Financial Planning Working Party - Chester 1979

Introduction and Summary of Papers

The members of the group comprised:

Bill Abbott	Russell Devitt
Ron Akhurst (leader)	Graham Lyons
Geoff Booth	Jim McCaughan
Roger Davies (in discussion)	Jon Wallis

The work on Financial Planning for this year consists of a series of individual papers, which have been discussed within the group at various stages, but which remain the especial contribution of each particular author. A number of open questions have been included in some of the papers to stimulate discussion and to suggest further lines of particular research for the future.

A brief summary of the subject matter of each paper is as follows:-

1. Adaptive Control : Bill Abbott

   Bill reviews some of the recent work in this field, particularly in Australia, and includes the main part of a recent paper by Richard Cumston, together with suggestions for possible further investigation and research.

2. Discounting and Inflation : Ron Akhurst

   Ron continues the theme of his GIRO 22 paper (itself a contribution to this year's discussions) by looking at the way current revenue accounting distorts profitability when compared with an inflation adjusted system combined with discounted claims reserves.

3. Capital Allocation : Geoff Booth

   Geoff explores the controversy of whether or not to allocate capital by class or profit centre, and outlines some ideas based on portfolio theory for maximising the return on an overall account without specific sub-allocation. He produces some preliminary results from analysis of D.o.T. returns, looking at the effect of various portfolio mixes.

4. Concepts of Profit in the Context of Non-Life Insurance : Russell Devitt

   Russell summarises the ways in which the accountancy profession has been developing the concept of profit, given the impact of inflation on conventional accounts. He concludes that insurers overstate their current profitability and run the risk of becoming over-taxed if they do not achieve some relief on solvency adjustments comparable to stock appreciation relief in the rest of industry.

5. Reinsurance : Sustainable Growth of Funded Accounts : Graham Lyons

   Graham explores the particular problems of determining sustainable growth rates in the funded accounts that reinsurers, Marine and Aviation insurers adopt. He produces some relatively simple formulae under a variety of common tax and profit adjustments and derives a similar set of formulae for policy year accounting in conventional business.

6. Investment Policy of GI Companies - Practice and a Little Theory : Jim McCaughan

Jim draws on a range of material to compare the current investment holdings of the seven major composites and some aspects of the relative performance of the various investment categories over the recent past. He concludes there is evidence for continued faith in the equity/property markets in inflationary conditions, and suggests some rough limits for the asset value exposure that companies should contemplate.

7. Financial Planning in Composite Offices conducting mainly Life Business : Jon Wallis

Jon considers the problems of a profitable Life company diversifying into general business, and concludes that shareholders may have to be prepared to forego some potential dividends if, as is likely in practice, the levels of premiums obtainable in the market are not sufficient to sustain the rate of non-Life growth envisaged.

In addition, it is hoped to have available by September a brief summary of the 13+ papers produced for the May 1979 meeting of the C.A.S. in Colorado, dealing in the main with the application of modern financial theory to general insurance, and the implications of total return on capital for the financial management and planning of such business. These areas are considered particularly important at the present time in the USA, and all those interested should try to obtain a copy of these C.A.S. papers.

R.B.A.
June, 1979

ADAPTIVE CONTROL

"Adaptive Control" is a phrase which has received some attention in recent actuarial discussions on financial management in non-life insurance. It is a phrase which most people intuitively think that they understand. These notes are a very limited attempt to track down the pedigree of the subject.

My first reference was John Ryder's paper on subjectivism to the Institute, (JIA 103,Pt 1), Pages 71/2 refer and I will assume that the reader will have referred back to these pages.

Ryder's bibliography had two references relating to adaptive control

1) Operational Research by Ackoff and Sasieni.

   A summary of the final section is enclosed as Appendix A. The book refers more to adaptive planning than to the engineering science of adaptive control.

2) An Engineering Handbook

   So far I have received Volumes 1 and 2, and not Volume 3 which is the one Ryder refers to. Vol. 1 covers the mathematics of FEEDBACK CONTROL in detail but with no initial generalised description. I hesitate to summarise and will not. However a paper by Richard Cumpston may be indicative of the techniques used (although its practical relevance without further development is nil.)

John Ryder again extolled the virtues of adaptive control in the Australian G.I. Bulletin (Nos. 5 and 6)

He says

"...we use two types of mathematical models.

(i) a very simple model for control

(ii) an elaborate model for testing

Adaptive control theory is simply the analysis, testing and adaptation of simple mathematical models. The simple model is used to "model" the reaction of a system to disturbance and is used to determine optimum conditions for control action. The simple model does not predict, not even as a probability statement. The simple model is a "control device" not an unwieldy "realistic" model; a control device which will not set up too great an oscillation in the systems behaviour or lag too far behind. Since it is not possible to predict the future we give up trying to. Instead we concentrate on demonstrating that our simple control models will work using elaborate model office studies. The simple secret for controlling most processes is to leave yourself something to adapt.

This "philosophical" statement is something that I agree with, and I would welcome other views on the subject as it is fairly fundamental to the development of models for planning purposes.

Cont'd. ...

Cumpston wrote a paper on Control Systems or more specifically Feedback Control for the First Australian G.I. Actuarial Conference. This paper is attached as Appendix B.

He took the equation

$$\Delta S_t = P_{t+1} - (1 + e)\ C_{t+1}$$

where S_t = shareholders funds (S.M) at end of year t

P_t = written premium in year t

C_t = incurred claims and eC_t = expenses in year t

He then looked at an automatic control system which

a) assumed a method has been devised for predicting claims ($\tilde{C}_t$ = predicted claims)

b) set an objective of maintaining a solvency margin $\tilde{S}_t = kP_t$, starting with $S_c = kP_o$

c) the premiums are controlled by setting them in accordance with the formula

$$f'(kP_{t+1} - S_t) = P_{t+1} - (1 + e)\ \tilde{C}_{t+1}$$

f is called the feedback factor.

"Negative" Feedback occurs when f is greater than 0(!?). This means, if f = 1, that we set premiums to try to produce a profit which finances the growth in a 40% solvency margin plus the deficiency of the actual solvency margin.

As far as I can make out the whole object of the paper is a trial and error study to see if a sensible control system can be set up using various values of f. It transpires that oscillations greater than those considered desirable are set up by the automatic control process envisaged and that the actual control system being used is superior to that envisaged.

Cumpston himself recognises the unsatisfactory nature of the work to date. This paper may be the start or end of a particular line of investigation. Particular possibilities for further work have been suggested, e.g.

1. Earned premiums rather than written
2. Superior prediction of claims

Cont'd. ...

3. Alternative control formulae, e.g.

$$k(P_{t+1} - P_t) + f\,(kP_t - S_t) = P_{t+1} - (1 + e)\,\tilde{C}_{t+1}$$

4. The fact that C_t depends on claim estimates which may have been estimated a posteriora to reduce fluctuations.

Finally it may be worthwhile to recall one aspect of the addendum to the Financial Planning paper which was handed out at the York seminar. This included a model which set premiums automatically by reference to a profit objective based on projected revenue account profits. The model found that once a jolt to steady state assumptions was introduced into the model, e.g. by the introduction of an unexpected change in the rate of inflation, the actual profit achieved began to oscillate round the target profit, sometimes with increasing rather than reducing oscillations. The profit objectives tested in that study would appear to have been using too much or too little feedback.

W.M. Abbott
3 July 1979

APPENDIX A

Ackoff & Sasieni

Nature of Plan

Planning is anticipatory decision making. The decisions involved in it form a system of independent parts. Because this system is too large and complex to be handled all at once, planning must be done in parts, and each part must be evaluated and re-evaluated in light of at least one other part. The system being planned for is part of a dynamic environment, which is such that organisational performance is likely to deteriorate unless management intervenes in the process that is taking place inside and outside the organisation.

Content of a Plan

1. Specification of organizational objectives and goals.
2. Specification of operating policies.
3. Determination of resourse requirements, how they are to be generated and how they should be allocated to components of the organisation.
4. Design of the organisational structure that is required to carry out the plan.
5. Design and control over the plan.

> "The most essential assumption in any planning process is that much of the plan will turn out to be wrong. Therefore, provisions must be made for detecting errors and inefficiencies and for correcting the plan accordingly. A plan must provide for its own continuous improvement"

Patterns of planning

(1) Satisficing (2) Optimising (3) Adaptivising

Satisficing

Setting goals believed to be feasible and desirable.

Usually implies

(i) no significant departure from current policies & practices
(ii) at most, moderate increase in resource requirement
(iii) no significant changes in organization's structure
(iv) little or no provision for possible errors or changes from expectations. Little concern with controls.

Optimising

Setting of goals and selection of operating policies interact. Calls for development of mathematical models of the system being planned for. A control unit or monitor is added to system but is not built into the system.

Cont'd. ...

Adaptivising

Plan organisations and operations so that they can not only adapt to major changes in the future but also adjust themselves to short run fluctuations in demand.

Two approaches to control. One attempts to stabilise demands made on a system over the long run, the other over the short-term. Examples 1) Variations of annual production loads of a manufacturer subject to demand cycles may be reduced by investment using same technology in another industry with demand ran in a counter-cycle 2) Motivating participants in a system to act in a way that is compatible with the interests of the organisation as a whole. It does this by providing incentives that make individual and organisational interests more compatible.

Adaptive planning should not only build into the system controls that protect against major and relatively stable changes in it and its environment; it should also build adaptiveness into the components of the system so that short-run variations can be either more adequately handled or reduced.

CONTROL SYSTEMS J.R. CUMPSTON

(Submitted to the Institute of Actuaries of Australia First General Insurance Seminar, December 1978)

Summary This paper shows that Australian motor insurers, over the last 28 years, have increased premiums smoothly and avoided large solvency fluctuations. With the same claims a number of simple theoretical control systems would have produced much more erratic premiums and much larger solvency fluctuations. The paper shows that control systems using positive feedback, or too much negative feedback, produce instability. Methods of examining control system performance are discussed.

Introduction Control systems have been useful in many fields. For example, early steam engines were controlled by rotating balls. As the speed of the engine increased, the balls moved outwards, reducing the flow of steam and thus helping to keep engine speed stable. Another example of the value of negative feedback occurs in electronic amplifiers, where many erratic components can in total give stable performance.

Unlike these examples, the control systems used by insurers are not easy to analyse mathematically. The main objectives are probably smooth premiums and stable solvency, but these are hard to define mathematically. Insurers are suprisingly successful in achieving these objectives, but it is easy to overlook some of the mechanisms which contribute to their success. For example, increased premium rates are likely to reduce policy numbers, so that profits increase while total premiums do not greatly alter.

It is also easy to overlook the practical difficulties that afflict insurers. For example, most insurers have to use industry data to supplement their own claims experience, but this data may only be published a year or two after the accidents. The performance of many control systems deteriorates rapidly if there are data transmission delays.

It is essential that actuaries understand why insurers have been so successful, before suggesting new control systems. Analyses which attempt to allow accurately for all apparently relevant factors are however complex, and do not give much help in understanding the important problems. Simplified analyses, such as those in this paper, are dangerously likely to overlook vital mechanisms.

Further difficulties arise in choosing test conditions and performance criteria. The examples at the start of this paper use actual Australian motor claims data, and simple criteria such as the mean and standard deviation of the solvency margin. Such test data has the advantage of apparent realism. If however a multiple-parameter control system was fitted so as to give optimum performance with this test data, much worse performance might result with live data.

The appendix describes a continuous control system, and examines its performance using step and sinusoid test inputs. Using these inputs, control performance can be measured in terms of response times, overshoots and transmission ratios. These test inputs and criteria are of considerab value in optimising electronic control systems, and may be useful for examining insurance control systems.

Table 1: Actual performance of Australian motor insurers

Year	Premiums		Claims		Shareholders' funds		
	Amount	Increase	Amount	Increase	Amount	Solvency margin	Solvency increase
	$M	%	$M	%	$M	%	%
76/77	722.363	21.32	444.774	15.17	300.738	41.63	10.11
75/76	595.426	22.74	386.202	6.07	187.715	31.53	6.50
74/75	485.102	32.50	364.095	35.42	121.386	25.02	-11.88
73/74	366.126	10.97	268.856	20.37	135.094	36.90	-4.72
72/73	329.932	9.85	223.364	2.49	137.301	41.61	3.87
71/72	300.343	19.08	217.933	16.75	113.378	37.75	-6.50
70/71	252.225	11.20	186.673	8.51	111.603	44.25	-6.51
69/70	226.819	10.55	172.031	15.60	115.120	50.75	-9.67
68/69	205.171	5.77	148.810	11.29	123.983	60.43	-2.82
67/68	193.975	5.81	133.709	7.33	122.682	63.25	2.22
66/67	183.330	10.37	124.581	5.32	111.888	61.03	1.29
65/66	166.106	9.66	118.292	4.35	99.234	59.74	-3.10
64/65	151.478	12.84	113.356	15.96	95.188	62.84	-10.91
63/64	134.241	11.46	97.752	18.30	99.008	73.75	-8.19
62/63	120.436	6.62	82.630	9.41	98.687	81.94	.98
61/62	112.961	7.25	75.521	-2.87	91.454	80.96	3.15
60/61	105.324	7.61	77.751	19.93	81.957	77.81	-7.14
59/60	97.878	11.66	64.832	14.12	83.152	84.95	.42
58/59	87.654	4.04	56.810	3.45	74.094	84.53	8.25
57/58	84.254	11.30	54.918	7.89	64.270	76.28	3.29
56/57	75.702	15.90	50.904	16.09	55.254	72.99	-2.47
55/56	65.318	11.05	43.848	27.18	49.290	75.46	.58
54/55	58.818	13.97	34.478	23.58	44.044	74.88	11.99
53/54	51.610	17.65	27.900	3.83	32.461	62.90	19.42
52/53	43.868	21.53	26.872	11.73	19.074	43.48	10.18
51/52	36.096	51.41	24.050	52.85	12.021	33.30	-3.92
50/51	23.840	44.73	15.734	58.29	8.873	37.22	-2.78
49/50	16.472		9.940		6.589	40.00	
Mean		15.51		15.87		58.41	.06
S.D.		11.33		14.17		18.69	7.61

Australian motor insurers Table 1 shows the premiums and claims reported to the Australian Bureau of Statistics from 1949/50 to 1976/77. State and private insurers are included, but compulsory third party insurance is excluded. Each insurer reports data for its office year ending in the financial year. "Premiums" are amounts received, not earned premiums, but for simplicity they have been treated as earned when estimating changes in shareholders' funds "Claims" are incurred claims, not claims paid.

