

PROPORTIONAL TREATIES

The attached note has been prepared with two, somewhat diverse, purposes in mind:

- (a) As a paper to be submitted to the GISG conference in October, 1986.
- (b) As a study document for actuaries newly coming into the London Market.

Hence the note has been written as an outline with several Appendices to provide more detailed information on specific points.

Delegates attending the GISG conference should read the main part of the paper but study the Appendices only if there is time and their interest takes them there. The Appendices can, in any case be left as library information for general reference later.

## PROPORTIONAL TREATIES

### Underwriting

#### 1. Underwriter's Procedures

This memorandum has been drafted to explain the considerations that must be taken into account when an Underwriter is presented with a Slip drafted to cover inwards reinsurance written by way of a Proportional Treaty and is asked to accept a line on the Slip.

Proportional treaties are usually thought of as covering a complete class of business, e.g. the property account or motor but many are written to cover special cases and these give rise to additional considerations. (See Appendix A.)

A proportional treaty can provide substantial premium income which may be useful to an underwriter who is striving to increase his overall portfolio, yet with quite a large spread of risk. On the other hand, margins are likely to be small at best and can easily become negative. Where the cedant office is operating under highly competitive conditions and is likely to cut his margins fine, the reinsurance must pay brokerage and his own costs and may well have sharply reduced scope from potential interest income if reserves are retained by the cedant office.

If the underwriter is to be the Lead Underwriter and is presented with the proposal for the first time, there is likely to be time and scope for discussion as to terms and conditions. If it is a renewal, then there will possibly be less scope for discussion of the treaty terms but much will depend on the past performance of the treaty itself and on market conditions. If the market is a soft one (as in recent years) and the treaty results have been reasonably good, then he will probably be in the position of having to accept renewal as it stands or even of easing some of the conditions. If the market is very tight (as at present - 1986 renewals) then it is likely that a tightening of conditions will be required and perhaps the treaty only accepted at all if the underlying rates being charged by the cedant Company have been improved. On the other hand, the cedant may well be less willing to cede business written at profitable rates.

If the Underwriter is not the leader, there is likely to be scope only for acceptance or rejection. He may follow the guidance of the leader; he may alternatively reject the offer. Much will depend on the Broker.

If the Broker finds it difficult to place the treaty even though a percentage has already been accepted by a Leader then the terms may have to be revised, but only if the cedant still wishes to place the treaty and no other Broker has better luck.

2. The Broker

The Underwriter's relationship with the Broker will have considerable influence on the underwriter's decision in a marginal case. How much business does that particular broker bring him? Is it overall good business? What is shown statistically by the results of business accepted from that Broker? How valuable is the contact? To what extent can the Broker's own judgement be relied on? Is he expert in drafting policy conditions? Is he finely tuned to the needs of a changing market? Has he considered the treaty conditions in depth? Is the business being offered to be accepted as an accommodation line, a "sweetener" or does it stand up in its own right?

3. The Cedant and/or Country

Is the Underwriter prepared to accept any business at all from that Cedant/Country?

4. The business portfolio

What are the cedant's limits (by detailed class of business and by geographical area)? What are the estimates of EML of the portfolio? Can a full profile of the business written by the cedant be produced? Can historical details be produced of the business portfolio of the cedant? Is any inwards reinsurance business included in the treaty (see para. 10 below)?

What portfolio of business does the Underwriter already carry in that section of the market, in that currency and in that geographical area? How would acceptance of the treaty affect his spread of business? How would it affect his aggregations of liability in that area?

Do the limits involved mean that reinsurance outwards will have to be sought for the excess? If so, is such a treaty already in existence? What are the terms and how do those terms tie in to the treaty under considerations.

How will it relate to the Whole Account Excess Loss protections? Will some of the premium paid have to be taken into account in the costing of the treaty?

5. Considerations before acceptance

In the case of whole account or major class quota share treaties the number of underlying insurances is likely to be large, sometimes very large indeed, and there is unlikely to be much fluctuation in the underwriting results due to the effects purely of stochastic variation. In the case of small cedant companies the number of underlying insurances will be smaller but the fluctuations in results may still not be all that large due to the absence of large insurances or to the presence of prior facultative reinsurances or of excess loss protections to the treaty.

In the case of surplus or fac-oblig treaties the variation in results may be considerably larger and will depend in large measure on the retention of the cedant office and on whether there has been selection against or in favour of the reinsurer. (See Appendix A for a more detailed discussion of this aspect.)

Large losses to the treaty may be an upsetting factor unless they are adequately covered by built-in protections which should "top-slice" the claims. The emergence of claims of a special type, however, may well influence the results somewhat more greatly. A winter of bad weather could be one such cause. Such factors may possibly be covered by catastrophe excess loss protections, which may be inbuilt to the treaty.

The main factors the Underwriter will bear in mind in deciding whether to accept the Risk are

- (a) General underwriting results for primary carries in general on that class of business world-wide and, in particular, within the country concerned.
- (b) Any legislation in the country concerned that might bear on underwriting results; pressures of consumerism, social attitudes and attitudes of the Courts.
- (c) Whether legislation requires the retention of premium reserves by the Cedant and how outstanding losses are to be covered.
- (d) Inflation rates, strength of the currency, delays in settlement.
- (e) The primary carrier's own record and its managerial ability, including
  - (i) An examination of the rating scales currently in use, both for the class of business concerned and overall and, particularly if the treaty is a continuous

one, a comparison with the rating scales in use over the last few years.

- (ii) A comparison of those rating scales with market rates.
  - (iii) Whether the cedant uses actuarial reporting.
  - (iv) A financial statement of the cedant office and some idea of his business plan i.e. whether his business is likely to increase or decrease and why.
  - (v) His record in regard to R/I balance payments.
- (f) The rates of treaty commission in their relationship to the cedant's own actual acquisition and administration costs.

6. The treaty conditions

While the Slip provides a summary of the conditions applicable and provides the basis on which any subsequent disagreements must be resolved, account must also be taken of the policy conditions. These will not be issued until later and only the lead underwriter will have any part in drafting them. At that time, his scope for change is likely to be limited by practical obstacles in the way of important changes.

The underwriter is likely to have very little time to study the treaty conditions as set out in the Slip but his attention to detail can be crucial and major effects can stem from comparatively minor aspects.

The points to be watched for are considerable in number

- (a) The scope of the treaty:
  - The classes of business covered
  - The geographical area(s)
  - The currency(ies)
- (b) The limits applicable.
- (c) Whether it is a surplus line treaty and, if so, the cedant's retention, or whether it is a residual quota share treaty.
- (d) Whether any exclusions or other restrictions exist in respect of the coverage of the treaty e.g. whether a property treaty can include factories in which dangerous chemicals are manufactured.

If, as a further example, Marine reinsurance is on the basis of total loss only, then it is against the background of the statistics of total losses that results must be judged, as well as the Marine market as a whole.

