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PECUNIARY LOSS

REPORT OF THE WORKING PARTY ON

PECUNIARY LOSS INSURANCE

To be presented to the Institute of Actuaries General Insurance Convention, Llandrindod Wells, October, 1991.

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Introduction

In 1990 the pecuniary loss working party presented a paper to the General Insurance Convention which covered mortgage indemnity insurance. Several areas of possible further investigation were highlighted. This year the working party has endeavoured to pursue these, and to investigate other aspects of pecuniary loss insuance. In the event, only one aspect of mortgage indemnity has been pursued – that of building a model to assist in the pricing of and reserving for this type of business.

What constitutes pecuniary loss is not clearly defined. We have taken it to mean any insurances which mitigate financial loss – the inability to collect from one's debtors or the obligation to fulfill a guarantee or warranty. These do not necessarily fall into the DTI accounting class for miscellaneous financial loss, while we would not regard all business so classified as our province. For example consequential loss insurance would more sensibly be reviewed by a group looking at commercial fire.

Two other areas have also been investiaged this year. A report on creditor insurance has been prepared, which gives what we hope is a full introduction to this type of insurance. It covers both general descriptions of the business, and some more technical actuarial aspects. The last two subjects which have been tackled are trade indemnity and export credit insurance. The paper produced on this is also of an introductory type, and aims to familiarise readers unfamiliar with these covers both of the nature of the risks covered and the products available to meet them, and also of the actuarial challenges which are likely to be met.

The working party split into a number of subgroups to tackle these different aspects. The work on mortgage indemnity was coordinated by Julian Leigh, that on creditor by Graham Masters, and the trade papers were prepared by Paul Delbridge and Bryan Joseph. By and large, members worked independently on their aspects of the papers, and the working party held few meetings.

One item which is common to all three areas discussed is the relationship which exists between claims experience and various aspects of the economic cycle. This raises significant problems when reserving, since the reserves required for an insurer to withstand extremes of claims experience may be many times those financed by a risk premium based on expected losses. This aspect is examined in the mortgage indemnity paper. A possible solution is based on equalisation reserves, which are now needed for trade indemnity policies, and covered in that paper. Further work in that area will be of benefit to insurers of pecuniary losses.

Other areas of pecuniary loss which we were not able to tackle include motor and appliance warranty business. The convention may wish to consider establishing a working party to look into these aspects next year.

13th September, 1991

Modelling Mortgage Indemnity Insurance

The claim rates for mortgage indemnity insurance depend heavily on general economic variables. While there may be such a correlation in other types of insurance (for example arson tend to become more common in economic downturns) it is unusual for the performance of an insurance line to be quite so intimately linked with economic aggregates. The most notable field in which similar problems have had to be faced is reserving for maturity guarantees for unit linked life policies.

The Institute's working party on that subject [1] favoured a stochastic approach. Their main suggestion was that reserves should be established which were sufficient, according to a stochastic model of an insurer's portfolio, to produce a ruin probability which was considered acceptable. While this could be eroded, if the erosion reached a critical point, reserves would have to be strengthened. This is now the main method used to reserve for maturity guarantees.

A similar approach may be taken to mortgage indemnity. The design of the insurance is simple enough to lend itself to modelling, and a stochastic model is simple and runs quickly. The approach may be used either for reserving or as a guide to premium rating. The problem lies in setting parameters.

The basic model which was constructed was written in Microsoft Quick C, and run on an Amstrad 3286 microcomputer. The main programme, which tests six different values of loans on one property, using twenty thousand simulations of up to three hundred months each, took just over six hours to run. A copy of the programme for this run is shown as appendix A.

There are four sets of parameters to choose. These are interest rates, house price movements, inflation rates, and movements into and out of arrears.

For interest rates and house price movements, the Building Societies Association publish regular statistics, and have done since the 1950's. For a record of a longer period we are indebted to a certain insurance group. Requiring this information for research on a different product, it commissioned research on average house price movements and mortgage interest rates for each year since 1918. The result of this was an index of annual values of house prices from 1918 to 1989, and a record of the mortgage interest rate in that year (or an average value for years when it was not controlled). This information was made available to us, and we gratefully acknowledge this assistance.

For the simulation itself, in each year of each run we select a year at random from the 72 available. The monthly interest rate from that year is taken as the interest rate for each month in that year of the simulation. The interest rate earned on insurance assets and the general inflation rate at that time are both taken as three quarters of the mortgage interest rate. For house price inflation in that year we take the selected year's house price inflation, again converted to a monthly rate.

It may be that the taking of successive years at random is antirealistic, and that there might be found, on analysis of the data, to be a cyclical pattern involved. We have not pursued this, nor is it clear whether the effect would be to reduce claims because no set of unpropitious circumstances can go on for ever, or to increase them since there will always be regular downturns.

These figures were given to us in confidence, and we are not able to publish them. However, it is absolutely clear that interest rates and house price movements have been generally much higher in the last 25 years or so than in the preceding decades. It is tempting to conclude that conditions have changed so much that what went before is irrelevant, and may be discarded. It is probably unjustifiably arrogant to assume that the conditions to which we have become used

[1] JIA vol 107 II, no 435, January 1980.

in the last decade are the only ones which may henceforward be encountered. On the other hand, when there has been so notable a change sustained for so long recent years must have special influence. Therefore we have run alternative runs of the model, selecting data from only the last 25 years, and from only the years before that.

The other important parameter set is the probabilities of mortgagors moving between various stages of arrears. Obviously, all mortgages start with the mortgagor being up to date with payments. Each month, he may remain in that category, repay his mortgage entirely, or go one month into arrears. If in arrears, he may repay his arrears and become up to date, remain in arrears, becoming one more month in arrears, repay the mortgage in its entirety, repay some of his arrears, so becoming fewer months in arrears, or the mortgage may be terminated by foreclosure.

This position is very complicated, and certain simplifying assumptions were made. These related to the behaviour of those in arrears. It was assumed that they either went one more month in arrears, repaid their mortgage entirely, or repaid their arrears entirely. In addition, it was assumed that the probabilities associated with these various possibilities did not depend on the period of arrears so far accumulated. With these simplifying assumptions, the probability structure is that of a Markov chain with three states – being up to date, being in arrears, and the mortgage terminating. A further simplifying assumption we made was that mortgages were foreclosed after a set period of arrears. To have assumed a probabilistic foreclosure process would probably have complicated the model more that it would have illuminated the results.

We assumed that delinquent mortgagors were proceeded against after eight months of arrears. In practice, this is probably as short a period as any now in use. Different mortgagees have different policies, greater or lesser amounts of leniency will be exercised in different cases depending on how likely a mortgagor looks to get out of his difficulties himself if given time, and different magistrates' benches are more or less ready than others to give repossession orders when requested by a mortgagee. It is not obvious what effect greater forebearance will have on claims – if it reduces the number by allowing more delinquent mortgagors eventually to get up to date with their payments then it will reduce claim numbers, but in every case where it fails, the claim will be higher. It is far from unknown for repossession to take place two or three years after arrears commenced.

In practice, it has often been observed that mortgagors with very high loan to value ratios have rather greater rates of delinquency than others. We did not have data of this form to model, but it is undoubtedly something which affects the insurance. This will be especially important in a time of generally depressed house prices, when current loan to value ratios generally will rise, and so may the propensity to go into arrears.

Actual values for these parameters were supplied by a major underwriter of this class of business, and compiled through their relationships with a number of bulding societies.

The remaining items of data are house values, mortgage sizes and expense costs. Since what matters is the relative sizes of these, we assumed a constant property value of £100,000 at the start of each simulation. Mortgage sizes were considered from £75,000 to £100,000. It was also assumed that the fixed costs of repossession were £2500 each time. Proper consideration of this aspect would justify taking a range of property sizes. However, we considered this an unjustifiable refinement. While there are costs involved which are fixed in monetary terms (although subject to inflation), others such as agency fees are still proportional to the sale value of the property.

On forced sale, it was assumed that the property would be realised for 90% of its value, as inflated by the years since the mortgage began. The reduction is to reflect the depressed price which repossesed properties tend to fetch, as well as costs of sale which are proportional to sale price. From this is deducted the fixed costs – £2,500 increased for inflation. The mortgage to be cleared is equal to the original amount borrowed, plus interest for eight months, the period

of arrears which has been built up. The amount of the claim to the mortgage indemnity policy is the mortgage plus these arrears, less the net amount realised for the property after expenses.

Expected claims

The original run produced the following results.

Initial mortgage	No of repossessions	No of claims	Total claims	Mean Claim	P'pn claims to repos	Premium Rate
£75,000	1366	16	£68,427	£4,277	1.2%	inf
£80,000	1329	39	£218,214	£5,595	2.9%	0.2%
£85,000	1379	96	£627,748	£6,539	7.0%	0.3%
£90,000	1305	174	£1,179,088	£6,776	13.3%	0.4%
£95,000	1265	295	£2,782,604	£9,433	23.3%	0.7%
£100,000	1335	406	£4,288,345	£10,562	30.4%	0.9%

Note: the "premium rate" is equal to the total claims, divided by 20,000 (the number of simulations), divided by (the initial advance minus £75,000).

That the number of repossessions does not depend on the amount of the initial mortgage is not surprising. The probabilities of mortgagors moving from category to category which were used did not depend on the loan to value ratio. Therefore the proportion which should end in repossession should not do so. The number of repossessions out of 20,000 simulations should have approximately a poisson distribution, and the results seem to be consistent with this.

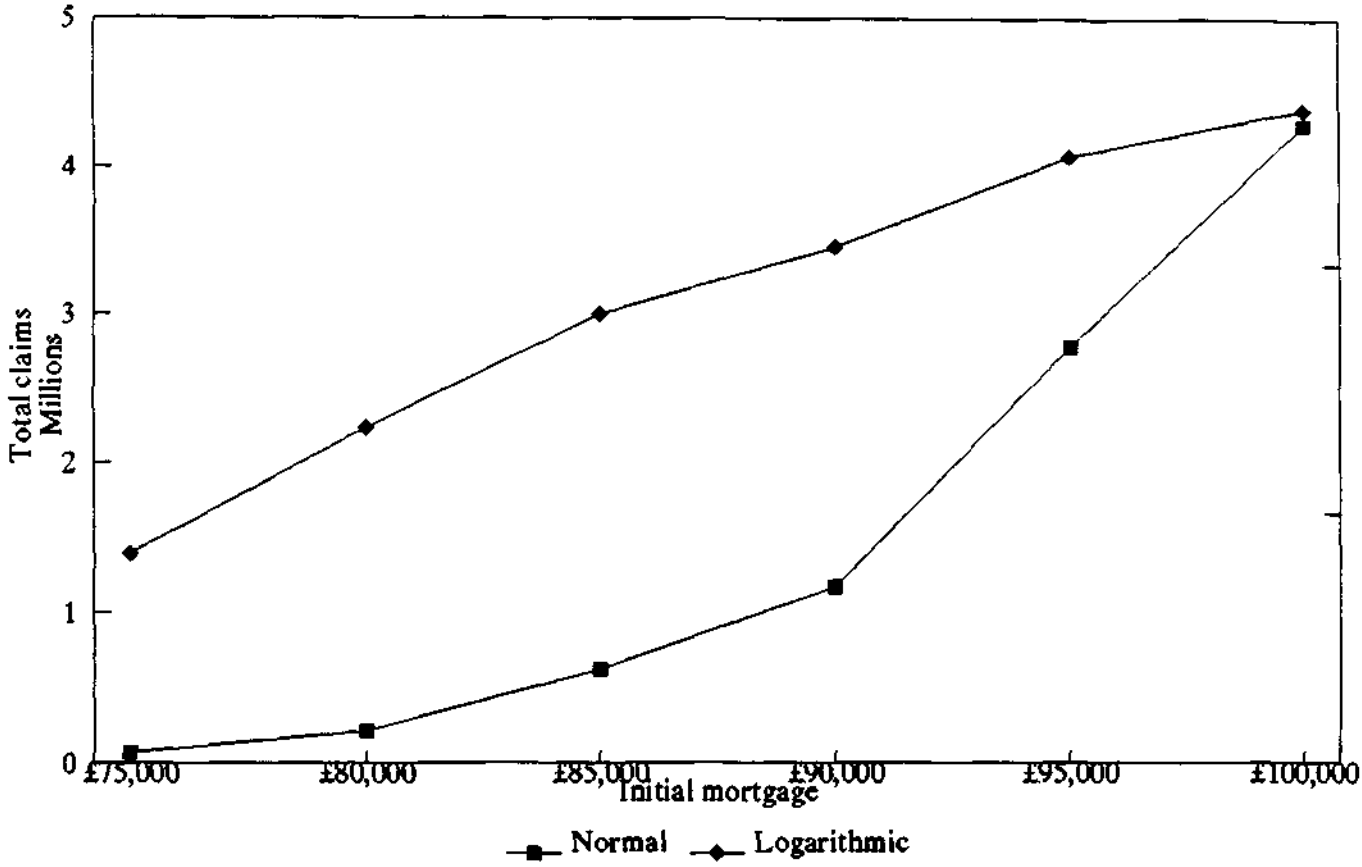
The level of claims shown seems to be at a much lower level than insurers have been reporting recently. This casts some doubt on the model and the parameters, but current experience is among the worst ever suffered, and the model should produce average results. Another observation made by people active in the field is that average claims tend to be roughly equal to the sum assured (i.e. the excess of the mortgage over £75,000) plus one third. This also is not borne out by the model.

In order for a claim to occur, a property's value at repossession must be insufficient to pay for the mortgage plus costs. Therefore we should expect rising numbers of claims with higher mortgages, and a higher proportion of repossessions to end in claims. Both these conditions are found.

The graph of total claims against the initial mortgage is shown below. The relationship is shown both linearly (left hand scale) and logarithmically.

There appears to be a strong relationship between the initial mortgage and the total cost. It is also apparent that the logarithmic function better explains the relationship than the linear. There does appear to be some reduction in the gradient of the logarithmic line as it nears £100,000, but it is far from clear whether this is within the variation to be expected, or whether it casts doubt upon the exponential nature of the relationship.

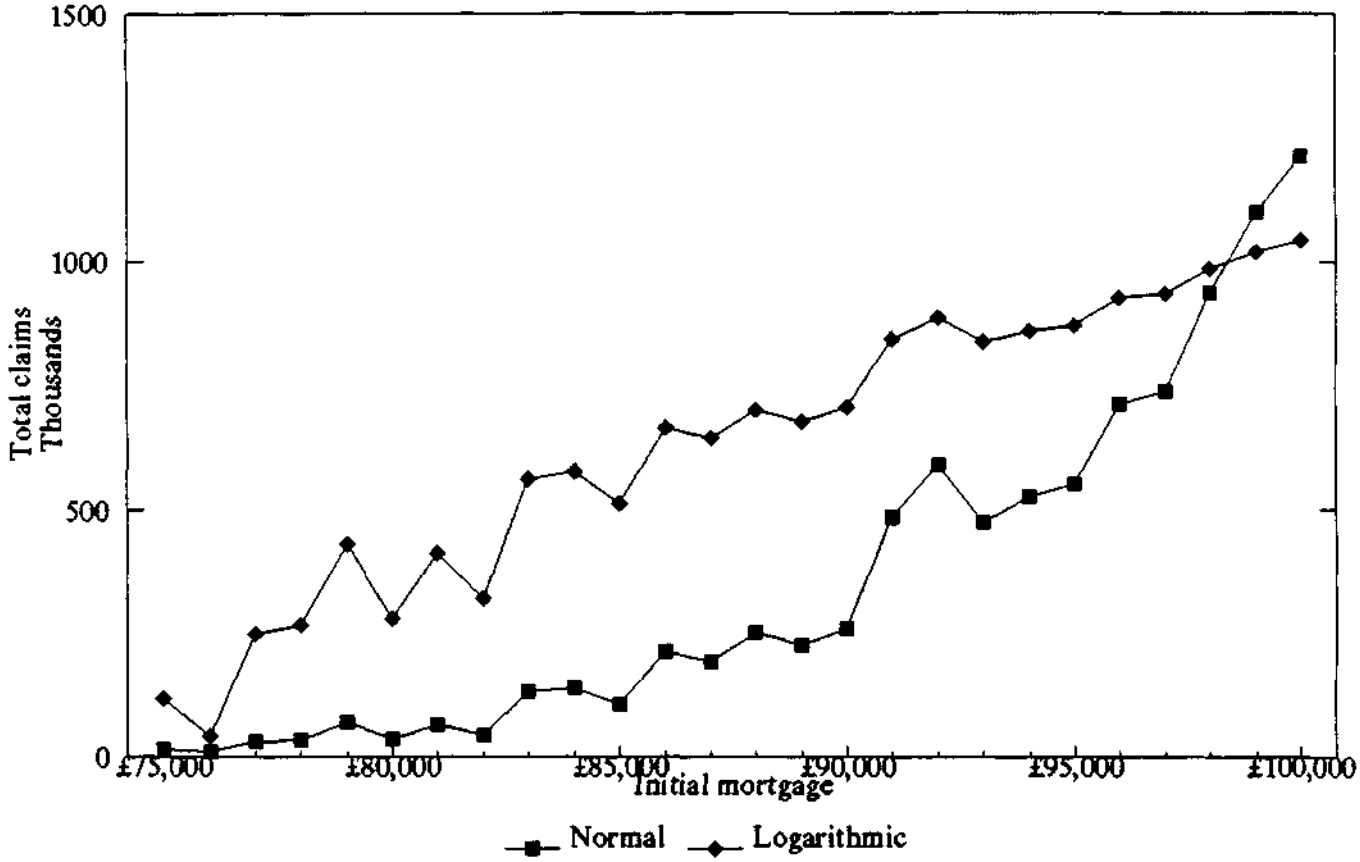
Almost no claims are shown for £75,000 mortgages. This seems to confirm the sense of this as a starting point for many lenders requiring this insurance. Of course, with any claims at all, the premium rate, based on the excess of a mortgage over 75%, will be infinite. However, it appears that the model's results do suggest an increasing premium rate with the loan to value ratio, as several U.K. insurers have introduced in recent years. It should be remembered that this result has arisen without any allowance in the parameters for a high ratio being associated with a high tendency to default, as has been noted by several market observers.



In order to test these apparent relationships, a further set of simulations was run, on the same parameters. These each consisted of 5,000 simulations, on mortgages of £75,000 to £100,000, in steps of £1,000. The results were:

Initial mortgage	No of repossessions	No of claims	Total claims	Mean Claim	P'pn claims to repos	Premium Rate
£75,000	345	5	£17,296	£3,459	1.4%	inf
£76,000	340	5	£12,188	£2,438	1.5%	0.2%
£77,000	337	5	£31,328	£6,266	1.5%	0.3%
£78,000	344	5	£34,235	£6,847	1.5%	0.2%
£79,000	364	11	£71,876	£6,534	3.0%	0.4%
£80,000	334	8	£36,193	£4,524	2.4%	0.1%
£81,000	311	14	£66,110	£4,722	4.5%	0.2%
£82,000	320	13	£44,112	£3,393	4.1%	0.1%
£83,000	358	19	£131,655	£6,929	5.3%	0.3%
£84,000	341	23	£141,884	£6,169	6.7%	0.3%
£85,000	348	18	£106,125	£5,896	5.2%	0.2%
£86,000	332	34	£213,045	£6,266	10.2%	0.4%
£87,000	344	34	£192,726	£5,668	9.9%	0.3%
£88,000	312	34	£251,741	£7,404	10.9%	0.4%
£89,000	319	32	£224,932	£7,029	10.0%	0.3%
£90,000	330	40	£258,086	£6,452	12.1%	0.3%
£91,000	321	60	£482,682	£8,045	18.7%	0.6%
£92,000	318	59	£590,451	£10,008	18.6%	0.7%
£93,000	310	62	£472,996	£7,629	20.0%	0.5%
£94,000	316	57	£524,184	£9,196	18.0%	0.6%
£95,000	322	79	£551,458	£6,980	24.5%	0.6%
£96,000	328	72	£712,618	£9,897	22.0%	0.7%
£97,000	355	97	£739,715	£7,626	27.3%	0.7%
£98,000	330	94	£936,767	£9,966	28.5%	0.8%
£99,000	319	94	£1,100,312	£11,705	29.5%	0.9%
£100,000	344	107	£1,213,607	£11,342	31.1%	1.0%

The equivalent graph to the above is:



Again, the logarithmic graph does seem to be a more linear realtionship, but it looks as if the error term is heteroscedastic. If we fit curves using least squares the results are as follows:

Logarithmic fitting		Linear fitting
−2.83127	Constant term	(£3,357,652)
0.31056	Standard error	£140,309
0.17073	Coefficient	42399
0.00812	Standard error	3669
0.9485	R squared	0.8477

All the fitted terms are clearly significant, and the R squareds are high. The fitted values are:

Linear fitting

Initial mortgage	Fitted value	Simulated value	Error
£75,000	(£177,742)	£17,296	(£195,038)
£76,000	(£135,343)	£12,188	(£147,531)
£77,000	(£92,944)	£31,328	(£124,273)
£78,000	(£50,546)	£34,235	(£84,780)
£79,000	(£8,147)	£71,876	(£80,022)
£80,000	£34,252	£36,193	(£1,941)
£81,000	£76,651	£66,110	£10,541
£82,000	£119,050	£44,112	£74,938
£83,000	£161,448	£131,655	£29,793
£84,000	£203,847	£141,884	£61,964
£85,000	£246,246	£106,125	£140,121
£86,000	£288,645	£213,045	£75,600
£87,000	£331,044	£192,726	£138,317
£88,000	£373,442	£251,741	£121,702
£89,000	£415,841	£224,932	£190,909
£90,000	£458,240	£258,086	£200,154
£91,000	£500,639	£482,682	£17,957
£92,000	£543,038	£590,451	(£47,413)

£93,000	£585,436	£472,996	£112,441
£94,000	£627,835	£524,184	£103,651
£95,000	£670,234	£551,458	£118,776
£96,000	£712,633	£712,618	£15
£97,000	£755,032	£739,715	£15,317
£98,000	£797,430	£936,767	(£139,337)
£99,000	£839,829	£1,100,312	(£260,483)
£100,000	£882,228	£1,213,607	(£331,379)

Logarithmic fitting

Initial mortgage	Fitted value	Simulated value	Error
£75,000	9.974	9.758	0.216
£76,000	10.145	9.408	0.736
£77,000	10.315	10.352	−0.037
£78,000	10.486	10.441	0.045
£79,000	10.657	11.183	−0.526
£80,000	10.828	10.497	0.331
£81,000	10.998	11.099	−0.101
£82,000	11.169	10.694	0.474
£83,000	11.340	11.788	−0.448
£84,000	11.510	11.863	−0.352
£85,000	11.681	11.572	0.109
£86,000	11.852	12.269	−0.417
£87,000	12.023	12.169	−0.146
£88,000	12.193	12.436	−0.243
£89,000	12.364	12.324	0.041
£90,000	12.535	12.461	0.074
£91,000	12.706	13.087	−0.382
£92,000	12.876	13.289	−0.412
£93,000	13.047	13.067	−0.020
£94,000	13.218	13.170	0.048
£95,000	13.389	13.220	0.168
£96,000	13.559	13.477	0.083
£97,000	13.730	13.514	0.216
£98,000	13.901	13.750	0.151
£99,000	14.071	13.911	0.160
£100,000	14.242	14.009	0.233

The linear fitting is clearly poor – with one exception all negative deviations are concentrated at one end or other of the sample. Applying the runs test gives a test value of 3.09 standard deviations from the expected value, which is clearly significant. (There are five runs, compared with 12.3 expected, and standard deviation of 2.35.) The exponential curve has thirteen runs, almost as close as possible to the expected value, although a run of seven positive deviations at the end suggests that it may not be quite such a good fit over this part of the range.

Testing for heteroscedasticity is ambiguous. There does seem to be a general reduction in the size of differences as the initial mortgage increases. However, the tendency is not very clear, and an attempt to correct for it made little difference. It is not clear whether it is a quirk of the results or something fundamental to the model.

If this is an appropriate model, then we have the relationship that

$$\text{Expected claims} = A * B^{\text{loan to value ratio}} \quad \text{with } B>1, \text{ and A depending on initial value.}$$

The pure premium rate will properly increase with the loan to value ratio (LTV), as is now normal. However, it is not clear that the risk disappears at some particular low LTV – indeed even if the

relationship specified were correct beyond the limits of the LTVs examined, it would still not do so. Therefore, the use of (loan – value * .75) as the rating factor is not appropriate. Even so, it does appear that a premium rate based on this factor was tending towards zero as did the factor. On this basis, the current normal structure of premium rates based on this factor, increasing in steps with the LTV, seems to be as good an approximation to a correct structure as we are likely to be able to specify for practical use.

Sensitivity analysis

Three alternative runs were made on the following bases:

- Using mortgage rates and price movements only from the first 45 years.
- Using mortgage rates and price movements only from the last 25 years.
- Allowing variations in house prices from the average movements. Specifically it was assumed that a price varies normally from average with a standard deviation of 7½% in the first year, increasing exponentially to 22½% after fifteen years.

The results were (20,000 simulations each, except for the last one – 10,000 each,and the results doubled):

Total claims

Initial mortgage	Main run	Early years	Late years	Variable prices
£75,000	£68,427	£342,591	£0	£230,398
£80,000	£218,214	£682,124	£0	
£85,000	£627,748	£1,892,012	£23,676	
£90,000	£1,179,088	£3,155,242	£143,135	
£95,000	£2,782,604	£4,952,161	£623,422	
£100,000	£4,288,345	£7,252,844	£1,356,178	£5,653,448

Number of claims

Initial mortgage	Main run	Early years	Late years	Variable prices
£75,000	16	66	0	1328
£80,000	39	99	0	
£85,000	96	247	11	
£90,000	174	325	53	
£95,000	295	450	124	
£100,000	406	571	192	1318

It is quite contrary to experience that the more recent years should have produced fewer claims and a much smaller claims cost than previous years. Certainly it is possible that the later years suffer from not including the last two years in the data, when house prices have fallen significantly, especially on forced sale. However, if this is the case, it would throw grave doubt on the whole model, which should not be unduly sensitive to the inclusion or omission of two years out of seventy. In the later period, the average annual rise in house prices was about 2½ times the average annual rise in the first period, and this is probably the key to the result. If so, it suggests that the reason insurers have recently begun to suffer much heavier losses lies only partly in the behaviour of house prices. There has certainly been a substantial change in the behaviour of insured borrowers. This is not an unlikely hypothesis. In the early 1980's the whole attitude to mortgage financed buying of houses changed. Lenders became more competitive and more willing to offer high LTV loans, meaning that there were far more high risk exposures on these insurances than before. Also, the widespread sale of coucil houses to their former tenants meant that mortgage borrowing became much more common among socio

economic groups which had hitherto given rise to only a little exposure. It may be that the recent combination of a very sharp increase in mortgage interest rates following on a time of exceptional boom in house prices in which the view became common that house prices were always going to show large rises, so that rational behaviour was always to take on the maximum mortgage affordable, provided a uniquely pernicious set of circumstances for mortgage defaults.