Shareholders' funds were derived by assuming 40% solvency at the end of 1949/50, and an expense rate thereafter of 37% of claims. This expense rate was chosen so as to give a solvency margin of about 40% at the end of 1976/77. This expense rate was intended to cover commission, administration expenses, taxes and dividends.

For example, shareholders' funds at the end of 1950/51 were estimated as

6.589 + 23.840 - 1.37 x 15.734 i.e. $8.873M.

Premiums and claims both had mean annual increases of about 16%. Premiums however increased more smoothly than claims (premium increases had a standard deviation of about 11%, compared with 14% for claims). Mean solvency was estimated as 58%, but the artificial estimation procedure probably greatly over-estimated solvency in many years. In practice taxes and dividends are likely to be higher when profits are high, and no allowance for this was made. The standard deviation of the year-by-year solvency increases was 7.61%, and this figure may also be an overestimate.

Table 2 shows the disastrous results of applying a simple control system to the same claims data as in Table 1. Claims were forecast by assuming the same claim growth rate as in the previous year. For example, 1951/52 claims were forecast as

15.734 x (15.734/9.940) i.e. $24.905M.

This procedure could not be used for 1950/51 claims, so a forecast was obtained by arbitrarily adding 15% to 1949/50 claims.

The premiums needed to give solvency of 40% at the end of the year were then calculated from the forecast claims. For example, 1951/52 premiums were calculated as

(1.37 x 24.905 - .152)/(1-.4) i.e. $56.613M.

In this calculation, 1.37 allowed for total expenses of 37% of claims, $24.905M was the forecast claims, $.152M was the shareholders funds at the end of the previous year, and .4 was the desired solvency margin of 40%.

The mean solvency margin of 37.75% was reasonably close to the desired level. The standard deviation of premium increases was however nearly 12 times greater than in Table 1, and the standard deviation of solvency increases was more than 3 times greater than in Table 1.

Table 2: Premium and solvency fluctuations using a simple control system

Year	Premiums		Claims		Shareholders funds		
	Amount	Increase	Amount	Increase	Amount	Solvency margin	Solvency increase
	$M	%	$M	%	$M	%	%
76/77	204.216	-72.05	444.774	15.17	33.568	16.44	-43.60
75/76	730.704	-.09	386.202	6.07	438.692	60.04	27.62
74/75	731.363	393.91	364.095	35.42	237.085	32.42	29.36
73/74	148.077	-67.50	268.856	20.37	4.532	3.06	-46.28
72/73	455.576	89.27	223.364	2.49	224.788	49.34	18.09
71/72	240.701	-17.26	217.933	16.75	75.221	31.25	-14.50
70/71	290.924	9.07	186.673	8.51	133.088	45.75	9.04
69/70	266.735	43.95	172.031	15.60	97.906	36.71	.63
68/69	185.300	-16.58	148.810	11.29	66.853	36.08	-2.38
67/68	222.137	85.01	133.709	7.33	85.423	38.46	-.25
66/67	120.065	-39.25	124.581	5.32	46.467	38.70	-10.42
65/66	197.626	35.40	118.292	4.35	97.078	49.12	6.98
64/65	145.955	-27.85	113.356	15.96	61.512	42.14	7.12
63/64	202.290	432.64	97.752	18.30	70.855	35.03	28.48
62/63	37.979	-71.57	82.630	9.41	2.485	6.54	-51.63
61/62	133.572	1.27	75.521	-2.87	77.709	58.18	22.09
60/61	131.895	72.78	77.751	19.93	47.601	36.09	6.97
59/60	76.335	-2.66	64.832	14.12	22.225	29.12	-15.15
58/59	78.422	10.47	56.810	3.45	34.710	44.26	-3.80
57/58	70.989	-10.45	54.918	7.89	34.118	48.06	-.34
56/57	79.271	3.84	50.904	16.09	38.367	48.40	10.63
55/56	76.336	51.76	43.848	27.18	28.834	37.77	12.78
54/55	50.301	205.19	34.478	23.58	12.570	24.99	-32.67
53/54	16.482	-62.75	27.900	3.83	9.504	57.66	-12.96
52/53	44.243	-21.85	26.872	11.73	31.245	70.62	28.55
51/52	56.613	274.45	24.050	52.85	23.817	42.07	41.06
50/51	15.119	-8.21	15.734	58.29	.152	1.01	-39.00
49/50	16.472		9.940		6.589	40.00	
Mean		47.81		15.87		37.75	-.87
S.D.		131.11		14.17		16.78	25.02

The simple control system used in Table 2 has two defects

- only the two most recent years of claims data are used to forecast claims

- too much negative feedback is involved, in that the system tries to correct any solvency surplus or deficiency in one year.

Trials were therefore made using claims forecast by fitting straight lines to the claims in the last three or four years, as well as the two year basis used in Table 2.

For each forecasting method, trials were made using varying levels of a feedback factor f. Premiums were calculated as

$$((1+e)C - f\,S_o)/(1-kf)$$

where C is the forecast claims

e is the expense factor

f is the feedback factor

S_0 is shareholders' funds at the end of the previous year

and k is the desired solvency margin.

With f=1, this formula is the same as used in Table 1.

With f=0, premiums are equal to forecast claims and expenses, so that no correction of forecasting errors or solvency deviation ever occurs. This is often described as a "zero feedback" or "open loop" system.

From the premium formula, it can be readily shown that if claims are always zero,

$$S_1/S_0 = 1 - f/(1-kf)$$

where S_1 is the shareholders' funds at the end of the year.

Table 3: Results using different control systems

Years of past data	Feedback factor f	Increase in premiums		Solvency		Increase in solvency	
		Mean	S.D.	Mean	S.D.	Mean	S.D.
		%	%	%	%	%	%
2	-1	*	*	*	*	*	*
2	0	16.92	28.84	15.31	11.78	-1.22	13.44
2	.5	20.55	45.35	37.10	13.27	.22	17.10
2	1	47.81	131.11	37.75	16.78	-.87	25.02
2	2	*	*	*	*	*	*
2	5	*	*	*	*	*	*
3	0	16.31	24.37	-.95	14.06	-1.97	13.12
3	.5	18.98	38.59	32.64	12.11	-.04	15.67
3	1	28.35	75.03	37.47	12.49	.15	17.60
3	2	*	*	*	*	*	*
4	0	15.98	22.73	-2.39	17.29	-2.37	12.55
4	.5	18.33	35.67	31.88	12.59	-.25	15.33
4	1	24.59	62.63	37.46	11.89	.11	15.87
4	2	*	*	*	*	*	*
Actual results		15.51	11.33	58.41	18.69	.06	7.61

If f is less than 0 or greater than 2/(1+2k), S_1/S_0 will be greater than unity, and rapid divergence from the starting point will occur. Such a control system is described as "unstable".

For k=.4, instability will occur for any negative f, and for any f greater than 10/9. The results of trials confirming this are shown in Table 3, marked with asterisks. The trial shown in Table 2 used f=1, which is close to the boundary of instability.

The results in Table 3 are all vastly inferior to those actually achieved by insurers. The varying results obtained with f=0 reflect the different forecasting systems, as no feedback is involved. The results with f=.5 all show premium increase standard deviations 3 to 4 times greater than achieved by insurers, and solvency increase standard deviations about double.

Confusingly, systems with negative f are normally described as "positive feedback" systems. In general, such systems will undesirably amplify temporary disturbances, even if not going completely out of control. As shown here, systems with too much negative feedback can also be unstable.

Continuous control The appendix analyses a system which assumes continuous control of premiums, based on fitting trend lines to recent claims experience. As with the systems discussed earlier, positive feedback or too much negative feedback produces instability.

The advantage of continuous control is however that more negative feedback can be used before instability occurs. The parameter λ in (4.1) corresponds to the feedback factor f used earlier. With a desired solvency margin of 40%, instability does not occur until λ=2.5, as compared with f=10/9.

Comments The results in Table 3 show that very unsatisfactory results can be obtained with poorly designed control systems. The appendix illustrates the mathematical complexities of analysing some control systems, even with unrealistic simplifications. Nowhere does this paper give any clear guide to control systems that are likely to work in practice for insurers.

A vital question is how insurers have achieved such good results in the past. Some answers may emerge by testing fairly simple control systems using actual data, each system including a different practical mechanism. For example, price elasticity and proper conversion of written to earned premiums may give smoother premiums. With luck, something useful to insurers may one day result.

2 November 1978 J.R. Cumpston

DISCOUNTING AND INFLATION

by R.B. Akhurst

1. Introduction

This paper continues the examination and discussion of profit, solvency and risk by considering some aspects of:

(i) operating with and without discounting claims reserves

(ii) the effects of a transition to such a basis

(iii) the impact of a pre-tax solvency adjustment

It concludes that there is some evidence that both these changes would correct distortions in current accounting methods, and on balance assist the industry in conditions of high inflation.

2. Discounting Reserves (see also the 1976 York papers)

2.1 The three projections shown in more detail in Section 5 illustrate the progression of three companies, starting in identical circumstances and reaching a more stabilised profit/growth position from the 6th year onwards:

Company (A) accounting on a conventional revenue year basis
(B) accounting on a discounted reserve basis
(C) switching from conventional to discounted in year 6

2.2 The simple model used tries to avoid many difficulties of the real life situation without losing the essential validity of comparison. In particular:

- it ignores the difference between written and earned premiums
- investment income is assumed only on opening solvency and claims reserves for each year (other income is, in fact, common to both)
- simple compound growth rates are used

2.3 Points of note from a start-up situation include:

1) post-tax profitability is more stable under a discounting situation, avoiding 'new business strain'

2) equally, especially under high growth conditions, the discounting company is more viable, and may require less capital

3) conversely, although consistently disclosing higher solvency, the discounting company might conventionally be seen as more risky

4) the retention of current methods effectively locks up substantial interest-earning solvency funds, pre-tax, in claims reserves. These can, however, only be released by a switch to a discounting system.

2.4 Some comparative examples after ten years under the same basic assumptions are as follows:-

		Growth Rates			
		0%	10%	15%	25%
Premiums	Both	100.0	235.8	351.8	745.1
Total Profit	Company A	9.8	12.9	13.8	10.5
(Post tax)	Company B	8.6	14.1	17.6	25.7
Solvency	Company A	79.2	47.5	39.0	28.9
Ratio %	Company B	87.9	57.9	49.6	39.8

It can be seen that, after a pre-tax replenishment of a 20% solvency margin:

- under higher growth conditions, conventional profits are considerably less than discounted profits
- the relative attractiveness of the two methods is sensitive to both growth and interest assumptions
- discounted solvency margins are higher, total assets lower, growth is easier to sustain at all levels

2.5 Other variations of the length of settlement tail give results as follows after ten years, assuming a 15% per annum compound growth rate:

		Short tail	Medium tail	Long tail
Post tax	Company A	0.5	13.8	29.9
Profits	Company B	1.7	17.6	35.1
Solvency	Company A	22.2	39.0	61.9
Ratio %	Company B	25.3	49.6	76.2

- the real difference between the methods is the timing of the recognition of investment income, which becomes more marked with increasing rates of growth and length of tail.

2.6 To summarise, the broad conclusions reached from the simplified model utilised, and confirmed by the actuary of at least one US company operating on such a discounted basis, are that discounting reserves can, in many circumstances, enable a company under inflationary conditions:-

(i) to publish a higher apparent solvency margin
or (ii) to sustain higher growth rates
or (iii) to pay higher dividends
or (iv) to operate with less start-up capitalisation

2.7 Where the companies' rating is calculated or controlled on a total return accident year basis, there might be no difference between them in the premium charged. However, the conventional reporting mechanism under inflationary conditions results in lower annual published profits and apparent solvency. This distortion is, to a large extent, removed by discounting which brings the premium and reporting bases more into line.

2.8 The company profitability working party for the York meeting in 1976 demonstrated that a further desirable feature of discounted reserves was their apparent greater stability under radical and unexpected changes in inflation. It is possible that this result holds under a range of conditions, since discounting reserves would allow more consistency between the valuation of balance sheet items.

3. <u>Effect of a Changeover (Company C)</u>

3.1 Points of note after the changeover, compared with continued progression under the original accounting system are:-

- accelerated tax payments
- lower claims reserves, and ultimately investment income
- higher disclosed profitability
- possibly higher risk of ruin (after failure to meet statutory solvency requirements)
- once and for all increase in solvency, in fact to a higher level than the pure discounting Company (B) through investment income on with-held tax in earlier years

3.2 There would be stronger need for an agreed explicit and efficient minimum solvency margin being determined, which should take into account not only risk exposure but also operational margins and size of company.

Such a solvency margin would need to be broadly international and discussions re EEC levels are relevant in this context.

3.3 The interesting conclusion is that a company accounting on a conventional basis produces an apparently better overall picture immediately after a changeover than before, and better through investment of higher reserves in earlier years than a company which had been discounting for a longer period.

3.4 It should be borne in mind that even this simple model has produced situations (e.g. very low growth) where the benefits of a change would not be so obvious.

4. <u>Pre-Tax Inflation Adjustments</u> (as also discussed in Russell Devitt's paper)

4.1 The main projections contain an example of this adjustment in action, assuming full pre-tax relief for 15% growth on a notional 20% minimum solvency margin. This is shown as an annual charge to profits, and thus published profits are lower - but solvency is increased.

