National Economics University Institut de Science Financière et d'Assurances

PROJECT FOR MASTER 1

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T O P I C :

Solvency for Life Insurance Company

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Contents

List of Tables

List of Figures

INTRODUCTION

"In Risk Management, the expected value is not to be expected"

- Bryis, de Varenne (2001) -

A rapidly growing and well evolved insurance sector can be very beneficial for economic growth of any country as it fulfills the long term fund requirement which can be positively used for infrastructural development of country at least risk. However, as the economic scenarios become increasingly complex and volatile, it is almost undeniable that there will be more deleveraged financial system and substantially different regulatory environments. Around the world, for ample amount of internationally active banks, the Basel II and III is the priority of carrying out economic capital in their risk management practice. On a par, the insurance industry is adopted the concept of the standard risk measurement system.

The initiative purpose of any risk management framework is improving the consumer protection. A more vigorous structure will give policyholders greater confidence in the products of insurers. Furthermore, the shift of supervisor' focus between the compliance monitoring and capital to evaluating insurers' risk profiles and the quality of their risk management and governance systems is also one of the attention of the legislators when choosing the foundation of the risk management framework.

Our thesis gives attention on introducing the regular risk management framework for life-insurance part throughout the world, such as the Risk-Based Capital and the Solvency II. Afterwards, we bring up the pragmatic situation of the implementation in the case of Vietnam.

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MODEL OF RISKED BASED CAPITAL MANAGEMENT

Policyholders, insurers, employees, creditors, and owners of enterprises, as well as the public, were all exposed during the liability insurance crisis of the 1980s. Economists and actuaries recognized the flaws in fixed capital rules because of the crisis and decided to change them. The Risk-Based Capital standard was developed by National Association of Insurance Commissioners (NAIC) and was implemented in the 1990s. Many markets have adopted the management approach, starting with the United States. Risk-based capital management is used in North America, Australia, New Zealand, and several Asian countries, albeit the calculating method varies.

Risk-based capital management is a way of calculating the minimum amount of capital required for an insurance company's overall operation depending on the size of the company and the level of risk it faces. Risk-based capital is intended to be the bare minimum of regulatory capital, and it is not necessary for a company to keep all its capital for safety and competitiveness reasons. There are two major parts to the RBC system:

- Insurance businesses' minimum capital levels are determined by risk-based capital calculations.
- The Risk-Based Capital Model Law allows state management authorities to take certain management and supervisory actions based on the degree of impairment, which is calculated by comparing an insurance company's actual capital to risk-based capital.

1.1 WHAT IS RISK BASED CAPITAL?

Assume that client Z signs a motor vehicle insurance contract with insurance company ABC. The one-year insurance policy says that in the event of an accident, ABC Company must cover the repair costs for customer Z in the amount of $20,000.

According to company estimates, the probability of a client having an accident in the next year

is 0.3, whereas the probability of no accident is 0.7. According to state management agencies, the corporation must maintain a risk-based capital level capable of paying up to 99.5% of cases to assure safety during operation.

Let X be the amount of the insuring risk in this example. The reserve for risk X is:

$$Reserves = \mathbb{E}(\mathbf{X}) = \$20,000 \times 0.3 = \$6,000$$

In addition to the $6,000 provision, the company must ensure that 99.5% of all unexpected risks are covered. As a result, the firm must maintain a capital level of:

$$Risk\ capital = Value\ at\ risk\ at\ 99.5\%\ confidence\ level - Reserves = \$14,000$$

Clearly, the company can afford to pay clients at any degree of confidence, with a provision of $6,000 and a capital of $14,000. However, no corporation can make a profit while keeping such a high capital ratio. So, how much risk capital should this ABC insurer have if it wants to sell 10,000 vehicle insurance policies to 10,000 independent customers?
At this moment, the risk reserve will be:

$$Reserves = \mathbb{E}(\mathbf{X}) = 10,000 \times \$6,000 = \$60\ million$$

Since the customer's accident risk is independent of each other, to cover 99.5% of extraordinary risks, the company must maintain a capital level of:

$$Risk\ capital = VaR_{99,5\%}(\mathbf{X}) - \mathbb{E}(\mathbf{X}) \sim 2.58\ \sigma(\mathbf{X}) = \$2.36\ mil$$

If the company only signs 1 insurance contract, the capital ratio must be maintained so that the entire number of provisions and capital equals 100% of the insurance amount to meet the state management's requirements. Due to portfolio diversification, the total provision and capital for up to 10,000 policies is 31% of the sum insured.
To define risk-based capital, a business must first assess which risks are critical to its long-term existence. Each of these risks must be measured by a monetary amount that the company must keep on hand to cover them if they arise. Diversification must be considered when assessing a company's risk-based capital. However, because each company in the market has a unique risk profile, developing a single formula that applies to the entire industry is far more difficult.

1.2 RBC US

Life insurance companies in the United States were first subjected to the risk-based capital-financial safety regulatory system in 1993. As a result, state regulators require a certain amount of capital for enterprises in the insurance industry, calculated using the NAIC's RBC calculation formula. The risk-based capital calculation for life insurance includes the following elements:

- C-1 Asset risk
- C-2 Insurance risk
- C-3 Interest rate risk
- C-4 Business risk.

RBC formula applied to life insurance businesses in the US:

$$RBC = \left(C_4 + \sqrt{(C_1 + C_3)^2 + C_2^2}\right) \times 0.5$$

1.2.1 Risk-Based Capital Ratio:

The risk-based capital is then compared to the adjusted total capital of the company. For decentralizing supervisory management intervention levels, the ratio of adjusted total capital to risk-based capital is employed as the basis.

$$RBCRatio = \frac{Total\ Adjusted\ Capital}{Risk\ Based\ Capital}$$

Where:

- The uninvested surplus, asset value provision, and 50% of the insurance company's dividend liability make up total adjusted capital
- Risk-based capital is the bare minimum of capital required for an insurance company to operate.

