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Letter from the Editor-in-Chief

Myanmar and Korea have many similarities and are complementary relationship. Therefore, we believe that research exchange will expand mutual understanding between Myanmar and Korea, and will be the cornerstone for mutual development.

KOMYRA and YUE have co-published The Myanmar Journal since August 2014. So far, many scholars have published numerous papers through the journal, and We are sure that this journal has helped many people understand Myanmar and Korea more clearly and closely.

The Myanmar Journal covers various issues in Myanmar and Korea. It covers various topics that can promote bilateral development and mutual understanding, not limited to specific topics such as economy, industry, society, education, welfare, culture, energy, engineering, healthcare, and agriculture.

We hope that this journal will continue to promote understanding of the current status and potential capabilities of Myanmar and South Korea and promote in-depth international exchange and cooperation.

We would like to express our deepest gratitude to the editorial board and YUE and KOMYRA for their valuable support in The Myanmar Journal publication.

February 28, 2022

Youngjun Choi *yj choi*

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INFORMATION ABOUT
The Myanmar Journal

The Myanmar Journal (ISSN 2383-6563) is the official international journal co-published by Yangon University of Economics (YUE) and Korea Myanmar Research Institute (KOMYRA).

This journal aims to promote the mutual cooperation and development of Myanmar and Korea through intensive researches in the entire filed of society, economy, culture, and industry.

It will cover all general academic and industrial issues, and share ideas, problems and solution for development of Myanmar.

Articles for publication will be on-line released twice a year at the end of February and August every year on the Myanmar Journal webpage (http://www.komyra.com/bbs/board.php?bo_table=articles).

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Improvement of Regulatory Risk Management System for Myanmar Insurance Industry

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ABSTRACT : In this paper a suggestion for the improvement of regulatory risk management system for the Myanmar insurance industry was made. Recent years have seen Myanmar's insurance sector take significant steps forward, with liberalization giving rise to a number of foreign insurance companies entering the market. In order to keep effective financial soundness, the Myanmar insurance industry needs to adopt a more advanced risk management system. As an example of advanced regulatory risk management system EU countries are currently applying Solvency II system. There are other countries adopting RBC system. This study deals with the analysis of the insurance risk, credit risk and operational risk of an insurance company. Based on this analysis, direction for new regulatory risk management system of the Myanmar insurance industry is suggested. By implementing a step-by-step approach, regulatory risk management system for the Myanmar insurance industry can be developed to be able to meet the global standard ultimately.

Key words : *Risk management, Insurance, Claim, Solvency II, Capital*

I. Introduction

A risk management system is used to keep the financial soundness of insurance companies, in particular to ensure that they can survive the worst periods. The usages of risk management are to identify possible risks, to reduce, remove or manage risks, to provide a rational basis for better decision making in regard to all

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risks, to reduce the cost of controlling risks and to improve the performance of the business. Elements of good risk management are appropriate qualitative standards, good internal and external supervisory systems, and transparent information disclosure. Without a good risk management system, insurance companies may become bankrupt, policyholders may suffer severe damages, and the stability of the financial system as a whole can be jeopardized. R. R. Doff (2006), and Paul Sweeting (2011), provided good material for the overall understanding of risk management for insurance company.

The objective of the research is to improve the regulatory risk management system for the Myanmar insurance industry. There is a lack of understanding of the importance of a risk management system, lack of a reliable database, lack of a good regulatory system and lack of expertise in Myanmar. Accordingly, the Myanmar risk management system is far behind global standard. Under current circumstances, there are many aspects to improve in order to have a satisfactory advanced system, so taking step-by-step approach for the improving system is recommended.

First of all, it shows that there is need to study the risk management system in other developed countries, such as Solvency II of the EU, and the Korean RBC System, for recommending a new, applicable system that could be easily and immediately implemented in Myanmar. During the implementation of the new system, it shall be advised that the whole sector needs to improve collection and storage of data which will help to establish a reliable insurance database, to develop good practices in risk management.

This paper consists of five chapters: Chapter 2 describes the risk management systems in other countries, Chapter 3 describes the suggestions to implement a new system in Myanmar, Chapter 4 introduces the analysis for the application of a new RBC system in Myanmar utilizing specific insurance company data and Chapter 5 makes a conclusion and provides suggestions.

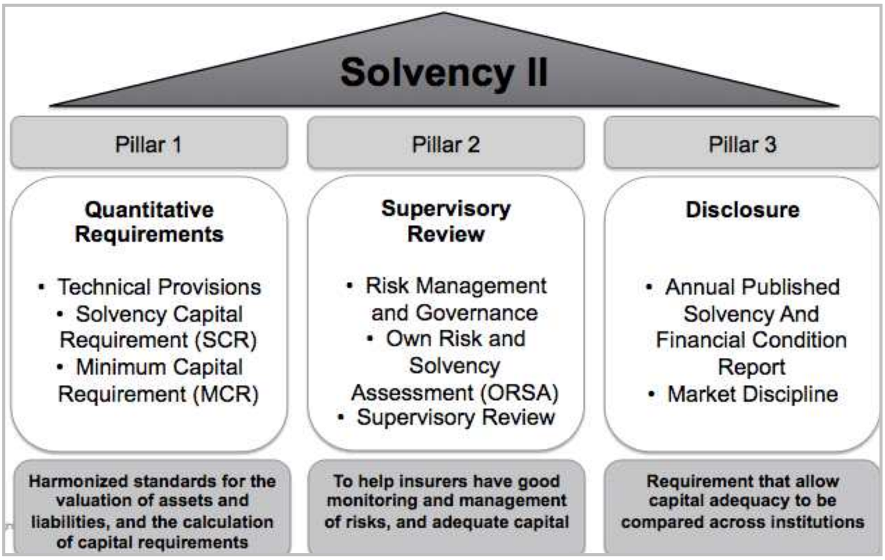
II. The Risk Management Systems in other Countries

1. Solvency II: EU System

Recent developments in insurance regulation emphasize risk management. European regulators implemented new capital requirements that are directly based on the risk taken by insurance companies. This framework is called Solvency II. It is a project under which a new regime will be introduced for managing insurance risk in the European Union. It emphasizes new adequacy requirements, risk management practices, increased transparency, and enhanced supervision. Moreover, it encourages insurance companies to put in place a system of governance and control that demonstrates capital adequacy and tests the validity of risk-based decisions. Authors referred to a report by HM Treasury of the UK (2006), for the details of Solvency II system.

