

OBSERVATION OF RISK-BASED CAPITAL FOR DEVELOPMENT OF SOLVENCY MARGIN OF THAILAND

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Abstract. Solvency margin of Thailand has been using maximum of 2 percent of statutory reserve or 50 million baht (whichever is higher) as a required capital in order to absorb unexpected large loss for the sake of solvency in Life insurance industry while modified net level premium has been adopted to establish statutory reserve. Investment securities and market environment tend to be more complicated, simple and traditional monitoring may not be able to guarantee solvency of Life Insurance Company in future. As such, Thai regulator recently has planned to develop new solvency margin for Thailand by using risk-based capital concept to implement in Life insurance Company, which is operating in Thailand.

As a part of The Society of Actuaries of Thailand, this paper tends to assist Thai regulators to observe risk-based capital model as well as its history and development in Life insurance industry. Risk-based capital models developed from various countries during past several years are also observed as a stable benchmark. With author opinion to provide advantage and disadvantage from each model, it also recommends what can be holistically achieved and positioning for upcoming development of new risk-based capital of Thailand so as to encourage well risk management practice while having effective model but not too complicated to implement by Life insurance industry in Thailand.

Key-words: capital, solvency, risk-based capital, solvency margin, risk factor, asset risk, insurance risk, interest rate risk, business risk, exchange rate risk, cash flow projection, risk free rate, economic capital, value at risk, solvency margin of Thailand, Standard & Poor's capital adequacy model, risk-based capital framework in Singapore

CONTENT

What is Capital?

- Definition and Objective of capital

What is Risk-Based Capital?

- Definition
- Stakeholders

History and development on RBC

- Simple factor with fixed percentage to all products
- Factor derivation style
- More risk-based model
- Most advanced risk-based model

“Risk Based Capital”: A focus on Standard & Poor’s requirement (2005 version)

- Asset risk, Liability Risk, Cash flow mismatch risk, and business risk

Risk-Based Capital Framework in Indonesia

- More on foreign exchange risk, reinsurance risk, reinvestment risk
- Surplus and admitted asset

Comparison of risk-based capital (as of 2004)

- US, Canada, Taiwan, Singapore, Indonesia, China
- Tabulated table for comparison

New Risk-Based Capital Framework in Singapore

- More on cash flow projection and fair value concept

Economic Capital (EC)

- Components of Economic Capital
- Simple illustration in how to calculate Value at Risk

What else can be done, if not RBC?

- Minimum working capital
- Stress testing
- Dynamic solvency testing
- Cash flow testing – NY 7 (interest rate scenarios)

What can be holistically achieved and positioning for Thailand?

- Observation of each model
- Rudimentary establishments for Thai industry
- Conclusion

What is Capital?

Capital is the surplus from the balance sheet. It is the excess of the asset less liability. In short, Asset less Liability equal to Capital. Capital in fact is injected from shareholder or investor or entrepreneur since inception of the company.

As a matter of fact, the advantage of the form of corporation is that if Liability is more than Asset, the Capital would be depleted to zero, not negative. This means that the obligation from liability will not be able to be paid in the end.

Balance sheet	
Asset	Liability
	Capital & Surplus

Figure 1: simple balance sheet to show asset, liability, and capital

Objective of Capital

With respect to “The professional Risk Mangers’ Handbook” (Edited by Carol Alexander and Elizabeth Sheedy), the summary of the objective of the capital is that it is established to aim to:-

1. Absorb large unexpected losses.

Although Life Insurance Company already set up the reserve to match the obligation of the provision in future, the company still has to set the capital. The objective of reserve is totally different from that of capital. In general, reserve is established to absorb expected loss which is due to pay the obligation of the company in future. Apparently, there will be always unexpected events, which consequently result the unexpected large loss. The capital will act as a cushion to support the solvency of the company in case the liability is higher or the asset is

lower unexpectedly. Sometime we call it as a “shock” in the market. There are few general concepts which capital will kick in to play the role

1) Increase in reserve unexpectedly

- plummet in interest rate
- deterioration of result from experience mortality (e.g. mortality, morbidity, expense, and persistency)

Another way of saying this is that, from above reasons, capital will transform itself to absorb such a reserve increment from unexpected incidents.

2) Decrease in asset unexpectedly

- default or loss in value of what the company invested in asset
- increase in cost of capital (i.e. discount rate of asset)

3) Volatility of market

- Increase or decrease in interest rate which results the reduction of surplus to the company
- Exchange rate in each currency to the domestic currency

2. Provide enough confidence

Capital serves the confidence to external investors and rating agencies on financial health and viability of the firm.

Regulators also concern whether insurer can fulfill its obligation to policyholder. This will affect policyholder interest and public interest as well as media.

Hence, the more capital the company holds, the more the stakeholders can ensure that the Life Insurance Company can honor its obligation even in the adverse situation. The definition of adverse can define as a percentage of confident intervals (e.g. 95% C.I.)

What is Risk-Based Capital?

“Risk Based Capital is amount of capital that company should hold based on a risk assessment of the company”

- Amount of capital
- Company should hold
- Based on risk assessment

The company is suggested to hold the absolute value of surplus that the company determines in certain amount based on the risk which the company possesses.

Risk is the possibility of an event occurring that will have an impact on the achievement of objectives and it is measured in terms of impact and likelihood. Actuarially, risk is the standard deviation of the return or objectives that we expected. It is fair to say that the risk will cause the impact (in term of amount) and likelihood (in term of possibility) of unexpected incidents.

Hence, the company which possesses high risk should hold high capital to absorb the unexpected loss and ensure solvency and viability of the firm. And RBC is the minimum capital level which the company should hold so that it can ensure that asset will be higher than liability.

Below are the relevant parties or stakeholders of RBC. All concerns in the point of company's solvency.

- Regulator
- Crediting agency
- Shareholder / investor
- Policyholder

History and development on RBC

1. Simple factor with fixed percentage to all products
 - a. Traditional UK style: 2% of NaR and 4% of statutory reserve.
 - b. Traditional Malaysia style: 2% of NaR and 4% of statutory reserve.
 - c. Current Thai style: 2% of statutory reserve

Advantage

- Simple and easy to calculate in both product level and portfolio level
- Low cost and least complicate to derive and implement
- One fit all factor for all products

Disadvantage

- The amount of capital required doesn't relate to the risk the company possesses.
- It can not reflect asset allocation and asset mix of the company. The company can hold same capital amount no matter how risky portfolio the company is holding.
- It does not reward the performance of ALM strategy of the company.
- Different product type can have different type of risk.

2. Factor derivation style

- a. Standard & Poor's capital adequacy model (2005 version)
- b. Current Indonesia solvency margin

Advantage

- Simple and easy to calculate in both product level and portfolio level.
- Low cost to derive and implement. Basically, it needs to define type of risk, stratify product categories, collect all exposure, and then generate risk factor in each set. This can be performed periodically (e.g. biannually)
- Mostly, risk factor can address asset risk, insurance risk, interest rate risk, and business risk
- Investment strategy, including ALM and asset mix, can reflect the amount of required capital
- Different product type can have different factor. One fit all factor for each product type category.

Disadvantage

- It still may not be able to address some type of risk that can evolve (e.g. exchange rate risk, risk from off balance sheet, risk from high leverage, risk from complicated securities, etc).
- The company tends to design the product to hold minimum capital based on each set of risk factor despite of the fact that the product itself has a high risk and need to hold high capital. Anyway, it is upon whether each set of factor is adequate or updated to cover the product in current market.
- Asset is valuated in "book value" basis or "amortized value" which there is no linkage between asset and liability.
- It somehow can not reflect the level of capital for the balance sheet containing derivatives and off balance sheet.
- Investment securities tend to be more complicated in the market, traditional monitoring may not be able to guarantee solvency of insurance company in future.

