A study of risk management and capital allocation in Korean Insurance Companies

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Abstract

The Korean life insurance industry has rapidly grown over the past decades. The CAGR (Compounded Annual Growth Rate) of asset from 1978 to 2008 is 22.8%. As the asset size increases very fast, risk management plays a vital role in the Korean life insurance industry. Before the financial crisis in 1998, the risk management system was very weak in Korea. It was because the government controlled and protected the life insurance companies. However, the financial crisis brought changes in risk management. 7 of 30 insurance companies were bankrupt in financial crisis. The survivors also suffered from the absence of risk management system. But the financial crisis fostered the ability to propagate in the wild. Korean insurance companies started to realize the risks and built up a risk management system with their experiences. With this effort, they quickly overcame the recent global financial crisis. But there is still room for improvement. Especially, they have not dealt with the risk allocation which is an essential part in risk management. In this paper, I will discuss the current risk management system and capital allocation in the Korean life insurance industry.

Thesis Supervisor: Stewart C. Myers

Title: Robert C. Merton Professor

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I would like to thank my company Samsung Life Insurance Company which gave me a chance to study in the MIT Sloan School of Management. In addition, they helped me choose my thesis topic and supported it with the meaningful data. I wish this thesis will help SLI upgrade the risk management level.

I'm truly thankful to my lovely two daughters, Yejin and Yelim. They gave me strength in the face of adversity. My parents always trust and help me even when I wander from the course. I can't express my gratitude enough for their selfless love.

Above all other considerations, I don't know how I can show my special thanks to my wife, Eunyoung for her love and support. Eunyoung's love melts my stress and her wisdom gives me an inspiration to get out of my troubles.
Eunyoung, Sarang Hapnida.

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1. Introduction

1.1 Background

Insurance companies can be defined as risk managing companies. When insurance companies develop their products, their main focus is on the probability that the accident the insurance company should cover will happen. For example, life insurance comes from the mortality rates. Health insurance comes from disease rates.

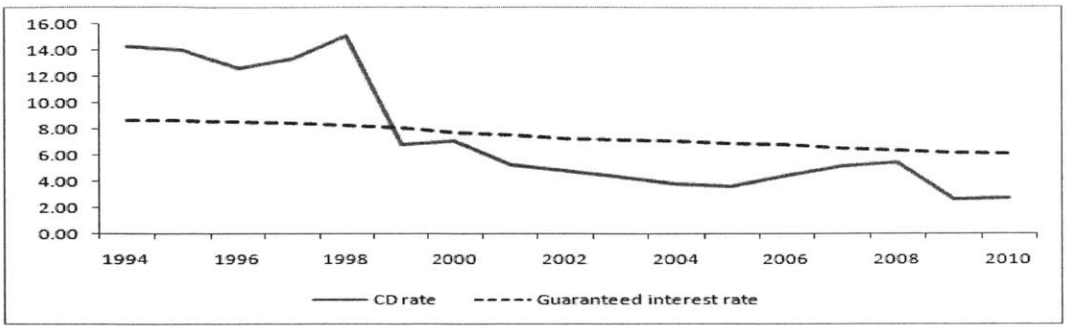
After selling the products, insurance companies should manage the premium, which the policy holder pays in advance. When the insured has the accident related with the risks which customer paid to protect, insurance company should compensate the policy holder for the accident. If the period of insurance is long compared with the premium period, the ALM (asset-liability management) creates additional risks.

For those reasons, the supervisory governance of capital management is very strict in every country. Moreover every individual insurance company also has its own risk management policy.

This is the same story with Korean life insurance companies. Before the financial crisis in 1998, their risk management system was very rudimentary. The lapse rate of insurance policies was too high and the high inflation obtunded the benefits that the life insurance company should compensate in the future. In addition, the government controlled and protected the life insurance companies.

But the financial crisis brought changes in Korean life insurance companies. For example, the money market rate had decreased a lot, although the life insurance company still guaranteed high interest rates.

[Graph 1.1: The trend of CD rates and average guaranteed interest rates in Korea]



※ Source: Korean Life Insurance Association

The interest-rate risk between assets and liabilities is the one of main risks that Korean life insurance companies have overcome over the past decade. Risk management has become the critical factor for survival in Korea. Korean life insurance companies have abandoned the growth of new contracts and focused on the risk management in the past ten years.

1.2 Objectives of the thesis

Risk management in Korean life industry only dates back to ten years ago. Korean life industry has gone through so many ups and downs within these ten years. With this experience, they have built advanced risk management systems. But the current asset portfolios of insurance companies are more complicated and diversified. They also contain financial products embedded with derivatives, which don't need any capital requirement, although it is very hard to measure the risk of derivatives. Moreover, as improvement in health and welfare increases life expectancy, the disease rates risk, which was not a critical in the past, has become important.

The purpose of this paper is to analyze the past decade's experience, examine the current risks Korean life insurance companies have, and draw improvements for those risks.

In addition, I want to focus on the capital allocation strategy, which Korean life insurance companies have not built up, although it is a very important risk management area. Korean life insurance companies have only focused on measuring the integrated risk of a company as a whole and have been indifferent to capital allocation.

But without capital allocation, they cannot evaluate the risk adjusted performance of each business unit and also cannot set the appropriate the price of products, which means that it is impossible to do an elaborate profit management and risk management. If Korean life insurance companies build up an effective capital allocation strategy, they can upgrade the risk management level.

1.3 Structure of thesis

This thesis comprises 7 chapters. Chapter 1 begins with background, objectives of thesis, and the structure of thesis. Chapter 2 provides a broad look of Korean life insurance industry. This industry level analysis will help diagnose Korean life insurance industry. This chapter will also discuss why Korean life insurance companies have specific risks and how they have overcome the risks. Chapter 3 defines risk management and shows the current risk management level of Korea. In chapter 4, I suggest the risk management strategy for Korean life insurance companies, focusing on risk measurement and control. I narrow down the topic to discuss capital allocation in chapter 5. In detail, I will discuss the importance of capital allocation and the capital allocation method. In chapter 6, I suggest the effective capital allocation strategy for Korean life insurance companies. First, I simulate the capital allocation with various methods to find the best way. Second, I recommend the marginal default method as the optimal method. I will summarize my recommendations for risk management of Korean life insurance companies in chapter 7.

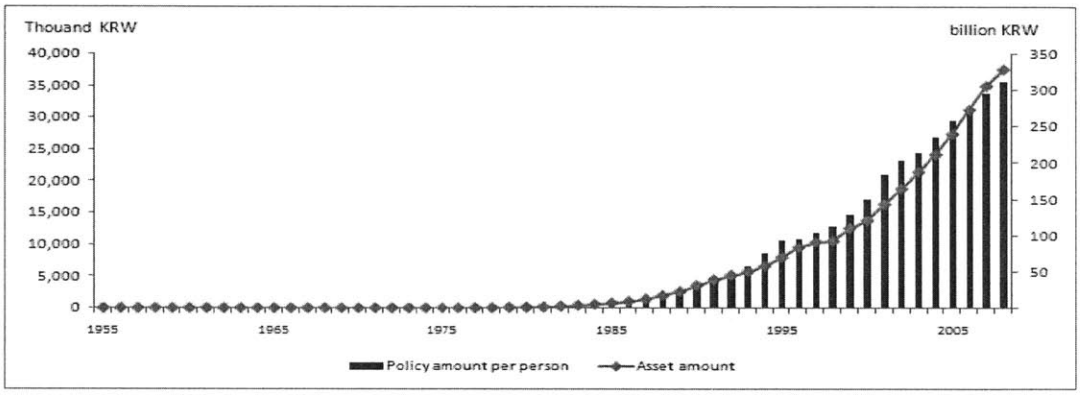
2. Overview of Life Insurance Industry in Korea

2.1 History of Life Insurance Industry in Korea

(See appendix1: History of Korean life insurance industry)

The Korean life insurance industry has rapidly grown over the past decades. The asset size has grown from 355 billion KRW in 1978 to 328,332 billion KRW in 2008. The policy amount per person has grown from 119,000 KRW to 35,734,000 KRW.

[Graph 2.1: The trend of asset size and policy amount per person]



※ Source: Korean Life Insurance Association

According to the "the Sigma No (Feb, 2010)" issued by Swiss Re. Korean life insurance is ranked 8th in 2009.

[Table 2.1: The Total premium and premium per person]

Ranking	Country	Insurance Premium (USD)	Market share of premium(%)	Premium/GDP(%)	Premium per person(USD)
1	U S	492,345	21.1	3.5	1,603
2	Japan	399,100	17.1	7.8	3,139
3	U K	217,681	9.3	10.0	3,528
4	France	194,077	8.3	7.2	2,980
5	Italy	115,290	4.9	5.3	1,878
6	Germany	111,775	4.8	3.3	72
7	China	109,175	4.7	2.3	81
8	**Korea**	**57,436**	**2.5**	**6.5**	**1,181**
9	India	57,144	2.5	4.6	48
10	Taiwan	52,204	2.2	13.8	2,257

※ Source: the Sigma No (Feb, 2010)

The above table also shows that the potential of growth is not so huge in the premium to GDP ratio. As you see the below table2.2, the insurance penetration rate per household also has increased from 24.1 % in 1976 to 87.5% in 2009.

