - (S + T), \qquad (f)$$

which represents the sum total of all reinsurance transactions as they affect present members.

A very interesting feature of the whole financial interchange is the fact that under the scheme the railroad retirement system gains considerably on present members but loses rather heavily on new entrants. The loss on new entrants amounting to $t - (r_2 - r_3)$ percent of their payrolls is the price railroad retirement has to pay in order to realize the expected larger gain on present members. To this extent, the excess reinsurance premiums for new entrants may be considered as special charges designed to service the extra liabilities taken over by OASI with respect to present members of the railroad retirement system. This, in turn, means that it would not be proper to think that the unfunded liabilities of the railroad retirement system have been reduced by $(B_2 - B_3) - (S + T)$, which is the "profit" made on present members. The effective net gain for the railroad retirement system still remains the amount

$$[(B_2 - B_3) - (S + T)] - [t - (r_2 - r_3)]P'',$$

where the expression involving the second bracket represents the present value of the loss on new entrants. According to the latest valuation, the net effect of the financial interchange is to reduce the net costs of the railroad retirement system by 0.59 percent of payroll. This is on the assumption that social security taxes will go up exactly as scheduled. There are still other features of the 1951 amendments that make the coordination with OASI profitable to the railroad retirement system, but these features are outside the scope of this paper.

To illustrate the extent of the difference between the several unfunded liability and deficit amounts discussed in this section of the paper, a few

figures will be shown below. These figures were calculated on the basis of the findings of the latest actuarial valuation.

A. Portion of unfunded actuarial liabilities remaining with the railroad retirement system after considering the effect of the financial interchange with OASI

    Method I.. $4,560 million

    Method II.. 3,705 million

    Method III... 9,477 million

B. Deficit for present members (Method IV)............... 2,928 million

SUMMARY

The unfunded accrued liability is generally regarded as a measure of the degree of actuarial soundness. In the case of the railroad retirement plan and other public plans using the same method of financing, such a criterion of actuarial soundness does not seem appropriate. The important question there is to what extent the future well-being of the plan depends on excess contributions of new entrants. It is suggested that another type of figure, called the "deficit for present members," will provide a better answer to this question.