3. More risk-based model
 - a. Singapore and Malaysia
 - b. Some risk factor need cash flow projection using GPV with risk free rate basis
 - c. If regulation not cover some risk, it is opened to talk to regulator (e.g. Monetary Authority of Singapore) for discussion in particular risk

Advantage

- Encourage risk management
- Risk factor is based on projection and index to financial health of company
- Assist bureau and insurance company to monitoring financial status and risk
- Consistent to “fair value” concept

Disadvantage

- Each company needs to have good cash flow projection
- Cash flow projection is subject to assumption which appointed actuary has to review and underpin it before any usage of such projection.
- It is necessary to implement the software or system to handle cash flow projection.
- Definition of “risk free yield curve” has to be articulate and applicable. Type of benchmark should be concurred (e.g. government bond using either foreign or domestic benchmark, swap curve using either LIBOR or domestic)
- Frequency for marked-to-market basis can make the result more fluctuate and volatile than previous basis.

4. Most advanced risk-based model
 - a. Solvency II in Europe or economic capital as true risk-based measures, and UK Financial Service Authority (FSA)
 - b. Need extensive modeling and testing in every potential risk

Advantage

- Reflect best risk management practice
- The amount of capital is based on projection and index to financial health of company.
- Assist bureau and insurance company to monitoring financial status and risk.
- Every risk is consistent to fair value and marked-to-market concept.

Disadvantage

- Each company needs to have extensive cash flow projection to calculate amount of capital.
- Assumptions of each parameter for shocking up and down are necessary and left to the judgment of appointed actuary.
- The model might be complicated and consume considerable resource to come up with the results.
- Regulator has to review the basis and judgment of individual company separately.
- Solvency II is on discussion and will be implemented in 2011.

“Risk Based Capital”: A focus on Standard & Poor’s requirement (2005 version)

Standard & Poor’s Capital Adequacy Model is selected to represent a good example for RBC in factor derivation style.

Standard & Poor's Ratings Services capital adequacy model plays a significant role in its assessment of the capital strength of a life insurer. The model produces a capital adequacy ratio that compares adjusted capital and surplus (excluding realistic expectations of potential investment losses) with a base level of surplus appropriate to support liabilities at a secure rating level ('BBB' or better). Standard & Poor's standards for extremely strong, very strong, strong, good, adequate, and marginal capital strength are based on this ratio.

To be secure ('BBB' or higher), the capital adequacy ratio must be at least 100%. The capital adequacy ratio is only a starting point for judging capital adequacy. Qualitative and quantitative enhancements are applied as warranted to derive a more complete picture of an insurer's capital position. The analyst plays a critical role in adjusting the model to best assess risks that are unique to a company while maintaining a standard of comparability between companies.

In this model, it is necessary to derive appropriate Standard & Poor’s factor for the company which targets to obtain AAA rating. Each particular product need to incorporate new Standard & Poor’s required capital to our pricing model in the future. It is worth noting the possible way to improve Capital Adequacy Ratio in company practice in this presentation.

Moreover, it will affect profit measurement of upcoming product in Return of Investment (ROI) and Return on Equity (ROE).

The benefit of this section is

1. To understand what Risk Based Capital and Return of Capital is
2. To understand and able to justify what could impact company’s Return of Capital and Risk Based Capital.

3. To interpret this Standard & Poor's paper if the country may want to apply for developing RBC model and new product development.
4. To point out that it has an affect in how change of investment policy, launching new product, revise level of product guarantee can affect company's capital charge.

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How the Model Works

The numerator of the capital adequacy ratio is total adjusted capital (TAC) minus realistic expectations of potential investment losses under stress scenarios. The total asset risk (C-1) charge is adjusted by a portfolio size factor and for any single-issuer concentration risk. The denominator of the ratio is derived by going through the same process for liabilities: applying risk factors to each type of liability (C-2 and C-3 risks). The last ingredient in the denominator is a general business risk charge (C-4) that is assessed against U.S. premiums or separate account liabilities. The ranges of capital adequacy consistent with certain rating levels are shown in Figure 2

Determining TAC

TAC is statutory capital and surplus plus the asset valuation reserve, voluntary reserves, and 50% of the policyholder dividend liability. All of the components of the TAC are based on statutory accounting values.

Since January 2003, goodwill has been excluded from the calculation of the TAC. Goodwill has been increasingly viewed as a very soft form of capital, and given the spate of write-downs Standard & Poor's has seen, it has been unreliable as a cushion to absorb long-term risks. As a result, goodwill is not an appropriate loss-absorption asset. The goodwill embedded in statutory capital and surplus is limited in the U.S. by regulators, and it is substantially lower than the GAAP value of goodwill.

Analysts may add to or subtract from TAC to include items—such as surplus notes—that meet Standard & Poor's criteria as capital. If surplus notes (or other hybrid instruments being given equity credit) constitute more than 15% of total capital, Standard & Poor's will give less equity credit for the note, in most cases treating the excess as debt. Surplus notes (or other hybrid instruments being given equity credit) are amortized at 20% per year beginning 10 years prior to maturity or potential call by the holder. As a result, these instruments have no equity credit by the fifth year prior to maturity”^[1]

[1] “Life Insurance Criteria: Capitalization” published on 23-Sep 2004 by Credit Analyst: Jose Siberon, CFA, FSA, New York,

$$\text{Capital Adequacy Ratio} = \frac{\text{Total Adjusted Capital} - C1}{C2 + C3 + C4}$$

Total adjusted capital is “Stat capital & surplus” plus “Asset Valuation Reserve” plus “50% dividend liability” plus “voluntary reserve”

Capital Adequacy Ranges Per Rating Level		
Capital adequacy ratio	Indicating rating level	Assessment of capital adequacy
Less than 100%	BB or lower	Various
100%-125%	BBB	Good
125%-150%	A	Strong
150%-175%	AA	Very strong
more than 175%	AAA	Extremely strong

Figure 2: Capital adequacy range per rating level

Summary of C1 from Standard & Poor's paper – Asset Risk

- It is the risk charged due to losing value what the company invested
 - Default of bond
 - Depreciation of stock/real estate
- C1 factor is mostly derived from
 - Fixed Income: default rate, recovery rate, and discount rate
 - Equity : one standard deviation of Standard & Poor's 500
- Factor for adjustment from diversification effect
 - Concentration risk
 - Size factor on total invested asset
- Risk exposure is “Asset Value” (practically, use reserve in product level)
- Unrated bond is drawback of model. Every bond which is not classified as international will be rated at “B” only.
- In product level, difficult to identify rating in each bond from portfolio
- Common stock is tied with S&P 500 (US stock market). Real estate will be simply marked up from common stock.
- Cash has C1, while Policy loan has no C1
- Separate account with (high) investment guarantee calculates with asset backing its product.
- Separate account with non-investment guarantee need to consider risk that value in account loss and cannot cover acquisition cost.