4.2 Comparative results, after ten years at 15% per annum growth are:-

		No Relief	20% Margin Relief	50% Margin Relief
Published Post-Tax Profits	Company A	17.6	13.8	8.1
	Company B	21.4	17.6	11.9
Solvency Ratio %	Company A	28.7	39.0	54.4
	Company B	39.3	49.6	65.1

4.3 Points of note are:-

- the benefits to solvency (net worth) are extremely significant, with a trade-off against apparent published profits

- there are many analogies with other industries, particularly with stock relief and the inflation accounting principle of maintaining real worth on a pre-tax basis

- ultimately lower premiums, higher solvency or higher growth could be sustained

Open questions are:-

(a) Discounting Reserves

1. If we are to certify reserves - which reserves would we prefer to certify (and what margins would we want?)?

2. What should we do about:-

   (i) discounting other balance sheet items (e.g. premium reserves)?

   (ii) amortising fixed interest stocks?

   (iii) dealing with variable investments?

3. Under which method are results more sensitive to mis-estimates in major assumptions regarding settlement patterns, interest and inflation?

4. Should future anticipated interest profits be recognised in principle in published accounts?

5. Is a discounting company more risky? In this context, do we mean failure to meet statutory solvency requirements?

(b) Inflation Adjustments

1. Are we being taxed equitably as an industry in relation to others - particularly in inflationary conditions?

2. If the correct way out is to apply a pre-tax solvency adjustment:-

   (i) what level of solvency should be allowed?

   (ii) what growth is allowable as a charge:

   (a) total growth?

   or (b) some inflationary index level ... and if so, what index?

5. Projections and Assumptions

5.1 Projections

A: STANDARD METHOD

U/S RESERVES YEAR -6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
U/S RESERVES YEAR -5	.0	.0	.0	.0	.0	5.0	5.7	6.6	7.6	8.7
U/S RESERVES YEAR -4	.0	.0	.0	.0	10.0	11.5	13.2	15.2	17.5	20.1
U/S RESERVES YEAR -3	.0	.0	.0	20.0	23.0	26.4	30.4	35.0	40.2	46.3
U/S RESERVES YEAR -2	.0	.0	30.0	34.5	39.7	45.6	52.5	60.3	69.4	79.8
U/S RESERVES YEAR -1	.0	45.0	51.7	59.5	68.4	78.7	90.5	104.1	119.7	137.7
U/S RESERVES YEAR -0	60.0	69.0	79.3	91.3	104.9	120.7	138.8	159.6	183.5	211.1
EARNED PREMIUMS	100.0	115.0	132.2	152.1	174.9	201.1	231.3	266.0	305.9	351.8
INCURRED CLAIMS	75.0	86.2	99.2	114.1	131.2	150.9	173.5	199.5	229.4	263.8
EXPENSES/COMMNS	30.0	34.5	39.7	45.6	52.5	60.3	69.4	79.8	91.8	105.5
U/W RESULT	-5.0	-5.8	-6.6	-7.6	-8.7	-10.1	-11.6	-13.3	-15.3	-17.6
INVESTMENT INCOME	5.0	10.9	16.5	21.6	26.6	31.4	36.6	42.1	48.4	55.7
LESS RESERVE TOP-UP	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
PRE-TAX PROFITS	.0	5.2	9.8	13.9	17.8	21.4	25.0	28.8	33.1	38.1
SOLVENCY CONTN	3.0	3.4	4.0	4.6	5.2	6.0	6.9	8.0	9.2	10.6
TAX	-1.5	.9	2.9	4.7	6.3	7.7	9.0	10.4	12.0	13.8
POST TAX PROFITS	-1.5	.9	2.9	4.7	6.3	7.7	9.0	10.4	12.0	13.8
DIVIDENDS	2.5	2.7	3.0	3.3	3.7	4.0	4.4	4.9	5.4	5.9
ADDN TO SH.FUNDS	-1.0	1.6	3.9	5.9	7.9	9.7	11.6	13.5	15.8	18.4
SHAREHOLDERS FUNDS	49.0	50.5	54.4	60.4	68.2	77.9	89.5	103.0	118.7	137.1
CLAIMS RESERVES	60.0	114.0	161.1	205.5	246.1	288.0	331.2	380.8	438.0	503.6
SOLVENCY RATIO	49.0	44.0	41.2	39.7	39.0	38.7	38.7	38.7	38.8	39.0

B: DISCOUNTED BASIS

U/S RESERVES YEAR -6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
U/S RESERVES YEAR -5	.0	.0	.0	.0	.0	4.5	5.2	6.0	6.9	8.0
U/S RESERVES YEAR -4	.0	.0	.0	.0	8.7	10.0	11.5	13.2	15.2	17.5
U/S RESERVES YEAR -3	.0	.0	.0	17.0	19.5	22.5	25.8	29.7	34.2	39.3
U/S RESERVES YEAR -2	.0	.0	24.5	28.2	32.4	37.3	42.9	49.3	56.7	65.2
U/S RESERVES YEAR -1	.0	35.9	41.3	47.5	54.7	62.8	72.3	83.1	95.6	109.9
U/S RESERVES YEAR -0	46.3	53.2	61.2	70.4	81.0	93.1	107.1	123.2	141.6	162.9
EARNED PREMIUMS	100.0	115.0	132.2	152.1	174.9	201.1	231.3	266.0	305.9	351.8
INCURRED CLAIMS	61.3	70.5	81.1	93.2	107.2	123.3	141.8	163.1	187.5	215.7
EXPENSES/COMMNS	30.0	34.5	39.7	45.6	52.5	60.3	69.4	79.8	91.8	105.5
U/W RESULT	8.7	10.0	11.5	13.2	15.2	17.5	20.1	23.1	26.6	30.6
INVESTMENT INCOME	5.0	10.2	15.2	19.8	24.3	28.6	33.3	38.1	43.8	50.2
LESS RESERVE TOP-UP	.0	-4.6	-8.9	-12.7	-16.3	-19.6	-23.0	-26.5	-30.5	-35.0
PRE-TAX PROFITS	13.7	15.6	17.8	20.3	23.2	26.5	30.3	34.8	39.9	45.8
SOLVENCY CONTN	3.0	3.4	4.0	4.6	5.2	6.0	6.9	8.0	9.2	10.6
TAX	5.3	6.1	6.9	7.9	9.0	10.2	11.7	13.4	15.4	17.6
POST TAX PROFITS	5.4	6.1	6.9	7.9	9.0	10.2	11.7	13.4	15.4	17.6
DIVIDENDS	2.5	2.7	3.0	3.3	3.7	4.0	4.4	4.9	5.4	5.9
ADDN TO SH.FUNDS	5.9	6.8	7.8	9.1	10.5	12.2	14.2	16.5	19.2	22.3
SHAREHOLDERS FUNDS	55.9	62.6	70.5	79.5	90.1	102.3	116.6	133.1	152.3	174.6
DISC CLAIMS RESERVES	46.3	89.2	127.1	165.1	196.5	230.3	264.8	304.5	350.2	402.7
SOLVENCY RATIO	55.9	54.5	53.3	52.3	51.5	50.9	50.4	50.0	49.5	49.6

C: CHANGE TO DISCOUNTED BASIS @ YEAR 6

U/S RESERVES YEAR -6	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
U/S RESERVES YEAR -5	.0	.0	.0	.0	.0	4.5	5.2	6.0	6.9	8.0
U/S RESERVES YEAR -4	.0	.0	.0	.0	10.0	10.0	11.5	13.2	15.2	17.5
U/S RESERVES YEAR -3	.0	.0	.0	20.0	23.0	22.5	25.8	29.7	34.2	39.3
U/S RESERVES YEAR -2	.0	.0	30.0	34.5	39.7	37.3	42.9	49.3	56.7	65.2
U/S RESERVES YEAR -1	.0	45.0	51.7	59.5	68.4	62.8	72.3	83.1	95.6	109.9
U/S RESERVES YEAR -0	60.0	69.0	79.3	91.3	104.9	93.1	107.1	123.2	141.6	162.9
EARNED PREMIUMS	100.0	115.0	132.2	152.1	174.9	201.1	231.3	266.0	305.9	351.8
INCURRED CLAIMS	75.0	86.2	99.2	114.1	131.2	93.2	141.8	163.1	187.5	215.7
EXPENSES/COMMNS	30.0	34.5	39.7	45.6	52.5	60.3	69.4	79.8	91.8	105.5
U/W RESULT	-5.0	-5.8	-6.6	-7.6	-8.7	47.5	20.1	23.1	26.6	30.6
INVESTMENT INCOME	5.0	10.9	16.5	21.6	26.6	31.4	33.7	38.6	44.2	50.8
LESS RESERVE TOP-UP	.0	.0	.0	.0	.0	.0	25.0	-26.5	-30.5	-35.0
PRE-TAX PROFITS	.0	5.2	9.8	13.9	17.8	79.0	30.8	35.5	40.4	46.5
SOLVENCY CONTN	3.0	3.4	4.0	4.6	5.2	6.0	6.9	8.0	9.2	10.6
TAX	1.5	.9	2.9	4.7	6.3	36.5	11.9	13.6	15.8	17.9
POST TAX PROFITS	1.5	.9	2.9	4.7	6.3	36.5	11.9	13.5	15.8	17.9
DIVIDENDS	2.5	2.7	3.0	3.3	3.7	4.0	4.4	4.9	5.4	5.9
ADDN TO SH.FUNDS	1.0	1.6	3.9	5.9	7.9	36.5	14.4	16.7	19.4	22.5
SHAREHOLDERS FUNDS	49.0	50.5	54.4	60.4	68.2	105.7	121.2	137.9	157.2	179.9
CLAIMS RESERVES	60.0	114.0	161.1	205.5	246.1	230.3	264.8	304.5	350.2	402.7
SOLVENCY RATIO	49.0	44.0	41.2	39.7	39.0	53.1	52.4	51.8	51.4	51.1

5.2 Assumptions

Starting capital		50
Growth rates (main projections)		15% per annum
Investment income rates on opening funds		10% per annum
Claims discount rates:	Company A	0%
	Company B/C	10%
Tax rate (all profits)		50%

Pre-tax solvency adjustment on a notional 20% solvency margin

		First Year Incurred	% Incurred
Claims payments	Year 0	15	20.0%
	" 1	15	20.0%
	" 2	15	20.0%
	" 3	10	13.3%
	" 4	10	13.3%
	" 5	5	6.7%
	" 6	5	6.7%
		75	100.0%

Incurred claims:	Company A	75% premiums
	Company B	75% premiums discounted by year of payment
Expenses/Commissions		30% premiums

5.3 Explanation of Print-Out

Reserve top-up : Amount required each year to increase opening discounted reserve to pay claims and set up closing reserves

Solvency Contribution : An amount deducted from pre-tax profits and added to shareholders' funds to increase a notional solvency level by the rate of growth:

e.g. 100 (premium) x 20% (solvency level) x 15% (growth) = 3

13th June, 1979

CAPITAL ALLOCATION

1. INTRODUCTION

1.1. This subject is part of the very much wider one of financial theory, which in itself possibly merits the attentions of a study group.

This note deals mainly with the application of portfolio theory to the problem of capital allocation. The origins of the note lie in an experiment attempting to test whether the broad strategy of the authors company was reasonable. Throughout a large number of assumptions are made and it is possible that for practical purposes the subject is only a curiosity.

2. METHODS OF ALLOCATION

2.1. Capital is required for a number of reasons but in the following it is assumed that it is to provide against adverse claims fluctuation.

The allocation of capital (solvency margin) is required to judge the performance of a profit centre (class of business, branch of company or whatever) against the capital employed.

2.2. Three methods of capital allocation are immediately obvious:-

(a) Spread the overall level evenly across classes according to Premium Income.

(b) Split according to a risk factor.

(c) Do not allocate at all.

3. ALLOCATION ACCORDING TO PREMIUM INCOME

3.1. The main factors in favour of this method are simplicity of approach and that statutory margins are determined in this way.

3.2. The method fails to take into account that the result of some classes are inherently more suitable than others, are more likely to cause insolvency and therefore require more capital in order to transact business.

4. ALLOCATION ACCORDING TO A RISK FACTOR

4.1. Ideally the capital required to obtain a given ruin probability arising from the variance of the claims experience should be used as the capital of the profit centre. However, the fact that several profit centres are operated together by the company enables a lower amount of capital to be employed to achieve the same ruin probability.

4.2. Division of the overall solvency margin could be achieved in proportion to the capital required by each profit centre, effectively a higher probability of ruin is chosen for the individual profit centres than for the whole.

contd......

4.3. This ignores relationships between the profit centres. For instance Household business is affected in a similar way to Fire business by such incidents as storms, cold weather, Firemens Strikes and there is a degree of correlation between the results of these classes. There may even be a degree of negative correlation between profit centres. If this is so then transaction of business in a combination of these will provide a very much more stable result than transacting business wholly in one or other of the two separate profit centres and will require very much less capital. Equally if the two classes are perfectly correlated the effect is that of transacting one class of business and there is no beneficial stabilization.

4.4. A fair allocation could be made by considering the contribution of a profit centre to the overall variance.

For profit centres A, B, C with proportions a, b, c, the combined variance of the portfolio is:-

$$a^2 \text{ var } A + b^2 \text{ var } B + c^2 \text{ var } C + 2\, ab \text{ covar } A,B + 2\, ac \text{ covar } A,C + 2\, bc \text{ covar } B,C$$

It is the split of the covariance terms which makes allocation difficult. One way in which this could be done is in accordance with the variance of the profit centre, thus A's contribution would be

$$a^2 \text{ var } A + \frac{a^2 \text{ var } A}{a^2 \text{ var } A + b^2 \text{ var } B} \; 2\, a\, b \text{ covar } AB$$

$$+ \frac{a^2 \text{ var } A}{a^2 \text{ var } A + b^2 \text{ var } B} \; 2\, a\, c \text{ covar } A\,C$$

The overall solvency margin could then be divided in proportion to the figures so found.

4.5. Ideally if a profit centre is divided then the allocation to other profit centres should not change. The capital for the new profit centres should equal the capital of the divided profit centre.

In the suggested allocation of 4.4. this does not happen. An alternative to which 4.4. is an approximation is to allocate the covariance term according to the proportion the profit centre contributes to the variance. For example, in the case of two profit centres A and B.

$$\text{Contribution of A to variance } (X) = a^2 \text{ var } A + \frac{X}{\text{var } A + B} \; 2\, a\, b \text{ cov } A,B$$

$$\text{Simplifying} \quad X = \frac{a^2 \text{ var } A \;\; \text{var } A + B}{a^2 \text{ var } A + b^2 \text{ var } B}$$

contd......