- (e) What rates of commission, taxes, brokerage and other initial charges are involved? Generally what proportion reduction in gross premiums arises from initial charges? Does the treaty allow sufficient margin for an adequate return to the reinsurers?
- (f) Are there sliding scales of commission? Is profit commission involved?
- (g) Whether portfolio transfers are involved (see para 7 below and Appendix B).
- (h) Whether premium and/or loss reserves retained by the cedant are involved and, if so, what rate of interest is allowed (see para. 9 below and Appendix D).
- (i) What provision is there for notices of cancellation?
- (j) Whether Letters of Credit will have to be set up and, if so

What they will cover            and  
What rate of interest can be obtained  
The cost of setting up the LOC (which  
can vary from 1/8% up to 1%).

Does the amount to be covered include IBNR claims?  
(a step which is generally being resisted in the  
London Market).

- (k) Whether the treaty is covered by a built-in excess loss protection and, if so, the excess point and limit - also, whether it is for common account (i.e. protecting both the cedant and the treaty reinsurer) and the strength of the security.
- (l) The ultimate retention of the cedant office, after all reinsurances have been taken into account. The cedant may be operating a "gearing factor" in his favour which is explained in Appendix E and hence be enabled to write business below normal market rates.

7. Accounting

The accounting procedures with a proportional treaty stem from the conditions of the treaty itself and the conventions that have grown up in the market generally, centring around the quarterly (sometimes half-yearly or even annual) statements and the effect of portfolio transfers which are found mainly in the US Non-Marine market and are used to obtain a clean-cut ending to the treaty.

Complexities in accounting procedures abound in practice and are discussed in Appendix B. Some of these complexities must be taken into account in underwriting but the situation in regard to any one cedant office is likely to be known in detail only after some years' experience with the cedant office.

8. Experience reporting

In order to obtain a clear picture of the statistical results thrown up by one particular treaty in respect of its past record, a special procedure is suggested in Appendix C which is radically different from methods currently in use in that it starts from the time periods elapsed in reporting at the Cedant's end (and hence is akin to the statistical analyses of direct business) and not from the point in time at which the accounting report happens to be received in the Reinsurer's office (which is the current basis of analysis of most London Market business).

Results must, however, be judged against the background of possible changing conditions in the market involved and in the country concerned.

9. Cash flow

Since insurance and reinsurance currently derive more income from investment income than from underwriting and large sums of money may be involved it is crucial that the treaty will give a positive cash flow and that such cash is likely to be available for sufficient periods of time to enable temporary investment to provide a reasonable income. Treaty conditions, more particularly in regard to premium reserves retained by the cedant, are not always such as to provide a positive cash flow.

The Methods of analysing the cash flow expected are set out in Appendix D. In practice the Underwriter will require to be put in a position of judging the expected cash flow forecast very rapidly.

10. Retrocession treaties and Pools

In the soft market that existed up to 1985 retrocession treaties abounded but under the hard conditions of 1986 they have virtually disappeared from the market; that is, except for those that have been placed for some years by reputable underwriters and have shown consistent profits.

A retrocession treaty can be useful to a small Company accepting reinsurance business which does not have a competent underwriter of its own but harsh experience has shown time and again that caution is necessary.

A retrocession treaty may well include cessions of business including:

Direct facultative business  
Reinsurance business accepted facultatively  
Business arising from Covers and Line Slips  
Non-proportional treaties  
London Market Excess Loss Protections  
Proportional treaties of direct business or even of other retrocession treaties

Hence:

- (i) The reporting may involve considerable complications and many unknown factors.
- (ii) There is added delay and, in fact, reporting can go on ad infinitum.
- (iii) An incestuous cycle can quite easily arise.
- (iv) The accepting office has very little control over coverage and even less over claim settlement.
- (v) Limits can be unknown and the effect of catastrophes unforeseeable.

In general, it may be stated, and with some reason for the statement, that poor management of an office often results in both poor underwriting and poor administration; the poor underwriting then involving acceptance of retrocession treaties from offices that are themselves in a similar or worse position. The market is currently (1985 and 1986) seeing a flood of treaty reporting two, three, even five or six years late from offices which are insolvent or have given up underwriting and are in the hands of run-off specialists. There are often massive cash flow problems as an added burden, stemming partly from failed reinsurance security.

Many of the Pools operated by the less competent underwriting agencies fall into the same category. They differ little in their operation from large retrocession treaties.

11. Products liability

Many treaties, and most of all the retrocession treaties, are now exhibiting the effect of claims arising from

Asbestosis  
Agent Orange  
Des  
Dalkon Shield

and a few lesser known similar causes of claim. It is highly likely that, even when those claims finally have been exhausted, new and similar factors will arise. Pollution problems are already with us with further claims looming on the horizon. Their possible influence must always be in the background of an underwriter's mind.

## Appendix A

### Special Types of Proportional Treaties

The 1985 GIRO conference discussed a very interesting paper on the cash flow mechanics of proportional reinsurance business. It was noticeable that both the paper and discussion centred on the traditional concept of pro-rata business, i.e. a whole account quota share or a quota share of a significant general insurance class such as motor or homeowners.

This type of business usually exhibits the following characteristics:

- a) Large premium volumes.
- b) In percentage terms, low profit margins.
- c) Relative stability of results (it is usual for net loss ratios to lie in the range 80% to 120%).

For this type of business, with large fairly predictable cash flows and small profit margins, it would be sensible for the underwriter to take into account the timing of the likely future cash movements. However much London Market reinsurance, which is classified as proportional business, exhibits very different characteristics. Some of the classes described below will produce net loss ratios ranging from 0% to 500%, or more. An underwriter writing the full spectrum of proportional risks might be forgiven for believing that his priority lies in trying to select risks with technical results at the bottom end of the potential range rather than concentrating on cash flow projections which in many cases will have only a marginal influence on the final decision.

### Surplus Treaties

These treaties contain a relatively few, large risks. For this reason alone surplus treaties would exhibit more variable results than standard quota share treaties.

### Excess Cessions

An insurance company may wish to issue limits of up to say \$1million for certain class of business. The demands of the market however may require that higher limits be issued. The primary company could automatically dispose of the higher limits coverage using an excess cession reinsurance treaty. The rates to be charged for the higher limits would be predetermined, often as a percentage of the company's primary premium. The factor to be applied to the primary rate is usually called an 'increased limit factor' (ILF) or alternatively a 'manual increase' (MI) factor.

Excess cessions are similar to excess of loss treaties (but note that they respond to 'each and every loss each and every policy' rather than 'each and every loss occurrence' which is common for XOL treaties) however most Underwriters classify them as pro-rata business because they believe that the important feature is that the cessions 'follow the fortunes' of the original rating.

#### Excess and Special Risks Quota Share

Most of the large US property/casualty companies have excess and special risks departments which write non-standard risks (e.g. hole in one insurance) and excess limits business either above a self insured retention (S.I.R.) or another company's primary policy.

The business which falls within these departments is very heterogeneous. Results are often excellent but because there is such a mixed bag of business it is difficult to predict how, when and where deteriorations could occur. For this reason the E&S business is frequently reinsured on a quota share basis. If the history of the risk shows good results then the ceding company usually demands a high level of profit commission.

#### M.G.A.'s (Managing General Agents)

Underwriting agencies which underwrite business on behalf of others, often do so through a 'fronting company'. The fronting company would be an insurance company which allows it's policy paper to be issued by the M.G.A. The risks would then be passed from the fronting company to the risk-taking companies using quota share reinsurance. The business written by the MGA's may be standard or non-standard, specialist or broadly based.