ASSET RISK C-1	S&P	A	B	C	C	D
	Factor			Non PAR	PAR	
UNAFFILIATED BONDS						
NAIC Class 1 (A or higher)	0.0051	43.40%	31.50%	62.50%	25.20%	61.60%
NAIC Class 2 (BBB)	0.0391	43.40%	23.00%	4.10%	22.85%	4.20%
NAIC Class 3 (BB)	0.0936	3.20%				
NAIC Class 4 (B, or unrated bond)	0.1740			4.10%	22.85%	6.70%
NAIC Class 5 (CCC)	0.2756					
NAIC Class 6 (In or near default)	0.3000					
MORTGAGES						
RESIDENTIAL	0.0050		6.50%	11.20%		0.60%
COMMERCIAL & FARM	0.0200			3.70%		1.20%
Commercial Mortgage Backed Security	0.0450		15.00%			
UNAFFILIATED COMMON STOCK	0.1500	10.00%	24.00%	12.80%	18.90%	20.30%
REAL ESTATE & LONG-TERM ASSETS	0.1800			1.60%		
Cash	0.0030				10.20%	0.70%
Policy loan	0.0000					4.70%
TOTAL C-1 CHARGE		3.72%	5.37%	3.53%	7.8635%	4.72%

Figure 3: Illustration of C1 risk factor

Summary of C2 from Standard & Poor’s paper – Insurance/Liability Risk

- Pricing risk (mortality, persistency, expense, and liability option).
- The more NAR, the less risk factor (due to the law of large number)
- Risk exposure is NAR (Net Amount at Risk)
- Stratify Individual Life from Group. Mostly, health and disability are separated due to using different claim study.
- Separate account which guarantee (GMDB) will calculate unit reserve and NAR separately to calculate risk charged

OL, UL	C2 Factor	Company A		Company B	
		Amount	Capital Charge	Amount	Capital Charge
<\$500 mm	0.0020	500	1.00	500	1.00
\$500-5000 mm	0.0013	4,500	5.85	4,500	5.85
\$5000-25,000 mm	0.0010	20,000	20.00	20,000	20.00
> \$25,000	0.0008	17,681	14.15	40,372	32.30
Total		42,681	41.00	65,372	59.15
Adopted C2 Factor		1.681		1.583	

Group&Credit Life	C2 Factor	Company A		Company B	
		Amount	Capital Charge	Amount	Capital Charge
<\$500 mm	0.0016	500	0.80	500	0.80
\$500-5000 mm	0.0011	4,472	4.92	4,500	4.95
\$5000-25,000 mm	0.0008	0	0.00	7,948	6.36
> \$25,000	0.0007	0	0.00	0	0.00
Total		4,972	5.72	12,948	12.11
Adopted C2 Factor		2.013		1.637	

Separate account with non guarantee	C2 Factor	Company A		Company B	
		Amount	Capital Charge	Amount	Capital Charge
< \$5000 mm	0.0025	753	1.88	2,148	5.37
\$5000-25,000 mm	0.0010	0	0.00	0	0.00
> \$25,000	0.0006	0	0.00	0	0.00
Total		753	1.88	2,148	5.37
Adopted C2 Factor		0.44%		0.44%	

Figure 4: Illustration of C2 risk factor

If the company target for “AAA”, the C2 is equal to “Total Capital Charge / Total Amount * 1.75 *1000”

Summary of C3 from Standard & Poor’s paper – Interest rate Risk

- Mismatch between “asset cash flow and “liability cash flow” when interest rates fluctuate which consequently reduce capital in balance sheet (i.e. loss)
- Cash Flow testing can help to assess the risk
- Risk exposure is “Reserve”
- Separate account with no investment guarantee will have no C3
- Annuity product has C3 higher than Life insurance product due to long tail liability and unpredictable cash flow.
- Annuity can classify as low, medium, and high risk. Key point to distinguish is Market Value Adjustment/surrender charge and flexibility of withdrawal.
- C3 of Accident & Health product is nil if it is YRT type.
- C3 of disability rider is also nil although it pays long term liability (but it can treat as claim reserve)

<i>Interest Rate Risk (C-3)</i>	S&P Factor	Adopted Factor
LOW RISK CATEGORY		
Life insurance	0.0050	0.875%
Separate Account Liabilities with Guarantees	0.0100	1.750%
MEDIUM RISK CATEGORY		
Annuity not withdrawable (excl. structured settlements)	0.0200	3.500%
Annuity with surrender charges	0.0200	3.500%
GICs	0.0200	3.500%
Annuity with market value adjustment-Guaranteed over 1 yr.	0.0200	3.500%
Structured settlements	0.0200	3.500%
HIGH RISK CATEGORY		
Annuity with no adjustments	0.0300	5.250%
Single Prem individual annuity (such as pension closeout)	0.0300	5.250%

Figure 5: Illustration of C3 risk factor

Summary of C4 from Standard & Poor’s paper – Business/Operating Risk

- Risk due to management incompetence and fraud
- Risk exposure is “Premiums”
- Derived from experience of US companies

<i>Business Risk (C-4)</i>	S&P Factor	Adopted Factor
Life & annuity premium	0.0200	3.5000%
Accident and Health premium	0.0050	0.8750%
Separate account liability	0.0005	0.0875%

Figure 6: Illustration of C4 risk factor

Adjustment to model

- Quality of ALM technique, other contingent liability, and reinsurance amount
- Financial strength rating. This model is only one of many factors used in arriving at the financial strength rating on company. Company's management and corporate strategy, business profile, operating performance, liquidity, and financial flexibility can more than offset relative strength or weakness in capital adequacy.

Possible actions to improve ratio

- Pricing Upgrade bond portfolio quality,
- Replace stock with convertible bonds/equity-linked bonds
- Diversify bond portfolio by increasing number of bond issuer
- Adjust 10 largest asset exposures with asset exposures with asset
- Securitize commercial mortgage
- Reduce reserve to statutory minimum
- Reinsurance, increase policy loan, sell of blocks of business

RBC model law requires regulatory action is upon RBC ratio. There will be a Company Action Level, if ratio is not enough.

- Filing of Action Plan to restore Capital
- Filing of Action Plan, and regulator perform examination
- Regulator take control of insurer
- Required to place insurer under control

Anyway, above RBC model may not be able to reflect the realistic solvency position of insurer due to:-

- Asset valuation
- Liability valuation
- RBC formula
- Additional requirement for capital

Risk-Based Capital Framework in Indonesia

The risk factor is derived in the consistent way of S&P's capital adequacy model (2005). It is worthwhile noting that foreign currency mismatch has been raised in this model apparently. Below table serves as an observation and the author will not put any comments into it.

RBC detailed components

Solvency Margin requirements

- | | |
|--|-----------------------------|
| 1 Asset default risk | S&P type C1 risk |
| 2 Cash Flow Mismatch | 4% of Reserve (excl. UEPR) |
| 3 Foreign Currency Mismatch | 50% of (Assets - Liability) |
| 4 Claims Experience worse than Expected | |
| Mortality Component | |
| Life Participating | 0.1% of NAR |
| Non participating | 0.2% of NAR |
| Accident | 0.015% of NAR |
| Morbidity Component | |
| New Claims | 10% of Premium (net Reins.) |
| Continuing Claims (incl. IBNR) | 10% of Reserve (net Reins) |
| 5 Risk of Insufficient Premium due to Investment Experience | |
| Participating | 0.5% reserve |
| Others | 1% reserve |
| Remarks: exclude Single Premium and paid up products | |
| 6 Reinsurance risk | |

RBC ratio = Surplus / Solvency Margin, minimum 120% (actual 100%)

Asset default risk, claim experience worse than expected, and cash flow mismatch are analogous to C1 (Asset risk), C2 (Liability risk), and C3 (Interest rate risk) of S&P's adequacy model (2005) respectively. These types of risk are prevailing in risk-based capital model in most countries.

Apart from foreign currency mismatch, risk of insufficient premium due to investment experience is delineated and stratified to participating and others. In short, reinvestment risk will have an affect to this type of risk. And since it concerns new money coming into the company in future, it therefore excludes single premium and paid up products.

Every reinsurer tends to hold the same class or type of asset on their balance sheet. The diversification effect among reinsurers themselves might be limited. And that results reinsurance risk becoming more important nowadays. The reinsurance risk is concerned about counterparty risk from reinsurer occurring to insurance company.

To get better understanding on RBC ratio, definition of surplus is imperative and should be underpinned. Surplus is equal to admitted asset less liabilities. The attention goes to definition of admitted asset, which is followed by investment limit. For Indonesia, it defines bond above certain investment grade, say "A", as admitted asset. Or, it has limit of investment concentration. If the company invests in the same asset/entity over than some certain percent, say 20%, the admitted asset will cap at that certain amount, say at 20% only.

More importantly, Indonesia change accounting practice of bond, mostly, from book value (Hold to Maturity method) to market value (Available for sales). This can make the surplus volatile.