Solvency II is a fundamental review of the capital adequacy regime for the European insurance industry and it establishes a revised set of market-consistent, EU-wide capital requirements and risk management standards. Solvency II will be based on a 'three pillar' framework. The pillar system originates from the approach taken in the Capital Requirements Directive (CRD), which follows the international Basel II Accord for banks and investment firms.

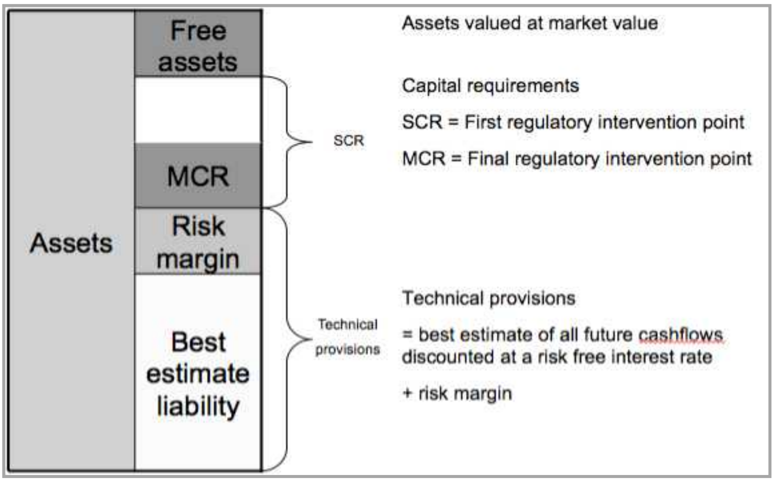
Figure 1. Structure of Solvency II System



1) Pillar 1 Quantitative Requirements

This pillar aims to ensure firms are adequately capitalized with risk-based capital. All valuations in this pillar are to be done prudently and in a market-consistent manner. Capital requirements represent regulators' views about the minimum level of capital that firms should hold to have a reasonable expectation of being able to continue to meet their obligations to policyholders. Firms may hold capital in excess of regulatory requirements for various reasons, including the capacity to deliver their business strategy and to achieve a certain credit rating. It is proposed that Solvency II should have two capital requirements: the SCR and the MCR.

Figure 2. Summary of capital requirement for insurance firms



Solvency II should also allow an additional capital requirement resulting from the Pillar 2 supervisory review process. The capital requirements represent trigger points for progressive supervisory scrutiny and action. Solvency II will need to set out clearly the functions of the SCR and MCR and be calibrated to ensure that the level of solvency each requires is appropriate.

Insurers are required to maintain reserves against liabilities (technical provisions). A consistent market-based system is applied for assessing liabilities as well as ensuring a greater matching of assets to liabilities.

Insurers and reinsurers must adhere to a Minimum Capital Requirement (MCR), which is the fundamental level of solvency required of any insurer. The Solvency Capital Requirement (SCR) represents the target level of solvency which an insurer or reinsurer needs to maintain. It is a fully risk-based calculation using standard formula or using internal models (or a combination of both). Basically, the SCR is the amount of capital needed to leave a less than 1 in 200 chance of capital being inadequate over the forthcoming year.

2) Pillar 2 Supervisory Review

Pillar 2 refers to the supervisory review process that complements capital requirements (Pillar 1) and disclosures (Pillar 2). The Pillar 2 supervisory review process has two aims: to help ensure that a firm is well run and meets adequate risk management standards, and to help ensure that the firm is adequately capitalized. Pillar 2 refers to the supervisory review process that complements capital requirements (Pillar 1) and disclosures (Pillar 2).

Pillar 2 also requires firms, as part of the risk management system that forms part of the governance arrangements to undertake an Own Risk and Solvency Assessment (ORSA). The ORSA can be defined as the entirety of the processes and procedures employed to identify, assess, monitor, manage, and report the short-and long-term risks that the business faces or may face, and to determine the funds necessary to ensure that its overall solvency needs are met at all times.

The ORSA aims at enhancing awareness of the interrelationships between the risks the business is currently exposed to, or may face in the long term, and the internal capital needs that follow from this risk exposure.

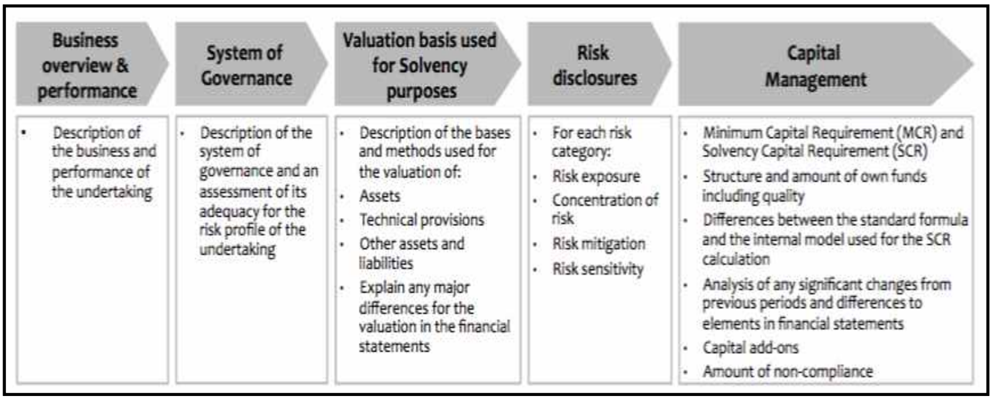
3) Pillar 3 Disclosure

The purpose of Pillar 3 disclosures is to encourage market discipline by providing key information about the capital adequacy of insurance firms. These disclosures would target market participants such as equity holders, debt holders, reinsurers and large commercial buyers of insurance.

Their objectives (e.g. an adequate return on capital) are such that if market discipline is effective, their actions will encourage firms to take measures which promote regulatory objectives such as stronger risk management.

It is also important that appropriate verification of the information disclosed takes place without necessarily requiring an audit of all data.

