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ON SOLVENCY AND RISK MODELS

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1. Abstract

1.1. A comprehensive research project was recently completed in Finland concerning the solvency conditions of insurers in general, and some related problems such as the dimensioning of the fluctuation buffer (equalization reserve) in particular. Empirical data and experience were collected and the risks jeopardizing insurers were analysed making use of a specially constructed model. The resulting research report comprising two volumes is now published in an English-language version and will be offered as a discussion contribution to the colloquium subject a), the generalised risk models. In this paper some of the background factors concerning modelling and its applications will be discussed making references to detailed considerations in the report.

The solvency report (briefly SR) will be frequently referred to in the following text giving the volume (I or II) and chapter, section, subsection, and item e.g. I.2 or II.3.1 or II.3.1.14.1. References to pertinent books and publications indicate the reference lists at the end of both volumes.

1.2. The subject report will be distributed as an enclosure to this paper to the colloquium participants. Extra copies can be ordered from the Insurance Publishing Company Ltd., Address: Bulevardi 28, 00120 Helsinki 12, Finland (Price FIM 170 + 80).

2. Various Purposes of Models

2.1. Many of the major problems continually present in the insurance industry, such as solvency, business planning, and the different types of analyses necessary for decision making are often extremely complicated. Background factors are numerous and often have simultaneous effects, and frequently are only partially comprehended and controlled. A deep understanding and remedial treatment of them necessitates a structuring of the maze of the aspects involved. This means, in fact, the construction of a model in one way or another (even though perhaps the result is not always called a 'model'). Approaches may and should vary depending on the environment and objectives, but generally applicable common features also exist.

2.2. Corporate planning. According to current practice insurers produce analyses and (short-term) prognoses to support management.

Ideas may be borrowed from the standard text books of accounting and management. Models are mostly deterministic and based on a constant value of money, ignoring inflation. The major service which the models of an 'actuarial' type can render is introduction of stochastic elements into the conventional scemes. Stochasticity herein is to be understood in a broad sense, including also underwriting cycles, inflation etc.

Corporate models can be used for general 'strategic planning' as well as for many special problems such as evaluation of solvency, net retention, safety loadings etc. It may be possible to incorporate the stochastic elements into the already existing accounting systems so that instead of deterministicly calculated future values for relevant quantities the system can produce a range of values within which the future flow of the business can be expected to run with a desired confidence probability.

2.3. General-purpose models. It is also necessary to obtain a general understanding of the structure and behaviour of the insurance business, regarding it as a mixture of stochastic and many other elements. This is necessary e.g. for planning of legal solvency requirements, and dimensioning of solvency margins and safety loadings (some of which may be controlled by supervising offices). These kinds of models are also useful for the compilation of teaching material, and in creating general theories for application guidance on many levels and in various environments.

The subject Finnish research work can be classified in this category. The idea was to construct a model, which includes numerous control parameters and optional basic distributions and assumptions, by means of which it is possible to simulate insurers of different sizes and quality.

2.4. Two objectives. The selection of parameters depends on the objectives of the model. If e.g. solvency margins are evaluated for legal purposes, usually a short (possibly only one year) time horizon is applied (I.1.1.3A, I.5.3.2). If the probability of survival over the long-term is investigated (which of course is the point of view of management), then the time span should be long (cf. I.1.1.3B).

2.5. Business games are another type of model application. Then several insurers are programmed into the same model and a whole insurance market is simulated thus permitting playing a competition game between the units (e.g. Pentikäinen (1978b) and Galitz (1981)).

2.6. Risk theory. The idea of general models can also be applied to risk theory, and vice versa, the so-extended theory can be used for model building in an effective way. A major benefit of this approach is that it makes it possible to consider numerous problems as a whole and to examine the interdependence of numerous variables and aspects, whereas earlier many of the problems such as retentions, safety loadings, reserves etc. were treated in isolation.

It is well known that opinions on the usefulness of risk theory differ. The Finnish Research Group stated that the present

Summaries of the variation indicators, the amplitude z_m of the cycles and the standard deviation and skewness of the short-term fluctuation of the basic parameters σ_q and γ_q are given in Table 2.3.1. These are parametres which are conventionally used to characterize the fluctuation phenomenon. Due to the fact that the statistical time series were rather short and subject to simultaneous variations and disturbances it was not possible to derive the values of skewness for most classes, and the values given in the table are also rather uncertain. Fortunately the uncertainty of the skewness parametres does not significantly affect the final results.

