



Reinsurance decisions in life insurance: An empirical test of the risk–return criterion



Elena Veprauskaite^{a,*}, Michael Sherris^{b,1}

^a School of Management, University of Bath, Claverton Down, Bath BA2 7AY, United Kingdom

^b Risk and Actuarial Studies and ARC Centre of Excellence in Population Ageing Research (CEPAR), Australian School of Business, University of New South Wales, Australia

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ABSTRACT

Recent studies have analyzed optimal reinsurance contracts within the framework of profit maximization and/or risk minimization. This type of framework, however, does not consider reinsurance as a tool for capital management and financing. In the present paper, we consider different proportional reinsurance contracts used in life insurance (viz., quota-share, surplus, and combinations of quota-share and surplus) while taking into account the insurer's capital constraints. The objective is to determine how different reinsurance transactions affect the risk/reward profile of the insurer and whether factors, such as claims severity, premiums, and insurer's risk appetite, influence the choice of a proportional reinsurance coverage. We compare each reinsurance structure based on actual insurance company data, using the risk–return criterion. This criterion determines the type of reinsurance that enables insurer to retain the largest underwriting profits and/or minimize the risk of the retained claims while keeping the insurer's risk appetite constant, assuming a given capital constraint. The results of this study confirm that the choice of reinsurance arrangement depends on many factors, including risk retention levels, premiums, and the variance of the sum insured values (and therefore claims). As such, under heterogeneous insurance portfolio single type of reinsurance arrangement cannot maximize insurer's returns and/or minimize the risk, therefore a combination of different reinsurance coverages should be employed. Hence, future research on optimal risk management choices should consider heterogeneous portfolios while determining the effects of different financial and risk management tools on companies' risk–return profiles.

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1. Introduction

Almost every phase of economic behavior is affected by risk exposure. The trade-off between the strategic decisions which lead to optimal outcomes and “acceptable” risk exposure, is central to the economic performance of every corporation. This “acceptable” risk exposure is usually determined by the amount of capital that company holds. Financial institutions are required by regulators to maintain minimum levels of capital in order to reduce such risk exposures. These capital constraints also affect the type and the volume of business that companies undertake. A number of studies in the finance literature have analyzed the optimal behavior of financial institutions subject to these capital constraints (e.g., Cuoco & Liu, 2006; Stoughton & Zechner, 2007). In order to increase business volumes (and therefore take new risks) companies have to hold additional capital and/or shift increased risk among different entities. The most apparent and familiar form of risk shifting is the insurance/

reinsurance policy. Mayers and Smith (1990) explain that a reinsurance contract is an insurance policy purchased by an insurance company, and that the decision of an insurer to purchase reinsurance resembles the decisions of any nonfinancial firm or individual to purchase insurance. In this study, we extend both the finance literature on capital allocation and risk management literature on hedging choice decisions in financial services firms by examining the effects of different types of reinsurance on an insurer's risk–reward profile subject to capital constraints.

Risk management decisions (such as the purchase of (re)insurance) have important implications for solvency, earnings, and tax management, and directly impact the economic value of the firm (Krvavych & Sherris, 2006; Zou & Adams, 2006). Froot, Scharstein, and Stein (1993) provide a theoretical framework for the analysis of risk management decisions in terms of market imperfections, including frictions, such as agency costs, the costs of financial distress and bankruptcy, and the impact of financing policy on investment decisions. They argue that cash flow volatility is costly for shareholders and that by stabilizing the cash flows following unexpected shock events, risk management techniques (such as (re)insurance) enhance the market value of (insurance) firms by enabling managers to realize positive net present value (NPV) projects in the investment opportunity set. Gavern and Lamm-Tennant (2003) and Abdul Kader, Adams, and Mouritidis (2010) add that (re)insurance can help smooth company earnings and thereby lead to permanent increases

* Corresponding author. Tel.: +44 7731 439450.

E-mail addresses: E.Veprauskaite@bath.ac.uk, elena_veprauskaite@yahoo.com

(E. Veprauskaite), m.sherris@unsw.edu.au (M. Sherris).

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in insurers' market value. This is because transferring excess risks (e.g., the risk that an insurer is not willing to accept) provides investors with a clearer picture of an insurer's future earnings generating capability and, therefore, its future economic value. Adams, Hardwick, and Zou (2008) note that reinsurance can also reduce expected taxes by stabilizing period earnings and reducing the magnitude and timing of discharged liabilities. In addition, Shimpi (2002) and Cummins, Dionne, Gagné, and Nouira (2008) show that the optimal use of (re)insurance can increase shareholder value by substituting for equity, thereby reducing the cost of capital and increasing the returns from underwriting activities.

Reinsurance, however, comes at a cost, and it is therefore important to maintain a balance between the perceived benefit of buying reinsurance and its costs. For instance, Froot (2001) finds that in the catastrophe reinsurance market, reinsurance premiums several times exceed the actual price of the risk transferred. Cummins and Weiss (2000) add that factors, such as a shortage of capital in the reinsurance market, and the agency problems due to shareholder–manager conflicts, drive the price of reinsurance up.