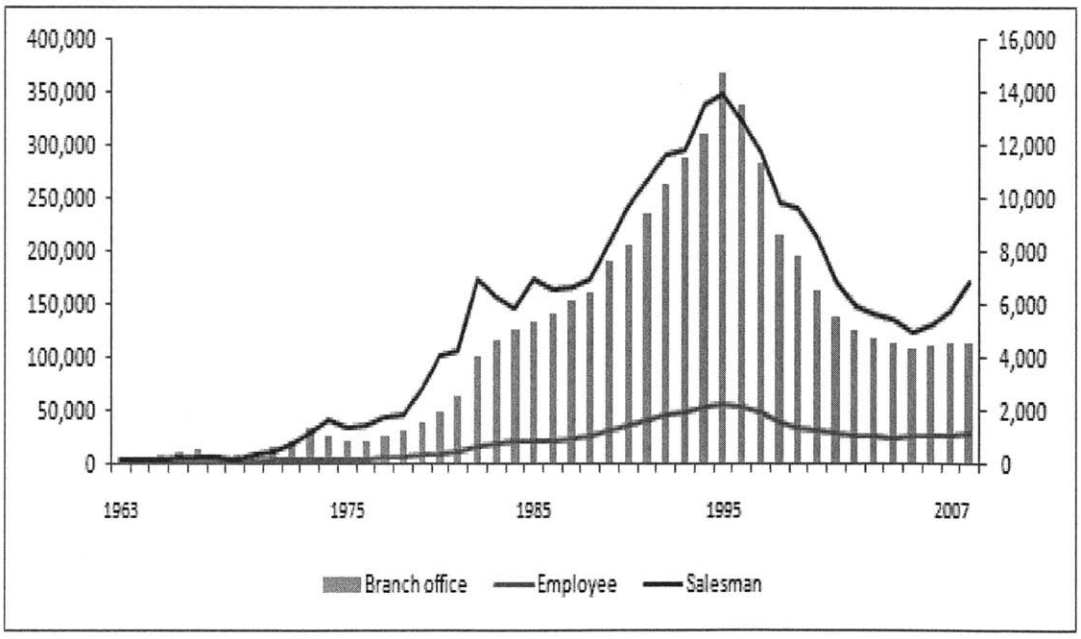
[Table 2.2: The Penetration rate of life insurance per household]

year	1976	1979	1982	1985	1988	1991	1994	1997	2000	2003	2006	2009
peneration rate(%)	24.1	26.9	27.5	34.5	36.4	36.4	57.8	73.7	86.2	89.9	89.2	87.5

※ Source: Insurance Fact Book (2010)

Although Korean life insurance industry has grown dramatically over the past decades in asset size, life insurance companies have downsized the employees, solicitors, and branch offices. After the financial crisis in 1998, Korean life insurance companies have focused on the efficiency of the management. The below graph shows that Korean life insurance companies have struggled to survive since the financial crisis in 1998.

[Graph 2.2: The numbers of branch office, employee, and salesmen]



※ Source: Korean Life Insurance Association

2.2 Main Products

2.2.1. Categories by coverage

The main categories of life insurance are life insurance, health insurance, accident insurance, annuity, saving, and group insurance. The distinct characteristic of Korean life insurance product compared to other countries is coverage of other areas such as annuity and health. This characteristic comes from the change of regulation and risk management.

[Table 2.3: The main product types]

(2007)

Product Type			New contract premium	Sales in force
Protection	Life	Whole life	25.5%	12.9%
		Term life	0.5%	0.3%
	health	Critical illness	16.5%	8.0%
		Cancer	6.5%	9.5%
		Children	4.5%	5.5%
	accident		1.0%	2.0%
Annuity	Variable annuity		12.0%	2.5%
	Fixed annuity		1.0%	25.5%
	Interest sensitive annuity		15.0%	15.5%
Saving	Interest Sensitive		6.0%	10.5%
	Variable		8.5%	3.0%
Endowment			1.0%	2.5%
Group protection			2.0%	2.3%

※ Source: Korean Life Insurance Association

2.2.1.1 Life insurance products

Life insurance products have become the main product since 2000. Although life insurance companies had to offer life insurance products, Korean life insurance companies did not concentrate on life insurance products before 2000. It is because of the negative perception for death insurance in Korean culture and the low insurance premium and surrender value. However, as life expectancy increases, the profit margin of life insurance increases. In addition, there is low interest risk because of the low surrender charges. For those reasons, Korean life insurance companies are now focusing on life insurance products.

2.2.1.2 Health insurance and accident products

Korean life insurance companies buckled down to this market after the government permitted the third party in 1998. Third party means the insurance products which the life insurance companies and indemnity companies cover together. Because Korean people had great interest in health, these products became the main products as soon as they were launched. But as the rates of diseases covered by insurance companies increased, the profit decreased and potential loss risk increased. For those reasons, insurance companies are trying to reduce coverage and are changing from fixed benefits to renewable benefits.

2.2.1.3 Annuity

As life expectancy increases and aging population becomes an issue, the demands for annuity contracts increase. The annuity products have been the main products of Korean life insurance companies since 1980's. Therefore the portion of sales-in-force premium and reserve is the highest among products. Korean life insurance companies mainly had sold the

fixed interest rate over 7.5% from 1980's to 1990's, which has brought the negative spread between asset and liability since 2000. The Korean life insurance companies have stopped selling the fixed products and developed the variable annuity and interest sensitive products. With these efforts, Korean life insurance companies expect that the negative spread will change to positive in 2015.

2.2.1.4 Saving insurance

The main advantages of saving products is the tax saving. If the policy holder keeps the insurance policy over 10 years, the policy holder doesn't need to pay tax for the interest income in Korea.

[Table 2.4: The history of minimum holding period for tax exempt]

~1994	1994~1996	1996~1998	1998~2000	2001~2003	2004~
3 year	5 year	7 year	5year	7year	10year

※ Source: the department of Korean tax service

2.2.2. Risk management in Product Development

Although some of risks in life insurance industry were already embedded in the beginning of product development, Korean life insurance companies did not perceive the risks before it happened. To resolve this matter, they have set up the detailed product development process since 2000. In detail, they made the product development guide line considering interest risk and mortality risk. In addition, they organized the risk management committee to control the risk of products. With these efforts, they could reduce the risk of product development.

2.3 Major Companies

As you see in table 2.5, the big three life insurance companies have covered over 50% of market share for the past decades. Although the influence of the big three has become weak because they have not focused on growth but risk management for the past decade, they have still a significant power on insurance market. Among the big three, Samsung Life Insurance Company (SLI) is undoubtedly the number one life insurance company in terms of asset size, profitability, and number of customers. Accordingly, if you understand SLI, you can understand Korean life insurance industry. I will use the example of SLI for risk management and capital allocation.

[Table 2.5: The insurance premium of Korean life insurance companies]

(2010, million KRW)

Companies	Premium	%
Samsung	**14,514,662**	**27.2%**
Kyobo	6,677,854	12.5%
Korea life	6,544,759	12.3%
Big 3	**27,737,275**	**52.0%**
Other 11 domestic companies	14,859,130	27.8%
8 foreign companies	10,762,661	20.2%
Total	53,359,066	100.0%

※ Source: Korean Life Insurance Association

3. Risk management in Korean Life Insurance industry

3.1 Financial risk management

Before analyzing the current risk management level of Korea, I will elaborate on what risk management is in detail, which will help me examine the current risks in detail and draw improvements for those risks.

3.1.1 Risk management process

Financial risk management is the process of identifying, measuring, and managing financial risks. In a typical company, the role of risk management is to identify and evaluate the risks faced by the firm, to communicate these risks to senior management, and to monitor and manage these risks in a way that ensures the firm bears only the risks its management and board want exposure to. It helps companies to minimize the risks and maximize the profits at the same time. For example, risk manager can eliminate the possibility of financial distress and tax risks, avoid costly or untimely debt financing by managing risk. The risk management process can be explained in detail as followings.

3.1.2 Identifying the risks

We can see many types of risks in the real world and also define risks in various ways. When it comes to corporate risk, risk can be defined as the unexpected decline of an asset price or the loss of earnings which could be divided between business risk and financial risk.

A. Business risks

Business risks include all the risks that happen in real business, such as daily business operations, decision making, and business environment changes, including macroeconomic risks.

