

Fair valuation of life insurance liabilities: The impact of interest rate guarantees, surrender options, and bonus policies

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Abstract

The paper analyzes one of the most common life insurance products — the so-called *participating* (or *with profits*) policy. This type of contract stands in contrast to unit-linked (UL) products in that interest is credited to the policy periodically according to some mechanism which smoothes past returns on the life insurance company's (LIC) assets. As is the case for UL products, the participating policies are typically equipped with an interest rate guarantee and possibly also an option to surrender (sell-back) the policy to the LIC before maturity.

The paper shows that the typical participating policy can be decomposed into a risk free bond element, a bonus option, and a surrender option. A dynamic model is constructed in which these elements can be valued separately using contingent claims analysis. The impact of various bonus policies and various levels of the guaranteed interest rate is analyzed numerically. We find that values of participating policies are highly sensitive to the bonus policy, that surrender options can be quite valuable, and that LIC solvency can be quickly jeopardized if earning opportunities deteriorate in a situation where bonus reserves are low and promised returns are high. ©2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

Embedded options pervade the wide range of products offered by pension funds and life insurance companies. Interest rate guarantees, bonus distribution schemes, and surrender possibilities are common examples of implicit option elements in standard type policies issued in the United States, Europe, as well as in Japan. Such issued guarantees and written options are liabilities to the issuer. They represent a value and constitute a potential hazard to company solvency and these contract elements should therefore ideally be properly valued and reported separately

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on the liability side of the balance sheet. But historically this has not been done, to which there are a number of possible explanations. Firstly, it is likely that some companies have failed to realize that their policies in fact comprised multiple components, some of which were shorted options. Secondly, it seems fair to speculate that other companies have simply not cared. The options embedded in their policies may have appeared so *far out of the money*, in particular at the time of issuance, that company actuaries have considered the costs associated with proper assessment of their otherwise negligible value to far outweigh any benefits. Thirdly, the lack of analytical tools for the evaluation of these particular obligations may have played a part. Whatever the reason, we now know that the negligence turned out to be catastrophic for some companies, and as a result shareholders and policyowners have suffered. In the United States, a large number of companies have been unable to meet their obligations and have simply defaulted (see e.g. Briys and de Varenne, 1997 and the references cited therein for details), whereas in e.g. the United Kingdom and Denmark, companies have started cutting their bonuses in order to ensure survival.

The main trigger for these unfortunate events is found on the other side of the balance sheet where life insurance companies have experienced significantly lower rates of return on their assets than in the 1970s and 1980s. The lower asset returns in combination with the reluctance of insurance and pension companies to adjust their interest rate guarantees on new policies according to prevailing market conditions have resulted in a dramatic narrowing of the safety margin between the companies' earning power and the level of the promised returns. Stated differently, the issued interest rate guarantees have moved from being far out of the money to being very much *in the money*, and many companies have experienced solvency problems as a result. The reality of this threat has most recently been illustrated in Japan where Nissan Mutual life insurance group collapsed as the company failed to meet interest rate guarantees of 4.7% p.a.² Nissan Mutual's uncovered liabilities were estimated to amount to \$2.56 billion, so in this case policyholders' options indeed expired in the money without the company being able to fulfil its obligations.

Partly as a result of Nissan Mutual Life's collapse, Japanese life insurance companies have been ordered to reduce the interest rate guarantee from 4.5% to 2.5% p.a. In Europe, the EU authorities have also responded to the threat of insolvency from return guarantees. Specifically, Article 18 of the Third EU Life Insurance Directive, which was effective as of 10 November, 1992, requires that interest rate guarantees do not exceed 60% of the rate of return on government debt (of unspecified maturity). In relation to this, Table 1 shows the prevalent maximum level of interest rate guarantees as of October 1998 for Japan and the EU member countries. In several of these countries, the maximum guaranteed interest rate has decreased during recent years and further cuts are likely to be seen.³

As a consequence of the problems outlined above, insurance companies have experienced an increased focus on their risk management policy from regulatory authorities, academics, and the financial press. In particular the shortcomings of traditional deterministic actuarial pricing principles when it comes to the valuation of option elements are surfacing. Recent years have also revealed an increasing interest in applying financial pricing techniques to the fair valuation of insurance liabilities, see for example Babbel and Merrill (1999), Boyle and Hardy (1997), Vanderhoof and Altman (1998).⁴

In the literature dealing with the valuation of and to some extent also the reserving for insurance liabilities, several types of contracts and associated guarantees and option elements are recognized. Some of the contracts considered contain option elements of *European type*, meaning that the option(s) can be exercised only at maturity. This

² *The Financial Times*, 2 June, 1997.

³ From personal communication with members of the Insurance Committee of *Groupe Consultatif des Associations d'Actuaires des Pays des Communautés Européennes* (sic!).

⁴ The concern about traditional deterministic actuarial pricing principles and in particular the *principle of equivalence* is not entirely new. In the United Kingdom, the valuation of *maturity guarantees* (as opposed to the *interest rate guarantees* studied in the present paper) was a concern 20 years ago when the Institute of Actuaries commissioned the Report of the Maturity Guarantees Working Party (1980), in which the valuation of maturity guarantees in life insurance was studied (see also the discussion in Boyle and Hardy, 1997). It was recognized that a guarantee has a cost and that explicit payment for these guarantees is necessary. For an interesting view and a discussion of actuarial vs. financial pricing, the reader is referred to Embrechts (1996).

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