HOW INSOLVENT ARE WE?

P. D. JOHNSON

Can archaeology help us?

As we grapple with the problems of conducting non-life insurance in a world of high inflation, we should perhaps pause for a moment to look for historical analogies for our present predicament. Let us, then, look back at a distressing period many years ago in the history of the Kingdom of Carmania.

Inflation was by no means new to the citizens of Carmania. Year after year, all prices and incomes had been rising at a steady rate of 5% per annum. The economy functioned quite well, albeit in a rather uninteresting way, and the people were accustomed to the idea that the purchasing power of the Carmanian dollar would fall by roughly 5% every year. There were, however, some economists who argued that inflation was both undesirable and unnecessary, and prevailed upon the King to adopt some measures which, they assured him, would quickly reduce the rate of inflation to zero. The measures were adopted, and the following year the rate of inflation rose to 10%.

At this point a rival group of economists explained that this unfortunate development was simply what should have been expected, and they set out an alternative policy which would undoubtedly reverse the trend and bring inflation quickly under control. Convinced by the weight of their arguments, the King introduced what became known as Phase 2 of the counter-inflation policy. By the next year, the rate of inflation had risen to 20%.

Hereupon a third group of economists, who had been travelling to many foreign lands, returned with news of how, in one of those countries, the rate of inflation had been brought down from no less than 80% to 10% by adopting policies whose wisdom was so obvious that it required—and received—no explanation. With great relief, the King seized upon these new policies, called them Phase 3 and put them into force. The rate of inflation rose to 30%.

By this time, the King was beginning to wonder whether his

faith in economists was entirely justified. After giving the matter careful thought, he decided to dismiss all his economists and adopt some new measures which were entirely his own.

While all this was going on, the members of the Carmanian Insurance Association (CIA) were naturally experiencing some difficulties. The extent of these can be gauged from the historical records, discovered during recent excavations, for one company whose business consisted entirely of chariot insurance.

During the long period of 5% inflation, the company's business showed a remarkable stability. Not only did the volume of business remain constant but the expenses and the pattern of claim payments remained unchanged apart from the regular increase of 5% over the amounts for the previous year. Every claim payment was made on 31st December and, expressed in terms of the purchasing power of a base year, the pattern of payments for each year's claims was as follows, where year C is the year of claim:

Year	C	$C+1$	$C+2$	$C+3$	$C+4$	$C+5$	$C+6$
Payments at end of year	550	240	80	60	30	20	20
Cumulative payments	550	790	870	930	960	980	1000

The actual payments made at the various durations, and the cumulative payments, would be equal to the value of the inflation index for the end of the year of claim, multiplied by the following amounts:

Year	C	$C+1$	$C+2$	$C+3$	$C+4$	$C+5$	$C+6$
Payments at end of year	550	252	88	69	36	26	27
Cumulative payments	550	802	890	959	995	1021	1048

Expenses associated with the settlement of claims are included in the above payments. Other expenses, amouting to 300, were all paid at the end of the year of claim. In addition, commission was paid at the rate of 15% of the premiums, which were all due on 1st January.

Year 0: the last year of tranquillity

We shall begin our story in year 0, the last of the long series of years with inflation at 5%. The value of the inflation index at the end of year 0 was unity.

All money was placed on short-term deposit and earned a rate

of interest of 5%, the same as the rate of inflation. The premiums of 1456 charged on 1st January of year 0, after deduction of commission amounting to 218, earned interest of 62 and were therefore just sufficient to meet the total claim and expense payments of 1300 at the end of the year. At the start of the year the provision for outstanding claims was 876 and the free reserves amounted to 1456, exactly 100% of the premiums paid on 1st January. Of the total free reserves of 1456, 500 represented shareholders' capital. Interest at 5% on the provision for outstanding claims and on that part of the free reserves which did not represent shareholders' capital was exactly sufficient to maintain their real value, and thus at the end of the year they stood at 920 and 1004 respectively. The shareholders received dividends at the rate of 5% and, for reasons which have not been discovered, were apparently quite content to receive a return no greater than that which they could have obtained by simply placing their money on deposit. At any rate, the company had no difficulty in finding people who were willing to subscribe further capital to replenish the 25 paid out in dividends. Thus the free reserves at the end of year 0 stood at 1529.