B. Financial risks

This kind of risks is the result of a firm's financial activities, including volatilities of interest rate and exchange rate, defaults on loans, and changes in credit ratings. Financial risks can be attributed into the following major categories: market risk, liquidity risk, credit risk as well as operational risk.

- **Market risk:** Market risk is the risk of the decline of financial prices that will result in loss, which could be divided further as absolute risk and relative risk. Absolute risk focuses on the volatility of market returns and relative risk means the relative measurement of risk by a benchmark or portfolio.

- **Liquidity risk:** Liquidity risk rises from the inability to liquidate the asset or position at a fair market price, including funding liquidity risk and asset liquidity risk. Funding liquidity risk (cash flow risk) is that the financial institutions cannot raise the cash in order to roll over their debt, to fulfill the cash or margin or to meet capital withdrawals. Asset liquidity risk (market liquidity risk) indicates that a large sale of position will depress market price. However, we could establish the limits of a position to manage the asset liquidity risk.

- **Credit risk:** Credit risk means the size or value of loss that can be realized when a credit default happens.

- **Operational risk:** Operation risk is the loss due to the inadequate monitoring systems, management failure, fraud, or human errors. This risk is interrelated to other risks such as market risks and credit risks, because operational failure can increase market and credit risk. Model risks happen due to misapplied models and legal risks associate legal issues such as lawsuits, fines, and penalties also can be included in operational risk.

3.1.3 Measurement of Risk

There are various ways to measure the risks in accordance with the types of risks. We can measure the credit risks with help from external rating agencies. The cumulative loss limit of the company can be considered as the risk amount and measurement; in this case we can use the stop-loss limit that can limit the amount of loss by terminating the position once the cumulative loss limit is exceeded. We can also use the notional limit which establishes the limits on the notional amount invested. This method is easy to understand but cannot explain the real risk well. For example, the two bonds which have different risk levels could have the same amount of notional limit. In addition, this method is unable to sum up risks across different assets. We can also use exposure limits such as duration in interest rate, beta in equity market, and delta in options. With these measures, the exposure of an asset to the risk factors can be identified, but the volatility of the risk factors and the correlations among the risk factors cannot be identified. Besides, this approach is very hard to elaborate and cannot sum up multiple assets.

Risk measurement using VAR

As you see above, there are various ways to measure risk. But many of them cannot explain the total risk exposure across assets well. Usually we estimate the amount of financial risk with the mean-variance approach. In other words, we calculate the return distribution of

the portfolio and the variance of this portfolio, and measure risk with the variance of return. This is the basic concept of value at risk (VAR). It can catch exposure to risk factors and explain variation and covariance among risk factors, which means that VAR can compare different assets with various risk factors. Generally, VAR is considered as a probabilistic measure of the range of values a firm's portfolio that could lose given the market volatility, including changes in interest rates, exchange rates as well as other general market risks. In other words, the VAR is the maximum loss in a given normal market condition where has a defined period of time and a stated confidence level. It estimates the loss in the tail of the return distribution (normal distribution) which is used by many financial institutions as a statistical risk measuring method. A typical reporting of VAR would be: "There is a 1% chance the bank will lose more than $2 million over the next trading week".

A variety of methods could be employed to calculate VAR. Therefore, firms with different calculating approaches can reach different VAR for the same asset or business. Meanwhile, it is very important to keep in mind that the method of computation and the statistical significance of the result described in VAR. Three major ways of measuring VAR, such as portfolio approach, historical simulation, and Monte Carlo simulation, would be elaborated as below. Each method is based on parameters derived from the historical price data in the portfolio and values the portfolio in the next period.

A. Portfolio approach: This approach calculates the mean and the variance of the entire portfolio given the variances of each asset in the portfolio by using historical data. It also assumes a normally distributed return. The value of the portfolio at the chosen probability level is VAR.

B. Historical simulation: This simulation uses actual historical data to anticipate the returns on risk factors, rather than using a normal distribution. It starts by gathering the

market data for each of the assets over historical period and estimating the percentage changes of price from day to day. After evaluating the portfolio with repeatable changes and subtracting the future portfolio value from current value, the amount that could be lost due to market risk if these conditions occurred again can be known. Then, we need to repeat the analysis for each trading day in the data period in the aim to build a distribution of possible outcomes for the portfolio. When it is finished, we need to rank all the possible outcomes in order with gain/loss and choose a confidence level for the prediction. The value at that percentile in the distribution tells us the VAR for that portfolio.

C. Monte Carlo simulation: Monte Carlo simulation is much more complicated and comprehensive than historical method, since it takes the potential for market shocks into consideration and employs mathematical models to predict future shocks. It is usually generated through some form of regression analysis, offering a model of risk factors that could change in the future. By providing current values and a distribution of random numbers, Monte Carlo simulation calculates a possible future risk factor. When this simulation is repeated many times (at least 10,000), a distribution of possible future values could be formed.

As discussed above, the portfolio approach is the least complex primarily because it makes some simplified assumptions such as normal distribution, which also enable it to be the fastest and easiest ways to calculate VAR. The historical simulation is more complicated since it uses exact trends in historical prices to enable the greater presence of shocks to the market. Assuming past data is a good predictor of future prices and only need to use a single sample path of prices to compute VAR. Although Monte Carlo simulation is the most complicated of all mentioned, but it is the most flexible one in application due to incorporate historical data with statistical constraints built by risk managers in a mathematical model.

VAR based on the normal market conditions cannot be used in the extremely left-tailed events such as Black Monday and Russian default crisis. In other words, VAR is not able to predict the magnitude of the losses beyond the limit and cannot identify the causes that can be lead to the huge losses. We need to conduct extreme stress scenario tests to make up the defects of VAR approach. The stress scenario test focuses on the infrequent but large scale events that occur in the left tail of the return distribution. It could estimate VAR at a large number of times, create a distribution of worst case scenario outcomes, and form the distribution to compute the worst case scenario for the scenario analysis.

3.1.4 Risk control

If we know the amount of risk, we should control the risk. There are various ways of controlling risk. But the basic concept is to maximize the profits and minimize the risks. In other words, if the risk is not endurable, we should find a way to reduce risk. For example, we can sell the risky assets; reallocate portfolios with the assets which have low correlations or use derivatives such as futures, options, and swaps in order to hedge the risks. If the amount of risk is too small, we can increase the risk exposure in order to maximize the profits.

When we evaluate the performance, we should consider the risk. Without risk evaluation we can not measure the fair performance. If we evaluate the return only, the individual business unit will only take more risks. If we evaluate the risk only, the individual business unit will take more risk free assets.

Therefore, we should implement RAPM (Risk-adjusted performance measurement) to control risk. The most popular index of RAPM is RAROC (Risk adjusted return on capital) and SVA (Shareholder's value added). The most important factor for RAPM is the risk capital allocation for individual business unit to calculate this index and set up RAPM. It is

because the performance is decided by the risk capital which is allocated by the company. I will discuss this topic in chapter 5 and 6 in detail.

3.2 The risk management in Korean life insurance companies

As I already mentioned, Korean life insurance companies have similar risk management systems. It is because they have the similar life insurance products and asset management systems. In addition, the risk management system was formed by the regulation by Korean government. Accordingly, I will analyze the risk management system focusing on the big three of Korean life insurance companies.

3.2.1 The concept of risk management in Korean life insurance industry

Based on the general definition of risk management, Korean life insurance companies also build the following key risk management factors.

[Table 3.1: The key factors of risk management in Korean life insurance companies]

Key Factor	Detail
1. Risk culture and controlling system	- The perception on risks of top management - The individual risk management organization - The written risk management rule - The timely reports of current states
2. Risk identification and measurement	- Identify risk type - Measure the individual risk and integrated risk
3. risk control	- The integrated risk management - The risk allocation by products, types, business units - Evaluation by RAPM - Stress test
4. Management the adequate capital	- Required capital(RBC) - Economic capital - Rating company(S&P, A.M. Best)

※ Source: Samsung Life insurance company

The remarkable thing in the above table is the emphasis on the risk culture. It took ten years to inculcate the concept of risk management in employees of Korean life insurance industry. Without the agreement with the employees, the Korean life insurance companies would have not overcome the crisis of last decades. The following shows the proceeds of building the risk management system in Korea.

A. The introduction period (1998~2001)

The companies built the basic risk management system after the financial crisis in 1998. In this period, they constructed a risk management committee and an individual risk management team. Moreover, they started to measure the interest risk, market risk, and credit risk using VAR.

B. The development period (2002-2005)

They set up the written rule on risk guide lines in product development process and strategic asset allocation. They also tried to set up the RAPM (Risk adjusted performance measurement), but failed to implement it. One of the main reasons was the failure in allocating the risk capital. I will discuss capital allocation in chapter 5 and 6 in detail.