Table 2.3.1. Summary of empirical data.

Class of insurance	Loss ratio			Number of claims	
	Amplitude of long-term cycles z_m	Fluctuation		Amplitude of long-term cycle z_m	Std. deviation of the short-term fluctuation σ_q
		Std. deviation σ_q	Skewness γ_q		
Workers' compensation	12.7	3.5 %	.	19	1.7
Other accident	30	7.7	18.7	33	9.5
Motor Third Party Liability	20	4.3	40	35	2.7
Motor vehicle	20	5.2	.	17	7.8
Combined policies	15	5.2	.	13	4.3
Liability	24	12.9	.	33	7.0
Other	21	8.5	2.9	44	8.2
Total	13	2.7	.	25	2.2
Fire	20	8.0	60	10	3.3
Loss of profits	45	26.5	.	46	7.7
Cargo	17	16.9	1.27	12	1.8
Forest	.	79	34.6	.	71.5
Credit	.	109	135	.	.
Grand total	10	2.8	7.8	22	1.9

conventional risk theory approaches are not satisfactory. Therefore, an extended risk theoretical model was created, which permits regard for underwriting cycles, inflation, arbitrary time horizon, and numerous other 'non-standard' aspects. The increasing utilization of computers and the Monte Carlo simulation (and short cuts) no longer necessarily dictate the building of models on rather restrictive assumptions, a feature which has been a burden in earlier disciplines (and has been a major reason for the negative attitudes prevailing among 'practitioners' towards the theory). It may not be an exaggeration to expect that the comprihensive-model approach is opening a new era in the development of risk theory. However, (assuming this to be a fact) one must appreciate that risk theory, even after future major advancements is not capable, nor is it ever intended, to provide any final answers to practical problems. In fact numerous aspects, other than those tractable by risk theory, are to be regarded in the solution frame of general common sense. Risk theory, as well as all kinds models, is created only to give support and specialized information for general decision making.

3. Selection of Background Factors

3.1. Search problem. The first step in model building is to acquire a general view, as far as is possible, of all the background factors that may affect the model outcomes and then to try an evaluation of their significance for final selection of the varables and assumptions which will be accepted into the model. Quite many pages were used for this procedure in the SR (I.2, I.3 and testings I.4). Some of the main lines will be recapitulated and further discussed below.

3.2. Compound Poisson fluctuation. The traditional risk theory focused attention mainly on the 'pure' random fluctuation rendered by the variation of the number of claims and of claim sizes. This is, of course, also one of the elements of our model. Furthermore, it was assumed that the risk exposure was subject to time dependent variations (so-called mixed Poisson process).

It is well known that the 'Poisson fluctuation' is relatively small, especially in large portfolios. This is, however, not necessarily true concerning small portfolios. Both large and small portfolios can be vulnerable to the variation of the basic probabilities. This is the case if numerous risk units are simultaneously affected by some external causes, e.g. natural forces. The forest insurance depicted in Fig. I.2.3.1 and I.4.2.4.1 is an example.

On the other hand, a slight Poisson fluctuation can also be an indication of an irrationally low net retention. It is important to note that net retention, or more generally the reinsurance policy of the insurer concerned, is one of the relevant model variables.

3.3. Underwriting cycles. It proved that underwriting results are subject to remarkable up and down swings, the duration of which

is several years. Numerous reports from other countries confirmed the conclusion that this is a very characteristic phenomenon for most non-life insurance. Several explaining causes are suggested: reflection of the general economic climate (recessions and prosperous periods), the built-in mechanism of the market, the working schedule of insurers (delays in the flow of information, in decision-making and implimentation), inflation, and many other reasons (cf.I.2.4, II.2.2). Even though the amplitude of a cycle may not be more than 10...15%, it proved the most dangerous background factor because the effect <u>accumulates</u> during the adverse half of the cycle. The wavelength (to be on the safe side in solvency considerations) was evaluated at up to 12 years. The observed wavelengths reported from some other countries seems often to be no more than 6...7 years. (Introduction of the cycles in I.3.3.9, testings I.4.2.5.)

