1985 General Insurance Convention

INDEXED ANNUITIES AND THE STABILITY CLAUSE

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1. INTRODUCTION AND SUMMARY

In some reinsurance contracts of the Casualty Excess of Loss type (XL) one may find simultaneously two clauses defined separately:

-1- the Stability Clause (SC): in this clause the procedures are formulated by which the burden of monetary inflation is shared more equally between the insurer and the reinsurer, i.e. between the two parties of the XL-contract

-2- the Indexed Annuity Clause (IAC): this clause gives the rules according to which claims of the Indexed Annuity type (e.g. as a consequence of a traffic accident) are settled in the XL-contract.

Of both clauses there is a score of variants available with each of them having its own merits and justifications of existence.
It is not the purpose of this paper to describe all these variants and to select finally the best one according to some reasonably objective criterion.
The paper merely describes formally the most frequently seen variant of the Stability Clause. Furthermore it tries to prove that as soon as this SC has been accepted, there is no reason to define a separate IAC since all the mechanisms of the latter are already handled implicitly in the SC.
The conclusions of the ROA [1]*) from 1978 are a bit less outspoken although it is the author's subjective opinion that the observations of the ROA cannot lead to another one than stated above.

*) references are given at page 14.

2. A REGULAR STABILITY CLAUSE: an example

Let us focuss our attention to this basic example:

- The reinsurance cover in force is XL 1000 xs 500: it has been written at time 0 (index 100).
- Under the cover there is one claim and this is settled in three partial payments

  360 at time 2 (index 120)

  420 at time 3 (index 140)

  600 at time 4 (index 150)

  So in total the claim amounts to 1380.

Without a Stability Clause the accounts of this example are very simple:

- at time 2 the reinsurer pays nothing: the total claim amount paid sofar does not exceed 500 (if however the reinsurer has been notified about possible future payments he will set up a claimreserve as an explicit item or as an IBNER);
- at time 3 the insurer pays 140 and the reinsurer 280, since with this amount the priority of 500 has been exceeded by the total payments sofar;
- at time 4 finally only the reinsurer has to pay: his liability will be the full 600.

Sofar it is ABC and hardly something to write papers about.
Since however the observation can be made that in the 360, 420 and 600 there are inflationary components which could not be predicted properly at time 0 - and consequently could not be weighed in the pricetag of the cover 1000 xs 500 at time 0 - the Stability Clause is introduced, which often sounds like this:

> "All payments in the future carry an inflationary component, which follows the development of an objective index: take this component out by readjusting all your payments back to 0".

In our example this means:

- 360 at index 120 becomes 300 at time 0
- also 420 at index 140 becomes 300 at time 0
- finally 600 at index 150 becomes 400 at time 0 (with index 100, yes).

In monetary value of time 0 the total claim becomes 300 + 300 + 400 = 1000, which means that the insurer pays 500 of this and the reinsurer also 500.

It is therefore decided in the SC that also the total amount of nominal payments - which is 1380 - is shared fifty-fifty, and that indeed both the insurer and the reinsurer will pay 690 of this claim.

How this claim is paid can be calculated by applying the same principles as above also at time 2 and 3. One will find:

time	payments from ground up		payments by the insurer		payments by the reinsurer	
	partial	sum	partial	sum	partial	sum
2	360	360	360	360	0	0
3	420	780	290	650	130	130
4	600	1380	40	690	560	690
total	1380		690		690	

3. A FORMAL DESCRIPTION OF THE STABILITY CLAUSE

The example of chapter 2 is very simple and so is the set of formulae around this Stability Clause. Let us define initially:

A_j : the partial payment under the claim from ground up at time j, to be split into:

C_j : the amount for the ceding company (the insurer)

R_j : the amount for the reinsurer

i_j : the value of the predefined (objective) index for Stability Clause purposes at time j, in which for simplicity we gauge:

$i_0 = 1$

π : the priority (or as the Americans say: the deductible) in the XL-cover;

in order to avoid complications we will assume that the cover unlimited xs π has been written at time 0.

Our clock will run for $j=0,1,2,\ldots$etc., while all A_j, C_j, R_j and i_j are random variables: since however in this paper I donot use this property I donot have to notate these variables differently.

The crux of the Stability Clause is to define reinsurer's share of the claim at time k by

$$\beta_k = \max\left\{0,\ 1 - \frac{\pi}{\sum_{j=0}^{k} \frac{A_j}{i_j}}\right\} \tag{1}$$

for $k=0,1,\ldots$..