That extra variation in house prices produces much higher claims for low LTV is no surprise – since there are very few claims anyway, introducing extra variation will reduce the value of some properties and cause them to give rise to claims, while there were few that were claims to begin with which might be reduced. It is notable that on the higher LTV (only two were tested), the increase in claims on the model with random variations was far less.

Reserving

The work of the maturity guarantees working party has already been mentioned. However, the situation it covered differed from the one currently being investigated in several ways:

- that party was investigating reserving only; we have attempted also to examine pricing.
- with maturity guarantees the only stochastic variation was in the likely movement of unit prices; with mortgage indemnity we have also a variation in the timing and number of claims.

The first of these differences is not fundamental – the model derived for maturity guarantees could also be used – and no doubt has been used – to shed light on pricing. The second is more important. The maturity of a policy is the event which may give rise to the calling in of a guarantee, which may happen only on a simgle known date. Withdrawals, including deaths, may happen before then, so the probability is less than one of the event actually occuring, but at least only one date needs to be examined for each policy.

The reverse is true with mortgage indemnity. Not only do few mortgages last to maturity, making it ridiculous to ignore early withdrawals, but since claims occur on particular early withdrawals it would entirely defeat the object of the exercise. Also, the reason for using simulation rather than the more normal deterministic expected value techniques more usual in reserving is that all policies are subject to the same economic conditions, and in order to reserve with a high degree of confidence that reserves will be sufficient, it is necessary to examine explicitly the extremes of the distribution of outcomes. However, our model as constructed so far does not link the economic parameters with the behavioural. This is undoubtedly a weakness – it is perfectly clear from present experience that high interest rates, or possibly more exactly sharp increases in interest rates, lead to a higher incidence of repossessions.

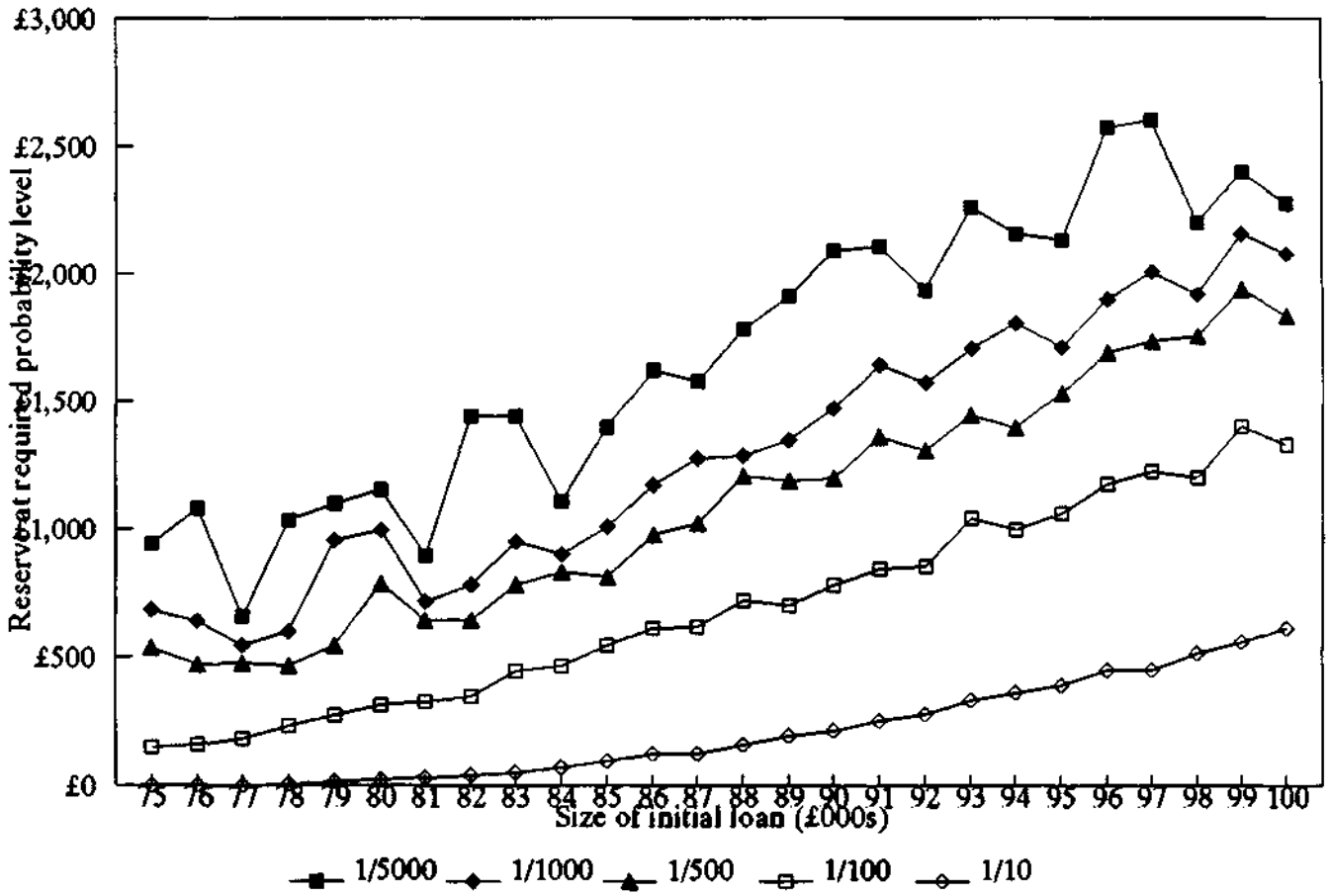
To pursue this problem is beyond our present resources. It is still appropriate to investigate the reserving implications of the model as it has been specified. This involves individual policyholders whose propensity to claim on their policies is independant both of each other and of the economic environment. (In this sense, "claim" refers to the repossession which may give rise to a claim, even if there is no amount payable.) In this situation we may use a deterministic sequence of claim rates through the twenty five years of a mortgage, and simulate only the economic factors which produce the payment amounts in the event of claims. If this were actually used as a basis for reserving, we would be able to introduce a safety margin into claim rates. However, this is not as simple as it appears. If we merely use a higher rate of moving into arrears, we may reduce the exposed to risk at a later period, in which the payments on a claim might tend to be higher. What we have done is generate the probability of a repossession at each month of the mortgage, using the parameters used above. These probabilities do not add up to 1, since most mortgages do not end in repossession. If a safety margin were required, these probabilities could all be increased, without any danger of reducing projected repossessions at any other term of the mortgage.

If we do this for a large number of simulated economic progressions, then what we get is not a distribution of amounts of claims, but a distribution of average claim amounts for a large number

of similar policies over the simulated range of economic environments. This simulation was performed for the same initial conditions as the rating simulation, with 5000 simulations at each mortgage amount in £000s from £75,000 to £100,000. The graph of the results is reproduced below. The line marked 1/100, for example is the 1st percentile at each level, or the fiftieth worst result out of the five thousand.

The results do appear to the eye to be more or less linear with the initial mortgage, although as one would expect, there is more random variation at the more extreme levels of probability. A linear regression gives successive values for R^2 of 89.8%, 95.4%, 97.0%, 98.4% and 93.2%. It is not clear why the 10% level should give a worse fit, though examining the graph visually its line does have a suggestion of an exponential progression about it. However, all five lines have worse fits for a logarithmic regression.

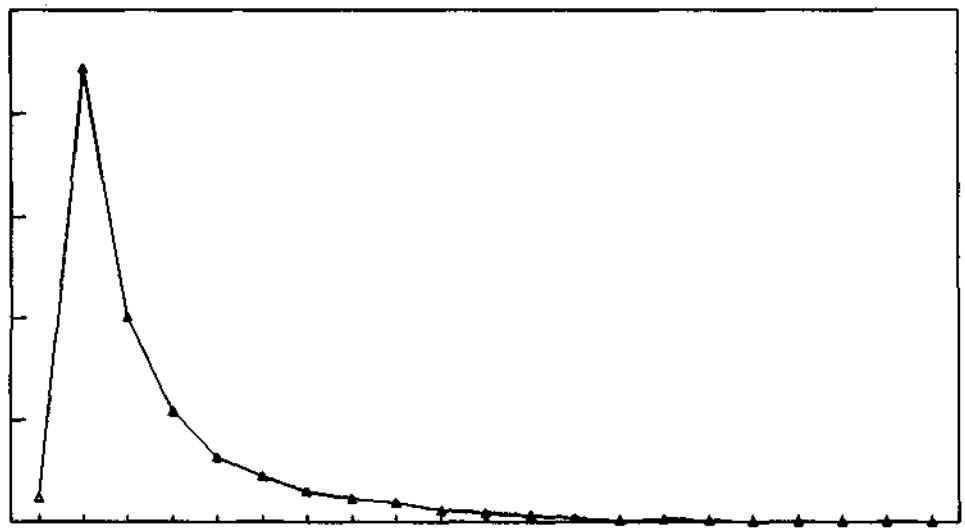
Not unnaturally, all the higher quantiles examined have much higher values than the corresponding expected value. The ratio decreases with the mortgage size, so that the 1/1000 reserve level divided by expected claims falls from 128 at £75,000, through 64 at £80,000, 30 at £85,000, 21 at £90,000, and 12 at £95,000 to 9 at £100,000.



The maturity guarantee working party proposed an initial level of reserves which corresponded to a ruin probability of 1%. However, this was a proxy for a reserve which gave a ruin probability of one thousandth but which incorporated a margin for withdrawals. One thousandth would probably be regarded as a more acceptable level of ruin probability by most actuaries and regulators. The following table shows the pure premium rate required according to the logarithmic fit derived above, expressed in the conventional form of a percentage of the excess of the mortgage over 75% of the property value, and the required reserve at the 1/1000 level taken from the regressed results of the later simulation, expressed in the same form. Their quotient is also shown. It should be noted that the quotient does not depend on the manner of expressing the premium rate.

Initial mortgage	Premium Rate	Required Reserve	Reserve + premium
£75,000	inf	inf	–
£76,000	0.5%	55.5%	109
£77,000	0.3%	31.0%	103
£78,000	0.2%	22.8%	96
£79,000	0.2%	18.8%	88
£80,000	0.2%	16.3%	81
£81,000	0.2%	14.7%	74
£82,000	0.2%	13.5%	67
£83,000	0.2%	12.6%	60
£84,000	0.2%	12.0%	54
£85,000	0.2%	11.4%	48
£86,000	0.3%	11.0%	43
£87,000	0.3%	10.6%	38
£88,000	0.3%	10.3%	34
£89,000	0.3%	10.0%	30
£90,000	0.4%	9.8%	26
£91,000	0.4%	9.6%	23
£92,000	0.5%	9.4%	20
£93,000	0.5%	9.2%	18
£94,000	0.6%	9.1%	16
£95,000	0.7%	9.0%	14
£96,000	0.7%	8.8%	12
£97,000	0.8%	8.7%	10
£98,000	0.9%	8.6%	9
£99,000	1.1%	8.5%	8
£100,000	1.2%	8.5%	7

That the quotient falls sharply over the range shown should come as no surprise. A 100% mortgage will give rise to a positive claim if repossession is immediate. Therefore the extreme values will be simply the extremes of a distribution in which positive values are usual; the 75% mortgage gives rise to only a very few positive cases, and the extremes are more extreme. All claim size distributions are very highly skewed. The graph for the least skewed, that for the 100% mortgage, is shown below. (The divisions are one twentieth of the highest recorded value.)



To reserve on this basis is clearly not viable. The original simulations suggested that the present value of payments was about 87% to 88% of their undiscounted amount, and the mean term of mortgages was about seven years. To achieve an acceptable risk rate of return on the capital required to establish a reserve of ten times the risk premium (as shown above for a 97%

mortgage), would require a profit loading of about 500%. (This assumes a risk premium of 10% of capital above the riskless return, and thus a profit each year equal to the risk premium, discounted to the present.) With lower mortgages the loading will rise sharply. However, if reserving is not done on this basis, acceptable levels of ruin probability will not be achieved. It should be recalled that while the existence of other lines of business may reduce overall ruin probability, increasing quantities of this type of business do not.

Reserves will also be required for policies at each stage of their existence. For a policy which is up to date, there is no conceptual difficulty whatsoever – the process simply needs to be repeated with a property value equal to the latest valuation, and a newly generated set of repossession probabilities. For policies already in arrears, there is clearly a higher probability of repossession in the immediate future, and it might also be found that a mortgagor who had once been in arrears had a greater probability of being repossessed than one who had never been. Probably the best approach would be to use a common table of repossession which took no account of the current condition of the mortgage. In an analagous case, a life company does not value life policies according to the health of each assured life. This also has the advantage of not requiring information from mortgagees about the condition of each mortgage. The main problem is likely to be getting sensible estimates of the value of each property.

If a valuation of business in force shows reserves held to be excessive or inadequate, they may be released or strengthened as appropriate. The maturity guarantees working party suggested that if ruin probabilities equivalent to 1/2500 or 1/100 were reached, reserves could be released or should be required to restore a 1/1000 probability. Naturally, if a mortgage terminates, its reserve could be released.

Conclusion

The model has suggested that while the current premium structure is wrong in theory, it is a reasonably close approximation to what is theoreticaly required. This appears to be a premium which increases exponentially with the loan to value ratio, although fixed costs would make the relationship slightly different with every absolute size of loan. To ensure a suitably low probability of ruin, reserves will be required which may make the premium unviable. This suggests that either a redesigned product might be needed, or that a more desirable alternative would be based on an equalisation reserve.

Reference has been made throughout this note to the Maturity Guarantees Working Party. The problem faced has been similar. However, this party has covered only a small proportion of the ground that that party covered. It is a relatively simple matter to construct and run models, and to draw inferences from them. The choice of parameters which would produce appropriate results from which valuable inferences may be drawn is the largest part of the battle. We believe that the parameters we have used have been as good as any which could be presently available. Even so, the losses they have generated have been well below recent experience, which is admittedly only a couple of years out of a great many when this product has been available. This underlines the fact that the following important questions have been begged, or at least put into the "too hard" file:

- Is it better to use actual past years as economic data, or to develop a model of how economic variables may move?
- How are the economic and the behavioural variables inter–related.?
- Is it necessary to allow for variations between individual property ?
- How is the propensity to go into arrears related to the loan to value ratio?
- To what extent have the changes in the mortgage market in the 1980's reduced the past's appropriateness as a projection basis for the future? (Wider home ownership, competition to lend by mortgagees.)
- To what extent have changes in the economic climate since about the mid–1960's been permanent? In particular, is greater volatility, as well as simply higher levels of interest rates and inflation, permanent?
- How much does the mortgagee's dicretion in dealing with a mortgagor in arrears,

affect the parameters, and can this sensibly be modelled?

- Do demographic trends and planning laws make a probabilistic approach to house prices inappropriate?

We hope that our model has shown how results may vary in this type of insurance, and how pricing and reserving might scientifically be carried out. However, we are aware, and anybody reading this paper should be aware, that these questions, which will be hard to answer, must be answered before a model of this type could actually be used as a basis for pricing or reserving.

We wish to acknowledge our debt to the insurers who have made available to us the data from which we were able to construct parameters, both of whom have asked to remain anonymous.

APPENDIX A

```
#include <stdio.h>
void simlate(int numsim,float valer,float lown,float costz,double morat[71],double housinf[71],float mprobs[4][4][25]);
main ()
{     int n,n1,n2,netgro=0;
      unsigned houspri[72];
      int rand(void);
      double pow(double,double);
      double totgro=0.0,twlfth=1.0/12.0,housinf[71],morrat[71];
      float moves2[4][4][25],mor[71];
      FILE *moves2f,*housef;
      if((housef=fopen("c:\\pecios\\houses.dat","r"))!=NULL)
      {     for(n=1;n<=71;n=n+1)fscanf(housef,"%u\n",&houspri[n]);
            for(n=1;n<=70;n=n+1)fscanf(housef,"%f\n",&mor[n]);}
      for(n=1;n<=70;n=n+1)
            {housinf[n] = pow((double)houspri[n+1]/(double)houspri[n],twlfth)-1;
            morrat[n]=pow(1.0+(double)mor[n],twlfth)-1.0;
            }
      if((moves2f=fopen("c:\\pecios\\moves2f.dat","r"))!=NULL)
      {     for(n=0;n<=24;n=n+1)fscanf(moves2f,"%f\n",&moves2[1][2][n]);
            for(n=0;n<=24;n=n+1)fscanf(moves2f,"%f\n",&moves2[1][3][n]);
            for(n=0;n<=24;n=n+1)fscanf(moves2f,"%f\n",&moves2[3][2][n]);
            for(n=0;n<=24;n=n+1)fscanf(moves2f,"%f\n",&moves2[2][3][n]);
            for(n=0;n<=24;n=n+1)
                  {moves2[1][2][n]=moves2[1][2][n]/12.0;
                  moves2[1][3][n]=moves2[1][3][n]/12.0;
                  moves2[3][2][n]=moves2[3][2][n]/12.0;
                  moves2[2][3][n]=moves2[2][3][n]/12.0;
                  moves2[2][2][n]=1.0-moves2[1][2][n]-moves2[3][2][n];
                  moves2[3][3][n]=1.0-moves2[1][3][n]-moves2[2][3][n];}
            }
      fclose(moves2f);
      printf("Monthly probabilities of changing state:\nFrom up to date with payments  From being in arrears\nTo repayment  To arrears  To repayment  To up to date\n");
      for(n1=0;n1<=24;n1=n1+1)printf("%2.4f  %2.4f  %2.4f  %2.4f\n",moves2[1][2][n1],moves2[3][2][n1],moves2[1][2][n1],moves2[2][3][n1]);
      printf("\n");
      for(n=0;n<=25;n=n+5)
            simlate(20000,100000.0,75000.0+1000.0*n,2500.0,morrat,housinf,moves2);
}

void simlate(int numsim,float valer,float lown,float costz,double morat[71],double housinf[71],float mprobs[4][4][25])
      {int numco=0,n1,no[4]={0,0,0,0},nn,posyr[26]={0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0},
      float totcos=0.0,totprco=0.0,nomo[4]={0.0,0.0,0.0,0.0},totcst[26],totpc[26],t=0.0,worst[11]={t,t,t,t,t,t,t,t,t,t,t};
      printf("Results of %i simulations of the following:\n",numsim);
      printf("    Starting value %10.0f\n",valer);
      printf("    Loan amount %10.0f\n",lown);
      printf("    Fixed costs %9.0f\n",costz);
      printf("Houses are repossesed after eight months of arrears\n");
      for(n1=1;n1<=numsim;n1=n1+1)
            {float value=valer,loan=lown,costs=costz,prv=1.0;
            int yr=0,mo=0,arrs=2,arrs1,arrmo=0;
            while(yr<25 && arrs>1)
                  {int ymr,random,movn;
                  float claim,inflat,move;
                  yr=yr+1;
```

* Houspri is an array which contains the house price
* index values. Mor is an array which contains the
* mortgage interest rates for the same years. This part of
* the programme reads them in from a file, and converts
* them to monthly interest rates and house price inflation
* rates.

* Moves2 is an array of probabilities of a mortgagor moving from one arrears position to
* another. The positions are 1 – the mortgage is repaid; 2 – the mortgagor is up to date with
* payments; 3 – the mortgagor is in arrears. Moves2[x][y][z] is the probability in year z of the
* mortgage (z=0,1,...,25) that a mortgagor in category y will move into category x. This part of
* the programme reads in from a file the probabilities of movement (i.e. x<>y), computes the
* probabilities of not moving (x=y) and converts them to monthly rather than annual
* probabilities.

* Simlate is a subrouting which actually performs the required simulations.

* The parameters in the head of simlate are respectively: the number of simulations; the initial value of the
* property; the amount of the mortgage; the amount of fixed costs on a foreclosure; the array of mortgage
* interest rates; the array of house price inflation rates; and the array of probabilities of a mortgagor moving
* between states.

```
            yrnr=70.0*rand()/32767.0+1;                    * This line chooses a year of data to use as this year's economic conditions.  Note that in C the
            mo=0;                                          * rand() function produces a random integer between 0 and 32767.
            while(mo<12 && arrs>1)
                 {mo=mo+1;
                 prv=prv*(1+morat[yrnr]*.75);              * Each month we update prv (present value factor), value (the value of the propert), and the fixed costs of repossessing
                 value=value*(1+housrf[yrnr]);             * the property.  Note that the general rate of inflation and the discount rate appropriate for the insurer are both taken as
                 costs=costs*(1+morat[yrnr]*.75);          * three quarters of the mortgage interest rate.  The amount of a claim, should one occur in the month, is calculated at
                 claim=loan*(1+morat[yrnr]*8)+costs-0.9*value;  * the amount of the loan, plus eight months interest, plus the fixed costs, less 90% of the value of the property.
                 move=rand()/32767.0;                        This random number determines the state of the mortgagor next month.
                 arrs1=3;
                 if(mprobs[2][arrs][yr-1]+mprobs[1][arrs][yr-1]>move)arrs1=2;
                 if(mprobs[1][arrs][yr-1]>move)arrs1=1;
                 if(arrs1==3)
                      arrmo=arrmo+1;                       * At the end of this process, arrs1 dentifies the position at the end of the month, at 1 (repaid), 2
                 else                                      * (up to date), or 3 (in arrears).  Then arrs (the previous position is reset to arrs1.  If in arrears, 1
                      arrmo=0;                             * is added to the number of months which the mortgagor has been in arrears.
                 arrs=arrs1;
                 if(arrmo==8)
                      {arrs=0;                               * If a mortgagor is eight months in arrears, repossession is triggered.
                      if(claim>0)                            * If the claim is positive, it is added to the tally.
                           {totcos=totcos+claim;
                           totprco=totprco+claim/prv;
                           numco=numco+1;
                           if(claim>worst[10])
                                {nn=10;
                                while(claim>worst[nn]&&claim>worst[nn-1]&&nn>1)
                                     {worst[nn]=worst[nn-1];
                                     nn=nn-1;}.
                                worst[nn]=claim;             * The ten worst claims are sorted out for information.
                                }
                           }
                      }
                 }
            }
       yr=yr-1;
       if(mo==12)
            {yr=yr+1;
            mo=0;}
       no[arrs]=no[arrs]+1;
       nomo[arrs]=nomo[arrs]+mo/12.0+yr;
       }
if(no[0]>0)printf("%i ended in repossession, after an average of %6.2f years.\n",no[0],nomo[0]/no[0]);
printf("Total cost was %10.2f, with present value %10.2f, in %i cases.\n",totcos,totprco,numco);
if(numco>0)printf("Average cost per simulation resulting in cost was %8.2f, with present value %8.2f.\n",totcos/numco,totprco/numco);
if(no[1]>0)printf("%i ended in repayment, after an average of %6.2f years.\n",no[1],nomo[1]/no[1]);
if(no[2]>0)printf("%i ended in expiry, after 25 years.\n",no[2]);
if(no[3]>0)printf("%i expired in arrears after 25 years.\n",no[3]);
printf("The worst ten cases were:\n");
for(n1=1;n1<=10;n1=n1+1)
     printf("        £ %8.2f \n",worst[n1]);
printf("\n");
}
```

Appendix B Main Run Output

Monthly probabilities of changing state:

From up to date with payments		From being in arrears	
To repayment	To arrears	To repayment	To up to date
0.0063	0.0050	0.0063	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0100	0.0125	0.2636
0.0125	0.0075	0.0125	0.2636
0.0125	0.0075	0.0125	0.2636
0.0125	0.0075	0.0125	0.2636
0.0125	0.0075	0.0125	0.2636
0.0125	0.0075	0.0125	0.2636
0.0125	0.0050	0.0125	0.2636
0.0125	0.0050	0.0125	0.2636
0.0125	0.0050	0.0125	0.2636
0.0083	0.0050	0.0083	0.2636
0.0083	0.0050	0.0083	0.2636
0.0083	0.0025	0.0083	0.2636
0.0083	0.0025	0.0083	0.2636
0.0063	0.0025	0.0063	0.2636
0.0063	0.0025	0.0063	0.2636
0.0063	0.0025	0.0063	0.2636

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 75000
Fixed costs 2500
Houses are repossesed after eight months of arrears
1366 ended in repossession, after an average of 5.90 years.
Total cost was 68426.79, with present value 59872.29, in 16 cases.
Average cost per simulation resulting in cost was 4276.67, with present value 3742.02.
18046 ended in repayment, after an average of 6.08 years.
581 ended in expiry, after 25 years.
7 expired in arrears after 25 years.
The worst ten cases were:
£ 15319.40
£ 10011.09
£ 7737.03
£ 5172.02
£ 4221.80
£ 4019.27
£ 3819.88
£ 3759.14
£ 3486.71
£ 2890.81

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 80000

Fixed costs 2500
Houses are repossesed after eight months of arrears
1329 ended in repossession, after an average of 5.87 years.
Total cost was 218213.81, with present value 187240.63, in 39 cases.
Average cost per simulation resulting in cost was 5595.23, with present value 4801.04.
18099 ended in repayment, after an average of 6.02 years.
568 ended in expiry, after 25 years.
4 expired in arrears after 25 years.
The worst ten cases were:
£ 27234.98
£ 14323.35
£ 13256.54
£ 11135.25
£ 11099.15
£ 9682.50
£ 8520.17
£ 8027.15
£ 7920.09
£ 7912.81

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 85000
Fixed costs 2500
Houses are repossesed after eight months of arrears
1379 ended in repossession, after an average of 6.02 years.
Total cost was 627747.81, with present value 543863.63, in 96 cases.
Average cost per simulation resulting in cost was 6539.04, with present value 5665.25.
18015 ended in repayment, after an average of 5.95 years.
601 ended in expiry, after 25 years.
5 expired in arrears after 25 years.
The worst ten cases were:
£ 30293.75
£ 22525.96
£ 20797.91
£ 18625.48
£ 16486.47
£ 15619.81
£ 15258.03
£ 15176.55
£ 14334.70
£ 13628.33

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 90000
Fixed costs 2500
Houses are repossesed after eight months of arrears
1305 ended in repossession, after an average of 5.84 years.
Total cost was 1179088.13, with present value 1032859.81, in 174 cases.
Average cost per simulation resulting in cost was 6776.37, with present value 5935.98.
18063 ended in repayment, after an average of 5.97 years.
626 ended in expiry, after 25 years.
6 expired in arrears after 25 years.
The worst ten cases were:
£ 27539.43
£ 23372.64

£ 23066.94
£ 22395.63
£ 22233.67
£ 21993.59
£ 21305.74
£ 20187.03
£ 19411.46
£ 19175.40

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 95000
Fixed costs 2500
Houses are repossesed after eight months of arrears
1265 ended in repossession, after an average of 5.78 years.
Total cost was 2782603.50, with present value 2448855.50, in 295 cases.
Average cost per simulation resulting in cost was 9432.55, with present value 8301.21.
18150 ended in repayment, after an average of 5.99 years.
581 ended in expiry, after 25 years.
4 expired in arrears after 25 years.
The worst ten cases were:
£ 37126.77
£ 33749.67
£ 33229.27
£ 32656.02
£ 31386.34
£ 31159.78
£ 30405.13
£ 30046.56
£ 28459.72
£ 27531.31

Results of 20000 simulations of the following:
Starting value 100000
Loan amount 100000
Fixed costs 2500
Houses are repossesed after eight months of arrears
1335 ended in repossession, after an average of 5.93 years.
Total cost was 4288344.50, with present value 3789965.75, in 406 cases.
Average cost per simulation resulting in cost was 10562.42, with present value 9334.89.
18128 ended in repayment, after an average of 6.01 years.
535 ended in expiry, after 25 years.
2 expired in arrears after 25 years.
The worst ten cases were:
£ 40374.51
£ 33902.39
£ 32062.74
£ 32037.24
£ 31678.81
£ 31196.60
£ 30829.54
£ 30229.00
£ 29983.96
£ 29353.82

Creditor Insurance

Introduction

Creditor insurance is often considered to be pecuniary loss. This is because it is associated with the failure to repay loans. However, it is technically only partly included in the DTI authorisation class 16, miscellaneous financial loss. It is sometimes confused with class 14, credit. This is a complete misunderstanding. However, we have decided to include it within a pecuniary loss paper since it falls across several classes and, when considered as a whole, the relationship with loan repayment makes it a logical inclusion.