C. The maturity period (2006-present)

They integrated the individual risks into a company level and also divided risk management team into asset risk management team and insurance risk management team. In addition, they started to control the non-financial risks such as imperfect sales risks in BSC (Balanced Score Card).

3.2.2 The major risks in Korean life insurance industry

3.2.2. 1 Interest rate risk

Interest rate risk means ALM (Asset Liability Management). Korean life insurance companies sold the fixed interest rate over 7.5% before the financial crisis in 1998. But as you see in graph1.1, the market interest rate has dropped sharply since 2000. For those reasons Korean life insurance companies were exposed to ALM risks. As you see table 3.2, the fixed reserve was 101 billion KRW whose average interest rate was 7.5% in 2001. Moreover, the duration gap between asset and liability was 9.8 (asset 2.7, liability 12.5).

[Table 3.2: The fixed reserve in 2001]

(2001 Year)	Portion(100 billion KRW)	%	average interest burden	Market interest rate	spread
Fixed reserves	101	75%	7.50%	5.40%	-2.10%

※ Source: Korean Life Insurance Association

The goal of financial institutions is to earn an adequate return on funds invested and maintain a comfortable surplus of assets beyond liabilities. The difference between the market value of assets and liabilities is economic surplus. Financial institutions should maintain this surplus positively. However this surplus can change with interest rates changes. For example, when interest rate becomes low, if the liability duration is higher than that of asset, the decreasing speed of asset market value will be higher than that of liability market value.

To solve the interest risk most Korean life insurance companies organized the individual risk management team and risk. The team leader is CRO (Chief Risk Management Officer), who controls the risk from the beginning of product development to end of claim. In addition, they set up risk management committees where the chairman is CEO. Based on this strong organization, they started to reduce the ALM risks from 2001. First, they focused on

the liability side. They stopped the fixed products and started to sell the ISP (interest sensitive products). The floating interest rate was the most competitive factor in ISP, but the floating interest rate was also very conservative. Second, they shifted the asset management strategy from the short term management to long term management. In other words, they tried to find the long term asset such as 10 year treasury bonds to match the insurance period of liability side. In addition, they reduced the growth assets such as stocks and increased the income assets such as bonds to meet the cash for costs and interest of liability.

With these efforts, they could reduce the ALM risks. First, the negative margin between asset and liability is expected to become positive in 2013.

[Table 3.3: Interest rate margin between asset and liability]

	2006	2007	2008	2009	2010
Margin	**-0.3**	**-0.34**	**-0.21**	**-0.29**	**-0.08**
Asset	6.38	6.17	6.24	6.08	6.01
Liability	6.68	6.51	6.45	6.37	6.09

※ Source: Korean Life Insurance Association

Second, the duration gap also improved.

[Table 3.4: The duration gap between asset and liability]

	2001	2008	2009	2010	2011(e)	2013(e)	2015(e)
Gap	**9.8**	**4.93**	**4.84**	**4.78**	**4.54**	**3.79**	**3.02**
Liability	12.46	9.65	9.24	9.08	8.84	8.09	7.32
Asset	2.65	4.72	4.4	4.3	4.3	4.3	4.3

※ Source: Korean Life Insurance Association

3.2.2.2 Insurance risk

The insurance risk means the mortality risks. In other words, this risks increase when the gap between the predicted disease/death rate and actual rates increases. Insurance risk is another main risk that Korean life insurance companies have experienced over the past

decade. As the life expectancy increases and the technology of diagnosing the disease increases, the actual rate of special disease such as cancer increases beyond the life insurance companies' expectation. The Korean life insurance companies changed mortality rate from the fixed rate to the floating rate, replace the non renewable benefits with renewable benefits. In addition, they examined the claims in detail, and tried to find the insurance fraud. With these efforts, they could sustain the safe mortality margin over 15%.

3.2.2.3 Market risk

The key point of market risk is to measure the amount of market risk using VAR and to maintain the amount within the risk tolerance. Korean life insurance companies have already set up the market risk measuring system in 1998 and have maintained the amount within the 1.5% of capital.

3.2.2.4 Credit risk

They set up the credit risk management system in 2000 and upgraded it in 2009. The have tried to maintain the amount of credit risks within the 0.6% of assets. The current issue in credit risks is to include the reinsurance and real estate.

3.2.2.5 Operation risk

The operations risks come from the inappropriate internal process, human error, system error, and external events. There is no standard risk management process in operational risk. But the Korean big three companies focus on imperfect sales risk by the agents and try to educate the importance the imperfect sales and monitor the sales process.

3.2.2.6 Other potential risks

The one of current main issues is the option risk about variable insurance. The Korean life insurance companies have shifted the fixed interest annuity to variable annuity to evade the interest risk. And they added the GMAB (Guaranteed minimum annuity benefits) to the variable annuity to guarantee the minimum annuity payment. When they simulated with the past risks such as Korean financial crisis in 1998 and the global financial crisis in 2009, there was no GMAB option risk of a huge loss. But they are trying to hedge the risk in more stress situation using catastrophe hedging and reinsurance.

3.2.3 The risk measurement in Korean life insurance industry

Korean life insurance companies have measured the risk amounts individually and overall. In calculating the risk amounts, they have followed the regulation of Korean RBC based on the VAR method. (See Appendix 2: Comparison of regulations among Korea, US, and EU)

The big three already have met the required capital of regulation and rating companies. In other words, they have already controlled the individual risks and also maintained the integrated risk capital over 250% to meet the regulation and A+ level in rating. But they have not set up the internal economic capital allocation in detail.

3.2.4 The risk control in Korean life insurance industry

As I mentioned above, Korean life insurance companies deferred the adoption of RAPM, and use SAA guide line, individual risk amount guide line, and individual ROE to control the risk of individual business line.

4. Recommendation on risk management

As I discussed in the above, the Korean life insurance companies have already installed the basic risk management system. Especially they have already built up the advanced risk management organization and the employees also understand the importance of risk management. However, there is still a lot of room for improvement in detail.

4.1 Risk identification and measurement

Korean life insurance companies already have identified and measured all the risks which I mentioned above. But some of them are not matched with the RBC regulation, which will become effect in 2012. They should make up for the following weak points to meet the RBC regulations.

[Table 4.1: The recommendation for risk identification and measurement]

Risk Types	Recommendation
Interest rate risk	- Include separate accounts such as pension account
Insurance risk	- Elaborate the risk multiples by coverages - Simulate the future increase of claims reflecting current rates
Credit Risk	- Include the real estate and reinsurance
Market Risk	- Include the new financial products such as FX, derivatves, and guaranteed option
Operation Risk	- Develop the nonquantative method such as BSC, KPI

4.2 Build up the integrated risk management system

First, Korean Life Insurance companies should follow the requirement of the integrated risk capital of Korean RBC. The Korean Life Insurance Authority simulated the minimum capital to avoid the bankruptcy using the past data and created the following standards. This is the minimum risk capital they should keep.

※ Integration risk formula of Korean RBC regulation

$$\sqrt{insurance\ risk^2 + (interest\ risk + credit\ risk)^2 + market\ risk^2} + \text{Operation risk}$$

Second, Korean life insurance companies should set up the target level for economic capital of internal policy and also measure the risk amount by the credit rating companies such as A.M. Best. For example the minimum requirement by RBC method in regulation is 150% of RBC and A+ requirement by credit rating companies is over 250%. After set up the target capital level, they should keep the companies' capital more than target level.

Third, they should set up the target amount for the individual risks. By monitoring and measuring the risks amount of integrated level and individual level, they can keep the companies' capital more than target level.

4.3 Risk control

Korean life insurance companies have installed risk management system in risk identification and measurement. But there are a lot of rooms to improve in control. It is because they did not apply the capital allocation methodology.

I will discuss it in chapter 5 and 6.

5. Studies on capital allocation

5.1 The importance of capital allocation

The insurance company should carry enough capital to reduce the default risk to a minimum level. Consequently the integrated risk capital management and control was one of the first priorities in Korean insurance market. The amount of integrated risk capital comes from the risk of individual business units. In other words, the riskier business requires more capital than safer ones. If we know the capital requirements of each individual business units and have enough capital, we can allocate the risk capital back to business. But the capital is costly[1]. Accordingly, we should evaluate the performance of individual business and set the compensation[2]. Another reason that capital allocation is important is that we can decide the price of products by capital allocation, meaning that the more the product requires capital, the higher the break-even price.

5.2 Implementing RAPM in Korean life insurance companies.

The risk allocation is very important in evaluating performance. If individual business unit takes more risk to perform a high return, we should consider the risk when we evaluate the performance of business unit. We define this method as RAPM. The most popular index of RAPM is RAROC[3] (Risk adjusted return on capital) and SVA[4] (Shareholder's value added). In implementing RAPM, the key factor is calculation of risk capital of each individual asset. Accordingly, the Korean life insurance companies such as

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[1] The main reason of costly capital is limited capital which will force the company to pass up the positive NPV projects. Taxes, information asymmetry and agency problems are also the reasons why capital is costly.