This reinsurer's share β_k is the part for the reinsurer of all payments made sofar, therefore the reinsurer's payment at time k R_k becomes:

$$R_k = \beta_k \sum_{j=1}^{k} A_j - \beta_{k-1} \sum_{j=1}^{k-1} A_j \tag{2}$$

with of course

$$C_k = A_k - R_k \qquad \text{for all } k \tag{3}$$

This formularium has been described back in 1981 (viz [2]): I have never seen it somewhere else but it is still very useful to describe this risk-sharing process.

A couple of remarks may be useful at this point:

-1- The definition of i_j in terms of "predefined for Stability Clause purposes" has been so on purpose: with this definition it is possible to catch a variety of gadgets in Stability Clauses such as:

- the corridor (e.g. the first 10% of inflation does not count until this 10% is exceeded): take $i_j=1$ as long as the corridor is not exceeded;
- the Severe Inflation Clause (SIC): at a treshold of (say) 150% take $i_j=1$ as long as this point is not reached and i_j divided by 1.5 further on;
- etcetera.

However, also XL-covers without Stability Clauses - like they still have in the US - are described perfectly by (1) and (2): just take $i_j=1$ for all j.

-2- Our example has been "unlimited xs π": the more realistic covers can also be described by (1) and (2) as long as the type of reinsurer's liability is watched very closely.
The easiest advise is: "design the layer like the cover", then there is no possibility for double-reinsurance or no reinsurance at all.

-3- For redemption purposes one can also use (1) and (2): it must be possible to estimate the set of future R_k with some sort of accuracy, but of course both this accuracy and the interest factor i in

$$\sum_{j=1}^{\infty} R_{k_0+j} \; (1+i)^{-j}$$

will be subject to negotiations.
There are (re)insurance companies who reserve this way.

4. INDEXED ANNUITIES

Although everybody knows what it is I prefer to attempt a definition of an IA:

> An Indexed Annuity is an annuity in which the payments are connected to the life of one or more natural persons and in which the payments are adjusted frequently by some objective indexation mechanism.

Most of the time this indexation mechanism is some official index like the CPI or the wage index, with or without the application of socalled "ceilings" or "floors" (it sometimes sounds like a building society).
In XL-covers we meet Indexed Annuities as consequences of liabilities in traffic accidents but also as General liability claims: most of the time we have to deal with heavily disabled victims of an accident of various kinds.

This will mean that those claims are extremely expensive, which may be illustrated with this case from reality:

> A little boy stayed in kindergarten and was hit in his eye during a dart-game (apparently nobody of the staff was around). As a consequence of this he was totally paralysed and had to be nursed during his entire life, first in an hospital and later on in a nursery home.
> At a moderate rate of inflation of 8% - medical science is expensive - we estimated the claim from ground up at 100 million French Francs.

Of course one can design separate clauses for Indexed Annuity claims, but in case there is a Stability Clause I may advise strongly against it, for these two reasons:

-1- It will become very complicated to handle a socalled "mixed" claim: the regular payments follow the SC wile all IA-payments (and reserves?) are regulated by the IAC. This will lead to conflicts.

-2- It is not necessary to have a separate IAC, since all the properties of an Indexed Annuity fit perfectly into the SC.

This last statement is very easy to prove. Since of each Indexed Annuity it is not certain whether the next payment is going to be made (the victim may die) and when it's made to what amount (the index has its uncertainties) there is no difference whatsoever between the partial payments in an Indexed Annuity and partial payments as they are regulated by a Stability Clause. Also for the latter the problem is How much? and Whether/when?

The direct consequences of this may be proved with the following example:

> In an auto liability claim there are no other liabilities than an Indexed Annuity for the amount of FF 200,000 a year initially to be paid out to somebody who is 25 years of age at inception. At that moment the relevant index is 140, while the original index in the XL-cover is 100: this cover is Unlimited xs FF 2,500,000.

A way to treat this claim may be to estimate what this claim from ground up is going to cost. For that aim it will be necessary to estimate the future interest and the future inflation in French Francs: for the argument sake let us assume that both are equal to 10%.
In that case the initial claimreserve will be (say) FF 9.8 mio at index 140, which is FF 7 mio readjusted to index 100.
So people tend to conclude that the reinsurers share should be something like

$$(1 - \frac{2.5}{7}) \times \text{FF } 9.8 \text{ mio} = \text{FF } 6.3 \text{ mio}$$

and that this amount can be considered as a redemption value right now.

In the computer output on the next pages the R_k-philosophy in formula (1) and (2) is strictly applied to this case. Reserves (and also redemption values) are calculated as expected future payment of liable parties, taking into account regular expectations of future mortality, future development of inflation and of interest: of course this prediction pattern will be a subject of negotiations between the parties.