Figure 3. Overview of Pillar 3 requirements for public disclosures



2. Korean RBC System

Advanced countries such as the U.S and Canada have adopted a risk-based approach to insurance supervision by implementing risk-based capital regulations and risk assessment systems.

In 2003, the Financial Supervisory Service of Korea developed a Master Plan for Risk-Based Insurance Supervision. A Risk-Based Capital (RBC) system was introduced in Korea in 2009. For the first two years after the introduction of the RBC system, the more favorable of either the former solvency margin regime or the RBC regime was applied to insurers.

Korean risk-based insurance supervision consists of three pillars: risk-based capital (RBC) requirements, the Risk Assessment & Application System (RAAS), and market discipline.

Table 1. Structure of Risk Based Insurance Supervision

Pillar	Supervision	Risk-Based Approach
Pillar 1	Capital Regulations	Risk-Capital Capital Requirements (RBC)
Pillar 2	Prudential Supervision	Risk Assessment and Application System (RAAS)
Pillar 3	Public Disclosure	Expanded scope of risk disclosure

1) RBC Requirements

Korean Risk-Based Capital (RBC) aims to ensure that financial institutions reserve their capital sufficiently enough to cover any unpredicted loss they may sustain, thereby allowing them to maintain solvency margins for their policy holders. The RBC system to be introduced has been designed to comply with the global financial standards suggested by the International Association of Insurance Supervisors (IAIS) to the maximum extent possible. "Guide to Korea's Risk Based Capital for Korean Insurance Companies" (2013), explains details of Korean RBC system.

Risks are classified and measured in a detailed and sophisticated manner to capture a wide range of underlying risks faced by insurance companies. The RBC system uses a simple and standardized model that can be commonly applied to all insurers. The Korean RBC system adopts risk coefficients commonly used across the insurance industry. In the future, it will also introduce the internal model approval system, by which insurers are allowed to take into consideration their own underlying risk factors, thereby institutionalizing differentiated levels of required capital.

Table 2. The Calculation method of Korean RBC System

	Items	Amount
1	Available Capital	1 = 1.1 + 1.2 − 1.3 + 1.4
1.1	Core Capital	
1.2	Supplementary Capital	
1.3	Deducted Items	
1.4	Capital deficiency of subsidiaries	
2	Required Capital (Total Risk)	$2 = \sqrt{2.1^2+2.2^2+2.3^2+2.4^2}+2.5^2$
2.1	Insurance Risk	$2.1 = \sqrt{2.1.1^2+2.1.2^2}$
2.1.1	Pricing Risk	
2.1.2	Reserve Risk	
2.2	Credit Risk	
2.3	Interest Risk	
2.4	Market Risk	
2.5	Operational Risk	
3	RBC Ratio	$3 = \frac{1}{2} \cdot 100\%$

Available capital: A risk buffer to ensure that insurers maintain their solvency margin to cover any unpredicted loss they may sustain; equivalent to the solvency margin in the former system.

Required capital: The necessary capital calculated by measuring an insurer's underlying exposures to insurance, interest rate, market, credit, and operational risk.

The confidence level of RBC is partly 95%. The confidence level for market risk and insurance risk is 99%, while the level for interest rate risk and credit risk is 95%. The RBC ratio, which is expressed as the available capital divided by the required capital, can be used as the criteria for prompt corrective actions, and as a management evaluation indicator or risk evaluation indicator. The required capital is calculated by summing up all types of risks so as to effectively consider the total risks of an insurer.

2) Risk Assessment and Application System (RAAS)

According to FSS of Korea (2013), the RAAS is a risk-based monitoring system that assesses insurers' risks on an ongoing basis and concentrates supervisory resources on insurers and areas that show weaknesses. Under the RAAS, a sophisticated and comprehensive assessment of insurers' exposure to risks arising from their business activities and risk management is conducted. The evaluation results are used in implementing risk-based supervisory measures and planning examinations to improve supervision efficiency, stability of the financial system and soundness of insurers.

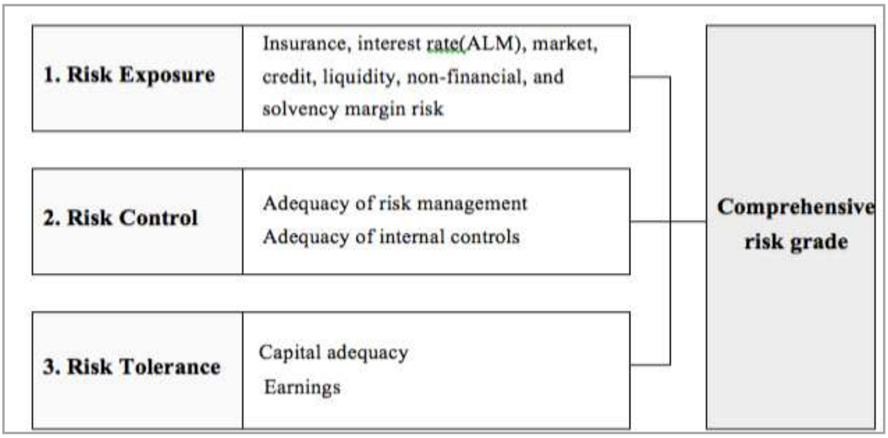
Risk assessment process: 1) Understand financial institutions, 2) Conduct an assessment of risks, 3) Develop and implement supervision and examination plans, and 4) Conduct follow-up work and monitor on an ongoing basis.

The RAAS assesses not only the financial results, such as asset soundness at the time of the evaluation, but also the possibility of future losses by looking at historical and empirical data (insolvency ratio, loss ratio, etc.). The results from the risk assessment are used as a key supervisory tool in planning examinations and developing supervisory measures.

To conduct a comprehensive and systemic assessment of risk and management weaknesses, insurers are evaluated on risk exposure, risk control and risk tolerance. A comprehensive risk grade is given based on the ratings in these three areas.

- √ Quantitative assessment of risk exposure: Exposure to insurance, interest rate (ALM), market, credit, liquidity, non-financial, and solvency margin risks are measured
- √ Qualitative assessment of risk control: To assess risk control, checklists are used to evaluate risk management
- √ Quantitative assessment of risk tolerance: Capital levels and earnings are assessed to evaluate insurers' ability to absorb losses and secure capital

Figure 4. RAAS Structure and Assessment Framework



3) Comparison of Solvency II and Korean RBC System

While both Solvency II and the Korean RBC system share the common goals of protecting policyholders and strengthening insurers through sound regulation, they are very different. Solvency II is currently the most advanced level system in the world and it has already become an international standard.