[2] Revenue, ROA and ROE can not be the performance index for individual units, because the cost or risk of individual units is not included.

[3] RAROC = Risk adjusted return(Revenue-Cost-expected loss)/risk capital

[4] SVA= Risk adjusted return – risk capital*minimum required return

Samsung Life Insurance and Korea Life Insurance tried to calculate the risk capital of individual business unit with various methods in early 2000's as part of an effort to develop the risk management system. Unfortunately they didn't succeed, because they did not find the optimal method of capital allocation. They initially tried to charge capital proportional to the asset or VARs of the individual business unit. But this way did not reflect the risk of the individual business unit. They also tried to adopt the contribution VAR method, which depends on the covariance or beta of individual business units' returns and returns for the company as a whole. But this method was also criticized, because the optimal marginal allocations are proportional to that covariance. Moreover contribution VARs only work in a mean-variance setting.

Consequently they deferred the adoption of capital allocation and concentrated their attention on the integrated risk measurement and control. In terms of evaluation and compensation of the individual business unit, they compared the performance of the individual business unit to the market index, which was always arguable because they were not able to compare the market risk and the risk of individual business unit.

5.3 The capital allocation method

5.3.1 Capital allocation proportional to the asset

According to this method, the life insurance companies just allocate their capital to the individual business unit proportional to asset size. Before financial crisis in 1998, Korean life insurance companies adopted this method to evaluate the individual companies. Because risk management was not important in those days, they just set the target ROE of individual business unit after considering the average market return. This method is too simple and naïve, but it was acceptable because return was the most important consideration in those days.

5.3.2 Capital allocation using VAR

Although there are many papers on risk allocation method, most of them focused on the approach using VAR. The VAR and risk management are closely bound up each other. Accordingly there are a lot of approaches on capital allocation using VAR. I will show the typical approaches using VAR.

5.3.2.1 Capital allocation proportional to the stand-alone VAR

According to this method, the life insurance companies just allocate their capital to the individual business unit proportional to VAR. This method can be adopted in the companies which have only one business unit because the risk amount of whole company is same with that of the business unit. But this method can not be adopted in the companies which have multiple business units. Because of diversification, the VARs for the whole company are less than the sum of VARs of the individual business units. We can not divide the diversification effects into the individual business units. Furthermore, Merton and Perold insisted that the financial institution should not even attempt a complete allocation of capital[5].

5.3.2.2 Capital allocation using contribution VAR[6]

This method solved one weakness of proportional to the VAR approach. Contribution VAR for individual business is the amount of risk a particular business unit contributes to a company as a whole. It is generally less than the VAR of the individual business unit (i.e. stand alone VAR) because of the diversification effects. The contribution VAR comes from marginal VAR. Marginal VAR applies to each individual business unit in a

[5] Merton and Perold (1993), p. 30.
[6] Philippe Jorion, Value at risk

whole company, and it is the per unit change in a company's VAR that occurs from an additional investment in the individual business unit. Mathematically speaking it is the partial derivative of the company VAR with the respect to the individual business unit. In a large portfolio with many positions, the contribution VAR is the marginal VAR multiplied by the dollar weight in the position.

5.3.3 Capital allocation using marginal default value[7]

According to this method, capital should be allocated in proportion to the marginal default value of each business unit, where marginal default value is the derivative of the value of the insurance companies' default put with respect to a change in the scale of the business. This method starts with the present value of the company's default put in order to allocate the existing capital to the individual business units. This method shows that capital allocation depends on the business unit's marginal contribution to default value, which is defined as the present value of the bank's default put option. The following is the detailed procedure.

A. Allocate the capital proportional to the business unit's asset value

B. Calculate the marginal default value of the individual business unit:

   The marginal default value differs because of A.

C. The difference of B will be offset by changing marginal capital allocation.

D. Cross subsidies are avoided if allocation is set so that the capital-adjusted marginal default values are the same for the all business units.

The most important implication of this method is that the capital allocation should not be based on small probability of failure with the assumption of normal distribution, VAR or normal VAR, but on the present value of losses when the company is bankrupt.

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[7]. Erel, Myers, Read (2010)

6. Effective capital allocation strategy

In this chapter, I discuss the example of capital allocations with the different methods such as capital allocation proportional to the asset, capital allocation proportional to the VAR, capital allocation using contribution VAR, and capital allocation using marginal default value. To find the best capital allocation method for Korean life insurance market, I chose Samsung Life Insurance Company (SLI) as the example of the capital allocation SLI represents Korean life insurance very well. SLI is the biggest life insurance company in Korea and also has a well developed risk management system. (See Appendix 3: Overview of Samsung Life Insurance Company)

I will briefly explain the implications in the example of Samsung Life Insurance before I present the results in detail.

a. Capital allocation proportional to the asset

This method is very easy to apply: just allocate the capital to the individual business unit proportional to asset size. But this method doesn't include the risk exposure of individual business units. In other words, although it easy very easy to adapt and understand, we can not introduce this methods when the individual business units have the different risk profiles.

b. Capital allocation proportional to stand alone VAR

Although this method considers the risks of individual business units, it just calculates the stand alone VAR of individual business units and allocates the capital to the individual business unit proportional to stand alone VAR. In other words, this method doesn't consider diversification and the risk contribution of the individual business unit to the total risk.

c. Capital allocation using contribution VAR

This method explains the amount of risk a particular business unit contributes to a company. But we need calculate the covariances or betas of individual units versus for the SLI as a whole. And this method only works in the assumption of normal or lognormal distribution. In addition, this method is based on the small probability of failure with the normal distribution.

d. Capital allocation using marginal default value.

This method can solve the weakness of the capital allocation using contribution VAR. In other words, this method is more reasonable for risk allocation because it is based on the present value of losses when the SLI is bankrupt. We can use the dollar based marginal default value as the expected loss in RAROC. Moreover we can extend this method to the any probability distribution. The powerful competitiveness of this method appears when the probability distribution is skewed or has fat tails because it can reflect the default risk in capital allocation very well.

In case of SLI, their historical distribution was similar with the normal distribution and the difference between the capital allocation using contribution VAR and marginal default value is not so large. But the change of capital allocation is still meaningful because the more risky individual asset has the more capital in this method.

[Table 6.1: The example of capital allocations with the different methods in SLI]

Business Unit	asset method	%	stand alone VAR	%	contribution VAR	%	marginal default value	%
MMF	273	2.76%	66	0.66%	55	0.55%	-2	-0.02%
Domestic Bonds	4,967	50.17%	3,694	37.32%	4,996	50.47%	5,004	50.55%
Foreign Bonds	834	8.42%	1,039	10.50%	221	2.24%	64	0.64%
Stocks	501	5.06%	1,645	16.62%	939	9.48%	1,051	10.62%
Loan Portfolio	2,803	28.32%	2,676	27.03%	3,151	31.83%	3,240	32.73%
Real estate	522	5.27%	780	7.88%	538	5.44%	542	5.48%
Total	**9,900**	**100.00%**	**9,900**	**100.00%**	**9,900**	**100.00%**	**9,900**	**100.00%**

6.1 Capital allocation test for Korean insurance companies

6.1.1 Basic Assumption

To find the best capital allocation method for Korean life insurance market, I have allocated the capital with the different methods, which I mentioned above. The following are the basic assumptions.

A. I chose Samsung Life Insurance Company (SLI) as the object of the capital allocation.

B. I modified the financial statement of SLI to adopt risk allocation as follows.

i. **I changed book value of the asset to market value** and assumed that there is no intangible value such as market power and future growth opportunities. The intangible value disappears if the company is bankrupt.

ii. The liability is the default-risk free value of debt. The default risk is captured on the asset side as a default put option (the present value of the company's default put over the next period). If SLI defaults, the default put value is the shortfall at the end of the period.

iii. The equity is integrated capital, which will be allocated (C = Asset – Liability)

[Table 6.2: The original marking to market balance sheet]

(2009.12.31, $ million)

Asset	105,033	100%	Liability	89,100	85%
- MMF	2,731	2.6%	- Policy reserve	85,510	81.4%
- Domestic Bond	49,670	47.3%	- Other liability	3,589	3.4%
- Foreign Bond	8,339	7.9%	**Equity**	**15,933**	**15.2%**
- Stock	5,010	4.8%	- Common Stock	100	0.1%
- Loan Portfolio	28,033	26.7%	- Additional Paid	94	0.1%
- Real estate	5,217	5.0%	- OCI	2,025	1.9%
- Others	6,033	5.7%	- Retained Earnings	13,715	13.1%

* Others: Prepaid Agency fee(90%)

iv. I excluded the other of the asset because most of them are the prepaid agency fee, which are not traded in the market[8].