The computerprogram is freely available on request and in this case it leads to the following conclusions:

-1- Using the SC we donot find an initial share of 64% for the reinsurer as above: based upon the expected value concept of future payments we find 52% versus 48% at the inception of the annuity; of course the share of the ceding company goes down in time (e.g. to 29% after 25 years).

-2- If for reserve purposes one is forced to use a more conservative approach - which is a lower interestrate, mitigated by a higher mortality rate - this can have dramatic consequences: e.g. for the reinsurer. This means an initial gross reserve of some FF 40 mio instead of the FF 4.6 at more realistic assumptions.

-3- It is not necessary to assume that the development of the IA is equal to the development of the index: in most cases the former will grow faster.

-4- Etcetera.

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      MAINPROGRAM
IN THIS PROGRAM RESERVE- AND SHARECALCULATIONS ARE MADE FOR INDEXED ANNUITIES IN XL-CONTRACTS
BETWEEN A CEDING COMPANY AND THE REINSURER XYZ (BOTH NET AND GROSS):
FOR THAT AIM YOU WILL HAVE TO FEED THE COMPUTER WITH THE DATA IT ASKS YOU
WHAT IS THE NAME OF THE ANNUITY WE ARE ANALYZING
EXAMPLE FOR BIARRITZ
IN WHICH CURRENCY ARE YOU GOING TO GIVE THE AMOUNTS
000 FF
WHAT IS THE AGE OF THE PERSON CONCERNED AT THE INCEPTION-DATE OF THE ANUITY
D:
      25
WHAT IS THE RELEVANT INDEX AT THAT MOMENT (A TIME 0 THE INDEX IS GAUGED AT 100):
D:
      140
WHAT IS THE DURATION OF THE ANNUITY (AS LONG AS HE LIVES: PRINT LIFE)
LIFE
WHAT IS THE INITIAL AMOUNT OF THE ANNUITY
D:
      200
WHICH PERCENTAGES OF GROWTH DO YOU EXPECT ON THIS ANNUITY ( 74 PCTS, PLEASE)
D:
      74ρ10

NOW FOR THE AMOUNTS FROM GROUND UP
WHICH PERCENTAGES OF INTEREST ARE USED TO CALCULATE THE PRESENT VALUES ( 74 PCTS PLEASE)
D:
      74ρ10
PRINT THE # OF THE FILE WHERE THE RELEVANT MORTALITY TABLE CAN BE FOUND (NO MORTALITY: PRINT 0)
D:
      12021
FOR WHICH PERCENTAGE DO YOU TAKE THIS MORTALITY INTO ACCOUNT
D:
      80

THE SAME QUESTIONS FOR THE SHARES RETAINED BY THE CEDING COMPANY
WHICH PERCENTAGES OF INTEREST ARE USED TO CALCULATE THE PRESENT VALUES ( 74 PCTS PLEASE)
D:
      74ρ10
PRINT THE # OF THE FILE WHERE THE RELEVANT MORTALITY TABLE CAN BE FOUND (NO MORTALITY: PRINT 0)
D:
      12021
FOR WHICH PERCENTAGE DO YOU TAKE THIS MORTALITY INTO ACCOUNT
D:
      80

FINALLY THESE QUESTIONS FOR THE LIABILITIES OF XYZ
WHICH PERCENTAGES OF INTEREST ARE USED TO CALCULATE THE PRESENT VALUES ( 74 PCTS PLEASE)
D:
      74ρ4
PRINT THE # OF THE FILE WHERE THE RELEVANT MORTALITY TABLE CAN BE FOUND (NO MORTALITY: PRINT 0)
D:
      12021
FOR WHICH PERCENTAGE DO YOU TAKE THIS MORTALITY INTO ACCOUNT
D:
      100
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NOW SOME RELEVANT DATA AS FAR AS THE INSURANCE AND THE REINSURANCE OF THIS ANNUITY IS CONCERNED:
WHAT IS THE POLICYLIMIT UNDER CONSIDERATION (NO LIMIT: PRINT INFINITE)
INFINITE
WHAT IS THE PRIORITY OF THE XL-COVER
⎕:
      2500
WHICH 0/0 OF GROWTH DO YOU EXPECT FOR THE INDEX IN THE STABILITY CLAUSE ( 74 0/0 PLEASE)
⎕:
      74ρ8
WHICH THRESHOLD HAS BEEN DEFINED IN THE SEVERE INFLATION CLAUSE (NO SIC: PRINT 100)
⎕:
      100
FINALLY THE PROTECTION OF XYZ: UNTIL WHICH NOMINAL AMOUNT DO WE HAVE TO CARRY THIS LOSS BEFORE THE PROTECTION
COVER IS HIT
⎕:
      50000
PLEASE AIM THE PRINTER PROPERLY
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EXAMPLE FOR BIARRITZ