4.5. (Contd.)

Extending this to three classes the contribution of A to the variance

$$= a^2 \text{ var } A + \frac{X_1}{\text{var } A + B} 2\,a\,b \text{ cov } A,B + \frac{X_2}{\text{var } A + C} 2\,a\,c \text{ cov } A,C$$

where X_1 and X_2 are the proportions A contributes to variance of A and B, A and C.

This does not simplify readily covariance terms are introduced and the simplicity is lost. Again the split of a profit centre affects profit centres other than the split ones. A ready solution does not appear available.

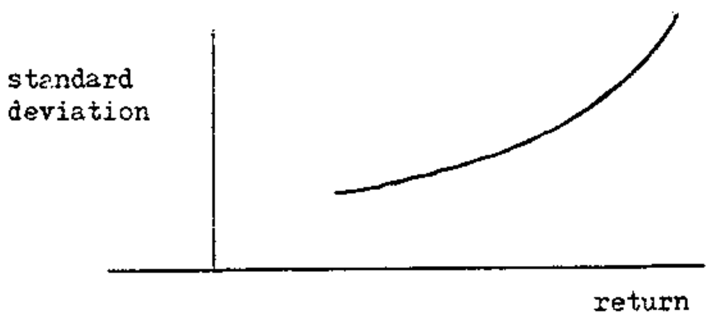
5. Do not allocate.

5.1. If the performance of the whole portfolio is considered then the problem can be restated in terms of maximising the return of a portfolio for a given amount of capital. Assuming the capital required is proportional to the standard deviation of the claims experience then using the duality theorem this can be re-expressed as minimising the standard deviation for a given return.

5.2. This approach considers the mix and georgraphical spread of business and their effect on the overall result of the portfolio.

5.3. A considerable amount of development has been made in the investment field, especially in the U.S.A. on portfolio theory following the work of Markowitz. The original theory was aimed at minimising the standard deviation of a portfolio of investments for a given expected return. This theory can and has been extended to determining the mix of business an insurance company should transact in order to provide the smallest standard deviation for a given return and which would thus require the smallest amount of capital.

5.4. The objective is to minimise the standard deviation of the result of the portfolio for a given return and this is done using quadratic programming techniques. The process is repeated for differing returns and the efficient sets, those with minimum standard deviation for a given return, can be plotted and would usually be of the form:-



All other sets (mixes of business, geographical spread) appear above the curve.

contd......

5.5. It is then a matter of decision how to optimize the portfolio. Either a maximum standard deviation can be set or a level of return can be chosen and the aim can then be to change the balance towards the ideal. From any portfolio which is not efficient and the return, standard deviation point lies above the curve, it is possible to improve the portfolio make-up either by reducing the standard deviation of the result or by improving the return.

5.6. The author is experimenting with a computer program to construct this curve of efficient sets although this has not yet been completed.

The input is to be the percentage contribution to profit by class of business and is derived by taking

Premium of 100 less claims ratio less commission ratio

less direct expense ratio plus investment return.

5.7. The claims ratio to be used in each class has been derived from D.o.T. returns and is an average for the last 5 years and for a number of companies which represent a good proportion of the total market. The standard deviation and correlation coefficient of the claim ratios of the classes were also derived from the same data.

A number of faults exist in this data:-

1. The companies are not all the same size and thus some of the variation of result comes from size and not merely the variability of the experience of a class over time.
2. Individual companies have portfolios which are influenced by underwriting practice, source of business, structure of the company and some of the variation in results will result from inter-company differences.
3. The claims ratio chosen was the latest known position on any year of origin. This introduces a further variation as between different years of development.

A fault with the theory is that the standard deviation does not measure the skewness of the distribution, the claims ratios being limited at the lower end but not at the upper.

The effect of reinsurance is to reduce the variance of claims experience and the reinsurance policy is very much part of the same capital equation. The effect of the reinsurance programme of the authors company has been superimposed on the D.o.T. data.

5.8. Investment income has been taken as the return generated by using a notional rate on the funds of the authors company allowing for different cash collection rates within each class. This is not ideal as the funds are generated by transacting business over a number of years and the rate will not be the true investment income that should be attributed to the transaction of business in a particular class over one year. The investment income is also affected by company structure, source of business, etc.

contd.....

5.8. (contd.)

A better way would be to discount claims at chosen rates in the D.o.T. returns and use these figures to calculate averages and standard deviations. Some allowance would need to be made for the rate at which premiums are paid.

This also overcomes the objection that it is only the variation of the claims experience which is taken into account in minimising process.

5.9. Commission and direct expenses have also been determined by reference the experience of the authors company.

5.10. Because a company has an existing portfolio and is limited in what it does by its structure and its outlets some constraints are to be placed on the business mix, of the form - Fire not to exceed 25% of the total account, Theft not to be less than 5% of the Fire account, etc.

This overcomes one major shortcoming of the theory which is that the ideal results usually suggest that business should only be transacted in a very limited number of classes.

5.11. Prior to a full computer program being ready, some research has been done using an alternative approach choosing a number of different mixes of business and determining the overall standard deviation. Some surprising results emerge in that the mean and standard deviation of the return do not vary very much, although this could be due to the assumptions built into the data.

The implications are:-

1. That business should be obtained wherever it is easiest.
2. That insurance market is a perfect market.

6. CONCLUSION

6.1. The note has considered only the need for capital to meet variation in claims experience and other factors such as the length of time over which profit emerges has not been considered.

6.2. A number of questions arise:-

1. What factors should be considered for allocation of capital ?
2. Is there any need to allocate capital ?
3. Can the Markowitz theory be of practical use and can it be extended to include matching the variance of assets and liabilities ?
4. If trading results are more or less constant over a variety of mixes should the objective become the secondary one of maximising underwriting result to improve image with the shareholders ?
5. If the theory is inadequate, how should we plan mix of business, geographical spread, etc. ?
6. In 4.4. and 4.5. two suggestions were made for the split of capital. Are there better solutions? In particular, is there a solution in which further splits do not affect the other profit centres ?

THE CONCEPT OF PROFIT IN THE CONTEXT OF NON-LIFE INSURANCE

Introduction

Uses of measures such as the rate of return on capital employed to assess financial performance presuppose a consensus on what is understood by the concept of "profit". The appropriate definition may vary with the circumstances. The Sandilands Report (1) for example distinguishes five different concepts of profit.

Historic Cost Accounting

The method of accounting used by the majority of companies is known as historic cost accounting. This method uses a concept of profit based on the matching of revenue receivable during the year against the historic costs incurred in generating that revenue, in accordance with the accruals concept described in SSAP2 (2).

Conventional insurance company accounting is based on the historic cost convention. However, this is modified to the extent to which advantage is taken of the exemptions permitted to insurance companies from the disclosure requirements of the Companies Acts. Broadly, the effect of these exemptions is to allow insurance companies to:

(a) understate the value of the investments which form the greater part of their assets;

(b) charge fixed assets to revenue, thereby understating the disclosed profit and assets;

(c) overstate their liabilities.

Companies vary in the extent to which they take advantage of these exemptions.

It has long been recognised that inflation can materially distort the financial position and results disclosed by historic cost accounts. Baxter (3) writing in 1962, pointed out that the potential distortions were that different figures in the same account were not comparable, figures in a given balance sheet were not comparable, and that figures in a given income account were not comparable. The first two are likely to understate assets, the latter to understate profits.

Modifications have been made to historic cost accounting to try to overcome some of these problems. The best example is the practice of including such assets as freehold property in the balance sheet at valuation rather than original cost. This tendency has been reflected perhaps in insurance company accounts by the increasing trend towards showing investments at market price, rather than the more conventional presentation of "cost, less amounts written off".

Current Purchasing Power Accounting

The upsurge in the rate of inflation during the early 1970's led to the Accounting Standards Committee (ASC) issuing proposals for inflation accounting in what eventually became PSSAP7 (4). This document advocated a supplementary statement using a method known as Current Purchasing Power Accounting. This method involves expressing accounts in terms of a unit of measurement of constant value.

PSSAP7 excited much criticism, not least because its concept of profit included all gains accruing to the company, including gains and losses on monetary assets and liabilities, and regards these as distributable, provided the shareholders' interest is maintained in real terms. As a consequence of this reaction, the Sandilands Committee was set up.

Current Cost Accounting

The Sandilands Report (5) recommended a form of value accounting known as Current Cost Accounting. This is based on a concept of profit whereby all gains arising during the year are regarded as distributable, provided the productive capacity of the assets of the company are maintained. Assets are included in the balance sheet at their 'value to the business'.

After the publication of Sandilands the Inflation Accounting Steering Group was given the task of translating the recommendations into accounting standards. Their attempt to do this, ED18 (6) was eventually rejected by the accounting profession, on the grounds that it went too far too fast.

Hyde Guidelines

Following the rejection of ED18, the ASC issued interim guidance on inflation accounting, the 'Hyde Guidelines'(7). These proposed three adjustments to the historic cost figure - a cost of sales adjustment, a depreciation adjustment and a "gearing" adjustment.

The cost of sales adjustment is not applicable to insurance companies, because of the nature of their business, and the depreciation adjustment is not significant, because few companies carry fixed assets in their balance sheets. The form of the "gearing" adjustment depends on whether a company has net monetary assets or net monetary liabilities. If an insurance company's investments are regarded as monetary assets, then these will invariably exceed the liabilities and the adjustment consists broadly of reducing the historic cost profit by the amount required to maintain the real value of the net monetary assets. Making such an adjustment materially reduces the disclosed profits of insurance companies.

The Hyde Guidelines were intended as an interim measures, and the proposals to supersede them were published by the ASC in April of this year as Exposure Draft 24 (ED24) (8). They represent an evolution of the Hyde Guidelines, inasmuch as they contain the same adjustments, together with a new one, to be known as the Monetary Working Capital Adjustment. This reduces the historic cost by a further amount representing the amount required to maintain the real value of working capital. The amount involved is unlikely to be significant compared with the gearing adjustment described in the previous paragraph.

Solvency Maintenance Adjustments

Another industry with net monetary assets is the banks, and the Inflation Accounting Steering Group set up a Working Party to consider their position. Their report (9) contains the suggestion of a Free Capital Maintenance Adjustment. There is an obvious analogy between a bank's free capital ratio and the solvency ratio of an insurance company, and a case can thus be argued for a Solvency Maintenance Adjustment. (It is interesting in this context to consider the comparison between banking and insurance made by Quirin (10) and Plymen (11)).

Making such an adjustment results in much lower profits than those remaining after the orthodox Hyde-type adjustments described above. It shows that for at least the last five years, the main composites have not covered their dividends, which have, therefore, effectively been paid for reserves.

A further development of ED24 over the Hyde Guidelines is the introduction of a Current Cost Balance Sheet. The consequent effect of the adjustments on the balance sheet must not be overlooked. Making the solvency adjustment referred to above would have the effect of reclassifying part of the shareholders' funds as non-distributable. Providing dividend policies were adjusted accordingly, solvency should be maintained in the long run; at least as far as increases in premium income of an inflationary nature are concerned.

Both the Hyde Guidelines and now ED24 are firmly in the Current Cost Accounting tradition, and it seems clear that this method of inflation accounting is to remain the conventional wisdom. This will presumably reinforce the growing tendency of insurance companies to show assets at market value in their balance sheets, which has been accelerated by the 1976 Valuation Regulations, which require, broadly, market values to be used in Department of Trade returns. Strict interpretation of the "value to the business" concept would also suggest that claims reserves should be in the balance sheet at their discounted value.

Conclusions

The manufacturing sector has succeeded in obtaining fiscal recognition of the impact of inflation on their profits by stock appreciation relief. The insurance industry, by remaining wedded to the outmoded historical cost concept, now runs the risk that the shift in the burden of corporate taxation which this has brought about will become permament.

Kelly (12) has recently demonstrated the poor underwriting experience of the composites over the past few years, and explained how their results have been bolstered by non-recurring factors. He shows that the (historic cost) return on capital employed has lagged behind the growth in premium income, hence the pressure on solvency and the capital raising exercises of the recent past. The expansion of premium income over this period he attributes mainly to inflation, and hence the capital base of the industry has not been maintained intact.

Employing inflation-adjusted figures shows that the underwriting performance in real terms is even worse than that suggested by Kelly. It also underlines his point about erosion of the capital base, and, it would seem, corroborates the proposition of Sale and Scapens[13] that a Current Cost Accounting model can be used to assess dividend paying ability.

It is also interesting to note that the correspondence in Giro 21 about the maintenance of solvency margins is caused by the use of a historic cost notion of profit. If the current cost concept, involving the solvency maintenance adjustment, is used, the problem of "abnormal profit" disappears.

A problem that requires further attention arises as a consequence of the fact that the solvency margin relates to the general business of a company as a whole, rather than the assets being earmarked for individual classes of business. Until a method is found of allocating assets over the classes, the solvency maintenance adjustment cannot be apportioned on other than an arbitrary basis.

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CONCEPT OF PROFIT IN NON-LIFE INSURANCE OPEN QUESTIONS

1. Is the historic cost concept of profit outdated as far as insurance companies are concerned?

2. Is Current Cost Accounting a more appropriate method of accounting for inflation than Current Purchasing Power in the context of insurance? Or is there some other method apart from these two that is more suitable?

3. Is the distinction between monetary and non-monetary assets meaningful for an insurance company? Is a Hyde-type gearing adjustment appropriate?

4. Is a Solvency Maintenance Adjustment a suitable method for coping with the effects of inflation?

5. How should the "value to the business" concept be applied in the insurance industry? Does this imply discounted claims reserves?

6. Is a Solvency Maintenance Adjustment the best answer to the tax problem? Would any quid pro quo be required, and if so, what?

7. Is maintenance of the real value of the capital base a valid objective for an insurance company? Is it realistic under present conditions?