3.4. Inflation. When the time horizon of the considerations is extended, as it shuold, over several years, inflation is necessarily to be taken into account. On one hand it has a corrosive effect on the solvency ratio, reflecting on the outstanding reserves, and on the other hand suddenly occurring changes in the inflation rate produce shock impulses affecting the whole structure of the model. Inflation effects are described in I.2.5 and I.3.3.5. The system was 'immunised' against the direct influence of inflation utilizing variables of ratio-character like $u=U/B$ and $f=X/B$ (U - solvency margin, B - premiums, X - claims, u - solvency ratio and f - loss ratio). (I.3.1.7, 3.3.5). Tests can be found in I.4.2.6.

3.5. Trends. Insurance portfolios are also subject to gradually affecting changes. These were introduced into the model by a special trend or "real growth" coefficient (I.3.3.6). It takes into account the real growth of the portfolio and, in addtion, changes in its risk structure (frequencies, mean claim sizes). It is important to note that the real growth of the volume of the business has, partially, effects similar to those caused by steady inflation, it necessitates an increase in the solvency margin in order to maintain the solcency level (tests 4.2.7).

3.6. Catastrophes. The conventional models often ignore the risk of very large but seldom occurring claims, like those caused by earthquakes or wind storms. A 'super catastrophe', the occurrence of which can be considered quite possible, may induce serious disturbances in the world-wide reinsurance network and, in that way, also be troublesome for insurers not operating directly in the sensitive areas. This risk factor is described in I.2.8 and suggestions for its consideration are given in I.4.3, I.7.9 and II.5.

3.7. Profitability. One of the absolutely necessary conditions for the survival of any insurer is, of course, that (in the long run) the premiums and yield from investments must cover expenditures. It is, however, not enough. The revenues must include a safety loading. It is quite an intricate problem to evaluate just what is its nece_sary minimum limit to ensure long-term solvency. By incorporating one or more safety loading variable into the model some guidance for the solution can be found. A particularily precarious situation arises if the actual rate of interest is smaller than the

rate of the increase of the nominal value of the business volume (measured e.g. by the premium income B and caused by inflation and the real growth of the business volume). Then the maintenance of the solvency ratio must be financed from the income produced by the safety loading (if in the case of a joint stock company it is not possible to aquire fresh capital from capital markets).

The safety loading aspects are discussed i I.3.4.8, I.4.2.12, II.4.1, II.6.1 and tested in I.4.2.14 and I.7.13.

3.8. Investments. One of risks involved with the normal insurance business is losses, depreciation etc. in the values of assets. In the future model discussion on this important topic may deserve increased attention. The problems are, however, local varying very much from country to country, probably more than most other considerations listed here. The variation in the yield of investments apparently is not easily modelled. Its pure random component is relatively insignificant. Instead there are similar long-term swings up and down, as in many other economic time series. Interest rates are often controlled by governments or central banks. The rate is usually high when the rate of inflation is also high. For this reason and, especially because these two rates are always tied together in the 'inflation-immunised' formula apparatus (cf. I.3.1.7), the variations of interest were introduced into the model via the inflation rate. The risk of major failures is considered under the title 'miscellaneous' risk (below, item 3.10).

3.9. Uncertainty of data. One of the great difficulties in all insurance operations is the uncertainty of basic data. This concerns rating, reserve calculations, balance sheets, and also risk theoretical and other models. An adequate data base is required to be reasonably reliable, covering rather broad statistical ground, and it is not always available until after a greater or lesser time delay. In addition, it is vulnerable to many different kinds of disturbances (requiring quite qualified actuarial skills). Furthermore, general applicable standards for e.g. reserves may still be lacking in some countries, or the practices may vary widely. In professional insurance journals warnings are often seen stating that inflation is not being adequately regarded.

If the management of the company is not fully aware of the total operational situation, it can procrastinate the remedial measures with possible fatal consequences.

Non-systematic errors in reserve calculations, in fact, basically will be corrected in some later year (when the claims are finally settled) and in this way they move the profits and losses from one year to another, but their effect on the total amplitude of the fluctuation of the underwriting result is likely to be negligible.

Delays in reserve reaction to observations concerning biases in the case of increased inflation or for any other cause are one of the factors which increase the amplitude of cycles (cf.I.2.4.7).