The essential details of year 0 are set out in column 1 of Appendix 1.

Year 1: the first cloud appears

The introduction of the first counter-inflation policy naturally disturbed this happy state of affairs. Fortunately the company was not convinced that inflation would disappear as a consequence of the new policy, and at the beginning of year 1 it duly charged premiums amounting to 1529, just 5% higher than those of the previous year. Another fortunate feature was that interest continued to be obtainable at the rate of 5% despite the official proclamations that inflation was to be eliminated.

Column 2 of Appendix 1 shows the main features of year 1. During the year inflation was at the rate of 10%, and at the end of the year the premiums of 1529, less commission of 229, had amounted with interest to 1365, a sum insufficient to meet the expenses and claim payments of 1430 (10% higher than the previous year's figures of 1300). Furthermore, the company decided to

assume that inflation would continue at 10% and fix its provision for outstanding claims accordingly. On the other hand, it found that at the end of year 1 interest was available at the rate of 10%, and it assumed that if inflation were to remain at that level the interest rate would do likewise. It therefore assumed that the effect of future inflation on the outstanding claims would continue to be exactly offset by the interest earned on the money held to pay those claims and it set up a provision for outstanding claims of 1012, just 10% higher than the previous year's provision of 920.

Thus at the end of year 1 the free reserves, which had begun the year at 1529, had been augmented by interest of 76 but depleted by 111, representing the shortfall of 65 on the payments and 46 on the provision for outstanding claims. The company decided that since it had suffered a trading loss it would make no distribution to shareholders. Thus the free reserves at the end of year 1 stood at 1494.

Year 2: the sky gets cloudier

The rise in the rate of inflation in year 1 had occurred towards the end of the year, after the decision had been made to increase the premium rates by the usual 5%. Thus the premiums charged on 1st January of year 2 were 1605. Premiums less commission amounted to 1364, which together with interest of 136 gave 1500, compared with 1716 required for payment of expenses and claims at the end of the year after inflation at 20%. The company decided to assume that inflation would continue at 20%, as would the rate of interest which had just then risen to 20% from the previous level of 10%. The provision for outstanding claims at the end of year 2 was therefore 1214.

The free reserves of 1494 at the start of year 2 were increased by interest of 149 but decreased by 317 (the sum of 216 and 101). Again no dividends were paid to shareholders, and thus at the end of year 2 the free reserves stood at 1326.

Year 3: darkness looms

The premiums to be charged at the start of year 3 had to be decided upon during year 2, and at the time this matter was being considered the increase in the rate of inflation from 10% to 20%

had not yet taken place. The company decided it would certainly need to increase its premiums by 10% above the level which they apparently should have reached the previous year; this gave a total increase of about 15%. The company would have liked to go further—not because it was then expecting a further rise in the rate of inflation but in order to restore its free reserves to their previous level in real terms. Unfortunately, however, the current counter-inflation policy decreed that past losses could not be recouped and that premiums could not be raised by more than 15%. The premiums charged on 1st January of year 3 therefore amounted to 1846.

Year 3 thus proceeded in a similar fashion to year 2. Premiums after deducting commission of 276 amounted to 1570. With interest of 314, the amount available at the end of the year for expenses and claims was 1884, compared with the required amount of 2231; a shortfall of 347. The provision for outstanding claims was fixed at 1578, and the free reserves fell from 1326 to 1123, with again no dividend to shareholders.

In year 3, the increase in the rate of inflation had again occurred near the end of the year, too late to be taken into account when fixing the premiums for year 4. In the event, they were raised by 30% to 2400—roughly sufficient on the assumption of rates of interest and inflation of 20% but with no provision for recovery of past losses.

Year 4: the meteorologists are consulted

During year 4, the company decided to take stock of the situation. In three years its prospective solvency margin had fallen from 100% to 47% of premiums and no longer seemed so comfortably in excess of the statutory minimum level of 20%. Whatever else might be done, it seemed that there was a need for further capital to support the business, but unfortunately the general economic state of the country and the fact that the company had been making trading losses and declaring no dividends in the past three years did not make the prospect of raising further capital seem encouraging.