8. How should a Solvency Maintenace Adjustment be allocated between different classes of business?

<u>Reinsurance: Sustainable Growth of Funded Accounts</u>

Reinsurance business for Marine, Aviation and for non-proportional Fire and Accident business is accounted for on an underwriting year basis. Claims payment run-offs for each underwriting year are usually long-tailed so that calculations are essential at the end of each revenue year to determine the liability for run-off of claims less premiums. In practice transfers are made to or from the Profit and Loss Account after determining whether the Fund for each Branch is sufficient to cover the run-off liability. The funded basis of accounting ensures that the concept of unearned premium reserves is not applicable.

The problem which this note examines is the rate of growth which can be sustained by a particular branch or class of business taking into account all the factors which could affect the result such as loss ratio, claims and premium development patterns, investment income, solvency margin requirements etc.

An algebraic approach is adopted and simple models of a particular Account and its effect on the Profit and Loss Account have been developed. The problem is primarily of conversion from an underwriting year basis to a revenue year basis.

The following sets out the Branch Account and the Effect on the Profit and Loss Account with results from the simplest possible example alongside.

Items	Symbols	Simple Example Based on 10% p.a. growth
Branch Account		
Fund b/fwd.	F (O)	13,248
+ Exchange adjustment	X	O
+ Premium Income	P	9,009
- Claims	C	8,471
- Management Expenses	E	O
- Underwriting Profit/(Loss)	U	(786)
Fund c/fwd.	F (1)	14,572
Effect on P & L Account		
Shareholders' Fund b/fwd	S (O)	2,457
+ Investment Income	I	1,277
+ Underwriting Profit/(Loss)	U	(786)
- Expenses not included above	E′	O
- Tax	T	245
- Dividend	D	O
Shareholders' Fund c/fwd.	S (1)	2,703

<u>Current Underwriting Year</u>:	Premium Income	10,000
	Claims	10,786
	Loss Ratio	108%

i.e. on the assumptions used a loss ratio of 108% can be sustained with a growth rate of 10% per annum

<u>Basic Assumptions</u>

The basic assumptions used throughout this note are that:

1. The Growth of a particular account is at a constant rate per annum:

   100 i%, (10% in example)
   So that, inter alia: F(O) = v.F(1)
   S(O) = v.S(1) where v = 1/(1+i)

2. There is a constant development pattern for each underwriting year, for each account, for premiums and claims. i.e. for an underwriting year premium income of 1 the premiums paid in development years 1, 2, ..., m are $p_1, p_2, \ldots, p_m$ where $\sum_{t=1}^{m} p_t = 1$

   And for an underwriting year claims total of 1 claims paid in development years 1,2,...,n are $c_1, c_2, \ldots, c_n$ where $\sum_{t=1}^{n} c_t = 1$

   E.g. for a typical Aviation reinsurance account (used in example).

Development Year, t		1	2	3	4	5	6	7	8	9	10	11
Premium Income,	p_t	.17	.58	.21	.04							
Claims,	c_t	.05	.29	.22	.16	.10	.08	.05	.02	.015	.01	.005

3. For a given rate of growth all the items in the Branch Account and Profit and Loss Account can be expressed in the form ax + b, so that a linear equation in x can be derived and solved for x, the underwriting year loss ratio.

<u>Simple Example Explained</u>

(a) Branch Account

The exchange adjustment and expenses have been taken as zero.

For a current underwriting year premium of 1		10,000
the current revenue year premiums, $P=p=\sum_{t=1}^{m} p_t v^{t-1}$		9,009
For current underwriting year claims of x	10,000x	=10,786
current revenue year claims, $C=x.c.= x\sum_{t=1}^{n} c_t v^{t-1}$	7,853x	= 8,471

The Fund carried forward is here taken equal to the liability for future claims less future premiums which works out (for i ≠ O) as:

F(1)=(x(1-c)-(1-p))(1+i)/i	23,617x -	10,901	=14,573
so that F(O)=(x(1-c)-(1-p))/i	21,470x -	9,910	=13,248

The underwriting profit/(loss) is the balancing item:

U = 1-x	10,000 - 10,000x = -786

(b) Profit and Loss Account

Dividend and Expenses taken as zero.

Shareholders' fund is taken equal to 30% of revenue year premiums. i.e. a solvency margin requirement of 30%.

S(1) = 0.3 P	2,703
so that S(0) = 0.3 Pv	2,457

Investment income is taken as an 8% yield on mean Branch Reserves plus shareholders' Fund:

I = 0.08 (S(O)+F(O)+(P-C)/2)	1,403x - 236 = 1,277

Underwriting result, as above:

U = 1-x	10,000 - 10,000x = -786

Tax, assumed to be at a rate of 50% on investment income plus underwriting result

T = 0.5(I+U)	4,882 - 4,299x = 245

For the example, substituting in the Profit and Loss Account gives:

7,339 - 4,298x = 2,703
Hence x = 1.0786

Further Exposition

Analysis of Branch Account

Basic Equation

Taking the exchange adjustment as zero and expenses as a constant proportion, e, of premium, i.e.

$$X = 0$$
$$E = e\,P$$

the Branch Account equation becomes:

$$F(0) + p(1-e) - xc - U = F(1)$$

Fund Calculations

As mentioned earlier the underwriting result is determined after assessing how large the Fund should be in order to cover the run-off liabilities. In practice various methods are used to calculate the Fund depending inter alia on the degree of confidence that can be placed in the most recent underwriting years' results. The following are four different methods which could be used.

(i) Basic Theoretical Method

The Fund is taken equal to the theoretical reserve needed for all underwriting years i.e. expected future claims less expected future premium income (net of expenses).

So that, for $i \neq 0$, the formulae reduce to:

$$F(1) = (x(1-c) - (1-e)(1-p)).(1+i)/i$$
$$F(0) = vF(1) = (x(1-c) - (1-e)(1-p))/i-$$
$$U = 1 - x - e$$

In words,

Current revenue year underwriting profit = (1 - underwriting year loss ratio - expense ratio) x (current underwriting year premium income).

(ii) Latest Underwriting Years' Adjustment to Basic Theoretical Method

In some Branches of Reinsurance business the position at the end of the first (or second) development year for any underwriting year is too unclear to determine with any degree of accuracy the final result for that year. The method then used is to take the reserve needed as the balance of premium income less claims paid and expenses for the latest underwriting year (or two) plus the expected future claims less premiums net of expenses for previous underwriting years. (This is equivalent to assuming that the latest K underwriting years break-even). The Fund formula then reduces to:

$$F(1) = (x(v^k-c) - (1-e)(v^k - p))\ (1+i)/i$$
$$F(0) = vF(1) = (x(v^k-c) - (1-e)\ (v^k-p))/i$$
$$U = v^k(1-x-e)$$

(iii) Expenses Adjustment

Reserve needed taken as premiums received less claims paid for latest k underwriting years and as expected future claims less future premiums for previous underwriting years i.e. expenses are ignored in the reserve calculations.

$$F(1) = (x(v^k - c) - (v^k - p))\,(1+i)/i$$
$$F(0) = (x(v^k - c) - (v^k - p))/i$$
$$\underline{U = v^k(1-x) - ep}$$

(iv) Discounted Reserves

This method assumes that the theoretical reserves in (i) can be discounted at 100 i'% by discounting the expected future payments. The assumption could be made that premium and claim payments are evenly spread over each revenue year. However, by taking payments as made at the end of each year rather simpler equations are produced (which can easily be modified to the previous assumptions, if considered necessary).

$$\text{Take } v' = 1/(1+i')$$
$$c' = \sum_{t=1}^{k} c(v')^{t-1}$$
$$p' = \sum_{t=1}^{k} p(v')^{t-1}$$

$$\text{For } i \neq i': F(1) = (x(c'-c) - (1-e)(p'-p))(1+i)/(i-i')$$
$$F(0) = (x(c'-c) - (1-e)(p'-p))/(i-i')$$
$$\underline{U = ((1-e)(p'i - pi') - x(c'i - ci'))/(i-i')}$$

Effect on Profit and Loss Account

The basic assumption for the Profit and Loss Account is that the Solvency Margin is to be maintained as a constant proportion of the previous revenue year's premium income i.e. that Shareholders' Fund carried forward is a fixed proportion, s, of premium.

$$\underline{S(1) = sP}$$
$$\underline{S(0) = vsP}$$

For simplicity the dividend, D, and expenses, E', are taken as zero although they could easily have been taken as a fixed proportion of premiums, for example.

The formula for investment income used assumes that tax is paid at the end of the revenue year and premiums, claims and expenses payments are spread evenly over the year:

$$\underline{I = (F(0) + S(0) + (P-C-E)/2)j}$$

where j is the investment yield. However, it may be considered that not all the investment return on the shareholders' fund should be assigned to the Branch Account in which case S(0) in the above formula should be replaced by vs'P where s' is the proportion of premium income to be assigned to the Branch Account i.e. (s-s')/s of the return on the shareholders' fund should be retained in the Profit and Loss Account and not be assigned to any Branch.

Taxation

Tax is paid on investment income plus underwriting result.

$$T = t_1 \; I + t_2 U'$$

t_1 is the tax rate assumed for investment income and t_2 for the underwriting result for tax purposes, which need not be equal to U. The method of arriving at a figure for the underwriting result for tax purposes is subject to negotiation with the Inspector of Taxes. E.g. for Miscellaneous non-proportional business full allowance can be made for outstanding losses notified to the reinsurer by its ceding companies. The reserve set up in the Branch Account will be considerably in excess of this figure due to I.B.N.R. claims and inflation of known claims. The formula for calculating I.B.N.R. for tax purposes must be negotiated with the tax authorities.

Some alternative formulae for calculation of U' are as follows:

(i) Three Year Account System

For Marine, Aviation and Transport, if the company is operating a three year account system and no arrangement has been agreed with the tax authorities for allowing for run-off liabilities, a taxable profit or loss has to be struck at the end of the third development year for each underwriting year (unless special reinsurance arrangements are made). Then:

$$U' = (p_1 + p_2 + p_3)v^2 + p_4 v^3 + \ldots + p_n v^{n-1})(1-e) - x(c_1 + c_2 + c_3)v^2 + c_4 v^3 + \ldots + c_n v^{n-1})$$

(ii) One Year Account System - Full Allowance

If a one year account system is operated and the full allowance can be obtained:

$$U' = 1-x-e$$

(iii) One Year Account System - Restriction

A compromise arrangement is more likely than full allowance. One system is for the Fund carried forward, for tax purposes, to be restricted by assuming a loss ratio of 1-r (e.g. 95%) for the current underwriting year.

$$U = v(1-x) - ep + riv$$

Summary

Using the above equations (or variations thereon), for a particular rate of growth the maximum possible underwriting year loss ratio for which the assumed solvency margin ratio can be maintained can be calculated. Conversely, for a given assumed underwriting year loss ratio (which can be, say 100%, or a figure suggested by the underwriters, or based on past experience) the maximum growth rate can be calculated at which the account can grow subject to the imposed constraints.

Practical Examples (Aviation Reinsurance Account)

The following are more practical examples using the same claims and premium development patterns, and starting point of 10,000 premium less commission for the current underwriting year.

Other assumptions: e: Expenses: 2% of revenue year premiums
s(1) : Shareholders' fund: 30% of premiums

I = Investment income: 8% of (mean branch fund + mean shareholders' fund)

T = Tax: 50% of (investment income plus "taxable" underwriting result)

Exchange adjustment, expenses in P & L account, dividend all 0.

Fund: One year break-even i.e.:

$$F(1) = (x(v-c) - (v-p))\ (1+i)/i$$

Taxation:

(1) 3 year accounts system with no allowance for outstanding claims.

(2) 1 year account system with 95% restriction on underwriting year loss ratio for current underwriting year.

Results Per Annum Growth Rates

(1) 3 year tax account system

Branch Account

	5%	10%	15%	20%
Fund b/fwd.	14,085	11,267	9,291	7,838
+ Premium Income	9,474	9,009	8,594	8,223
- Claims	9,180	7,668	6,590	5,785
- Management Expenses	189	180	172	164
- Underwriting Profit/ (Loss)	(600)	34	439	706
Fund c/fwd.	14,790	12,394	10,684	9,406

P & L Account

	5%	10%	15%	20%
Shareholders' Fund b/fwd.	2,707	2,457	2,242	2,056
+ Investment Income	1,348	1,144	995	883
+ Underwriting Profit/ (Loss)	(600)	34	439	706
- Tax	613	932	1,098	1,178
Shareholders' Fund c/fwd.	2,842	2,703	2,578	2,467

Underwriting Result for tax Purposes:

	5%	10%	15%	20%
	(122)	720	1,200	1,473

Current Underwriting Year

	5%	10%	15%	20%
Premium Income	10,000	10,000	10,000	10,000
Claims	10,431	9,765	9,298	8,955
Loss Ratio	104%	98%	93%	90%

Per Annum Growth Rates

(2) 1 year tax account system

Branch Account

	5%	10%	15%	20%
Fund b/fwd.	14,837	12,211	10,210	8,654
+ Premium Income	9,474	9,009	8,594	8,223
- Claims	9,638	8,267	7,198	6,347
- Managements Expenses	189	180	172	164
- Underwriting Profit/ (Loss)	(1,095)	(659)	(307)	(19)
Fund c/fwd.	15,579	13,432	11,741	10,385

P & L Account

	5%	10%	15%	20%
Shareholders' Fund b/fwd.	2,707	2,457	2,242	2,056
+ Investment Income	1,389	1,196	1,045	925
+ Underwriting Profit/ (Loss)	(1,095)	(659)	(307)	(19)
- Tax	159	291	402	495
Shareholders' Fund c/fwd.	2,842	2,703	2,578	2,467

Underwriting Result for Tax Purposes:

	5%	10%	15%	20%
	(1,071)	(614)	(242)	64

Current Underwriting Year

	5%	10%	15%	20%
Premium Income	10,000	10,000	10,000	10,000
Claims	10,951	10,527	10,156	9,826
Loss Ratio	110%	105%	102%	98%

Conclusions to be Drawn from Examples

Firstly it can be seen at a glance the additional tax which has to be paid under the three year tax account system if there is no allowance for outstanding claims. Also, for any growth rate a higher loss ratio can be sustained under the one year tax system than for the three year system: from 5% higher for 5% p.a. growth rate to 9% higher for 20% growth rate.