Some key differences of Pillar 1 of the two systems are shown in the following table:

Table 3. Comparison of Pillar 1 of Solvency II and Korean RBC System

	Korean RBC	Solvency II
Assets risk measure	Market Value	Market Value
Confidence Level	95% and 99%	99.5%
Risk Classification	Basic	More detailed
Risk Aggregation	Simple	More advanced
Internal Model	Not accepted	Accepted

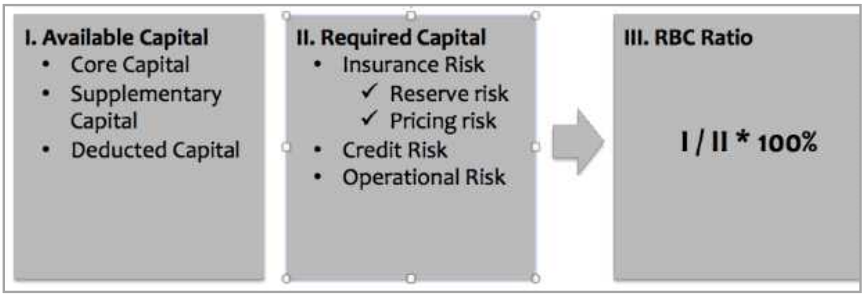
For risk aggregation, while Solvency II considers correlation within and across risk categories, the Korean RBC uses a square root formula that assumes risk components are independent.

III. Suggestions to Implement New System in Myanmar

The current Myanmar risk management system should be improved in many aspects in order to match an advanced system like Solvency II. The Myanmar risk management system should ultimately be able to meet global standards. Therefore, it is needed to prepare a system to satisfy the requirements of an advanced system using a step-by-step approach. For quantitative requirements, the current system uses a very simple method which is based on financial statements and not based on insurance data.

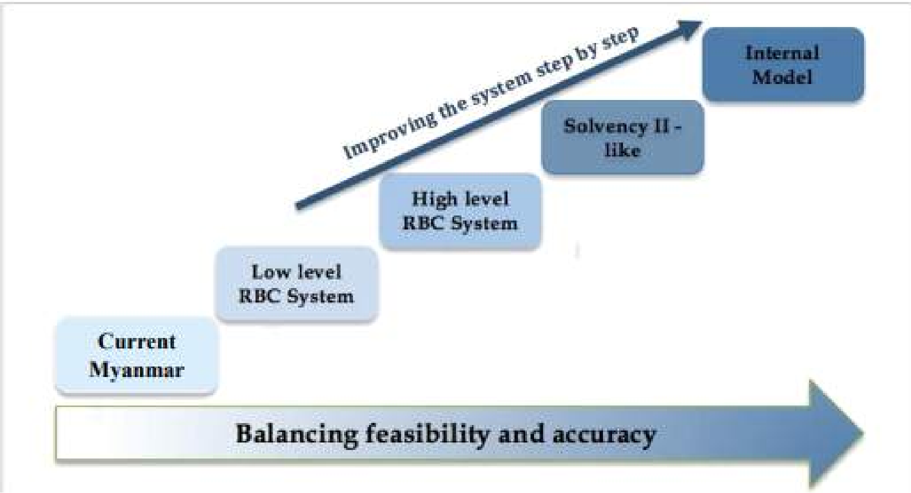
The first step for Myanmar is a low-level RBC system like Pillar 1 which can be implemented relatively easily. It should adopt some part of the existing Korean RBC system and we should also consider that the implementation process itself it will take time due to a lack of data. It would take time to implement this because of a lack of reliable data.

Figure 5. Components of the New System



For the first two or three years after the introduction of the new system, insurers can follow two systems: either the current solvency margin regime, or the new RBC regime. It is needed to prepare systems to satisfy the requirements of Pillar 2 and Pillar 3 of Solvency II as soon as possible. Details of regulations should be improved, including incentives and penalties regarding risk management practices. Insurance companies need to improve their capabilities and framework of risk management at the same time.

Figure 6. Roadmap to improve Risk Management System for Myanmar Insurance Industry



The Myanmar Insurance Industry needs to:
√ Establish reliable insurance database
√ Improve Regulators' professionalism and expertise
√ Develop supervisory system
√ Improve Risk Management Framework for Myanmar Insurance Industry

IV. Analysis for the Application of New RBC System in Myanmar

Individual claims data of car insurance, accident insurance, and third-party liability driver's insurance and other insurance (integrated the property, liability, and cargo insurance) from 2010-2014 filings, as provided by MIG Insurance, were utilized for this analysis.

1. Method of the Evaluation of Insurance Risk

1) Data required for using run-off triangle methods

A claim event is an event that gives rise to a claim against an insurer by a policyholder. The ultimate cost to the insurer of a claim event, including the benefit payments and claims handling expenses, is called the ultimate gross claim loss. The ultimate net claim loss allows for the deduction of any reinsurance recoveries and other recoveries.

For any claim event, there may be a delay between the occurrence of the event and the date on which the claim is reported to the insurer (reporting delay), and another delay between the reporting date and the date on which the claim loss is finally settled (settlement delay). Any amount paid or expense incurred in respect of a claim event is called a claim loss settlement amount or a claim loss settled. The insurance undertaking wishes to determine the technical provisions required for claims that have already been reported but not yet fully settled. The insurer has data for all claims that have been reported in the past. For our purposes, we consider only the claims benefit payments and the associated claims handling expenses.

The first step in creating the claims loss settlement run-off triangle is to group the claims loss settlement amounts by the year in which the associated claims events occurred; this is called the claims occurrence year (or the accident year).

In order to fully understand this, use of run-off triangles is demonstrated through a working example using fictitious claims loss data. Typically, when calculating technical provisions, the actuary should consider homogeneous groups of insurance business. The claims data should be segmented by the line of business. The business should be further segmented if it is known that there are differences in, for example, the claims handling process, claim sizes, or reporting/settlement delays. The working example considers the settlement delays only. The process for estimating future reported claims amounts is similar.