The observation hereby is that the insurance company occasionally hold non-admitted asset still due to looking for the better return to their book.

Illustration of RBC ratio in industry position (Indonesia)

Company	Dec-2004	Dec-2005
Prudential Life	468%	645%
AIA Indonesia	275%	258%
AIG Life	262%	209%
MLC Life	213%	215%
Sun Life	179%	181%
Cigna Life	178%	164%
Astra CMG Life	159%	145%
Allianz Life	216%	142%

Figure 7: Illustration of RBC ratio as of 2004 and 2005

Unit-Linked or Variable Universal Life are not required to hold asset risk (C1 of S&P's) or cash flow mismatch risk (C3 of S&P's) since these risk would pass to policyholder. It is worth noting that Prudential has considerable product mix of Unit-Linked and therefore has very low risk charge and high RBC ratio. From this point, the observation is that the product mix can also shape profile of required capital.

Public information and media issue in Indonesia is sensitive. Hence, strong RBC ratio can improve the perception of market strength. It can also avoid capital injection and consequently build the confidence to local partner and media.

Major source of change in surplus and solvency margin is

1. Change in net income. For example, claims, litigation, and expenses
2. Change in asset value. For example, market value movement, RCG, Foreign Exchange gain/loss
3. Capital strain on new business. For example, the more the company sale, the more the capital depletes.

RBC work need accounts team cooperation on balance sheet items and good reconciliation. It also has to identify major source of solvency margin. It may have to assess impact and run projection.

Comparison of risk-based capital

Risk-based capital models developed from various countries during past several years (e.g. as of 2004) are also observed as a stable benchmark for Thailand. Tabulated table and more details are shown for easy comparison. It is worth noting that the selected model from each country may not be the latest one. Most model shown are risk factor derivation style.

US regulator

Method: Risk Based Capital

Objective: To establish a "minimum" capital level based on company specific risks, which allow regulators to monitor insurers' capital level and require supervisors, and companies to take specific action once a company triggered a certain level.

Canada regulator

Method: MCCSR

Objective: To ensure that the financial institution has adequate capital to support the risks it undertakes, safeguard policyholders and depositors from undue loss and to enhance the safety and soundness of the financial system.

Singapore regulator

Method: Capital Adequacy

Objective: To address asset and mismatching risks that are not adequately reflected in the existing framework, as well as refining the allowance for liability risk. The capital requirement aims to reflect all relevant risks faced by the life insurance business.

Taiwan regulator

Method: Risk Based Capital

Objective: To maintain the financial soundness of the insurance company by addressing the specific risks that the insurer may face.

Indonesia regulator

Method: Solvency Margin

Objective: To maintain the financial soundness of the insurance company by addressing the risk of asset default, cash flow mismatch, foreign currency mismatch, adverse claims experience, premium insufficiency due to unfavorable investment experience, and inability for reinsurers to fulfill their obligation.

China regulator

Method: Solvency Margin

Objective: To strengthen the scrutiny on insurance company, protect the interest of the policyholders and maintain the stability of the insurance field.

Risk-based capital models developed from various countries during past several years (e.g. as of 2004) are also observed as a stable benchmark for Thailand.

RBC model	US	Canada	Singapore	Taiwan	Indonesia	China
Method:	RBC	MCCSR	Capital Adequacy	RBC	Solvency Margin	Solvency Margin
Objective:	To establish a "minimum" capital level based on company specific risks which allow regulators to monitor insurers' capital level and require supervisors and companies to take specific action once a company triggered a certain level.	To ensure that the financial institution has adequate capital to support the risks it undertakes, safeguard policyholders and depositors from undue loss and to enhance the safety and soundness of the financial system.	To address asset and mismatching risks that are not adequately reflected in the existing framework, as well as refining the allowance for liability risk. The capital requirement aims to reflect all relevant risks faced by the life insurance business.	To maintain the financial soundness of the insurance company by addressing the specific risks that the insurer may face.	To maintain the financial soundness of the insurance company by addressing the risk of asset default, cash flow mismatch, foreign currency mismatch, adverse claims experience, premium insufficiency due to unfavorable investment experience, inability for reinsurers to fulfill their obligation.	To strengthen the scrutinize on insurance company, protect the interest of the policyholders and maintain the stability of the insurance field.
Status of development:	Implemented by NAIC in 1993 Each state adopted the models for use in their state shortly thereafter	Implemented by OFSI in 1992 Annual revisions were made from 1994 onwards in MCCSR Guideline & Formula	Target effective date: Jan 1, 2004 Transition year: 2004 (companies can comply with either current or new RBC basis) Year end 2004 returns based on RBC	Effective date: July 9, 2003 RBC regulation will first apply to 2003 returns (to be reported in April 2004)	Effective date: Dec 31, 1999	Effective date: Mar 24, 2003
Risks covered:	C1 - Asset Default Risk C2 - Insurance Risk C3 - Interest Rate Risk C4 - Business Risk	1) Asset default risk 2) Mortality, Morbidity & Lapse risk 3) Interest Margin Pricing Risk 4) Change in interest rate environment 5) Segregated funds risk	LC1 - Liability risk LC2 - Market, Credit and Mismatching Risks LC3 - Inadmissible Asset Risk	C0 - Asset risk - related parties C1 - Asset risk - non related parties C2 - Insurance risk C3 - Interest rate risk C4 - Business risk	C1 - Asset risk C2 - Insurance risk C3 - Interest rate risk	
Asset Risk	C1 - Asset Default Risk	1) Asset default risk	LC2 - Market, Credit and Mismatch Risks	C0 - Asset risk (related parties) and C1 - Asset risk	C1 - Asset risk	
Bonds	Depends on Grade Ranges from 0.3% to 30%; Book Value 0% for US Gov't bond Adjustment factor based on no of bond issuers 2.5 when no. of issuers is 50 or less	Depends on Grade; Ranges from 0.25% to 16%; Book Value 0% for Canada Gov't bond 2% or higher for non-rated bonds	<i>Specific Risk:</i> 1) 0% Gov't Bond; 2) 0.25-1.6% Qualifying Bond; 3) 8% Others <i>General Risk:</i> Yield change 0.6-1%; Depends on the maturity term of bonds	Depends on type Range from 0.3% to 1%: Book value 0% for Government bond	Depends on grade Range from 0.25% to 16%: Mkt Value 0% for bonds guaranteed by the Government	
Equities	Unaffiliated Common Stock Unaffiliated Preferred Stock Affiliated Insurance Common Stock Affiliated Non-Insurance Common Stock Trust Fund	15% Market Value 1-15% Depends preferred stock class 7.5-15% Market Value	<i>Specific Risk:</i> 2-8% Gross equity position <i>General Risk:</i> 2-8% Net equity position	24% - 38% of Market value depends on listed or not 21% of Market value 38% - 49% of Market value depends on insurance type 29% - 34% of Market value depends on business type 8% - 30% of Market value depends on asset mix.	Depends on listed or not Range from 10% to 15% of Market value 15% of Market value	
Property	10% Company -occupied and investment; Book Value 15% Foreclosed; Book Value	4% Company-occupied 7% Rental properties 35% Oil & Gas properties 15% Others Applies to Statutory Book Value	<i>Specific Risk:</i> 8% <i>General Risk:</i> 8%	7.5% of Book value Company-occupied 14% - 16% of Book value for investment 7.5% - 19% of Book value for foreclosed	4% of appraisal value for Company-occupied 7% to 15% of appraisal value depends on the net investment yield of the real estate.	
Loans						
- Policy Loan	0%	0%	0%	0%	0%	
- Mortgage / Mortgage Loan	0.5-6% depends on type of properties 20% in foreclosure	2% residential 4% commercial 8% others	<i>Specific Risk:</i> 6% residential 12% commercial <i>General Risk:</i> Same as bond	1% - 12% of Book value depends on the default risk	8% of loan balance value	
- Collateral Loan	5%	2% (same as bond with rating not available)				
Foreign Exchange (mis-match liability)			8% Net open position	4% - 32% of Book value or Market value depend on the type of foreign currency investment	50% of the shortfall of assets and liabilities in each currency.	
Off-Balance Sheet	8% gtee & contingent Liabilities 0-8% - Derivatives depending on credit equivalent amount & counterparty factor	1% 0.3% Exchange Traded; 0.3% - 30% for other 6 classes of derivatives	0-12% Counterparty Risk Factor & 0-12% Credit Exposure Risk depending on types of derivatives			