Creditor insurance is sold alongside loans. The main market is associated with personal loans, but small business loans and mortgages are also vehicles for this type of insurance. Interpreting the term creditor insurance in its widest sense would also include the life policies which are sold alongside large commercial loans (key man cover) and mortgages, where until recently it was usual for lenders to make this type of insurance compulsory for all mortgagors. Indeed, some creditor insurance companies do underwrite the former type of policy. However, the latter do not display the distinguishing characteristics of other forms of creditor insurance, and we have decided that they should fall outside the scope of this paper.

Most creditor insurance policies include an element of life assurance. The main exception is mortgage related creditor insurance, where the benefit is rendered unnecessary by the existence of policies of the type alluded to above. Strictly speaking, this should be outside the scope of a paper prepared for a general insurance convention. However, it is an integral part of the insurance, and in many ways in this context resembles typical general insurance rather than life assurance, so we have decided to include it. However, specifically life assurance related aspects, such as the management of excess expense losses which tend to arise, have not been pursued.

Perils Covered

The purpose of creditor insurance is to reduce the incidence of inability to repay loans. The benefits of this to both borrowers and lenders are obvious. The commission earnings to the lending institution, which will be the agent of the insurer, are also substantial, and will probably exceed the financial benefits of the reduced arrears.

The concept is most familiarly associated with personal loans. However, it is also used with mortgages and revolving credit (including credit cards), both budget and option accounts. It may easily be extended to any other type of regular

payment, such as utility monthly accounts and save as you earn schemes.

The perils covered by the policy will not actually refer to inability to repay. Rather, the insurance will pay the outstanding balance of the loan under certain circumstances, or will make the insured borrower's repayments on his behalf for a period in other cases. In most policies, only the death of the borrower will cause full repayment of the loan. This requires a life policy, and it follows that insurance groups underwriting creditor insurance must comprise a life assurance company as well as a general insurance company. Variations on this include a joint life policy covering both the borrower and his/her spouse, or a widening of the cover to include permanent and total disablement.

Almost all policies will make the regular payments on the loan in the event of a policyholder becoming temporarily disabled through accident or sickness. This is occasionally restricted to accident only. Many policies also make payments while the policyholder is unemployed. While the precise definition of unemployment varies from insurer to insurer, one important distinction must be made at this point. Some policies will allow claims for unemployment which has arisen from any cause, although most will exclude periods of unemployment which began with the policyholder voluntarily giving up a job or being dismissed for misconduct. On the other hand, many policies only cover periods of unemployment caused by the policyholder being made redundant. This is a more restricted form of cover, as it only includes dismissals where the policyholder's former job has ceased to exist, and on his dismissal he is entitled to compensation for redundancy, under the Employment Protection Act.

Joint cover is rarely offered on unemployment or sickness policies. This is partly because it tends to make the cost prohibitive, and partly because differing eligibility for cover tends to make it inequitable. This is because these covers may only be invoked by those in employment or active self employment, so non-working spouses would have to pay for insurance they would not be able to use.

It should be noted that, in the accident and sickness policy, it is the disability itself which gives the right to claim. Although the purpose of the insurance is to prevent distressed debtors defaulting, it is not necessary for sick or injured policyholders to have lost their income, or to be unable to repay their debts. In an unemployment claim, income is naturally lost, and under some policy conditions if redundancy pay is given a claim will not commence until the period for which it was given has expired, but still it is the loss of employment which gives rise to the claim, not inability to repay the loan.

Personal Loans

To actuaries who learned about compound interest under the influence of Institute

exams, the methods for calculating interest on personal loans, as commonly used by finance companies, may appear somewhat alien. To understand fully the construction of a creditor policy it is necessary to understand these methods. This section, which is a digression from the general course of this paper, is intended to rectify this situation.

Consider a person wishing to borrow £3,000. He intends tc repay it in equal monthly instalments over three years. He is quoted a rate of interest of 12% per annum. The calculation of the repayments proceeds thus:

Total interest to be charged:
£3,000 @ 12% per annum for three years = £3,000 * 12 * 3 = £1,080
Add the capital amount to be repaid: £3,000
Total amount repayable £4,080
Monthly repayment = £4,080 ÷ 36 = £113.33

The most important difference between this and actuarial methods of calculation is that interest at the stated rate is charged on the whole loan for its entire period, and not on the outstanding balance at any time. This has the considerable benefit of simplicity, but also allows lenders to quote rates of interest substantially lower than they are actually charging. In the example given, the true interest rate per annum convertible annually is actually 23.386%. (As a good rule of thumb, double the quoted interest rate.) Under current legislation, the lender must quote this rate on loan documents, as the "APR". (Annual percentage rate).

In the remainder of this paper, these two interest rates will be referred to, where necessary, as the "flat" rate and the "true" rate.

In recognition that interest is actually earned on an outstanding balance, the division of each repayment into capital and interest elements shows an increasing element of capital repayment and a decreasing element of interest. The normal method of calculation is made on the basis of what is known as the rule of seventy eighths. This name arises from the fact that the sum of all numbers up to 12 is 78. In the case of a thirty six month loan, the appropriate number is not 78, but 666. In this case, 36/666 of the total interest will be regarded as being part of the first repayment, 35/666 in the second repayment, and 1/666 in the final repayment. If a borrower repays his loan early, the outstanding balance will be calculated using this rule. For example, if the borrower wishes to repay immediately after the twelfth instalment, the calculation will be this:

Interest charged 366/666 * £1,080 = £593.51
(366 is the sum of the numbers from 36 to 25 inclusive).
Total repaid to date = £4,080 ÷ 3 = £1,360
Total capital repayments = £1,360 – £593.51 = £766.49
Total balance outstanding = £3,000 – £766.49 = £2,233.51

This is actually a good approximation to the true balance which an actuary would calculate using the true interest rate. The greatest difference between the true balance and the balance calculated on this basis is £32.21 on this loan, if repayment is made after 13 months. However, readers who have read this far are unlikely to be surprised that the difference is in favour of the lender.

In practice, when making the actual calculation, it is usually assumed that a borrower should pay the interest due for some time after the date of repayment. The result of this is that a borrower who wishes to repay early in the term of his loan may be required to repay more than he borrowed, even if all payments are completely up to date.

In this paper, reference is occasionally made to budget accounts and option accounts. These are types of revolving credit arrangements. Under a budget account, a borrower pays a fixed repayment per month, and is allowed to borrow, usually by means of a credit card, up to a certain multiple of the monthly payment. With an option account, the borrower may borrow up to a certain amount known as a credit limit. The minimum repayment will be a proportion of the balance on a particular month's statement. Interest is added every month on the outstanding balance, although frequently on an option account no interest is charged if the full balance is repaid immediately.

Product Design

As discussed above, a creditor insuance normally provides benefits in the event of at least one of death, disability and unemployment. The benefit on death is simple – it will be the amount needed to repay the loan at the date of death in accordance with the loan conditions. Usually, the insurer will retain the right to repay an entire loan in the event of a disability claim which in its opinion would last for the remainder of the term of the loan.

The benefits on normal periods of disability are more complicated, and variations in product design more subtle. There are three important variables – the waiting period for benefits, whether benefits are retrospective and the maximum length of claim period.

Disability benefits will not normally be payable until a certain minimum length of time has elapsed from the start of disability. This is normally measured from the date when a doctor certifies a patient as being disabled to the extent of being unable to work, or from the date unemployment commenced or possibly a period of pay in lieu of notice ended. This is equivalent to the deferred period in permanent health insurance, although it is usually much shorter than normal deferred periods. Fourteen or fifteen day periods are common, as are thirty day periods. Longer periods are less common, but obviously can be provided more cheaply. There are other variations, generally to meet the needs of particular

lenders, such as benefits starting on the first payment date after sickness commences.

Once benefits have become payable, the most common method of calculating entitlements is that the claimant becomes entitled to one thirtieth of his monthly repayment for every day he remains disabled or unemployed. The benefit therefore accrues daily, although it will normally be payable only monthly or at the end of a claim. The main variation here is whether, once the waiting period is ended, the claimant becomes entitled to benefits in respect of the waiting period itself. When this entitlement is given, the waiting period is often known as a franchise period and, when it is not, as an elimination period, although there is little market consistency in terminology. This paper will use these terms for these benefits.

One important variation on this method is where, after a waiting period, a full month's benefit is paid. After another full month of sickness or unemployment, another month's benefit will be paid, and so on. The waiting period is commonly a month, but other periods, including shorter periods, are commonly used, and there is no reason why the concept could not be extended to weekly or fortnightly, or indeed any other period.

Once benefits have started to be paid, they will commonly continue until the earlier of recovery or until the loan has been repaid in full. In order to reduce the cost of the cover, there is sometimes a maximum placed on the number of months payments which can be made on a single claim.

Benefit design considerations obviously include the cost of the insurance. Long waiting periods clearly will cost less than short ones. Franchise schemes are clearly more expensive than elimination ones, and the relative position of monthly schemes will depend on the length of the waiting period. It reduces the cost, especially of the longer term policies, to impose a maximum period on benefits.

Other design considerations include:

- Lender's systems. If claims are paid direct to the lender on the borrower's behalf, monthly benefits may be more appropriate, especially if the lender's systems are not good at handling partial payments.
- If benefits are large, such as a monthly mortgage repayment, then a monthly scheme is ill advised. A patient who is fit to return to work after 27 days might well malinger for a few days if he becomes entitled to a whole month's payment after 30 days. This is far less of a danger with small benefits. This consideration also suggests avoiding franchise benefits with long waiting periods.
- Policy ownership. Borrowers who have lost their income may be reluctant to use claim proceeds to keep up repayments as a first priority. If the policy is owned by or assigned to the lender, or if it specifies that claim

payments shall be made to him, this may assist in the objective of reducing arrears.

- The monthly benefit payable is usually equal to the monthly amount of repayment due. With an option account, it will normally be the minimum monthly repayment on the statement immediately before the claim commenced. In some flexible loans where there is not a fixed monthly repayment, the benefit will usually be a stated proportion of the balance at the start of the claim.
- The maximum term for which a claim may continue is normally until recovery or full repayment. Frequently, a maximum will be placed on the unemployment portion to reduce the cost of the cover. However, some payments are open ended or very long term, such as save as you earn schemes or mortgages respectively, and it will be necessary to impose a maximum claim period on these.
- When a claim ends, but a relapse occurs, rules are needed for whether a new claim is made, or the old one continued. Also there must be rules on how long a recovered claimant, or a claimant who has made a claim of maximum length, must wait before making a new claim.

Mortgage creditor policies are very different from those designed for short term personal loans. In the first place, life cover is usually granted separately under an endowment policy, so the creditor policy does not need to include it. Secondly, because of the long term but high probability of early repayment, a single premium is impractical, and the normal product has a monthly premium. This will generally be a rate per cent of the insured monthly payment. In the early days of this type of product, premiums were sometimes made age (either at entry or attained) dependant, but this practice is now very uncommon. The premium may be collected by the insurer by direct debit, or by the lender who may capitalise it to the mortgage and adjust the repayments accordingly.

The amount of monthly payment to be insured depends to some extent on the lender's systems. If these are sophisticated, they may be able to react to changes in interest rates and so change the amount of cover to the new monthly payment, possibly including associated payments such as endowment premiums, house and contents insurance premiums, and the creditor premium itself, all exactly, and adjust the creditor premium collected accordingly. If the lender's systems are not sophisticated enough to record all this, then the insured payment has to be fixed for the period of the policy. This will normally be enough to cover the monthly mortgage payment at that time, and the borrower is often allowed to increase the cover to include the associated payments, and possibly some margin to allow for the possibility of interest rates being increased. There is obviously some moral hazard here, and mortgagors should not be given too much scope for discretionary cover.

Although there are some variations in cover, most schemes are very similar,

almost to the extent of there being a market "norm". This would be elimination cover with a 30 day waiting period, and a maximum claim duration of twelve months. Cover is normally against disability and redundancy or unemployment.

Underwriting

In most schemes, there is no underwriting of individual applicants for insurance. A common exception is in mortgage related creditor policies, where there is often a simple set of declarations about health, or even simply a statement to sign that "I am in good health and not aware of any likely unemployment", or, even more simply "I am currently at work". In the event of the applicant not being able to sign the prepared statements cover will be refused, as there is generally no scope in the systems creditor insurers use to rate up premiums. What underwriting there is tends to be stricter on schemes involving large amounts insured, and where there is scope for selection against the insurer, such as mortgage schemes available over a Building Society's counter.

Insurers usually guard against the worst effects of anti-selection by exclusions from cover, and exclusion of claims. Examples are:

- Limited offers. Insurance will normally only be available to borrowers at the time of effecting the loan. Any later solicitation of non-insured borrowers by the insurer will have a strict "use by" date.
- Exclusion of older (normally over 65) borrowers from insurance, and expiry of insurance at that age for policies in progress. Sometimes an alternative benefit may be offered, such as life cover only.
- Exclusion of claims for conditions from which the insured had suffered before the policy, even if recovery was complete. (The "pre-existing" exclusion.) Sometimes this is a complete exclusion. However, some policies will only exclude such claims for the first several months of a new policy, or will exclude only conditions from which the insured had suffered during a limited period before the policy started.
- It is usual to exclude claims which are self inflicted – this includes suicide, self inflicted wounds and voluntary unemployment. Alcohol related claims may also be excluded.
- Claims arising from war, civil insurrections, riots, and nuclear explosions are often excluded.
- Claims arising from AIDS, whether sickness or death are now frequently excluded, whether death or disability. Often this is at the insistence of reinsurers.

Since it is normal for the whole premium rate structure to be fixed on a loan scheme, the important assessment which the underwriter must make is of the likely overall quality of borrowers likely to become insured. The main types of lender to the personal sector in the United Kingdom include:

- Banks
- Building societies
- Credit unions
- Friendly societies
- Finance companies
- Retailers
- Credit card companies
- Utilities
- Trades unions
- Mail order catalogue companies

(There is some overlap here. For example, the finance company making personal loans is also often the actual lender when credit is arranged through a retailer. However, as the natures of the clientèles differ, they have been listed separately. Utilities are not strictly lenders, except perhaps when they are also retailers – the criterion is whether they command a potentially insurable regular stream of payments).

As a general rule, the more socially upmarket a group of borrowers, the better will be the claims experience. This is because of the general association between social status and health, which has been commonly observed. Also, the more salubrious forms of employment tend to be generally less at risk of job loss than others. However, other differences arise. An older than normal group of borrowers will tend to have a poorer experience, as will one which has a higher concentration of women borrowers than normal. The above categories are certainly not homogeneous – while finance companies tend to have a more select clientèle than banks, the best of them will be much the same, while the most downmarket, lending small sums with weekly collections of repayment, will be very much worse.

Differences may also be observed between different parts of the United Kingdom. In general, claims experience tend to be lower among schemes with borrowers concentrated in the South–East of England than in other parts of England. Scotland and Wales tend to be worse than England, and Northern Ireland does not bear thinking about. To a large extent, these differenes mirror differences in unemployment rates in these areas, and it will be interesting to see if the relative differences change as these change.

Another important difference between schemes lies in the likely average size of monthly benefit. While few people entitled to claim their mortgage repayment in a month will not bother to do so, even if the event which has entitled them to do so has not left them financially embarrased, there is a reluctance to claim for small amounts. Where this effect first becomes noticeable will depend on the nature of the clientèle, and the method of payment of premiums. (if a premium is payable monthly from a bank account, the policyholder is more likely to remember the insurance than if a single premium had been paid some years before.) In an

extreme case, where benefits are less than the cost of obtaining a doctor's certificate, unless the insured needs one anyway, possibly for his employer, there is actual disincentive to claim.

The possibility of accumulations of risk should be avoided. For example, if a lender's clients are all concentrated in a small geographical area, heavily dependant on a single employer, it may be best to refuse unemployment cover.

A possible problem arises if a lender may want to use the insurance to underwrite loans. In a lender's eyes, a loan to a person in ill health or likely to lose his job will not be good lending. If a lender allows his criteria for lending to be relaxed where there is to be creditor insurance, the insurer may well pay the cost. The underwriter should be alert for this type of moral hazard.

A very important consideration in containing claims is the level of penetration – the proportion of eligible borrowers effecting the insurance. Not only does high penetration generate more business, but it dilutes the effect of antiselection which is bound to occur. Even when this is not calculated, it will show itself in such ways as people at the higher end of the age eligibility range finding flat premium rate cover more attractive than younger clients. For both these reasons, creditor insurers place great stress on lenders achieving high penetration, and several of the larger companies offer training services to train the staff of lenders to produce high credit sales and high penetration.

As with any type of insurance, there is no royal road to underwriting. The underwriter must be aware of the sorts of differences discussed above, endeavour to get as good an impression as possible of the potential policyholders in a scheme, probably from very scanty information, and use a mixture of this information, his experience and guesswork, to decide on a realistic premium basis.

Negative Option

Historically the vast majority of creditor business has been sold by means of the "negative option". This means that on the application form for a loan or credit card or other form of credit, the borrower has to tick a box to state that he does not want the insurance, or else it will automatically be incuded with his loan. A typical form that this negative option takes is:

> "Death, disability and unemployment insurance will be automatically arranged to protect you. If you do not require this, please tick here."

The obvious advantage to the insurance company of this form of selling is that it will increase penetration, and hence reduce the impact of antiselection, especially in those cases where there is no face to face contact in the selling of the credit.

In January 1988 the DTI issued proposals that raised the possibility of extending the Unsolicited Goods and Services Acts to deal with, amongst other items, the inertia selling of insurance through chargecard and mail order accounts. The DTI subsequently concluded that it would be desirable to have improved controls in the area of "negative selling/inertia selling", but did not think that amendments to the Acts in the form previously proposed would be the most effective way of meeting with that objective. They indicated that they would be looking at alternative methods tackling the practice of selling by "negative option".

There were no significant developments for a period of time, but the OFT then became involved with an expression of particular disquiet about boxes tucked away in a mass of paperwork and misleading techniques. They emphasised that a consumer should have a genuinely free and informed choice as to whether he wanted to buy insurance. This stimulated action on the part of ABI members and a draft ABI Code of Practice was produced. However, during the preparation of the proposed code, the DTI issued a consultation paper in August 1989 setting out proposed amendments to the Agreements Regulations under the Consumer Credit Act 1974. One of these proposals was to prohibit the use of "negative options" and inertia selling in relation to creditor agreements. Ancillary agreements, linked to principle credit agreements would require a positive expression of acceptance by consumers such as a ticking of a box. This signposted a very real possibility of legislation banning the use of "negative options" and all interested parties eventually came together to prepare industry proposals as an alternative. This resulted in the preparation and addition of an addendum to the ABI's code in terms which were acceptable to virtually all the interested parties.

Unfortunately, the DTI decided that whilst there was merit in the proposals and that they would have gone a significant way to resolving many of the difficulties with the sale of creditor insurance, the view was taken that, as a matter of principle, consumers should not be charged for services which they have not positively and expressly requested. Consequently the DTI issued proposals for new legislation on credit marketing in December 1990. The specific proposal under inertia selling is that "a person licensed under the Consumer Credit Act should not present or send to borrowers or prospective borrowers, consumer credit documents containing inertia selling provisions; i.e. provisions such as 'negative options' which had the effect that an optional service would be provided and charged to the borrower unless he takes some positive action to decline the service." It was proposed that the new regulations should come into force three months after they were laid before Parliament. A time for discussion of these proposals was given for which the closing date was 15 March 1991. It was intended that legislation would be brought forward some time in 1991. However, to date there are no definite indications as to when the legislation will be introduced. However, there seems little doubt that at some stage in the near future the "negative option" will be banned. The obvious question to consider is

what impact this will have on the selling of creditor insurance.

In future all creditor insurance would have to be sold by means of a positive option, i.e. the purchaser will actually have to tick a box on the application form to state that he wants it rather than as at present to state that he does not want it. In cases where there is face to face selling of the insurance this can probably be overcome by improved training and is therefore unlikely to lead to a significant drop in penetration levels. Indeed the methods of selling may be improved so that there is actually an increase in penetration. The main problem would seem to arise in the case where selling is done by remote means, such as the use of mail shots. In this case penetration is likely to drop substantially resulting in increased antiselection. This may make the future selling of creditor insurance by this method unviable.

Cost of Claims

It is normal in creditor insurance products to charge a premium which depends only on term and benefits, and not on the policyholder's age or sex. While mortality and morbidity bases are required, they are very simple. Some products are age banded, usually with two or three premium rates depending on age. This was sometimes age at entry – indeed this is the only possibility for single premiums, but could also be age attained. Such products are now rare.

The most usual form of premium rate for a personal loan is one which is expressed in terms of a percentage of the total amount repayable. This will be payable as a single premium at the outset of the loan, and normally lent as part of the loan. If a borrower needs a personal loan, it is unlikely that he will have spare funds available for the associated insurance premium! The reason for this particular structure is seen below. The relationship between this and a rate per cent of the loan is:

$$Rl = \frac{(1 + iN) * Rt}{1 - (1 + iN) * Rt}$$

Where:
- N is the full term in months
- i is the flat monthly interest rate
- Rl is the rate proportional to the loan
- Rt is the rate proportional to the total amount repayable

(A rate per cent of total amount repayable must obviously be increased by the amount of interest to give the rate per cent of the loan. The interest is iN, and this explains the form of the numerator. However, this permium must also be loaned, and will itself give reise to interest and insurance premium. Thus the denominator is in the well known form for the sum of an infinite geometric sequence.)
To take an example with the loan discussed above (£3,000 for three years at 12%

flat interest per annum), assuming a premium rate of 7½% of total amount repayable:

Premium = £3,000 * 1.36 * .075 / (1 – 1.36 * .075) = £340.76

The new total interest payable, on the total loan equal to the original loan plus the premium lent, will be £3,340.76 * 1% * 36 = £1,202.67. Comparing the loan calculation with and without insurance, we get:

	With insurance	Without insurance
Loan	£3,000.00	£3,000.00
Premium	£340.76	£0.00
Interest	£1,202.80	£1,079.88
Total amount repayable	£4,543.56	£4,079.88
Monthly repayment	£126.21	£113.33

Note that the precise amount of interest must be adjusted to produce equal monthly repayments of an exact number of pence.

The age range for creditor insurance is usually eighteen to sixty five. However, most groups of borrowers are dominated by the younger half of this range, reflecting typical lifetime spending and earning patterns. The average age of a group may be perhaps 30, although the appropriate average mortality rate to use would, of course be higher than q(30). The rate chosen will generally be in the range of q(35) to q(50). Population mortality such as ELT14 is probably appropriate, although there are certain selective and anti–selective processes going on. The fact that a single mortality rate is to be used over the whole age range renders subtle considerations inappropriate.

The death benefit will be the amount required to repay the loan at the date of death. If this occurs after n months, this will be:

$$L - \frac{n\,L\,(1 + iN)}{N} + \frac{n\,(2N - n + 1)\,iL}{(N + 1)}$$

The original loan ↑ Payments ↑ to date — Interest ↑ earned to date

Where: L is original loan amount; n = 0,1,2,....,N–1

(This formula assumes that on a death claim there is no interest penalty for early repayment. It also assumes that the lender earns each month's interest at the start of that month. It may easily be adjusted if the conditions are different).