Table 4. Claims paid by accident year

Accident Year	Claims Paid
2008	11.85
2009	10.91
2010	13.43
2011	14.84
2012	23.27
2013	33.35
2014	13.14
Total	196.31

The complete number of years that have elapsed between the end of the claims occurrence year and the end of the year in which a claims loss amount is settled (partly or in full); k∈ {0; 1; ...; n}, where n represents the maximum number of the development years observed for any claims occurrence year.

Table 5. Incremental claims paid data presented as a run-off triangle

Incremental claims paid		Development year (k)									
		0	1	2	3	4	5	6	7	8	9
Accident Year	2005	12.56	13.30	2.60	1.11	0.52	-0.02	0.03	0.06	0.02	0.00
	2006	14.62	10.78	1.75	0.79	0.28	0.26	-0.06	0.02	0.06	
	2007	9.96	5.48	0.96	0.28	0.13	0.01	0.01	0.00		
	2008	6.63	4.37	0.40	0.18	0.10	0.06	0.09			
	2009	6.29	3.19	0.61	0.32	0.28	0.22				
	2010	7.34	4.49	0.88	0.39	0.33					
	2011	7.59	5.05	0.87	1.34						
	2012	10.82	9.40	3.05							
	2013	17.83	15.52								
	2014	13.14									

The sum of each row in [Table 5] is equal to the amount shown for that row in [Table 4]. The development year for a claims settlement amount reflects how long after the claims occurrence year the amount was settled. An amount settled during the claims occurrence year is considered to be settled in development year 0, an amount settled in the following year is settled in development year 1, and so on.

In the data used for the example, it is assumed that the largest development year observed for any claims occurrence year is 9. The data shown in each of the cells in [Table 5] represents the incremental claims losses settled in the development year for the given claims occurrence year. The representation of the data in a table requires it to be shown as a triangle, the so-called 'run-off triangle'. For any cell in the table, the value shown represents the incremental claims loss amount that was settled in a calendar year (claims occurrence year + claims development year). Each diagonal set of data represents the amounts settled in a single calendar year. [Table 4-3] represents a claims loss amount settled in 2014, the latest completed calendar year.

Table 6. Claims paid in 2014

Accident Year	Claims Paid
2005	0.00
2006	0.06
2007	0.00
2008	0.09
2009	0.22
2010	0.33
2011	1.34
2012	3.05
2013	15.52
2014	13.14
Total	33.75

Finally, it can be noted that all green cells represent observed data (amounts settled in the past) and all red cells represent time periods in the future for which we wish to estimate the expected claims settlement amounts.

Table 7. Cumulative claims paid data presented as a run-off triangle

Cumulative claims paid		Development year (k)									
		0	1	2	3	4	5	6	7	8	9
Accident Year	2005	12.56	25.86	28.47	29.58	30.09	30.07	30.10	30.17	30.19	30.19
	2006	14.62	25.40	27.16	27.95	28.22	28.48	28.42	28.44	28.50	
	2007	9.96	15.44	16.40	16.68	16.81	16.82	16.83	16.83		
	2008	6.63	11.01	11.41	11.59	11.70	11.76	11.85			
	2009	6.29	9.48	10.09	10.41	10.69	10.91				
	2010	7.34	11.83	12.71	13.10	13.43					
	2011	7.59	12.63	13.50	14.84						
	2012	10.82	20.22	23.27							
	2013	17.83	33.35								
	2014	13.14									

The data in [Table 7] can be presented as cumulative claims losses settled. For each claims occurrence year, the incremental claims loss settled for a particular development year is the amount settled in that development year. The cumulative claims losses settled is the total amount settled up to that development year; i.e. it is the sum of the incremental claims losses settled up to that date.

The amounts shown in the last diagonal of [Table 7] correspond with those in Table [4]. Once the raw data for claims losses settled is collected and segmented as in [Table 7], the insurer is ready to estimate the values that can be expected in the red cells; i.e. in the future. Klaus D. Schmidt (2006), is a good survey of methods and models of loss reserving based on run–off triangle data.

2) Estimation of Loss Reserve

For accidents that occurred in 2002, for example, 12,56 was paid out in the first year; $25,86 was paid in the first 2 years, and so on. Dividing 25,86 by 12,56 results in a loss development factor (LDF) of 2.06. Cumulative losses at the end of 2006 are 2.06 times the value of those losses at the end of 2005. Applying this same procedure to the rest of the triangle, we get a triangle of LDFs:

Table 8. Loss Development Factors

Age to age		0-1	1-2	2-4	3-4	4-5	5-6	6-7	7-8	8-Ult
Accident Year	2005	2.06	1.10	1.04	1.02	1.00	1.00	1.00	1.00	1.00
	2006	1.74	1.07	1.03	1.01	1.01	1.00	1.00	1.00	
	2007	1.55	1.06	1.02	1.01	1.00	1.00	1.00		
	2008	1.66	1.04	1.02	1.01	1.01	1.01			
	2009	1.51	1.06	1.03	1.03	1.02				
	2010	1.61	1.07	1.03	1.03					
	2011	1.67	1.07	1.10						
	2012	1.87	1.15							
	2013	1.87								
	2014									
Average		1.73	1.08	1.04	1.02	1.01	1.00	1.00	1.00	1.00
ATU		1.98*	1.15**	1.07	1.03	1.01	1.00	1.00	1.00	1.00

* 1.98=1.73x1.08x1.04x1.02x1.01x1.00x1.00x1.00x1.00

** 1.15=1.08x1.04x1.02x1.01x1.00x1.00x1.00x1.00

The last lines give an average LDF for each period and the age to ultimate (ATU), which gives a factor which can be applied to predict ultimate losses for each development period. LDFs are used to estimate the cumulative claims loss settlement amounts in the future. For each claims occurrence year, the last historical observation is used together with the appropriate LDFs to estimate the cumulative settlement amount in the next development year. This value is, in turn, multiplied by the LDFs for the next development year and so on.