When the ratio falls below 200%, the NAIC initiates regulatory action:

- If the ratio falls between 200% and 150%, the company is subject to Company Action Level and must submit an RBC plan to bring its RBC ratio into compliance
- If the ratio is between 150% and 100%, the company is in Regulatory Action Level and must submit a corrective action plan. If the commissioner deems it essential, the NAIC will conduct an examination or take regulatory action
- If the ratio is between 100% and 70%, the firm enters Authorized Control Level, and the NAIC can take regulatory action against the insurer, such as rehabilitating or liquidating it
- If the ratio falls below 70%, the firm enters Mandatory Control Level, and the NAIC is empowered to take regulatory action against the insurer, including placing it under regulatory supervision.

1.2.2 Asset Risk - C-1

Definition: Asset risk, according to NAIC (1993), is the risk that the company's assets would devalue or that the issuer will be unable to pay (for valuable papers such as bonds, stocks, etc.)

The risk of default (bonds and mortgages) or a drop in the value of assets (stocks) that an insurance company maintains in its portfolio is measured by C-1 asset risk. The RBC for asset risk is computed by multiplying various risk indicators by various investment types, such as bonds, stocks, mortgages, real estate, and other long-term assets, and then aggregating the results. Depending on the size of the portfolio, we may need to alter certain asset types.

1.2.2.1 Bonds: Bonds are a type of investment that makes up most a company's idle capital. Bonds are a safe kind of investment that will provide life insurance firms with a consistent stream of income over time, while also reducing risks, increasing capital adequacy, and ensuring financial

strength to meet the insurance contract's obligations. However, the issuer may be unable to pay the interest or principle on schedule.

The Securities Valuation Division of the NAIC separates bonds into six investment grade classes. Investment-grade bonds, which are the least likely to default and thus the least dangerous, are classes 1 and 2. Subprime and high-risk bonds fall under categories 3 through 6. Class 6 bonds, on the other hand, are the riskiest bonds to invest in. Furthermore, government bonds in the United States have a risk factor of 0.

SVO Bond Category	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
Factor	0.003	0.010	0.040	0.090	0.200	0.300

Table 1: Adjustment Factors for Bonds

When evaluating risk capital, the diversification of a bond portfolio is also significant. A portfolio of bonds with a wide number of bonds from multiple issuers is less risky than a portfolio of bonds with a small number of bonds from a small number of publishers, all other things being equal.

Number of Issuers	First 50	Next 50	Next 300	Above 400
Factor	2.5	1.3	1.0	0.9

Table 2: Adjustment Factors based on Number of Issuers

The bond factors produced from the simulation study mentioned above are based on a hypothetical portfolio of 1,300 bonds, these ratios must be adjusted up (down) based on the actual number of bonds in the portfolio. For example, a 600-issuer portfolio would have an adjustment factor which may be calculated as follows:

$$\frac{50 \times 2.5 + 50 \times 1.3 + 300 \times 1.0 + 200 \times 0.9}{600} = 1.12$$

Here are the correction coefficients for numerous portfolio sizes using a similar technique:

In general, there are two processes in the risk-based capital calculation procedure for a bond portfolio:

Number of Issuers	50	100	200	300	400	600	800	1200	1600	2400
Factor	2.50	1.90	1.45	1.30	1.23	1.12	1.06	1.01	0.98	0.95

Table 3: Adjustment Factors for Several Portfolio Sizes

- Determine the adjustment factor for diversification. Note that government-guaranteed Class 1 bonds are not factored in, therefore their risk-based capital does not apply to them.
- Multiply the amounts from the financial statements by the applicable risk factors to get the risk-based capital for each bond. After removing the risk-based capital for government agency-guaranteed Class 1 bonds, multiply the total capital from the first step by the diversification adjustment factor.

1.2.2.2 Mortgage: Another popular investment is a mortgage. Farm Mortgages, Insured or Guaranteed Mortgages, Residential Mortgages, and more are all accessible on the market. Because some of these mortgages are guaranteed or insured, while others are not, their default risk varies. The insurance company's real estate mortgage assets are of higher quality, lowering the chance of default. Two mortgage experience adjustment factors are created to separate the quality of real estate mortgages: one for good quality mortgages and the other for 90-day delinquent loans.

1.2.2.3 Stocks: Include 2 categories: affiliated and unaffiliated stocks. Affiliates' risk weights are different from those allocated to unaffiliated firms' stocks.

- *Unaffiliated Preferred Stocks:* Assume that preferred stocks have a significantly higher default rate than bonds with the same credit grade. Each preferred stock's risk weights must be equivalent to the risk weight for similar-class bonds plus 0.02 but not more than 0.3.
- *Unaffiliated Common Stocks:* Consists of 2 groups: (1) non-governmental money market fund and (2) other common stocks.
- *Stocks of Affiliate Companies:* More than a quarter of the industry surplus and Asset Valuation Reserve (AVR) is made up of affiliate company stocks, which account for around

2.4% of life insurance business assets.

RBC is determined for affiliated stock by multiplying The RBC of the affiliate's insurance subsidiary by the affiliate's percentage ownership of the subsidiary + (0.03 times the statement value of the affiliate less the statement value of all insurance subsidiaries).

1.2.2.4 Separate Accounts: There are four different types of separate accounts:

- (1) Separate accounts that are secured from indexing.
- (2) Separate accounts that are not secured from indexing and are subject to New York Regulation 128.
- (3) Non-indexed, secured separate accounts not subject to New York Regulation 128.
- (4) Accounts that are not secure.

1.2.2.5 Real Estate: To refer to the risk factor in real estate, we can only utilize extremely limited data. In this regard, much research has reached varied conclusions, but a factor of 10% has been adopted. Because the NAIC annual reporting criteria require mortgage properties to be foreclosed on, the foreclosed real estate factor (15%) is lower than the mortgages in foreclosure factor (20%). As soon as a foreclosure becomes a reality, it must be written down. The liabilities will then be added to the real estate basis because of the property's forfeited value.

