

Estimating Outstanding Claims Reserves - From the standpoint of an external observer.

John Ross/Chris Pountain

Summary

In this paper we describe a computerised method of assessing the relative strengths of the outstanding claims reserves of general insurers from the statutory returns.

While Wood MacKenzie & Co. Ltd. has developed this system principally as a tool of investment analysis it could also be of interest to insurance brokers, the Regulatory authorities and the insurance companies themselves. The method, which in its latest phase of development includes an explicit allowance for inflation, is described in detail in the appendices with the main body of the paper concentrating on general principles.

The means by which historical reserving strength is gauged are touched on and possible sources of distortion are discussed.

The success of the method in practical use is illustrated and we end by suggesting improvements to the data available.

1. Introduction

This paper describes a computerised system of analysing the adequacy of outstanding claims reserves established by non-life insurance companies. The method has been applied principally to the UK operations of the quoted composite insurers but it can also be adapted to the study of US operations.

It should be appreciated that the method relies on data published according to the requirements of the UK and US regulatory authorities and as such must involve less detailed analysis than would be possible with unlimited access to an office's records.

Given the restrictions imposed by reliance on published data, one could well ask, why bother? The answer, from our point of view, lies in the need to have an appreciation of the balance sheet strength of an insurance company when making an assessment of the attractiveness of its shares as an investment.

It is not only stockbrokers who should be concerned with reserving adequacy : anyone with an interest in the published accounts of an insurance company should be aware of the uncertainty that surrounds the revenue accounts and balance sheets. For instance, the Insurance Services Office, the US industry's rating organisation, estimated that the end-1982 reserves in aggregate were inadequate by at least 10%. Given that the aggregate published reserves for the industry are about twice its free capital a 10% reserving inadequacy represents a capital shortfall of 20%. Any rapid corrective action would have a major impact on the companies' revenue accounts.

It is therefore essential in a complete analysis of the investment potential of a non-life or composite insurance company to consider the adequacy of outstanding claims reserves.

More generally, we see the method as being of use to the following:

- o Investment advisors, such as stockbrokers, who wish to identify these companies which may suffer depressed results because of reserve strengthening or conversely, which have hidden sources of equity in their claims reserves.
- o Insurance brokers wishing to satisfy themselves of the security of the companies they recommend to their clients.
- o Regulatory authorities in their solvency checks.
- o Insurance companies wishing to compare their own reserving standards with the industry.

2. Database

UK insurers are required to make annual returns to the Department of Trade and Industry which include, inter alia, details of claims, subdivided by year of origin of claim and year of payment. The principal source of information is Form 33. Our database consists of personal accident, property, motor, liability and pecuniary loss claims. The three year accounting business, marine, aviation and goods in transit are not considered because of the different reporting conditions and the relative smallness of these types of business amongst the quoted companies.

For US insurers the data is extracted from Schedules O and P of the Consolidated Annual Statement, commonly known as the "Yellow Peril". The data is presented in a different format but the information is essentially the same, if somewhat less extensive.

Schedule O reports on the short tail business, such as the auto physical damage, theft and accident and health lines where reserves are small in relation to premium income. These returns do not give a sufficiently detailed breakdown of claims patterns so we concentrate on Schedule P which reports on the longer tail business - auto liability, other liability, workers' compensation, medical malpractice, and a combined group which includes, inter alia, commercial multi peril, homeowners'.

Our analysis is performed separately for each risk group but we have the facility to combine the data according to accounting class or for all business.

The most significant difference between the UK and US data is that while UK returns are completed gross of reinsurance, US schedules are net.

3. Historical Perspective

While it is clear from an investment point of view that interest should be centred on the present reserving position it is informative to consider a company's "track record". We therefore look at:

- o The relationship between the reserves actually set up at the end of previous years of origin and the reserve that should have been set up according to the latest estimate of total ultimate claims payments.
- o The distortion to underwriting results produced by changes in prior provisions for outstanding claims payments. We also look at claims incurred by each year of origin, both paid and unpaid.

