Study and application of an Asset Sufficiency Test and an Asset-Liability Management model for life insurance products

Proposal presentation
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Useful Concepts

- Assets: Something valuable that an entity owns, benefits from, or has use of, in generating income.

- Liability: a current obligation of an entity arising from past transactions or events.

- Actuarial reserves: is a liability equal to the actuarial present value of the future cash flows of a contingent event.

- Technical result (TR): The financial state that a life insurance product has, including items such as, expenses, payment of claims and primes.
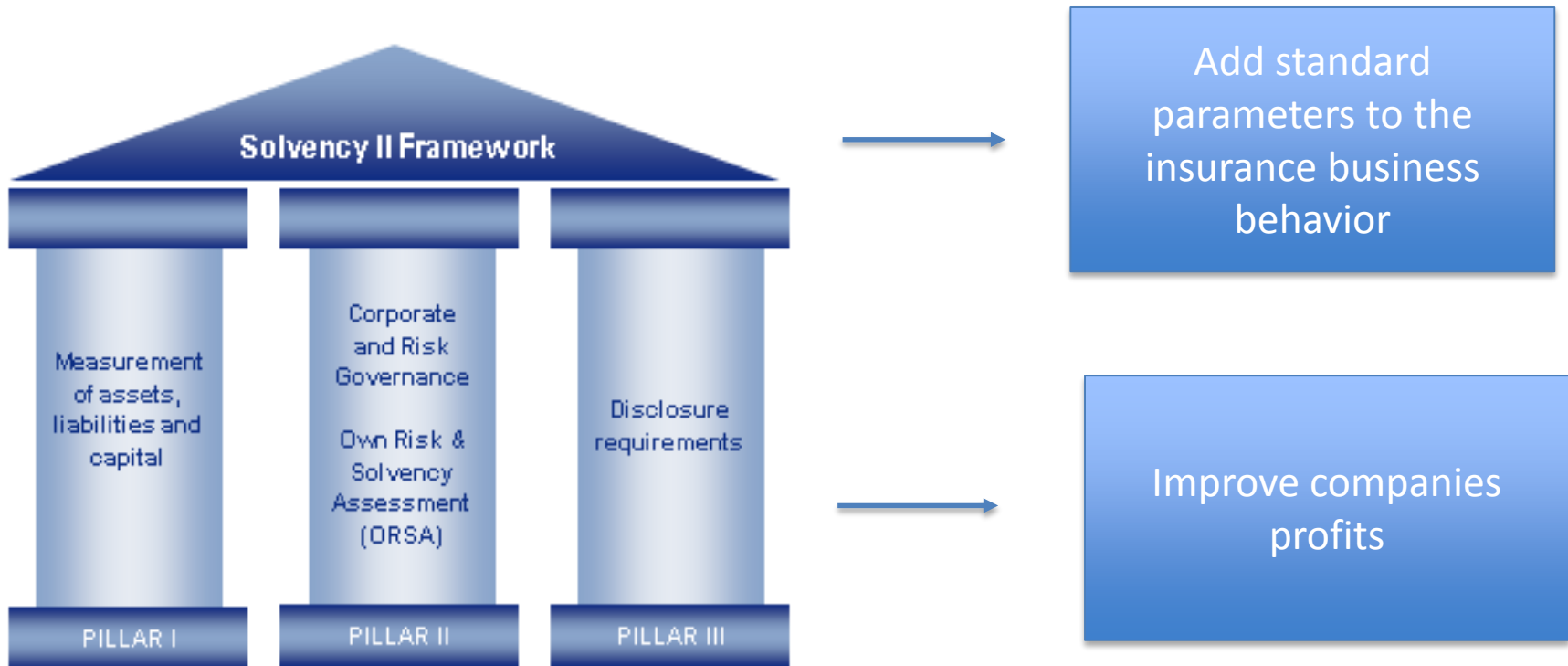
Useful Concepts

Solvency II:

Image 1. Solvency II description. Taken from [1].

Useful Concepts

Asset Sufficiency Test (AST):

- This methodology tries to measure the capabilities of each company to meet its financial commitments over time.

- In this regulation the flow of assets according to their risk classification is punished, which eventually corrects the potential credit deterioration of the portfolio indirectly through technical reserves. This type of test mainly consider the risk associated to the interest rate and reinvestment.

Useful Concepts

Asset-Liability Management (ALM):

- It is defined as a continuous process of formulation, implementation and supervision to the strategies related to the own resources (assets) and obligations (liabilities).