1.2.2.6 Other Long-term Assets: These are the assets listed in the annual report's long-term assets section. This asset class is believed to be riskier or more speculative than others. Assuming that these values are displayed in long-term assets below their depreciation expense or market value, and that volatility is restricted by that valuation approach, a risk factor of 0.20 was determined to apply to assets in the long-term asset category.

1.2.2.7 Concentration Factor: When a portfolio's assets are concentrated on a small number of assets, the risk associated with them rises. This risk is taken into consideration by the RBC formula's asset concentration component.

1.2.2.8 Miscellaneous Assets: Consists of:

- (1) Cash.
- (2) Short term investment.
- (3) Premium notes.
- (4) Write-ins.

1.2.2.9 Reinsurance: There are 16 divisions in the reinsurance segment, separated into reinsurance assets and reinsurance liabilities. Each reinsurance asset class has a risk factor of 0.005, which assumes the risk of not being able to obtain reinsurance when the contract falls between the risks of a Class 1 bond (0.003) and a Class 2 bond (0.010).

1.2.2.10 Off Balance Sheet Items: The final C1 risk category contains corporate assets or commitments that aren't necessarily shown in the balance sheet but are detailed in the annual report or financial statement notes.

1.2.3 Insurance Risk C-2

The danger of mispricing of products is known as insurance risk. The risk factor decreases as the number of insurance written increases: the loss risk is spread out. Mispricing, underestimate of expenses, overestimation of interest rate and investment income, improper mortality and morbidity selection, and the incidence of catastrophe and contagion are all examples of insurance risk. For all insurance companies, these risks are inescapable.

The formula's C2 component consists of three major components:

- Health insurance.
- Life insurance.
- Premium stabilization reserves.

C2 total risk capital = RBC for Life insurance + RBC for Health insurance - 50% of Premium stabilization reserves are represented as liabilities on the company's book.

RBC does not drop below 0 in this case.

1.2.4 Interest Rate Risk C-3

The C-3 risk, also known as interest rate risk, is the danger of losing money owing to fluctuations in interest rates. This risk is fundamentally different from the C-1 and C-2 concerns. The link between assets and liabilities determines the C-3 risk. C-1 risk is associated with the asset side of the balance sheet and the risk of principal and interest default, whereas C-2 risk is associated with the liability side of the balance sheet and the risk of mortality, morbidity, and expense changes that exceed pricing expectations.

The degree to which asset and obligation cash flows are coordinated determines C-3 risk. To put it another way, do the assets repay the liabilities as they mature, or do they refund too early or too late.

Interest rate risks are divided into three categories based on the assumption that asset and obligation duration are well-matched.

- Low risk.
- Medium risk.
- High risk.

The following table shows the risk factors for all three types of interest rate risk:

Class	Low risk	Medium risk	High risk
Factor	0.0075	0.015	0.03

Table 4: Risk Factors for Interest rate Risk

According to C3, risk capital is calculated under four conditions:

- Joint account that has been sponsored.
- The interest reserve fund, also known as the long-term interest rate guarantee fund, must be less than or equal to 4%.
- Mechanism of Experience Rating.
- Market corrections or arbitrary withdrawals of investments are not allowed.

1.2.5 Business Risk C-4

The business risk is unavoidable. It encompasses all additional threats that do not fit neatly into the preceding three risk categories. While business risk differs from one company to the next, only one component is considered in the calculation: a risk premium for the underwriting fund (a type of fund typically used when an insurer is insolvent and cannot pay its debts to the policyholder).

The table below shows the business risk for a variety of different sorts of companies:

Type of Companies	Factor
Life and Annuity Business	0.02
Health Insurance	0.005

Table 5: Risk Factors for Business Risk

1.3 THE RISK-BASED CAPITAL MODEL IN JAPAN (1996)

Because of the increased risks associated with the liberalization of insurance products and premium rates, as well as the deregulation of the insurance industry, solvency margin criteria were introduced to Japan for application at the end of fiscal 1996. By referring to the method utilized in the United States, their objective was to act as indices required to prove the level of solvency for higher risks than normally expected for insurance companies, thereby confirming a sound basis for the insurance business.

The solvency margin ratio means the ratio of "solvency margin of general insurance companies by means of their capital, reserves, etc." to "risks which will exceed their usual estimates", as calculated below. The solvency margin ratio is one of the indices which the supervisory authority utilizes in order to judge the management soundness of an insurance company.

Early remedial action based on the solvency margin ratio was introduced in April 1999, as one of the key factors in the new insurance supervisory and regulatory framework. The objective of early remedial action is to ensure the sound and proper business operation of an insurance company and the protection of policyholders by enabling the supervisory authority to urge insurance companies to maintain sound management regarding their solvency margin ratios. The Financial Services Agency (FSA) would take some remedial action if the insurance company has the Solvency Margin Ration drop below 200%.

Category	**Solvency Margin Ratio**	**Directive**
None	200% and over	None
Category 1	100% to less than 200%	Submission and implementation of a business improvement plan
Category 2	0% to less than 100%	a. Submission and implementation of a plan for adequate solvency of insurers. b. Prohibition or limitation of dividends. c. Prohibition or limitation of policy dividends or distribution of surplus to policyholder. d. Change in calculation method of premium for policies to be newly underwritten. e. Prohibition or limitation of directors' bonuses, limitation of other operating costs, etc.
Category 3	Less than 0%	Partial or total suspension of operation for a limited period

Table 6: Early Remedial Action corresponding to Solvency Margin Ratio

The formula of the calculation of the solvency margin ratio is as follows:

$$\text{Solvency margin ratio (\%)} \quad = \quad \frac{\text{Total amount of solvency margin}}{\text{Total amounts of risks} \times \frac{1}{2}} \times 100$$

The term "solvency margin" refers to the amount by which a company's assets exceed its obligations, and in other word, the difference between assets, A, and liabilities, L: S=A-L. The supervisors' duties include ensuring the insurers' financial stability in the face of erratic capital markets in addition to defending policyholders' rights to obtain the promised benefits. Therefore, it's crucial to keep the solvency buffer above a specific threshold.

