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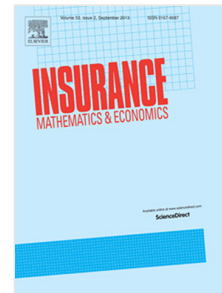Please cite this article as: Engsner, H., Lindholm, M., Lindskog, F., Insurance valuation: A computable multi-period cost-of-capital approach. *Insurance: Mathematics and Economics* (2016), http://dx.doi.org/10.1016/j.insmatheco.2016.12.002

INSURANCE VALUATION: A COMPUTABLE MULTI-PERIOD COST-OF-CAPITAL APPROACH

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ABSTRACT. We present an approach to market-consistent multi-period valuation of insurance liability cash flows based on a two-stage valuation procedure. First, a portfolio of traded financial instrument aimed at replicating the liability cash flow is fixed. Then the residual cash flow is managed by repeated one-period replication using only cash funds. The latter part takes capital requirements and costs into account, as well as limited liability and risk averseness of capital providers. The cost-of-capital margin is the value of the residual cash flow. We set up a general framework for the cost-of-capital margin and relate it to dynamic risk measurement. Moreover, we present explicit formulas and properties of the cost-of-capital margin under further assumptions on the model for the liability cash flow and on the conditional risk measures and utility functions. Finally, we highlight computational aspects of the cost-of-capital margin, and related quantities, in terms of an example from life insurance.

Keywords: valuation of insurance liabilities, multi-period valuation, market-consistent valuation, cost of capital, risk margin, dynamic risk measurement

JEL Classification: G22, G11, G28

1. INTRODUCTION

The current solvency regulatory framework Solvency II emphasizes market-consistent valuation of liabilities; it is explicitly stated that liabilities should be "valued at the amount for which they could be ... transferred or settled ... between knowledgeable and willing parties in an arm's length transaction". Solvency assessment of an insurance company is based on future net values of assets and liabilities, and market-consistent valuation enables solvency assessments that take dependence between future values of assets and liabilities into account. Moreover, current regulatory frameworks emphasize risk measurement over a one-year period. In particular, at any given time, the whole liability cash flow is taken into account in terms of the cash flow during the next one-year period and the market-consistent value at the end of the one-year period of the remaining liability cash flow. However, liability cash flows are typically not replicable by financial instruments. Therefore, the contribution to the liability value from the residual cash flow resulting from imperfect replication must be determined.

Given an aggregate liability cash flow of an insurance company, portfolios may be formed that generate cash flows with expected values matching that