Asymmetric Information and Insurance

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It is in the very nature of any insurance activity that there is only limited information available about the risk under consideration, and additional information is always desirable. This is obviously true for reinsurance as well. Reinsurance is insurance purchased by an insurance company (the ”cedent”) from another insurance company (the ”reinsurer”), and hence it is first of all an insurance activity. However, in addition to some common features there are a number of structural differences between first-line insurance and reinsurance, some of which particularly concern the information structure about the underlying risks of the policies. With several involved entities in the process, it is clear that asymmetry of information of market participants is an important aspect to consider. The discipline deals (directly and indirectly) with this asymmetry in various different ways, and in the following I would like to highlight some of them, considering these items from the particular perspective of degree of available information:

- **Information Asymmetry between Us and Mother Nature**
  Whenever we have to deal with the quantification of insurance risk (and this is necessary for the determination of fair premiums, formulation of robust risk management strategies and the determination of necessary solvency capital requirements), we face the losses as an unknown outcome of the future. Letting aside the (to some extent philosophical) question whether uncertainty about the future (in this context the sizes of claims) is due to lack of sufficient information about the physical processes and their current states at all scales or whether there is intrinsic and per se unpredictable inherent randomness, we typically face in any case the following workflow:

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  \text{UNCERTAINTY} \rightarrow \text{RISK} \rightarrow \text{DATA} \rightarrow \text{MODELS}
  \]

  A popular distinction (brought forward by the economist Frank Knight) between uncertainty and risk is that the latter can be quantified, i.e. one can in principle obtain a probability distribution for the outcome under consideration. After deciding which aspects of the unknown quantities fall under this category, the step of identifying the odds for the ”risks” crucially relies on some sort of experience, typically historical data points. The decision which data points are relevant (and to which extent) for a particular risk is a classical problem of actuarial science (see e.g. credibility theory). An additional challenge in this context is the fact that the nature of the risks may change over time, and besides external knowledge about such changes that may stem from concrete side information (such as changes of contract specifications, of environmental conditions etc.), one also has to consider statistical techniques to possibly detect such non-stationarities from the data.
The experience gained over the years as to which risks can be categorized in certain patterns and whether there are causal justifications for particular choices, leads to the development of models, which themselves are then starting points for the assessment of somewhat related risks at a later point in time.

Despite the fact that modellers are typically well aware of the limits of the modelling procedure, the driving motivation behind such an approach is the idea that it actually is possible to quantify the risks, and the imperfectness of a resulting model is mainly due to insufficient data and (more generally) insufficient information about the nature of the risks (and the relations among them). In that sense one could describe the development of models for insurance risk in general as an attempt to reduce the asymmetry of information that is available altogether and the one available to us.

- **Information Asymmetry between Policyholders and Insurer**
  When a policyholder and the insurer agree on a contract to exchange a deterministic premium payment against the payment of a possible loss as specified in the policy, there are obvious different information patterns on the two sides, but the asymmetry of information is both ways: the insurer typically has much more experience (i.e. suitable models) available for the risk that the policyholder faces, and hence (together with the principle of pooling) this risk can be managed much more efficiently by the insurer. However, for certain products policyholders would prefer more transparency, see e.g. [12].

  At the same time, in most lines of business, the insured may have much more information available on the actual risk profile than what he discloses to the insurer (and may have even have ways to influence the outcome by his behavior). A typical example is health insurance, where there is a natural asymmetry of information about the actual current state of the policyholder and correspondingly questions of moral hazard arise (see e.g. [22]). For recent research on asymmetry of information of certain kinds in life insurance, see e.g. [19, 21]. In car insurance, there is a long tradition to reduce the asymmetry of information in terms of the risk profile of the insured through bonus-malus systems, which at the same time provides incentives for a more cautious driving behavior. Recently, this development is going much further with collecting detailed telematics data of the actual driving behavior, see e.g. [18, 6]. The latter is a prominent example of how a plethora of additional data (i.e. information) can and will be used for the design of future contracts (a trend that is sometimes coined *Big Data in Insurance*). This also includes a detailed analysis of lapse behavior of customers [16, 20], and how to use the respective knowledge for business purposes (see e.g. [17]).