The MGA's would be remunerated by profit commission and a percentage of the written premiums. Because they are seldom risk takers themselves, MGA's are usually the last to cut back business in an underwriting down-cycle. This type of business produced disastrous results for London Market underwriters during the early 1980's.

#### Retrocessional Business

Quota share and surplus treaties of reinsurance accounts could include any type of proportional or non-proportional business. They should be underwritten with extreme caution.

#### New Classes of Business

New insurance concepts are often developed with the protection of quota share reinsurance. In the early stages, the statistics on which the rates are promulgated can be rather questionable, however the absence of a competitive market can often allow generous margins to be included in the rate making.

### Sub-Standard Business

A number of insurance companies use quota share reinsurance to write, with low retentions, business which is not usually considered acceptable by the standard insurance market. (e.g. high risk auto, medical malpractice on doctors with a history of alcohol or drug abuse, etc.) In the USA this is usually referred to as 'surplus lines' insurance.

The rates charged for this type of business can be as much as five times the standard rates. If expertly underwritten and managed this business can be quite profitable.

Sometimes companies accept surplus lines risks to prevent the insurance supervisory authority interfering to fill what would otherwise be a vacuum in the market. One needs to be wary where this business is written for non-commercial reasons or indeed in a soft market where companies begin to compete for the class.

### Umbrella Quota Share

In the USA, it is common for both companies and private individuals to buy insurance which provides a limit of cover in excess of their other, standard insurance policies. These are called umbrella policies. For a commercial policy, a typical schedule of cover for say a hospital might be:-

\$5,000,000 any one occurrence excess of underlying limits of:-

Professional Liability	\$ 1,000,000 each and every claim and £3,000,000 in all
General Liability	\$ 1,000,000 any one occurrence
Auto	\$ 1,000,000 any one occurrence
Employers Liability	\$ 100,000 any one occurrence
Aircraft	\$25,000,000 any one occurrence
Uninsured Perils	\$ 25,000 S.l.R.

Due to the diversity of coverage this business is very difficult to rate and, similar to Excess and Special Risks above, it is impossible to predict how and where future losses will arise. For this reason the business is again often protected with quota share reinsurance.

One can see that much London Market business, which is classified as proportional, has excess of loss exposure. An actuary working on the reserving of the prorata account would be well advised to investigate the content before applying 'typical' proportional development factors.

## Appendix B

### Accounting for Proportional Treaties

When considering a portfolio of proportional treaties it is particularly important to obtain a thorough understanding of the way in which they are accounted both by the cedants (and any intermediaries) and also by the accepting reinsurer. Since proportional treaties are "tailor made" to suit the particular circumstances of the cedant each one is very likely to have its own peculiarities and to pose its own problems to processing staff. Such problems may, or may not, have been solved in a logical or even consistent manner.

There are two extreme forms of proportional treaties:-

- a) "Clean Cut". These, in essence, cede business on a financial year basis and in their purest form are associated with incoming and outgoing premium and claim portfolios. In general these will generate four quarterly accounts, and very often information relating to the period of origin of premiums and claims is not provided.
- b) "Underwriting Year". These cede business written or renewed by the cedant in a period of time. In general quarterly accounts will continue to be generated until such time as all arising claims have been finally settled.

It is not always immediately obvious to what category any particular treaty may belong (even placing brokers have been known to be uncertain). In particular the following variations are not uncommon:

- i) Clean cut with no incoming portfolio at inception i.e., in the first year, only the new and renewed part of the revenue account is ceded.
- ii) Clean cut but with no accounted portfolio transfers between successive treaty years, except upon a change in the accepting office's share. (Even then, the outgoing portfolios might represent the whole of the old line and the incoming portfolios the whole of the new; or, possibly, only the net change in the line written may be the subject of portfolio).
- iii) Clean cut with no outgoing portfolios on cancellation i.e., the cedant also reinsures the run off. (Beware the treaty that arrives with a loss portfolio, but does not leave with one!).
- iv) Underwriting Year, but with Unearned Premium Portfolios: Here the business being ceded is on an accident year basis and claims payments and outstanding loss advices are related back to the year of origin. Effectively this cedes a proportion of the cedant's exposure in the year.

- v) Underwriting Year with incoming portfolios at inception.
- vi) Underwriting Year with a clean cut of outstanding claims by way of portfolio, after a number of years (very often 3 years). This obviously has great attraction in terms of administrative efficiency in that old underwriting years are not kept open endlessly merely to account a few odd pence.
- vii) As (vi), but with the added complication that the "clean cut" losses are transferred to the next Underwriting Year by way of an incoming portfolio: Proportional Aviation treaties may be of this type with the treaty being cut off after five years. Some quota share of Excess of Loss accounts are also of this type, with the clean cut being (somewhat prematurely it might be felt) after four years.
- viii) Quota Shares of Reinsurance Pro-rata treaties assumed by the cedant i.e., retrocessions. These may well contain a violently changing mixture of some or all of the previously mentioned types.

A further complication may well be the availability (or lack of availability) of estimates of outstanding losses from cedants. In assembling data it should never be taken for granted that either:

- i) Outstanding loss estimates are in accord with accounts received, particularly with regard to date.
- ii) Outstanding losses "not available" have not been entered as "nil".

#### Claims Portfolio transfers

1. It has already been established that proportional treaties which transfer claims portfolios can have a distorting effect on the statistics of the account and hence on any reserving model used. The purpose of this note is to provide an illustration of the sort of effects that appear.
2. There are three basic types of claims portfolio transfer situations:-
  - Type A - The clean cutting of an existing outstanding claims portfolio whereby the reinsurer pays an agreed amount to be relieved of its liability for the run off of the claims.
  - Type B - The acceptance, by the reinsurer, of the liability for the run-off of an existing portfolio of outstanding claims in return for an agreed amount.

Type C - This is a combination of A & B since the reinsurer is relieved of the liability and immediately re-accepts it but in a different underwriting year. Normally an agreed amount is transferred from one underwriting year to the next although the position is sometimes further complicated by the fact that the proportions of the treaty accepted and/or retroceded may vary from year to year.

3. It is fairly clear that given a claims paid based reserving model if we treat portfolio transfers as claims paid (as we have done) Type A above will, due to the acceleration of payments, cause an over-reserve. Similarly the mirror image case - Type B will cause an under reserve due to the large negative initial claim payment.
4. The effect of Type C is more subtle and requires some assumptions to be made to demonstrate what occurs. It will be important to distinguish between claims actually arising in an underwriting year and claims being administered in an underwriting year. The former may no longer be dealt with in that year (subsequent to a portfolio transfer), whilst the latter may include claims arising in previous years (after having been subject to a portfolio transfer).
5. An example:

5.1. A nine year run off trail as below for the claims originating in a given year.

<u>Development Year</u>	<u>% Paid in Year</u>	<u>% Paid to date</u>	<u>% Outstanding</u>	<u>% Outstanding Paid</u>
1	5			
2	30			
3	25			
4	15	75	25	33.3
5	7	82	18	22.0
6	6	88	12	
7	5	93	7	7.5
8	4	97	3	3.1
9	3	100	0	-

5.2. The treaty to have a portfolio transfer at the end of year 5, and the amount outstanding is estimated correctly. In this case the claims paid development for an underwriting year will appear as below, if the total claims arising in that year are 100.