An argument developed regarding the likely future course of inflation. On the one hand there were those who had great faith

in the ability of the King and thought that now that he had rid himself of the economists whose advice had had such unhappy results he would succeed in restoring the country quickly to its old state of uniform inflation at what now seemed the extremely modest rate of 5%. On the other hand there were those who argued that there was no reason to suppose that the recent trend would be reversed, and that by far the likeliest outcome was that the rate of inflation would continue to increase year by year. Between these two factions there were some who thought that inflation might be stabilised at its current rate of 30%.

Accordingly it was decided to perform calculations based on three different sets of assumptions regarding the future rates of inflation, as follows:

Year		4	5	6	7	8	9	10
Percentage rate of	(1)	30	30	30	30	30	30	30
inflation in year	(2)	20	10	5	5	5	5	5
	(3)	40	50	65	80	100	120	150

It was assumed that in each case the rate of interest obtained in any year would be equal to the rate of inflation in the preceding year.

First forecast: continuing cloudy

If the outcome were to correspond to Assumption 1, which was the basis on which the provision for outstanding claims had been made at the end of year 3, then an increase in premiums of about 42% at the start of year 5, followed by subsequent increases of 30%, would result in a stable development similar to that of the old days of 5% inflation, but with free reserves equal to 35.5% of the following year's premiums. The details are given in Appendix 2. It has been assumed that each year the provision for outstanding claims would be arrived at on the same principles as in years 1 to 3, namely that future inflation would be exactly matched by interest earnings. Since this outcome is implicit in Assumption 1, the provisions arrived at in this way are identical to the correct provisions, set out at the foot of Appendix 2.

Second forecast: fine and sunny

The outcome corresponding to Assumption 2 is given in Appendix 3. The provision for outstanding claims, as shown in the pro-

jected accounts, is again based on the assumption that future inflation would be matched by interest earnings. The correct provision which would ultimately turn out to have been required is shown at the foot of Appendix 2. Thus the provision made in the accounts at the end of year 3 would prove to have been 200 in excess of the amount required. If the premiums were increased by about 42% at the start of year 5 and then by about 12% at the start of year 6, followed by two years with no increase and subsequent increases at 5%, the position would again stabilise, this time with free reserves restored to 100% of the following year's premiums.

Third forecast: après nous le déluge

On assumption 3, for which the figures are given in Appendix 4, the true provision for outstanding claims at the end of year 3 would have been 1862, i.e. 284 greater than the provision actually made. This alone would reduce the prospective solvency margin to 839, or 35% of the premiums charged in year 4. Also, the premiums charged at the start of year 4, less commission, were equal to only 2040 compared with 2565 required to meet the cost of claims and expenses. This further deficiency of 525 would mean that the company was already insolvent; the true deficiency in the premiums would be even greater, since the rate of interest obtainable on the free reserves would be insufficient to maintain their real value, let alone maintain them at a constant percentage of premiums. Not only was the company already insolvent, but by the time the higher rate of inflation in year 4 was known, the premium rates for the start of year 5 would have been decided; if the increase were around 42%, those premiums would clearly be hopelessly inadequate. If, however, the company continued to assume, when determining the provision for outstanding claims at the end of year 4, that future inflation would be offset by future interest, the free reserves would stand at 831 and since this would be 24% of the following year's premiums the company would even then appear from its accounts to be solvent.

The end of the Carmanian story

Unfortunately, no records have yet been found showing what happened to inflation in Carmania in year 4 and later, nor what

happened to this particular company. While excavations continue, let us first note one or two significant features of the experience of our Carmanian company and then go on to consider its relevance to the problems we face to-day.

Perhaps the most striking feature of the Carmanian situation is that, bad as things became, they could have been much worse:

(a) The company entered the period of increasing inflation with a prospective solvency margin of 100%, five times the statutory minimum level in Carmania, and even higher in relation to the minimum levels which are commonly found to-day. If the solvency margin at the end of year 0 had been only 47% of the following year's premiums, then on the assumptions made in preparing the accounts at the end of year 3 its free reserves would have been zero.