[Table 6.3: The modified mark to market balance sheet]

(2009.12.31, $ million)

Asset	99,000	100%	Liability	89,100	90%
- MMF	2,731	2.8%	- Policy reserve	85,510	86.4%
- Domestic Bond	49,670	50.2%	- Other liability	3,589	3.6%
- Foreign Bond	8,339	8.4%	**Equity**	**9,900**	**10.0%**
- Stock	5,010	5.1%	- Common Stock	100	0.1%
- Loan Portfolio	28,033	28.3%	- Additional Paid	94	0.1%
- Real estate	5,217	5.3%	- OCI	2,025	2.0%
			- Retained Earnings	7,682	7.8%

* Excluded the asset of others because it is a prepaid expenses

C. I assumed that the probability distribution of returns is normal in order to compare each method with the same assumptions.

D. I used the historical returns from 2004 to 2009 to calculate the VAR and marginal default value. But I adjust the returns of stocks excluding the left skewed data of the recent financial crisis. (See Appendix4: Monthly return of the individual business lines)

6.1.2 Capital allocation proportional to the asset of individual business unit

I allocated the capital (equity) with the proportion of individual business unit.

[Table 6.4: The capital allocation proportional to the individual asset]

Business Unit	Asset amount($ million)	Proportion	Capital Allocation	Proportion
MMF	2,731	2.76%	273	2.76%
Domestic Bonds	49,670	50.17%	4,967	50.17%
Foreign Bonds	8,339	8.42%	834	8.42%
Stocks	5,010	5.06%	501	5.06%
Loan Portfolio	28,033	28.32%	2,803	28.32%
Real estate	5,217	5.27%	522	5.27%
Total	**99,000**	**100.00%**	**9,900**	**100.00%**

[8] When the agency sells the insurance policy, insurance company pays the fee in advance and recognizes it as an asset. When policy holder pays the premium, this fee is changed into expense.

6.1.3 Capital allocation proportional to the stand alone VARs

I calculated the 95% probability of stand alone VARs of individual business unit and allocate the capital proportional to the stand alone VAR of individual business unit. The sum of total VAR is $27,917 million. It is bigger than the company VAR of $18,313 million because diversification is ignored in stand alone VAR.

[Table 6.5: the capital allocation proportional to the VARs]

Business Unit	Asset amount	Z-level(95%)	Standard Deviation	Stand alone VAR	Proportion	Capital Allocation	Proportion
MMF	2,731	2.33	2.91%	185	0.7%	66	0.7%
Domestic Bonds	49,670	2.33	9.00%	10,418	37.3%	3,694	37.3%
Foreign Bonds	8,339	2.33	15.08%	2,930	10.5%	1,039	10.5%
Stocks	5,010	2.33	39.75%	4,639	16.6%	1,645	16.6%
Loan Portfolio	28,033	2.33	11.55%	7,545	27.0%	2,676	27.0%
Real estate	5,217	2.33	18.10%	2,200	7.9%	780	7.9%
Total	**99,000**	**2.33**	**7.94%**	**27,917 ※**	**100.0%**	**9,900**	**100.0%**

※ This is simple sum of stand alone VAR(Company VAR is 18,313 thanks to diversification)

6.1.4 Capital allocation using contribution VAR

Marginal VAR is the partial derivative of the company VAR with the respect to the individual business unit. In other words, it is the per unit change in a portfolio VAR that occurs from an additional investment in that position. Index the position by i and the overall portfolio by p. Contribution or marginal VARs are calculated as follows.

- Marginal VARi

$$= \frac{\partial \text{VARp}}{\partial(\text{Monetary investment in i})}$$

a. ∂VARp= Change in a portfolio VAR ($= Zc \times \partial\sigma_p \times$ Value of company)

b. Zc = Confidence Level

c. ∂(Monetaryinvestmentin i)

= Additional investment in i (=Value of company X Weight of i)

$$= Zc\frac{\partial\sigma_P}{\partial Wi}$$

$$= Zc\frac{cov(Ri,Rp)}{\partial\sigma_P}$$

(p= the company as a whole, i= individual business unit)

Using the capital asset pricing model (CAPM), a regression of the returns of a single asset i in a portfolio on the returns of the entire portfolio gives a beta (βi), which is a measure that includes the covariance of the single asset i's return with the total portfolio:

- $\beta i = \frac{cov(Ri,Rp)}{\sigma_p^2}$,

- $\text{Marginal VARi} = \frac{\text{VARp}}{\text{Portfolio Value}} X\ \beta i$

The Contribution VAR is the marginal VAR multiplied by the dollar weight in position i:

- CVARi

  $= MVARi \times Wi \times P$

  $= VARp \times \beta i \times Wi$

- VARp

  $= \sum_{i=1}^{N} CVARi = VAR \times \sum_{i=1}^{N} Wi \times \beta i,\ \sum_{i=1}^{N} Wi \times \beta i = 1$

Using the above definitions, I calculated the contribution VARs

[Table 6.6: The contribution VAR]

a. Weight

MMF	Domestic Bonds	Foreign Bonds	Stocks	Loan Portfolio	Real estate
2.76%	50.17%	8.42%	5.06%	28.32%	5.27%

b. Variance and Covariance of individual asset

	MMF	Domestic Bonds	Foreign Bonds	Stocks	Loan Portfolio	Real estate
MMF	0.00084402	0.00142332	0.00097341	0.00161222	0.00116515	0.00052503
Domestic Bonds	0.00142332	0.00810305	0.00030502	0.00680124	0.00579799	0.00425074
Foreign Bonds	0.00097341	0.00030502	0.02274658	0.01399055	- 0.00295936	- 0.00554472
Stocks	0.00161222	0.00680124	0.01399055	0.15797694	- 0.00107095	- 0.00982860
Loan Portfolio	0.00116515	0.00579799	- 0.00295936	- 0.00107095	0.01334313	0.01268988
Real estate	0.00052503	0.00425074	- 0.00554472	- 0.00982860	0.01268988	0.03275540

c. Variance and Standard deviation of company

portfolio variace	0.63%
Portfolio standard deviation	7.94%

d. Covariance between portfolio and individual asset

	MMF	Domestic Bonds	Foreign Bonds	Stocks	Loan Portfolio	Real estate
Covariance (A,i)	0.1259%	0.6340%	0.1674%	1.1808%	0.7085%	0.6502%

Stdev of i	2.905%	9.002%	15.082%	39.746%	11.551%	18.098%
Stdev of a	7.939%	7.939%	7.939%	7.939%	7.939%	7.939%
Correlation coefficient	0.54566320	0.88718529	0.13977207	0.37420323	0.77252843	0.45252183
Covariance (A,i)	0.1259%	0.6340%	0.1674%	1.1808%	0.7085%	0.6502%

e. Marginal VAR, Contribution VAR, and Capital allocation

Business Unit	Asset amount (①)	%	Marginal VAR(②)	Contribution VAR (①*②)	%	Capital allocation	%
MMF	2,731	2.76%	0.04	101	0.55%	55	0.55%
Domestic Bonds	49,670	50.17%	0.19	9,243	50.47%	4,996	50.47%
Foreign Bonds	8,339	8.42%	0.05	410	2.24%	221	2.24%
Stocks	5,010	5.06%	0.35	1,736	9.48%	939	9.48%
Loan Portfolio	28,033	28.32%	0.21	5,829	31.83%	3,151	31.83%
Real estate	5,217	5.27%	0.19	995	5.44%	538	5.44%
Total	**99,000**	**100.00%**	**0.18**	**18,313**	**100%**	**9,900**	**100%**

As you see the above table, the total VAR of SLI decreased from $27,917 million in stand alone VAR to $18,313 million in contribution VAR because of the diversification effect.

6.1.5 Capital allocation using marginal default value

I assumed that the probability distribution of returns is normal distribution as I mentioned in basic assumption and use the Black-Sholes model to calculate the marginal default values and capital allocation. The following set up follows Eril, Myers, and Reed (2010).

The default put value depends on D, A, and the volatility of A (σ_A);

- $P = f(D, A, \sigma_A)$, $D = (1-c) \times A$ $(c = C/A)$

The ratio of put option to asset value is the following function.

- $p = \frac{P}{A} = f((1-c), 1, \sigma_A) = f(c, \sigma_A)$.

The marginal default put value p for each asset [ai = Ai/A)] gives

- $p_i = \frac{\partial P}{\partial A_i} = p + \frac{\partial p}{\partial a_i}(1-a_i)$. , $\frac{\partial p}{\partial a_i} = \frac{\partial p}{\partial c}\frac{\partial c}{\partial a_i} + \frac{\partial p}{\partial \sigma_A}\frac{\partial \sigma_A}{\partial a_i}$.