A general experience may be that an insurer being in a precarious position also often has 'weak' reserves and insufficient rates. (Then another factor is what is a cause and what is a consequence). <u>Systematically</u> inadequate reserves are, however, one of the most serious dangers. It is an aspect which cannot be solely helped by model building, it also requires other stringent measures (cf. item 3.11 below).

Risk theoretical approaches have also been criticized for the fact that it is difficult to find all the necessary data and distributions needed for their application. This is, of course, a real problem. However, nearly all the basic data is the same as that which is also necessary for rating and reserve calculations, or it can be deduced from the same claims files which are maintained for other purposes, e.g. the claim size distribution. The evaluation of cycles is as equally significant for the rates as it is for solvency considerations (on rates and cycles cf. e.g. McGuinness (1970)). Fortunately, the model seems to be fairly robust for minor inaccuracies of basic data. In case of uncertainty it is, of course, advisable to test defferent alternatives in order to gain a concept of the sensitivity of the model to the risk of miscalculation.

3.10. Miscellaneous risks. In addition to the above discussed risks there are also others, which cannot be ignored. Many kinds of misfortunes can occur. A former insurance commissioner has stated that most insolvencies of insurers are caused by 'misfeasance' or 'malfeasance' on the part of management (I.2.9.11). The category of 'miscellaneous' risks is discussed in I.2.9 and their reflections on solvency margins is considered in I.5.1.6.

3.11. Conclusions. It is naturally highly desirable to construct a model, which can employ as many as possible of the above listed risks. Totally this is not, however, feasible, because some are not calculable. This concerns above all the 'miscellaneous' risks, as well as inadequate calculation of reserves or rates or other relevant data. In fact, the solvency of insurers (considered from the point of view of public solvency policy and supervisors) must rest on several pillars. They are a sufficient solvency margin, reinsurance, well-checked reserve calculations and other financial statements, and competent supervision (preferably as a blend of reports, early-warning indicators and, on-site inspections), and (hopefully) also a competent audit of the company itself. These pillars cannot completely replace each other. No audit can protect against risk fluctuations (only afterward state their consequences), on the other hand no solvency margin can give a guarantee against every risk. An effective audit is necessary to prevent them or, at least, limit their size and effect.

From the point of view of management, of course, adequate and well diversified and analysed information on the state of the company as well as on the trends, environments etc. are necessary. The problem is discussed in I.2.9 and I.5.1.6.

4. The Outline of the Model
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4.1. We shall now present some of the more prominent considerations associated with the preparation of the Finnish SR.

4.2. The relevant __empirical data__ was collected from actual fluctuations and other risks of past decades. This material is reported in Chapter 2. Especially the predominantly important influence of underwriting cycles is clearly seen (I.2.4), as well as inflation (I.2.5). The empirical material was used as guidance for the construction and parameter calibration of the model.

__4.3. Model.__ Even if the empirical material as such is interesting and informative, it is necessary to analyze the phenomena which are behind the observed data in order to reach a deeper understanding of the very complicated insurance process. This was done by building the above mentioned general-purpose model to simulate different kinds of insurers.

The main ideas are explained in I.3.1, and in more detail in the remaining section of Chapter 3. The mathematical solutions are given in detail in Volume II.

__4.4. From year to year algorithm.__ Broadly speaking the idea is to define the state of an insurer by means of (making use of the terms of the theory of dynamic programming) state variables which define the volume, quality, etc. of the business at the end of each financial year. Furthermore, so-called transition equations are needed, which determine how premiums, yield of investments etc. are coming in and how claims expenditures, expenses etc. are flowing out, the difference between revenues and expenditures being accumulated in a solvency margin (risk reserve). In this way an algorithm is received which allows the follow-up of the state from year to year (I, Fig. 3.1.1).

__4.5. Simulation.__ Owing to the complicated structure of the model mainly Monte Carlo simulation technique was employed for numerical calculations. For the purpose a random number generator was designed to generate random numbers which are distributed according to the assumed conditions. The method can be described as a macrosimulation ('im Grossen') as distinguished from the micro ('im Kleinen') approach which operates on a grass-roots level handling the claims one by one. Our technique was to directly generate the amount of __aggregate__ claims (I.3.4.6 and II.1.7).