YEAR #	AGE	FROM GROUND UP			CEDING COMPANY			XYZ GROSS			XYZ NET		
		PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL
1	25	200	9480	9680	200	4410	4610	0	40260	40260	0	13410	13410
2	26	420	10221	10641	420	4637	5057	0	41937	41937	0	13969	13969
3	27	662	11016	11678	662	4866	5528	0	43686	43686	0	14552	14552
4	28	928	11868	12796	928	5093	6021	0	45509	45509	0	15159	15159
5	29	1221	12779	14000	1221	5317	6538	0	47410	47410	0	15792	15792
6	30	1543	13755	15298	1543	5535	7078	0	49392	49392	0	16452	16452
7	31	1897	14798	16695	1897	5743	7640	0	51461	51461	0	17142	17142
8	32	2287	15914	18201	2287	5937	8225	0	53625	53625	0	17862	17862
9	33	2716	17106	19822	2716	6114	8829	0	55888	55888	0	18616	18616
10	34	3187	18379	21567	3187	6266	9453	0	58255	58255	0	19405	19405
11	35	3706	19738	23444	3706	6387	10093	0	60734	60734	0	20231	20231
12	36	4277	21187	25464	4277	6470	10747	0	63330	63330	0	21095	21095
13	37	4905	22731	27636	4905	6505	11410	0	66052	66052	0	22002	22002
14	38	5595	24376	29971	5595	6483	12078	0	68906	68906	0	22953	22953
15	39	6354	26125	32480	6354	6391	12745	0	71902	71902	0	23950	23950
16	40	7190	27985	35175	6828	6576	13405	361	74687	75048	361	24637	24999
17	41	8109	29961	38070	7179	6906	14085	930	77410	78340	930	25154	26084
18	42	9120	32059	41178	7552	7250	14802	1568	80210	81778	1568	25634	27202
19	43	10232	34282	44514	7949	7607	15556	2283	83089	85371	2283	26067	28350
20	44	11455	36638	48093	8373	7977	16350	3082	86045	89127	3082	26446	29528
21	45	12800	39132	51932	8824	8362	17186	3976	89079	93056	3976	26760	30736
22	46	14281	41768	56049	9306	8760	18066	4975	92191	97166	4975	26996	31971
23	47	15909	44553	60461	9819	9172	18991	6089	95380	101470	6089	27141	33231
24	48	17699	47491	65190	10367	9598	19964	7333	98646	105978	7333	27181	34514
25	49	19669	50587	70257	10951	10037	20988	8718	101987	110705	8718	27098	35816
26	50	21836	53847	75684	11575	10490	22065	10261	105402	115663	10261	26872	37133
27	51	24220	57275	81495	12241	10956	23197	11979	108889	120868	11979	26482	38461
28	52	26842	60875	87717	12953	11435	24388	13889	112448	126337	13889	25901	39791
29	53	29726	64651	94378	13712	11926	25639	16014	116074	132088	16014	25101	41115
30	54	32899	68607	101506	14524	12430	26954	18375	119767	138142	18375	24050	42424

EXAMPLE FOR BIARRITZ (CONTINUED)