- $\frac{\partial c}{\partial a_i} = \frac{c_i - c}{(1-a_i)}$ and $\frac{\partial \sigma_A}{\partial a_i} = \frac{\sigma_{iA} - \sigma_A^2}{\sigma_A(1-a_i)}$,

- $p_i = p + \frac{\partial p}{\partial c}\frac{(c_i - c)}{(1-a_i)} + \frac{\partial p}{\partial \sigma_A}\frac{(\sigma_{iA} - \sigma_A^2)}{\sigma_A}$,

  (σ_{iA} = the covariance of R_i and R_A)

Using Black-Sholes model:

- $p = (1-c)N\{x\} - N\{x - \sigma_A\}$,

  so $\frac{\partial p}{\partial c}(delta) = -N\{x\}$, $\frac{\partial p}{\partial \sigma_A}(vega) = N'\{x - \sigma_A\}$ where $x = \frac{\ln(1-c)}{\sigma_A} + \frac{\sigma_A}{2}$

In the above equation, the assets will have different marginal default values if the marginal capital allocations are the same. When capital is allocated to equal marginal default values, cross-subsidies are avoided. Accordingly pi is p to solve ci

$$- \quad c_i = c - \left(\frac{\partial p}{\partial c}\right)^{-1}\left[\frac{\partial p}{\partial \sigma_A}\frac{(\sigma_{iA} - \sigma_A^2)}{\sigma_A}\right].$$

Using the above equations, I calculated the following marginal default values and capital allocations.

A. Marginal Default Value

[Table 6.7: The marginal default value]

Asset Category	Amount	P/F	Standard Deviation	c	old capital allocation	Marginal default value(%)	Marginal default value($)
MMF	2,731	2.76%	2.9%	0.10	273	-0.673%	-18
Domestic Bonds	49,670	50.17%	9.0%	0.10	4,967	0.331%	164
Foreign Bonds	8,339	8.42%	15.1%	0.10	834	-0.591%	-49
Stocks	5,010	5.06%	39.7%	0.10	501	1.410%	71
Loan Portfolio	28,033	28.32%	11.6%	0.10	2,803	0.478%	134
Real estate	5,217	5.27%	18.1%	0.10	522	0.363%	19
Total	99,000	100.00%	7.94%	0.10	9,900	0.323%	320

The delta and Vega of the default put option are - 0.099 and 0.086 respectively. Put value is 0.323% ($320M). I assumed that the capital is allocated proportional to the size of asset category (individual business unit) and I calculated the above marginal default value. However the marginal default values add up are not the same. The negative marginal default value of MMF and Foreign bonds are offset by large positive value of Domestic bonds and loan portfolio. These two large positive asset categories would get a subsidy from other lines.

B. Capital Allocation

[Table 6.8: The Capital allocation using marginal default value]

Asset Category	ci	New Capital allocation	Captital adjusted contribution to default value
MMF	-0.001	-2	9
Domestic Bonds	0.101	5,004	161
Foreign Bonds	0.008	64	27
Stocks	0.210	1,051	16
Loan Portfolio	0.116	3,240	91
Real estate	0.104	542	17
Total	0.100	9,900	320

The capital allocation should be changed like the above table. As you see the above table, making each individual business unit's default value p*i*=0.323% gives different marginal capital allocations ci. This allocation deletes the cross subsidies. This allocation adds up exactly but it is not proportional to covariance of each individual business units. In other words, this allocation is not proportional to conditional VAR.

6.2 Effective capital allocation strategy for Korean life Insurance companies

As I showed in the above, there are various ways of capital allocation. However, when we consider the risk, the contribution VAR method or marginal default method could be the best solutions. The contribution VAR method solved the problem of allocating the diversification effects to the individual business units. In addition, VAR is the common language in risk management area. But this method works well in the assumption of normal distribution. In addition, it is based on the small probability of failure. For those reasons, Korean life insurance companies have failed to adopt the capital allocation. On the other hands, the marginal default method is based on the present value of losses, meaning that this

method is based on the whole default probability not the small probability of failure. In addition, we can adopt this method for any probability distributions, although calculating allocations will require numerical procedures in place of closed-form solutions such as the Black-Scholes model.

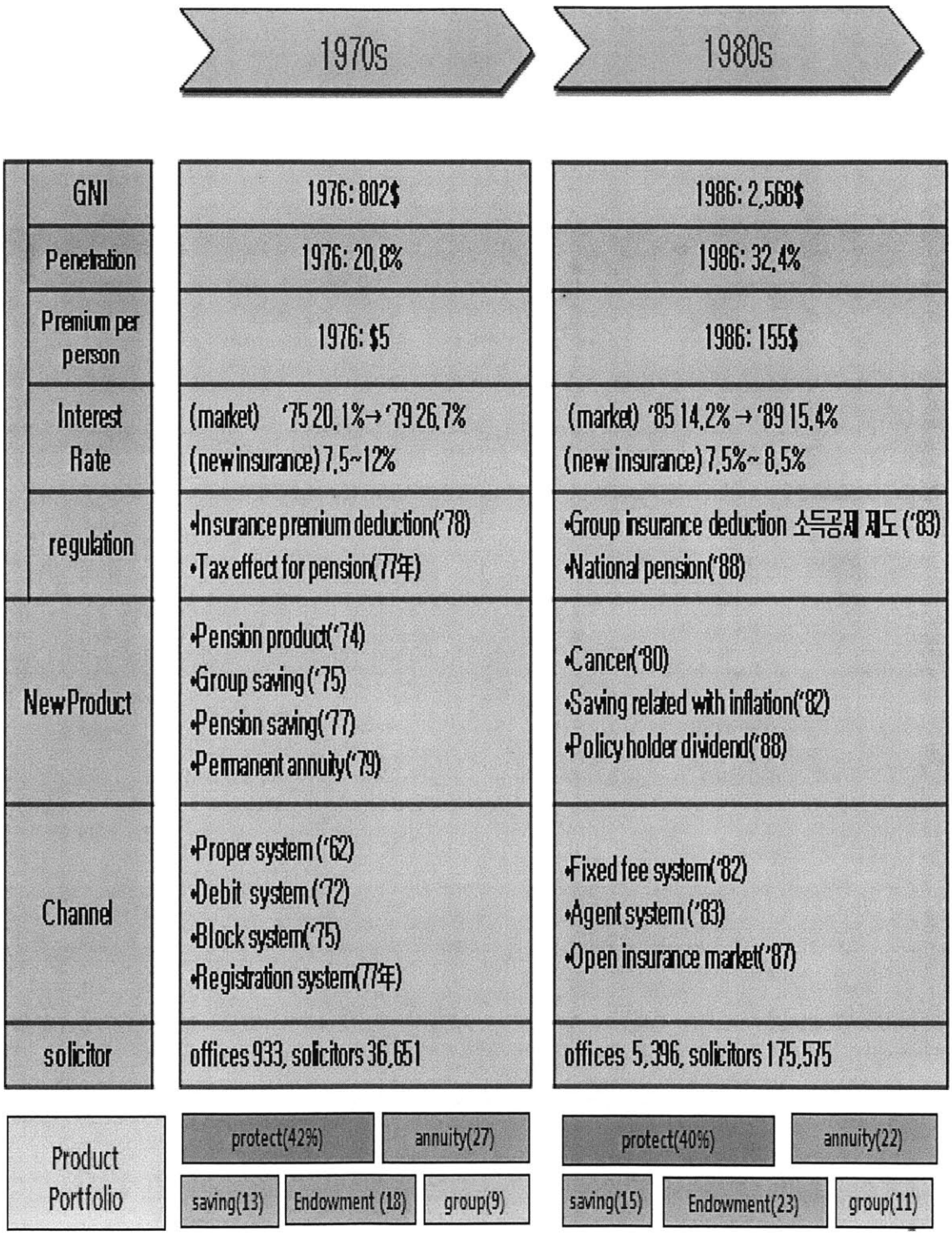
But the Korean insurance companies should make great efforts to adopt the marginal default method in Korean insurance industry. First they should define the individual business units more clearly. Some of business units share the assets or revenue in Korean insurance companies. If business units share the asset and revenue, we can not measure the risk and performance of the individual units. Second they should develop the measurement of the probability of return. The historical data which I used to test the capital allocation can not predict the future. Although it is very hard to predict the future, some of Korean insurance companies already have an excellent predicting the return to measure the company risk. They should develop this system. If they improve the above situations, the marginal default method will work very well in Korean life insurance market.