RBC model	US	Canada	Singapore	Taiwan	Indonesia	China
Method:	RBC	MCCSR	Capital Adequacy	RBC	Solvency Margin	Solvency Margin
Other Assets - Cash -Deposit -Receivables from Reinsurers -Accrued Income -Outstanding premiums -Impaired Investment	0.3% 0.3% 0.5%	0% 0-0.25% depends on where to place deposit 0% 0% 8% 35% of o/s balance - insured balance net of individual allowances and write-downs	0% 0.25-1.6% depends on where to place deposit 2.4-12% depends on counterparty risks & reinsurer's status (registered / authorized) 8% 8-100% depends on due date	0% 0% 1% 3.75%	0% Depends on the bank rating, range from 0% to 16% of nominal or cash value 8% for oversea reinsurers with lower than BBB rating. 0% 8% 12.5% of investment value	
Other Asset Related Charges / Discount	Asset Concentration Risk 1) Select 10 largest asset and aggregate exposures 2) Apply appropriate C1 factor <i>Effectively double the basic factor but capped at 30%</i>	Asset default factors for qualifying par policies will be reduced by 50%	Asset Concentration Limit for different types of assets (as % of total assets)			
Interest Rate / Mismatch Risk	C3 - Interest Rate Risk Risk exposure = Statutory Reserve	4) Change in interest rate environment a) On Policy Liability Risk exposure = Statutory Reserve 0.5% for all qualifying par policies & on-par policies with adjustable premium / interest credit 1% for other businesses b) On Debt Obligation 1% on Book Value c) Asset Cash Flow Uncertainty Risk - covers losses against prepayment or extension of investment - only applies to mortgages or asset backed securities w no prepayment penalty: 1% or 8% if not tested	LC2 - Market , Credit and Mismatch Risks Max [A, B] under two different interest scenarios i) Increase in interest rate: A = Asset risk charge less Decrease in liability (LC1) ii) Decrease in interest rate B = Asset risk charge plus Increase in liability (LC1)	C3 - Interest rate risk Statutory reserve x {[Max(A,B) - C],0} where A - Filing pricing interest rate B - Interest rate used to determine dividend. C - Company's investment return	C3 - Interest rate risk 4% of statutory reserve (excluding unearned premium)	
Risk Factor (if applicable)	LOW: 0.5% for life insurance net of reinsurance & policy loans, annuities with MVA, GICs mature within 1 yr etc. MED: 1% for annuities with surrender chrg >= 5% & no bailout provision and structured settlements HI: 2% for annuities with surrender chrg < 5% & bailout provision etc. <i>Factor increase by 50% if qualified on</i> <i>No Opinion</i>	3) Interest Margin Pricing Risk Risk exposure = Statutory Reserve 0.5% for all qualifying par policies & non-par policies with adjustable premium / interest credit 1% for other businesses	<i>Asset risk charge calculation as stated in above section "Asset Risk"</i>			

RBC model	US	Canada	Singapore	Taiwan	Indonesia	China
Method:	RBC	MCCSR	Capital Adequacy	RBC	Solvency Margin	Solvency Margin
Liability / Insurance Risk	C2 - Insurance Risk	2) Mortality & Morbidity Risk	LC1 - Liability risk	C2 - Insurance risk	C2 - Insurance risk	
<i>Life Insurance</i>	Based on Net Amount at Risk First \$0.5b: 0.15% (Ind); 0.12% (Grp) Next \$4.5b: 0.1% (Ind); 0.08% (Grp) Next \$20b: 0.075% (Ind); 0.06% (Grp) > \$25b: 0.06% (Ind); 0.05% (Grp)	Based on Net Amount at Risk 0.05% for Group Par policies 0.1% for Ind UL policies 0.05-0.2% for Non-Par (depends on gtee term) Add'l adjustment for Group Biz and statistical fluctuations	Risk Charge = LC1 - MCL for Guaranteed Benefits only where LC1 = BEL with prescribed margins from regulatory & risk free rate MCL(Min. Condition Liability) = BEL with PAD & risk free rate PAD = Provision for Adverse Deviation BEL = Best Estimate Liability	% of NAAR for Life Business, % varies by (1) Product type (2) Amount of the NAAR with different tier plus 0.038% of statutory reserve for endowment business plus 0.038% of statutory reserve for short term business plus 0.075% of statutory reserve for annuity plus 2% of premium for Accident Insurance plus	<i>Adverse claims experience:</i> Applying each risk factor to the respective component: 1) Mortality component: Participating life insurance - 0.1% NAAR Non-participating life insurance - 0.2% NAAR Annuity - 1% statutory reserve Personal accident - 0.015% sum insured 2) Morbidity component 10% of past 12 months premium for policies which have not been claimed as at balance sheet date, plus 10% of net statutory reserve of the continuing claims policies. <i>Premium insufficiency due to investment experience:</i> 1) Participating policy - 0.5% statutory reserve 2) Non-participating policy - 1% statutory reserve where paid-up, single premium policies and policies where reserves are not discounted for interest are excluded.	
<i>Annuities</i>	No RBC requirement	1% statutory reserve	Risk free rates are based on Singapore Government Bond yield curve	3.75% -20% of statutory reserve depends on renewability option and the availability of benefit cap plus 0.038% of unearned premium for group business with term less than 1 year plus 0.038% of NAAR for group business with term more than 1 year plus 0.113% of statutory reserve for group annuity business plus 3% of statutory reserve for group accident business plus 5.625% of statutory reserve for group health business plus 31.5% of statutory reserve for group D.I.		
<i>Accident and Health Insurance</i>	Based on earned premium Individual: (depends on plan features) First \$25m: 8-25% Thereafter: 8-15% Group: (depends on plan features) First \$50m: 8-25% Thereafter: 7-25%	Based on earned premium 12% Continuing claim risks: 10% incurred but unpaid claims reserve Add'l adjustment for statistical fluctuations				
<i>Disability Income</i>	Based on earned premium First \$50m: 23-35% (depends on plan type) Thereafter: 15%	Based on earned premium 12-40% depends on length of premium gtee remaining & underwriting standard Continuing claim risks: 4-8% claim reserve depends on length of disability				
<i>Claims Reserve</i>	5% on claim reserve for individual, Group & credit coverage	2) Lapse Risk 1. Divide policies into 2 groups Grp A: Lower lapse will increase Reserve Grp B: higher lapse will increase Reserve 2. Recalculate reserve with: Grp A: reduce* lapse rate by increasing MAD by 15 % pt (e.g. BE:6%, MAD: -0.6% -> new MAD: -1.5%, new lapse = 4.5%) Grp B: increase* lapse rate by increasing MAD by 15 % pt (e.g. BE:6%, MAD: +0.6% -> new MAD: +1.5%, new lapse = 7.5%) 3. Subtract the difference btw 1 & 2 for results * Adjustment to lapse assumptions are required at all policy durations		1.25% of claim reserve		