4. Estimation of the degree of over or under reserving

In Section 3 we mentioned the historical position of a company's reserves. The main interest of shareholders is in the current reserving position.

The crucial assumption we make in developing our estimates of the required reserves is that claims settlement patterns experienced in the past give a reliable indication of the future outcome. The method adopted is essentially a variant of the "chain-ladder" method.

The detailed calculations involved in estimating the reserves required are described in Appendix 1.

Briefly however, we estimate the required outstanding claims reserves for the latest three years' of origin of claim as follows:

- o Cumulative claims paid to date for each year of origin are grossed up by the average historic run-off ratio for the corresponding duration since year of origin. The run-off ratio is defined as the total claims paid to date after the appropriate duration divided by the total ultimate claims paid (possibly an estimate).
- o From these figures are deducted the cumulative claims paid - we are left with the estimated reserving requirements for each year of origin.

This method has been used each year from 1978 onwards and it has enabled us to grade the quoted composites according to our estimate of reserving strength.

We have tended to concentrate on relative reserving strength rather than absolute reserving strength amongst the companies studied. There are two main reasons:

- o The ultimate objective is to make an assessment of the relative attractiveness of the company's shares.
- o Fluctuations in inflation can directly affect the absolute estimates of required reserves but should affect each company's reserves in a broadly similar fashion.

The results from year to year have displayed a satisfying degree of consistency. Further, on a number of occasions, large amounts of over or under reserving have been identified in advance of companies taking corrective action.

5. Adjusting for Inflation

In order to enable reserving strength to be assessed in absolute terms a system has been developed which makes an explicit allowance for inflation. To date only UK reserves at end-1983 have been considered. The method described in Section 4 relies on the assumption that past claims settlement patterns will be repeated in the future. If we hypothecate an "inflation-free" set of run-off ratios, that is a claims settlement pattern established during a period of stationary prices, then in times of varying price inflation the relative weights of the run-off ratios will alter. As a result the estimates of outstanding reserves will be distorted.

To consider an example, assume that there has been zero price inflation over the period of past experience in question and that there has been no change in the rate of claims settlement. Also assume that the first year of claims payments have been made from the latest year of origin of claim and that in future claims payments will be subject to a uniform annual rate of inflation. In these circumstances the first year's claims form a smaller proportion of total claims payments than is the case for rates experienced in the past. The method of Section 4 would underestimate reserving requirements.

The essence of the adjustment for inflation is to estimate the "inflation-free" run off rates hypothesized above and then to superimpose estimates of price inflation over the future lifetime of the claims reserves.

There are two main practical difficulties in implementing the system:

- o Not all claims will have been settled for the years of origin included in the past experience. Assumptions therefore have to be made about the timing and amounts of these outstanding claims payments.

- o A suitable index of price inflation has to be found.

The first of these points does not in the event give rise to serious problems. Given the numbers of years of development of claims patterns the proportion of total claims payments that is still outstanding is small and the average term until final settlement will be short. The assumption has therefore been made that claims for longer tail lines will be settled in 2 years while for shorter tail business a term of 1 year has been assumed. In order to reflect the information that was available to the companies at the time they were determining their reserving requirements we use the inflation experience over the most recent year.

The second point - the choice of an index or indices for inflation - has been dealt with, in the absence of something better, by opting to use the General Index of Retail Prices (R.P.I.). While indices do exist which are more specific to certain types of risk - for example, the B.I.A. House Rebuilding Cost Index - and which ostensibly would be more relevant, this is by no means true for all groups.

A detailed description of the calculation of the inflation-free run-off ratios and the estimated required reserves is given in Appendix 2.

The estimates derived by the above methods are then compared with the published reserves held by the companies to establish whether, on the basis described above, there is an excess or shortfall in the prior provisions.

