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INFLATION AND THE PACE OF FUNDING
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A. PURPOSE

The purpose of this paper is to offer some comments, and possibly some new thoughts, on the funding of defined benefit pension plans. It is specifically concerned with various questions relating to how actuarial assumptions and the pace of funding are affected by inflation. In the sense used here, "funding" refers to the practice of accumulating assets prior to retirement, as is the common practice in the United States, United Kingdom, Holland, Australia and a number of other countries.

Although it can be argued that inflation affects pension plans in other ways, emphasis is placed on experience in two key areas, namely the interest rate (or rate of return) and salary increases.

B. SIMPLIFICATIONS

In order to focus attention on the essential issues, a number of simplifications have been made. These are as follows:

- The plan under consideration provides pension benefits only with no ancillary death or disability features.
- The benefit formula is a flat 1% of final year's earnings for each year of service. The complications of integration with Social Security have, therefore, been eliminated although in some countries, especially where state benefits are relatively high, integration may have an important effect on pension costs.
- Retirement age is 65.
- There are no employee contributions to the plan.
- All participants are males who enter service (and the plan) at age 25. This assumption is obviously unrealistic, but it does simplify the tables and distorts the results only to a minor degree.
- It is assumed that salary increases resulting from promotion, seniority and merit (but not inflation) can be expressed as a flat 2% per year compound increase. For most organizations, these increases tend to be higher in the early years of service and younger ages and to be lower at higher ages. A flat 2% non-inflationary salary scale has been chosen merely for convenience.

C. BACKGROUND

For many years, it has been the "conventional wisdom" that the *difference* between assumed interest rate and assumed salary increases (which we will call Delta for convenience) is the key element in selecting actuarial assumptions. Most actuaries are aware that a given value of Delta does not mean that actuarial liabilities are the same no matter what other assumptions are chosen but it is common to find more emphasis on Delta than on the absolute level of assumed interest rate or salary increases.

However, Delta is the key element in the actuarial assumptions *only* of certain hypotheses are made:

1. That actuarial liabilities (or costs) are approximately the same for any given value of Delta. As we shall see, this is only partly true, unless the valuation system includes allowance for pre-funding of post-retirement cost-of-living increases.
2. That the plan is fully-funded on the actuarial basis selected. Typically, this is not so, although many plans are fully-funded on the basis of accrued benefits.
3. That the "concept of symmetry" in investment fund performance holds true. For those of you who may not be familiar with this terminology, the concept of symmetry states that as inflation increases, the rate of interest (or return) will increase by a like amount. Thus, if 3% yeield can be expected under conditions of no inflation, then a 6% yield will be obtained if inflation is at a rate of 3%. In the last few years, most of us have seen dramatically "asymmetrical" performance, and it is one of the themes of this paper that symmetry has not been evidenced for many years.

In the next three Sections, we will take a quick look at each of these hypotheses.

D. VARIATIONS IN COSTS

Table I below shows the cost as a percentage of salary required to fund the simple plan chosen for illustrative purposes for a male participant at entry age of 25. The matrix is not very extensive but it does show how costs vary according to the assumed rates of interest and salary increases.

TABLE I
Costs as Percentage of Payroll

Assumed Rate of Salary Increase	Assumed Rate of Interest 4%	5%	6%	7%	8%
2%	4.18	3.00	2.15	1.53	1.09
3%	5.36	3.89	2.81	2.03	1.46
4%	6.77	4.98	3.62	2.65	1.92
5%	8.40	6.28	4.59	3.41	2.49
6%	10.27	7.80	5.72	4.33	3.19
7%	12.34	9.56	7.02	5.39	4.02

Note: Mortality according to GA 71 table.
Moderate turnover included.

The results for a Delta of 2% may be summarized as:

Interest Rate	Salary Increases	Cost as Percent of Salary
4%	2%	4.18%
5%	3%	3.89%
6%	4%	3.62%
7%	5%	3.41%
8%	6%	3.19%

It will be seen that costs do vary quite significantly (by about 7% for each 1% change in interest rate) even for a constant value of Delta.

The reasons for these variations are, of course, well-known but it might be worth summarizing them here:

- The salary scale operates only up to retirement age (in this case 65) so for annuity values at or after this age there is no offset to the increase in assumed rate of interest.
- The interest rate and salary increase assumptions operate in a compounding manner so the arithmetical difference is not strictly valid. For interest at 4% and salary increases at 2%, the difference is really 1.96% (1.04 ÷ 1.02) while at an interest rate of 8% the difference is 1.89% (1.08 ÷ 1.06).

