



## Reinsurance and securitisation of life insurance risk: The impact of regulatory constraints

Pauline Barrieu<sup>a,\*</sup>, Henri Loubergé<sup>b</sup>

<sup>a</sup> LSE, Statistics Department, Houghton Street, London WC2A 2AE, United Kingdom

<sup>b</sup> Département des Sciences Economiques, Uni Mail, Bd du Pont d'Arve 40 1211 Geneva 4, Switzerland

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### ABSTRACT

Large systematic risks, such as those arising from natural catastrophes, climatic changes and uncertain trends in longevity increases, have risen in prominence at a societal level and, more particularly, have become a highly relevant issue for the insurance industry. Against this background, the combination of reinsurance and capital market solutions (insurance-linked securities) has received an increasing interest. In this paper, we develop a general model of optimal risk-sharing among three representative agents—an insurer, a reinsurer and a financial investor, making a distinction between systematic and idiosyncratic risks. We focus on the impact of regulation on risk transfer, by differentiating reinsurance and securitisation in terms of their impact on reserve requirements. Our results show that different regulatory prescriptions will lead to quite different results in terms of global risk-sharing.

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The convergence of the insurance industry with capital markets has become ever more important over recent years (see, for instance, the papers by Cowley and Cummins, 2005, Cummins, 2004, Cummins, 2008 or Cummins and Weiss, 2009 or the recent handbook by Barrieu and Albertini, 2009). Such convergence has taken many forms. And of the many convergence attempts, some have been more successful than others. The first academic reference to the use of capital markets in order to transfer insurance risk was in a paper by Goshay and Sandor (1973). The authors considered the feasibility of an organised market, and how this could complement the reinsurance industry in catastrophic risk management. In practice, whilst some attempts have been made to develop an insurance future and option market, the results have, so far, been rather disappointing. In parallel to these attempts, however, the Insurance-Linked Securities (ILS) market has been growing rapidly over the last 15 years. There are many different motivations for ILS, including risk transfer, capital strain relief, boosting of profits, speed of settlement, and duration. Different motives mean different solutions and structures, as the variety of instruments on the ILS market illustrates.

Among the key challenges faced by the insurance industry, the management of longevity risk, i.e. the risk that the trend of longevity improvements significantly changes in the future, is certainly one of the most important. Ever more capital has to be accumulated to face this long-term risk, and new regulations in Europe, together with the recent financial crisis, only amplify this phenomenon. Under the Solvency II rules, put forward by the European Commission, the more stringent capital requirements that have been introduced for banks should also be applied to insurance company operations (see Eling et al., 2007; Harrington, 2009; and Geneva Association, 2010). Moreover, in addition to this risk of observing a significant change in the longevity trend, the insurance sector is facing some basis risk, as the evolution of the policyholders' mortality is usually different from that of the national population, due to selection effects. These selection effects have different impacts on different insurance companies' portfolios, as mortality levels and speeds of decrease and increase are very heterogeneous in the insurance industry. This makes it hard for insurance companies to rely on national, or even industry, indices, in order to manage their own longevity risk. Hence, it has become more and more important for insurance companies and pension funds to find a suitable and efficient way to deal with this risk. Recently, various risk mitigation techniques have been attempted. Reinsurance and capital market solutions, in particular, have received an increasing interest (see for instance Blake and

\* Corresponding author. Tel.: +44 207 955 6016; fax: +44 207 955 7416.  
E-mail address: [p.m.barrieu@lse.ac.uk](mailto:p.m.barrieu@lse.ac.uk) (P. Barrieu).

Burrows, 2001 and Blake et al., 2006). Even if no Insurance-Linked Securitisation related to longevity risk has yet been completed, the development of this market for other insurance risks has been experiencing a continuous growth for several years, mainly encouraged by changes in the regulatory environment and the need for additional capital from the insurance industry. Today, longevity risk securitisation lies at the heart of many discussions, and is widely seen as a potentiality for the future.

The classical and standard framework of risk sharing in the insurance industry, as studied, for instance, by Borch (1960, 1962), involves two types of agents: primary insurers and a pool of reinsurers. The risk is shared among different agents of the same type, but with both differing sizes and utility functions. The possible financial consequences of some risks, such as large-scale catastrophes or dramatic changes in longevity trends, however, make this sharing process difficult to conduct within a reinsurance pool. In this case, capital markets may improve the risk-sharing process. Indeed, non-diversifiable risks for the insurance industry may be seen as a source of diversification for financial investors, such as a new asset class, enhancing the overall diversification of traditional investment portfolios, particularly in the case of low correlations with overall market risk. Even if the correlation is not necessarily low, which may be the case for changes in longevity, the non-diversifiable insurance risks may be shared by a larger population of financial investors, instead of being assumed by reinsurers only. In Section 1 of the paper, we focus on some insurance risks (for instance, longevity and mortality risks), and, from a general point of view, study the optimal strategy of risk-sharing and risk-transfer between three representative agents (an insurer, a reinsurer and an investor), taking into account pricing principles in insurance and finance within a unified framework. Comments on an optimal securitisation process and, in particular, on the design of an appropriate alternative risk transfer are made. In Section 2, we focus on the impact of regulation upon risk transfer, by differentiating reinsurance and securitisation in terms of their impact upon reserves. More precisely, we will study the bias introduced by the regulatory framework, and the subsequent impact upon the aforementioned risk transfer techniques.