We can thereafter relate the amount of over or under-reserving to the reserves held by each company. In this way we can establish the percentage by which reserves could be reduced or should be increased in order to follow reserving standards in the past.

Table 1 below shows our estimate of over- or under-reserving at end-1983 as a percentage of total UK liability, motor and property reserves for claims originating after 1980. We show figures for the three different inflation assumptions and for our traditional assumption which makes no adjustment for inflation.

It is interesting to note the difference between the inflation adjusted figures and those with no adjustment. The relative insensitivity of the inflation adjusted figures to the assumptions after year two is due to the smallness of the reserves after two years of run-off.

Table 1. Estimated Over/Under Reserving for UK Accounts - End 1983

Company	No inflation adjustment 1983	% over/(under) reserved		
		Inflation adjustment		
		Basis 1 5/5/0 (4) 1983	Basis 2 5/5/5 (4) 1983	Basis 3 5/5/10 (4) 1983
A	18.8	32.7	30.9	28.7
B	5.2	16.0	11.3	5.1
C	(2.2)	18.2	15.5	12.4
D	11.5	28.3	26.4	24.1
E	6.0	22.5	19.2	15.1
F	(23.6)	(1.4)	(4.0)	(7.0)
G	(6.6)	12.7	9.8	6.3
H	2.7	21.5	17.9	13.3
I	(16.3)	11.8	7.4	2.0

(1) The WM estimates of over/(under) reserving are expressed as a percentage of published reserves. (2) Figures refer to liability, motor and property lines combined. (3) Over- or under-reserving figures refer to reserves required for claims originating in the latest three years. (4) The format I1/I2/I3 defines the assumed average inflation rates in 1984, 1985 and each year thereafter, respectively.

6. Qualifications and Restrictions

The following features of the methods described above should be noted:

- o It is assumed that the speed of settlement of claims experienced over the historical period will continue to apply in future. If claims are now being settled more quickly the method will tend to overestimate reserve requirements.
- o Changes in the business mix within a risk group may distort the results.
- o It is assumed that the distribution of claims payments over the financial year remains constant. If, for example, there are unusually heavy weather losses early in the year then the reserving requirements will be over-stated as the proportion of claims which have been settled by the end of the financial year will be greater than for a more uniform claims pattern.

- o The use of claims data which is gross of reinsurance in the UK means that the net reserving strength cannot be explicitly calculated. The DTI returns do provide some claims details net of reinsurance in Forms 22 and 23, but non-UK business is included and the breakdown by year of origin is less extensive. There is thus inadequate data to consider the net reserving position.

- o The advent of loss portfolio transfer reinsurance arrangements - so far mainly in the US - has introduced a possible source of distortion to the analysis. These arrangements transfer, in return for a consideration, responsibility for meeting claims on certain blocks of policies to a reinsurer. For the ceding company, claims payments increase in the year of transfer but claims reserves can be reduced, *ceteris paribus*. The difference between the two figures largely represents investment income the reinsurer expects to earn on the consideration.

7. The Success of Reserve Analysis

We have studied the reserving strength of UK composites in both the UK and US annually, commencing in 1978. A general feature which has emerged - and this has been supported by other sources - is that US operations tend to be under-reserved while UK portfolios tend to be over-reserved.

The results of our analyses have been extremely useful in identifying the companies whose results are vulnerable to the need to make good inadequacies in prior years' provisions for outstanding claims.

To illustrate the success of the method we have compared our original rankings of the UK business at the end of 1978 with rankings by subsequent reserve movements. We have expressed these changes in reserves as a percentage of reserves held at end-1978. This test is based on run-off ratios calculated for all business combined for each company (our original study included this basis although we prefer - in order to avoid unnecessary heterogeneity - to base our calculations on the individual accounts).

Table 2 below details the rankings, for the three years of origin of claims achieved by the above method - 1 indicates strongest reserved, 9 indicates weakest reserved.