The tables also show for the two tax systems the maximum loss ratios which can be allowed at the chosen growth rates or alternatively the maximum growth rates which can be sustained for various underwriting year loss ratios. In particular, by interpolation, for a loss ratio of 100%, under the three year tax system a growth rate of 8% per annum can be sustained whereas for the one year tax system a growth rate of 17% per annum is possible.

Appendix 1

Break-down of claims development (for the latest three underwriting years).

Current revenue year: Y
Current U/Wtg. year: Z
For current U/Wtg. year claims of 1:

Revenue Year

U/Wtg. Year	Y-2	Y-1	Y	Y+1	Y+2	Y+3		Total
Z-2	$c_1 v^2$	$c_2 v^2$	$c_3 v^2$	$c_4 v^2$	$c_5 v^2$	$c_6 v^2$	... $c_n v^2$	v^2
Z-1		$c_1 v$	$c_2 v$	$c_3 v$	$c_4 v$	$c_5 v$	.........$c_n v$	v
Z			c_1	c_2	c_3	c_4	..............c_n	1

Current U/Wtg. year (Z) claims $= \sum_{r=1}^{n} c_r = 1$

Current revenue year (Y) claims $= \sum_{r=1}^{n} c_r v^{r-1} = c$

At end of current revenue year (Y) future claims

$$= \sum_{r=2}^{n} c_r \left(\sum_{k=1}^{r-1} v^{k-1} \right)$$

$$= (1+i) \sum_{r=2}^{n} c_r a_{\overline{r-1}|}$$

$$= \frac{(1+i)}{i} \sum_{r=1}^{n} (1-v^{r-1}) c_r \quad \text{for } i \neq 0$$

$$= \frac{(1+i)}{i} (1-c)$$

Appendix 2

Application to Direct Insurance

The following simplified example shows how the preceding method can be adapted to direct insurance. The Branch Account only is examined here, the effect on the Profit and Loss Account being similar to that for Reinsurance, as examined above.

Whereas in the Reinsurance exercise the problem was of conversion from an underwriting year to a revenue year basis, for Direct Insurance conversion is from a policy year to a revenue year basis. The Branch Account has been transposed to a cash flow format so that claims are claims paid rather than incurred claims and premiums are written rather than earned.

Branch Account:

Fund b/fwd	$F(0) = P(0) + C(0)$
+ Premium income	P
- Claims Paid	C
- Expenses	E
- Underwriting Result	U
Fund c/fwd	$F(1) = P(1) + C(1)$

where $P(1)$, $C(1)$ are the premium reserve and claims reserve c/fwd
$P(0)$, $C(0)$ are the premium reserve and claims reserve b/fwd

Taking premiums as paid at the start of each policy year: $P=1$
Expenses: $E = e.P = e$

Claims development pattern for each policy year:

$$c_1 , c_2 , \ldots , c_n \qquad \sum_{t=1}^{n} c_t = 1$$

For the current revenue year:

Claims Paid $= C = xc$

$$\text{where } c = \tfrac{1}{2}c_1 + \tfrac{1}{2}(c_1 + c_2)v + \ldots + \tfrac{1}{2}(c_{n-1} + c_n)v^{n-1} + \tfrac{1}{2}c_n v^n$$

x is the policy year loss ratio and claims are assumed evenly spread over each policy development year.

Premium reserve c/fwd: $P(1) = \tfrac{1}{2}(1-e')$

b/fwd: $P(0) = \tfrac{1}{2}v(1-e')$

where e' may or may not equal e

Claims reserve c/fwd:

$$\begin{aligned} C(1) &= \tfrac{1}{2}(c_2 + c_3 + \ldots + c_n)x \\ &\quad + v(\tfrac{1}{2} c_2 + c_3 + \ldots + c_n)x \\ &\quad + \ldots + v(\tfrac{1}{2}c_n)x \\ &= x((1 + i/2) - c(1 + i))/i \end{aligned}$$

b/fwd: $C(0) = xv((1 + i/2) - c(1 + i))/i$

Substituting in the Branch Account formula:

$$\underline{U = v(1 + i/2)(1 - x - e') - (e - e')}$$

Or, using the approximation $v^{-1/2} = 1 + i/2$:

$$C(1) = x(1 + i)\ (v^{1/2} - c)/i$$

$$C(0) = x(v^{1/2} - c)/i$$

$$\underline{U = v^{1/2}(1 - x - e') - (e - e')}$$

If an unexpired risk reserve is required i.e. if $x > 1 - e'$

$$P(1) = \tfrac{1}{2}x$$

$$P(0) = \tfrac{1}{2}vx$$

$$F(1) = x(1-c)\ (1+i)/i$$

$$F(0) = x(1-c)/i$$

$$\underline{U = 1 - x - e}$$

Open Questions are:

1. In the above note I have considered inflationary growth to be at a constant annual rate so that the claims and premium development patterns are based on the assumed rate of inflation and are taken to apply when inflation is at the assumed rate. Thus the growth rates in the note are taken to be a combination of the assumed rate of inflation and of real growth. Are these reasonable assumptions?

2. When considering the effect on the Profit and Loss Account of a sub-section of a company's business is it reasonable to take the Shareholders' Fund as a percentage of Premium Income and also to take Investment Income as earned on the Branch Fund and Shareholders' Fund?

3. What uses can be made of the method? E.g. premium growth tables by territory or class.

Investment Policy of General Insurance Companies - Practice and a little theory

Jim McCaughan

1. Practice of U. K. Insurance Companies

1.1 Table 1 shows a summary of the distribution of the investments, excluding life fund investments, of the seven U. K. quoted composite insurance companies at the end of 1978. The solvency margin and the proportion of premiums arising in the U. K. are shown for all seven companies because these factors appear to be related to the distribution of the investments.

1.2 The information has been taken from the published annual reports of the companies. Investment distributions are given by market value for Commercial Union and GRE and by book value for the other companies. Annual reports have been used, rather than DOT returns, in order to make use of fully consolidated figures. The likely differences between book values and market values are discussed below.

1.3 Loan stocks, debentures, and preference shares have been amalgamated as "other fixed interest", but mortgages are shown separately because in some cases these may include variable rate as well as fixed interest loans. The total for gilts, other fixed interest, and mortgages is shown because this is the proportion in essentially fixed interest assets. Ordinary shares and property have many features in common, with a relatively low, and not guaranteed, initial yield and growth of income being expected, particularly in inflationary times. Little reliable and unambiguous evidence is available regarding the past performance of property investment, but what there is suggests that the record has been close to that for equities. The property market has been less volatile than the equity market in terms of capital values but this feature is closely related to the fact that the property market virtually ceases to exist when circumstances are adverse. Since ordinary shares and property seem to have many features in common, both being essentially equity investments, a total proportion for equities and property is shown in the bottom line.

1.4 The equity proportions, taking ordinary shares and property together, are in the fairly narrow range 33-41% with two exceptions - Commercial Union and Royal Insurance. These two exceptions are notable for having very low proportions of premiums arising in the U. K. - they are the largest and most international of the companies. Royal Insurance has the lowest solvency margin and Commercial Union's solvency margin is the second highest only because of heavy capital raising over the last five years. The company's recent history has involved periods of relatively low disclosed solvency margin. These two companies appear to have taken higher levels of insurance risk, at least to the extent that solvency margins have been lower, and this has been compensated for by the lower level of asset risk, in other words the lower equity proportions. It is possible also that these companies, being more international, write more of their business in territories where equity investment by insurance companies is unconventional.

1.5 The total fixed interest proportions mirror the equity proportions, with Commercial Union and Royal Insurance being highest, and Sun Alliance being the only company with under half of its investments in fixed interest. No particular conclusion seems obvious from the cash proportions shown.

Table 1 U.K. Quoted Composite Insurance Companies
Distribution of Investments - end 1978

	Commercial Union	Eagle Star	General Accident	Royal Insurance	Sun Alliance	GRE	Phoenix
Gilts	36	15)	58	(35	29	28	31
Other Fixed Interest	10	33)		(35	15	12	17
Mortgages	17	5	2	2	3	10	6
Ordinary Shares	16	29	24	17	25	21	17
Property	12	10	9	6	16	19	19
Cash	9	8	7	5	12	10	10
Total	100	100	100	100	100	100	100
Size of Portfolio £m.	2,076	578	1,065	1,635	715	1,035	533
Solvency Margin %	59	57	53	45	74	52	56
Proportion of premiums arising in U.K. %	16	75	40	25	54	39	45
Total Gilts, Other Fixed Interest, and Mortgages %	63	53	60	72	47	50	54
Total ordinary shares and property %	28	39	33	23	41	40	36

1.6 Further information regarding the investment policy of actual insurance companies may be derived from the data published by the Central Statistical Office in "Financial Statistics". These figures include official estimates, based on a wide survey, of the financial assets of all insurers operating in the U.K. Direct investment by U.K. companies in overseas branches and subsidiaries is excluded as are assets held by or on behalf of these branches. Table 2 summarises the distribution shown for general insurance funds at the end of 1977, the last date for which data had been published at the time of writing.

Table 2: Total assets of U.K. General Insurance Companies at 31.12.77

	Book Value		Market Value	
	£m	%	£m	%
Gilts	2,290	39.8	2,235	33.3
Other Fixed Interest Stocks	514	8.9	518	7.8
Mortgages	308	5.3	308	4.6
Ordinary Shares	1,266	22.0	2,181	32.5
Property	495	8.6	579	8.6
Cash	887	15.4	887	13.2
	5,760	100.0	6,708	100.0
Gilts, Other Fixed Interest and Mortgages		54.0		45.7
Ordinary Shares and Property		30.6		41.1

Agents balances have been excluded in Table 2, as they were in Table 1. The average book value in fixed interest is 54.0% compared with the size-weighted average of 60.7% for the five sets of book values in Table 1, and the comparable figures for equities are 30.6% and 31.8% respectively. These figures agree fairly closely considering the radical differences in coverage.

Table 3

U.K. quoted composite insurance companies
Shareholders' funds compared with equity assets

£m	(1) Share Capital and Reserves	(2) Ordinary Shares	(3) Property	(4) Total Equity Assets	(4) / (1) %
Commercial Union	647	325	241	566	87
Eagle Star	123	155	51	206	167
General Accident	268	258	92	350	131
Royal Insurance	537	274	96	370	69
Sun Alliance	199	179	117	296	149
GRE	338	215	193	408	121
Phoenix	141	91	100	191	135

1.7 It has been suggested at past meetings that shareholders' funds might be invested in equity assets - ordinary shares and property - and the other assets, corresponding to the underwriting provisions, might be invested in bonds and cash. Table 3 compares equity assets with shareholders' funds for the seven quoted composites. For Commercial Union and Royal Insurance the equity assets are significantly less in value than the shareholders' funds, and for the other five, they are greater, the range in value being from 121% to 167% of shareholders' funds.

2. Some theories on how policy should be decided

2.1 The Funds held by a general insurance company are intended to make provision for payment of claims and for payments to those who provided the company's capital, its shareholders. Most claims relate to replacement of physical assets or damages in various contingencies, mainly related to loss of earnings or profits. One important feature of claims is, therefore, that they are subject to inflation. Shareholders receive dividends from companies and the main categories of shareholders, other insurance companies, pension funds, and private individuals, all invest in ordinary shares in the hope of obtaining an income which increases with inflation.

Although claims in many lines of business can remain open for ten years or more, in general underwriting provisions are not much more than one year's premiums, and very seldom are as much as two years' premiums. The average terms of these liabilities is, therefore, very short, typically less than 2 years.

2.2 Gilts and other fixed interest stocks provide fixed incomes and in most cases return of the nominal value of the stock at the redemption date. Yields on fixed interest stocks tend to rise and fall with expectations regarding the inflation rate. This means that values fall when the inflation outlook worsens and rise when the inflation outlook improves. A fixed income is mismatched for a fund whose requirements rise with inflation. Fixed interest stocks do, however, produce high incomes, which are advantageous within the framework of profit and loss accounts as currently presented. Yields tend to be higher than incomes on cash holdings and relatively short term fixed interest stocks, matching liabilities by term, are available.

2.3 Equities and property have in recent years given lower initial yields than fixed interest stocks but have offered rising incomes. Table 4 shows a comparison with inflation of the increases over the five and ten years to the end of 1977 of company profits, dividends, and rents on commercial and industrial properties.

Table 4: Five and Ten Year Trends

	1967/77	1972/77
Dividends per share	8	12
Earnings per share	14	18
Inflation of		
(i) Retail Prices	11	16
(ii) Wages and Salaries	13	17
Company Profits, as estimated by		
(i) the Central Statistical Office	13	15
(ii) The Financial Times	16	18
(iii) Phillips and Drew	16	20
Rents - The Investors Chronicle		
Hillier Parker Rent Index	12*	13

* trend 1965/77

Company profits and earnings per share both kept up with inflation over the periods shown, but dividends fell behind for a number of reasons, not least being the stringent dividend controls in force for seven of the ten years. These figures are sufficiently encouraging to give some confidence regarding the likely performance of equity dividends and property rents in the face of continuing inflation. A rise in the rate of inflation tends to increase yields on fixed interest and cash and so in spite of the favourable longer term evidence, equity values can fall quite sharply in inflationary circumstances. For a general insurance company where solvency must be demonstrated such short term fluctuations can be very important, and will limit the proportion of assets which can safely be held in equities. The lack of any reasonable market in property in adverse circumstances, in spite of property's apparent lack of volatility in value, also restricts the proportion of the fund which it is safe to hold in property.

2.4 Table 5 compares, for the last ten years, the average seven-day local authority rate, a typical return on money market deposits, with the annual increase in the index of retail prices.