The average payment on death during the loan is simply the average value of this formula over the values of n from 0 to N–1. This simplifies to:

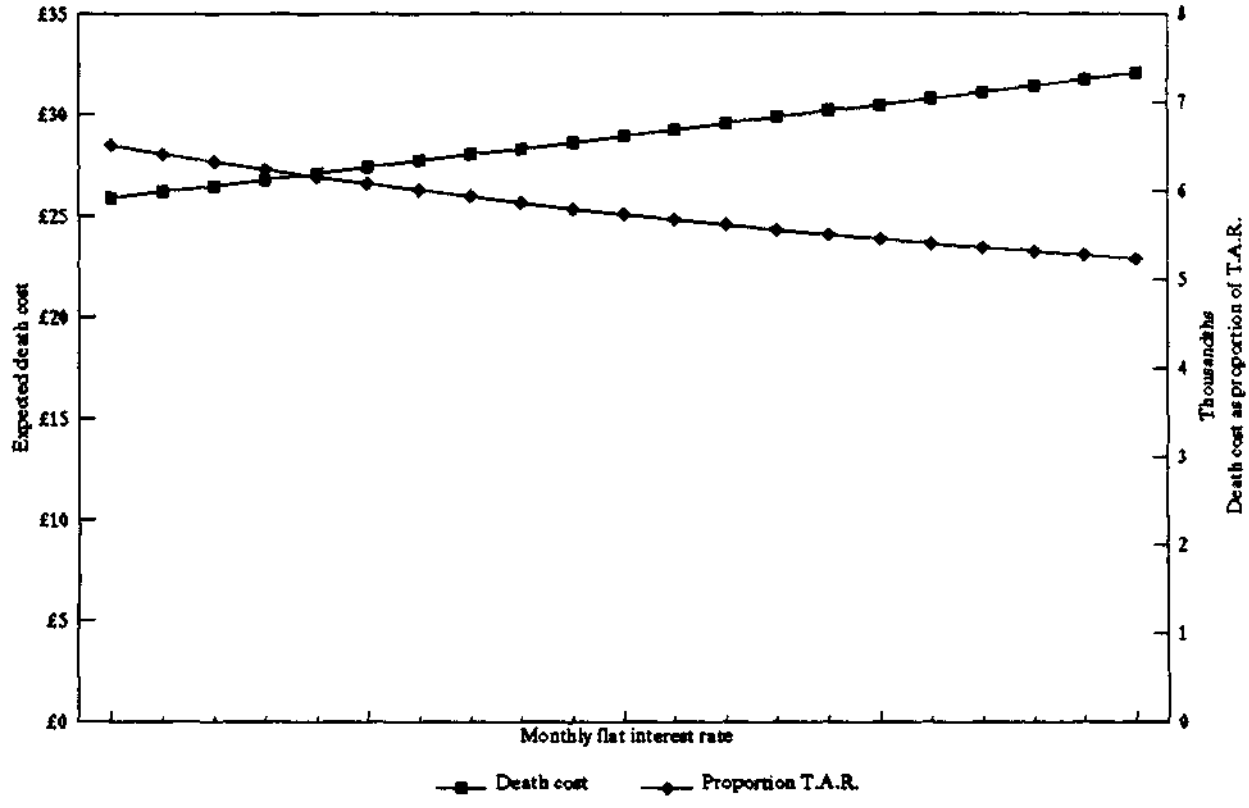
$$\frac{L}{2N} * (N + 1) + \frac{iL * (N + 5)}{6}$$

With the assumption of a single rate of mortality, the expected cost of death claims is equal to:

$$\frac{qL}{24} * (N + 1 + iN(N + 5)/3)$$

(Multiplying by qN/12.)

The relationships between the expected death claims and the loan and the expected death claims and the T.A.R. both depend on the rate of interest. It follows that neither is an ideal basis for a premium rate. The following graph illustrates this. It shows the expected death payments on the loan used as an example above, assuming that the £3,000 loaned already includes the premium, over the range of interest rates likely to be discovered in practice. It also shows this as a proportion of the total amount repayable. It will be observed that while the former increases with the interest rate (not surprisingly, since the balance will fall more slowly with a high interest rate), the latter falls since an increasing interest rate increases the T.A.R. faster than the expected death cost. However, the difference is not great – from 0.70% of T.A.R. at ½% per month flat interest rate corresponding to a true rate of approximately 12% per annum, to 0.54% at 2½% per month, a true rate of around 60% per annum. (These assume an average mortality rate of ½% per annum, but the result is proportional to that.)
Most underwriters are likely to use a table of pure death premiums which does not take account of varying interest rates. It might be based on a rate of, say, 1% a month, and will give rates as a proportion of T.A.R.



In order to estimate morbidity and unemployment costs, tables of sickness and unemployment will be required. There are no published tables for these – CMI reports on PHI experience are unlikely to be of any use, as the insured population is so different. This is something an insurer will need to develop for itself if it is to underwrite with any confidence.

The normal method of premium rating follows that more common in America than clasically used in Britain for long term sickness business. This makes use separately of claim inception and recovery statistics. Separate functions will be required for sickness and unemployment.

The recovery function will be in the same form as the lx column of a life table. No published tables for this exist, and indeed creditor insurers regard these as important commercially confidential information. For a company wanting to write this business, the best approach would probably be to adapt PHI tables, bearing in mind that there is little opportunity for insurers to decline individual risks, and that the risk group is generally down market of PHI customers. After a sufficient time, each insurer should be able to graduate its own tables from its own statistics. Thereafter, it should conduct occasional investigations into whether or not the table remains appropriate. Here, however, given a radix lo, lx represents out of lo becoming sick at day 0, the number still sick at day x. The expected number of days payments on a claim may then be calculated as:

Elimination $$1 / l_0 * \sum_{x=D}^{30*M} l_x$$

Franchise $$1/l_0 (D * l_D + \sum_{x=D}^{30*M} l_x)$$

Monthly $$30 / l_0 * \sum_{t=0}^{M'-1} l_{30t+D}$$

Where:

M is the maximum claim months. (not necessarily integer).
D is the waiting period (days).
M' = [(30 * M – D)/30 + 1]

(Put simply the derivation of these formualae is this. Under elimination, we expect to pay benefit for every day beyond D while the claimant remains sick. With franchise, in addition we make a payments of D days benefit if the claimant remains sick for D days. With monthly, we make make 30 days' payment after D

days, and every 30 days thereafter. If a payment of any sort is due after t days, the probability of it being made is l_t / l_0. The expected value is the sum of the probabilities.)

If the number of payments on any claim is limited, then the upper limit of summation will be replaced by 30*(M" + 1) for elimination, 30*M" for franchise and M" for monthly, where M" is the maximum number of payments. Note that in this case, the elimination claim starts later but goes on for longer than the franchise. A claimant who does not recover until the maximum number of payments has been received will get the same number eventually, while if the payment can go on for the full term of the loan, then the claimant will receive less under elimination benefits than under franchise.

An underwriter will want to develop a set of tables of these functions. Let us denote them a(w,d,m), where w is the number of waiting days, d is e, f, or m, depending on whether the benefit is to be elimination, franchise or monthly, and m the maximum length of period to be claimed for in months. Note that the summation should be divided by 30 to relate it to a number of monthly payments. As specified above, daily payments are implicitly used.

Relating these functions to an expected cost of benefit is fairly straightforward. For example, under an elimination type policy with w waiting days, no limit on benefits and a term of N months, then the expected cost of a claim occuring on the first day is the monthly benefit multiplied by a(w,e,N). Had the incident occured one day later, the benefit would have been multiplied by a(w,e,N−1/30), and so on. If there were a maximum period of claim, say N'<N, then these would be replaced by a(w,e,N'+w/30) until the number of months remaining in the loan term was less than N'+w/30. The average benefit payment for a single claim in number of months of insured monthly benefit over the whole term of the loan becomes:

$$1/30N \sum_{t=0}^{30*N-1-w} a(w,e,(N-t)/30)/30 = 1/N \sum_{t=0}^{30*N-1-w} \sum_{u=w}^{30*N-t} l_u / l_0 / 30 /30$$

Discarding the four divisors, this simplifies to:

$$\sum_{t=0}^{30*N-1} \sum_{u=0}^{t} l_u - (30N-w) \sum_{u=0}^{w-1} l_u - \sum_{t=0}^{w-1} \sum_{u=0}^{t} l_u$$

It may be objected that this is actually less simple than its parent. However, it facilitates calculation, as will be seen in appendix 2. This is the formula referred to in that appendix.

If the number of monthly benefit payments is limited to N' this will be:

$$1/30N(\sum_{t=0}^{30*N'-1} a(w,e,(N'-t)/30) + ((N - N' - w) * a(w,e,N'+w/30)))/30 =$$

$$1/30N(\sum_{t=0}^{30*N'-1} \sum_{u=w}^{30*N'-t} l_u / l_0 + ((N-N'-w)*a(w,e,N'+w/30)))/30$$

While these functions look complex, they are simply a set of double summations, and complete tables may be compiled in a few minutes on a personal computer.

If the benefits are on a franchise basis, the summations are slightly different:

$$1/30N \sum_{t=0}^{30*N-1-w} a(w,f,(N-t)/30) = 1/N \left(\sum_{t=0}^{30*N-1-w} \sum_{u=w}^{30*N-t} l_u / l_0 + (30 * N - w) * w * l_w / l_0 \right)/30$$

With an equivalent adaptation where there is a limit to payments.

A slightly different principle is involved for monthly benefits. Here the expected payments are:

$$1/30N \sum_{t=1}^{N-1} a(30,m,t) = \sum_{t=1}^{N-1} \sum_{u=1}^{t} l_{30*u} / l_0 / N /30$$

if the waiting period is 30 days, or for a waiting period of 15 days:

$$1/30N \sum_{t=1}^{N-1} a(15,m,t) + \tfrac{1}{2}a(15,m,N) = \left(\sum_{t=1}^{N-1} \sum_{u=1}^{t} l_{30*u-15} / l_0 + \tfrac{1}{2} \sum_{u=1}^{N} l_{30*u-15} / l_0 \right)/N/30$$

Equivalent expressions can be derived for different waiting periods.

The number of possible combinations of these rates appears very great, but this is not so. There are ten commonly used personal loan terms (six monthly intervals up to five years), although loans of 42 and 54 months are rare. The choice of waiting days will normally be between 14 or 15 (different companies appear to have different standards for short waiting periods), 30, 60 and 90, although the latter two are rare, giving four choices. There are three ways of paying the benefit, and benefits on one claim will normally be unlimited or limited to 12, 24 or 36 months, four choices. This gives a total of 48 different rules for paying benefits at each term, which may be summarised on a small table. A separate table will be needed for unemployment, but in the same form.

The underwriter will probably not adjust these tables for different groups of insureds. Rather, he will use different claim inception rates. A claim inception rate must be applied to the factors as found above to produce expected amounts of claim over the term of the policy. As the factors have been developed, this will need to be in the form of the probability of a period of disability (or unemployment) commencing in any month, multipled by the number of months of the policy. The product will then be the expected cost of claims over the entire period of the policy per unit of monthly payment. To convert this to a rate per cent of total amount repayable, it is necessary to multiply by 100÷N. It will be noted that this calculation is independent of the rate of interest or the gross premium rate charged. This is why relating net premiums to total amount repayable is a robust form of premium rating.

An example of a calculation leading to a net premium rate is given in Appendix 2.

For revolving credit and mortgage schemes a different approach is needed.

The benefits for a budget account are normally the balance outstanding repaid on death, and the contractual monthly payment continued for a maximum period, normally equal to the budget multiplier (the maximum balance a borrower is allowed divided by his monthly payment). However, it is also possible to have a more restrictive maximum, or a benefit payable until the actual balance outstanding at the date of claim is cleared. This is longer, because of the monthly interest and continuing insurance charges added each month. For example, if monthly interest is 2% (not unusual on revolving credit) and the insurance charge 1% of outstanding balance, then with a multiplier of 30, a maximum balance will take 78 months to clear. ($a_{\overline{77}|} < 30 < a_{\overline{78}|}$ at 3%.) In this situation it will almost certainly be necessary to impose a maximum length of claim.

Rating this product requires information on the amount of the credit limit which is normally used up. With some retail credit cards, an account is opened typically to facilitate the purchase of one expensive item, and rarely used thereafter. In this case, balances tend to be low, although if payments do not stop when there is a nil balance, then such accounts are likely to be closed. With bank cards which may be used at many stores, it is more likely for a high proportion of the credit limit to be used and for the card to continue to be used for new purchases. (Sometimes these accounts use cheque books rather than credit cards, but the principle is the same.) The distinction is important because the only practical way for the premium to be charged is usually as a rate per cent per month of the outstanding balance. However the expected amount of a claim is more nearly constant than proportional to the outstanding balance, since the vast majority of claimants recover quickly, so that the expected number of payments on a claim with a maximum of 30 payments may be only, say, double the number on a claim with a maximum of three payments. In this case an account with a 30 multiplier and monthly charges for interest and insurance of 3% which has only 9½% of the credit limit used will generate only 9½% of the premium of one which is fully used, but will give rise to half as much disability claims cost. It is important that the underwriter should not overestimate the usage of these accounts when calculating premium.

The actual calculation proceeds as follows. The claims cost per month as a proportion of the outstanding balance is:

$$q / 12 + i * a(w,u,r) / k / M$$

Where:

- q is the annual mortality rate
- i is the monthly sickness claim inception rate
- k is the anticipated average use of the account ($0<k<1$)
- w is the wait days for benefit
- u is e,f, or m

M is the multiplier
r is defined by $a_{\overline{r}|} = kM$

The definition of r will require it to be taken to the nearest integer. It will also require an interest rate. This should be the sum of the interest rate to be charged on the account and the insurance premium rate. This requires that the latter be known, and the former should not change. These conditions are not likely to be met in practice, and compromises are needed.

If unemployment cover is required the form will be the same as the sickness portion of the above.

An option account does not give these problems. The monthly benefit is normally a proportion of the outstanding balance, so the maximum claim is of a constant length. This would be equal to r in $a_{\overline{r}|} = 1 / k$, where k is the proportion of outstanding balance which is to be repaid every month. The expected cost of claims per month as a proportion of the outstanding balance is then:

$$q / 12 + i * a(w,u,r) * k / 12$$

This is robust to the proportion of the credit limit used, although the value of r may be slightly affected by changes in the rate of interest.

The arithmetic involved in the assessment of mortgage products is much simpler. These normally provide payment of the insured monthly payments for a maximum of twelve months, on an elimination basis. The premium is charged monthly to the insured as a proportion of the insured monthly payment, usually by direct debit, although some mortgage lenders are able to include the cost in the mortgage payment itself. The cost per month as a proportion of the insured payment is simply:

$$i * a(30,e,12) / 12$$

The cost of unemployment claims is of exactly the same form.

It will be noted in the above that it is not normal to allow for interest in the assessment of premiums.

Commission Arrangements and Gross Premium

Creditor insurance policies are typically characterised by a dual commission arrangement. There will be a commission paid to the lender, who for this purpose is the insurer's agent, as a flat rate on the gross premium written. This is typically at a higher rate than most general insurance commissions. Rates of between 25% and 40% are common, and rates over 50% are not unknown. In general, rates will be lower on schemes where unemployment is included, since the higher risk premium required may make a gross premium loaded for the same rates of commission higher than the market will bear.

Almost universally, there will be a profit commission arrangement. The commonest form of this is that, after deducting initial commission, claims and reserves from premiums received, and probably also an allowance for the insurer's expenses, the remaining profit, if any, is shared between the insurer and its agent. The proportions in which this profit is split vary between different arrangements, but generally more than one half is returned to the lender, and it is not unusual for 100% of the profit to be returned.

In some cases, the anticipated profit commission is retained by the lender along with the initial commission. When the final amount actually payable is known, the difference will be paid either to the lender or the insurer, sometimes with interest. This practice is known as advanced profit commission.

The greater the proportion of profit returned to the lender, the more of the insured risk is actually being borne by him. With what is sometimes known – illogically – as a 100% profit share, the insurer has in effect become an insurance administrator and stop loss reinsurer for the lender. Since the possibility of insurance profit is given away by this type of arrangement, it follows that sufficient margins must be taken within the premium to reduce to an acceptable level the stop loss risk, and a premium for the risk that does remain should be included in the insurer's expense loading.

When there is no profit commission paid to the lender, then there is no need for a specific buffer to ensure claims are within the proportion of premium allowed for them. The insurer should take a profit loading within the premium. In general, the higher the proportion of profit returned to the lender, the greater the specific margin required.

With arrangements such as these, the calculation of a gross premium proceeds as follows:

- Calculate risk premium – say 2% of total amount repayable.
- Define premium structure, say:

Commission	40%
Insurer's expenses	15%
Leaving, for losses	45%

- Determine how much loading of the risk premium for profit return is required. This will depend, inter alia, on the past experience of the scheme (whether it is large enough to be reliable, rather than the volume of losses, which should be dealt with in the setting of the risk premium) and on the size of the scheme. Suppose we decide we need a 20% loading on the risk premium. Then five sixths of the 45% of premium, or 37½% of the gross premium, is required for the risk premium. This gives a gross premium of:

  2% ÷ .375 = 5.33% of total amount repayable.

Premiums will then be remitted to the insurer net of commission. A quarterly, half yearly or annual calculation such as the following will then be made to determine the amount of profit commission to be paid.

Premium received	A	£1,000,000	
Less unearned premium	B	£100,000	
Commission at 40%	C	£360,000	=40%* (A−B)
Insurer's expenses at 15%	D	£135,000	=15%* (A−B)
Claims paid	E	£180,000	
Claim reserves (outstanding + IBNR)	F	£30,000	
Balance	G	£195,000	=A−B−C−D−E−F
Profit share at, say, 75%	H	£146,250	=75%*G
Less previous payment of profit share	I	£120,000	
Profit share now owing	J	£26,250	=H−I

All these calculations will be newly made each time on an inception to date basis, so there is no need for an explicit adjustment for the development of prior years' claims.

The calculation of reserves will be dealt with below.

If the profit share payable, J, is negative, it would normally be carried forward to the ensuing period, or it could be refundable to the limit of previous profit share payments. The exact arrangements would depend on the agreement between the insurer and the lender. This calculation would normally be made on an inception to date basis each time.

Variations on this are possible, as are variations within the structure shown. To preserve good relations between the insurer and lender it is generally undesirable to require the return of past profit commissions paid. Indeed, the agreement between them may preclude such recovery, other than from profit share arising in later periods. These may persuade the insurer to adopt calculation conventions which delay the release of profit back to lenders. This also has obvious beneficial effect on the insurer's cash flow. Points where a conservative approach to calculation may be taken are:

- Calculation of unearned premium
- Commission may be taken into account as a proportion of written, not earned, premium
- The same may be done with the expense allowance
- Calculation of claim reserves

Clearly, there are limits to the extent to which exercise of discretion may be regarded as legitimate. Formulae should be laid down in agreements wherever possible. It should be noted however, that where there is a 100% profit share, conservative reserves should be matched by reduced liabilities for profit sharing, and have no effect on the insurer's profits.

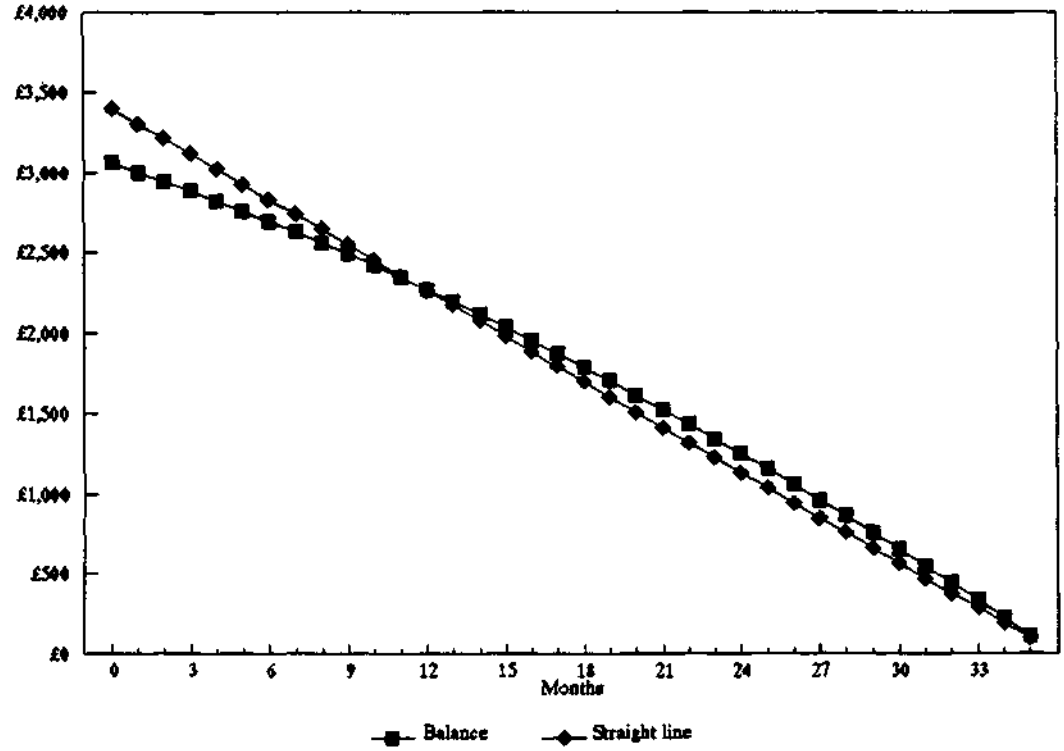
Earning of Premium and Premium Reserves

Unlike most general insurance, the earning of premium in equal portions over the term of the contract is clearly slower than the pattern of the risk justifies.We shall consider the two aspects of the contract separately.

The life sum at risk reduces over the term of the contract. Being the repayment amount of the loan, this is not in a straight line, but slightly slower. However, even with the high interest rates typical with consumer loans, their short periods ensures that the difference is not great. In the example of a loan used above, almost half of the first payment is devoted to balance reduction rather than interest.

The graph below shows the balance, month by month on this loan, together with a straight line reduction in balance over the same period which would give the same average balance. This is the balance implicit in straight line earning of premium.

It will be observed that this method earns the premium too quickly. This is likely to be exacerbated by the increasing risk of a claim during the term of the loan. However, the difference is not great, and there is probably no other formula so conceptually simple which would so nearly match the true incidence of the risk. We believe that most creditor insurers will earn their life premium in this way. Analogously with the method for earning interest, it may be known as the rule of seventy eighths.



The insurer will need to recognise that on average only half a month's premium is earned in the month a policy comes on risk. One month's will be earned in each ensuing month. Hence the proportion to be earned in each month will be:

½N / S		in month 0 (the month of inception)
½(2 * (N − n) + 1) / S		in months n=1, 2, ... N
	Where:	N is the term in months
		S = ½ N * (N + 1)

It follows that after n months (n=0, 1, 2, ... , N−1) the unearned premium will be :

$(N - n)^2 / 2S$

(Other possible treatments of this are possible, for example with slightly different proportions allocated to the starting and ending months. The difference to the final results will be trivial).

The position with disability and unemployment benefits is rather more complex. The benefit paid is a monthly one, payable until the earlier of recovery and repayment of the loan. With each month that passes, there is one less month that may be paid in the event of a claim. There is clearly a reduction in the cover granted as the loan progresses, and this argues for a bias in premium earning towards the earlier months of the policy. This seems to suggest earning on the rule of seventy eighths again.

However, this would be an excessively quick earning of premium. The reason for this is that most claims cease quickly by the recovery or re−employment of the claimant. If, say 80% of claims are concluded within two years, the difference in expected amount of claim between one which could last a maximum of 35 months, and one which could last 36 months is much less than one thirty sixth. Also if a policy has a maximum claim period which is less than the term of many loans, in the early months of a policy there will be no reduction in the risk.

For example, if there were a maximum of twelve payments on a sickness claim, then the expected number of payments on a sickness claim would not reduce for the first forty eight months of a five year loan. It is unlikely that an insurer would wish to have a large variety of earning methods for each particular set of policy conditions. These considerations suggest the use of a twelfths or twenty fourths method for premium earning, especially for unemployment, where it is more common for there to be a limitation on the length of a claim.

Some insurers have noted that the incidence of new claims tends to reduce over the term of a loan. If this were confirmed, it would tend to justify a quicker earning of premium than a constant incidence.

An alternative approach is to adopt a compromise − perhaps one which earns some of the premium on a rule of seventyeighths basis and some on a twelfths basis. An infinite variety of permutations may be constructed, none of which will reflect the incidence of risk exactly, but some of which will be better than others. The twelfths method is clearly too slow, but not ridiculously slow, and its adoption might well prove to be an acceptably conservative method for profit sharing

calculations.

Most credit card and mortgage product pay premiums monthly to cover that month's risk. This is generally reported to the insurer monthly in arrear, so that by the time the premium is booked the associated insurance has already been provided. Therefore there is no need to hold an unearned premium reserve.

Most monthly creditor insurance is written with no guarantee of premium rates, or even of continued cover, beyond perhaps the scheme's next annual renewal. If a scheme were guaranteed to continue for the term of a mortgage, or until a credit card holder attained age 65 (normally the cessation date of the insurance), then long term actuarial reserves would be needed, analogous to PHI reserves. No general rules can be adduced for these – they would depend on the precise nature of the scheme and the guarantees given. In these cases the approximations to theoretically correct earning of premium which are quite acceptable for the usual short term creditor policies will be inadequate. Particular care should be taken where existing policies could be continued at guaranteed rates when a scheme is closed to new entrants.

Claims Reserves

Creditor insurance is subject to the usual delays in reporting claims to which all insurance is prone. Once a claim is notified, unless there is a dispute over liability or a delay in producing satisfactory evidence, then payments are normally made promptly. The main reserve needed in respect of outstanding claims is for future payments on claims which have already commenced.

Claims reserves need to be deducted from profits before profit commissions are calculated. If the proportion of profit released to the lender is 100% or close to it, then the main effect of over reserving will be to delay the release of profit commission. It will not delay the release of the insurer's profit or liability to tax, except in the cases of schemes which are in deficit. The effect of under reserving will be to exaggerate profits and accelerate the release of profit commission. If a scheme is comfortably profitable, this will not matter greatly – the scheme will simply release lower profits than expected when in maturity or runoff. If the scheme is only marginally profitable or actually unprofitable, it will lead to the payment of unjustified profit commission which may be impossible to recover.

Even more than most lines of business, creditor insurance is a suitable case for statistical estimation of claims reserves. Each company should be able to compile from its own records a distribution of periods of delay in notifying claims. It would be better if this were done separately for life, disability and unemployment claims, and might even be done separately for general unemployment and for redundancy claims.

To produce a life IBNR, we should first estimate the number of months it takes until the vast majority of claims have been submitted. In practice, twelve months would probably be sufficient, although a prudent reserver might deliberately underestimate the proportion of claims received at the time horizon to make allowance for any later reports. Then a commonsense formula for the IBNR reserve will be:

$$\sum_{t=0}^{N} (1 - P_t) * SA_{-t} * q \div 12$$

Where:
- P_t is the proportion of claims which have been reported after t months.
- SA_{-t} is the life sum assured in force t months prior to reserving.
- q is the annual mortality rate to be used.
- N is the time horizon in months.

An alternative approach, easier to apply, would be to estimate the average number of months delay in receiving claims, n say, and then set up the IBNR reserve equal to q * n ÷ 12 * SA, where SA is the current sum assured. This reduces the amount of past data required to produce the reserve, but is obviously going to be wrong on books of business which are growing or shrinking.