## 1. Complementarity of reinsurance and securitisation in insurance risk management

### 1.1. Framework

In the following section, we consider a simplified economy composed of three different types of agents, namely an insurer, a reinsurer and a representative investor. The problem we would like to study is the risk-transfer of some insurance risk between the three types of agents, which is initially supported by the insurer. The various decisions will take place over a normalised time horizon  $[0, 1]$ , and, for the sake of simplicity, we neglect interest rates because they are unessential to the analysis. We also introduce a probability space  $(\Omega, \mathcal{F}, \mathbb{P})$  where  $\mathbb{P}$  represents a prior probability measure, typically the historical or statistical probability measure. The expected value under the probability measure  $\mathbb{P}$  is simply denoted as  $\mathbb{E}(\cdot)$ . We first need to introduce the various agents and their respective exposure to this insurance risk.

#### 1.1.1. The exposure of the insurer

We consider the following simplified framework: we assume that a representative insurance company is offering some insurance contracts, and makes some payments when a given event occurs (for instance when the insured dies in the case of a life insurance policy). It is, therefore, exposed to some insurance risk. Let us be more specific regarding the overall exposure of the insurer to

this insurance risk, introducing a distinction, in the nature of the risk itself, between  $\Theta$  representing the systematic component of the risk, and  $\Theta^\perp$  the specific or idiosyncratic component of the risk in the insurer's portfolio:

$$\begin{aligned}\widehat{X} &= \mathbb{E}(\widehat{X}/\Theta) + (\widehat{X} - \mathbb{E}(\widehat{X}/\Theta)) \\ &\doteq X(\Theta) + \bar{X}(\Theta^\perp)\end{aligned}$$

where  $\bar{X}(\Theta^\perp)$  and  $X(\Theta)$  are independent.  $X(\Theta)$  represents the part of the insurer's exposure that is related to the global insurance risk, while  $\bar{X}(\Theta^\perp)$  represents the part of the exposure that is related to the specific nature of the insurer's portfolio, hence, the part that can be diversified within a larger portfolio.

The insurer will transfer part of its exposure to the reinsurance company. The characteristics of the reinsurance risk transfer will be determined later.

#### 1.1.2. The problem for the reinsurer

In the economy we consider, there is a representative reinsurance company. It has an initial portfolio with a random value at time 1 equal to  $W_R$ . The reinsurer is providing reinsurance cover to the insurer for an amount  $\hat{J}$  against the payment of a reinsurance premium  $\kappa$ . The reinsurer can also transfer part of its risk to the capital markets by sponsoring an insurance-related bond.

This bond is written on a contingent payoff of  $M(\Theta)$ . Note that the risk covered by the bond is the systematic part only. The idiosyncratic part of the risk is not transferred to the capital markets. Therefore, the type of structure we consider in this paper is index-based. The product is based upon the global insurance risk that can be measured, for instance, using a global index on the population in the case of life insurance risk, or a parametric index in the case of non-life insurance risks. This avoids issues of asymmetric information between the reinsurer and the investor.<sup>1</sup> The financial investors will be willing to add these products to their existing financial portfolio to enhance diversification. The reinsurer will be interested in issuing such products if they can help her with transferring the non-diversifiable part of the insurance risk. Considering a bond based upon an index enables the issuer to filter out the non-diversifiable risk from the rest, and to end up with a portfolio to which there is a solely asymptotic relationship to the diversifiable part of the risk. At this stage, there is a trade-off between the mitigation of the non-diversifiable risk and the introduction of some basis risk for the issuer. By  $\pi$  we denote the initial price of such a (zero-coupon) bond paid at time 0 by the investor.

The exposure for the reinsurer is, therefore

$$W_R - \hat{J} + \kappa - M(\Theta) + \pi.$$

The problem is now a question of how to determine the optimal characteristics for both risk transfers  $(\hat{J}, \kappa)$  and  $(M(\Theta), \pi)$  under the participation constraints imposed by the insurer and by the investor.

<sup>1</sup> Note that this type of approach allows the reinsurer to transfer some of his risk to some agents in the capital markets, likely to be outside of the insurance industry.

The considered structure is that of a bond with contingent payoff  $M$ . It will typically involve the constitution of a collateral account at the beginning of the transaction using the initial payment by the investor, bringing an additional protection against any default in the transaction. The structure could also be that of a swap, where  $M$  represents the contingent cash flow in this case.

Note also, that the risk transfer using the capital markets imposes some constraint upon the type of risk covered by the transaction (the systemic part of the risk, and not the idiosyncratic risk). Indeed, this makes the bond a financial contract, and not an insurance contract based upon the actual losses of the protection seeker.

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