__4.6. Straightforward calculation__ of the outcomes proved to be possible in a great number of cases. This considerably facilitates the work. Also this method, which among other things can produce finite time ruin probabilities, has not been published before (as far as we know) (I.3.2, II.3.1).

4.7. Communication. One of the major problems to overcome was controlling the fairly large number of variables and assumptions, distributions, etc. involved. It is quite difficult to obtain any consistent view over the total phenomena and the quite numerous relationships and interdependencies of the variables and aspects. Still more difficult than these is to report to readers who are not familiar with model building. Quite too often good ideas are difficult to implement, because they may be technically too complicated and may generate, instead of enthusiasm, irritation and frustration especially among non-actuarial people.

An attempt to solve the communication problem was an abundant use of graphs. The stochastic processes were presented graphically plotting a number of outcomes (simulation realizations) in one and the same picture (cf. typical examples I, Fig. 3.1.2 and 3.1.3). Our experience was positive. Understanding of this kind of 'stochastic bundle' does not require special expertise in risk theory, the idea is possible to explain to 'laymen' and also to tell how the pictures are to be interpreted. In fact a stochastic bundle can give essential features of the process in a quite conscise and illustrative way. By comparing different bundles it is easy to get a conception of how the different background factors affect the process and, in that way, solvency structures (compare e.g. Figures I.4.1.1 and 4.1.2).

4.8. Standard insurer. Another solution for the communication problem was to construct a special 'standard insurer' corresponding to a typical medium-size insurer. This prototype was used as a yard-stick. Then the variables and basic assumptions were changed one or two in turn and in this way it was possible to reach a concept of the sensitivity of the structure to quite various aspects (I.3.3.1.2 and I.3.3.14).

Furthermore, in order to facilitate comparison a concise general view of the complicated system main indicator, the minimum solvency ratio, was depicted by pillars for numerous parameter combinations in one and the same picture. A profile figure I.4.2.15.1 (page 4.2-44) was developed in this way.

5. Results and Applications
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5.1. Programming. The models, both Monte Carlo simulation and straightforward calculation, were programmed by Jukka Rantala (at that time in the employ of the Sampo insurance company, now in the service of the Insurance Supervising Office) and by Esa Säyrinen and Pertti Savijoki both of the Pohjola insurance company on an IBM computer, model 370/158, and using APL language. Most of the calculations were programmed by Pentikäinen in parallel (in order to divide the work load and to permit checking) for a Radio Shack micro computer (model I equipped with two disk drives, printer and plotter) making use of advanced BASIC computer language (having the possibility to compile into the machine language). Rantala and Säyrinen also experimented with models where the portfolio was divided into sections (cf. I.4.2.2). Micro processor application was
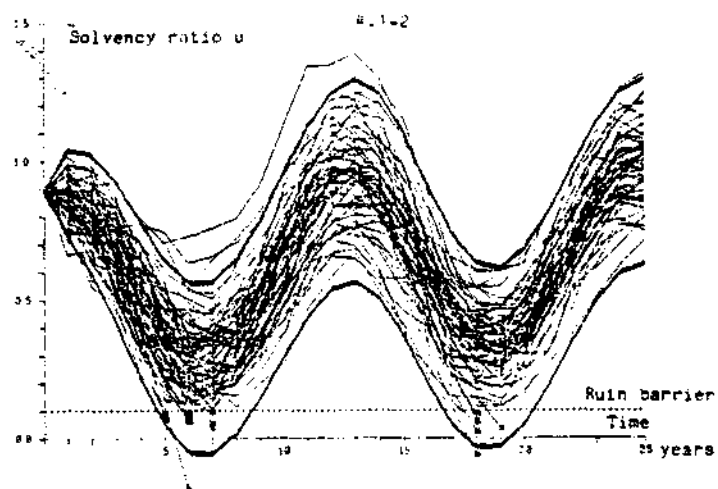
Fig. 4.1.2. The basic figure when long term cycles are incorporated. The amplitude z_m = 0.1. Inflation was synchronized with the long waves according to eq. (3.3.5.1), where the synchronizing factor c_i = 0.5.

Number of 'ruins' 24/100.

based on only one section, but allowed the parameters to be calculated as weighted mean values of the section parameters and distributions (cf. II.1.4).