The reserve needs to be set up separately for each scheme which is subject to profit commissions. However, on small schemes, this formula will produce a reserve which will not pay a single claim, if there should be one waiting to be received. In order not to release profit commission prematurely, a minimum equal to the current average or maximum sum assured on each scheme might be imposed.

A prudent reserver might add a margin to the reserve thus calculated. One approach is to take the weighted exposed to risk, calculated as:

$$E = \sum_{t=0}^{N} E_{-t} * (1 - P_t)$$

Where:
- E_{-t} is the number of lives exposed to risk t months prior to reserving.

Then the expected number of deaths is E * q' and the variance of the number of deaths E * q' * (1 − q') where q' = q ÷ 12. To allow for the possibility of the number of deaths being two standard deviations in excess of the expected number, the reserve should be increased by a factor of:

$$2 \sqrt{\frac{(1 - q')}{E * q'}}$$

The situation with sickness and unemployment claims IBNR is similar, but complicated by the allowance which must be made for the duration of each claim. If we take the same general approach, we will look several months back and note the premium earned and monthly benefits exposed to risk at that time. We might

then estimate the IBNR as:

$$\sum_{t=0}^{N}(1-P_t) * MB_{-t} * i * a \div 12$$

Where: MB_{-t} is the monthly benefit at risk t months before reserving.
i is the annual inception rate for claims of this type.
a is the average duration of claims of this type.

A problem may be estimating a in this equation. The appropriate value of a for any particular scheme will depend on:

- The length of the waiting period.
- The payment rules (franchise, elimination or monthly).
- The maximum benefit period, if any.
- The distibution of policy terms in the portfolio.
- The sales pattern in the previous years.

Another problem will arise with i. This will vary from scheme to scheme – for one scheme to have a claim inception rate of double that of another scheme is far from uncommon, and differences in magnitude for a of this size are also quite normal. Overall this will not matter, but when large proportions of underwriting profit are being returned to the lender as profit commission, the use of company wide averages will lead to early release of commission in some cases where it may not be warranted, and to deteriorating relations between insurer and lender if reserves are clearly delaying unjustifiably the release of profit commissions. This argues for the use of parameters based on the rules and sales pattern (a) and experience (i) of each scheme. This would be an ideal situation, but with the number of possible combinations, it may well be impracticable.

An alternative approach is to base the IBNR on the loss ratio of each scheme. A suitable approach would be to investigate delay patterns in the receipt of claims, from their inception. A suitable formula is then:

$$\sum_{t=1}^{N} q_t * EP_{-t} * lr$$

Where: q_t is the proportion of claims still to be received t–½ month after occurrence
EP_{-t} is the premium earned in the t th month before reserving
lr is the loss ratio
N is a suitable time horizon

The loss ratio would have to be calculated allowing in the numerator for outstanding claims and for IBNR, which makes the formula circular. Alternatively, IBNR could be allowed for in the denominator by deducting the proportions of each month's earned premium which were expected to correspond to claims incurred but not reported.

Again, a margin for safety is necessary, since the loss ratio recorded will be a random variable, and may be understated. A credibility type formula, based on the number of claims which compose the losses used to calculate the loss ratio, is a possibility. In this case, the loss ratio would be raised by a proportion to ensure a suitable probability, 95% say, that the actual losses recorded plus the margin, exceeded the true mean.

Outstanding claims may be dealt with on a claim by claim basis. Assuming the claim file includes details of the maximum number of payments which may be made if there is no recovery (either because this datum is placed on the claim file or by cross reference to policy conditions and termination dates), the reserve is simply the sum of these future payments, multipled by the probability that each future payment is made, given the duration already reached. This involves the specification of the recovery curve, but once that is specified the mathematics involved is actuarially very simple. Ideally, different probabilities would be used for monthly and daily paid claims, but the difference is not very great, especially after a claim has been going some months, when recovery tends to be very slow.

This will tend to overstate the reserve. The reason for this is that many claims are never closed. The insured recovers and simply does not collect his next instalment. This is especially so for monthly schemes, where the insured will not be entitled to another instalment, but may also happen on daily schemes, where the insured will be entitled to claim for the period from the last payment to recovery. Either recovery is soon after the last payment, and the insured does not consider the amount worth collecting, or else having returned to work and income, claiming against a loan or credit card debt is no longer a matter of financial urgency. Either the insurer must chase up outstanding claims in order to clear them from the books, or else develop a probability distribution relating the probability of a further instalment being paid to the time since the last one was claimed.

Cash Flow

A creditor insurer generally offers large profit sharing commission. As discussed above, this can even be 100% of profits. In this situation the possibility of investment income is, if anything, even more fundamental to the profitability of the office than to other companies, since the opportunities for making underwriting profits are tightly circumscribed or even removed entirely. If a 100% rebate of profit is offered to the lender, then the insurer's only sources of profit are the expense allowance, after it has been used to pay for expenses and any underwriting losses, and investment income.

Most creditor insurance consists of single premium policies, covering several years of risk. Even though initital commissions are a high proportion of the premium, this is well designed to give a significant investment income. Exactly

how much depends, of course, on the design and performance of particular schemes, and the precise rules for paying profit commission. If a scheme turns out to be more profitable than anticipated this will generally work to the advantage of the insurer, since the payment of profit commission is generally longer delayed than that of claims. However this situation may not last too long, as the lender is then in an excellent position to press for a higher initial commission.

On one set of assumptions which we believe to be realistic (see appendix 1), the total investment earnings on a portfolio of 36 month policies are 8.3% of gross premiums when funds may be invested at 10% per annum. Compared with some very long tailed business this may not seem a great deal, but compared to the insurer's typical allowance for expenses it is a great deal. Certainly it is liable to be very much greater than any profit margin in the expense allowance.

Solvency

The insurer has two basic sources of income – the interest on reserves and the expense allowance in the premium. There is also his share of the profit on any schemes which do not have 100% profit share arrangements. Against this must be set outgo of expenses of management, and any claims in excess of the claims fund on schemes which make a loss.

The insurer will be subject to the normal solvency requirements of any authorised U.K. insurer, and will therefore have to have free capital of between 16% and 18% of premiums. (The claims basis is not normally relevant, since the claims ratios are usually low.) However, the DTI, shareholders and customers are unlikely to be satisfied with a margin very close to the minimum, even though the variations in claims likely to have to be supported is small. Nevertheless, there is no need for a lavish capital base. Unless there are some special circumstances, a company writing only creditor insurance would probably consider itself comfortably capitalised on a solvency margin of 25%.

The theoretical margin required to support claims variations will depend on the nature of the business being written. If most of the business is on the basis of a 100% profit share, then the margin is required only for supporting claims which exceed the claims fund. How much this is depends on the size of the margin allowed for profit commission in premium rate calculations. At the other extreme, a company that did not give any profit commissions will have to support all claims variations from its solvency margin. One problem is that claims experience is likely to be cyclical. This applies especially to unemployment claims which naturally tend to be highest when the unemployment rate is rising (not necessarily when it is high), but it is noticeable that sickness claims tend to follow the same cycle to some extent. This type of claims variation requires a higher solvency margin than one where the variations in claims are simply random. The solvency margin held must also be sufficient, of course, to fund the expenses of running

down the company if it were closed to new business.

(As noted above, this type of insurance generates significant excess expenses in the life fund. These may allow scope for the sale of other types of policy which use this up. This is a further source of profit, but requires further capital support. Since these policies have been considered beyond the scope of this paper, so will these further considerations.)

Appendix 1 Projection of cash flow for a creditor insurance contract

Assumptions:

- Term of policies in months: 36
- New premium per month: £1,000
- Annual interest rate received: 10.0%
- Expenses onf total premium: 10.0%
  (Assumed to be incurred half when premium written and half when earned.)
- Premiums are earned in accordance with methods discussed in the text.
- The contract is closed to new business after 100 months.

Proportion of premium :

- Rate of initial commission: 40%
- Claims ratio: 40%
- Insurer's expense allowance: 10%
- Returned as profit commission: 10%

Claims are assumed to be paid 24% in the month following inception, then in reducing amounts over the ensuing year.
Profit commission is paid quarterly.

Month	Premium written	Comm'n	UEP	EP	Expenses	Claims arising	Claims paid	EP net of commn and exps	Claims + reserves	Profit comm'n	Net cash flow	Cash balance	Reserves needed	Interest
0	£1,000	£400	£979	£21	£51	£8	£0	£10	£8		£549	£549	£596	0
1	£1,000	£400	£1,918	£61	£53	£24	£2	£41	£33		£545	£1,094	£1,182	£5
2	£1,000	£400	£2,817	£101	£55	£40	£8	£91	£73	£18	£519	£1,613	£1,754	£9
3	£1,000	£400	£3,678	£140	£57	£56	£16	£161	£129		£527	£2,140	£2,309	£13
4	£1,000	£400	£4,499	£178	£59	£71	£27	£250	£200		£515	£2,654	£2,847	£18
5	£1,000	£400	£5,284	£216	£61	£96	£38	£358	£287	£53	£448	£3,102	£3,366	£22
6	£1,000	£400	£6,031	£253	£63	£101	£51	£484	£388		£467	£3,589	£3,865	£26
7	£1,000	£400	£6,742	£289	£64	£115	£63	£629	£503		£472	£4,061	£4,344	£30
8	£1,000	£400	£7,419	£324	£66	£130	£77	£791	£633	£86	£371	£4,431	£4,802	£34
9	£1,000	£400	£8,060	£358	£68	£143	£90	£970	£776		£442	£4,873	£5,240	£37
10	£1,000	£400	£8,668	£392	£70	£157	£104	£1,166	£933		£427	£5,300	£5,658	£41
11	£1,000	£400	£9,243	£425	£71	£170	£118	£1,379	£1,103	£118	£294	£5,593	£6,056	£44
12	£1,000	£400	£9,785	£457	£73	£183	£131	£1,607	£1,286		£396	£5,989	£6,433	£47
13	£1,000	£400	£10,296	£489	£74	£196	£145	£1,852	£1,481		£380	£6,370	£6,790	£50
14	£1,000	£400	£10,777	£520	£76	£208	£159	£2,112	£1,689	£147	£219	£6,588	£7,127	£53
15	£1,000	£400	£11,227	£550	£77	£220	£172	£2,387	£1,909		£351	£6,939	£7,446	£55
16	£1,000	£400	£11,648	£579	£79	£232	£185	£2,676	£2,141		£336	£7,276	£7,745	£58
17	£1,000	£400	£12,040	£608	£80	£243	£197	£2,980	£2,384	£174	£149	£7,424	£8,026	£61
18	£1,000	£400	£12,405	£635	£82	£254	£209	£3,298	£2,638		£309	£7,733	£8,290	£62
19	£1,000	£400	£12,742	£662	£83	£265	£221	£3,629	£2,903		£296	£8,029	£8,536	£64
20	£1,000	£400	£13,053	£689	£84	£275	£233	£3,973	£3,179	£199	£84	£8,113	£8,766	£67
21	£1,000	£400	£13,339	£714	£86	£286	£244	£4,330	£3,464		£270	£8,383	£8,978	£68
22	£1,000	£400	£13,600	£739	£87	£296	£255	£4,700	£3,760		£258	£8,641	£9,175	£70
23	£1,000	£400	£13,837	£763	£88	£305	£266	£5,081	£4,065	£222	£24	£8,665	£9,357	£72
24	£1,000	£400	£14,051	£786	£89	£315	£277	£5,475	£4,380		£234	£8,899	£9,523	£72
25	£1,000	£400	£14,242	£809	£90	£324	£287	£5,879	£4,703		£223	£9,122	£9,674	£74
26	£1,000	£400	£14,411	£831	£92	£332	£297	£6,294	£5,035	£243	(£31)	£9,091	£9,812	£76
27	£1,000	£400	£14,560	£852	£93	£341	£306	£6,720	£5,376		£201	£9,293	£9,935	£76
28	£1,000	£400	£14,688	£872	£94	£349	£315	£7,156	£5,725		£191	£9,484	£10,046	£77
29	£1,000	£400	£14,796	£891	£95	£357	£324	£7,602	£6,081	£261	(£80)	£9,403	£10,143	£79
30	£1,000	£400	£14,886	£910	£96	£364	£333	£8,057	£6,446		£172	£9,575	£10,228	£78
31	£1,000	£400	£14,958	£928	£96	£371	£341	£8,521	£6,817		£162	£9,737	£10,301	£80
32	£1,000	£400	£15,012	£945	£97	£378	£349	£8,994	£7,195	£278	(£125)	£9,613	£10,363	£81
33	£1,000	£400	£15,050	£962	£98	£385	£357	£9,475	£7,580		£145	£9,757	£10,414	£80
34	£1,000	£400	£15,073	£978	£99	£391	£364	£9,964	£7,971		£137	£9,894	£10,454	£81
35	£1,000	£400	£15,080	£993	£100	£397	£372	£10,460	£8,368	£293	(£164)	£9,730	£10,484	£82
36	£1,000	£400	£15,080	£1,000	£100	£400	£378	£10,960	£8,768		£122	£9,851	£10,505	£81
37	£1,000	£400	£15,080	£1,000	£100	£400	£384	£11,460	£9,168		£116	£9,967	£10,521	£82
38	£1,000	£400	£15,080	£1,000	£100	£400	£389	£11,960	£9,568	£300	(£189)	£9,778	£10,532	£83
39	£1,000	£400	£15,080	£1,000	£100	£400	£392	£12,460	£9,968		£108	£9,887	£10,541	£81
40	£1,000	£400	£15,080	£1,000	£100	£400	£394	£12,960	£10,368		£106	£9,993	£10,547	£82
41	£1,000	£400	£15,080	£1,000	£100	£400	£396	£13,460	£10,768	£300	(£196)	£9,797	£10,551	£83
42	£1,000	£400	£15,080	£1,000	£100	£400	£397	£13,960	£11,168		£103	£9,900	£10,554	£82
43	£1,000	£400	£15,080	£1,000	£100	£400	£398	£14,460	£11,568		£102	£10,002	£10,556	£82
44	£1,000	£400	£15,080	£1,000	£100	£400	£399	£14,960	£11,968	£300	(£199)	£9,803	£10,557	£83
45	£1,000	£400	£15,080	£1,000	£100	£400	£399	£15,460	£12,368		£101	£9,904	£10,558	£82
46	£1,000	£400	£15,080	£1,000	£100	£400	£400	£15,960	£12,768		£100	£10,004	£10,558	£83
47	£1,000	£400	£15,080	£1,000	£100	£400	£400	£16,460	£13,168	£300	(£200)	£9,804	£10,558	£83
48	£1,000	£400	£15,080	£1,000	£100	£400	£400	£16,960	£13,568		£100	£9,904	£10,558	£82
49	£1,000	£400	£15,080	£1,000	£100	£400	£400	£17,460	£13,968		£100	£10,004	£10,558	£83
50	£1,000	£400	£15,080	£1,000	£100	£400	£400	£17,960	£14,368	£300	(£200)	£9,804	£10,558	£83
51	£1,000	£400	£15,080	£1,000	£100	£400	£400	£18,460	£14,768		£100	£9,904	£10,558	£82
52	£1,000	£400	£15,080	£1,000	£100	£400	£400	£18,960	£15,168		£100	£10,004	£10,558	£83
53	£1,000	£400	£15,080	£1,000	£100	£400	£400	£19,460	£15,568	£300	(£200)	£9,804	£10,558	£83
54	£1,000	£400	£15,080	£1,000	£100	£400	£400	£19,960	£15,968		£100	£9,904	£10,558	£82
55	£1,000	£400	£15,080	£1,000	£100	£400	£400	£20,460	£16,368		£100	£10,004	£10,558	£83
56	£1,000	£400	£15,080	£1,000	£100	£400	£400	£20,960	£16,768	£300	(£200)	£9,804	£10,558	£83
57	£1,000	£400	£15,080	£1,000	£100	£400	£400	£21,460	£17,168		£100	£9,904	£10,558	£82
58	£1,000	£400	£15,080	£1,000	£100	£400	£400	£21,960	£17,568		£100	£10,004	£10,558	£83
59	£1,000	£400	£15,080	£1,000	£100	£400	£400	£22,460	£17,968	£300	(£200)	£9,804	£10,558	£83
60	£1,000	£400	£15,080	£1,000	£100	£400	£400	£22,960	£18,368		£100	£9,904	£10,558	£82
61	£1,000	£400	£15,080	£1,000	£100	£400	£400	£23,460	£18,768		£100	£10,004	£10,558	£83
62	£1,000	£400	£15,080	£1,000	£100	£400	£400	£23,960	£19,168	£300	(£200)	£9,804	£10,558	£83
63	£1,000	£400	£15,080	£1,000	£100	£400	£400	£24,460	£19,568		£100	£9,904	£10,558	£82
64	£1,000	£400	£15,080	£1,000	£100	£400	£400	£24,960	£19,968		£100	£10,004	£10,558	£83
65	£1,000	£400	£15,080	£1,000	£100	£400	£400	£25,460	£20,368	£300	(£200)	£9,804	£10,558	£83

66	£1,000	£400	£15,060	£1,000	£100	£400	£400	£25,960	£20,766		£100	£9,904	£10,558	£82
67	£1,000	£400	£15,080	£1,000	£100	£400	£400	£26,460	£21,166		£100	£10,004	£10,558	£83
68	£1,000	£400	£15,080	£1,000	£100	£400	£400	£26,960	£21,566	£300	(£200)	£9,804	£10,558	£83
69	£1,000	£400	£15,080	£1,000	£100	£400	£400	£27,460	£21,966		£100	£9,904	£10,558	£82
70	£1,000	£400	£15,080	£1,000	£100	£400	£400	£27,960	£22,366		£100	£10,004	£10,558	£83
71	£1,000	£400	£15,080	£1,000	£100	£400	£400	£28,460	£22,766	£300	(£200)	£9,804	£10,558	£83
72	£1,000	£400	£15,080	£1,000	£100	£400	£400	£28,960	£23,166		£100	£9,904	£10,558	£82
73	£1,000	£400	£15,080	£1,000	£100	£400	£400	£29,460	£23,566		£100	£10,004	£10,558	£83
74	£1,000	£400	£15,080	£1,000	£100	£400	£400	£29,960	£23,966	£300	(£200)	£9,804	£10,558	£83
75	£1,000	£400	£15,080	£1,000	£100	£400	£400	£30,460	£24,366		£100	£9,904	£10,558	£82
76	£1,000	£400	£15,080	£1,000	£100	£400	£400	£30,960	£24,766		£100	£10,004	£10,558	£83
77	£1,000	£400	£15,080	£1,000	£100	£400	£400	£31,460	£25,166	£300	(£200)	£9,804	£10,558	£83
78	£1,000	£400	£15,080	£1,000	£100	£400	£400	£31,960	£25,566		£100	£9,904	£10,558	£82
79	£1,000	£400	£15,080	£1,000	£100	£400	£400	£32,460	£25,966		£100	£10,004	£10,558	£83
80	£1,000	£400	£15,080	£1,000	£100	£400	£400	£32,960	£26,366	£300	(£200)	£9,804	£10,558	£83
81	£1,000	£400	£15,080	£1,000	£100	£400	£400	£33,460	£26,766		£100	£9,904	£10,558	£82
82	£1,000	£400	£15,080	£1,000	£100	£400	£400	£33,960	£27,166		£100	£10,004	£10,558	£83
83	£1,000	£400	£15,080	£1,000	£100	£400	£400	£34,460	£27,566	£300	(£200)	£9,804	£10,558	£83
84	£1,000	£400	£15,080	£1,000	£100	£400	£400	£34,960	£27,966		£100	£9,904	£10,558	£82
85	£1,000	£400	£15,080	£1,000	£100	£400	£400	£35,460	£28,366		£100	£10,004	£10,558	£83
86	£1,000	£400	£15,080	£1,000	£100	£400	£400	£35,960	£28,766	£300	(£200)	£9,804	£10,558	£83
87	£1,000	£400	£15,080	£1,000	£100	£400	£400	£36,460	£29,166		£100	£9,904	£10,558	£82
88	£1,000	£400	£15,080	£1,000	£100	£400	£400	£36,960	£29,566		£100	£10,004	£10,558	£83
89	£1,000	£400	£15,080	£1,000	£100	£400	£400	£37,460	£29,966	£300	(£200)	£9,804	£10,558	£83
90	£1,000	£400	£15,080	£1,000	£100	£400	£400	£37,960	£30,366		£100	£9,904	£10,558	£82
91	£1,000	£400	£15,080	£1,000	£100	£400	£400	£38,460	£30,766		£100	£10,004	£10,558	£83
92	£1,000	£400	£15,080	£1,000	£100	£400	£400	£38,960	£31,166	£300	(£200)	£9,804	£10,558	£83
93	£1,000	£400	£15,080	£1,000	£100	£400	£400	£39,460	£31,566		£100	£9,904	£10,558	£82
94	£1,000	£400	£15,080	£1,000	£100	£400	£400	£39,960	£31,966		£100	£10,004	£10,558	£83
95	£1,000	£400	£15,080	£1,000	£100	£400	£400	£40,460	£32,366	£300	(£200)	£9,804	£10,558	£83
96	£1,000	£400	£15,080	£1,000	£100	£400	£400	£40,960	£32,766		£100	£9,904	£10,558	£82
97	£1,000	£400	£15,080	£1,000	£100	£400	£400	£41,460	£33,166		£100	£10,004	£10,558	£83
98	£1,000	£400	£15,080	£1,000	£100	£400	£400	£41,960	£33,566	£300	(£200)	£9,804	£10,558	£83
99	£1,000	£400	£15,080	£1,000	£100	£400	£400	£42,460	£33,966		£100	£9,904	£10,558	£82
100	£1,000	£400	£15,080	£1,000	£100	£400	£400	£42,960	£34,366		£100	£10,004	£10,558	£83
101	£0	£0	£14,101	£979	£49	£392	£400	£43,450	£34,760	£298	(£747)	£9,257	£9,962	£83
102	£0	£0	£13,162	£939	£47	£376	£398	£43,919	£35,135		(£445)	£8,812	£9,376	£77
103	£0	£0	£12,262	£899	£45	£360	£392	£44,369	£35,495		(£437)	£8,375	£8,804	£73
104	£0	£0	£11,402	£860	£43	£344	£384	£44,799	£35,839	£270	(£897)	£7,678	£8,248	£70
105	£0	£0	£10,581	£822	£41	£329	£373	£45,210	£36,168		(£415)	£7,264	£7,711	£64
106	£0	£0	£9,796	£784	£39	£314	£362	£45,602	£36,481		(£401)	£6,863	£7,192	£61
107	£0	£0	£9,049	£747	£37	£299	£349	£45,976	£36,780	£235	(£622)	£6,241	£6,693	£57
108	£0	£0	£8,337	£711	£36	£285	£337	£46,331	£37,065		(£372)	£5,868	£6,214	£52
109	£0	£0	£7,661	£676	£34	£270	£323	£46,669	£37,335		(£357)	£5,511	£5,756	£49
110	£0	£0	£7,020	£642	£32	£257	£310	£46,990	£37,592	£203	(£545)	£4,967	£5,318	£46
111	£0	£0	£6,412	£608	£30	£243	£296	£47,294	£37,835		(£327)	£4,640	£4,900	£41
112	£0	£0	£5,837	£575	£29	£230	£282	£47,581	£38,065		(£311)	£4,329	£4,502	£39
113	£0	£0	£5,295	£543	£27	£217	£269	£47,853	£38,282	£173	(£468)	£3,861	£4,125	£36
114	£0	£0	£4,784	£511	£26	£204	£255	£48,108	£38,487		(£280)	£3,580	£3,768	£32
115	£0	£0	£4,303	£480	£24	£192	£241	£48,348	£38,679		(£265)	£3,315	£3,431	£30
116	£0	£0	£3,853	£450	£23	£180	£228	£48,573	£38,859	£144	(£398)	£2,920	£3,112	£28
117	£0	£0	£3,432	£421	£21	£168	£215	£48,784	£39,027		(£236)	£2,683	£2,813	£24
118	£0	£0	£3,040	£392	£20	£157	£203	£48,980	£39,184		(£223)	£2,461	£2,531	£22
119	£0	£0	£2,675	£365	£18	£146	£191	£49,162	£39,330	£118	(£327)	£2,134	£2,268	£21
120	£0	£0	£2,338	£338	£17	£135	£179	£49,331	£39,465		(£196)	£1,939	£2,022	£18
121	£0	£0	£2,027	£311	£16	£125	£167	£49,487	£39,589		(£183)	£1,756	£1,792	£16
122	£0	£0	£1,741	£286	£14	£114	£156	£49,630	£39,704	£93	(£263)	£1,492	£1,580	£15
123	£0	£0	£1,480	£261	£13	£104	£145	£49,760	£39,808		(£158)	£1,335	£1,383	£12
124	£0	£0	£1,243	£237	£12	£95	£134	£49,879	£39,903		(£146)	£1,189	£1,201	£11
125	£0	£0	£1,029	£214	£11	£86	£123	£49,985	£39,988	£71	(£205)	£984	£1,035	£10
126	£0	£0	£838	£191	£10	£76	£113	£50,081	£40,065		(£123)	£861	£884	£8
127	£0	£0	£669	£169	£8	£68	£103	£50,166	£40,133		(£112)	£749	£746	£7
128	£0	£0	£520	£148	£7	£59	£94	£50,240	£40,192	£51	(£152)	£597	£623	£6
129	£0	£0	£392	£128	£6	£51	£85	£50,304	£40,243		(£91)	£505	£512	£5
130	£0	£0	£284	£109	£5	£43	£78	£50,358	£40,287		(£81)	£424	£415	£4
131	£0	£0	£194	£90	£4	£36	£67	£50,403	£40,322	£33	(£104)	£320	£330	£4
132	£0	£0	£122	£72	£4	£29	£59	£50,439	£40,351		(£62)	£258	£256	£3
133	£0	£0	£67	£55	£3	£22	£51	£50,466	£40,373		(£53)	£204	£195	£2
134	£0	£0	£29	£38	£2	£15	£43	£50,485	£40,388	£16	(£81)	£143	£144	£2
135	£0	£0	£7	£22	£1	£9	£36	£50,498	£40,397		(£37)	£106	£104	£1
136	£0	£0	£0	£7	£0	£3	£28	£50,500	£40,400		(£29)	£77	£74	£1
137	£0	£0	£0	£0	£0	£0	£22	£50,500	£40,400	£3	(£25)	£53	£53	£1
138	£0	£0	£0	£0	£0	£0	£16	£50,500	£40,400		(£16)	£37	£37	£0
139	£0	£0	£0	£0	£0	£0	£11	£50,500	£40,400		(£11)	£26	£26	£0
140	£0	£0	£0	£0	£0	£0	£8	£50,500	£40,400	£0	(£8)	£17	£17	£0
141	£0	£0	£0	£0	£0	£0	£6	£50,500	£40,400		(£6)	£11	£11	£0
142	£0	£0	£0	£0	£0	£0	£4	£50,500	£40,400		(£4)	£7	£7	£0
143	£0	£0	£0	£0	£0	£0	£3	£50,500	£40,400	£0	(£3)	£4	£4	£0
144	£0	£0	£0	£0	£0	£0	£2	£50,500	£40,400		(£2)	£2	£2	£0
145	£0	£0	£0	£0	£0	£0	£1	£50,500	£40,400		(£1)	£1	£1	£0
146	£0	£0	£0	£0	£0	£0	£1	£50,500	£40,400	£0	(£1)	£0	£0	£0
	£101,000	£40,400	£0	£101,000	£10,100	£40,400	£40,400	£50,500	£40,400	£10,100	£0	£0	£0	£8,336

Appendix 2 Calculation of a Premium rate

Policy is to cover a 12 month loan, against death or disability. The terms of the disability cover are 14 day exclusion, with no limit on the number of payments.