- The main idea of ALM is that the available capital has to be invested as profitably as possible (asset management) and the obligations against policyholders have to be met (liability management).

Useful Concepts

Types of models ALM:

- **Asset Share**: defined as the retrospective accumulation of past premiums, less expenses and the cost of cover, at the actual rate of return on the assets.

- **Capital Asset Pricing Model:** an empirical model used to determine a theoretically appropriate required rate of return of an asset, if that asset is to be added to an already well-diversified portfolio, given that asset's non-diversifiable risk.

Problem description

Basic model: defining an Asset Share model AS_t as the surpluses kept by the shareholders in year t:

$$AS_t = I_t - O_t - RA_t,$$

where I_t is the income or revenue, O_t the outcome and RA_t the actuarial reserve adjustement, which is defined as:

$$RA_t = R_{t-1} - E[R_t],$$

R_t: reserve at the end of year t.

Problem description

Disagregatting the past model:

$$AS_t = P_t - E_t - D_t - W_t + I_t - AR_t,$$

P_t: Net premium.

E_t: Expenses.

D_t: Claims paid for death.

W_t: Claims paid for withdrawals.

I_t: Earned interest due to reserve and income management.

Problem description

Finally, including two decrements (mortality and withdrawal) :

$$AS_t = (al)_{x+t}\left[(P_t + R_{t-1} - G_t)(1 + i_t) - VA_t q_{x+t}^d - VC_t q_{x+t}^w\right] - (al)_{x+t+1}R_t,$$

al_{x+t} : Number of people that survives from $x + t$ to $x + t + 1$.

VA_t: Cash value at moment t.

VC_t: Ceded premium at moment t.

q_{x+t}^d: Probability that a person dies between ages $x + t$ to $x + t + 1$.

q_{x+t}^w: Probability that a person withdraws a policy between ages $x + t$ to $x + t + 1$.

Objectives

General: To measure the minimum profitability from future investments to be able to meet financial commitments through time using different methodologies.

Specifics:

- To model the assets and liability interactions to mitigate the financial risk associate to the future market behaviors.

- To address a problem associated with actuarial science from a mathematical perspective, applying a model that serves to estimate the future financial obligations of the company.

- To find the optimal point where the assets and liabilities fit, avoiding this way, the overruns of the reserves.

- To apply the Asset Sufficiency Test (AST) and the Asset-Liability Management (ALM) for a life insurance product, called *Plan Vida Personal*. To achieve a part of the financial stability that Solvency II proposed.

Justification

One of the main concerns of insurance companies is to assess the financial viability and long term stability. Also, the continuous increasing in regulations leads to some questions:

- What future scenarios may cause insolvency problems?

- Are appropiate the strategies for asset allocation and profit sharing?

- How much capital is needed to support the gap and what is the risk-return relationship on that capital?

- How to incorporate risks quantitatively?

Justification

Insurance companies are exposed to different risks, classified in Table 1.

Insurance Risk	Market Risk	Credit Risk	Operational Risk
Sinistrality	Rate interest	Credit Insurance	External/Internal Fraud
Price	Currency	Reinsurance	Commercial practices
Cancellation	Financial derivatives	Issuing	Databases information
Expense	Inflation		

Table 1. Classification of risks.

Justification

There is also a classification, giving the importance of ALM models to different business lines, shown in Table 2.

Business Line	Liability Term	Cash Flow Forecast	ALM order of Importance
Life	Long	High	2
Annuity	Medium	High	1
Non-life	Short	Low	3

Table 2. Business line classification.

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Background

- Chilean companies have made approaches applying AST methodologies, especially in life annuities products due to government regulations [2].

- There have been approaches using discrete time stochastic ALM describing the most significant characteristics of these products in order to simulate its balance sheets [3].

- Another approach optimizes pricing embedded options in life insurance contracts [4].

References

[1] Lloyds, "What is solvency ii? - lloyd's -the world's specialist insurance market. also known as lloyd's of london; is a market where members join together as syndicates to insure risks.," 2016.

[2] L. Figueroa and E. Parrado, "Compañías de seguros de vida y estabilidad financiera en chile," Informe de Estabilidad Financiera, vol. 2, no. 2, pp. 75–82, 2005.

[3] T. Gerstner, M. Griebel, M. Holtz, R. Goschnick, and M. Haep, Numerical simulation for asset-liability management in life insurance. Springer, 2008.

[4] Y. Li et al., "Asset liability management in a life insurance company," 2010.

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