<u>Development Year</u>	<u>Actual Paid</u>	<u>Transfers In</u>	<u>Transfers Out</u>	<u>Apparent Paid</u>
1	5	-	-	5
2	30	-	-	30
3	25	-	-	25
4	15	40	-	(25)
5	25	-	40	65

- 5.3. The figures above may require some explanation. Suppose we are dealing with the 1974 Underwriting Year. Then the portfolio transfer in of 40 takes place at 31 December, 1977. It represents the amounts outstanding on all claims originating prior to 1st January, 1974 and comprises the amounts in column (2) of the table below.

The portfolio transfer out is similar but calculated "one year on" see column (4) below. The claims paid for years 1 - 4 are before the portfolio transfer and are in respect of claims originating in 1974. Thus they follow the normal pattern. The claims paid in year 5 (i.e. after the portfolio transfer) are for all claims originating prior to 1st January, 1975 and are made up as in column (3) below.

<u>Claims Originating in year</u>	<u>Outstanding at 31 December 1977</u>	<u>Paid in 1978</u>	<u>Outstanding at 31 Dec.1977</u>
1970	3	3	0
1971	7	4	3
1972	12	5	7
1973	18	6	12
1974	*	7	18
	40	25	40

\* The amount outstanding at 31 December 1977 for claims originating in 1974 is not included in the portfolio transfer in.

- 6.1. The table in section 5.3. has been constructed assuming that the total claims originating in each year is constant and equals 100. If we now assume that there is a constant growth rate of 20% per annum and the claims originating in 1974 still total 100 the table will appear as below.

(1) <u>Claims Originating in Year</u>	(2) <u>Outstanding at 31 Dec. 1977</u>	(3) <u>Paid in 1978</u>	(4) <u>Outstanding at 31 Dec. 1978</u>
1970	1.4	1.4	-
1971	4.1	2.3	1.8
1972	8.3	3.5	4.8
1973	15.0	5.0	10.0
1974	*	7.0	18.0
	28.8	19.2	34.6

6.2. The table in 5.2. will now appear thus.

<u>Development Year</u>	<u>Actual Paid</u>	<u>Transfer In</u>	<u>Transfer Out</u>	<u>Apparent Paid</u>
1	5.0	-	-	5.0
2	30.0	-	-	30.0
3	25.0	-	-	25.0
4	15.0	28.8	-	(13.8)
5	19.2	-	34.6	53.8

Note that the total of the Apparent Paid column after 5 years is 100 which is the total of the claims arising in the year. There will be no further claim payments for this year (except for corrections of past errors) after development year 5.

6.3. Consider also the 1975 underwriting year which closes at 31 December 1978. On the assumption of 20% growth the total claims originating in the year amount to 120.0 and the account to 31 December 1978 appears thus.

<u>Development Year</u>	<u>Actual Paid</u>	<u>Transfers In</u>	<u>Transfers Out</u>	<u>Apparent Paid</u>
1	6.0	-	-	6.0
2	36.0	-	-	36.0
3	30.0	-	-	30.0
4	18.0	34.6	-	(16.6)

7.1 It is clear that the total reserve for claims originating before 1st January 1976 should be

1974 & prior	34.6	(see 6.2.)
1975	<u>30.0</u>	(= 25% x 120)
	64.6	

7.2 If we use our model without adjustment for transfers the reserve produced will be:-

<u>Year</u>	<u>Apparent Paid to date</u>	<u>Factor</u>	<u>Reserve</u>
1971	57.8	3.1%	1.8
1972	69.4	7.5%	5.2
1973	83.3	11.4%	9.5
1974	100.0	22.0%	22.0
1975	55.4	33.3%	18.3
			<u>56.8</u>

7.3 From 7.1 and 7.2 it is clear that strict application of the model without adjustment for transfers can cause under-reserving.

7.4 It may be argued that given the figures arising it would be obviously inappropriate to use the model. This will be less true if only a part of the account is of the "transfer" type and for a short time at least, divergence between one model and the experience might be ascribed to random fluctuations.

7.5 Another argument might be that any model based on the apparent paid would be derived from the apparent paid and not from the actual paid. True, but the assumption here is that Type C cases form a stable subset of the total portfolio and this may be very far from the case.

Appendix C

THE STATISTICAL ANALYSIS OF INDIVIDUAL PROPORTIONAL TREATIES

1. The standard method of analysis is by the reporting of closings by quarter of the Year of Account, from which triangulations can be built up.

It would be far more accurate, however, if the recording could be divided by the quarterly reporting of the ceding office and this note presumes that the analysis will be made on that basis.

2. On the LPSO advices as they stand at present the indicator as to which quarterly reporting is involved is through the "Treaty Period of Statement" which is printed, not punched, on the card (line 3, positions 1 - 20) but is provided directly to the computer on the magnetic tape provided.

Unfortunately, however, the information is provided in the form of free-form narrative, up to 20 characters. A quick look at a few cards shows

1st Q 1984  
1 Q 83 - 2 Q 84  
JUN - AUG 84  
Q E 30/6/84  
1/1/84 - 31/3/84

Hence it looks as if it would be a hopeless task for the computer to search for some pattern.

There would have to be clerical intervention, although the task would be no great one, examining the card and then inputting the entry on a screen.

The entry could be a date - say end of period, from which the computer would work out the Q involved, in purely sequential form, by comparing that date with the date of inception.

3. Once the Q is known, the computer can provide reports in 2 ways, as set out below. It is suggested that both be used.
  - (a) To provide triangulations of paid and incurred loss ratios by Q of year of account of the Cedant. When sufficiently developed, these can be used to analyse the length of the tail involved for that treaty and the ultimate loss ratio expected.
  - (b) To set in Unearned Premium Reserves and IBNR amounts automatically (the latter as preliminary estimates) so as to obtain the expected ultimate losses at a fairly early stage (say from 2 quarters reporting onwards).

4. Unearned Premium Reserves: (Called UPR)

Since Lloyd's does not give the gross premium but only the premium net of original costs it is not necessary to allow the usual 20% for the front-end loading. The ratios must be set to the net premium, before transfers to reserves:

Building up by quarter (the so-called "1/8 th" basis)

End of first Q: 75% of any portfolio premium in  $\times .5625$   
+ 87.5% of premiums

End of second Q: 50% of any portfolio premiums in  $\times .25$   
+ 62.5% of premium of 1st Q  
+ 87.5% of premium of 2nd Q

End of third Q: 25% of any portfolio premium in  $\times .0625$   
+ 37.5% of premium of 1st Q  
+ 62.5% of premium of 2nd Q  
+ 87.5% of premium of 3rd Q

End of fourth Q: 12.5% of premium of 1st Q  
+ 37.5% of premium of 2nd Q  
+ 62.5% of premium of 3rd Q  
+ 87.5% of premium of 4th Q

Unless there is a premium portfolio transfer out, in which case there is nil UPR (provided however that the premium portfolio transfer relates to the whole of the treaty and not only to part of it).

One of the difficulties that can arise in practice is that there may be a supplementary closing for a particular quarter or two quarters' closings may be amalgamated into one. Great care must be exercised in determining to which quarter a closing advice refers.