Table 9. The estimated cumulative claims loss settlements in future periods

Cumulative claims paid		Development year (k)									
		0	1	2	3	4	5	6	7	8	Ult. loss
Accident Year	2005	12.56	25.86	28.47	29.58	30.09	30.07	30.10	30.17	30.19	**30.19**
	2006	14.62	25.40	27.16	27.95	28.22	28.48	28.42	28.44	**28.50**	28.50
	2007	9.96	15.44	16.40	16.68	16.81	16.82	16.83	**16.83**	16.86	16.86
	2008	6.63	11.01	11.41	11.59	11.70	11.76	**11.85**	11.86	11.88	11.88
	2009	6.29	9.48	10.09	10.41	10.69	**10.91**	10.93	10.94	10.95	10.96
	2010	7.34	11.83	12.71	13.10	**13.43**	13.52	13.55	13.56	13.58	13.58
	2011	7.59	12.63	13.50	**14.84**	15.08	15.18	15.21	15.23	15.25	15.25
	2012	10.82	20.22	**23.27**	24.15	24.53	24.70	24.75	24.78	24.81	24.81
	2013	17.83	**33.35**	35.96	37.31	37.90	38.17	38.24	38.28	38.33	38.34
	2014	**13.14**	22.67	24.44	25.36	25.77	25.95	26.00	26.03	26.06	26.06

Table 10. The estimated loss reserve

Accident year	Claims Paid	LDF to Ultimate	Ultimate Claims	Loss Reserve
1	2	3	4	5=4-2
2005	30.19	1.00	30.19	-
2006	28.50	1.00	28.50	0.00
2007	16.83	1.00	16.86	0.02
2008	11.85	1.00	11.88	0.03
2009	10.91	1.00	10.96	0.05
2010	13.43	1.01	13.58	0.15
2011	14.84	1.03	15.25	0.41
2012	23.27	1.07	24.81	1.54
2013	33.35	1.15	38.34	4.99
2014	13.14	1.98	26.06	12.92
Total	196.31		216.43	20.13

We estimated 20.13 of loss reserve using ultimate claims and claims paid. The other step in the use of run-off triangles is to group the estimated incremental claims loss settlement amounts by the years in which they will be settled.

Table 11. The estimated incremental claims loss settlements in future periods

Incremental claims paid		Development year (k)									
		0	1	2	3	4	5	6	7	8	9
Accident Year	2005										
	2006										0.00
	2007									0.02	0.00
	2008								0.01	0.02	0.00
	2009							0.02	0.01	0.02	0.00
	2010						0.09	0.03	0.01	0.02	0.00
	2011					0.24	0.11	0.03	0.02	0.02	0.00
	2012				0.88	0.39	0.17	0.05	0.03	0.03	0.00
	2013			2.61	1.35	0.60	0.27	0.07	0.04	0.05	0.00
	2014		9.53	1.77	0.92	0.41	0.18	0.05	0.03	0.04	0.00

Table 12. The estimated loss reserve for each future calendar year

Calendar year	Loss Reserve
2015	13.41
2016	3.67
2017	1.75
2018	0.75
2019	0.18+0.07+0.03+0.02+0.00=0.30
2020	0.12
2021	0.08
2022	0.04
2023	0.00
Total	20.13

3) Reserve Risk

Reserve Risk, as used in Solvency II, is the risk that the current reserves are insufficient to cover their run-off over a 12-month' time horizon. Reserve risk relates to volatility of claim run-off. It is determined using the loss triangle method as discussed in section 4.1.1. Especially long tail insurance like liability insurance is exposed to reserve risk because it can take a number of years before the final amount of a claim can be determined. Whilst the impact of reserve risk is more prominent in liability insurance, the principle also holds in property insurance. The major difference is that the run-off period is shorter. This section will discuss the reserve risk calculation. Ira Robbinn (2012), shows a practical way to estimate loss reserve risk.

The parametric distributions commonly used in the field of modeling run-off triangles are lognormal and gamma distributions. Since these require the assumption of positive incremental claims.

The first step is to choose the most appropriate distribution for LDFs. I generally do this by looking at the descriptive statistics that provide simple summaries about sample and the measures for describing what is or what the data shows.

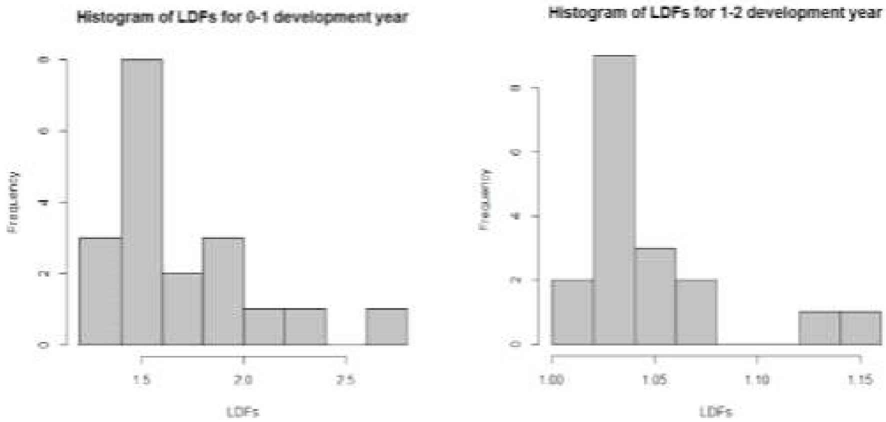
Table 13. Descriptive statistics for LDFs

Measures	LDFs for 0-1 development year	LDFs for 1-2 development year
Mean	1.703	1.049
Standard Error	0.080	0.009
Median	1.558	1.036
Standard Deviation	0.347	0.039
Sample Variance	0.121	0.002
Kurtosis	1.733	3.806
Skewness	1.250	2.040
Minimum	1.273	1.011

Maximum	2.651	1.157
Largest	2.651	1.157
Smallest	1.273	1.011
Confidence Level (95.0%)	0.167	0.020

According to the descriptive statistics, it has a skew distribution to right (there is positive skewness), it could be selected log-normal distribution. Also I do this by looking at the histogram and determining what distribution best fits the density shape.

Figure 7. Histogram of LDFs



[Figure 7] shows that it could be best modeled with lognormal distribution, but it could also be gamma distribution. I selected the lognormal distribution, since lognormal distribution is used to model continuous random quantities when the distribution is believed to be skewed, such as certain income and lifetime variables.