RBC model	US	Canada	Singapore	Taiwan	Indonesia	China
Method:	RBC	MCCSR	Capital Adequacy	RBC	Solvency Margin	Solvency Margin
Business Risk	C4 - Business Risk	N/A	N/A	C4 - Business risk		
Life & Annuity	2% premiums			0.5% of life insurance premium + 1% of annuity premium + 1.5% of premium from other business (e.g. A&H, ILP, Group, etc)		
Health	0.5% premiums			+ 0.25% total asset of the company.		
Other Risk / Margin	N/A	5) Segregated funds risk Risk associated w investment gtee on seg funds determined using prescribed or approved factors Companies operating in Canada on branch basis Need to keep margin of assets in Canada over liabilities in Canada	N/A		Reinsurance Risk: 10% of reinsurance reserve for foreign reinsurers rated below BBB.	
Required Capital - [1]	$\{\text{sqrt} [(C1 + C3)^2 + C2^2] + C4\} / 2$	Sum of 5 risks above	$(LC1 - MCL) + LC2 + LC3$ for all funds	$K * (C0 + C4 + \text{sqrt} [(C1 + C3)^2 + C2^2])$ where k = 0.4 for the transition period & 0.5 after then.	$C1 + C2 + C3$	
Available Capital - [2]	Total Adjusted Capital = Statutory Capital & Surplus + AVR + Voluntary Reserve + 50% policyholder dividend liability held by each subsidiary	Sum of the followings: a) Tier 1 Core Capital Common S/H equities + preferred shares + par a/c + non par a/c (for mutual co) + currency translation a/c + qualifying non-controlling interests in subsid + adj net deferred gain/loss on investment not incl. in reserve MINUS: Goodwill, CSV deficiencies, negative provisions, adj unrealized amort gain/loss and net deferred gain/loss on stocks & real estate etc. b) Tier 2 Supplementary Capital 2A: hybrid capital instruments 2B: limited life instruments like limited life redeemable preferred shares, qualifying capital instruments subj to conditions 2C: other capital items like 75% CSV deficiencies, 75% negative provisions with limitation, Net unrealized unamort net gain/loss on traded stocks etc.	Sum of the followings: a) Tier 1 capital Total assets - Total liabilities for non-par & UL funds where Total liabilities = BEL with PAD & risk free rate b) Tier 2 capital Capitals that contribute to overall strength of insurer but with less quality as Tier 1 capital (subject to approval by regulatory) c) Allowance for provision for Discretionary Benefits Min (Policy Liability - MCL, 25% of Provision for Discretionary Benefits) for par fund only	Adjusted Capital = Owner equity + mandated special reserve + unrealized capital gain from equity		
Solvency Requirement	RBC Ratio > 200% Trend Test: $200\% \leq \text{Ratio} < 250\%$ Company Action Level: $150\% \leq \text{Ratio} < 200\%$ Regulatory Action Level: $100\% \leq \text{Ratio} < 150\%$ Authorized Control Level: $70\% \leq \text{Ratio} < 100\%$ Mandatory Control Level: $\text{Ratio} < 70\%$	Available Capital > 120% x Required Capital Regulators will pay close attention to companies below 150%	Available Capital > 120% x Required Capital	Adjusted Capital > 200% x Required Capital	120% of the total loss risks that mentioned above.	<i>Minimum solvency required for long-term business:</i> (1) 1% reserve for ILP business + 4% reserve for Traditional business (2) 0.1% NAAR for term < 3 years + 0.15% NAAR for term between 3 - 5 years + 0.3% NAAR for term > 5 years. <i>plus minimum solvency required for short-term business:</i> (1) $18\% * \text{Min}(\text{Gross premium} - \text{reinsurance premium} - \text{premium tax}, \text{Yuan } 100 \text{ million}) + 16\% * \text{Max}(0, \text{Gross premium} - \text{reinsurance premium} - \text{premium tax} - \text{Yuan } 100 \text{ million})$ (2) $26\% * \text{Min}(\text{average claims amount over past 3 years}, \text{Yuan } 70 \text{ million}) + 23\% * \text{Max}(0, \text{average claims amount over past 3 years} - \text{Yuan } 70 \text{ million})$
Capital Adequacy Ratio (CAR) / RBC Ratio	RBC Ratio = [2] / [1]	MCCSR Ratio = [2] / [1]	[2] / [1] with higher weighting towards the product type that has a lower CAR			

New Risk-Based Capital Framework in Singapore

Solvency margin of insurance business in Singapore in the past:-

- Solvency = % of reserve
- Reserve method is modified net level premium which assumption can't tell how much conservative margin is applied
- Asset is valued in "book value" basis or "amortized value" which there is no linkage between asset and liability

Investment securities tend to be more complicated in the market, traditional monitoring may not be able to guarantee solvency of insurance company in future.

Refer to "Risk-Based Capital Framework in Singapore" by Eric Seah published in "International News" as of Nov 2006

Valuation of Assets and Liabilities

- Modified NLP vs GPV
- GPV of Non PAR business
- GPV of PAR business

Reserve under traditional framework:-

- Modified NLP with conservatively specified assumption by regulator
- No lapse rate assumed
- No non-guaranteed included

Reserve under new framework

- "gross premium valuation" which use all cash flows from policy including non-guaranteed benefit
- use all assumptions under "best estimate basis" and plus "Provision for Adverse Deviation (PAD)" which is margin for uncertainty and volatility of best estimate assumption

Reserve of nonparticipating product will use “risk free yield curve” (from yield curve of government bonds)

Reserve of participating products:

1. guaranteed @ risk free yield curve
2. guaranteed + non-guaranteed @ best estimate yield curve which expects from participating portfolio

Reserve = MAX (GPV1, GPV2)

Solvency Margin Requirements

- Determine each portfolio separately
- Calculate risk charge from risk factor, so called, C1, C2 and C3
- Risk charge will depend on level of exposure in each risk factor

C1 = insurance assumption

Derive 2 sets of reserve

1. best estimate assumption (plus PAD) and add risk margin to reflect assumption which might be unexpectedly beyond PAD
2. best estimate assumption (plus PAD)

C1 risk charge = difference between 1) and 2)

C2 = 1) asset portfolio risk

Determined by credit rating and maturity

- Common stock has risk charge at 16%
- Debenture has risk charge at 0.25-8%

C2 = 2) duration mismatch

Measure the impact of “value changed of asset and liability” when interest rates change in two scenarios (shock up and shock down)

- Liability valuation use “risk free yield curve” varying on each scenarios
- Asset valuation is fluctuated due to the volatility of bond prices

C3 = concentration risk

- Invested asset concentrate in certain types of asset or issuers
- No diversification to hedge the risk

Total Risk Requirement (TRR) = C1 + C2 + C3

Financial Resource (FR) = the amount of capital in each fund available to meet TRR

CAR is defined as the ratio of total FR to total TRR, for all funds combined

Capital Adequacy Requirement (CAR) = FR / TRR

- Meet CAR if CAR > 120%
- If CAR < 120%, must notify authorities and plan to rectify the situation

Impact of new RBC framework

- Reserves are more volatile due to the use of up-to-date risk free yield curve, causing CAR to fluctuate
- Companies are now actively performing Scenario testing to understand and evaluate the impact on capital
- Insurance company are more interested to reduce the duration gap
- Investment strategy of high return will have to contemplate the possibility of high risk with allocation of capital requirement
- Capital requirement is considered interactively in product design.