(The method is not quite accurate as one is looking at the picture from the point of view of the ceding office. The expenses allowed for in the treaty reinsurance cover both initial expenses and later expenses such as claim handling. Hence the normal restriction to 20% front-end expenses, leading to a UPR of 40%, at the end of the first year. The method given above, based on net premium, over-states the front-end loading somewhat but the difference is not great).

5. The IBNR factor depends on the nature of the business, whether property or liability. Most proportional treaties, not only in the non-Marine market but also in Marine and Aviation, are a mixture of the two.

The analysis can best be initiated by the Underwriter supplying his appreciation of the long-tail percentage, which can then be set into the Risk record via a screen.

The computer can then calculate an IBNR amount, working on the latest figure of paid losses and period involved, given as

$$IBNR = \text{Paid losses} \times \left\{ k \times \frac{e^{-\left(\frac{t}{B_1}\right)^2}}{1 - e^{-\left(\frac{t}{B_1}\right)^2}} + (1-k) \times \frac{e^{-\left(\frac{t}{B_2}\right)^2}}{1 - e^{-\left(\frac{t}{B_2}\right)^2}} \right\}$$

where  $t$  is the period elapsed from the renewal (inception) date of the treaty to the end of the period concerned.

$K$  is the ratio of long to short tail, a ratio from 0 by steps of .1 to 1

and  $B_1$  is a measure of the length of tail of the long-tail business, taken initially as equal to 8.

$B_2$  is a measure of the length of tail of the short-tail business, taken initially as equal to 2.

6. The ultimate loss ratio expected is then

(Paid claims + IBNR amounts)  
divided by (Premiums advised + premiums portfolio in - UPR)

Once there is a premium portfolio transfer out, it becomes

(Paid claims + IBNR amount) divided by  
(Premiums advised + premium portfolio in - premium portfolio out)

If there are loss portfolio transfers in and out the formula becomes

(Paid claims - loss portfolio transfer in + IBNR) divided by  
(Premiums advised to date - UPR)

When the loss portfolio out has been entered into the records, the IBNR ceases to exist provided the treaty conditions are such that all liability ceases for that Year of Account. By that time the UPR will also have ceased and the formula becomes

(Paid claims - loss portfolio in + loss portfolio out) divided by  
(Premiums advised + premium portfolio in - premium portfolio out)

7. By experiment with the results of the triangulations mentioned in para. 3(a) above, over a period of time, it should be possible to improve on the estimates of B and B and to judge the correctness of the overall split between long and short tail in respect of the values of K assigned on underwriting.
8. If the Underwriter then has before him the probable results of treaties from the second quarterly returns onwards, he can use those figures to judge results by any combination of

Cedant Company  
Country/Geographical area  
Class of business written  
etc.

9. If sufficiently frequent advices are received of claim outstanding amounts (in respect of both block claims and large claims) then the analysis can be made on the basis of incurred losses, the initial values of B and B then perhaps being reduced to 5 and 1 respectively.
10. Retrocession treaties result in a great deal of additional difficulty due to the extra delay involved in reporting. To increase the value of B does not meet the needs of the analysis as it changes the shape of the curve used in the model. Better results have been obtained by deducting something like 2 1/2 years from the value of t used in the equation given above but that leaves difficulties for durations up to, say, 3 years. During early elapsed durations it is almost impossible to say what is likely to happen to a retrocession treaty.

A roughly similar picture tends to arise in proportional treaties covering Contractors' All Risks policies due to the effect of extended contract periods and of maintenance clauses often built into the treaties. In such cases an increased value of B say of 10 (or 6 for incurred losses), may better meet requirements.

Treaties which involved products liability business can exhibit very peculiar features. Examples are asbestosis and Dalkon shield. They may not be capable of meaningful analysis at all.

## Appendix D

### Cash mechanics of Proportional Treaties by computer model

1.1 The model is designed to accept the following input data:

	Symbol
(i) Ultimate Premiums	UP
(ii) Ultimate Claims	UC
(iii) Commission and brokerage percentage	CB%
(iv) Quarterly interest rate on reserve retained	r
(v) Quarterly market rate of interest	i
(vi) Loss reserves retained by cedant - factor	LRR
(vii) Premium reserves retained by cedant -factor	PRR
(viii) Cumulative premium development factor at quarter j	WPj
(ix) Cumulative paid claims development factor at quarter j	PCj
Cumulative notified claim development factor at quarter j	NCj
(xi) Time lag of cash settlement from the quarter end	c

1.2 Given this data it is possible to generate the quarterly development of premiums, paid loss and notified claims by applying the quarterly cumulative patterns respectively to ultimate premiums and claims as follows:-

Written Premium during quarter  $j = UP \times (WP_j - WP_{j-1})$   
Paid Claims during quarter  $j = UC \times (PC_j - PC_{j-1})$   
Notified Claims during quarter  $j = UC \times (NC_j - NC_{j-1})$

1.3 The loss reserves retained are a function of the known case reserves (the outstanding losses) prevailing at the quarter end. It is normal for this relationship to be 100% of the known case reserves although this can vary from 0% to 150%. This variation is accommodated within the loss reserves retained factor (LRR). A similar rationale applies to the premium reserves where it is common to have a reserve of 25% of the previous calendar year's premium. Again this can be anything from 0% upwards.

- 1.4 Given these restrictions on cash it is possible to simulate the quarterly cash flow of a proportional treaty as:

Premium

plus

Interest on Loss & Premium Reserves Retained

less

Commission & Brokerage

less

Paid Losses

less

Change in Premium Reserves Retained by cedant

less

Change in Loss Reserves Retained by cedant

- 1.5 The generated monetary receipts are then lagged in accordance with normal market practice, let's say two quarters, and net present valued back to inception using the quarterly market discount rate  $i$ . The underwriter can then assess the true profit or loss in current monetary terms.

## 2. Main Results

- 2.1 The graphs at the end of this paper give an example of a typical set of results. The model has proved invaluable in measuring the impact on cash flow and its net present value of varying certain input variables whilst keeping others constant. Numerous linear relationships have been uncovered. From these a predictive theory of proportional treaty cash mechanics has been developed. The results of this research to date can be summarised as follows:

### 2.2 Result 1

Given a fixed development pattern of premiums and claims, fixed interest on reserves retained and a constant combined ratio;

- (i) the change in the undiscounted total cash flow is directly proportional to the change in commission and brokerage. The gradient of change is constant and equal to:

$$\tau \times LRR \times \sum_{All\ j} (NC_{j-1} - PC_{j-1})$$

- (ii) the change in the discounted total cash flow is directly proportional to the change in commission and brokerage. The gradient of change is constant and equal to:

$$v^t \times \left[ \tau \times LRR \sum_{All\ j} v^j \times (NC_{j-1} - PC_{j-1}) + \sum_{All\ j} v^j \times (WP_j - WP_{j-1}) - \sum_{All\ j} v^j \times (PC_j - PC_{j-1}) - \sum_{All\ j} v^j \times (NC_j - NC_{j-1}) \right]$$

- (iii) the gradient of the discounted cash flow is geometrically affected by the time lag  $t$  of cash settlement.