- o The rankings for claims originating in 1978 show a high degree of agreement. These claims, being the latest, were the most important. The largest discrepancy - between 1st and 3rd equal for Company D - does not give rise to concern as it does not contradict our conclusion that Company D was one of the strongest reservers.

- o The comparative rankings for claims originating in both 1976 and 1977 gave a satisfactory degree of agreement. The largest difference between the rankings is 3.

- o The correlation coefficients of the rankings for claims originating in 1976, 1977 and 1978 are 0.76, 0.73 and 0.87, confirming the goodness of fit.

Table 2. Ranking by Subsequent Reserve Releasing and Original End-1978 Reserve Assessment

	A	B	C	D	E	F	G	H	I
Claims originating in 1976									
Ranking by:									
Subsequent Reserve Movements	2	8	1	4	9	5	6	3	7
End-1978 Reserve Assessment	4=	7	2	1	8	4=	9	3	6
Claims originating in 1977									
Ranking by:									
Subsequent Reserve Movements	1	5	2	4	9	6	7	3	8
End-1978 Reserve Assessment	4	6	2	1	9	8	7	3	5
Claims originating in 1978									
Ranking by:									
Subsequent Reserve Movements	1	5	3=	3=	9	8	6	2	7
End-1978 Reserve Assessment	2=	6	2=	1	9	8	5	4	7

Correlation coefficients were calculated for the actual percentages of over/under reserving and subsequent reserve movements - although, as already discussed, we do not consider the absolute figures to be of prime importance in our analysis. For claims originating in 1978 the correlation coefficient is 0.64 whereas for the financially less important years of 1977 and 1976 the coefficients are 0.36 and 0.53, respectively. These results are not unsatisfactory bearing in mind the distortions caused by fluctuations in inflation, a problem which we have attempted to solve through the inflation adjusting method.

We can also give specific examples of successful identification of abnormal reserving positions. Firstly in the UK :

- o Company E according to our 1978 UK study was one of the weakest reservers. In 1979 and 1980 a programme of reserve strengthening was undertaken with serious consequences for the underwriting results in those years.
- o Company C was identified as one of the stronger UK reservers over the period 1970-76 in 1978 and was able to release substantial amounts of reserves in 1979, 1980 and 1981 while maintaining its strong relative position.

In our US studies we have considered three companies since end 1978.

- o Company C was identified as the most strongly reserved - a position which has continued - and subsequent releases of reserves have confirmed the assessment.
- o Company B we considered to be about adequately reserved and reserve movements subsequently have been small.
- o Company A was identified as being the weakest reserver - a position which was again highlighted in 1979 and 1980. Subsequently a program of major corrective action - including heavy reserve strengthening and loss portfolio transfer reinsurance - has been undertaken. Published results were depressed as a result.

8. Future Developments

In our calculations no allowance is made for investment income on the shareholders' funds : that is, claims payments are not discounted. Traditionally UK insurers have not discounted estimated claims payments but pressure is increasing, both due to poor underwriting results and from the tax authorities in the US, to change this practice. Our system is being developed so that an assumed rate of return on investments can be incorporated in order that we can estimate the implications for results if discounting becomes commonplace.

9. Conclusion

While there are several aspects of our method of analysing outstanding claims reserves which could be improved given more extensive data, the results have proved very satisfactory in practice. As illustrated in Section 7 we have been able to identify, in advance, companies which may be obliged to strengthen reserves or who may be in a position to release excess prior provisions. The analysis has proved an invaluable tool in assessing the investment potential of the quoted composite insurers.