For Life Insurance, the "Total Amounts of Risks" is calculated as follows:

$$\sqrt{(R1 + R8)^2 + (R2 + R3 + R7)^2} + R4$$

1.3.1 Insurance Risks (of Life Insurance) – R1

Insurance risks of Life Insurance are divided by types of risks, which are unable to cover the assumed mortality or other occurrence rates. The "Total Amounts of Risks" is calculated as follows:

$$\sqrt{A^2 + B^2} + C$$

Type of Risk	**Amount of Risk**	**Risk Coefficient**
A. Ordinary Mortality Risk	Amount of claims payable at death	0.006
B. Survivor's Risk	Amount of Reserves through term-end for individual annuity insurance	0.010
C. Other Risks	Amount of risk reserve	1

Table 7: Risk Coefficient of Life Insurance Risk

1.3.2 Assumed Interest Rate Risks – R2

Risks of invested assets failing to secure required yields corresponding to assumed rates of interest. The risks shall be calculated by applying the amount of underwriting reserves in each category of interest to the probability of assumed rates of interest causing a back spread considering the past development of indexes.

Assumed interest risk amount = Sum of (reserves for the category of the assumed interest rate x corresponding assumed interest rate coefficient)

Assumed Interest Rate	**Risk Coefficient**
0.0% - 2.0%	0.01
2.0% - 3.0%	0.2
3.0% - 4.0%	0.4
4.0% - 5.0%	0.6
5.0% - 6.0%	0.8
$\geq 6\%$	1

Table 8: Assumed Interest Rate Risks for Life Insurance

1.3.3 Asset Management Risks – R3

Risk of a drastic devaluation of assets because of a crash in stock prices or sharp fluctuation in the currency market, and risk of a sharp increase in irrecoverable loans due to failures of borrowing companies.

$$\begin{aligned} \text{Asset management} \\ \text{risk amount} \end{aligned} = \begin{aligned} &\text{Price fluctuation risk amount} + \text{Credit risk amount} + \\ &\text{Subsidiaries risk amount} + \text{Derivative transaction risk amount} + \\ &\text{Reinsurance risk amount} + \text{Reinsurance recoverable risk amount.} \end{aligned}$$

Where:

- Price Fluctuation Risks: Risks associated with retained securities and other assets experiencing price fluctuations that are greater than expected. Risks arise from yields in each type of investment being lower than normal expectations (with a 90 probability) on the basis of indexes in the past 10 years and more.

$$\begin{aligned} \text{Price fluctuation} \\ \text{risk amount} \end{aligned} = \begin{aligned} &\text{Sum of (assets at risk* } \times \text{ corresponding risk coefficient)} \times \text{coefficient} \\ &\text{for the effectiveness of investment diversification} \end{aligned}$$

** Assets at risk: Domestic stock, foreign stock, yen-denominated bonds, foreign currency-denominated bonds, foreign currency loans, real estate (domestic land), gold bullion, trading securities.*

Assets at Risk	**Risk Coefficient**
Domestic (Japanese) Equity	10%
Foreign Equity	10%
Yen-dominated Bonds	1%
Foreign Currency Bonds, Foreign Currency Loans	5%
Real Estate	5%
Gold Bullion	20%
Trading Securities	1%

Table 9: Price fluctuation risk

- Credit Risks: Risks associated with third parties' default, etc., in the transactions of retained stocks, loans, and other assets. Risks are classified according to the creditworthiness of other parties.

$$\text{Credit Risk Amount} \quad = \quad \text{Sum of (assets at risk* } \times \text{ corresponding risk coefficient)}$$

** Assets at risk: Loans, bonds, and deposits*

- Other asset management risks: include "Subsidiaries, etc. Risks" and "Derivative Transaction Risks", "Reinsurance Risk and Reinsurance Recoverable Risks". These risks are quantified by similar calculation formulas such as (amount at risk)×(risk coefficient).

Assets at Risk		**Credit Coefficient**
Loans	Rank 1	0.000
Bonds	Rank 2	0.010
Deposits	Rank 3	0.040
	Rank 4	0.300
Short-term Lending Transactions		0.001

Table 10: Credit Risks

1.3.4 Business Management Risks – R4

Risks arising in excess of normal expectations in connection with the management of business and not falling under any of the above categories. The risks must be estimated as a specific portion of all other hazards.

$$\begin{aligned} \text{Business Management} \\ \text{Risk Amount} \end{aligned} = \begin{aligned} &\text{Amount at risk* } \times \text{ risk coefficient according to} \\ &\text{the category of insurance company} \end{aligned}$$

Where:

$$\begin{aligned} \text{Amount at risk} = \ &\text{Amount at general insurance risk + Amount at assumed interest rate risk +} \\ &\text{Amount at asset management risk + Amount risk due to major catastrophe risk} \end{aligned}$$

Type of Company	**Risk Coefficient**
Companies reporting a loss at the end of the current accounting period	1%
Companies other than the above	2%

Table 11: Business Management Risks

1.3.5 Minimum Guarantee Risk (R7)

Minimum Guarantee Risk is related to the minimum guarantee for benefits of variable insurance and variable annuity products. The FSA's view is "a risk equivalent value corresponding to the minimum guarantee risks should be established consistently with the funding rules for policy reserves." and the additional amount that needs to be funded to cover the risks that arise due to potential price fluctuations in excess of what are currently projected as normal (to cover approximately 90% of events when combined with a policy reserve relating to minimum guarantees) should be set at 2under the standard method; or computed by risk evaluations that are based on multiple scenarios, etc. under the alternative method.

1.3.6 Insurance Risks [3rd sector insurance] (R8)

Insurance risks of 3rd sector insurance are divided by the following 5 types of risks, which are unable to cover the assumed mortality or other occurrence rates. Life insurance companies own all types of risks, but non-life insurance companies own type D risk. The "Total Amounts of Risks" is simply the total sum of all risk amounts.