Lognormal distribution: A variable X is lognormally distributed if Y=ln(X) is normally distributed with "LN" denoting the natural logarithm. The general formula for the probability density function of the lognormal distribution is

$$f(x)=\frac{1}{\sqrt{2\pi\sigma x}}e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}} \quad , \quad x\in(0,\infty)$$

ln(X) has normal distribution with a mean of μ and standard deviation of σ. The parameter σ is the shape parameter of X while $m=e^{\mu}$ is the scale parameter of X. Equivalently, $X=e^{Y}$ where Y is normally distributed with a mean of μ and standard deviation of σ. We can write Y=μ+σZ, where Z has a standard normal distribution.

The maximum likelihood estimates for the scale parameter, m, and the shape parameter σ, $\hat{m}=e^{\hat{u}}$ and

$$\hat{\sigma}=\sqrt{\frac{\sum_{i=1}^{N}(\ln(X_i)-\hat{\mu})^2}{N}} \quad \text{where } \hat{\mu}=\frac{\sum_{i=1}^{N}\ln(X_i)}{N}$$

We assumed that LDFs have lognormal distribution ~ $LNf_0(\mu_i, \sigma_i^2)$.

Table 14. LDFs ~ $LNf_0(\mu_i, \sigma_i^2)$.

Age to age		0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
h	2005	0.72	0.10	0.04	0.02	0.00	0.00	0.00	0.00	0.00
	2006	0.55	0.07	0.03	0.01	0.01	0.00	0.00	0.00	0.00
	2007	0.44	0.06	0.02	0.01	0.00	0.00	0.00	0.00	0.00
	2008	0.51	0.04	0.02	0.01	0.01	0.01	0.00	0.00	0.00
	2009	0.41	0.06	0.03	0.03	0.02	-0.00	0.00	0.00	0.00
	2010	0.48	0.07	0.03	0.02	-0.00	0.00	0.00	0.00	0.00
	2011	0.51	0.07	0.09	0.03	0.02	-0.00	0.00	0.00	0.00
	2012	0.63	0.14	0.02	0.02	-0.00	0.00	0.00	-0.00	0.00
	2013	0.63	0.09	0.05	0.02	0.01	0.00	0.00	0.00	-
	2014	0.72	0.02	0.04	0.01	0.01	-0.00	0.00	0.00	-
mean (μ_i)		0.54	0.07	0.04	0.02	0.01	0.00	0.00	0.00	0.00
STDev (σ_i)		0.10	0.03	0.03	0.01	0.01	0.00	0.00	0.00	-

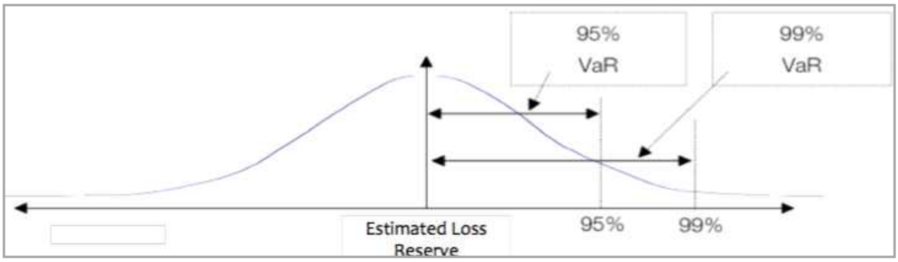
The product of independent lognormal random variables is also lognormal, which implies that age-to-ultimate loss development factors are lognormal. We used simulation to generate 10000 random numbers for future LDFs. Then, there are a total of 10000 ultimate loss scenarios generated based on generated LDFs.

Table 15. One sample scenario: LDFs using random numbers generated from estimated lognormal distribution

		0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
Acci dent year (i)	2005									
	2006									1.00
	2007								1.00	1.00
	2008							1.00	1.00	1.00
	2009						1.00	1.00	1.00	1.00
	2010					1.00	1.00	1.00	1.00	1.00
	2011				1.03	1.02	1.00	1.00	1.00	1.00
	2012			1.02	1.02	1.00	1.00	1.00	1.00	1.00
	2013		1.10	1.05	1.02	1.01	1.00	1.00	1.00	1.00
	2014	2.05	1.02	1.04	1.01	1.01	1.00	1.00	1.00	1.00

Next step is to estimate of loss reserve based on generated ultimate losses. Generated loss reserves through these procedures are ordered from lowest to largest. And then loss reserve corresponding to the 99% confidence level is the 9900th largest. It is the regarded as VaR at 99% security level.

Figure 8. Loss Reserve Distribution



As a final step reserve risk is determined by the following formula:

Reserve Risk = Requirement Capital
= [VaR(99.0%) for Loss Reserve] – [Best Estimate of Loss Reserve]

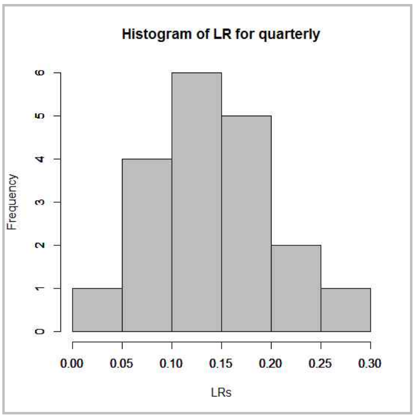
4) Pricing Risk

Premium risk relates to policies to be written during the period, and to unexpired risks on existing contracts. The historic loss ratios, from which the volatility is calculated, are given by the estimated cost at the end of the first development year, divided by earned premiums or net written premium. M.G.Wacek (2007), explain steps to estimate the ultimate loss ratio. In this paper pricing risk is determined by following procedures.

(1) Ultimate loss ratio (Xi)= ultimate loss / earned premium (or net written premium)

In order to choose the distribution of ultimate loss ratio, the histogram is used by determining what distribution best fits the density shape.

Figure 9. Histogram of loss ratios



[Figure 9] shows that it could be best modeled with normal distribution.

(2) Calculate the mean (μi) and standard deviation (σi) of ultimate loss ratio.

(3) Simulation is used to generate 10000 random numbers using normal distribution parameters.

(4) Generate 10000 ultimate loss ratios using simulation.