YEAR #	AGE	FROM GROUND UP PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	CEDING COMPANY PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	XYZ GROSS PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL	XYZ NET PAYMENTS CUMULATIVE	RESERVE AFTER PAYMENT	TOTAL
31	55	36389	72745	109134	15391	12944	28336	20997	123523	144520	20997	22708	43705
32	56	40228	77069	117296	16318	13470	29788	23909	127338	151247	23909	21033	44942
33	57	44450	81579	126029	17310	14005	31314	27141	131209	158350	27141	18974	46115
34	58	49095	86276	135372	18370	14549	32918	30726	135132	165858	30726	16475	47201
35	59	54205	91162	145367	19503	15100	34604	34702	139102	173804	34702	13468	48169
36	60	59825	96236	156061	20716	15659	36375	39109	143115	182224	39109	9875	48985
37	61	66008	101495	167503	22013	16223	38237	43994	147164	191159	43994	5607	49601
38	62	72809	106938	179747	23402	16792	40194	49407	151245	200651	49407	556	49963
39	63	80290	112562	192851	24889	17363	42252	55401	155350	210751	50000	0	50000
40	64	88519	118361	206879	26480	17935	44415	62038	159473	221511	50000	0	50000
41	65	97570	124330	221900	28184	18507	46692	69386	163606	232993	50000	0	50000
42	66	107527	130462	237989	30009	19077	49087	77518	167743	245261	50000	0	50000
43	67	118480	136748	255228	31964	19643	51607	86516	171873	258389	50000	0	50000
44	68	130528	143180	273708	34059	20203	54262	96469	175989	272458	50000	0	50000
45	69	143781	149746	293527	36303	20755	57058	107477	180081	287559	50000	0	50000
46	70	158359	156433	314793	38709	21297	60006	119650	184139	303789	50000	0	50000
47	71	174395	163229	337624	41288	21827	63114	133107	188153	321260	50000	0	50000
48	72	192034	170118	362152	44052	22342	66394	147983	192111	340093	50000	0	50000
49	73	211438	177083	388521	47016	22841	69857	164422	196001	360423	50000	0	50000
50	74	232782	184106	416888	50195	23321	73516	182587	199812	382399	50000	0	50000
51	75	256260	191169	447428	53604	23780	77384	202656	203530	406186	50000	0	50000
52	76	282086	198248	480334	57262	24216	81478	224824	207142	431966	50800	0	50000
53	77	310494	205323	515817	61186	24626	85812	249309	210632	459941	50000	0	50000
54	78	341744	212368	554112	65396	25009	90405	276348	213985	490333	50000	0	50000
55	79	376118	219358	595476	69915	25362	95276	306204	217184	523388	50000	0	50000
56	80	413930	226264	640195	74765	25682	100447	339165	220212	559378	50000	0	50000
57	81	455523	233058	688581	79971	25968	105939	375552	223051	598603	50000	0	50000
58	82	501275	239705	740980	85560	26217	111777	415715	225677	641392	50000	0	50000
59	83	551603	246168	797771	91562	26426	117988	460041	228069	688110	50000	0	50000
60	84	606963	252405	859368	98007	26594	124601	508957	230198	739155	50000	0	50000

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THE FOLLOWING DATA HAVE BEEN USED DURING THE CALCULATIONS:

NAME OF THE BUSINESS:                                      EXAMPLE FOR BIARRITZ
CURRENCY:                                                  000 FF
THE AGE OF THE PERSON AT THE INCEPTION DATE OF THE ANNUITY 25
THE INDEX AT THE INCEPTION DATE OF THE ANNUITY:            140
THE DURATION OF THE ANNUITY:                               LIFE
THE INITIAL AMOUNT OF THE ANNUITY:                         200

AS FAR AS THE GROWTH OF THE ANNUITY IS CONCERNED:
THIS FACTOR SHOWS A CONSTANT VALUE
ITS MEAN VALUE IS     10.00


FOR THE PRESENT VALUE CALCULATIONS FROM GROUND UP WE USE THE TABLE.   80 0/0 OF PM 60-64
AS FAR AS THE INTEREST IN THESE CALCULATIONS IS CONCERNED:
THIS FACTOR SHOWS A CONSTANT VALUE
ITS MEAN VALUE IS     10.00


FOR THE PRESENT VALUE CALCULATIONS THE CEDENT USES THE TABLE:   80 0/0 OF PM 60-64
AS FAR AS THE INTEREST IN THESE CALCULATIONS IS CONCERNED:
THIS FACTOR SHOWS A CONSTANT VALUE
ITS MEAN VALUE IS     10.00


FOR THE PRESENT VALUE CALCULATIONS XYZ USES THE TABLE:  100 0/0 OF PM 60-64
AS FAR AS THE INTEREST IN THESE CALCULATIONS IS CONCERNED:
THIS FACTOR SHOWS A CONSTANT VALUE
ITS MEAN VALUE IS      4.00


THE POLICY-LIMIT FOR THE AMOUNTS FROM GROUND UP IS INFINITE
THE PRIORITY OF THE XL-COVER IS:      2500

AS FAR THE GROWTH RATES IN THE STABILITY CLAUSE IS CONCERNED:
THIS FACTOR SHOWS A CONSTANT VALUE
ITS MEAN VALUE IS      8.00


THE NOMINAL PROTECTION OF XYZ FOR THIS CONTRACT IS     50000
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5. REFERENCES

1. Indexed annuities and the reinsurer: a report by an International Sub-Committee of the Reinsurance Offices Association, London 1978.

2. Some applicable actuarial forecasting models, by Bob J.J. Alting von Geusau.
   ASTIN 1981, Loen, Norway, page 29.