### 2.3 Result 2

Providing the following are constant,

- (a) loss ratio
- (b) commission & brokerage
- (c) interest on reserves retained
- (d) premium and claim patterns
- (e) loss reserves retained percentage

- (i) the change in the undiscounted cash flow is directly proportional to the change in premium reserves retained factor. The gradient of change is constant and equal to:

$$\tau \times \sum_{All\ j} (WP_{j-1} - WP_{j-5}) \times UP$$

- (ii) the change in the discounted total cash flow is inversely proportional to the change in premium reserves retained factor. The gradient of change is constant and equal to:

$$v^t \times \left[ \tau \times \sum_{All\ j} v^j \times (WP_{j-1} - WP_{j-5}) - \sum_{All\ j} v^j \times (WP_j - WP_{j-1} + WP_{j-5} - WP_{j-4}) \right] \times UP$$

A full expose of the theory behind these results is given in appendices 2 and 3 respectively.

### 3. General Observations

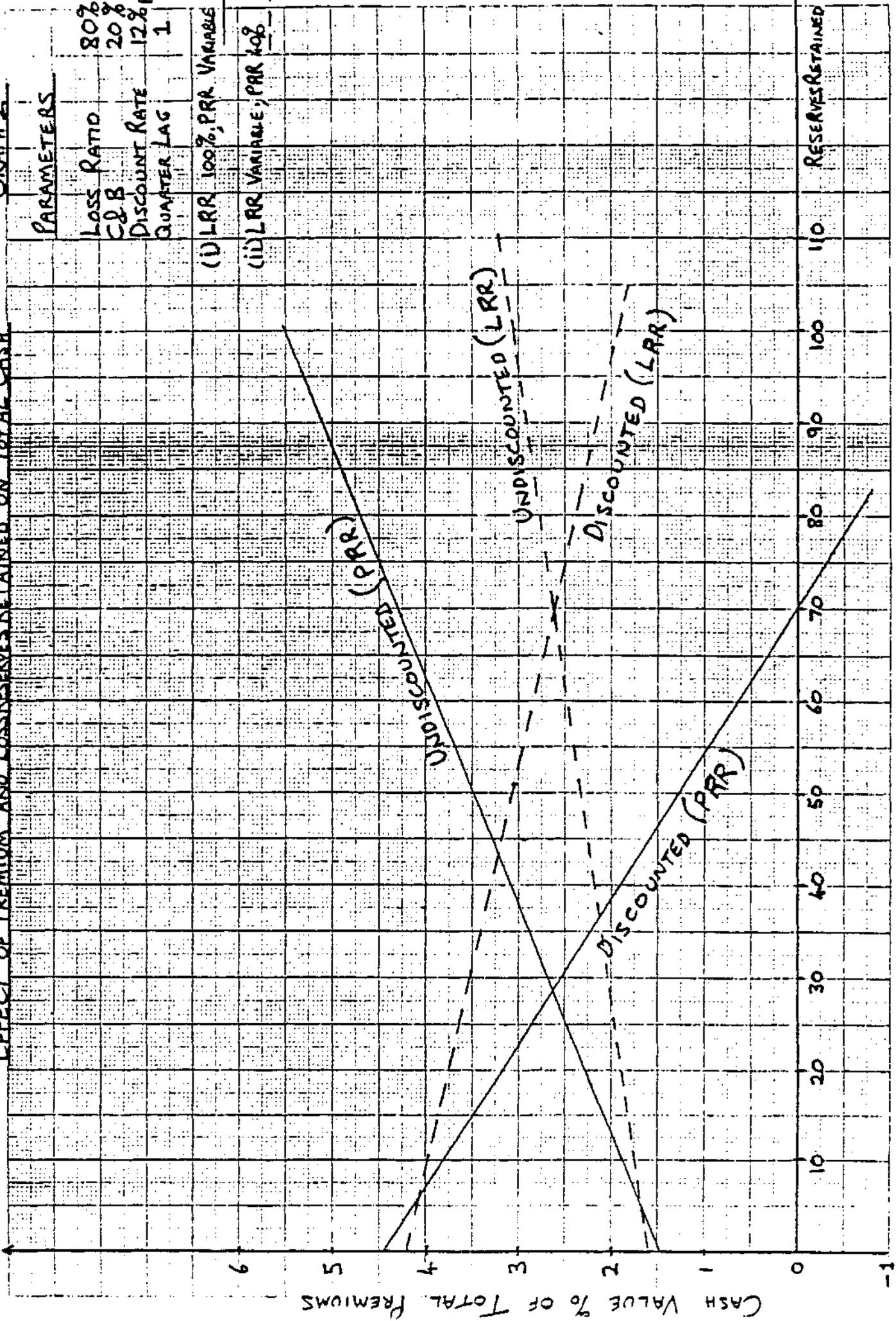
- 3.1 General observations of the work conducted to date are best illustrated in graphical form. Results 1 and 2 described earlier can be seen on graphs 1 and 2 respectively.
- 3.2 Another observation is the effect of changing the interest payable on reserves retained by the cedant office. This is demonstrated in graph 3. Here again, we can clearly see how the underwriter when reviewing the undiscounting cash receipt can easily overstate the true profitability of this account.
- 3.3 Lastely, we investigated the undiscounted and discounted effect on cash of changing the combined ratio (graph 4). Here again, the monetary restrictions of proportional treaties cause the true profit or loss always to be less than that observed from historical undiscounted receipts.
- 3.4 The model is a simple but powerful tool allowing any underwriter to assess, given a set of assumptions, the undiscounted and discounted profit or loss. Furthermore, the model provides an easy way of interpreting the break even loss ratio associated with a proportional treaty, an essential indicator for management. This knowledge is critical if underwriters are to insist on the inclusion or exclusion of clauses which maximise cash flow and hence profit.