Type of Risk	**Amount at Risk**	**Risk Coefficient**
E. Stress Risk	Amount of risk reserve	0.1
F. Accident Mortality Risk	Amount of claims payable at accidental death	0.06/1000
G. Injury Hospitalization Risk	Per diem amount for injury hospitalization × Expected average number of benefit days	3/1000
H. Sickness Hospitalization Risk	Per diem amount for sickness hospitalization × Expected average number of benefit days	7.5/1000
D. Other Risks	Amount of risk reserve	1

Table 12: Insurance Risks [3rd sector insurance]

SOLVENCY

The solvency regulations of the European Union have changed over time from a straightforward ratio-based strategy to a sophisticated risk-based approach. The history of insolvency legislation began with the first EU life and non-life directives (in the 1970s), continued through the Solvency I's era, and finally evolved into a more effective risk-based method known as Solvency II. Due to the topic's extreme complexity, we will only cover the most important aspects of the development of the legislative framework for solvency that originated in the EU in this chapter. The applicability of this risk management method in Vietnam, in particular, will also be discussed below.

2.1 Early Days of Solvency Regulations

The Life Insurance Directives (EEC 1979) and the Non-Life Insurance Directives (EEC 1973) can be seen as the beginning of a formal set of solvency requirements that insurance companies were required to meet in a free market, even though different methods have been used to calculate an insurer's solvency margin over the years. The method used at the time was easy to use and uncomplicated. For example, in the case of life insurance, simple factors were employed on the mathematical reserve or the capital at risk depending on who carried the investment risk. Solvency evaluation was based on simple factors and formulas that were used on accounting results after adjustment for reinsurance.

- A: Minimum Solvency Margin (Required Solvency Margin) = 4% of the mathematical reserves + 0.3% of the capital sum at risk
- B: Guarantee Fund = 800 000 ECU (European Currency Unit) in 1979
- C: Minimum Guarantee Fund = Maximum (1/3 A, B)

As of the date of the most recent balance sheet, insurers were required to conform to the Required Solvency Margin (RSM) standards. Typically, RSM should be higher than the Minimum

Guaranteed Fund. A "warning signal" would be sent if capital fell below the RSM threshold. "Wind up" would start if the capital drops to the Minimum Guaranteed Fund level. The "wind up" therefore used predetermined ratios.

Although the components were straightforward to administer, implement, and comprehend, they were based on a basic formula and did not expressly take hazards into account. As a result, they lacked the capacity to handle the growing complexity of the market and the escalating demands for client protection. Since simple factors were being used in life insurance, a strengthening of the reserving basis resulted in an increase in mathematical reserve and, as a result, a direct rise in the required solvency margin.

2.2 Solvency I

The Solvency I system was established in February 2002. It added a few more parameters to the solvency evaluation. The Life Directives saw very little alteration, nevertheless. The directive for life insurance stipulated that the available solvency margin to cover for the technical provisions must be of good quality. It also included information on unit-linked contracts' solvency margin.

Solvency I offered a simple but effective way to robust insurer solvency. Compared to the early restrictions, it has improved while keeping its simplicity. This has the advantageous consequence of making administration and compliance management simple and affordable.

Despite being quite simple, Solvency I did greatly increase policyholders' protection. That explains why the system worked well over time.

However, since these regulations were established, the insurance business has seen some significant changes, which made it necessary to correctly amend the standards (see below for more information).

- In the latter part of the 1990s, the equities markets were strong, which benefited insurance businesses.
- Falling interest rates make it challenging to get the guaranteed returns increased life expectancy
- High impact incidents are happening more frequently than before.

The need for a better system that detects the many risks to which an insurance firm is exposed in a more comprehensive way was previously mentioned in the working paper for Solvency I. In a sense, the creation of a more complex and comprehensive methodology, as required by Solvency II, had already been covered over by Solvency I.

2.3 Life Insurance Regulations in Vietnam

In Vietnam, the insurance market is regulated by the Ministry of Finance (MOF). The MOF has the jurisdiction to create legal documents (circulars/decisions) that set instructions for the operation and other operations of firms in the insurance sector. It also has the power to award and revoke licenses. The MOF receives assistance from the Insurance Supervisory Authority (ISA), a division of the MOF, in regulating the insurance industry and market in Vietnam.

The Government has published regulations on legal capital (Decree No. 73/2016/ND-CP on building up reserves and minimum solvency margin) on strengthening supervision of financial operations of insurance firms (Circular No. 50/2017/TT-BTC directing the execution of Decree No. 73/2016/ND-CP). The European Solvency I is the foundation for these legislative requirements.

2.3.1 Minimum capital

The legal capital of the life insurance businesses is regulated as follow:

(a) General insurance (Except items (b) and below) and health insurance	VND 300 billion
(b) Item (a) plus either aviation insurance or satellite insurance	VND 350 billion
(c) Item (a) plus both aviation and satellite insurances	VND 400 billion

In the legal text, we can also see Expansion of contents, scope and/or duration of operations as below:

- Providers of pension insurance:
  - Having a solvency margin that is 300 billion dong above the required solvency margin;
  - Generating the voluntary pension fund by taking at least 200 billion dong from the owner's equity;
- For companies that sell unit-linked insurance: With a solvency margin that is 200 billion dong above the required solvency margin;
- Having a solvency margin that is 100 billion dong over the required minimum for general linked insurance companies.

2.3.2 Solvency

The difference between total assets and outstanding liabilities at the moment the solvency margin is established is an insurance company's solvency margin. Assets that are utilized to determine an insurance company's solvency margin must be liquid.

Circular 50/2017/TT-BTC provides a method for calculating assets for purposes of determining the solvency margin.

The minimum solvency margin of a life or health insurer is:

- 1.5% of technical reserves + 0.3% of the sums insured for unit-linked insurance policies that involve risk;

- 4% of technical reserves + 0.3% of the sums insured for universal life insurance and retirement insurance policies that involve risk;
- Other life insurance contracts and health insurance contracts:
  - With a term of less than 5 years: 4% of technical reserves + 0.1% of the sums insured which carry risks;
  - With a term of over 05 years: 4% of technical reserves + 0.3% of the sums insured which carry risks.