Three other aspects should also be noted:

1. The variations in cost for a given value of Delta may be far larger if the plan is integrated with Social Security since an increase in final salary may cause a much greater increase in benefit.
2. There is an anomaly which many clients find confusing. They view a set of assumptions of 8% interest/6% salary increase as including allowance for future inflation whereas 4% interest/2% salary increases do not. However, the inflationary set of assumptions which one would expect to be more conservative, actually produces a lower cost.
3. Table 1 is based on a no pre-funding of cost-of-living adjustments after retirement. Of course, if these adjustments are included in the actuarial costs, the variation for a given value of Delta is very much smaller.

E. FUNDING LEVEL

The concentration on Delta in the setting of actuarial assumptions implies, at least to some extent, that once the value of Delta is established, the absolute levels of assumed interest and salary increase have relatively little significance. Carried one step further, the implication is that an assumption of 4% interest/2% salary increase will perform adequately if inflation occurs since the experience will be, say, 8% intersest/6% salary increases. This is the concept of symmetry which is analyzed in Section F below.

Let us now explore the effect of inflation on a pension plan *assuming for the time being that the concept of symmetry does hold true.* The effect can be illustrated in a number of different ways but Tables 2 and 3 below employ the classic gain and loss analysis technique which is widely used in the United States but perhaps less familiar in other countries. Basically this process takes liabilities and assets at the beginning of the year and projects them, with interest, to the end of the year to obtain "expected assets" and "expected actuarial liabilities". Comparison of expected with actual gives an "actuarial gain or loss" from assets and liabilities respectively.

In the two Tables below, it is assumed that:

- Basis A (4% interest/2% salary increases) produce exactly the same beginning liabilities as Basis B (7% interest/5% salary increases).
- Normal cost and contributions are both payable at the beginning of the year.
- All participants are active so that the complication of benefits payments is avoided and a 1% increase in salaries increases liabilities by 1%.
- Actual experience in the year is 9% interest rate and 7% salary increases which, it will be noted, preserves the "concept of symmetry".

In Table 2, it is assumed that the plan was fully-funded that is to say assets equal actuarial liabilities.

TABLE 2
Effect of Symmetrical Inflation-Fully-Funded Plan

	Basis A 4% Interest 2% Salary Increases	Basis B 7% Interest 5% Salary Increases
1. Actuarial Liability 1/1	$1,000,000	$1,000,000
2. Assets 1/1	1,000,000	1,000,000
3. Normal Cost due 1/1	100,000	100,000
4. Contributions paid 1/1	100,000	100,000
5. Benefit payments in year	-0-	-0-
6. Assumed interest on:		
(a) 1 for 1 year	40,000	70,000
(b) 3 for 1 year	4,000	7,000
(c) Total: (a) + (b)	44,000	77,000
7. Assumed interest on:		
(a) 2 for 1 year	40,000	70,000
(b) 4 for 1 year	4,000	7,000
(c) Total: (a) + (b)	44,000	77,000
8. Expected Actuarial Liability 12/31 (1) + (3) + (6) (c)	1,144,000	1,177,000
9. Actual Liability 12/31	1,200,078	1,200,078
10. Liability Gain (+) or Loss (-)	-56,078	-23,078
11. Expected Assets 12/31 (2) + (4) + (7) (c)	1,144,000	1,177,000
12. Actual Assets 12/31	1,199,000	1,199,000
13. Asset Gain (+) or Loss (-)	+55,000	+22,000
14. Total Gain (+) or Loss (-)	- 1,078	- 1,078

It will be seen that the two bases result in the same gain/loss (in this case a very small loss) *provided:*

- The two bases give the same liability figures, which as we have already seen is not strictly true.
- The plan is fully-funded.
- The concept of symmetry holds true.
- There are no retired participants (or participants with deferred vested benefits).

Table 3 below shows the same analysis of gain and loss but with one assumption changed. In this instance, the hypothesis is that the plan is only *half*-funded.

TABLE 3
Effect of Symmetrical Inflation — Half-Funded Plan

	Basis A 4% Interest 2% Salary Increases	Basis B 7% Interest 5% Salary Increases
1. Actuarial Liability 1/1	$1,000,000	$1,000,000
2. Assets 1/1	500,000	500,000
3. Normal Cost due 1/1	100,000	100,000
4. Contributions paid 1/1	130,000	130,000
5. Benefit payments in year	-0-	-0-
6. Assumed interest on:		
(a) 1 for 1 year	40,000	70,000
(b) 3 for 1 year	4,000	7,000
(c) Total: (a) + (b)	44,000	77,000
7. Assumed interest on:		
(a) 2 for 1 year	20,000	35,000
(b) 4 for 1 year	5,200	9,100
(c) Total: (a) + (b)	25,200	44,100
8. Expected Actuarial Liability 12/31 (1) + (3) + (6) (c)	1,144,000	1,177,000
9. Actual Liability 12/31	1,200,078	1,200,078
10. Liability Gain(+) or Loss(-)	-56,078	-23,078
11. Expected Assets 12/31 (2) + (4) + (7) (c)	655,200	674,100
12. Actual Assets 12/31	686,700	686,700
13. Asset Gain(+) or Loss(-)	+31,500	+12,600
14. Total Gain(+) or Loss(-)	- 24,578	-10,478