A typical simulation by means of the IBM facility takes about 20 sec. for 100 realizations (e.g. Fig. 4.1.1). In addition to that a half minute was needed for plotting.

The micro computer needed some 1 1/2 hours for the process, but compilation into the machine language may shorten the time to about a half hour.

The results comprised totally more than 1000 pictures, a typical collection of them is included in the report. They are exhibited in Chapters 4 and 7.

Some features of special interest thereon will be discussed in the following:

5.2. Cycles. The very dominant role of the underwriting cycles was also conclusively confirmed by the model. As, for instance, the profile picture (I.Fig. 4.2.15.2) proves, the effect is quite crucial. One must appreciate, however, that regarding the necessity to obtain reliable results especially for solvency considerations, the assumptions were selected to be on the safe side in the case of uncertainties, even though all the assumptions were based on actual observations.

The drastic effect of cycles can be clearly seen e.g. if the figures I.4.1.1 and I.4.1.2 are compared.

Worthy of attention is the technique by means of which the cycles are introduced into the model. It was mainly made in a deterministic way, even though the time series approach was also discussed by Rantala in II.2.2 (cf. also I.3.3.9.5). It seems likely that the deterministic approach is satisfactory for solvency considerations (I.3.3.9.1). One should note that for solvency considerations it is not necessary to forecast the time point of the coming cycles exactly. It is enough to assume that cycles are sooner or later appearing. Therefore it is natural to suppose that an adverse period is just beginning, because solvency can be understood and defined to mean an insurer's capacity to overcome an adverse cycle whenever it will occur.

The situation is quite different if models are intended to be used for corporate planning. Then probably forecasting of the future flow, at least for some few years ahead, can be of interest. Then possibly the time series approach can be suitable, because it can be programmed to take into account the past flow of business and to predict the future flow, especially if outside indicators like the general economic trends and cycles can also be (as is highly desirable) incorporated into the model. Because the subject work was concentrated only on general solvency studies, this forecasting aspect was not considered in detail (however, discussion and

applications can be found in II.1.5.2 and II.2.2).

5.3. Inflation. Both steady inflation and inflation shocks were examined (I.3.3.5 and I.4.2.6). One of the crucial points is whether or not the joint effect of inflation (i_x) and the real growth (1_g) of the portfolio is more than the rate of interest (i_n), i.e. $i_x + i_g > i_n$. If this is the situation, as it unfortunately is in many countries today, then the real value of the solvency ratio is eroding all the time and fresh money is needed to compensate for this deterioration. It was assumed that it will be raised by self-financing, i.e. providing the premium rates with a safety loading which is capable, together with the yield of interest, to maintain the level of an adequate solvency ratio. Of course, there are also other approaches, e.g. at least some part of the needed fresh capital can be acquired from the capital market in the case of a joint-stock company. This may be natural at least concerning that part of the capital need which arises from the real growth. This alternative was not discussed in SR, because it was insignificant in the Finnish circumstances (and the same may concern many other countries, at least for mutual companies which may not have access to capital markets).

To bring the eroding effect of inflation and real growth into balance with the yield of interest and safety loading an equilibrium level was derived. It determines a minimum level for the safety loading. This problem was discussed in I.4.2.12 and II.4.1.

It may also be interesting to study alternatives where inflation is low and the yield of interest can cover it and also the rate of real growth, i.e. $i_n > i_x + i_g$. Then the stochastic bundle has a tendency to move upwards unlimited, as is exhibited in Fig.I.4.2.7.1. The unlimited growth of the solvency ratio is clearly an unrealistic situation for practical applications and obviously further special assumptions are needed to render it realistic (by the way: the same condition appears in the conventional risk theory, if the ruin probability is calculated for a infinite time span providing that it should be less than one). These kinds of processes were not considered and the whole study was limited to the case where real growth and inflation are clearly larger than the rate of interest (15% versus 9%).

Furthermore, the study of inflation shocks was informative, it can be found in item 4.2.6.3. The effect of this phenomenon depends on, among other things, the assumed time lag which necessarily exists between the effect on claims and the effect on premiums. The standard assumption was two years. The effect on the minimum solvency ratio was evaluated in I.4.2.15.2 to be of the order of magnitude of some 10-20%.