An insurance company will be deemed insolvent if the appropriate solvency margins are not maintained. If an insurance company's solvency margin is below the minimum solvency margin, insolvency is seen to be a possibility. In this situation, the insurance company needs to act quickly to get its solvency back. It is required to update the MOF on its real financial situation, risk factors, and strategies for regaining financial security.

The MOF may ask an insurance company to take one of the following actions if it is unable to restore security on its own: increase capital; seek reinsurance from other insurance companies; limit the range of services and business activities; suspend some or all operations; consolidate the company's organizational structure; replace management personnel; or transfer insurance policies to other companies. A solvency control board will be established by the MOF to take action to restore solvency if all of these procedures are unsuccessful and the firm is placed under special management. The firm must carry out the choices made by the solvency control board in order to restore solvency.

2.3.3 Policyholder Protection

The Law on Insurance Business mandates the creation of an internal fund to safeguard the insureds in the case of the insolvency or bankruptcy of the insurer. This fund comes from a portion of the premiums collected. Decree 73/2016/ND-CP provides information on the creation (including the pertinent proportion of premiums), administration, and usage of the reserve fund.

To safeguard insured people in the event that an insurer goes bankrupt or insolvent, insurers and foreign general insurers' branches (apart from reinsurers) are required to make contributions to the insured person protection fund. The MOF will yearly declare the rate of appropriation for this fund, which will not be greater than 0.3% of the total premium money retained from primary insurance contracts in the previous fiscal year. Biannual 50/50 contributions will be needed until the accumulated fund reaches 3% in the case of a life insurer, 5% assets of a general insurer, a health insurer, or a branch of a foreign general insurer.

2.4 Solvency 2 for life insurance

The solvency requirements approach adopted those days were simple and straight ahead to manipulate and operate, despite that, with the growth of the equity in the later nineties and the fall of the interest rates, the increase in the expectation of life make the Solvency I risk management framework more tough and tricky to satisfy the guaranteed returns on the insurance sector than ever. However, the Solvency I had already laid the foundation for the development of a more sophisticated and holistic approach as entailed in Solvency II. Actually, it took regulators almost 15 years to get the Solvency II regulatory regime off the ground. Starting from 1999, at a meeting of the Insurance Committee and then finally, the Solvency II officially has come into force since 2016.

The EU's Solvency II prudential framework has offered many of intended benefits, including introducing a risk-based approach to solvency capital, setting very high standards for risk management system, and introducing extensive supervisory reporting and significant public reporting. As a result, the framework ensures high standard of policyholder protection and a more level regulatory operating field around the world, especially across Europe.

2.4.1 Three-pillars structure for insurance undertakings:

Analogous to the banking regulatory framework known as Basel II, KPMG International, a Swiss entity, in 2000 proposed a three-pillar structure for insurance solvency regulation, especially in

accordance with specific term *Quantitiative Impact*

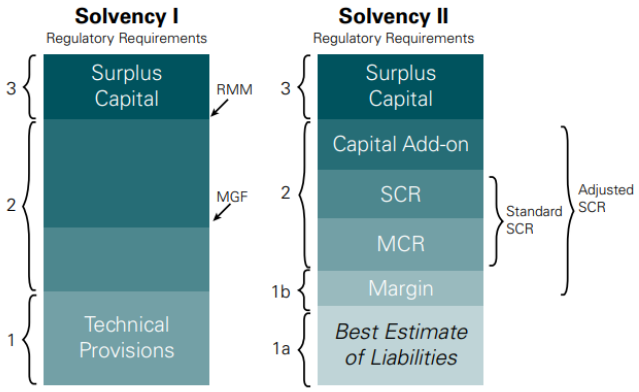

Figure 1: Changing regulatory requirements

The figure following described the basic alteration of risk management framework of the Solvency I and Solvency II. Where:

- Technical provisions to match insurers' liabilities
  - Best estimate of liabilities
  - Market Value Margin
- Regulatory capital requirements
- Capital held in excess of regulatory capital requirements

• **Pillar 1: The quantitative requirement**

Actually, mentioned about the first pillar, it is all about the calculations, the application of models and capital requirements. The first pillar describes two financial requirements which an insurer must match: the Solvency capital Requirement (SCR) and the Minimum Capital Requirements (MCR). The SCR is a risk sénitive capital measure calibrated to ensure each insurer

will be able to meet its obligations over the next 12 months with a probability of 99,5% level of confidence. If this level of capital is not reached, it will likely have a regulatory intervention and require remedial action. The Minimum Capital Requirement (MCR) is the minimum amount of capital the insurer needs to cover their own risks facing the organization. If an insurer´s risk capital falls below the MCR, they will be prohibited from writing any further business.

• **Pillar 2: The supervisory activities**

According to the point of view of the different Actuary organizations around the world, the risks recognized by quantitative models in the first pillar must be handled with appropriate processes and decisions in the context of a risk management system. It is the key linkage between the company´s risk capital modeling capability and the way the business operates and should be an integral part of the business strategy, taken into account strategic decisions and should be used to help identify and manage risk.

• **Pillar 3: The supervisory reporting and public disclosure** To the third pillar belong considerations about market transparency and disclosure requirements, which promote market discipline. The combination of minimum capital standards, qualitative risk management requirements, a rigorous and well-defined review proceeding of companies' solvency by regulators (supervisors) and prescribed disclosures to supervisors, policyholders and investors has been designed to render a better modern and secure regulatory system. Several additional intention are to be considered, in particular as discouraging publication of competition-distorting information. Furthermore, coordination should be sought where appropriate with international financial reporting standards (IFRS/IAS) and other relevant disclosures.

According to the opinion of EIOPA review of Solvency II, which is represented in Reporting and Disclosure: Quantitative Reporting Templates on the 2020, the Solvency and Financial Condition Report (SFCR) and Quantitative Report Template (QRT) are the completest view of future reporting and disclosure requirements.