Basis: Mortality: Constant mortality rate of 0.00416. (Corresponds to q_{45},ELT13, amle.)

Interest: 1% per month flat.

Premium structure:
5% profit sharing fund
35% initial commission
15% insurer's expenses
45% claims

Disability inception rate: ½% per month.

The calculation is to be made on the basis of a year consisting of twelve months of thirty days each.

Disability recovery function: Of 10000 sick at day, a constant recovery rate for the first month means that 50% are recovered after 30 days, and thereafter 20% recover each month. This gives us:

x	lx	$l^x_{t=0}$	$l^{x\ x-t}_{t=0\ u=0}$	x	lx	$l^x_{t=0}$	$l^{x\ x-t}_{t=0\ u=0}$
0	10000	10000	10000	180	1638	674177	77727753
1	9772	19772	29772	181	1626	675804	78403557
2	9548	29320	59092	182	1614	677418	79080975
3	9330	38650	97742	183	1602	679020	79759995
4	9117	47768	145510	184	1590	680611	80440605
5	8909	56677	202186	185	1579	682189	81122795
6	8706	65382	267568	186	1567	683756	81806551
7	8507	73889	341457	187	1555	685311	82491862
8	8312	82201	423658	188	1544	686855	83178717
9	8123	90324	513982	189	1532	688387	83867104
10	7937	98261	612242	190	1521	689908	84557012
11	7756	106016	718259	191	1510	691418	85248430
12	7579	113595	831854	192	1498	692916	85941347
13	7405	121000	952854	193	1487	694404	86635751
14	7236	128237	1081091	194	1476	695880	87331631
15	7071	135308	1216399	195	1465	697346	88028976
16	6910	142217	1358616	196	1455	698800	88727777
17	6752	148969	1507585	197	1444	700244	89428021
18	6598	155567	1663152	198	1433	701677	90129698
19	6447	162014	1825166	199	1422	703100	90832797
20	6300	168313	1993479	200	1412	704512	91537309
21	6156	174469	2167948	201	1401	705913	92243222
22	6015	180484	2348432	202	1391	707304	92950526
23	5878	186362	2534793	203	1381	708685	93659211
24	5743	192105	2726899	204	1371	710055	94369266
25	5612	197718	2924616	205	1360	711416	95080682
26	5484	203202	3127818	206	1350	712766	95793448
27	5359	208561	3336378	207	1340	714106	96507554
28	5236	213797	3550175	208	1330	715437	97222991
29	5117	218914	3769089	209	1321	716757	97939748
30	5000	223914	3993003	210	1311	718068	98657816
31	4963	228877	4221880	211	1301	719369	99377185
32	4926	233803	4455683	212	1291	720660	100097845
33	4890	238693	4694376	213	1282	721942	100819787
34	4853	243546	4937922	214	1272	723214	101543002

35	4817	248364	5186285	215	1263	724477	102267479
36	4782	253145	5439431	216	1254	725731	102993210
37	4746	257892	5697322	217	1244	726975	103720185
38	4711	262603	5959925	218	1235	728210	104448395
39	4676	267279	6227204	219	1226	729436	105177831
40	4642	271921	6499125	220	1217	730653	105908483
41	4607	276528	6775653	221	1208	731860	106640344
42	4573	281101	7056753	222	1199	733059	107373403
43	4539	285640	7342393	223	1190	734249	108107652
44	4506	290146	7632539	224	1181	735430	108843082
45	4472	294618	7927157	225	1172	736603	109579685
46	4439	299057	8226213	226	1164	737766	110317451
47	4406	303463	8529676	227	1155	738921	111056372
48	4373	307836	8837512	228	1146	740068	111796440
49	4341	312177	9149690	229	1138	741206	112537645
50	4309	316486	9466176	230	1130	742335	113279981
51	4277	320763	9786939	231	1121	743456	114023437
52	4245	325008	10111947	232	1113	744569	114768006
53	4214	329222	10441169	233	1105	745674	115513680
54	4183	333405	10774574	234	1096	746770	116260450
55	4152	337556	11112130	235	1088	747859	117008309
56	4121	341677	11453807	236	1080	748939	117757248
57	4090	345767	11799575	237	1072	750011	118507259
58	4060	349827	12149402	238	1064	751075	119258334
59	4030	353857	12503259	239	1056	752132	120010466
60	4000	357857	12861116	240	1049	753180	120763646
61	3970	361827	13222943	241	1041	754221	121517868
62	3941	365768	13588712	242	1033	755254	122273122
63	3912	369680	13958392	243	1025	756280	123029402
64	3883	373563	14331955	244	1018	757298	123786699
65	3854	377417	14709372	245	1010	758308	124545007
66	3825	381242	15090614	246	1003	759311	125304317
67	3797	385039	15475653	247	995	760306	126064623
68	3769	388808	15864462	248	988	761294	126825917
69	3741	392549	16257011	249	981	762275	127588192
70	3713	396263	16653273	250	973	763248	128351440
71	3686	399948	17053222	251	966	764214	129115655
72	3658	403607	17456828	252	959	765173	129880828
73	3631	407238	17864066	253	952	766125	130646953
74	3604	410842	18274909	254	945	767070	131414023
75	3578	414420	18689329	255	938	768008	132182031
76	3551	417971	19107300	256	931	768939	132950970
77	3525	421496	19528796	257	924	769863	133720833
78	3499	424995	19953791	258	917	770780	134491613
79	3473	428468	20382259	259	910	771691	135263304
80	3447	431915	20814174	260	904	772594	136035898
81	3422	435336	21249511	261	897	773491	136809389
82	3396	438733	21688243	262	890	774381	137583771
83	3371	442104	22130347	263	884	775265	138359036
84	3346	445450	22575797	264	877	776142	139135178
85	3321	448771	23024568	265	871	777013	139912191
86	3297	452068	23476635	266	864	777877	140690068
87	3272	455340	23931975	267	858	778735	141468803
88	3248	458588	24390563	268	851	779586	142248389
89	3224	461812	24852375	269	845	780431	143028820
90	3200	465012	25317386	270	839	781270	143810091
91	3176	468188	25785574	271	833	782103	144592194
92	3153	471341	26256915	272	826	782929	145375123
93	3129	474470	26731385	273	820	783750	146158873
94	3106	477576	27208961	274	814	784564	146943437
95	3083	480659	27689621	275	808	785372	147728809
96	3060	483720	28173341	276	802	786175	148514984
97	3038	486757	28660098	277	796	786971	149301954

98	3015	489773	29149871	278	790	787761	150089716
99	2993	492765	29642636	279	785	788546	150878261
100	2971	495736	30138372	280	779	789324	151667586
101	2949	498685	30637057	281	773	790097	152457683
102	2927	501611	31138668	282	767	790865	153248548
103	2905	504516	31643185	283	762	791626	154040174
104	2884	507400	32150585	284	756	792382	154832556
105	2862	510262	32660847	285	750	793132	155625689
106	2841	513103	33173950	286	745	793877	156419566
107	2820	515923	33689873	287	739	794616	157214182
108	2799	518722	34208595	288	734	795350	158009532
109	2778	521500	34730095	289	728	796078	158805611
110	2758	524258	35254353	290	723	796801	159602412
111	2737	526995	35781348	291	718	797519	160399931
112	2717	529712	36311060	292	712	798231	161198162
113	2697	532409	36843469	293	707	798938	161997100
114	2677	535086	37378555	294	702	799640	162796740
115	2657	537743	37916298	295	697	800336	163597076
116	2637	540380	38456678	296	691	801028	164398104
117	2618	542998	38999676	297	686	801714	165199818
118	2598	545596	39545272	298	681	802395	166002213
119	2579	548175	40093447	299	676	803071	166805284
120	2560	550735	40644183	300	671	803742	167609026
121	2541	553276	41197459	301	666	804408	168413434
122	2522	555799	41753258	302	661	805070	169218504
123	2504	558302	42311560	303	656	805726	170024230
124	2485	560787	42872347	304	651	806377	170830607
125	2467	563254	43435600	305	647	807024	171637631
126	2448	565702	44001302	306	642	807666	172445296
127	2430	568132	44569434	307	637	808303	173253599
128	2412	570544	45139978	308	632	808935	174062534
129	2394	572938	45712916	309	628	809563	174872097
130	2376	575315	46288231	310	623	810186	175682282
131	2359	577674	46865905	311	618	810804	176493086
132	2341	580015	47445920	312	614	811418	177304504
133	2324	582339	48028259	313	609	812027	178116531
134	2307	584646	48612905	314	605	812632	178929162
135	2290	586936	49199841	315	600	813232	179742394
136	2273	589208	49789049	316	596	813828	180556222
137	2256	591464	50380514	317	591	814419	181370641
138	2239	593704	50974217	318	587	815006	182185647
139	2223	595926	51570143	319	583	815589	183001236
140	2206	598132	52168276	320	578	816167	183817403
141	2190	600322	52768598	321	574	816741	184634144
142	2174	602496	53371094	322	570	817311	185451455
143	2157	604653	53975747	323	566	817876	186269332
144	2141	606795	54582541	324	561	818438	187087769
145	2126	608920	55191462	325	557	818995	187906764
146	2110	611030	55802492	326	553	819548	188726313
147	2094	613124	56415616	327	549	820097	189546410
148	2079	615203	57030819	328	545	820642	190367052
149	2063	617266	57648085	329	541	821183	191188235
150	2048	619314	58267400	330	537	821720	192009954
151	2033	621347	58888747	331	533	822253	192832207
152	2018	623365	59512112	332	529	822782	193654989
153	2003	625368	60137479	333	525	823307	194478295
154	1988	627356	60764835	334	521	823828	195302123
155	1973	629329	61394164	335	517	824345	196126468
156	1959	631287	62025451	336	513	824858	196951327
157	1944	633232	62658683	337	510	825368	197776695
158	1930	635161	63293844	338	506	825874	198602569
159	1915	637077	63930921	339	502	826376	199428945
160	1901	638978	64569899	340	498	826874	200255819

161	1887	640865	65210763	341	495	827369	201083188
162	1873	642738	65853502	342	491	827860	201911049
163	1859	644597	66498099	343	487	828348	202739396
164	1845	646443	67144542	344	484	828831	203568228
165	1832	648275	67792816	345	480	829312	204397539
166	1818	650093	68442909	346	477	829788	205227327
167	1805	651898	69094806	347	473	830261	206057589
168	1791	653689	69748495	348	470	830731	206888319
169	1778	655467	70403962	349	466	831197	207719516
170	1765	657232	71061194	350	463	831660	208551176
171	1752	658984	71720178	351	459	832119	209383295
172	1739	660723	72380900	352	456	832575	210215870
173	1726	662449	73043349	353	452	833027	211048897
174	1713	664162	73707511	354	449	833476	211882373
175	1700	665862	74373373	355	446	833922	212716295
176	1688	667550	75040923	356	442	834365	213550660
177	1675	669225	75710148	357	439	834804	214385463
178	1663	670888	76381037	358	436	835240	215220703
179	1651	672539	77053576	359	433	835672	216056375

Expected cost of death claims :

$$\frac{qL}{24} * (N + 1 + iN(N+5) / 3) =$$ (for a loan of 1000)

$0.00416 * 1000 \div 24 * (12 + 1 + .01 * 12 *(12 + 5)/3) = 2.3712$

The total amount repayable will be $1000 * (1 + .01 * 12) = 1120$

So the death cost per cent of T.A.R. is 0.211714.

Expected cost of disability claims (using the formula in the main paper):

$$\sum_{t=0}^{30*N-1} \left| \sum_{u=0}^{t} u \right. - (30N-w) \sum_{u=0}^{w-1} \left| u \right. - \sum_{t=0}^{w-1} \left| \sum_{u=0}^{t} u \right. =$$

$$\sum_{t=0}^{359} \left| \sum_{u=0}^{t} u \right. - 345 \sum_{u=0}^{13} \left| u \right. - \sum_{t=0}^{13} \left| \sum_{u=0}^{t} u \right. =$$

$216056375 - 345 * 121000 - 952854 = 210868521$

This must be divided by $30 * 30 * N * \left| \right._0 = 30 * 12 * 10000 = 10800000$, to give an expected benefit payment per claim of 1.9524 months' repayments. Since the total monthly repayments are twelve monthly repayments, this gives a claims cost per cent of total monthly repayments of

$1.9524 * ½\% * 12 * 100 \div 12 = 0.9762$

Total claims cost

$0.9762 + 0.2117 = 1.1880$ % of total amount repayable.

Gross premium rate

1.1880% + 45% = 2.64% of total amount repayeble.

It will be noted that this does depend on the interest rate charged, but the sensitivity is not great. If the interest rate were doubled to 2% flat per month, the gross premium rate should fall to 2.62%, a difference of only 1% for a very large change.

GENERAL INSURANCE CONVENTION 1991

EXPORT AND TRADE CREDIT INSURANCE

Paul Delbridge
Bryan Joseph

EXPORT AND TRADE CREDIT INSURANCE

TABLE OF CONTENTS

1. INTRODUCTION

This note concentrates on the various forms of Trade Credit Insurance. It introduces the insurance type and outlines some of the details and considerations which have to be taken into account when underwriting and reserving these policies. It also introduces the types of products and services being offered by the major companies in the Credit Insurance market. However, it does not discuss Factoring or other forms of insurance financing in any great detail.

Companies normally supply goods or services to corporate buyers accompanied by a delivery advice or note of the service(s) supplied. These notes are compiled and invoiced at a later date after which the buyer is expected to settle. Therefore there is a risk inherent in all trade that between the supply date and the expected settlement date the buyer may have become insolvent, bankrupt or gone into liquidation. The purpose of these insurances therefore is to indemnify companies against some of that risk.

Many of the issues relating to Domestic Trade Credit Insurance are the same for the commercial risks sector on Export Credit Insurance so the products are similar.

This paper attempts to highlight the special features of this class of insurance, and to show where actuaries can be involved in the rating, underwriting and reserving processes which surround it.

2. EXPORT CREDIT INSURANCE

The purpose of export credit insurance is to offer protection to exporters of goods or services who sell their products on credit terms. The exporter is insured against losses arising from a wide range of risks, which may be conveniently categorised into either commercial risks or political risks, although many private export credit insurers offer cover for commercial risks only. In order to protect the insurers in the private sector against adverse selection, an exporter is usually required to insure its entire book of export orders filled on credit terms, rather than being allowed to seek coverage in respect of countries where the peril is perceived to be the greatest.

2.1 Commercial Risks

These would generally include the following:-

(a) the insolvency of the purchaser;

(b) the default on payment by a private purchaser at the end of the credit period or after some specified period following the expiry of the agreed term of credit;

(c) non-acceptance of goods delivered to the purchaser, where such goods comply with any contracts in existence.

2.2 Political Risks

The scope for losses arising from risks of a political nature is wider than that in respect of commercial risks and would generally encompass all political events which have an impact on any contractual relationships covered by civil law, including the following:-

(a) cancellation or non-renewal of an insured's export licence after a contract has been struck;

(b) war and other such disturbances in the purchaser's country of domicile which affect the fulfilment of the contract;

(c) foreign currency conversion risks, ie difficulties and delays in remitting money from the purchaser's country, including losses arising as a result of a moratorium on external debt issued by that country's government;

(d) transfer risks (also referred to as "third country transfer risks") where one country can freeze the assets and bank accounts of another country held locally;

(e) any action of a foreign government which in some way hinders the enactment of the contract, including import/export restrictions, the confiscation or expropriation of goods and the nationalisation of corporations and industries;

(f) transactions between private exporters and public purchasers (ie the default on payment by a public purchaser).

2.3 Rationale Behind Export Credit Insurance

In its purest form, export credit insurance provides exporters of goods and services with a significant degree of financial security, thus allowing companies to pursue a bolder export policy, by accepting new purchasers and entering into new overseas markets, but with a smaller impact from the risks of non-payment and political instability. Indirect effects of the purchase of such insurance might include the use of policies as security against bank loans and other financial arrangements. The insurance content of such policies is typically supplemented by the extensive support services which are generally provided by export credit insurers. In particular, such insurers usually have access to extensive information from credit rating agencies and foreign embassies, and are able to provide information to their policyholders regarding the creditworthiness and trading records of potential purchasers of their goods. Such services may be charged for either on a standing charge basis, a per usage fee or may be built into the premium structure.

2.4 Extensions to the basic coverage offered can take many different forms. For example:-

(a) a manufacturer of specialist goods (which would not necessarily be resaleable elsewhere) might seek additional insurance from the date that the contract is struck to the date of shipment in order to protect against the risk of the purchaser being unable subsequently to fulfil its contractual obligations prior to completion of the manufacturing process;

(b) a policyholder with significant financial exposure arising from one-off products, for example, ship-building, would probably not be covered under the standard terms of its policies as a result of the high monetary values involved. Extensions to coverage in such circumstances might be granted on a discretionary case by case basis;

(c) an exporter may often need to offer credit terms longer than permitted under the policy's standard conditions, particularly where it is common practice within a specific manufacturing sector to do so.

2.5 **Limits of Indemnity**

Generally, cover is provided up to some specified percentage of any loss, typically between 80% and 95%. An excess may also be payable by the insured in respect of certain predetermined types of loss, with the limits of coverage applying to the balance of the claim amount. The element of co-insurance acts, to some extent, as a deterrent to the abuse of the coverage purchased; for example, exporters might otherwise simply claim on their policies rather than seek to effect a bad debt collection programme or find alternative purchasers for goods not taken up by the original buyer.

2.6 **Recoveries / Subrogation**

In any event, the export credit insurer will generally seek to effect recoveries on claims paid, either through the courts, via factors, through pressure from British embassies in the purchaser's country of domicile or via some other form of debt collection in order to offset individual losses. More typically, the goods concerned would be taken into the insurer's possession where possible and an alternative buyer sought. If, however, the insurer does not have the necessary administrative or resale capabilities, an arrangement may be entered into with the policyholder such that a specified proportion of any resale revenue is remitted to the insurer. A claim can therefore be settled quickly irrespective of any subsequent recovery prospects, thereby maintaining the insured's cash flow position, but still leaving the insurer free to pursue the possibility of effecting recoveries at a later stage.

2.7 **Who provides export credit insurance?**

Schemes are often operated by the governments of individual countries, as the potential volatility of this form of insurance means that only very large private insurers could weather exceptionally poor claims experience. Furthermore, reinsurance of this form of business is difficult to place in the commercial market owing to the substantial levels of coverage required. State schemes were therefore started up with the original intention of both encouraging and facilitating the export of domestic goods and services abroad. In particular, state-backed schemes have the added attraction of being generally considered to be less likely than private insurers to withdraw cover for political risks in respect of specific countries (eg in the event of the outbreak of war) and are thus in a position to provide cover for risks which might not be insurable in the commercial market.

2.8 There exist, nonetheless, a number of private insurers which can continue to provide coverage in respect of commercial and political risks under such circumstances via the vehicle of reinsurance with their respective governments. Furthermore, whereas Lloyd's of London once represented the sole private market for the reinsurance of political risks, cover is now available from the

American International Group, Chubb, LaReunion/UIC, Professional Indemnity Agency, Citicorp and Exporters Insurance Company.

2.9 **Policy Conditions**

Typically, private export credit insurers tend to provide short-term covers only, whilst state organisations additionally insure medium and long-term risks, as well as offering cover in respect of risks for substantial sums insured and 'national interest' risks. The period over which the insurer is on risk in respect of any one underwriting year depends on the amalgamation of the following:-

(a) the duration of any pre-shipment coverage, eg during the course of the manufacturing process;

(b) the length of the credit terms offered;

(c) the period over which the policy is in force.

2.10 Typical policy conditions for short-term covers might comprise the following:-

(a) a policy is generally in effect for 12 months such that all contracts entered into and all goods shipments notified to the insurer within this period are covered;

(b) credit terms from 90 days up to one year from the date of shipment or the date of receipt of goods;

(c) any period between striking a contract and the eventual shipment of completed goods to be limited to 24 months;

(d) premiums levied on the basis of the value of each shipment covered under the policy at terms fixed at the outset for the duration of the policy;

(e) limits on the maximum value of any individual contract or shipment.

3. DOMESTIC TRADE CREDIT INSURANCE

The object of Trade Credit insurance is to indemnify the supplier against losses which arise as a consequence of a buyer's inability to pay. It does not aim to replace profits lost on the transaction. This feature is important as it determines several characteristics of the product design and rating of this type of risk.

Cover is provided, in respect of all sales, against losses caused by commercial failure. This means that the buyer must be either in liquidation or bankrupt. It also covers the position where the buyer refuses to accept the goods supplied. Refusal to accept can arise where the buyer changes the nature of his business and therefore the goods to be supplied are redundant. In this case the buyer can be liable for breach of contract.

The Credit insurer refunds his share of the losses to the insured, and then makes every effort to recover the sums paid. These efforts include pursuing claims via the courts or the liquidators of the debtor company. Therefore there is usually some element of recovery which has to be taken into account.

3.1 Uses of Credit Insurance

(a) Indemnification of Losses - Bad debts are a consequence of normal trading activity. Credit insurance therefore protects working capital against the catastrophic occurrence of bad debts and can help quoted companies to maintain dividend levels.

(b) Helps to Reinforce Credit Controls - The credit insurance underwriters acquire information on the financial standing of many companies. This allows them to warn their clients of potential loss-making situations. The information provided by the Insurers helps to avoid losses in new markets. Trade Credit insurance can also be used as a tool for safeguarding companies where their marketing area's enthusiasm for new business may result in the organisation trading with companies who ultimately do not pay for their supplies.

(c) Aid to Finance - The policies can be used as collateral in financing situations. The policies also free reserves which otherwise would have had to be tied up in bad debt provisions.

(d) Insolvency Legislation - One piece of legislation which has affected the demand for credit insurance and its related services in the UK is the Insolvency Act 1986. This act is well known for its effect on the Directors and Officers Liability market. Section 317 introduced the concept of wrongful trading. Providing credit to companies which are known to be in financial difficulty, or insolvent, is as negligent as continuing to trade when one's own company is insolvent. This means that in the UK, Directors and Officers need to demonstrate that they are making prudent credit investigations of their trading

associates otherwise they could be found to be guilty of negligence under the Insolvency Act.

3.2 Product Design

There is a moral hazard associated with credit insurance. If the insurer were to provide the policyholder with protection for the whole of his credit risk, there is then the possibility that the policyholder may be lax in his duty in normal transactions to ensure that his debtors are credit-worthy. Therefore a feature of these policies is that the risks are always co-insured between the insurer and the insured. A credit policy will therefore never cover 100% of an insured's credit liability. The insured therefore retains an interest in the extent and type of credit that it is offering to its customers. The policyholder and the insurers are then both interested in minimising losses.

3.3 Limits of Indemnity

Credit insurance is not intended to replace profits, the insured percentage therefore is dependent on the actual or perceived "mark-up" in the invoice price. The supply cycle normally involves increasing "mark-up" as a product progresses from raw-material supplier to the final retailer. The percentages used are therefore dependent on the stage at which the insured is situated on the supply curve. Retailers have the largest mark-up. Therefore a retailer which purchases credit insurance against the risk that its commercial customers fail to meet their liabilities, is likely to be able to obtain cover for only 65 to 70 percent of its liability. Primary manufacturers on the other hand may be able to obtain cover for between 80 and 90 percent of their credit liability.

3.4 Types of Policy

There are two main types of policy:-

(a) Whole Turnover Policy - these with some minor exceptions cover the entire credit risk of trading.
(b) Specific Account Policy - these cover particular named accounts of the insured which in its view represent a higher credit risk.

Whole Turnover Policies

Because of the lower anti-selection risk, insurers favour whole turnover policies. The premium rate will then average the good risks with the poor and no specific loadings would be required. An underwriter will then consider the following risk factors in setting his premium rates:-

(a) the industry of the client;
(b) the client's position in the supply cycle;

(c) the mixture of credit granted - companies grant a mixture of short and long term credit, usually related to the price of the goods or service supplied;
(d) the spread of risk - whether the client is dependent on a small number of large accounts or has a large number of small accounts;
(e) the claims experience of the client;
(f) the geographical area of operation;
the client's own opinion on the standing of his accounts;
(g) size of discretionary limit.

Once these rating factors have been assessed the insurer normally grants cover on any single account up to a limit which is usually called the *"Discretionary Limit"* provided that the insured acts in a *"Prudent Manner"*. A prudent manner is considered to be behaving as though no insurance contract exists. Therefore the insured is expected to carry out the usual credit enquiries and obtain the necessary references including bank references and trading reports of his creditors. If a higher discretionary limit is required for a particular customer it can be obtained but that account will be subject to full underwriting by the insurer.

Specific Account Policies

Here, as implied by the name, cover is only granted for specific named accounts of the insured. The limits are agreed in advance and are set out in the policy. The underwriter will investigate the named accounts, and then, either offer terms at the requested limits, offer alternative lower limits at which they are prepared to underwrite the risks, or decline.

There are many varieties of specific account policies. The actual policy conditions will depend on the type of company insured. Deductibles, both for the whole account and for individual accounts, are common. The contract can be designed to apply to all or part of the business units or branches of the insured. It can also apply territorially to varying sub-units of the insured's business.

Specific Account policies have a clear anti-selection risk so terms are necessarily worse than for Whole Turnover Policies. Further, if cover is limited, the insured is still exposed to the risk of unforseen losses from its other trading.