EFFECT OF PREMIUM AND LOSS RESERVES RETAINED ON TOTAL CASH

GRAPH 2

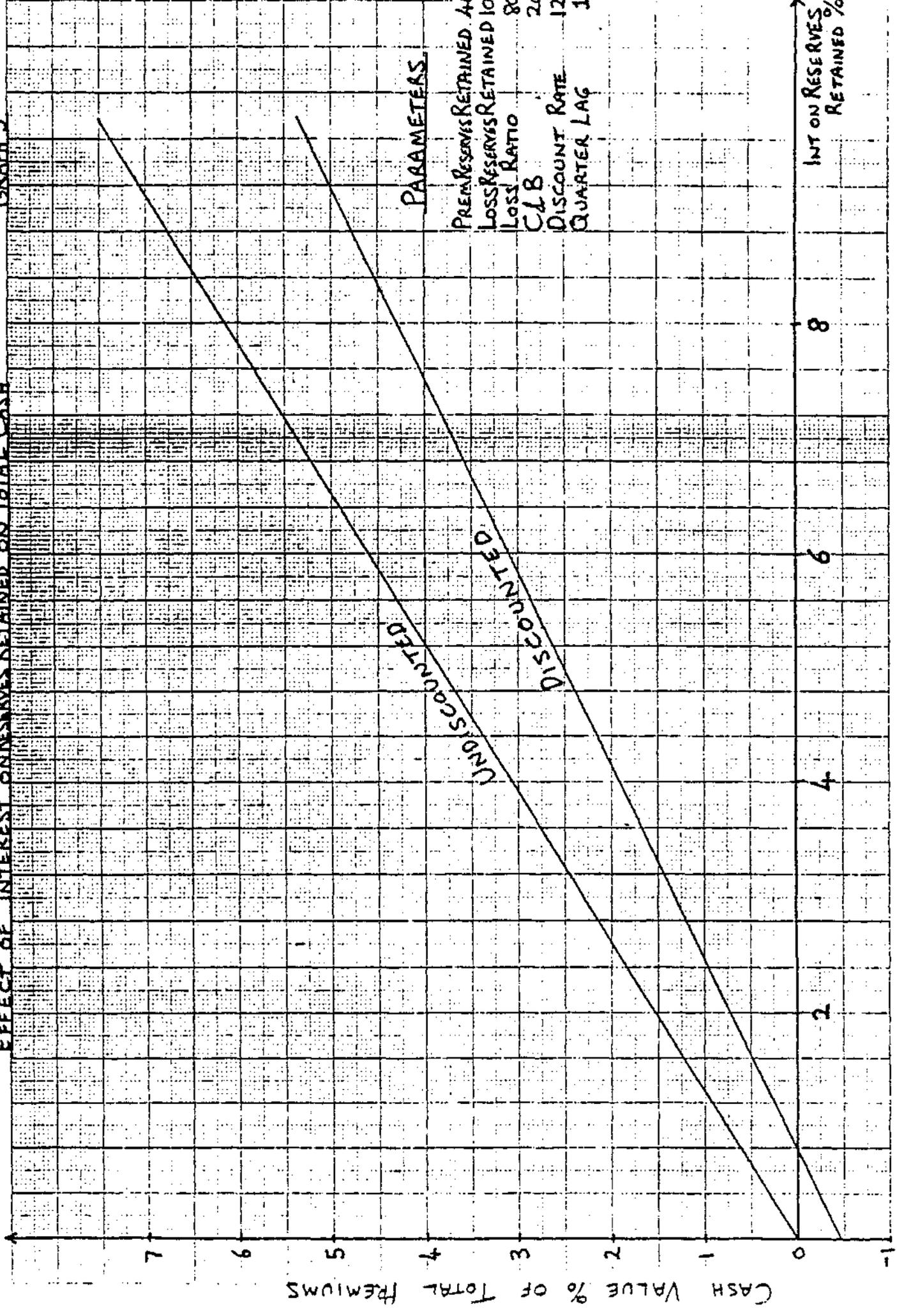
PARAMETERS	
LOSS RATIO	80%
C&B	20%
DISCOUNT RATE	12% p
QUARTER LAG	1

- (i) LRR 100%, PRR VARIABLE
- (ii) LRR VARIABLE, PRR 100%



GRAPH 3

EFFECT OF INTEREST ON RESERVES RETAINED ON TOTAL CASH



PARAMETERS

- PREM RESERVES RETAINED 40%
- LOSS RESERVES RETAINED 100%
- LOSS RATIO 80%
- C&B 20%
- DISCOUNT RATE 12 1/4%
- QUARTER LAG 1