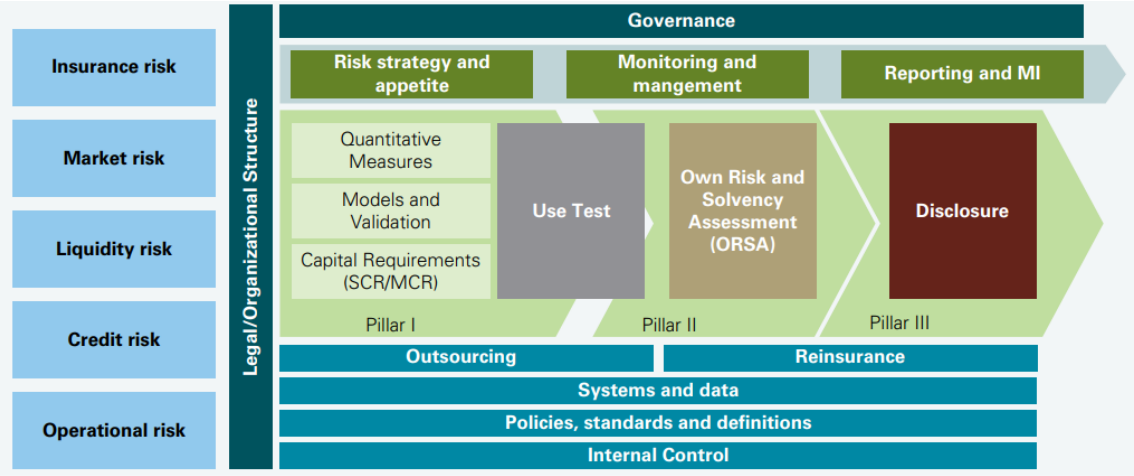

Figure 2: The Solvency 2 framework

2.4.2 Capital requirement

2.4.2.1 Solvency capital requirement (SCR)

In definition, the SCR is a Value at Risk measure based on a 99.5% confidence interval of the variation over one year of the amount of "basic own funds".

a. SCR Standard formula

The Solvency II standard formula comprises of a number of risk modules whose outcomes are aggregated stage by stage to reach each single capital requirement.

$$\text{SCR} = \text{BSCR} + SCR_{operational} + \text{Adjustement}$$

In the light of BSCR: the Basic Solvency capital requirement is calculated by considering different modules of risks: market (equity, property, interest rate, credit spread, currency and concentration), counter-party default, insurance (separately for life, health and non-life business) and intangible assets. Especially, with life insurance business, the insurance risk sub-module contains mortality, longevity, disability/morbidity, lapse, expenses, revision and catastrophe risk.

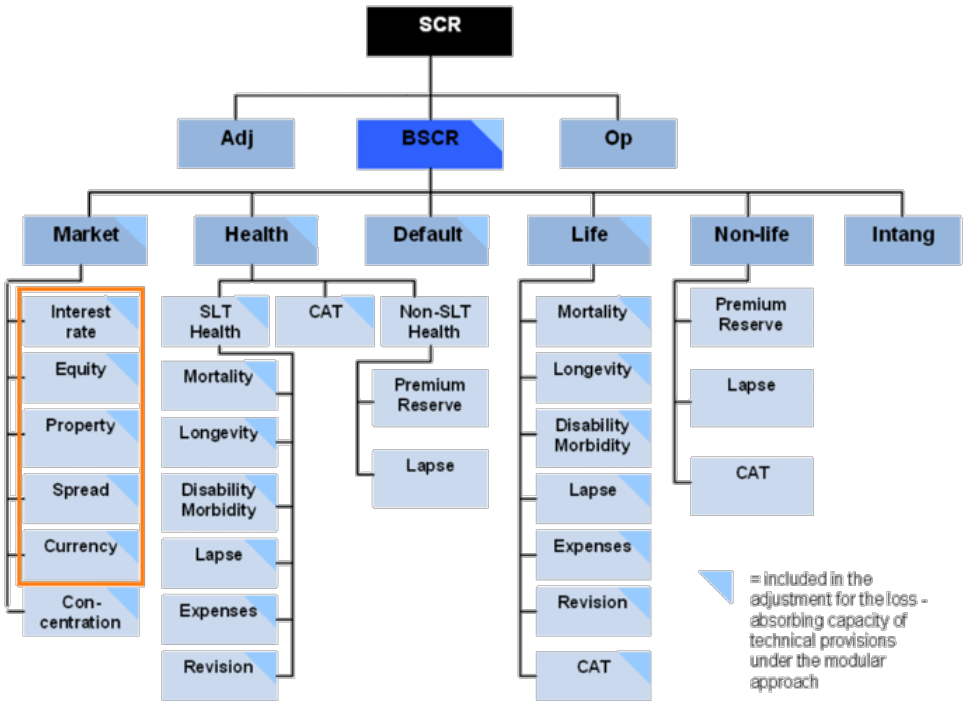

Figure 3: The associated horizons for interpretation of SCR standard formula

$$BSCR = \sqrt{\sum_{i,j} Corr_{i,j} * SCR_i * SCR_j} + SCR_{intangible}$$

Where i denotes the risk module i and j denotes the risk module j.

SCR for each individual risk = Net assets value in the unstressed (best estimate) balance sheet - Net assets value in the stress scenario for this risk

And the correlation coefficients are taken from the following coefficient matrix:

(Source: the QIS4 Technical Specifications)

There are 2 adjustments for BSCR. In the first place, an allowance for operational risk: relatively simple, the proportion between earned premiums and technical provision. Additionally, the loss absorbing capacity of deferred taxes. This could consist a reduction in any base balance sheet deferred tax liability, as this would no longer be fully payable in a stressed scenario.