Economic Capital (EC)

EC is “risk capital” assessed from the realistic scenarios and see how much capital the company should hold so as to maintain “solvency” over “certain time period” at “pre-specified probability” such as 99.95% (AA rating) in 1 year

*“The amount of risk capital, assessed on a realistic basis, which a firm requires to cover the risks that it is running or collecting. Typically this is calculated by determining the amount of capital that the firm needs to ensure that its realistic balance sheet stays solvent, over a certain time period, with a pre-specified probability. Firms and financial services regulators should then aim to hold risk capital of an amount equal at least to **economic capital**.”*

The concept of economic capital differs from "Regulatory Capital" in the sense that "Regulatory Capital" is the mandatory capital the regulators require to be maintained while economic capital is the best estimate of required capital that financial institutions use internally to manage their own risk and to allocate the cost of maintaining regulatory capital among different units within the organization.” [2]

Components of EC

Standalone risk	
MARKET RISK	LIFE RISK
Interest Rate Equity Real Estate Other	Trend uncertainty Level uncertainty Volatility Calamity
CREDIT RISK	OPERATIONAL
Credit Risk	Operational risk
BUSINESS RISK	MORBIDITY RISK
Expense Persistency Volatility & Calamity Persistency Uncertainty	Current Uncertainty Current Volatility Calamity

Figure 8: Economic Capital before diversification (standalone risk)

Value at Risk (VaR) measures Interest rate risk


- In 1 year, the company will be still solvent at confidential level of 99.95%
- Calculate Market Value Asset (MVA) and Market Value Liability (MVL)
- shock up / down interest rate, and see the difference of change of MVA and MVL

In short, economic capital is an amount of capital needed as a buffer to avoid insolvency. The common measure of economic capital is the difference between the VaR and the expected loss. It requires a horizon and a confidence level (e.g., one year and 99.95%). However, expected shortfall can be viewed as an average or expected value of all losses greater than the VaR. Because it gives an insight into the distribution of the size of losses greater than the VaR, it has become a popular measure to report along with VaR.

Simple illustration in how to calculate VaR

1. Shock up: no additional Capital in this case

Balance sheet	
Asset = 100 Duration = 10	Liability = 80 Duration = 30
Capital = 20	



Balance sheet (Interest rates rise 1%)	
Asset = $100 - 10$ = 90	Liability = $80 - 30$ = 50
Capital = 40	

2. Shock down: hold Capital of 20 in this case

Balance sheet	
Asset = 100 Duration = 10	Liability = 80 Duration = 30
Capital = 20	

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Balance sheet (Interest rates decrease 1%)	
Asset = 100 + 10 = 110	Liability = 80 + 30 = 110

3. From 1) and 2), Capital = 20 is cushion for interest rate risk

Balance sheet	
Asset = 100 Duration = 10	Liability = 80 Duration = 30
Capital = 20	

Balance sheet (Interest rates rise 1%)	
Asset = 100 - 10 = 90	Liability = 80 - 30 = 50
Capital = 40	

Balance sheet (Interest rates decrease 1%)	
Asset = 100 + 10 = 110	Liability = 80 + 30 = 110

What else can be done, if not RBC

The objective of RBC is to ensure that insurer can fulfill their obligation to policyholder since it would seriously affect 1) policyholder interest and 2) general public interest (i.e. public's confidence in insurance industry).

However, this concern also can be addressed by alternative ways.

1. Minimum working capital
2. Stress testing focuses on the infrequent but large scale incidents which occur unexpectedly while value at risk (VAR) is based on normal market conditions and cannot accommodate unusual incidents. Therefore, it is fair to say that stress testing will be a complement, not replacement, to VAR analysis.
 - a. Sensitivity testing or scenario analysis to highlight potential issues and formulate essential strategy.
 - b. *“Historical scenarios will examine previous market data to infer the joint movement of key financial variables during times of market stress (e.g. Asian financial crisis in 1997, Black Monday in 1987, terrorist attack on the World Trade Center). The obvious limitation is the limited number and unique features of each event. A long history is recommended to help provide perspective. For example, on Black Monday, the S&P 500 dropped more than 20% in one day (a statistically large event by any standard), but on a monthly basis, the return was not very different from historical monthly returns.*
 - c. *Prospective scenarios are hypothetical based on reasonable and relevant scenarios that could generate large losses. Examples could include the default of major sovereign debt, decrease in oil supply, or increased conflict in the Middle East. Prospective scenarios are either factor push or conditional. The factor push method addresses*

multidimensionality by “pushing” each risk factor up or down the same amount in the direction that would cause adverse price effects. The magnitude is assumed uniform for all variables (fix the significance level at alpha). This method is easy to implement by pushing each factor up or down, say 2.33 standard deviations, as appropriate, and measuring the price impact. Additionally, a worst-case scenario can be generated by simultaneously pushing each factor in its adverse direction. The drawback to this method is that the correlation between risk factors is ignored. For example, if two variables were positively correlated, it would not make sense to consider individual movements in opposite directions. Additionally, this naïve approach does not consider that some positions will suffer the greatest losses when the underlying variables do not move (e.g. option positions).” [3]

[3] “Financial Risk Manager Handbook” Fourth Edition by Philippe Jorion, Global Association of Risk Professionals (GARP)

3. Dynamic solvency testing (DST)

- a. Indonesia
- b. Malaysia
- c. Hong Kong

In dynamic solvency testing, the projection of all line of business will be done with main 3 scenarios

1. Base scenarios: 10-year projection using stat reserve with best estimate assumption.
2. Pessimistic scenarios: 5-year projection with 95% confidential level of interest rate. Same lapse but higher mortality.
3. Average scenarios: 10-year projection

The objective of dynamic solvency testing is to compare “Admitted asset” with “Solvency Margin”. Admitted asset is selected from Asset in balance sheet, Asset is equal to Asset share plus balancing item (Asset valuation reserve and other liability). Solvency margin is equal to total liability plus required capital.

4. Cash flow testing, such as NY-7 interest scenario in US (e.g. statutory requirement of New York Section 126).

The objectives of such cash flow testing is to:-

- i) To analyze the future insurance liabilities cash flows, and
- ii) To identify the possibility of deficiencies under the seven interest rates scenarios as per the statutory requirement of New York Section 126.

The projection period is established. It is usually around 30 years.

As per the statutory requirement of New York Section 126, the projections was based on the following interest rate scenarios:

Scenario	Description
1 Level	Level with no deviation
2 Uniform Up	Uniformly increasing over 10 years at 0.5% per year and then level
3 Up / Down	Uniformly increasing at 1% per year over 5 years and then uniformly decreasing at 1% per year to the original level at the end of 10 years and then level
4 Pop-Up	An immediate increase of 3% and then level
5 Uniform Down	Uniformly decreasing over 10 years at 0.5% per year and then level
6 Down / Up	Uniformly decreasing at 1% per year over 5 years and then uniformly increasing at 1% per year to the original level at the end of 10 years and then level
7 Pop-Down	An immediate decrease of 3% and then level

What can be holistically achieved and positioning for Thailand?

This paper will recommend what can be holistically achieved and positioning for upcoming development of new risk-based capital of Thailand so as to encourage well risk management practice while having effective model but not too complicated to implement by Life insurance industry in Thailand.

Observation of each model

From advantage and disadvantage in each model era of RBC development, the observation has been made.

1. The amount of capital required should be related to the risk that the company has hold. It also has to reflect the investment strategy of the company.
Different asset allocation or asset mix should reflect different amount of risk charged or capital required. Since the hedging has cost, in order to encourage risk management, good model should also reward the performance of ALM and hedging strategy.
2. Different product feature and product category should have different amount of risk charged or capital required. Product mix should also be able to shape profile of required capital. For example, investment-linked product is not required to hold asset risk (C1 of S&P's) or cash flow mismatch risk (C3 of S&P's) since these risks would pass to policyholder.
3. Risk factor should at least address asset risk, insurance risk, interest rate risk, and business/operation risk.
4. Good RBC model should improve the perception and confidence of market to media and public interest. It should be able to preclude the unnecessary capital injection too. Capital injection due to new business strain should be acceptable but reflect in model.
5. The model should also be able to track any anomaly of company's financial health. Monitoring mechanism and action required is necessary.