(b) The company kept the whole of its money in short-term deposits, and therefore did not suffer a fall in the capital value of its assets, either as a result of the rise in interest rates (as would have been the case if it had invested in, say, medium-term fixed-interest stocks) or as a result of a fall in market values of ordinary shares and property (as might easily have affected it if it had invested in assets of those kinds).

(c) The company's claims experience remained remarkably free from the year-to-year fluctuations which the actuaries, well versed in the classical theory of risk, had said it must expect. The figures on which it had in part to base its decisions were undistorted by variations in the volume of business, the volume of claims, the types of claims, the rate of settlement or the effectiveness of the control of claims costs; nor were there apparently any inaccuracies in the records. Its difficulties arose solely from the increases in the rate of inflation, the failure of interest rates to keep up with those increases, and the general uncertainty which developed regarding the future of those two items.

The Carmanian company's problems would clearly have been somewhat diminished if it had succeeded in predicting the sharp rise in the rate of inflation and had begun to raise its premiums by more than 5% each year well before the rise in inflation began—

although it might have had difficulties of another kind if the chariot insurance market were a competitive one and the other companies were not equally percipient. An increase in the rate of inflation means that a company whose premium rates have been just adequate must at some stage increase its rates by more than the current rate of inflation if it is to avoid a reduction in its free reserves.

The failure of the Carmanian company to anticipate the rise in inflation led to a fall in its free reserves. Thanks to its strong reserve position at the end of year 0, this fall could be accepted so long as it seemed likely to be a temporary feature. The real difficulty which confronted the company was that of predicting the future course of inflation and of interest rates. The higher the latest rate of inflation became, the harder it seemed to be to forecast the future rates. As the rate of inflation increased, there seemed to be a tendency for interest rates to lag behind the current rate of inflation, but whether that was likely to be a permanent feature of increasing inflation was far from clear. Likewise, if the rate of inflation were to fall, the rate of interest might exceed the current rate of inflation, but whether this would really happen and, if so, to what extent, was a matter for speculation. The range of uncertainty, expressed in monetary terms, was very large in relation to the premium income, and a wrong decision as to the level of premium rates to charge could quickly account for the whole of the statutory minimum solvency margin.

Back to 1975

In the past few years, many countries have experienced a sharp rise in the rates of increase of prices and earnings, a rise analogous to, though perhaps differing in degree from, that which occurred in Carmania in years 1 to 3. In some countries the rise has been followed by a fall, while in others, so far, it has not. As we survey the world in 1975 it seems difficult to be convinced that the general economic uncertainties are less than they appeared to be in Carmania.

In the United Kingdom, for example, not only has the rate of inflation, measured by the increase in prices or in earnings, reached

somewhere around 30%, but the rate of interest obtainable on short-term fixed interest investments has been as much as 15% to 20% less than this. Whilst it seems difficult to imagine that conditions of high negative rates of interest in real terms can continue for long, they can create considerable damage while they last. Insurance companies normally invest a proportion of their money in assets, such as ordinary shares and property, carrying a variable rate of return. They do so partly in order to spread their investment risks and partly in the hope that such assets will maintain or increase their real value in times of inflation. So indeed they may, in the long run; over a short period, however, they may suffer a sharp fall in their market value—as they obligingly demonstrated in 1974. Our ordinary shares and property may perform well enough to make us prosperous in 1990, but that is small consolation if we have been declared insolvent in 1975.

In place of the regularity displayed by the business of the Carmanian chariot insurance company, a modern motor insurance company has to contend with variations in the volume and mix of its business, in the volume and nature of its claims, in its staffing levels, in the effectiveness of the control over claim costs, in its progress in settling claims, and in the number of inaccuracies in its records. All these will add to the uncertainty surrounding our attempts to assess the present and predict the future. Fluctuations in the claims experience associated with what we may loosely describe as chance factors are superimposed on, and may reinforce, those due to inflation and the return on investments.

Our assessment of the provisions we need for our outstanding claims and, still more important, of the level of premiums we need to charge in the coming year requires us to take a view as to future inflation and link it with a careful interpretation of the figures derived from our recent experience. It is scarcely surprising that the premium rates currently charged for motor insurance in the United Kingdom seem to reflect a wide range of optimism and pessimism. For a typical portfolio of risks, the average premium of the cheapest company of significant size seems to be about two-thirds of that of the dearest. In a competitive market there is a clear danger that the more pessimistic companies will be reluctant to increase their rates to the full extent that their fears would seem

to justify and that this in turn will encourage the optimists to continue to charge low rates.