Table 5:

	Seven Day Local Authority Money %	Retail Price Inflation %
1969	9.1	5.4
1970	8.1	6.4
1971	6.3	9.4
1972	6.4	7.1
1973	11.5	9.2
1974	13.9	16.1
1975	10.8	24.2
1976	12.1	16.5
1977	8.4	15.8
1978	9.2	8.3
Geometric Average	9.6	11.7

The average seven day rate is the return which a gross fund invested entirely in such deposits would have earned. Clearly the returns need to be reduced significantly for tax paying funds. Although interest rates on cash deposits have risen in times of high inflation they have not risen sufficiently to compensate for the high inflation rates. There seems, therefore, to be some evidence that cash is likely to underperform equities over a period of high inflation. Market values of cash deposits are, by definition, steady, and so they have advantages given that insurance companies must demonstrate solvency.

2.5 As discussed briefly above, none of the available investment sectors is uniquely suitable for a general insurance company, but each has some advantages and some disadvantages. There seems to be a strong argument in favour of a diversified portfolio among the investment sectors, as is indeed the practice of most existing companies. The views of the investment department would normally determine the allocation of the funds between investment sectors. If, for example, the investment manager is optimistic regarding the relative prospects for fixed interest, a higher than standard proportion should be invested in fixed interest, probably gilt-edged stocks. It is not immediately obvious what is meant by standard in the preceding sentence. A long-term preference, for example 40% of funds in gilts, might be stated. It would also be possible to regard the average general insurance company, from government statistics, as the standard. The latter may be dangerous since, for example, companies vary regarding the mix of their business and the strength of their balance sheets.

2.6 One exercise which could be instructive is to project what would happen to the company's balance sheet in particularly severe adverse circumstances. It is not possible to calculate a sensible probability of insolvency, but some idea of its likelihood may be determined in this way. Take, as a simple example, a company with annual premiums of £100m and a balance sheet as follows:-

Table 6: Consolidated Balance Sheet of XYZ Insurance Company

	£m
Shareholders Funds	70
represented by:	
Gilt-edged stocks	85
Ordinary shares	85
Cash and other net current assets	30
less:	
Underwriting Liabilities and provisions	(130)
	70

If the most pessimistic assumption for investment values over a future period (undetermined) was that equities fall to 40% of their current value and the gilts held to 80% of their current value, the worst-case balance sheets, all other things being equal, would be:-

Table 7:

	£m
Shareholders Funds	2
represented by:	
Gilt-edged stocks	68
Ordinary shares	34
Cash and other net current assets	30
less:	
Underwriting Liabilities and provisions	(130)
	2

The solvency margin has fallen from 70% to only 2% even without any adverse underwriting or expense experience. Clearly life is not as simple as supposed in the schematic example given. For example assets could have been switched to cash at some stage. This is, however, very dangerous since it is all too likely to lead to switching from securities to cash near the bottom of the market. I would suggest that balance sheets should normally be arranged in such a way that the company would remain solvent in the kind of adverse circumstances envisaged. A re-arrangement for Company XYZ is shown in Table 8.

Table 8:

Revised Consolidated Balance Sheet for XYZ Insurance Company

	Current £m		Worst Case £m
Shareholders Funds	70		30
represented by:			
Gilt-edged stocks	50 x .8	=	40
Ordinary shares	50 x .4	=	20
Cash and other net current assets	100		100
less:			
Underwriting liabilities and provisions	(130)		(130)
	70		30

The solvency margin remains at 30% and so the company is still solvent.

2.7 The above example is grossly over-simplified, but some kind of worst case estimate for investment values, together with a projection of claims and expense experience, may give an idea of the investment distributions giving an acceptable level of investment risk. It would seem from this kind of consideration that the higher the level of risk associated with the insurance operations of a company, the lower should be the risk accepted in its investment policy.

2.8 The worst-case factors used in the example shown, 80% and 40% for gilts and ordinary shares respectively, have been chosen simply as examples, and the precise assumptions made should be related to the current market level. The severity of the four most recent bear markets in terms of the FTA All-Share Index is shown in Table 9.

Table 9:

Index at High Point		Index at Low Point		
Month	Monthly Average Index (1)	Month	Monthly Average Index (2)	(2)/(1) %
September 1964	109	November 1966	90	.83
January 1969	177	June 1970	122	.69
May 1972	224	December 1974	65	.29
February 1976	168	October 1976	125	.74

A factor more pessimistic then .4 was justified only by the fall from mid 1972 to the end of 1974. While it might be prudent to assume that ordinary share ratings could again fall to the values of late 1974 (with a P/E ratio around 4, and yields of 12%), it must also be pointed out that values are currently very much below the sort of ratings that were current in mid 1972. Average P/E ratios then went over 20 and yields under 3 per cent, compared with current values of 8 and $5\frac{1}{4}$ per cent respectively. These factors suggest that appropriate current assumptions for most pessimistic equity values might involve a factor of .45 or .5. In setting these factors for ordinary shares it should be borne in mind that profits and dividends can fall. Company profits did actually fall marginally in 1975 after very strong rises in the years 1972-4, and dividends have over the last ten years risen consistently in every year. These factors do not, therefore, seem to invalidate the conclusion suggested.

2.9 Gilt yields briefly rose above 17% in 1974, and so a rise to at least 17% would seem to be an appropriate worst case assumption. The resulting factor would depend on the precise nature of the portfolio held, but would seem likely to be around 0.8 for the typical general insurance fund currently.

2.10 Unambiguous evidence on past changes in property values is surprisingly sparse, but what there is suggests that a factor around 0.6 might be appropriate in this context at present. "Current" in paragraphs 2.8 - 2.10 refers to the end of June 1979.

2.11 Application of these factors to the asset distributions of the seven quoted composites, as set out in Table 1 suggests that a modest move towards cash and fixed interest might be prudent for the five companies with equity proportions of 33% and over, but that the case is not very strong. So long as a company is not widely out of line with other comparable companies, its competitors, and the market as a whole is not taking excessive asset risks there seems to be little case for a radical change.

2.12 The discussion in this section has referred entirely to market values and this seems appropriate in a discussion of appropriate levels for solvency margins and asset risks. Other bases of valuation, such as the discounting of an expected future stream of income, are appropriate for other purposes.

3. Investment Policy and Corporate Objectives

3.1 An attempt to define the objectives of the investment should be the first stage in the formulation of any institutional investment policy. In paragraph 2.6 maintenance of solvency was considered as the paramount objective. In some respects the interests of policyholders, shareholders, and employees may conflict, but they would all suffer if the company were to become insolvent.

3.2 Policyholders wish to obtain the highest possible level of security combined with the minimum possible premium rates. Maximum security implies the lowest possible level of asset risk, which means holding all assets as cash, while premium rates can be minimised, all other factors being equal, by maximising the investment return. Higher investment returns are often related to higher-risk investments. In particular in recent years investment in equities and property has often provided much higher returns than cash or fixed interest. From the policyholder's point of view, therefore, a balance is necessary between risk and return. In this context investment risk has been identified with volatility of capital value.

3.3 The interests of shareholders, as proprietors of the company, are clearly important in the formulation of investment policy. Who are the shareholders? Table 10 shows an estimate of the proportions of all U.K. quoted equities owned by various groups of shareholders at the end of 1978.

Table 10:

	Holdings of U.K. quoted equities
	%
Insurance Companies	19.0
Pension Funds	21.5
Investment Trusts	6.0
Unit Trusts	4.5
Total Institutional	51.0
Persons	28.5
Charities	2.5
Industrial, Commercial, and Financial Companies	9.5
Government	3.5
Overseas	5.0
Total	100.0
Total value of quoted equities	£63.5bn

The seven quoted composites are all large companies with easily marketable shares and it is possible that the institutional representation among their shareholders may be greater than average. The main categories are, therefore, pension funds, other insurance companies and "persons". Dividend growth at the maximum rate which can be sustained while maintaining the real value and business of the company would seem to be the most obvious aim on behalf of these shareholders. Growth in dividends is in the long run related to profits and so the composition of and fluctuations in declared profits, together with prospects for the foreseeable future are subject to close scrutiny from shareholders and their advisors.

3.4 It is difficult to be specific in a discussion of corporate objectives, and on this occasion, with the one particular aim of formulation of an investment policy in view, a detailed discussion would be out of place. Corporate objectives are sometimes deemed to include a target expressed in terms of a rate of return on capital employed (on some suitable definition) or in terms of some particular underwriting margin. Since management's objective must be the best possible performance, in serving and balancing the various interests involved, in the circumstances arising, such targets seem to be valuable only as a way of attempting a scientific allocation of the available resources, and not as a guide to overall corporate objectives.

3.5 When competition between insurers causes market premium rates to appear unprofitable, it may be best for a company to cease writing business at those rates. In these circumstances premium volume may fall or fail to rise and the employment of capital in the insurance activities of the company may become inefficient. Operation with high solvency margin and a high level of asset risk, related to high expected investment returns, could then be the best course of action for the company. It seems necessary, in any case, to relate the maximum acceptable level of asset risk closely to the strength of the company's balance sheet.

4. How well have U.K. composite insurance companies served their shareholders?

4.1 Table 11 shows how dividends have grown, on the seven quoted composites, in the ten years 1969/78 inclusive. All but one of the companies did better than the average industrial share, and the general performance was reasonable given average retail price inflation over the period of 12 per cent p.a.

Table 11: Annual Dividend Growth Rates 1969/78

	Dividend Growth Rate 1969-78 %
Commercial Union	8
Eagle Star	11
General Accident	12
Royal Insurance	11
Sun Alliance	11
GRE	11
Phoenix	11
Industrial Equities (FTA 500 Index)	9

4.2 The yields at year ends since 1962 on the FTA Composite Insurance sector index are shown in Table 12 and compared with yields on the FTA All Share Index.

Table 12:

	Yield on Composite Insurance A%	Yield All Share Index B%	Yield Relative A/B %
1962	3.42	4.35	79
1963	3.82	4.08	94
1964	4.73	5.18	91
1965	4.51	5.22	86
1966	4.68	5.78	81
1967	3.80	4.38	87
1968	3.73	3.19	117
1969	4.18	3.85	109
1970	4.50	4.39	103
1971	3.25	3.25	100
1972	3.51	3.15	111
1973	4.99	4.77	105
1974	12.95	11.71	111
1975	6.50	5.47	119
1976	8.16	6.42	127
1977	5.85	5.28	111
1978	7.16	5.79	124

Over the period covered composite insurers have moved from a high rating, on a yield only 79% that of the market, to a low rating, where the yield is 24% higher than that on the market. This de-rating is clearly related to the difficulties of maintaining solvency margins during a period of inflation, and to the heavy capital raising which has been necessary in the last few years. Adding in the problems of international competition in insurance, the problems of the insurance business are seen by the stock market as more serious than those facing industry in general. The most obvious simple conclusion to draw from Table 12 is that, notwithstanding the satisfactory past performance, the stock market does not expect future dividend growth on composite insurance companies to be as rapid as dividend growth generally.

4.3 The good performance in terms of dividend growth has been offset, so far as the shareholder is concerned, by the disappointing share price performance over a long period resulting from the de-rating described in 4.2. The relative performance of income and capital movements varies with the shareholder's tax position but so far as pension funds are concerned income and capital growth are of equal value since neither is taxed. Annual returns, combining income and capital changes, for composite insurance and for equities generally are shown in Table 13.

Table 13: Annual Gross Returns %, taking income and capital changes together

	Composite Insurance Shares	Equities Generally	Performance Ratio (Insurance/Equities generally)
1963	- 3.6	19.7	.805
1964	-14.6	-6.1	.909
1965	14.6	11.4	1.029
1966	.9	-4.4	1.055
1967	29.9	35.0	.962
1968	20.7	48.5	.813
1969	-5.6	-12.0	1.073
1970	11.4	-3.6	1.156
1971	55.5	47.1	1.057
1972	6.8	15.8	.922
1973	-24.2	-28.8	1.065
1974	-48.0	-51.7	1.077
1975	132.8	150.9	.928
1976	- 7.7	1.7	.908
1977	60.0	48.8	1.075
1978	-5.1	8.2	.877
Average (63-78)	7.9	10.4	.977
	(a)	(b)	$\frac{(1+a)}{(1+b)}$

For this particular class of investor, therefore, the fall in capital value has been sufficiently large to make composite insurance shares a poor investment, relative to other equities, over most of the period.

4.4 This section has been included in this note mainly because of the importance of shareholders' interests in consideration of corporate objectives, and therefore in formulation of investment policy. It makes no difference to shareholders whether profits are derived from underwriting or from the investment of the available funds. There may be times, when competition drives premium rates down, when shareholders' interests would be better served by undertaking less insurance risk and employing capital in the taking of investment risks. On the criteria discussed in Section 2, however, the level of asset risk currently taken by U.K. companies seems generally fairly near to the reasonable maximum.

Financial Planning in Composite Offices conducting mainly life business

For most of the large non-life insurers the contribution to profits from their life business is of far less significance than the profitable operation of their non-life business. The aim of this paper is to look at the problems of financial planning in the smaller companies, in particular home service offices, where this situation is often reversed. The main contribution to profits is from life business, non-life being conducted as an important subsidiary operation.

Why conduct non-life business?

For home service offices, in particular, the main reasons justifying the conducting of non-life business could be:-

a) To provide a complete service to policyholders, with whom they already have a direct link through their life business.

b) It helps spread the expense of employing a large agency force.

c) The business has generally been profitable (particularly in the property a/c) until recently.

The underwriting losses of recent years have made it necessary to review the future development and profitability of this business.

Basic Concepts

In trying to define the basic concepts involved, we consider the following questions:-

a) How do we define the capital base of the company's life and non-life operations?

b) Can the concept of return on capital have any meaning in this situation?

c) What level of solvency margin should the company maintain and how much of this margin is dependent on life business?

d) What level of growth in non-life business should be planned for and at what level of profitability?

e) At what point (after consistently poor results) does it become uneconomic to continue writing non-life business?

For illustration purposes, I attach account details of a hypothetical home service office conducting mainly life business (Appendix I).

The Capital Base of the company's life business

There will be within the life fund the following margins:-

a) The inherent margin in the office's published net premium valuation basis, when compared to a bonus reserve valuation on a 'realistic' basis.

b) The excess of asset values over book values.

c) Other hidden reserves and retained surplus.