3.5 Extra-ordinary Contracts

Where specialist goods or one-off products are involved, special policies are needed because they may involve either high monetary values or products which are specific to particular circumstances where it will be impossible to find an alternative purchaser. An example of this type of product is the manufacture of non-return valves for oil wells which are designed and made

to suit the specific bore hole and oil pressure. In these cases the insurer will design a specific policy insuring just those items.

3.6 Policy Conditions

Typical policy conditions are likely to include:

(a) that the policy covers all contracts entered into and/or all goods or services supplied in a twelve month period and notified to the insurer will be covered;
(b) the length of the credit period offered - typically 90 days, however longer periods are also covered;
(c) the maximum length of the contract delivery period;
(d) the deposit premium and the terms and timing for the final premium;
(e) limits on the maximum values which could be placed on the contract.

4. TYPES OF RISK IN EXPORT CREDIT INSURANCE

4.1 Introduction

As discussed previously, the two main types of risk from which exporters seek protection are:-

(a) commercial risks (also referred to as economic risks);

(b) political risks.

Both of these are considered in greater detail in the paragraphs which follow.

4.2 Commercial Risks

The three main types of commercial risk may be summarised as follows:-

(a) insolvency of the purchaser;

(b) default on payment by the purchaser;

(c) non-acceptance of goods by the purchaser.

4.3 The incidence of commercial risk related losses is very strongly linked to the underlying state of the economy both in the purchaser's country of domicile and in global terms, all other things being equal. In particular, the interaction between the following aspects of a particular importing country's economic composition and her current position within the economic cycle are major factors in determining the relative degree of economic risk attaching to that country:-

(a) The level of domestic rates of interest : this impacts a given importer's cash flow position to varying extents depending on its degree of gearing. For example, the level of domestic rates of interest in the UK is set by the Bank of England in order broadly to reflect Government policy. In particular, the level at which interest rates are set are generally designed either to stimulate the economy (by encouraging borrowing if rates are relatively low) or to slow down the economy (by discouraging borrowing and weakening cash flow positions if rates are high);

(b) The balance between the supply of goods and services and the domestic/international demand for those goods and services : this can vary significantly depending on the trade or service sector in question and directly influences the potential for the low take-up of filled export orders;

(c) The strength of the importing country's domestic currency relative to the currencies of the countries from which the majority of a given country's imports derive : fluctuations in these relativities add to the uncertainties surrounding the cost of final settlement for import orders, since goods delivered and services rendered would generally be invoiced in the currency of the exporting country;

(d) The importing country's position in the economic cycle relative to the peak or trough of the current cycle : retailers in a country heading into an economic recession are more likely to default on payment of goods ordered prior to changes in the economic climate than companies in a country enjoying boom conditions and thus satisfactory levels of domestic demand, all other things being equal. It is vital, therefore, that economic upturns or downturns in a particular country and that country's position relative to the worldwide economic cycle are considered both separately and simultaneously;

(e) The level of inflation in the importing country, which reflects to a large extent both the level of domestic demand and wage pressures : wage pressures in particular can have a substantial impact on a company's profitability and cash flow strength, while the levels of domestic rates of interest tend to reflect movements in the underlying levels of inflation, particularly where the country's government operates a monetarist policy in its running of the economy;

(f) Growth or contraction in the domestic economy as measured by Gross Domestic Product (GDP) : this is often cited as a key measure in identifying a particular country's relative position in the economic cycle (as a rough and ready rule, a positive real growth in GDP indicates economic upturn and vice-versa). Profitability in an economic downturn depends on the price elasticity of both domestic and international demand for a given company's products, with the level of international demand being highly dependent on the state of the world economy, or at least on the prevailing economic conditions in the major markets for that company's products.

4.4 Insolvency of the Purchaser

Whilst the frequency of corporate insolvencies is linked strongly to the economic cycle, record levels of company insolvencies in France and West Germany in the late 1980's have been attributed to deregulation in certain trade sectors which has encouraged high numbers of new business start-ups. Government aid to small businesses, for example Business Expansion Schemes in the UK, may further influence the numbers of business start-ups, irrespective of prevailing economic conditions. As a result of the myriad of factors which may contribute to corporate insolvencies, it is difficult for underwriters to forecast the expected frequency of future business failures and the financial impact of these.

4.5 The Exchange Rate Mechanism of the EMS may be expected to have a significant impact on trade within the major European countries. In particular, the restrictions imposed on the fluctuations of exchange rates via the banding mechanism should, in theory, mean that importers within the participating countries are less susceptible to unexpected exchange rate movements. This may be expected to benefit smaller importers which could previously have been placed into financial difficulties by sudden movements on the foreign exchange markets.

4.6 **Default on Payment by the Purchaser**

This is possibly the main reason for the purchase of export credit insurance. For exporters operating mainly within the major importing countries (and thus arguably exposed to political risks to a lesser extent), it might be possible to make use of factoring rather than to purchase insurance cover, although factoring differs from export credit insurance in the following main ways:-

(a) Factoring generally results in a percentage (typically 80 to 90%) of each invoice value being paid to the exporter by the factor on the remittances of each invoice, thereby improving the exporter's immediate cashflow position. The factoring company then seeks to settle the value of each individual invoice directly with the purchaser. The factor's fee comprises the margin in the full value of each invoice and the amount remitted to the exporter on the receipt of the invoice;

(b) Factoring is essentially a means of raising finance as opposed to a form of insurance. Factoring is, as such, an expensive means of raising finance and is typically restricted to smaller businesses;

(c) Worldwide "coverage" may not necessarily be available. If the factoring agreement extends to a global basis, the percentages of the invoice values remitted to the exporter may vary according to the destination of a particular shipment of goods;

(d) There may be limits on the values of invoices which may be submitted for factoring;

(e) The margin made by the factoring company may be subject to adjustment in the light of emerging experience, whereas premium rates under export credit insurance policies are typically fixed for the entire policy period.

4.7 **Non-Acceptance of Goods by the Purchaser**

The non-acceptance of goods on delivery to the purchaser, where the shipment of goods complies with any contracts in existence may be related, in part, to a particular buyer's cash flow position, which may be eventually traced back to the underlying economic conditions in the purchaser's country of domicile.

However, there are a number of other, less economically-founded reasons for the refusal to accept shipments of goods, including the following:-

(a) a change in the purchaser's core trading activities and/or products;

(b) following the signing of the contract, the purchaser has been able to purchase similar goods/services at a lower price (which would then leave the intended purchaser open to legal action on the grounds of breach of contract);

(c) a change in the ownership of the company may result in a change of policy, or indeed, the non-recognition of contracts entered into under the auspices of the previous management.

In such circumstances, an alternative buyer would be sought for such goods in order to effect recoveries.

4.8 **Political risks**

The main political risks which are covered by export credit insurance include the following:-

(a) cancellation or non-renewal of an insured's export licence after a contract has been struck;

(b) war and other such disturbances in the purchaser's country of domicile which affect the fulfilment of the contract;

(c) foreign currency conversion risks, ie difficulties and delays in remitting money from the purchaser's country, including losses arising as a result of a moratorium on external debt issued by that country's government;

(d) transfer risks (also referred to as "third country transfer risks") where one country can freeze the assets and bank accounts of another country held locally;

(e) any action of a foreign government which in some way hinders the enactment of the contract, including import/export restrictions, the confiscation or expropriation of goods and the nationalisation of corporations and industries;

(f) transactions between private exporters and public purchasers (ie the default on payment by a public purchaser).

These will now be considered in greater detail in the paragraphs which follow.

4.9 **Cancellation/non-renewal of an insured's export licence after a contract has been struck**

Such an event may result from one or more of the following situations:-

(a) A general trade embargo may be issued, either by the government of the purchaser's country of domicile or, for example, as a result of sanctions declared by the United Nations against any one country. Notable examples in the recent past would include sanctions levelled against South Africa and, more recently, the worldwide trade embargo imposed on Iraq by the United Nations Security Council following her invasion of Kuwait in August 1990;

(b) A change in the government of a particular country can have far-reaching consequences in this area. For example, a number of changes of government have in the past resulted from military invasions, coups and the deposition of dictators. As such, government policies may be drastically revised as a consequence, particularly in the light of any differences in religious, political or racial attitudes brought in by the new government, and this may ultimately have an impact on the country's stance on overseas trading with certain countries;

(c) A particular company may have its export licences to certain countries revoked if it were to come to light that the company in question has had dealings with a country subject to a United Nations trade embargo. At the time of underwriting a given policy, such practices are unlikely to be disclosed although the number of such policyholders within the portfolio of business might be expected to be small.

4.10 **War and other such disturbances**

A recent example of such a risk would be the 1990/91 crisis in the Gulf which resulted in a flood of claims in respect of shipments of goods to both Iraq and Kuwait. In particular, shipments of goods to Kuwait immediately prior to her invasion are likely to have resulted in total losses.

4.11 Civil war, coups d'état in third world countries, the political turmoil in the Soviet Union in 1991, the ongoing factional violence in South Africa and the prolonged crisis in the Lebanon are other examples of disturbances which would typically be classified as political risks in this category. The underwriting of such risks is dependent on the ability to predict, to some extent, the future political outlook for countries which have historically proven to be problematic. Furthermore, while historical experience may be considered to provide an indicator of future political stability, there remains a very real possibility that certain countries, which have hitherto enjoyed long spells of political stability, are likely to be subject to coups or other such occurences in the future.

4.12 While it may appear natural to consider the Middle East or Southern African states to represent the main areas of such political risk, political risks in all of its many forms can arise almost anywhere in the world. Even in the EEC politically motivated events are not uncommon; examples might include the so-called lamb and cheese 'wars' of the recent past. Indeed, the only exclusion to such war risk coverage generally relates to hostilities involving the five great powers of the USA, the USSR, the UK, France and The Peoples Republic of China.

4.13 **Foreign currency conversion risks**

An exporter will generally price its goods or services in terms of the currency of its country of domicile. As a result, an importer of goods will need to purchase the exporter's domestic currency on the foreign exchange markets in order to effect settlement in respect of shipments of goods or professional services rendered. However, what appears to be a superficially simple transaction may be subject to a number of delays. A country which imposes exchange controls on foreign investment transactions effectively controls both the volume of the local currency which may be sold and the volumes of each major foreign currency which may be purchased. The scale of "premiums" payable in order to purchase individual foreign currencies are susceptible to government or treasury intervention and, indeed, are highly dependent on the economic forces of supply and demand. For example, an importer in a particular country which is subject to tight exchange controls may find that it is unable to purchase US Dollars in order to pay for a shipment of goods received from a US exporter (owing to a shortage of US Dollars within the currency pool operated by the importing country's government). Alternatively, the currency pool premiums in respect of US Dollars may be excessively high at the time that the credit period expires, to the extent that the purchaser's cash flow position does not allow it to purchase the appropriate amount of US Dollars. In such circumstances, the purchaser may seek to delay settlement of the account until such time that the currency pool exchange rate returns to more normal levels.

4.14 Another risk generally included within this category relates to instances where third world countries with extremely high levels of external debt are forced to declare moratoria on such debts until loan repayment schedules can be renegotiated with creditors. The governments of such countries are often significant importers of goods and services from the Western World and thus such actions could have a significant impact on the overall trade credit situation of a given country. Although a substantial number of claims may arise as a result of such actions, such monies may be recoverable at a later stage from the governments of those countries. Nonetheless, the declarations of insolvency by both Poland and Mexico in the 1980's and the subsequent high levels of bad debts arising from African and South American countries may prompt underwriters to review their pricing strategy and potential claims recoverability in respect of such risks.

4.15 While the level of risk attributable, in this context, to any particular country may be assessed by a consideration of that country's external debt profile, a number of other factors may influence a particular government to freeze all debt payments. These might include exceptionally high domestic inflation (which has the knock-on effect of ultimately eroding the strength of the domestic currency within the foreign exchange markets) and the onset of a recession within a given country. To some extent, therefore, a view on the future economic development of each such country might be considered to represent an integral part of the underwriting process. On the other hand, the issue of moratoria on external debts might result from different attitudes towards the treatment of external debt on a change of government, whether by democratic or other means, which is somewhat more difficult to anticipate.

4.16 **Transfer risks**

Such risks attach to every foreign exchange transaction and have proven to be the most common source of political risk related loss in the recent past. The emergence of transfer risk losses can occur in the countries of both creditors and debtors, since these are triggered by the actions of the governments of individual countries. Examples of these would include the Iranian and Libyan crises of the 1980s whereby the settlement of financial obligations was adversely impacted by worldwide public announcements of foreign exchange measures in respect of these countries' currencies.

4.17 **Any action of a foreign government hindering the enactment of a contract**

Examples of such risks might include the following:-

(a) The imposition of new restrictions on certain categories of imported and exported goods. The scale and extent of such restrictions may inhibit the fulfilment of existing contracts, for example where a particular country introduces with immediate effect new limits on the quota of foreign cars to be imported in any given fiscal year;

(b) The change in a country's national laws prohibiting the sale and subsequently the importing of certain specific items. For example, a similar scenario to the prohibition era of the USA in respect of the sale of liquor would be expected to impact heavily on breweries with substantial export interests in the affected country;

(c) The confiscation or seizure of goods, either at the point of entry into the importing country by customs and excise or as a result of a sudden takeover of stock;

(d) The nationalization of a particular corporation such that all contracts entered into as a private entity are no longer recognised;

(e) The government of a country which is currently running a trade deficit may impose legislative measures on imports in order to arrest the widening of such a deficit.

5. UNDERWRITING CREDIT INSURANCE

5.1 Commercial risks and political risks are generally underwritten separately in Export Credit. Cover for commercial risks tends to comprise the main form of protection under export credit insurance policies, while political risks, if cover is offered, may be rated on a more or less ad hoc basis whereby premium loadings are imposed in respect of shipments of goods to countries which either have a history of political instability or debt crises, or which are suddenly impacted by, for example, an outbreak of war. Domestic Trade Credit Insurance on the other hand just covers commercial risks. There is no political risk involved in the UK and from 1992 EC trade.

5.2 **Data & Information**

As with all classes of insurance an insurer needs to maintain a database in order for it to be able to set its premium rates and to assess the level of claim reserves. Information needs to be maintained for each policy at a level which will allow the insurer to perform detailed analyses of his account by the various risk factors. This is providing that the information in each cell remains sufficient to be statistically credible.

The insurer therefore needs to maintain the following types of information in order to perform reasonable analyses of premium and claims experience:-

(a) claims information split between commercial and political losses and further subdivided by:-

- (i) type of loss (eg default of purchaser, insolvency, liquidation, etc.)
- (ii) type of policy (eg standard term, extended credit or policy term)
- (iii) territory of loss
- (iv) trade sector of loss (eg financial services, heavy goods industry);

(b) premium data split between:-

- (i) commercial risks and political risks
- (ii) territory
- (iii) trade sector
- (iv) type of policy;

(c) values of shipments of goods split between:-

- (i) territory
- (ii) trade sector
- (iii) type of policy;

(d) Policy Information

(i) policy type - Whole Account, Specific Account etc.

(ii) cover period - (inception date & cease date)

(iii) delivery period (if appropriate)

(iv) applicable premium rates, if appropriate;

(e) Policy-holder information

(i) turnover

(ii) industry

(iii) business(es) of client - retail, service, manufacturing etc.

(iv) type(s) of credit granted

(v) location of operation

(vi) account or items covered (if specific account)

(f) Additional claims file information

(i) policy identification (policy number or client etc)

(ii) dates of claim, notification, settlement

(iii) claim amount

(g) Recoveries

These should be traceable back to the original claims, and therefore sufficient information needs to be held to carry out this process.

(h) Reinsurance Recoveries

Split by type of reinsurance and allowing refunds to reinsurers from claim recoveries as appropriate

5.3 Commercial Risks

The following paragraphs consider the underwriting of commercial risks under export credit covers, although the same general principles are equally applicable to the rating of domestic trade credit business. The commercial risk premium rate is generally expressed in terms of the value of each shipment of goods declared to the insurer and is fixed for the duration of the policy term. The premium rate levied in respect of a particular shipment of goods depends typically on at least the following rating factors:-

(a) the policyholder's past trading and exporting performance, in particular its credit record and bad debt experience - this provides a measure of the relative degree of inherent risk associated with the particular policyholder;

(b) the country or countries to which the goods are to be shipped or services are to be tendered, although the European trend towards the privatisation of export credit insurers is thought to represent an opportunity to end the classical approach of geographically classifying risks (in other words, the new train of thought is that there may be good risks in a "poor risk" country as well as bad risks in a "good risk" country). Nonetheless, the country's forecasted economic climate should be taken into account when determining, for example, the expected claims frequency to be incorporated within any rating model used;

(c) the particular maximum credit limit allowed to an individual purchaser by the policyholder and that purchaser's credit rating (as determined by various credit rating agencies worldwide) -these might be expected to influence the buyer's relative likelihood of defaulting on the payments in respect of goods received and should therefore be reflected in the rating model;

(d) the type of goods or services being exported - for example, specialist goods (such as radars and custom-built machinery) tend to be less remarketable in the event of a particular buyer's refusal to accept a specific shipment of such goods or the cancellation of the order. A higher premium rate would be appropriate under such circumstances in order to reflect the greater difficulties which might be encountered in effecting recoveries subsequently;

(e) the policyholder's annual turnover or turnover attributable to exports - this provides a measure of the insurer's relative level of associated exposure in respect of any given policyholder;

(f) the insurer's view on the outlook for the world economic climate - in particular, specific localised events can have substantial knock-on effects on the world economy. For example, the quadrupling of world oil prices in 1974 sparked off a worldwide recession, while the invasion of Kuwait by Iraq in 1990 resulted in severe fluctuations in world oil prices;

(g) the credit period conditions under which the goods are to be shipped - generally, the longer the terms of credit offered, the higher the required risk premium in order to reflect the greater potential for exposure to downturns in the economic climate;

(h) the insurers' anticipated levels of expenses and outwards reinsurance costs.

Other factors specific to Domestic Trade Credit Insurance have been discussed in section 3.4 above.

5.4 The relative level of commercial risk attaching to a given country is, perhaps, the most difficult rating factor to underwrite effectively as the rating process incorporate forecasts of the future economic conditions which will prevail in each country over the period for which the rates are to apply, rather than involving solely standard statistical techniques. In this context, it is important to appreciate that the time lags between introducing modifications to the rating structure and the expiry of the last policy in respect of the underwriting year to which that rating structure is to apply can be significant and the resultant margin for premium rate inadequacies is correspondingly great. It is vital, therefore, to attempt to establish a premium structure which aims broadly to reflect the "average" economic conditions over the risk period covered. The effectiveness of economic forecasting is dependent in part on the ability to identify and forecast the individual components which interact to influence the country's relative position within the economic cycle at a given point in time.

5.5 Whilst a flexible rating system which takes into account fundamental changes in a particular country's economic climate as these occur would appear to be a straightforward solution to dealing with the problems associated with these time lags, exporters typically expect premium rates to remain fixed over the duration of the policy term in order that they may plan their annual insurance expenditure accordingly. As a consequence, an insurer who is heavily impacted by losses as a result of an economic downturn, and who has no interim recourse of action, may decide to attempt to recoup losses by increasing premium rates significantly for the subsequent underwriting period. Should economic conditions have improved by, say, the middle of that next underwriting period, the new rating structure would be inappropriate to the then current economic climate, leaving the insurer in an uncompetitive market position and unable to recoup its losses.

5.6 Two main types of rating system may be considered to be appropriate to the underwriting of commercial risks:-

(a) a points system, as most typically used in motor underwriting, whereby the relative risk attaching to each individual shipment of goods is calculated by the total number of points "scored" in respect of each rating factor eg the country in which the buyer is based, the trade sector concerned etc. The applicable premium rate may then be determined from a "points conversion table". The actual points table itself would typically be constructed on the basis of one-way and two-way analyses of claim frequencies and loss ratios, where loss ratios may be expressed

either as a percentage of the value of shipments of goods or as a percentage of premiums.

(b) an experience rating approach which might take account of, for example, the policyholders' relative credit and bad debt record (and thus its claim experience) over the last, say, 3 to 5 years of trading.

5.7 It may, however, be appropriate to use some form of band rating approach as an alternative to the points system in order to reduce administrative and underwriting complexities. In particular, the low volume of available claims data in respect of certain importing countries, especially Third World countries, can result in non-credible statistics for underwriting purposes. It may therefore be more appropriate to use premium banding systems for both the buyer's country of domicile and trade sector in order to differentiate broadly between relatively homogeneous risk groups.

5.8 An experience rating approach can clearly only be applied to those policyholders with an existing record of claims experience, whether with the current insurer or any previous insurers. Unlike certain other forms of experience rating, for example motor fleet rating, it is not possible to apply rigidly a burning cost type of approach to the underwriting of export credit insurance. Any approach which attempts to smooth out the claims experience over the previous, say, 3 to 5 years will understate the required risk premium if the economy of a particular country is entering the trough of the current economic cycle and vice-versa if that country's economy is currently enjoying boom conditions. It may, nonetheless, still be possible to apply some form of experience rating to specific purchasers or specific policyholders, particularly where the types of goods exported are extremely specialised in nature or where the main target importing countries have historically weak or strong domestic economies.

5.9 **Political risks**

The underwriting of political risks under export credit covers tends to take the form of the application of country-specific loadings as and when circumstances dictate. This provides a flexible approach to dealing with anticipated downturns in the political claims experience of specific countries, in a manner which cannot be applied in practice to the underwriting of commercial risks. The actual rating mechanism is by definition, however, somewhat less precise and may not necessarily be statistically based; indeed, the pricing of political risks may even be carried out on an essentially ad hoc basis.

5.10 The difficulties encountered in underwriting political risks arise largely from the general unpredictability of the types of risk covered. In particular, the outbreak of war and other far reaching actions of foreign governments are events which may not be easily analysed using a statistical approach; nonetheless, it may be possible to work on the basis that a country which has experienced political instability, structural change or continuing payment

difficulties in the past is likely to continue to exhibit such difficulties in the immediate future. There remains, however, the difficulties that risks such as those relating to foreign currency conversion and the cancellation of export licences are less straightforward to address in such a manner, although in the case of a country which operates a currency pool or some other form of exchange control, it would appear logical to presume that foreign exchange rate difficulties are more likely to arise.

5.11 To the extent that the underwriting of commercial risks typically incorporates the importing country as a major rating factor, it may appear logical to further incorporate an element in respect of any associated potential political risk within any points table or band-based commercial risk premium structure. An alternative approach to the rating of political risks as described above, therefore, is to include a country risk premium element within the underlying (commercial risk) premium rating structure. The advantages of this system might be considered to include the following:-

(a) it allows policyholders greater flexibility in planning their annual insurance expenditure, as the imposition of heavy loadings on premium rates as and when circumstances dictate could put heavy demands on the cash flow of smaller exporters;

(b) it enables insurers to build up a "contingency reserve" in order to meet political risk claims were they to arise. An approach utilising the application of loadings may be considered to be less effective as there is no recourse in respect of shipments made prior to, for example, an outbreak of war. In such an instance, only the subsequent imposition of premium loadings in respect of future shipments of goods may be used as a reaction to the underlying events in the affected countries. It would, perhaps, be difficult to offset fully losses in respect of those earlier goods shipments via the subsequent application of premium loadings over and above those considered to be appropriate to future shipments to the affected geographical regions, especially as the volumes of future shipments to those areas are likely to be depressed in any event.

5.12 There exist, however, a number of difficulties which tend to reduce the advantages discussed above. In particular, these might be considered to include the following:-

(a) the majority of the largest exporters are particularly price sensitive (since small differences in premium rates are magnified by the volume and value of business transactions conducted). Nonetheless, whilst the incorporation of the political risk premium element into the underlying premium rate structure results in the coverage appearing more expensive at the outset, the alternative approach which applies premium loadings as appropriate does not permit policyholders to plan their annual insurance expenditure to the same degree. Stability in premium

rates may, therefore, prove to be an overriding consideration in the long-term;

(b) insurers in certain countries, for example within the UK, do not generally establish contingency reserves as the local tax authorities do not allow such provisions to attract tax relief. Nonetheless, Scandinavian insurers, for example, do typically establish equalisation reserves as a result of the available tax privileges in their countries of domicile;

(c) the volumes of available political risk claims data may not lend themselves easily to providing a necessarily credible basis for establishing a political risk rating model. In order to "build in" a political risk element into the overall rating structure on a non-arbitrary basis, it might prove necessary instead to form an opinion on the political risk potential (including an assessment of political stability) of each country over the period for which the premium structure is to apply;

(d) in the event that the emerging political risk claims experience is worse than that allowed for within the premium structure, the insurer does not have recourse to the application of further premium loadings as the policyholders will generally understand that their coverage is to include such insurance at no extra cost;

(e) some exporters may prefer the system whereby loadings for political risks are effected as and when conditions dictate. Insureds then have the option of ceasing to export goods and services to trouble-stricken countries depending on the extent of the problems involved.

5.13 **Expenses**

Overheads, underwriting expenses, (including the utilisation of the services of international credit rating agencies) and administrative expenses (for example those involved in raising credit limits in respect of individual purchasers) may be met in one of three main ways:-

(a) within the premium rates levied on each individual shipment of goods as a margin over the risk premium;

(b) as an up-front annual charge or minimum premium designed to reflect a particular policyholder's expected use of credit limit and credit rating facilities, as well as including a contribution to overheads. This charge may be subject to some form of rebate or additional payment at the end of the policy year depending on the extent to which actual underwriting and administrative expenses deviated from those allowed for within the original assessments or expense basis;

(c) as a per transaction charge; for example, a fixed fee may be levied for each credit limit application, with this charge incorporating a contribution to overheads, underwriting and administrative expenses.

5.14 Some allowance might be made for the length of the policy term in setting expense loadings. The greater level of investment income which might be expected to be earned on premiums relating to medium and long-term policies is, however, offset to some degree by the higher degree of risk attaching to such business.

6. RESERVING

6.1 Credit insurance is typically accounted for using a three year accounting basis, which involves holding a fund of income less outgo while the underwriting year remains open. After three full years of development, the underwriting year is closed, thus necessitating prospective estimates of future premiums, future claims, future recoveries and future reinsurance recoveries. If firm evidence becomes available that an open underwriting year will eventually run off at a loss, three year accounting policy requires that support is given to the fund held whilst the year of account is still open. Whilst certain European export credit insurers have even gone so far as to utilise a five year accounting policy owing to the level of uncertainty attaching to the reserving process, the Export Credit Guarantee Department in the UK adopts a one year accounting policy.