It will be seen that Basis B shows a much smaller loss if the plan is less than fully-funded. This is because a smaller asset gain is required to offset the liability loss and the lack of assets on which to earn the asset gain is therefore less significant.

The conclusions from the part of the analysis may be summarized as follows:

1. Even if the concept of symmetry holds, inflation can cause material actuarial losses if the plan is not fully-funded. Table 4 illustrates this point in the form of the yield required to offset the effect of 5% inflation (assumed to be equivalent to 7% salary increases) for varying levels of funding and various actuarial assumptions (all including Delta of 2%).

TABLE 4
Yield Required to Offset 5% Inflation

Assumptions		Percentage Funded			
Interest	Salary Increase	25%	50%	75%	100%
4%	2%	18.20%	12.90%	10.48%	9.10%
5%	3%	16.41	12.16	10.21	9.10
6%	4%	14.63	11.41	9.94	9.10
7%	5%	12.84	10.66	9.67	9.10
8%	6%	11.06	9.92	9.40	9.10

2. The figures in Table 4 are based on active participants only. To the extent that there are retired lives and terminated participants with vested benefits included in the valuation, the yield required to offset a given amount of inflation will be reduced. However, inflation itself tends to reduce the significance of retired and vested benefits, and so many plans are in an immature status, that this decrease in required yield is often not very substantial.
3. The results in Table 4 imply that the added yield in inflationary times should be larger than the rate of inflation which is contrary to the concept of symmetry. What, in fact, will happen is that the actuarial loss has to be made up by larger contributions from the employer.
4. An interesting anomaly arises if we compare the conclusions reached in this Section E with those in Section D. It appears that under most plans (for an unchanged value of Delta) inflation will bring smaller actuarial losses if 8% interest/6% salary increases are assumed than if 4% interest/2% salary increases are assumed. Yet in Section D we showed that the 8%/6% assumptions would exhibit a lower cost. Thus, by raising both interest rate and salary increase assumptions, the actuary can at the same time lower the contribution level and decrease the probability of actuarial losses! (It will be appreciated that if the liability for inactive participants is relatively large this will not be so.)

5. It will also be seen from Table 4 that the percentage funded has relatively less effect on the yield required as the assumptions are closer to "realistic".

F. INVESTMENT PERFORMANCE

Up to this point, this analysis has not questioned the validity of the "concept of symmetry", which is really just another way of expressing the idea that pension fund investments can provide an adequate "hedge" against inflation. Traditionally, common stocks and other forms of equity investment have been thought of as providing such a hedge, but in recent years some doubts have appeared and some market authorities recommend investments in bonds and other forms of fixed-income securities.

The brief exploration outlined below covers both stocks and bonds in the United States over the 50-year period 1926 to 1975. Table 5 shows historical rates of return (including appreciation or depreciation) and cash yields (dividends and interest only) over this period. At the same time the movement in the Consumer Price Index, a widely accepted measure of inflation is shown. Similar rates of return, yields and inflation are then indicated for the six periods, in these 50 years, during which the rate of inflation exceeded 5% per year. We can then attempt to see whether, in fact, rates of return or yields increased in such a way as to offset, or act as a hedge against, inflation.

TABLE 5
Historical Record of Returns and Inflation

	Average Compound Annual Rates				
		Bonds		Stocks	
Period	Consumer Price Index	Cash Yield	Total Return	Cash Yield	Total Return
1926-1975	2.3%	3.6%	3.1%	4.5%	9.0%
1941-1942	9.5%	2.2%	2.1%	6.2%	3.1%
1945-1948	7.8%	2.3%	2.7%	4.8%	8.8%
1950-1951	5.8%	2.4%	-2.0%	6.9%	27.8%
1968-1970	5.4%	6.0%	2.0%	3.9%	1.9%
1973-1975	9.3%	6.8%	4.1%	4.0%	-4.9%

Notes: Bonds are assumed to be long-term U.S. Government bonds. Stocks are represented by the Standard & Poor's Composite Index.