- **Information Asymmetry between Insurer and Reinsurer**
  As loss data are something that insurers are very reluctant to share, for many
non-proportional reinsurance contracts, not the entire relevant data set available to the insurer is passed on to the reinsurer, but only those claims which touch the layer of the contract (or are close to it). This asymmetry of information leaves the reinsurer with the challenge of modelling with censored data (see e.g. [2] for an overview). In practice, this is then often to be combined with collected data experience from related portfolios (sometimes gained through a proportional reinsurance contract for risks with a similar exposure). Depending on the type of contract and method used, there are many subtle issues to consider for the modelling and the pricing of reinsurance risk (experience rating vs. exposure rating etc. [1]). Another source of information asymmetry is that claims of the past are often reported in terms of their incurred values (i.e. the paid amount up to now plus a reasonable estimate for the outstanding liability), which can differ substantially from the ultimate values. In lines of business where the claim settlement takes a number of years it may easily be the case that one can not rely solely on the available ultimate claim payments, but has to consider the available incurred values for the modelling procedure as well. This leads to interesting statistical challenges, and there is little academic research on this aspect available up to now (cf. [2]).

• Information Asymmetry between Insurer and Investor
Potential and current shareholders of an insurance company often base their investment decisions on business figures and performance measures, but these will typically not completely reveal the full risk structure of the company. In view of required solvency capital, a company has to take into account the cost of organizing and holding that capital, and this cost will have an effect on a number of business decisions, including the need for reinsurance. The cost of capital rate is a quantity that is influenced not only by the risk profile, but also by the information structure. In view of the latter, this rate is a result of demand and supply in the market, but there are also some guidelines for such a rate that influence decisions on the technical provisions in particular with respect to loss reserves. For a discussion of actuarial aspects in this context, see e.g. [5, 14].
Another active field of research that deals with practical aspects of information asymmetry is securitization of insurance risk, in particular catastrophes and more recently also longevity. Securitization transfers insurance risk to the large capital markets and hence is a particularly useful tool for risks with potentially large magnitude and strong correlations, where classical reinsurance contracts become less economical, in view of huge capital costs. The history of securitization products is a fine example for how the different attitude towards information asymmetry (namely between the issuer and the investor) over time has changed products and their popularity (from triggers defined on the individual loss experience, over an industry index towards parametric triggers often based on some measurable physical quantities of
catastrophes, like wind speed, air pressure etc.). Whereas such triggers reduce the asymmetry of information (which for company-specific triggers had been quite substantial before), they increase basis risk, which is the risk that the trigger in fact does not reflect the actual loss experience of the issuer, reducing the effectiveness of the product for the latter. Correspondingly, this branch has seen volatile business volumes over time, with substantial increases particularly in periods when the classical reinsurance market can not cover the demand for this type of insurance (see e.g. [9, 11] for general accounts on the topic). The valuation of these products is at the intersection between insurance and finance, and is an interesting research field also from the academic side, see e.g. [7, 15, 4, 8] and [10] for a recent survey.

- **Information Asymmetry between Competing Insurers**
  Finally, as in other types of business, in insurance there is also competition between different companies for a finite set of policyholders, and there is a natural asymmetry of information concerning the risk profile, attitude and assessment of the market between competitors. Among some recent approaches there has been an analysis based on game-theoretical ideas in setting insurance premiums, which includes anticipation of the premium policy of competitors, lapse behavior of customers and capital constraints, see [13], and under incomplete information [3].

The purpose of this short chapter was to point out a number of actuarial research fields in which asymmetry of information plays, explicitly or implicitly, a particular role. Even if such a list can clearly not be exhaustive, it may give an indication of how important appropriate modelling of information is in this field, which is underlined by the many on-going research activities as well.

**References**