	Market	Default	Life	Health	Non-life
Market	1	0.25	0.25	0.25	0.25
Default	0.25	1	0.25	0.25	0.25
Life	0.25	0.25	1	0.25	0.25
Health	0.25	0.25	0.25	1	0.25
Non-Life	0.25	0.25	0.25	0.25	1

Table 13: The coefficient matrix

- **Market risk:** comprising interest rate risk, equity risk, property risk, spread risk, currency risk and concentration risk.
- **Non-life underwriting risk:** comprising premium and reserve risk, catastrophe risk and lapse risk.
- **Life underwriting risk:** comprising mortality risk, longevity risk, disability/ morbidity risk, expenses risk, revision risk, catastrophe risk and lapse risk.
- **Health risk:** comprising SLT "similar to life techniques" health risk, non-SLT health risk and catastrophe risk.
- **Counter-party:** default risk
- **Intangible asset risk.**

In order to calculate the basic solvency capital requirement, it is necessary to compute each module. For example: with the calculation of the life underwriting risk module:

$$SCR(life) = \sqrt{\sum_{i,j} Corr_{i,j} * SCR_i * SCR_j}$$

In the calculation, SCR(i) and SCR(j) are replaced by the following:

- *SCR mortality denotes the mortality risk sub-module;*

- *SCR longevity denotes the longevity risk sub-module;*
- *SCR disability denotes the disability - morbidity risk sub-module;*
- *SCR life expense denotes the life expense risk sub-module;*
- *SCR revision denotes the revision risk sub-module;*
- *SCR lapse denotes the lapse risk sub-module;*
- *SCR life catastrophe denotes the life catastrophe risk sub-module.*

And as followed the QIS4, the correlation matrix was used (these factors are based on experts' experience):

	Mortality	Longevity	Disability	Lapse	Expenses	Revision	CAT
Mortality	1						
Longevity	-0.25	1					
Disability	0.5	0	1				
Lapse	0	0.25	0	1			
Expenses	0.25	0.25	0.5	0.5	1		
Revision	0	0.25	0	0	0.5	1	
CAT	0.25	0	0.25	0.25	0.25	0	1

Table 14: The correlation matrix hinge on expert' experience

(Source: the QIS4 Technical Specifications)

b. Internal model

An internal model can be generated in any way that the company chooses, provided the above tests are met. It does not have to follow step by step by the construction of the standard formula, and can be hinge on, for example, stochastic simulations rather than stress tests plus correlation

matrices, possibly using copulas to model dependency structures. Provided that it has been approved by the insurance company's regulatory body, an internal model can be used as a full or partial alternative to the detailed standard formula approach.

By way of illustration, this must be fitting if the risk profile of the business differs materially from that covered by the standard formula, and if the company already uses such a model for risk management or other decision-making purposes (pricing, investment strategy). Indeed, the supervisor can compel an insurance company to develop an internal model, if it feels that the standard formula is not suitable to the risk profile of the company.

However, the internal model must still generate an SCR based on the stated requirements, including coverage of the risk types as noted above and providing at least the equivalent protection to a 99.5% confidence level over one year.

The tests that the model must pass before it can gain approval are:

- **The "use test":** companies must demonstrate that their internal model is widely used throughout all relevant areas of the business and that it plays a significant role in the internal governance, risk management and decision-making processes, as well as the economic and solvency capital assessments and capital allocation processes.
- **Statistical quality standards:** a number of minimum quality standards must be met relating to assumptions and data, including probability distribution forecasting, the use of expert judgement, relevancy considerations and methods of aggregation.
- **Calibration standards:** these standards aim to assess whether the SCR derived from the internal model has a calibration equivalent to the Value at Risk at 99.5% confidence over one year.
- **Profit and loss attribution:** this includes a requirement to demonstrate how the categorization of risk chosen in the internal model will be used to explain the causes and sources

of actual profits and losses.

- **Validation standards:** the internal model must have been fully validated by the insurance company and must be subject to regular control cycle review, including testing results against emerging experience.
- **Documentation standards:** the design and operational aspects of the internal model must be clearly and thoroughly documented.

Calibration of such models will also require consideration rationally and expertise. In particular, the probability distribution used should properly reproduce the more extreme behavior of the variable being modeled, taking care to ensure that it does not understate the frequency of more extreme outcomes.

In general, the SCR which is calculated under the Internal Model will provide a more accurate reflection of the risks facing their organization, which is totally incentive for insurance company to develop their own internal models. Nevertheless, with the aim of allowing the running of the internal model, the regulators have to understand clearly the fit between the risk and its calibrated appropriately.

2.4.2.2 The Minimum Capital Requirement (MCR)

The Minimum Capital Requirement shall be calculated as a linear function of a set or sub-set of the following variables: the undertaking's technical provisions, written premiums, capital-at-risk, deferred tax and administrative expenses. The variables used shall be measured net of reinsurance. According to the Article 129- The calculation of The Minimum Capital Requirement of the Directive 2009/138/EC on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II):

$$25\% \text{ SCR} \leq MCR \leq 45\% \text{ SCR}$$

And the MCR should have an absolute floor of € 3.200.000 for life insurance undertakings.

CONCLUSION

At this moment in time, the most common management framework to manipulate the financial capacity of life insurance companies is the European system, as called as the Solvency II and the Risk-Based Capital system (RBC), implemented in United State. Actually, the countries across the globe, under the national adjustment, are all approaching these prestigious models following the different level. In Europe, the Solvency II model entered into force in 2016 and continues to be deployed. Accordingly, a number of countries (such as Canada, Switzerland, and the United Kingdom) have built a financial supervision management mechanism of insurance companies in accordance with their country's characteristics. In Asia, regulators are gradually making the transition to a risk-based management model, such as Taiwan, Singapore, and Thailand, which are in phase 2 of applying capital management on a risk-based basis.

In Vietnam, during the period 2016-2020, the Government frequently revised and promulgated the regulation on the legal capital level and the safety levels of the life insurance' solvency in order to improve the quality of managing of the enterprise.The question now rises whether regulations concerning risk management are enough to prevent problems from occurring the crisis that we cannot anticipate?

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