INT ON RESERVES RETAINED % OF P-9

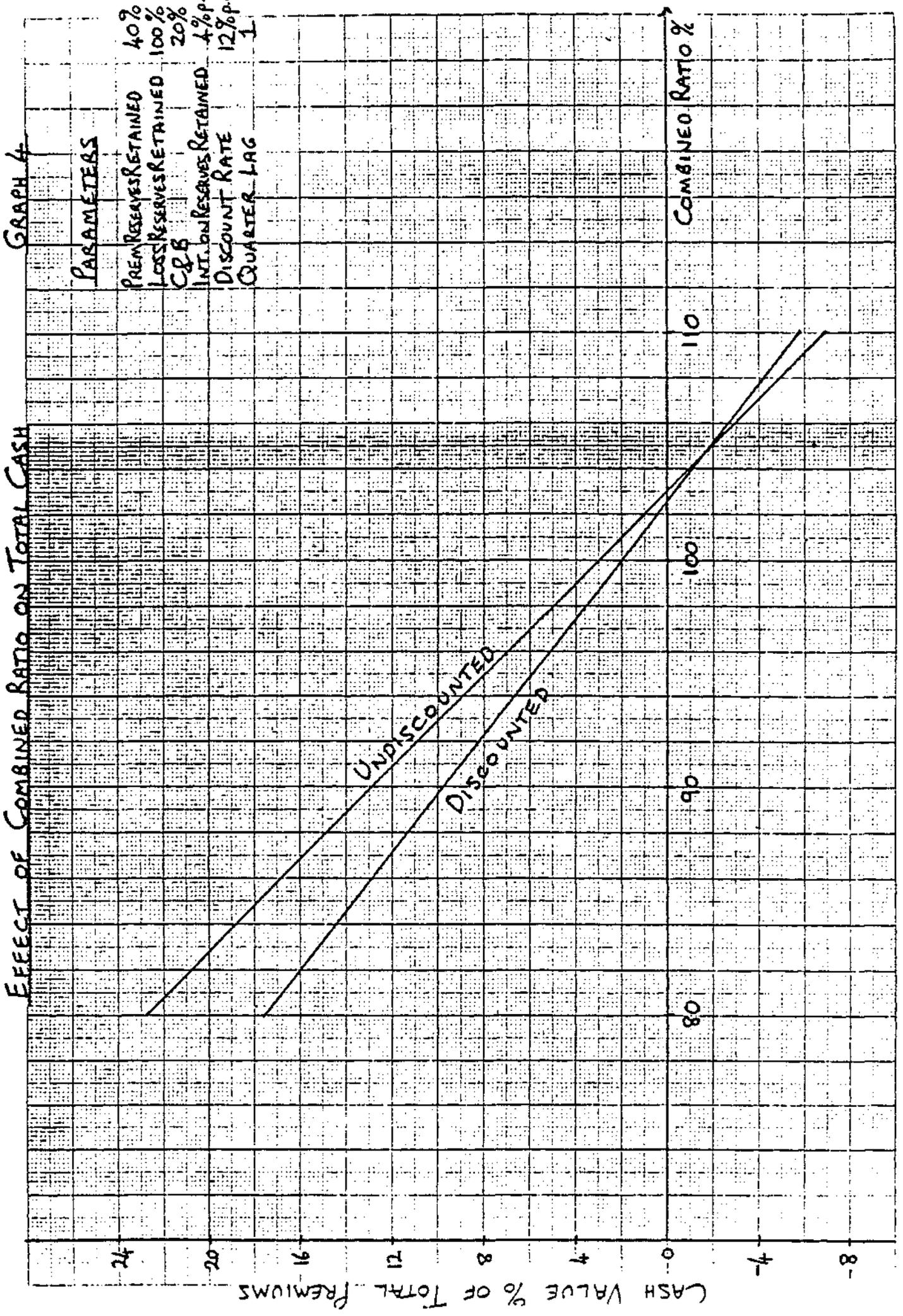
CASH VALUE % OF TOTAL PREMIUMS

GRAPH A

EFFECT OF COMBINED RATIO ON TOTAL CASH

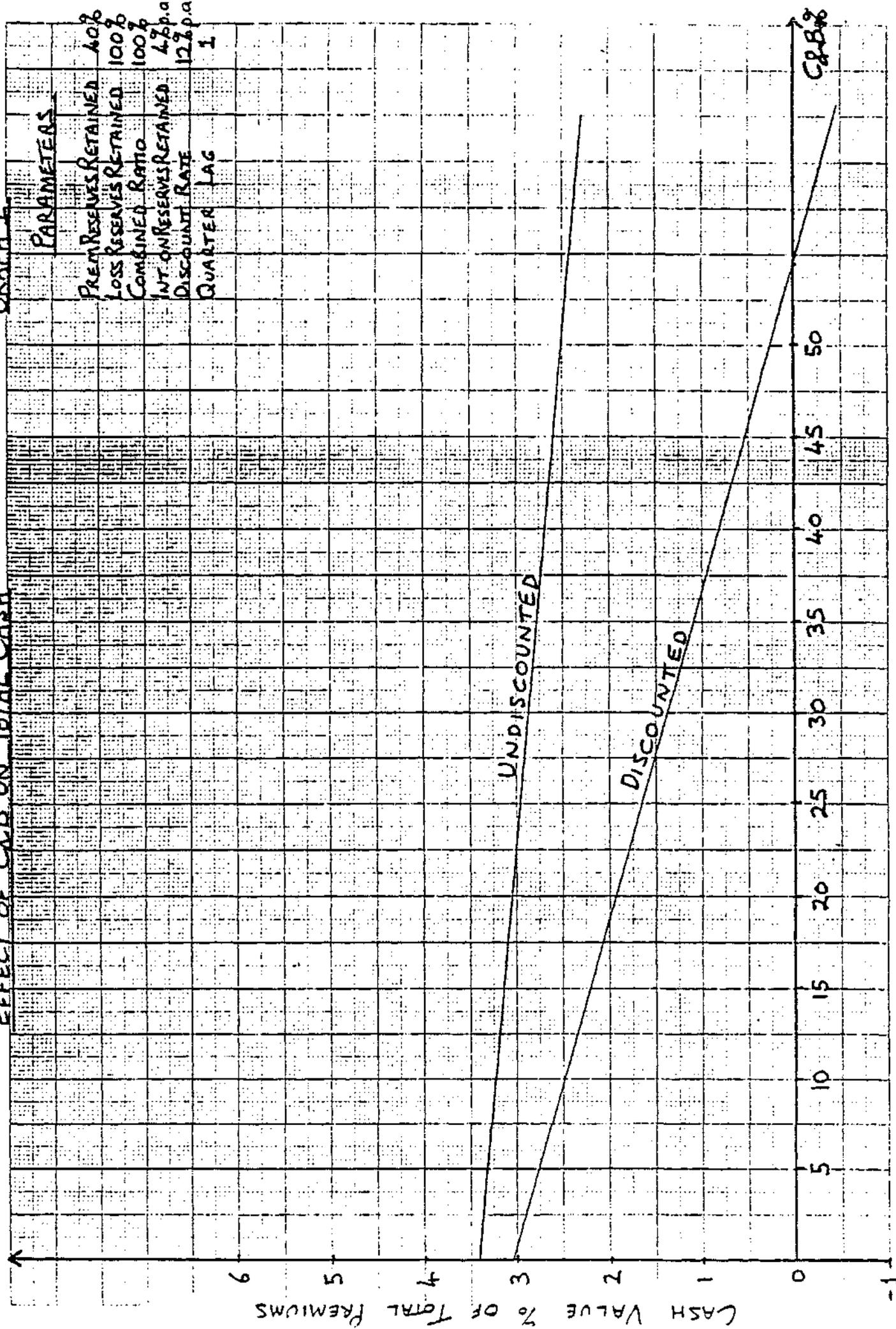
PARAMETERS

- PREM RESERVES RETAINED 40%
- LOSS RESERVES RETAINED 100%
- C&B 20%
- INT. ON RESERVES RETAINED 4% p.a.
- DISCOUNT RATE 12% p.a.
- QUARTER LAG 1



# EFFECT OF C&B ON TOTAL CASH

GRAPH 1



## PARAMETERS

PREMIUMS RETAINED	40%
LOSS RESERVES RETAINED	100%
COMBINED RATIO	100%
INT. ON RESERVES RETAINED	4.5% p.a.
DISCOUNT RATE	12.5% p.a.
QUARTER LAG	1

Appendix D.

Proportional Treaties - the Gearing Factor

The main item of negotiation in the placing of a proportional treaty of reinsurance is the commission allowed. In general the percentage applicable is likely to be determined chiefly by market practice at the time but close attention is also paid to the cedant's "front-end" costs in terms of commission, administrative costs, premium taxes etc. In a soft market, resulting from over-capacity, it is quite likely, particularly where a cedant's own costs are kept low and his treaty performance statistics are good, that the commission allowed by the reinsurer will exceed his own front-end costs.

If the number of lines being placed is large and hence the cedant's own retention small, the effect can obviously be substantial.

Examples which have been given by Neil Buchanan in Canada, on the basis of methods used by Swiss Re, show as follows:

$$\text{Gearing factor} = \left[ \frac{(C_R - C_I)}{(100 - C_I)} \times n \right] + 1$$

Where  $C_I$  is cedant's front-end costs as a percentage  
 $C_R$  is commission allowed by reinsurer  
 $n$  is number of lines placed

e.g. A 20-line Surplus treaty with the cedant insurer having a net retention of \$100,000.

On insurance of a \$2.1m apartment building the insurer lays off \$2m to the property proportional treaty on a fac-oblig basis.

e.g.  $C = 25\%$   
 $C = 35\%$

$$\begin{aligned} \text{Gearing factor} &= \left[ \frac{35 - 25}{100 - 25} \times 20 \right] + 1 \\ &= 3.66 \end{aligned}$$

Hence effectively the original insurer is receiving 3.66 times the original premium.

The following table shows relative Gearing Factors.

Insurer's front-end costs 30%

Reinsurer's Commission	32 1/2%	35%	40%	45%
Lines				
10	26%	41%	58%	68%
20	41%	58%	74%	81%
50	64%	78%	87%	91%
100	78%	87%	93%	95%

The danger lies in the resultant effect on the strategy adopted by the Insurer. In a competitive market he is now placed in the position of being able to cut his rates substantially (at the expense of the reinsurer).

Neil Buchanan quotes an actual example of a large US based international insurer who showed a pure loss ratio on the gross account of 133.9% on earned premiums of \$10.4m but was able, as a result of the gearing factor, to convert the 133.9% loss ratio into a loss ratio of - 33%. Excessive reinsurance commission had produced a negative expense ratio of - 167%.

An effective gearing factor can also be obtained by allowing reinsurers a lower rate of interest on premium reserves than can be obtained by investing the money. Say, for example, that there is a 40% premium reserve set up (calculated on gross premiums) and that 11% can be obtained on investments against 8% allowed on premium reserves. The ceding office thus obtains a "turn" of 3% on 40% of premiums or 1.2% on gross premiums. If 80% is ceded by way of reinsurance, the cedant can afford to drop his premium rates by  $x 1.2\% = 6\%$  without loss and the reinsurers lose both ways: on the lower rates of premium charged and on the lower rate of interest.