6. Model, which requires cash flow projection from each company in industry, is imperative to have following issues being ready
 - a. Appointed actuary who can underpin judgment in assumption (mortality, morbidity, operating expense, persistency, earning rate, discount rate) of cash flow projection.
 - b. Definition of Risk free rate might be adopted, and then need to be articulate and accessible.
 - c. Reasonable in frequency of marked-to-market
 - d. Software and implementation of each company in order to generate rational results.
7. Model, which requires fair value concept to be adopted in industry, is imperative to have following issue being ready.
 - a. Accounts team for cooperation on balance sheet items. Good reconciliation of financial report. Assessment of impact by running projection.
 - b. Handling the fluctuation and interpretation of surplus
 - c. Definition of risk free rate is crucial.
 - d. Definition of admitted asset to identify surplus. It is inevitable to have an issue to define illiquid asset in market value basis.
 - e. Accounting practice to book the bond as trading or available for sales.
 - f. Identification of major source of solvency margin.
8. The ideal model should encourage diversification effect
 - a. Diversify in product level.
 - b. Diversify in the company level.
 - c. Diversify among countries and affiliates.
9. The ideal model should encourage natural hedging in product design.
 - a. Mortality and morbidity risk, such as accelerated health product
 - b. Lapse and surrender charge
 - c. Investment margin and mortality margin
10. The advanced model should provide interactive between assumptions.
Dynamic lapse is the interactive between lapse rate assumption and interest rate (or crediting rate for Universal Life)

Apparently, simple factor with fixed percentage to all products is not able to reflect appropriate risk charged to the company anymore. To develop the risk-based capital model or solvency margin requirement for Life Insurance Company in Thailand, the following observations are justified.

Rudimentary establishments for Thai industry

Most advanced risk-based model such as solvency II or economic capital is the ideal model for Thai industry to aim in the long run. In order to do that, rudimentary establishments are recommended to implement in Thai industry to be ready.

1. Cash flow projection: each company will have to do extensive cash flow projection to generate market economic capital and non-market economic capital. Assumption, data availability, system, and human capital are imperative to make things success.
2. Definition of risk free rate: risk free rate is crucial factor. It is upon whether the industry can bear the fluctuating result from the model. The risk free rate can use the solvency II definition. Specific definition can be defined to ameliorate the fluctuation of the result, such as Singapore model which use the average rolling rate of risk free rate. Government bond can be adopted if there is liquidity issue of fixed income in the market. For Thailand, the author observes that the fixed income market is still limited and illiquid from time to time. Moreover, extrapolation of risk free rate is the issue that the author concerns as well because most of product in Thailand is traditional endowment product, which somehow guarantees more than 30 years.
3. Actuarial assumption and actuarial judgment: the assumptions of each cash flow item have to be made and reviewed by actuary from both private company and regulator. Actuarial auditor should be ready to support the assumption review. Assumptions of each parameter and judgment from actuary to formulate the shocking up/down result are crucial and inevitable. Not only the credibility and accuracy of data might create a great deal of difficulties to achieve a reasonable result, but also the reconciliation and accessibility of data might not be completely available in small company.

4. Concept to deal with participating contract: dividend declaration in Thailand is different from other countries. The policyholder expectation is more sensitive than others as well.
5. Influence from management: it is crucial to ensure that management will not have an influence into the result of the company when the model changes from “rule” to “principle” basis. Actuarial judgment should not be influenced from management. The regulation body can help to ensure the local actuarial profession.
6. Appointed actuary: since there will be a lot of actuarial judgment, appointed actuary should exist in the industry. Like UK, regulator can assign the responsibility of appointed actuary to endorse their appropriateness.
7. Number of actuary in the industry: to implement and use this model, a lot of actuarial works will overwhelm. While supply of local actuarial students from the industry cannot increase in fortnight, the demand of actuary from other countries might be surging which spontaneously increase the cost of implementation.
8. Sudden change from book value of fixed income to market value of fixed income: fixed income in the market should be liquid enough to use trading or available for sales method. It is fair to say that it should be consistent to other industries in local market as well.
9. System and software implementation: Not only is the cost of tools concerned, the human capital is necessary in this area.
10. Perception from the industry (e.g. local media, local financial analyst, foreign investors) and cost of implementation to achieve ideal target surplus comparing to other industries (e.g. banks, brokers, etc.): local and foreign analyst should be educated and able to interpret the result.
11. Technical advice, monitoring, and interpretation from regulator: regulator will need each company to dry run and test the result to fine-tune the model to be appropriate in local industry. The company expects to receive a piece of advice while it is imperative for regulator to interpret the result from each company. The mechanism and regulatory action should be established to ameliorate the shortage of surplus, if any, in the company. Additionally, the regulators will also have to monitor and make a justification, which

requires considerable resource and expertise from regulators, to each company projection model.

Solvency II or economic capital might be a long-term implementation plan in Thai industry. Each company will have to do extensive in cash flow production to general market economic capital and non-market economic capital.

In the end, it is fair to point out that the benefit of such complicated model might not be worth doing for small company. The author suggests adopting wait-and-see strategy for the implementation of solvency II. In the meantime, the industry should cultivate the solvency II and economic capital concept, and target to implement it in next 8 – 10 years. Understanding of advantage and disadvantage of solvency II and economic capital is necessary.

More risk-based model (e.g. Singapore or Malaysia's model) also mainly need cash flow project. GPV method is necessary to be well established in order to implement this. It is recommended to adopt this when every relevant parties in industry is ready to implement and understand fair value concept. Apparently, with corroboration from private company and regulators, considerable expertise and technical advice are essential and required from actuary in both sides. The statutory reserve using modified net level premium method is suggested to change under this model. However, the industry needs to assess the impact to such change.

For factor derivation style (e.g. Indonesia or US 2005's model), it is highly recommended that the solvency margin in Thailand should be at least adopted into this standard. Not only it is simple and easy to calculate in both product level and portfolio level, but also it has low cost to derive and implement. Basically, it needs to define type of risk, stratify product categories, collect all exposure, and then generate risk factor in each set. This can be flexibly performed periodically (e.g. biannually) Investment strategy, including ALM and asset mix, can reflect the amount of required capital which suffices the main objective of solvency margin. Different product type can have different factor and it is one fit all factor for each product type category. Although this model may not be able to capture the complicated securities and off

balance sheet very well, it is still moderately applicable to Thai industry as a matter of fact that hedging vehicles such as options in Thailand is not well developed at this stage.

Conclusion

Performance versus complexity and data availability versus data quality are the main important tradeoffs that should be addressed. Presumably, a more complex model would have a higher level of performance, but the complexity may make it more time consuming and less understandable. Other factors to consider when choosing between the models are 1) how easy the model is to understand, 2) how robust the model is when new data is added into the analysis, and 3) the time to calibrate and recalibrate the model. It is recommended that back testing and assessment will help in choosing and calibrating the appropriate models.

Hybrid between factor derivation style (Indonesia and US) and more risk based model (Singapore and Malaysia) might be the most holistic approach for local industry at this moment. In the meantime, the industry should be fully aware of the development of solvency II (which will be implemented in next 4 - 5 years (e.g. 2011)) and concurrently develop the rudimentary solvency II framework as well as human capital in industry in further steps.

For short and middle term solution, the industry could consider using model of factor derivation style providing by regulators. The regulators can provide the guidance or basis to the industry and request the company to submit the appropriate factors that they believe it is well-suitable for their companies. After extensive study and dry run, the regulator can propose the factors to industry. It is also strongly recommended that asset risk, liability risk, and interest rate risk should adopt the method and exposure (driver) of S&P's and Indonesia as aforementioned above. It is extremely crucial to note that statutory reserve can be the exposure for asset risk and interest rate risk and net amount at risk should be the exposure of liability risk.

Foreign currency risk and reinsurance risk are the outstanding point whether the industry would like to adopt or not. From the author's point of view, it is upon how asset and liability expose to currency risk. If the investment regulations are limited for the local investment instruments only and if the insurance company writes the contract in only local currency only, the foreign currency risk might not be necessary. So far, from the observation of Thai market, foreign currency risk might be minimal in Thai insurance company.

In addition, the author would suggest the industry to pursue one of the following alternatives to pad up the gap between factor model and more risk based model.

1. Dynamic solvency testing (DST) and financial conditional report (FCR)
2. GPV method on some type of risk, such as interest rate risk.

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