The literature has long identified the importance of insurance/reinsurance and devoted much attention to analyzing its use. A number of recent studies (e.g., Fu & Khury, 2011; Kaluzska, 2001; Lampaert & Walhin, 2005; Verlaak & Beirlant, 2003) analyze different reinsurance arrangements adopting the classical mean-variance framework, where reinsurance decisions are based on risk minimization (e.g., variance minimization) and profitability. Lampaert and Walhin (2005) adopt RAROC (risk adjusted returns on capital) maximization to analyze the optimality of proportional reinsurance in the fire insurance industry. They find that quota-share reinsurance is sub-optimal compared to other types of proportional reinsurance arrangements, as it does not reduce the relative variability of the retained claim amounts. However, Lampaert and Walhin (2005) do not consider combinations of different types of reinsurance, which are commonly used in practice. Verlaak and Beirlant (2003) analyze various combinations of proportional and non-proportional reinsurance protections for a heterogeneous insurance portfolio. They show that the order of application of reinsurance arrangements can change an insurer's risk–profitability trade-off. Verlaak and Beirlant (2003), however, only allow for variation in sum insured values in the portfolio while determining the optimal reinsurance coverage. In practice, insurers write a range of policies with varying risk premiums and claims experience. The choice of reinsurance coverage can be affected by this variability and the use of multiple retention levels can be required to reflect different reinsurance loading factors.

This study contributes to the previous literature in two main aspects. First, the current study allows for variations in claims experience, levels of premiums for both insurance and reinsurance, and sum insured or reinsured values. These variations enable us to obtain more realistic insights about the effects of different types of reinsurance on an insurer's risk and profitability. Second, traditional mean-variance approaches either keep the risk constant and maximize profits, or keep profits constant and minimize the risk. In the context of reinsurance purchases, this might not be feasible since insurance companies purchase reinsurance (especially proportional types) not only for risk mitigation but also for capital substitution reasons. Therefore, a predetermined risk appetite level is required in the risk analysis.² We use the data consisting of 430,000 life insurance policies, covering Income Protection, Total

and Permanent Disability (TPD), Life Insurance, Funeral, and Trauma risks (see Appendix A for the description of these risks) from a large Australian life insurer over the period of January 2008 and January, 2011. We focus on proportional reinsurance types, viz., quota-share, surplus, and combinations of quota-share and surplus, which are more commonly used in the Australian Life Insurance market compared with non-proportional reinsurance (see Section 2 for a description of different reinsurance contracts). Each type of reinsurance is assessed using a risk–return framework. The objective is to keep the risk appetite constant (defined by the insurer's risk retention) while assessing different proportional reinsurance arrangements. The reinsurance structure that enables to retain the largest proportion of premiums and minimizes the risk of the retained claims is preferred to other reinsurance structures. We employ semi-variance—the estimate of lower partial moment (LPM)—derived by Fishburn (1977), as a measure of risk. Fu and Khury (2011) note that the main advantage of semi-variance is that, unlike in the RAROC method, where true risk exists only at the tail of the distribution, in this approach all the losses are considered as generating risk, but severe losses contribute non-proportionally to semi-variance.

The results of this study show that the choice of proportional reinsurance coverage can be affected by various life insurance and reinsurance policy characteristics, such as size and variability of insurance and reinsurance coverage, and fluctuations in insurance and reinsurance premiums. For instance, when an insurer retains a relatively large amount of risk and the variations in these retentions are relatively low in the insurance portfolio, surplus reinsurance can be the most effective way of both minimizing the risk of the retained losses and maximizing an insurer's underwriting profits. When an insurer retains relatively low amounts of risk, surplus reinsurance can lead to lower underwriting profits than those from quota-share or a combination of quota-share and surplus due to on average higher reinsurance premiums compared with other two reinsurance coverages. Furthermore, a large number of different risk retention levels in insurance portfolio reinsured under surplus reinsurance can increase the risk of retained insurance losses. In summary, under heterogeneous insurance portfolio single type of reinsurance arrangement cannot maximize insurer's returns and/or minimize the risk, therefore a combination of different reinsurance coverages should be employed. Hence, future research on optimal financial and risk management choices should consider heterogeneous portfolios while determining the effects of different financial and risk management tools (e.g., financial and risk hedging) on companies' risk–return profiles.

The remainder of the paper is organized as follows. Section 2 explains the theoretical framework of different proportional reinsurance arrangements. Section 3 presents and discusses the criterion that is used to conduct the empirical tests. Section 4 describes the data used for the numerical assessment. Section 5 reports the results and Section 6 concludes.

2. Proportional reinsurance

Consider a life insurer with a portfolio of n_j risks where j indexes the different policy type (e.g., Trauma, Income Protection). The insurance policy, which covers one risk, is indexed by i_j and is characterized by its risk exposure (e.g., the sum insured value) SI_{i_j} , premium P_{i_j} , and individual loss or claim S_{i_j} . In the case of no reinsurance, the insurer retains all the risk exposure (SI_j), premium (P_j), and it pays the full loss (S_j):

$$SI_j = \sum_{i_j=1}^{n_j} SI_{i_j}, \quad (1)$$

$$P_j = \sum_{i_j=1}^{n_j} P_{i_j}, \quad (2)$$

$$S_j = \sum_{i_j=1}^{n_j} S_{i_j}. \quad (3)$$

² Given the solvency capital requirements and the loss distribution associated with the risk, an insurer can determine the amount of required capital to underwrite its business. Thus, the insurer's capital can restrict the volume of business underwritten. If the insurer wants to increase the underwriting volume, it may increase premiums, raise more capital, and/or buy the appropriate reinsurance. Raising capital can be a costly, lengthy (and complicated) procedure, and increasing insurance premiums is limited due to competition in the insurance market. Thus, buying reinsurance is often the most convenient and practical option for increasing an insurer's risk carrying capacity (Eden & Kahane, 1988). The insurer's risk appetite is a proxy for the volume of business that can be underwritten while holding a predetermined amount of capital. Business volumes above this level need to be reinsured in order to meet solvency capital requirements.

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