The financial management and supervision of insurance companies are in general made more complex by further factors. A company may transact several classes of life and non-life insurance and may do so in many different countries and currencies. Although the consequence may well be a desirable spreading of risks, there will often be greater uncertainty because of the difficulty of obtaining reliable relevant information.

The classes of non-life business differ in the delay in settlement of claims and in the degree to which they are exposed to the inflation risk. The delay distribution of the Carmanian company, expressed in terms of the purchasing power of the base year, happens to contain the same figures as the delay distribution derived from the motor insurance claims of one company in the United Kingdom, after observing the payments over a number of successive years, adjusting for past inflation and smoothing the results. The definition of the delay interval was different in that in the British company's experience the payments at "duration 1" were those made during the calendar year in which the claims were notified. The distribution in the case of the Carmanian company is, however, sufficiently similar to the kind of distribution which could easily be found in a present-day company to make it a reasonable basis for illustration. A company transacting mainly third-party motor insurance, or one with a large proportion of general liability business, would be expected to have a delay distribution with a much longer tail.

The currency risk introduces a further uncertainty. Although assets may be matched with technical liabilities according to currency, it is not practicable to eliminate the currency risk because of the need to draw upon the free reserves to meet fluctuations.

The position shown in the published accounts of a company may differ from what will turn out to be the real position, not only because a company will in general not succeed in predicting the future correctly, but also because of accounting conventions and perhaps deliberate adjustment of the figures in one direction or the other. Companies in the United Kingdom would, it is thought,

aim to take as their total provision for outstanding (including incurred but not reported) claims the total sum which those claims are estimated to cost, without discounting to allow for interest obtainable during the period before payment is made. Caution of this kind is entirely reasonable, but whatever the conventions adopted in practice may be, the underlying principles should be borne in mind.

The lesson of Carmania

The effects of compounding at high rates, whether of inflation or of interest, are so familiar to actuaries that none of the arithmetical results derived from the Carmanian experience will be at all surprising. The main message which this paper sets out to convey is that the uncertainties associated with high rates of inflation are in monetary terms uncomfortably large in relation to the generally accepted minimum margins of solvency. Fluctuations attributable to the element of chance in the occurrence of claims and in their size (before taking inflation into account) can largely be handled by well-established procedures of reinsurance, modified perhaps by the results of mathematical researches carried out by actuaries. Inflation, however, is fundamentally an uninsurable risk. If inflation reaches a very high level it soon becomes extremely difficult to find a satisfactory basis for taking business decisions. Much of the work which has been done in elucidating the principles on which insurance should be conducted will be of limited value until we return to a stable economic environment.

The dangers stemming from inflation serve to remind us that whatever the official definition of solvency may be, no insurance company in any country or at any time is in reality more than conditionally solvent. While we wait for the immediate future to reveal itself, we console ourselves with the though that many insurance companies appear to be strong enough to ensure their survival unless there is a general economic collapse, in which case insurance will not be our only problem.

APPENDIX 1

Actual Experience of Carmanian Company up to End of Year 3

	Year				
	0	1	2	3	4
Percentage rate of inflation in year	5	10	20	30	
Percentage rate of interest in year	5	5	10	20	
Percentage increase in premiums at start of year	5	5	5	15	30
Premiums charged at start of year	1456	1529	1605	1846	2400
Provision for outstanding claims at start of year	876	920	1012	1214	
Interest on provision for outstanding claims at start	44	46	101	243	
Free reserves at start of year	1456	1529	1494	1326	
Interest on free reserves at start	73	76	149	265	
Premiums less commission at start of year	1238	1300	1364	1570	
Interest on (premiums less commission)	62	65	136	314	
Claims and expenses paid at end of year	1300	1430	1716	2231	
Provision for outstanding claims at end of year	920	1012	1214	1578	
Free reserves at end of year	1529	1494	1326	1123	
Prospective solvency margin at end of year	100 %	93 %	72 %	47 %	