As most actuaries are aware, there a number of problems associated with general research of this kind. In the first place, here in the United States, we have what amounts to an over-abundance of statistics on the stock market. The figures in Table 5 were derived, in the main, from an excellent study by Roger Ibbotson and Rex Sinquefield but by using different indices and different mathematical techniques, somewhat different results are obtained.

Secondly, and more importantly, plans differ as to the manner in which investment performance is recognized. In particular, methods used for valuing pension fund assets (especially equities) can range all the way from full market value to formulas essentially independent of market value. Another related aspect is the extent to which assets are realized. It is for these reasons that both "Cash Yield" and "Total Return" are shown in Table 5.

Despite these problems, it seems clear from Table 5 that *neither* bonds *nor* stocks followed the "concept of symmetry" during the 50-year period from 1926 to 1975. In fact, with minor exceptions, stocks, which are reputed to provide a hedge against inflation, performed *worse* during the six actual inflationary periods than over the total period.

A rather more detailed analysis of the data from which Table 5 was extracted seems to indicate that a pension fund portfolio can do little better than replace *half the rate of inflation.* What this means is that if the non-inflationary yield (or return) is, say, 4% then if 5% inflation is experienced, the yield (or return) will increase to 6½% (4 + ½ x 5), rather than 9%. For convenience, we will refer to this as "half-symmetry".

Obviously, half-symmetry should not be taken too literally and there are undoubtedly circumstances under which a different degree of symmetry will be experienced. However it is interesting to note that corroboration, at least on an approximate basis was provided recently in an interesting paper entitled "Can We Maintain Real Values in Pensions and Fund Them?" presented by Professor E. Victor Morgan to the Annual Conference of the National Association of Pension Funds. Professor Morgan furnished statistics on nominal and real yield on 2½% Consols which are reproduced in Table 6 below.

TABLE 6
Nominal and Real Yields on 2½% Consols

Year	Average Nominal Yield	Inflation Rate	Real Yield
1960	5.42%	2.2%	3.2%
1961	6.20%	4.6%	1.5%
1962	5.98%	2.7%	3.2%
1963	5.58%	1.9%	3.6%
1964	6.03%	4.6%	1.4%
1965	6.42%	4.4%	1.9%
1966	6.80%	3.7%	3.0%
1967	6.69%	2.6%	4.0%
1968	7.39%	6.2%	1.1%
1969	8.88%	5.0%	3.7%
1970	9.18%	8.5%	0.6%
1971	9.05%	8.2%	0.8%
1972	9.11%	7.7%	1.3%
1973	10.85%	12.0%	-1.0%
1974	14.95%	20.0%	-4.2%
1975	14.60%	23.3%	-9.3%

These figures clearly do not support full-symmetry but they come very close to exhibiting half-symmetry.

Professor Morgan also gave some insights into why the "real yield" does not remain constant. In the first place, there is a lag effect between the advent of inflation and a lender's realization that an increased yield is required to offset it. Secondly, investors who do not obtain sufficiently increased yield to offset inflation are consoled by the possibility of a capital gain when market rates of interest decline in the future. To this I would add the psychological inability of most investors to think of inflation as continuing over a long period of time: the tendency is to think of a rise in the Consumer Price Index as a one-year aberration.

Regardless of the reasons, it does seem fair to conclude that, at least in the past, half-symmetry is closer to the facts than full-symmetry.

G. CHOICE OF ASSUMPTIONS

The conclusions submitted are that:

- The concept of symmetry is not valid.
- A conventional portfolio of stocks and bonds probably exhibits half-symmetry.
- Even common stocks provide only a partial hedge against inflation.

Obviously, these are generalities and conditions differ from one country to another, but it seems likely that, in an approximate fashion, these conclusions hold true in most of the countries represented in IACA.

Do these conclusions point to any change in the way the individual actuary might select assumptions? For many it will not, because they have, in one way or another, already taken into account the characteristics described earlier in this paper. Overall, however, we might expect to see some developments along the following lines:

1. There appear to be real disadvantages in setting assumptions that include no allowance for inflation such as 4% interest/2% salary increases. Losses will be relatively high in times of inflation and costs are higher than if inflation is built into both interest and salary increase elements.
2. However if half-symmetry is true and, say, 4% long-term inflation is anticipated then 6% interest/6% salary increases would seem more appropriate. This is considerably more conservative than most assumptions we have seen in recent years and would, for many plans, produce considerably higher contribution rates.
3. The contributions resulting from 6% interest/6% salary increases will appear unduly high during periods of favorable economic conditions, although they will level out costs in the long run which presumably includes periods of unfavorable conditions.
4. There may be considerable employer resistance to more stringent funding while inflation is low in anticipation of periods when inflation will be high. In many industries it is very difficult for the higher contributions required to "pre-fund inflation" to be included in the cost of today's products.
5. On the other hand, the substantially increased contributions required during a period of inflation to amortize salary and investment losses may also come at a very inopportune time.
6. There is a real dilemma here for the employer and his actuary. It may be argued that some procedures for valuation of pension fund assets will give relief but the effect would seem to be slight. Moreover, the asset valuation procedure itself contains another dilemma. If it follows marker values closely, then costs are unstable and market declines, when interest rates rise, will have a significant effect on contributions. On the other hand, if market values are largely ignored, appreciation will not be recognized and, when interest rates change, prior assets will effectively still be earning the prior rate of interest.
7. One result of this dilemma could be a trend to more frequent changes in actuarial assumptions. While inflation is low, rather more optimistic assumptions, producing relatively low costs, will be desirable. Then, during inflationary periods, there will be a tendency to use more stringent assumptions rather than show substantial actuarial losses or deficits. One advantage, which is really only cosmetic in nature, is that changes in liabilities due to changes in assumptions are typically amortized over long periods of time (30 years in the U.S. under ERISA) while actuarial gains and losses are paid off over shorter periods (15 years under ERISA).
8. An outcome that we can expect (or perhaps it is already with us) is a conflict between variability of contirbutions over time and the absolute levels of contribution.

H. COST-OF-LIVING ADJUSTMENTS

So far we have deliberately ignored cost-of-living adjustments to pensions being paid to retired participants, widows and other beneficiaries. But the writing seems to be on the wall that these adjustments will come to be expected as just one feature required of a "good plan".

The evidence seems to be overwhelming:

- For many years, France has paid pensions on the "point system" which effectively allows fully for the effects of inflation.
- In Germany, the 1974 law introduced mandatory indexation although there is some relief in that the employer's economic condition must be taken into account.
- In the United Kingdom, regular annual adjustments are now quite common (although not guaranteed in advance) and the Guaranteed Minimum Pension for contracted-out plans is "dynamized".
- U.S. employers have been much more cautious but many of them have given periodic *ex gratia* increases to pensioners.

If we feel there are problems now in the funding of pensions during inflation, the situation will be close to disastrous if we ever get to the position where there is a full commitment to cost-of-living adjustments and they are pre-funded. Many practitioners in our field believe this is precisely where we are headed and, at the same time, there are many employers who believe there is no way in which they can afford to support such a plan.

To take an example, the simple plan used here for illustrative purposes might have a cost of around 3½% of payroll on conventional assumptions of, say, 7% interest/5% salary increases. If the concept of half-symmetry replaces the concept of symmetry, we might change the assumptions to 6% interest/6% salary increases which increases the cost to about 5¾% of payroll. If we now add the cost to pre-fund cost-of-living adjustments at the long-term rate of, say, 4%, we would push the plan cost up to almost 8%, or more than double the original figure.

I. LOOKING TO THE FUTURE

Can employers afford these levels of pension cost? Do we tell them the only alternative is to reduce benefits? Perhaps, there are other solutions, of which the following is merely a tentative list:

1. The Government could, in effect, take over private pension plans by increasing Social Security up to a level that satisfies all reasonable retirement needs, as they have in Italy. It should be noted that nation-wide pay-as-you-go plans do not have problems with inflation although they may be vulnerable to demographic changes.
2. The Government could also solve the problem by issuing index-linked bonds as a number of economists have suggested. There is likely to be a price in the form of closer state supervision, and less flexibility, in private plans.
3. Other different types of investment may be developed. There is considerable disillusionment with the stock market and the poor position of a lender in times of inflation. Some experts believe that pension funds should be true "owners", not lenders, and should perhaps have direct investment in plant and machinery instead of holding pieces of paper.
4. Maybe we will come to favor less, rather than more, funding as a protection against inflation. This is the conclusion arrived at in France and Germany where true galloping inflation has been experienced.
5. There is some possibility that other developments will decrease costs and serve to offset the effects of inflation. One of these is later retirement, although experience in the last ten years has pointed in the opposite direction.
6. In the U.S. serious thought is being given to placing more emphasis on defined contribution plans (e.g., savings or profit-sharing) in order to get employees to share some of the burden caused by inflation.
7. Perhaps, employees should share in a different way, by accepting less benefit security during inflation.

Whether you agree or disagree with any or all of these alternatives, we do share some responsibility for resolving the acute problems associated with funding pension plans in periods of inflation.