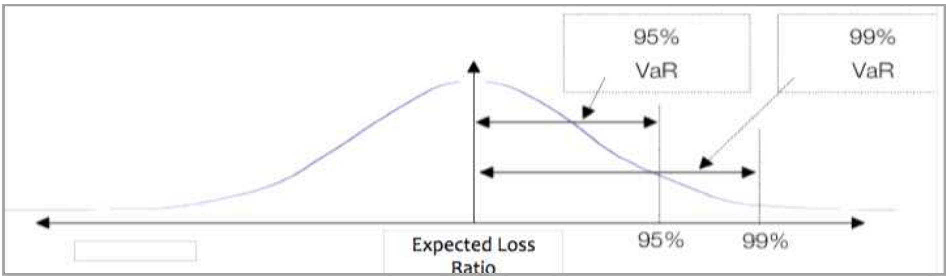
(5) Generated loss ratios are ordered from lowest to largest.

(6) Loss ratio corresponding to the 99% confidence level is the 9900th largest. It is same as VaR at 99% percentile.

(7) From Quarter VaR to Year VaR:

In our data, VaR is used to manage risk on a quarterly basis, so 1 year VaR is needed. If Xi is independent and identically distributed, then $Y_i = \sum_{i=1}^{4} X_i$ is also normal distributed with mean 4μk and variance 4σk2 since it is the sum of 4 i.i.d normal variables. It follows that: VaR[T:c]=Var[1:c] $\sqrt{T}$.

Figure 10. Loss Ratio Distribution



(8) Pricing Risk = Requirement Capital

= [VaR(99.0%) for Loss Ratio–Expected Loss Ratio] *NWPremium

2. Method of the Evaluation of Credit Risk

Credit risk is the risk that a counterparty to an agreement will be unable or unwilling to make the payments required under that agreement. It can also refer to risk arising from changes in the value of an asset (e.g. corporate bond) due to an actual or perceived change in the creditworthiness of the issuer. Niamh Crowley and Niall Dillon (2010), gave authors a good understanding of credit risk.

Credit risk amount is any risk exposure in excess of the expected losses. Since expected losses have the allowance for bad debts established, the credit risk amount used for calculating the required capital is regarded as unexpected losses.

Under RBC, the calculation for credit risks is referenced from a standardized approach from Basel II. The standardized approach uses risk factors, exposure and risk mitigation methods, etc. for credit risk calculation suggested by the Basel Committee. The basic structure for credit risk calculation is as follows:

Credit Risk Capital = Exposure x Risk coefficient

Under RBC framework, the risk coefficients are used according to the credit rating of the exposure.

Credit Risk Modeling – Basics:

EL = EAD x PD x LGD

EL - Expected Loss

EAD - Exposure at default

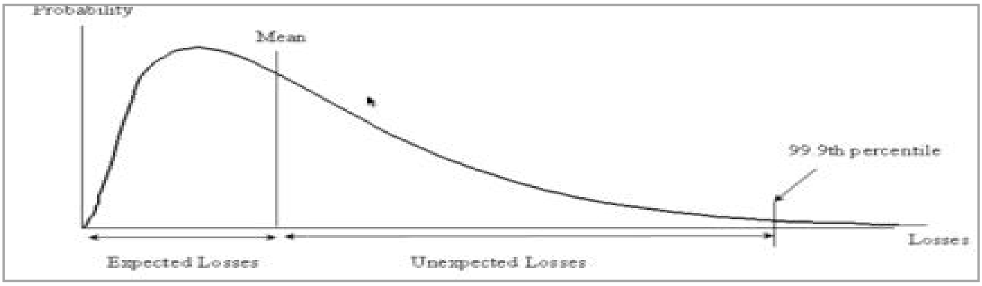
LGD - Loss Given Default - "

PD - Probability of Default

Portfolio Expected Loss = Sum (EL on each transaction)

Capital required = VaR(c%) – EL = Unexpected Loss = Credit risk

Figure 11. Credit Risk Loss Distribution



Credit risk loss distributions are skewed to the right. Beta and Gamma distributions are a good fit for this type of distribution.

3. Method of Evaluation of Operational Risk

Operational risks are a group of risks which impact the way in which a firm carries out business. They include a wide number of different risks, which often overlap each other to a significant degree. Operational risks can be the biggest risk faced by financial institutions. Operational risks are difficult to identify and quantify exposure. Thus, a simple method is allowed to calculate required capital as a certain percentage of premium income. As a simple way operational risk can be calculated as premium income over the past one year preceding the date of calculation multiplied by a risk coefficient of 0.05, for instance.

4. Result of the Analysis

The result of the analysis for an insurance company is shown in the following table.

Table 16. Result of the analysis for MIG Insurance Company

Available Capital	4,514.9m	4,514.9m	4,514.9m
Required Capital	1,603.8m	2,467.6m	2,907.2m
Confidence level	VaR(95.0%)	VaR(99.0%)	VaR(99.5%)
Pricing risk	1,006.4m	1,900.6m	2,228.0m
Reserve risk	233.5m	413.2m	877.8m
Insurance risk	1,033.1m	1944.9m	2394.7m
Credit risk	481.8m	481.8m	481.8m
Operational Risk	463.9m	463.9m	463.9m
RBC ratio (%)	281.5%	182.9%	155.3%

The expected loss ratio for pricing risk is assumed to be 60%. A confidence level of 99% for VaR of insurance risk is suggested. Under the current solvency regime, 4,859.8m of available capital, 3,500m of required capital and 138.8% of solvency ratio are estimated. Capital requirements in current solvency regime are overestimated than new system. Capital requirements in new system are calculated more accurately than current.

V. CONCLUSIONS

The current Myanmar risk management system should be improved in many aspects. First of all, the Myanmar insurance industry needs to develop a reliable database which can be utilized for various purposes, including a regulatory risk management system. The Myanmar risk management system should ultimately be able to meet global standards. But considering the feasibility of the implementation, a step-by-step approach is recommended. As a first step, I suggest a low-level RBC system which can be implemented relatively easily. The feasibility of a new system in this research using data for a one specific insurance company was shown.

Preparing systems to satisfy the requirements of Pillar 2 and Pillar 3 of Solvency II as soon as possible is needed. There should be improved details of regulations, including incentives and penalties regarding risk management practices. Insurance companies need to improve their capabilities and framework of risk management in parallel.

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