APPENDIX 2

Projected Experience of Carmanian Company—Assumption 1

	Year					
	3	4	5	6	7	8
Percentage rate of inflation in year	30	30	30	30	30	30
Percentage rate of interest in year	20	30	30	30	30	30
Percentage increase in premiums at start of year	15	30	42.2	30	30	30
Premiums charged at start of year	1846	2400	3412	4436	5766	7496
Provision for outstanding claims at start of year	1214	1578	2051	2666	3466	4506
Interest on provision for outstanding claims at start	243	473	615	800	1040	1352

	Year 3	4	5	6	7	8
Free reserves at start of year	1326	1123	1212	1576	2049	2664
Interest on free reserves at start	265	337	364	473	615	799
Premiums less commission at start of year	1570	2040	2900	3770	4901	6371
Interest on (premiums less commission)	314	612	870	1131	1470	1911
Claims and expenses paid at end of year	2231	2900	3770	4901	6371	8282
Provision for outstanding claims at end of year	1578	2051	2666	3466	4506	5858
Free reserves at end of year	1123	1212	1576	2049	2664	3463
Prospective solvency margin at end of year	47 %	35·5 %	35·5 %	35·5 %	35·5 %	35·5 %
Correct provision for outstanding claims at end	1578	2051	2666	3466	4506	5858
Correct free reserves at end	1123	1212	1576	2049	2664	3463
Correct prospective solvency margin at end	47 %	35·5 %	35·5 %	35·5 %	35·5 %	35·5 %

APPENDIX 3

Projected Experience of Carmanian Company—Assumption 2

	Year 3	4	5	6	7	8	9
Percentage rate of inflation in year	30	20	10	5	5	5	5
Percentage rate of interest in year	20	30	20	10	5	5	5
Percentage increase in premium at start of year	15	30	42.2	12	0	0	5
Premiums charged at start of year	1846	2400	3412	3820	3820	3820	4011
Provision for outstanding claims at start of year	1214	1578	1894	2083	2188	2297	2412
Interest on provision for outstanding claims at start	243	473	379	208	109	115	121
Free reserves at start of year	1326	1123	1592	2635	3482	3819	4010
Interest on free reserves at start	265	337	318	264	175	191	201

	Year						
	3	4	5	6	7	8	9
Premiums less commission at start of year	1570	2040	2900	3247	3247	3247	3409
Interest on (premiums less commission)	314	612	580	325	162	162	170
Claims and expenses paid at end of year	2231	2677	2945	3092	3247	3409	3579
Provision for outstanding claims at end of year	1578	1894	2083	2188	2297	2412	2533
Free reserves at end of year	1123	1592	2635	3482	3819	4010	4211
Prospective solvency margin at end of year	47 %	47 %	69 %	91 %	100 %	100 %	100 %
Correct provision for outstanding claims at end	1378	1696	1989	2188	2297	2412	2533
Correct free reserves at end	1323	1790	2729	3482	3819	4010	4211
Correct prospective solvency margin at end	55 %	52 %	71 %	91 %	100 %	100 %	100 %

APPENDIX 4

Projected Experience of Carmanian Company—Assumption 3

	Year					
	3	4	5	6	7	8
Percentage rate of inflation in year	30	40	50	65	80	100
Percentage rate of interest in year	20	30	40	50	65	80
Percentage increase in premiums at start of year	15	30	42.2			
Premiums charged at start of year	1846	2400	3412			
Provision for outstanding claims at start of year	1214	1578				
Interest on provision for outstanding claims at start	243	473				
Free reserves at start of year	1326	1123				
Interest on free reserves at start	265	337				
Premiums less commission at start of year	1570	2040				
Interest on (premiums less commission)	314	612				
Claims and expenses paid at end of year	2231	3123				
Provision for outstanding claims at end of year	1578	2209				
Free reserves at end of year	1123	831				

	Year 3	4	5	6	7	8
Prospective solvency margin at end of year	47 %	24 %				
Correct provision for outstanding claims at end	1862	2633				
Correct free reserves at end	839	407				
Correct prospective solvency margin at end	35 %	12 %				