It is to be hoped that the importance of outstanding claims reserves to companies' true profitability will become more evident both to the investment community and to the insurance industry in general. Improvements in information concomitant on the stricter disclosure requirements introduced by the Securities and Exchange Commission in the US are to be welcomed as providing stimuli to this objective and an opportunity for more accurate analysis. The S.E.C. requirements include, inter alia, disclosure of loss development over the previous ten years, distortions caused by unusual circumstances, assumptions made about future inflation, impact on pre-tax income of reserve discounting (if present), loss portfolio transfers, unusually large claims, reserving assumptions and changes therein, and the impact of currency fluctuations.

We would like to end this paper with a plea for improved information from the insurers - a plea directed particularly to the UK business. It would be of great value if DTI returns included notes qualifying the raw data. For example details of:

- o Changes in the composition of risk groups.
- o Changes in the speed of payment of claims.
- o Changes in the distribution of claims over the financial year.
- o The presence of discounting of claims payments.
- o The use of loss portfolio transfer reinsurance.

Moves by the DTI to require claims data on a net of reinsurance basis - in a similar format to the present gross data - would be most welcome.

Appendix 1 Description of the Method of Estimating Outstanding Claims Reserves

The first stage in the process is to construct a "claims triangle" as shown below. This triangle relates to a given year of development.

Year of Origin x	Year of Settlement y						Outstanding Claims	Total Claims
	1	2	3	4	5	6		
1	Q(1,1)	Q(1,2)	Q(1,3)	Q(1,4)	Q(1,5)	Q(1,6)	C(1)	T(1)
2	Q(2,1)	Q(2,2)	Q(2,3)	Q(2,4)	Q(2,5)		C(2)	T(2)
3	Q(3,1)	Q(3,2)	Q(3,3)	Q(3,4)			C(3)	T(3)
4	Q(4,1)	Q(4,2)	Q(4,3)				C(4)	T(4)
5	Q(5,1)	Q(5,2)					C(5)	T(5)
6	Q(6,1)						C(6)	T(6)

Then $T(x) = \sum_{y=1}^n Q(x,y) + C(x)$, where n = number of years of development for year of origin 1.

As discussed above, as the run off of claims proceeds, $C(x)$ tends to zero and $T(x)$ tends to a limiting value.

From this table we can be construct a table of run-off ratios defined by:-

$$R(x,y) = Q(x,y)/T(x)$$

In order to minimise the effects of year by year fluctuations the ratios are averaged over the years of origin to obtain an average proportion of claims payments made to total (estimated, possibly) claims payments, given by:-

$$R(y) = \sum_{x=1}^{N(y)} R(x,y)/N(y)$$

where $N(y)$ = no. of years of experience available depending on y.

The outstanding claims reserves required for each of the latest three years of origin of claim, where Year 1 is the latest year, are then estimated as:-

Year 1	$Q(x+n-1,1) \times (1/R(1)-1)$
Year 2	$(Q(x+n-2,1) + Q(x+n-2,2)) \times (1/R(2)-1)$
Year 3	$(Q(x+n-3,1) + Q(x+n-3,2) + Q(x+n-3,3)) \times (1/R(3)-1)$

For each year of origin of claims, Year 1, Year 2 and Year 3 the claims paid up to the end of year in question are grossed up by the average historical claims ratios for the corresponding run-off period. From that figure is deducted the total claims payments already made.

The expression $x+n-z$ defines the year of origin of claim for the latest three years (with $z = 1, 2$ or 3 and x denoting the earliest year of origin included in the experience) on a consistent basis with the derivation of the run-off ratios.

The method can be adapted to estimate the reserves in earlier years. However, we confine ourselves to three years as this gives the best balance between using as long a past experience as possible (consistent with homogeneity) and looking at as many years of origin as possible in estimating reserves. It should be remembered that for most lines of business the claims outstanding should be relatively small after three years development, reducing the importance of estimating reserves for earlier years of origin.