5.4. Catastrophic risks. These were introduced as mentioned in item 3.6 above and they were tested in I.4.3. A special consideration was the 'multi-channel' problem, i.e. the well-known fact that a major earthquake or windstorm can generate claims via quite numerous reinsurance contracts, if the insurer is extensively participating in international business. The Research Group received from Landin (I.1980) a quite interesting study concerning this multi-channel

effect and it was applied to the model. The experience reported by Landin suggests that the number of channels is approximately proportional to the size of the catastrophe.

5.5. Evaluation of the solvency margin. The main problem of the research work was to evaluate dimensions for a safe solvency ratio and safety loading taking into account a long-time horizon and the various assumptions listed above. The results in Chapter 4 can already give some concept of an order of magnitude. If the cycles are of the amplitude and length as assumed in SR, the solvency margin should be of the order of 100% of premium income in order to ensure long-term survival. It certainly widely exceeds many evaluations which have been published to date, e.g. as when the solvency margin problem was studied for the EEC directives. The difference depends mainly on the fact that the EEC directives, as well as many other legal rules, are intended to provide only minimum solvency and therefore apply a short-time span (objective A in item I.1.1.3). A long-time span necessarily greatly increases the need for a margin. For instance the empirical Fig.I.2.2.4 proves that the above-mentioned values may not be quite unrealistic. One can ask (and some people have already asked) are not these kinds of numbers in clear contradiction with real life. Quite numerous insurance companies have essentially a lesser margin than the suggested 100%. To answer this question first the fact should be appreciated that the 100% level is necessary only in that phase of the underwriting cycle when the prosperous half is ending and is turning to the adverse period. When the adverse period is ending, then of course the margin level has plunged down, but the expectation of the forthcoming prosperous period ensures survival. On the other hand, it is well-known that quite numerous insurance companies have actually disappeared from the market (in Finland fortunately always by means of a merger with another company). For instance, during the post-war years some 40% of the companies were dissolved, many of them under rather compelling circumstances, even if no direct bankruptcies occurred. In fact this experience is in fairly good conformity with the solvency evaluations found both in the empirical and theoretical part of the SR.

5.6. Equalization reserve. The dimensioning of the fluctuation buffer is specially considered in Chapter 7 which is devoted to the equalization reserve. The discussion of dimensions may be of interest. Some other problems considered in Chapter 7, on the other hand, are rather closely related to the necessity to strictly regulate (taxation and consumers as presented in Sections I.1.3 and I.1.4) the transfers to and from the equalization reserve as well as the limits for the reserve. The Research Group extensively discussed whether or not there is a conflict situation between insurers and insureds (insurance consumers) and the fiscal interests. One can ask if a high solvency margin is created by loading premiums excessively (or retaining the yield of interest and possibly investment profit in inflationary environments) for the purpose of building a large solvency margin (equalization reserve), is that not accomplished at the expense of the consumer and the fiscal interests? A counterargument of the Research Group was that an adequate solvency margin improved the risk-carrying capacity and in this way improves

profitability. It can be expected that what was first sacrificed in excessive loadings of premiums can be returned later as a function of improved profitability. This aspect is discussed in Section I.1.3 and especially in Chapter II.6. For instance, Fig. I.7.4.1 strongly supports the contention that the quite considerable equalization reserve (nowadays of the order of magnitude of up to 80% of the premiums) is totally financed by the improved profitability and risk-taking capacity of the past three decades (compared with the situation which would have existed if the conditions prevailing 30 years ago would have remained unchanged). The same problem is treated in II.6 on the basis of risk theoretical analysis.

5.7. Legal solvency margin problems. These problems are further discussed in Chapter 5.

5.8. Solvency measure. A quite interesting set of problems arose concerns public communication aspects. For the internal use of the insurance industry as well as for public relations adequate and simple methods, perhaps in form of some few indicators, are needed to convey the state of insurer. The present situation was judged to be unsatisfactory. Many quite crudely biased analyses are frequently published. The Finnish insurance companies had been in an exceptionally handicapped position because the main pillar of their solvency, the equalization reserve, had not been generally made public (the equalization reserve was included into the reserve of outstanding claims). The situation is now changed. The Ministry of Social Affairs and Health has ordered the companies to publish the equalization reserve data beginning with the 1981 financial statements. Details are presented in Section I.6.3 and the indicator problem generally is discussed in the other parts of Chapter 6.