6.2 **Claims Reserving Policy**

Reserves under these policies do not conform to the traditional methods of setting reserves. The contract term may be for under one year or for many years and the sums at risk under the policies vary over time depending on the type of organisation covered and the state of the economy.

Reserve analysis is required by policy period, duration of credit terms offered and policy type. This information also needs to be subdivided by the main industrial sub-groups and the business of the client. Finally the state of the economy and the business prospects for that particular industrial sector also will affect the level of reserves held on any individual contract.

The following paragraphs consider in greater detail the reserving issues that are applicable to credit insurance, highlighting the additional aspects which need to be addressed within the context of export credit business.

6.3 As a policy holder in a particular country will invoice its purchasers in its domestic currency, an insurer writing business only in that country will not be impacted by the effect of foreign exchange rate movements. If, however, that insurer was writing business in both the UK and France but was based in France, for example, claims would be denominated in either sterling or francs. Owing to the long delays which can arise between the receipt of premiums and the eventual settlement of claims, a significant movement in the sterling to franc exchange rate over this period will have a distorting effect on the profitability of the sterling book of business. For the purposes of reserving and management information, an insurer writing business in a number of countries should, therefore, further include the invoice currency as an additional data field within its policy and claims databases, in order that the portfolio of business may be analysed by currency.

6.4 It is particularly important to be able to analyse the emerging claims experience by both policy period and the duration of the credit terms offered. For example, policy periods may vary from a typical 12 months of coverage to extended policy terms of 2 to 3 years. Similarly, credit terms covered may range from 30 days to 2 years (particularly if pre-shipment coverage is also provided). As policy periods and credit terms lengthen, there exists an increasing potential for significant exposure to downturns or upswings in the world economy. The significance of this may be highlighted by considering, as an example, two policies written in the course of the 1988 underwriting year. If policy A was incepted on 1 January 1988 and provided coverage for 12 months and policy B was also incepted on 1 January 1988 but was in force up to 31 December 1990, policy A would probably have given rise to considerably better claims experience as the world economic downturn over the course of 1990 and 1991 is likely to have been greater than any allowance made in the premium rating of policy B.

6.5 The ability to be able to conduct reserve assessments on a territorial basis is, of course, only of practical importance if the volumes of available statistics are credible. In instances where the position of a particular country within her own economic cycle is at significant variance to world economic conditions, it is particularly important to be able to identify separately the eventual commercial risk claims outturn in respect of that country. Furthermore, where the country's political stability has been disrupted as a result of, say, civil war, it becomes necessary to be able also to consider the progression of that country's political risk claims experience in isolation.

6.6 Where the claims database facilitates the analysis of the claims experience by trade sector (eg textiles, electronics, financial services), the reserving exercise may be able to isolate the impact of economic upturns or downturns to specific trade sectors as these may be expected to be affected to varying extents. For example, the automobile industry has proven to be historically more susceptible to economic downturn than, say, the retail food industry.

6.7 **Premiums and values of goods shipments**

The statistical projection of ultimate premiums (in order to assess profitability) and values of shipments of goods (in order to provide a measure of exposure) tend to be relatively straightforward, although the development of these are influenced to some extent by the underlying economic conditions. For example, a downturn in the world economic cycle might result in a lower volume of goods being exported, which would in turn depress future premium income.

6.8 **Claim Projections - Overview**

The business is inherently medium to long tailed with time lags between the insolvency of a debtor and the recovery of any monies due from the liquidator or via the courts. Traditional mechanical methods for projecting claims are

clearly not appropriate for this class of business without adjustment. The economic cycle and the general business cycle produce surges in the claims experience which can distort any chain ladder type projections. Average costs per claim are also quite volatile - the failure of a debtor of a company with a small number of very large accounts produces a different average claim size to the failure of a debtor where accounts are smaller. Accumulations and large claims also act to distort the experience. Frequency/severity methods, Bornhuetter-Fergusson and graphical methods require predictions of the economic cycle.

The selected method may require the construction of a claims model which takes account of the economic factors as well as the factors relating to average loss size and claim development. The parameters used in this type of model will necessarily be subjective. Recoveries need to be projected separately from incurred claims and paid claims.

These issues are discussed in more detail below.

6.9 The projection of commercial risk claims data is particularly problematic and requires the use of a considerable degree of judgement. In particular, it is of vital importance that the impact of historic and future upswings and downturns in the world economic cycle are taken into account within the consideration of commercial risk claim progressions and within the projection of future claim developments respectively. The projection process will therefore involve an element of economic forecasting or, at least, some element of allowance for the expected impact of future economic conditions.

6.10 The projection process will further require an appreciation of the following:-

(a) The volatility of political risk claims development is often attributable, in part, to a small number of very large losses. As the progression of political risk claims data for a particular underwriting year is likely to be at odds with those of neighbouring underwriting years, empirical projection techniques may need to be utilised. Alternatively, if it is the case that the majority of a particular underwriting year's political claims experience stem from a particular country, exposure based analyses may also assist in the claims estimation process and it may, therefore, be necessary to project the political risk loss experience of specific countries on an individual basis.

(b) Any changes in policy conditions and the underlying mix of business (to the extent that these impact past and future claim developments) must be properly taken into account; the projection of claims data utilising the subdivisions into homogenous data sets as outlined in paragraph 4.2 above reduces the distorting effects of changes in the mix of business.

(c) The amounts of notified claims gross of all claim recoveries and deductibles are known, and hence future deterioration in case estimates

is not a feature of the business at the gross level (although this is not the case for claims handling expenses). However, savings on estimates of outstanding claims may emerge as a result of the failure of the policy holder to comply with certain policy conditions or where the insured and the purchaser (or some third party) reach a partial settlement.

(d) The significant time-lags involved in the eventual emergence of claim notifications - in particular, policies may be written on extended policy terms and a claim notification for a commercial risk loss resulting from, say, the default on payment by the purchaser may not need to be made to the insurer until a specified period of time has elapsed after the expected date of payment (in order to allow for delays in payments by purchasers). However, insurers may require policyholders to notify them of details in respect of any potential claims as soon as relevant information becomes available, for example, as soon as a purchaser defaults on a payment. It is important to recognise that the availability of extended policy terms tend to result in downturns or upswings in the world economic cycle manifesting themselves as a calendar year effect within triangulations of claim developments.

(e) Claims which have been notified may be subsequently withdrawn prior to their settlement if, for example, the purchaser involved effects a late payment in respect of a specific shipment of goods.

(f) Interactions of all of the above factors can take place to varying degrees at differing points in time.

(g) By effecting comparisons with previous economic cycles for a given country, it may be possible to form assessments of both the depth of the current cycle and the timing of economic downturn and recovery.

6.11 As with most forms of long-tail insurance, the progressions of paid claim amounts tend to be inappropriate as a basis for projection for underwriting years at relatively early stages of development. In particular, the assessment of expected outturns of open underwriting years might, if possible, include a consideration of notified claim amounts and a view on the anticipated levels of IBNR claims and claims arising from unexpired risk periods. The latter are strongly influenced by the prevailing economic conditions, reporting delays, policy durations and by the overall exposure to risk. A Bornhuetter-Ferguson type approach could, in principle, be applied to the estimation of claims outturn for relatively immature underwriting years. The choice of an initial "market" loss ratio would, however, involve an element of economic forecasting insofar as it will be necessary to estimate the effects of any economic downturn or upturn which are likely to impact the underwriting year in question. Furthermore, the gross claims experience is particularly susceptible to the impact of individual large losses and accumulations of losses relating to a single purchaser or a particular country.

6.12 While the projection of claims data may be based on either progressions of paid or incurred claim amounts, the impact of changes in the external environment on claims experience, particularly as a result of changes in underlying economic conditions, are recognised much more quickly by progressions of incurred claim amounts. Early identification of changes in the underlying claims experience is further facilitated by the availability of information regarding potential claims and insurers may require the immediate notification of any circumstances which may ultimately result in a claim.

6.13 The impact of large claims and accumulations on historical data progressions may be removed if sufficient information on such large claims is available to enable these to be stripped out of the main body of data and then analysed separately. Accumulations may result from the insolvency of a major overseas purchaser, the outbreak of war or the declaration of a moratorium on external debts by a major importing country. It is vital, therefore, that the claims database and individual claim records incorporate a sufficient detail of information in order to facilitate the analysis of claims at a variety of sub-levels.

6.14 It is clear from the above that mechanical claim projection methodologies are inappropriate for export credit insurance, as the features particular to this form of insurance cannot be explicitly incorporated into a claims projection model of this nature. The approach taken for the estimation of ultimate claim amounts could instead incorporate implicit allowance for each of these features on the basis of a full understanding of both the historical data progressions and the nature of the underlying business. Traditional actuarial techniques, even where judgement is applied in order to override otherwise mechanical projection methodologies, tend to be inappropriate for the estimation of outstanding claims. In particular, the most common projection techniques are essentially flawed or rendered more complex as follows:-

(a) chain ladder techniques - economic upturns/downturns tend to manifest themselves as calendar year effects and therefore distort the underlying claim development factors;

(b) average cost per claim methodologies - average costs tend to be extremely volatile and are dependent to a large extent on the prevailing economic climate. It will also be necessary to be able to isolate large claims in order to remove as many distorting effects as possible from the average claim amounts;

(c) Bornhuetter-Ferguson method - the selection of the initial market loss ratio requires an element of economic forecasting.

Alternatively a claims model which incorporates these features in an explicit manner may be utilised, although the identification of appropriate parameters for such a model may involve a high degree of subjectivity.

6.15 The volatile nature of the claims development, coupled with its interaction with the economic climate, means that empirical techniques (in the absence of sophisticated claims models) tend to be most effective for the projection of claims outturn. In particular, such techniques allow individual underwriting years to be treated in isolation, especially where years of account are developing at odds with neighbouring underwriting years. The availability of exposure information and profiles of risk periods (particularly where extended policy terms are offered) allow a subjective view to be formed on both IBNR claims and potential claims arising from unexpired risks. In particular, if claims have already been paid in respect of the default on payment by a specific purchaser, it is likely that subsequent shipments of goods to that purchaser will also result in losses.

6.16 **Recoveries**

The projections of recoveries arising from both commercial risk and political risk losses are strongly influenced by the underlying economic conditions. For example, a purchaser who defaults on payment in times of economic upturn is more likely to be able ultimately to meet its obligations than one defaulting in times of economic downturn, where the only alternative might be to wind up the company. In the event that such a course of action is taken, the insurer in seeking to effect recoveries via its legal representatives would effectively become another of the insolvent company's creditors. Alternatively, another purchaser for the goods concerned could be sought, if the shipment of goods can be recovered. However, the availability of alternative buyers is also strongly linked to the prevailing economic climate. The situation is more complicated in the case of recoveries in respect of political losses, since it may be the case that a particular country effectively cancels all of its obligations in respect of foreign debts, in which case the projection process would need to make explicit allowance for such a feature if possible.

6.17 Recoveries are typically projected explicitly although regard must be had to the relationship between the developments of claims and recoveries. In particular, it is generally reasonable to consider the historical progressions of recoveries as a percentage of claims data gross of recoveries for each individual underwriting year, taking into account the impact of external economic effects.

6.18 **Reinsurance recoveries**

The projection of outwards reinsurance recoveries, as with most forms of insurance, may be performed either explicitly or carried out implicitly by considering progressions of claims data net of outwards reinsurance recoveries. The projection of reinsurance recoveries may, however, be complicated by changes in the underlying outwards reinsurance programmes, particularly where excess points relating to excess of loss reinsurance protections vary dramatically from one year to the next resulting in a significant impact on the development of net statistics. In such instances, it may be more appropriate to project claim amounts at a gross of reinsurance level and then to allow for the impact of

outwards excess of loss reinsurances in an explicit manner. The situation may be further complicated by the presence of facultative reinsurance protections in place for specific risks.

Three Year Accounting versus One Year Accounting

6.19 Accounting Policies

Most companies in this market adopt a three-year funded approach to accounts and setting reserves. Premiums net of reinsurance are paid into an underwriting account and claims are settled from this account. After three years the account is closed into the next open year after any necessary strengthening of reserves.

One year accounts are used by some companies. These are quite complex as the calculation of the unearned premium liability is not straightforward as the earning pattern for premiums is not entirely clear and extends well beyond the cover period as claims are not recognised until the completion of the company's normal bad-debt recovery procedure.

6.20 A three year accounting policy is generally preferred to a one-year accounting approach for export credit insurance. The main advantages offered by the use of a three year accounting policy include the following:-

(a) certain claim types, particularly those in respect of political risks, exhibit a long tail of development and it is difficult to estimate ultimate claim costs until after at least three years of development. The corresponding recoveries in respect of such claims are similarly difficult to project;

(b) export credit insurance involves significant time lags between policy inception dates and claim notification dates. For example, claims arising from the default on payment by purchasers are typically required to be notified to the insurer some specified time after the date at which payment would have been due. These dates may themselves fall some considerable time after the expiration of the policy period, especially where pre-delivery coverage is offered;

(c) the establishment of unearned premium reserves (required under one year accounting policy) is complicated by the difficulties encountered in determining when premiums are in fact earned and in calculating the periods of unexpired risks.

6.21 **Premium Rates**

Many policies in this class of business are experience rated. This allows consideration of the client's own bad debt procedures. Experience rating however has to be modified to take account of future economic factors. It is clear that the longer the term of the contract, the more exposed the company is to changes in the economic cycle. Therefore past experience cannot easily predict the numbers and costs of claims in future periods.

6.22 **Presentation of results**

If the policy database is sufficiently detailed such that premium income may be allocated down to the levels outlined in paragraph 5.2, ultimate loss ratios may be formulated at these sub-levels. This is dependent, however, on the volumes of data being statistically credible although for the purposes of underwriting and management accounts, it is important that profitability can be identified for various trade sectors and territories. It is vital, therefore, that claims, premiums, recoveries and reinsurance recoveries may be allocated to such business cells.

6.23 **Equalisation Reserves**

The Insurance Companies (Credit Insurance) Regulations 1990, which came into force on 1 July 1990, were brought in to implement the EC Directive on Credit and Suretyship Insurance. The regulations require insurers transacting credit insurance to establish equalisation reserves in order to provide for above average fluctuations in claims experience and to maintain a higher minimum guarantee fund, although it is understood that State insurers will be exempted from the requirement to establish equalisation reserves. Equalisation reserves are to be established and maintained in accordance with one of the four specified methods, with the regulations stipulating how the reserve is to be calculated, built up and utilised, in addition to specifying the transfers which must be made while the equalisation reserve is below the required level. The regulations do not, however, indicate whether insurers may build up equalisation reserves more quickly by effecting higher transfers than those specified.

As equalisation reserves are the subject of another working party, we have only drawn attention for the need to establish them in line with the regulations.

7. REINSURANCE

The risk of a claim in any form of credit insurance policy depends on the economic cycle of the country. During times of recession, business failures and insolvencies rise. This rise means that bad debts rise and there is a surge in the claims experience. The surge is worsened by the fact that as the economy is in recession goods cannot be easily resold elsewhere, so recoveries fall.

The other form of catastrophic event which can affect this market is the accumulation risk from the failure of one or more large purchasers within the market. The recent Lowndes-Queensway and Poly Peck insolvencies are good examples of this. Here the failure of major purchasers with good credit records meant that suppliers who had provided goods and had not received payment would have had to make claims on their credit policies. These single events produced large numbers of claims.

This cyclical performance, and the exposure to accumulations means that the insurer needs to retain reserves from good years to cushion its experience in poor years. It also means that a suitably large outwards reinsurance programme must be in place to protect the company against insolvency during recessions, and against accumulations.

The reinsurance programme needs to include:

(a) Quota share to spread the risk across companies in the market.

(b) Catastrophe excess of loss to protect the company from accumulations in claims arising from a single insolvency or failure;

(c) Stop loss - although this is likely to be either unavailable or expensive.

Large risks may be placed facultatively on an excess of loss basis. The above issues are considered in greater detail in the paragraphs which follow, with a particular emphasis on the needs of the export credit insurer (although the same general principles apply to domestic trade credit insurers).

7.1 Reinsurance

It is crucial that a private sector export credit insurer has an appropriate reinsurance programme in place as the portfolio of business is susceptible to poor claims experience as a result of worldwide economic recession, outbreaks of war, civil war or coups d'état in countries to which the insurer has significant exposure. The potential recoverability of claim payments is insufficient in its own right to protect against adverse claims experience.

Indeed, the extent to which claims may be recoverable is influenced heavily by prevailing economic conditions. In particular, the availability of alternative purchasers for shipments of goods is likely to be depressed during periods of economic downturn.

7.2 The extremely volatile and cyclical nature of export credit insurance results in only the larger private insurers and State-backed schemes being able to offer the full range of credit insurance covers worldwide. Whilst State schemes are able to rely on tax revenue in order to meet exceptional claims costs, private insurers are generally dependent on extensive reinsurance programmes for protection against adverse claims experience. Reinsurance might be sought in the context of export credit insurance in order to offer protection against the following:-

(a) accumulations of claims arising from a single event, for example, a civil war;

(b) accumulations of claims arising from the insolvency or default on payment of an individual purchaser;

(c) aggregations of claims arising from a downturn in the economy, either within a particular country or on a wider, global basis;

(d) facultative covers in respect of a single large risk or risks not covered under existing treaty arrangements.

The outwards reinsurance programme actually purchased may either cover commercial risks only, or be extended to include political risks.

7.3 Reinsurance programmes might typically comprise the following elements:-

(a) quota share treaties on a country by country (or purchaser by purchaser) basis;

(b) excess of loss treaties on a country by country (or purchaser by purchaser) basis;

(c) stop loss protections or a worldwide aggregate excess of loss programme.

The quota share treaties might be utilised as a means of providing working capital whereas the non-proportional reinsurance coverages might represent catastrophe protection against large political losses or accumulations of claims arising from economic risks. These treaties would be supplemented by facultative covers as appropriate.

7.4 In some countries, reinsurance arrangements are often effected with the government rather than via the commercial reinsurance market owing to the

difficulties in obtaining cover for political risks. In particular, reinsurers underwriting worldwide portfolios of business are more likely to be subject to accumulations of losses in respect of individual countries or regions. In order to protect themselves against financial ruin reinsurers tend, therefore, to set limits on the volumes of goods which may be exported to a given country and also to provide coverage for political risks in respect of only a limited selection of countries. A government that wishes to encourage export business can do so by providing the levels of underwriting capacity unavailable within the commercial market, through its role as a reinsurer of last resort.

7.5 For example, a quota share treaty may specify details in respect of each of the following for each country covered:-

(a) the maximum value of individual shipments of goods which will be covered or the maximum credit limit allowable to any purchaser;

(b) the aggregate limit of coverage; the coverages which may be negotiated may be influenced by the reinsurance market's perception of the potential for poor claims experience, both in terms of severity and the likelihood of losses in any given country;

(c) the percentage participation by the reinsurers; the cedant is likely to require a higher degree of cession on countries which might be regarded as being less politically or economically stable;

(d) any exclusions (eg types of goods, specific purchasers, public purchasers etc).

7.6 An excess of loss treaty might specify details in respect of each of the following for each individual country covered:-

(a) the maximum value of an individual shipment of goods or the maximum credit limit which may be allowed to any specific purchaser;

(b) limits of coverage, which might be expected to be lower for countries with historically poor political and/or economic stability and, indeed, countries to which export volumes have been historically low;

(c) any degree of co-insurance on specific layers of coverage or in respect of specific countries, particularly where the historic claims experience has been poor;

(d) whether the coverage is on an aggregate basis or on an each and every loss basis (in which case the number and terms of reinstatements would also be specified) : in this context, a loss may refer either to a claim or all claims arising from a single purchaser;

(e) the types of risk covered.

7.7 The specific terms of the quota share and excess of loss treaties, particularly in respect of the maximum value of an individual shipment of goods, the maximum credit limit offerable to any given purchaser and the maximum length of credit term which may be granted in respect of a given shipment of goods, may mean that facultative covers are required in order to afford protection in respect of specific large risks. An example of the type of risk which might fall into this category is a contract for building an ocean liner under which a four year construction period is envisaged after which credit terms of 12 months are to be offered. This particular risk might not be covered under the insurer's outwards reinsurance treaties as a result of:-

(a) the high value of the contract;

(b) the potential difficulty in finding an alternative purchaser in the event that the contract is frustrated;

(c) the length of the period between striking the contract and the completion of the end product : the anticipated four year construction period leaves wide scope for economic conditions to have deteriorated to such an extent by the time the vessel is ready for delivery that the purchaser is unable to meet the final payment. (In practice, interim payments would be payable during the course of construction).

7.8 The need for extensive outwards reinsurance protections may be demonstrated by the following examples:-

(a) substantial losses arising from the invasion of Kuwait by Iraq in 1990 - Kuwait might previously have been considered to be a country with a relatively stable government and relatively low risk owing to the country's wealth;

(b) contracts entered into with purchasers from third world countries are often of significant value where the purchaser is the government of that country - in the event that the government fails to comply with the terms of the contract in any way, the resultant claim could consequently be substantial (although it may be possible to effectively recover the full amount at some later stage);

(c) the financial collapse of a major purchaser with significant outstanding payments for goods and services purchased on credit terms - the purchaser may operate solely in its country of domicile or may be an international organisation, in which case the scope for accumulations of claims can be substantial;

(d) a large contract entered into in respect of the manufacture and subsequent export of extremely specialised goods - in the event that the purchaser subsequently declines to accept the shipment of goods, the

potential market for the resale of these goods is likely to be extremely restricted.

7.9 **Reinsurance Pools in the European Community**

The EC Commission has proposed to create an EC reinsurance pool to spread the risks involved in export credit insurance in order to encourage trade with eastern Europe, with the ultimate aim of liberalising the EC export credit insurance market. The export credit insurance market was until recently very much localised, to the extent that insurers were authorised to provide cover only to exporters established in their own member state. This had led to increased premium rates and a reduction in the availability of cover, which had discouraged many smaller companies from venturing into new export markets. The implementation of the second EC Directive on non-life insurance in July 1990 has meant that export credit insurance has now become one of the forms of cover which EC companies may purchase from any insurer in the community, whether private or state-owned. The EC Commission is thought to be also considering the possibility of allowing the extension of cover to EC export consortia drawn from a number of member states.

7.10 The reinsurance pool is to be comprised of the State export credit insurance department of each of the EC's member countries and is intended to provide cover in respect of medium and long-term risks in Bulgaria, Czechoslovakia, Hungary, Poland and Romania initially for a two year period. Each participant will cede 40% of its portfolio to the reinsurance pool, with the losses being shared on a quota share basis.

8. THE CREDIT INSURANCE MARKET

8.1 Single European Market

No paper on any type of insurance can ignore the effect of EC legislation. The single European market in credit insurance is already in place. The European Credit Directive took effect from July 1, 1990. This directive allows credit insurers from any part of the EC to offer their services to exporters in other EC countries. The directive also states that after December 31, 1992 it will be illegal for state insurers (EGCD in the UK, Hermes in Germany, SACE in Italy etc.) to offer more favourable rates to their own exporters over the rates offered to any other EC based exporters.

This legislation means that exporters can seek and obtain their credit policies anywhere within the Community. It also means that the domestic credit insurance market must change to adapt to the new found freedom to operate abroad and the threat from its overseas competitors. In fact the major continental credit insurers have been becoming more active in the UK.

8.2 UK Market Statistics

There are now 15 Credit Insurance underwriters in the UK. Trade Indemnity is the largest and best known with 1990 UK premium income of £99.8 million. These companies offer their clients a range of packaged services to add value to their customers and to acquire market share. Others include Lloyds, Hermès of Germany, NCM of the Netherlands, AIG and Chubb.

8.3 Add on Services

These services include access to credit information via a computer link. NCM of The Netherlands leads in providing direct links. Trade Indemnity is not far behind in developing its own market information services in order to compete. Policies have also been linked to Infocheck Credit Indemnity where the underwriter grants automatic binding cover on the basis of Infocheck credit on line service credit limit guide.

8.4 For smaller companies there are organisations providing managed policies. These contracts provide all cover administration, the reporting to insurers of overdues, and turnovers, and debt collection services. Risks in these contracts are pooled with the manager buying cover from one or more market sources. The advantage to the smaller company is they get their insurance provided cheaper than if they were to purchase it directly themselves. The add-on reporting and bad-debt services are also provided to them at a level and costs which they can afford. The client hopes that the manager pools his risk with other equivalent risks.

The management of these pools is an interesting exercise in equity. Pools of all types need to construct measures so that the bad risks pay more than the better risks or else the better risks will leave the pool causing costs to rise. These types of contracts may well require increasing actuarial involvement as they mature and equity between members becomes an issue.

8.5 Future Developments

The intended removal of trade barriers within the European Community after 1992 has given rise to expectations of a greater degree of trading within the European Community, presumably necessitating the greater availability of export credit insurance. By the same token, however, the very dismantling of trade barriers will also open the export credit insurance market to greater competition, as is already the case via the implementation of the Freedom of Services Directive on 1 July 1990. In particular, the European Credit Directive permits export credit insurers within the EC to sell their products in all EC countries. However, it is not clear at present how the EC will develop in the future. The notion of a single European state has been firmly rejected to date by the UK government, although this appears to be the aim of many of the other member countries of the European Community. Should this aim be achieved, it may be considered that exports and imports within the EC as we currently know them will no longer be classified as such and would be treated no differently to, say, a movement of goods within the UK. This would effectively remove the need for export credit insurance within the Community and instead open up the domestic trade credit insurance market. Nonetheless, the need for export credit insurance in respect of shipments of goods to countries outside the EC would, presumably, remain.

9. CLOSING REMARKS

9.1 This paper attempts to summarise trade credit insurance in the UK and to discuss broadly the nature of export credit insurance. The actuary approaching this class of insurance needs to understand the nature of the business and its special features. Actuaries also need to consider how the economic cycle affects premium rates and reserves in this class of business.

9.2 Actuaries can contribute to the development of the techniques used in this business by applying their knowledge of economic theory and insurance to developing models for rating and reserving which take account of these factors. They can also evaluate ruin probabilities and reinsurance limits to assist companies in the construction of optimum reinsurance programs. Finally, they have a role to play in the financial management of pooled risks ensuring that the managers are able to maintain equity between participants.

9.3 Further subjects which could be considered in any additional work in this area might include economic forecasting, in particular, a consideration of those economic variables which represent key economic indicators and how to interpret and utilise these. This area is equally applicable to creditor insurance any further report in this area could consider both of these types of insurance in this context.