Appendix 2 Description of the Method of Estimating Outstanding Claims Reserves Allowing Explicitly for Inflation

We firstly calculate the adjusted claims payments and construct an adjusted claims triangle:-

Year of Origin x	Year of Settlement y						Outstanding Claims	Total Claims
	1	2	3	4	5	6		
1	QA(1,1)	QA(1,2)	QA(1,3)	QA(1,4)	QA(1,5)	QA(1,6)	CA(1)	TA(1)
2	QA(2,1)	QA(2,2)	QA(2,3)	QA(2,4)	QA(2,5)		CA(2)	TA(2)
3	QA(3,1)	QA(3,2)	QA(3,3)	QA(3,4)			CA(3)	TA(3)
4	QA(4,1)	QA(4,2)	QA(4,3)				CA(4)	TA(4)
5	QA(5,1)	QA(5,2)					CA(5)	TA(5)
6	QA(6,1)						CA(6)	TA(6)

where $QA(x,y) = Q(x,y) \times \frac{I(n)}{I(x+y-1)}$, where n = number of years of development for year of origin 1.

$$CA(x) = \begin{cases} C(x) \times \left[\frac{I(n)}{I(n-1)} \right]^2 & \text{for liability lines} \\ C(x) \times \frac{I(n)}{I(n-1)} & \text{otherwise} \end{cases}$$

and I(b) represents the average RPI for year b.

The last column TA(x) is then defined by:-

$$TA(x) = \sum_{y=1}^n QA(x,y) + CA(x)$$

and the adjusted claims ratios are thus

$$RA(x,y) = QA(x,y)/TA(x)$$

These inflation adjusted ratios are then averaged to minimise the effect of random fluctuations and we arrive at:-

$$\underline{RA}(y) = \sum_{x=1}^{N(y)} RA(x,y)/(N(y) \times F)$$

where $F = \sum_{y=1}^n \underline{RA}(y)$ - a scaling factor to ensure the adjusted, average

run-off ratios sum to unity and,

$N(y)$ = no. of years of experience available depending on y .

$\underline{RA}(y)$ represent the inflation-free run-off ratios hypothesized above. We can now superimpose selected inflation assumptions in order to establish realistic run-off patterns which take account of the fluctuating inflation experience over the period of claims history used.

Our computer system allows the operator to select the assumed rates of inflation for the next year, the year following that and thereafter. As there is a delay of between six months and one year between the books being closed and our analysis being performed, for a variety of reasons, the inflation experience in the first year following the end year is fairly well established and the likely course of price escalation for the following year can be estimated with more confidence. We would argue that to specify varying annual assumptions thereafter would give a spurious degree of accuracy to the results. It should also be borne in mind that for the majority of the risk groups any reserves held at the year end in question will be, to a substantial degree, run off by the end of the next two years.

If we denote the three inflation assumptions, representing compound annual percentage rates of growth, as I_1 , I_2 and I_3 then we can construct inflation adjusted run-off ratios.

$$IA(1) = RA(1)/S$$

$$IA(2) = RA(2) \times (1 + I1/100)/S$$

$$IA(k) = RA(k) \times (1 + I1/100) \times (1 + I2/100) \times (1 + I3/100)^{k-3}/S$$

for $k \geq 3$

Where $S = \sum_{y=1}^n IA(y)$, a scaling factor.

We are now in a position to achieve the original objective which was to estimate, on the basis of each company's past experience, the reserving requirements at the year end under consideration for claims originated in the three latest years. The formulae are analogues of those in Appendix 1, namely:-

$$\text{Year 1 } ER(1) = Q(x+n-1, 1) \times (1/IA(1)-1)$$

$$\text{Year 2 } ER(2) = (Q(x+n-2, 1) \times \frac{I(n)}{I(n+1)} + Q(x+n-2, 2)) \times (1/IA(2)-1)$$

$$\text{Year 3 } ER(3) = (Q(x+n-3, 1) \times \frac{I(n-1)}{I(n+1)} + Q(x+n-3, 2) \times \frac{I(n)}{I(n+1)} + Q(x+n-3, 3))(1/IA(3)-1)$$