These margins together with shareholders funds are referred to as the office's estate. An established fund like this can be considered "semi-mutualised" in the sense that the capital base for its continued operation is mainly contained within the policyholders' fund and such items as new business strain are absorbed within the fund without any provision of risk capital from shareholders, whose capital is only a small part of the estate. In fact the dividend potential of the shareholders is dependent on the rate of emergence of surplus which is largely determined by the actuary who will be aiming at a balance between the continuing strength and competitiveness of the fund.

With a conservative valuation basis, the bulk of the estate (i.e. the margin (a) above) will automatically grow with the growth in business. The concept of return on capital in this context is not particularly helpful therefore, as both the surplus emerging and the estate itself are dependent on the actuarial bases employed.

The Capital Base of the company's non-life business

In the attached example Company XYZ has a solvency margin of £5.0m - 50% of premiums - in respect of its non-life business. This consists of free reserves in the non-life and shareholders funds, including the excess of asset values over book value. This solvency margin would normally be considered the capital base of the company's non-life business, but the return on this capital is partly provided by the life fund.

It is probably more meaningful for planning purposes to decide what level of solvency it is considered necessary for the company to hold in respect of its non-life business. A suitable level could be 30% of premiums. In the example therefore the extra 20% (£2.0m) is an additional shareholders fund which provides an extra margin and which is supported by life earnings. The planning of the non-life business, however, should be aimed at maintaining a 30% solvency margin from within the business.

The Interlocking of Life and Non-Life Capital

The company can only support the non-life fund from the life fund by means of its transfer to shareholders which cannot increase (as a % of surplus) by more than ½% in consecutive years. Thus the life fund transfer can only be used to support the non-life fund if dividends are withheld from shareholders.

As mentioned above, however, the life branch earnings have resulted in a higher level of shareholders' capital than is strictly necessary for the non-life business. It is obviously important that this extra margin is not used to continually subsidise insufficient non-life profits, otherwise it would soon be eroded. It does, however, provide some scope for expansion of non-life business, provided this business is going to be self-supporting.

The Interdependence of Growth Rate, Solvency and Profitability

In his paper "Reinsurance - Sustainable Growth of Funded Accounts", Graham Lyons develops some useful relationships between profitability, solvency and growth which can be adapted into a direct insurance context. The formulae are outlined in Appendix II together with examples for an office such as XYZ with a short tailed claims pattern.

Obviously if solvency is 30% of premiums and the growth rate is 20% p.a., then the company must retain 6% of premiums in order to maintain solvency. In the example, we have

	£000
underwriting profit	-500
plus investment income	+1320
less tax	-410
less contribution to shareholders	-41
	369

In other words, retentions are only 3.7% of premiums and are clearly insufficient to maintain 30% solvency with 20% growth.

The level of interest earnings is dependent on a number of factors, including investment yield, claims pattern, growth rate and inherent profitability. The purpose of these formulae is to clarify the relationship between these factors for the 'steady state' growth situation.

The example is based on a short tailed overall claims pattern, but could be done separately by class of business, thus showing the varying effect of interest earnings due to differing claims patterns.

Company XYZ is growing at 20% p.a., paying 10% of its non-life profits to shareholders and earning interest at 12%. If these conditions continue then the company must achieve a policy year loss ratio of 55.0% (3% profit after 42% expenses) which will result in an underwriting profit of 0.5% of written premiums in the revenue account. If all non-life profits were retained, a slightly higher loss ratio of 56.3% would be sufficient (giving an underwriting loss of 0.7%).

To illustrate the effect of these figures, the solvency position of XYZ is projected in Appendix III, assuming the company continues to pay 10% of profits to shareholders and assuming:-

a) the underwriting loss continues at 5% and

b) the underwriting loss reduces to nil.

By applying the formulae, we can establish that, with growth at 20%, a 5% underwriting loss will only allow solvency to be maintained at 9.7% in a steady state situation and a nil loss will allow solvency to be maintained at 28.3%. The fact that XYZ is starting from 50% solvency improves these figures initially, but the level of solvency which is being maintained is indicated by column (10) and these figures are seen to gradually approach the steady state situation as the solvency margin decreases. Example A clearly indicates the dangers to the company of allowing underwriting losses to continue at current levels.

Conclusion

These techniques do not, of course, solve the problem of writing business at sufficient profit, but they do enable management to quantify the financial effect of likely future conditions. It is clear that with an expanding non-life portfolio, unless a good loss ratio can be maintained, this business can very soon create a drain on life profits - a situation which is unlikely to be acceptable to shareholders.

Management decisions would be required to improve profitability and/or curtail the growth of business and the insight these methods give into the factors affecting solvency should enable suitable targets to be set for sales staff and underwriters and facilitate effective planning and monitoring of the business.

J.R. Wallis,
July, 1979.

APPENDIX I

INSURANCE COMPANY XYZ (Extracts from 1978 Accounts)

MAIN DETAILS OF LONG TERM BUSINESS

	£000
Assets Valued according to Valn. Regns. 1976	500,000
Premium Income	45,000
Investment Income	30,000
Trfrs. Invest. Profits	1,000
Claims	30,000
Expenses	15,500
Taxation	4,000
Trans. P & L A/C	1,500
Fund carried forward	300,000
Earned Surplus after Taxation	18,500
Allocation to Policyholders	17,000
Allocation to Stockholders	1,500

NON-LIFE BUSINESS

Premium income growing at 20% per annum

Balance Sheet at 31.12.78	£000
Liabilities	
Unearned Premium	4,250
Outstanding Claims	2,966
Current Liabilities	75
Non-Life Reserve	672*
	7,963
Represented by	
Assets Valued according to Valn. Regns. 1976	8,463
Excess over book value	-500*
	7,963

Revenue Account 1978		£000
Premiums written		10,000
Less Increase in UPR		708
Earned Premium		9,292
LESS		
Claims Paid	5,097	
Increase in O/S Cl.	495	-5,592
Expenses		-4,200
Underwriting Profit (Loss)		(500)
Investment Income		884
Taxation		-192
		192
Transfer to P & L A/C		-20
Non-Life Reserve bt. fwd.		500
Non-Life Reserve cd. fwd.		672

STOCKHOLDERS FUND

Balance Sheet at 31.12.78	£000
Liabilities	
Issued and Paid Up Capital	1,500*
Profit & Loss A/C	828*
Current Liabilities	1,000
	3,328
Represented by	
Assets Valued according to Valn. Regns. 1976	4,828
Excess over book value	-1,500*
	3,328

Profit and Loss Account 1978	£000
Transfer from Life Fund	1,500
Transfer from Non-Life Fund	20
	1,520
Interest	436
Taxation	-218
	1,738
Dividend	-1,541
P & L A/C bt. fwd.	631
P & L A/C cd. fwd.	828

* SOLVENCY MARGIN IN RESPECT OF NON-LIFE BUSINESS = £5.0m.

APPENDIX II INTERDEPENDENCE OF GROWTH, PROFITABILITY & SOLVENCY

The following formulae are developed by Graham Lyons in his paper on reinsurance:-

Non-Life A/C

	Fund bt. fwd.	F(O) = P(O) + C(O)
+	Premium written	+P
-	Claims paid	-C
-	Expenses	-E
-	Underwriting Profit	-U
=	Fund cd. fwd.	F(1) = P(1) + C(1)

Stockholders/Solvency A/C

	Fund bt. fwd.	S(O)
+	Investment Income	+I
+	Underwriting Profit	$+U_1$
-	Expenses	$-E^1$
-	Tax	-T
-	Dividend	-D
+	Life Fund Transfer	+L
+	Change in Capital Values	+X
=	Fund cd. fwd.	S(1)

We define

Claims development pattern $c_1, c_2, c_3, \ldots\ldots\ldots c_n$ where $\sum_1^n c_t = 1$

Policy year loss ratio = x (assumed to remain constant).
Growth rate = i ($v = \frac{1}{1+i}$)
Investment income is earned at rate j
Expense ratio = e (assumed to remain a constant proportion of written premium).
In the U.P.R. initial expenses are assumed at e^1 ($e^1 < e$)
Tax rate t_i on investment income and t_u on underwriting profit.
Solvency margin = s per unit premium.

It can be shown that

In current revenue year claims paid C = xc per unit premium where $c = v\,(1+i/2)\sum_{t=1}^{n} c_t\, v^{t-1}$

For a unit premium (P=1)

O/S Claims reserve $C(1) = \frac{x}{i}\left(1+i/2 - c(1+i)\right)$ $C(O) = v\,C(1)$

U.P.R. $P(1) = \frac{1}{2}(1-e^1)$.

Underwriting profit $U = v(1+i/2)\,(1-x-e^1) - (e-e^1)$

Investment income $I = j(F(O) + S(O) + \frac{1}{2}(P-C-E))$
$= j(\frac{x}{i}(1+i/2)\,(v-c) + sv + \frac{1}{2}v\,(1-e^1) + \frac{1}{2}(1-e))$

Tax $T = t_i I + t_u U$.

If we assume a constant proportion α of non-life profits is paid to shareholders and no change in capital values, then

$S(O) + (1-\alpha)\,(I + U - T) = S(1)$

$= S(O) + (1-\alpha)\,(1-t)\,(I+U)$ if $t_i = t_u = t$

Thus

$$x = \frac{sv\,(j - \frac{i}{(1-\alpha)(1-t)}) + j_2\,(v(1-e^1)+(1-e)) + v(1+i/2)(1-e^1) - (e-e^1)}{v(1+i/2)(1-j/i) + j/i\,(1+i/2)\,c}$$

Example. Profitability ratios to maintain solvency (expressed as % of written premiums)

Basic Data. Claims development pattern c_1=.67 c_2=.20 c_3=.05 c_4=.04

c_5=.02 c_6=.01 c_7=.01

Expense ratios e=.42 e^1=.15

Tax rate t=.50

A) Assuming all non-life profits retained (α =0)

Solvency	Growth rate i Interest j	10% 8%	15% 10%	20% 12%	20% 10%
50%	Loss ratio x* u/w profit u	56.8% -0.1%	53.9% 2.0%	51.2% 4.0%	48.9% 6.1%
30%	Loss ratio x* u/w profit u	59.1% -2.3%	57.7% -1.4%	56.3% -0.7%	54.3% 1.1%
18%	Loss ratio x* u/w profit u	60.5% -3.6%	59.9% -3.5%	59.3% -3.4%	57.6% -1.9%

B) Assuming 10% of non-life profits paid to shareholders (α = 0.10)

Solvency	Growth rate i Interest j	10% 8%	15% 10%	20% 12%	20% 10%
50%	Loss ratio x* u/w profit u	55.8% 0.9%	52.4% 3.5%	49.2% 5.9%	46.9% 8.0%
30%	Loss ratio x* u/w profit u	58.5% -1.7%	56.7% -0.6%	55.0% 0.5%	53.1% 2.2%
18%	Loss ratio x* u/w profit u	60.1% -3.2%	59.3% -3.0%	58.6% -2.8%	56.9% -1.2%

* x = loss ratio per policy year

APPENDIX III

INSURANCE COMPANY XYZ — PROJECTED SOLVENCY POSITION ON DIFFERING PROFITS ASSUMPTIONS

Year	Premium Income (20% growth) P (1)	Reserves at start of year: UPR P(0) (2)	O/S Claims C(0) (3)	Solvency S(0) (4)	½(P-C-U) (5)	Interest Earning Funds (6) (2)+(3)+(4)+(5)	Interest at 12% I (7) = 0.12 x (6)	Underwriting Profit/Loss U (8)	Increase in Solvency after 50% Tax and 10% paid to stockholders .45 (I+U) (9)	As a % of increase in premium Δ S% (10)	Solvency Margin S(1) (11)	As a % of premiums % (12)
A) UNDERWRITING LOSS TO CONTINUE AT 5% OF WRITTEN PREMIUMS												
1978	10000	3542	2472	4631	352	10997	1320	-500	369	-	5000	50.0
1979	12000	4250	2966	5000	422	12638	1517	-600	413	20.7	5413	45.1
1980	14400	5100	3559	5413	506	14578	1749	-720	463	19.3	5876	40.8
1981	17280	6120	4271	5876	607	16874	2025	-864	522	18.1	6398	37.0
1982	20736	7344	5125	6398	728	19595	2351	-1037	591	17.1	6989	33.7
1983	24883	8813	6150	6989	874	22326	2739	-1244	673	16.2	7662	30.8
1984	29860	10576	7380	7662	1049	26667	3200	-1493	768	15.4	8430	28.2
1985	35832	12691	8856	8430	1259	31236	3748	-1792	880	14.7	9310	26.0
1986	42998	15229	10627	9310	1511	36677	4401	-2150	1013	14.1	10323	24.0
1987	51598	18275	12752	10323	1813	43163	5180	-2580	1170	13.6	11493	22.3
1988	61918	21930	15302	11493	2176	50901	6108	-3096	1355	13.1	12848	20.8
B) UNDERWRITING LOSS REDUCED TO NIL FROM 1979 ONWARDS												
1978	10000	3542	2472	4631	352	10997	1320	-500	369	-	5000	50.0
1979	12000	4250	2966	5000	514*	12730	1528	-	688	34.4	5688	47.4
1980	14400	5100	3455*	5688	726*	14969	1796	-	808	33.7	6496	45.1
1981	17280	6120	4019*	6496	1001*	17636	2116	-	952	33.1	7448	43.1
1982	20736	7344	4669*	7448	1201	20662	2479	-	1116	32.3	8564	41.3
1983	24883	8813	5603	8564	1441	24421	2931	-	1319	31.8	9883	39.7
1984	29860	10576	6724	9883	1729	28912	3469	-	1561	31.4	11444	38.3
1985	35832	12691	8069	11444	2075	34279	4113	-	1851	31.0	13295	37.1
1986	42998	15229	9683	13295	2490	40697	4884	-	2198	30.7	15493	36.0
1987	51598	18275	11620	15493	2988	48376	5805	-	2612	30.4	18105	35.1
1988	61918	21930	13944	18105	3586	57565	6908	-	[illegible]	30.1	21214	34.3

* Claims figures are assumed to reach a new 'steady state' level over 3 years.