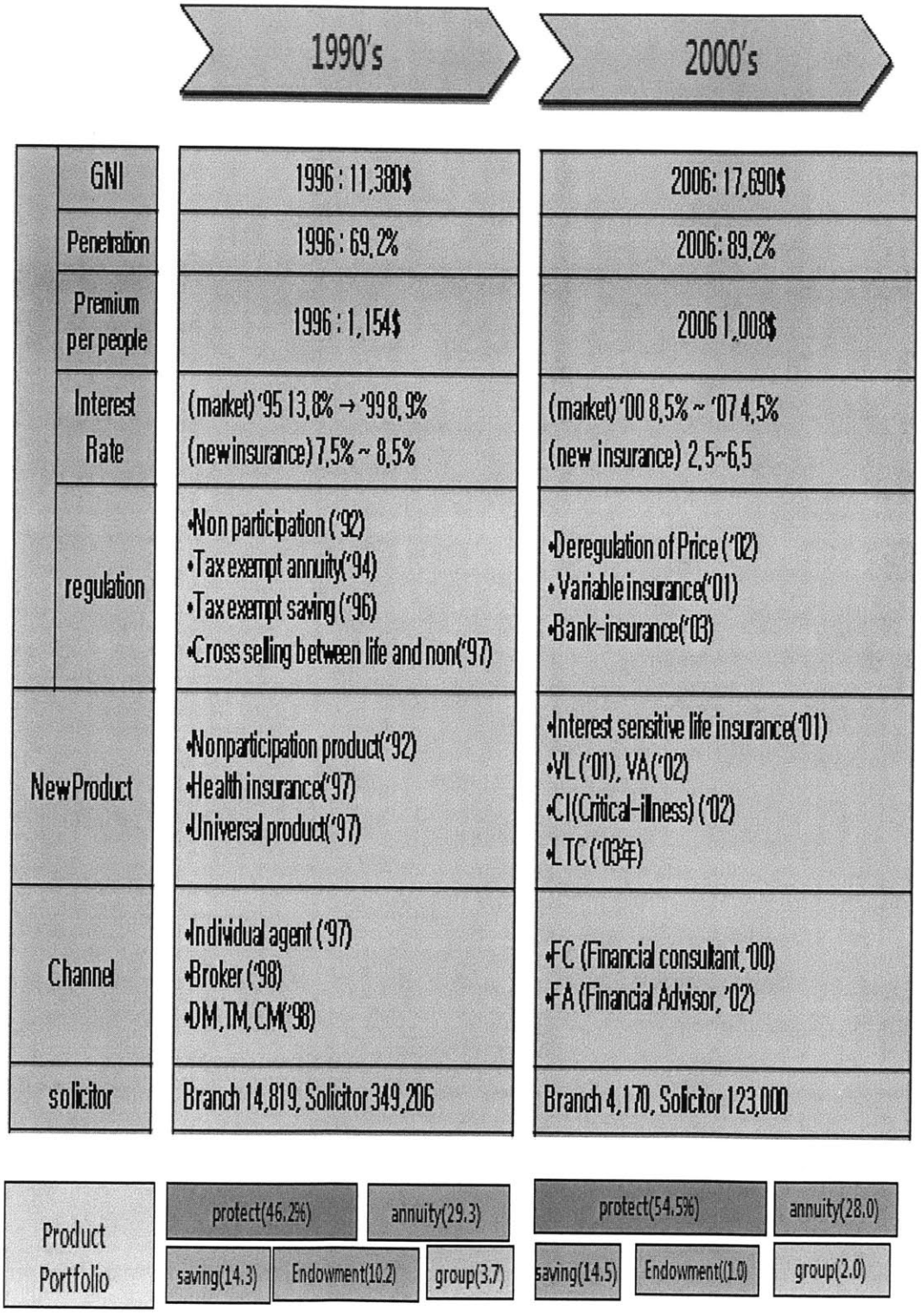
7. Conclusion

There are two objectives of this paper. First, I examined the current risk management system and suggest the best recommendation. In detail, I researched the current situation of risk identification, measurement, and controlling in risk management system and suggested the three recommendations in risk measurement, construction on the integrated risk management system, and risk control. Second, I researched capital allocation, which is the weakest point in risk management system in Koran life insurance companies, and suggested the effective capital allocation method. In other words, I focused on capital allocation among risk control issues. I analyzed the four capital allocation methods, including contribution VAR method and marginal default value method and simulated each method in a Korean life insurance company. Finally I suggest the marginal default value method. I strongly suggest that Korean life insurance companies should conduct the capital allocation to upgrade the risk management system.

When I worked for one of Korean Insurance companies, my main job was to make the internal financial statement of individual business units. In order to make it, the company should have very complicated methods in every area such as cost allocation of indirect cost, asset-liability matching, tax expenses allocation, and so one. Although we agreed with most of the arguable issues, but there was disagreement with the capital allocation. Accordingly, we cannot evaluate the performance of each business units and cannot set the appropriate the price of products, meaning that it is impossible to do an elaborate profit management and risk management. Now we have a good capital allocation method. Like the proverb that good workman does not quarrel with his tools, if the Korean insurance companies remedy the shortcomings and develop the method, as I already mentioned above, the risk management level will step further.

Appendix1. History of Korea life insurance industry




1990's
2000's
GNI
1996 : 11,380$
2006: 17,690$
Penetration
1996 : 69.2%
2006: 89.2%
Premium per people
1996 : 1,154$
2006 1,008$
Interest Rate
(market) '95 13.8% → '99 8.9%
(new insurance) 7.5% ~ 8.5%
(market) '00 8.5% ~ '07 4.5%
(new insurance) 2.5~6.5
regulation
•Non participation ('92)
•Tax exempt annuity('94)
•Tax exempt saving ('96)
•Cross selling between life and non('97)
•Deregulation of Price ('02)
•Variable insurance('01)
•Bank-insurance('03)
New Product
•Nonparticipation product('92)
•Health insurance('97)
•Universal product('97)
•Interest sensitive life insurance('01)
•VL ('01), VA ('02)
•CI(Critical-illness) ('02)
•LTC ('03年)
Channel
•Individual agent ('97)
•Broker ('98)
•DM, TM, CM('98)
•FC (Financial consultant, '00)
•FA (Financial Advisor, '02)
solicitor
Branch 14,819, Solicitor 349,206
Branch 4,170, Solicitor 123,000
Product Portfolio
protect(46.2%)
annuity(29.3)
saving(14.3)
Endowment(10.2)
group(3.7)
protect(54.5%)
annuity(28.0)
saving(14.5)
Endowment(1.0)
group(2.0)

Appendix2: Comparison of the regulations among Korea, US, and EU

A. Summary

	Korean RBC	US RBC	EU Solvency II
History	- Korean Solvency (1999~) - Korean RBC and Solvency (2009~2011) - Only Korean RBC (2012~)	- US RBC (1993~)	- Solvency I (1977~) - Solvency II (2012~)
Confidence level	95%	95%	99.50%
Calculation	Capital/RBC>100%	Capital/(RBC*0.5)>200%	Capital/required capital>100%
Immediate action	100%↓ Advise to increase the capital 50%↓ Require to increas the capital 0%↓ Order to increase the capital	200%↓ Self regulation 150%↓ implement regulation 100%↓ supervising level 70%↓ chapter 11	100%↓ require to increase capital
Capital(nominator)	(① - ② + ③) ① Contributed capital + Earned capital + Other comprehensive income ② Intangible asset ③ Excessive capital of subsidiaries	(① - ② + ③) ① Contributed capital + Earned capital + Other comprehensive income ② Intangible asset ③ Some asset of subsidiaries	(① - ② + ③) ① Contributed capital + Earned capital + Other comprehensive income ② Intangible asset ③ Some asset of subsidiaries
RBC or Required capital (Denominator)	Risk factors ① Interest risk ② Insurance risk ③ Credit risk ④ Market risk ⑤ Operation risk	Risk factors ① Interest risk ② Insurance risk ③ Asset risk ④ Operation risk ⑤ Related company risks	Risk factors ① Interest risk ② Insurance risk ③ Credit risk ④ Market risk ⑤ Operation risk

B. Calculation of each risk factors

	Korean RBC	US RBC	EU Solvency Ⅱ
Interest risk	- Calculation: (liability×duration-asset×duration) × 1.5% * Liability duration: The company data * Asset duration: Average of industry	- Calculation: Reserves × Multiples * Multiples: 1.15~4.62%	- Calculation: Best Case - Worst Case
Insurance risk	- Calculation: Multipled by products × mortality premium * Multiples: Savings 40.2%, Health 50.9% Death 14.8%, Accident 38.6%	- Calculation: Multipled by products × Policy amou * Multiples: 0.05~0.15%	- Calculation: Best Case - Worst Case
Credit risk	- Calculation: Asset amount × Multiples * Multiples: Security 8%, bond/loan 0.8%~6.0%, Real estate 6%, Reinsurance reserve × 0~6%	- Calculation(asset risk: Market + Credit): NAV × Multiples (Security 30%, bond/loan 0.4%~30%, Real estate 15%, Reinsurance account receivable × 0.5%	- Calculation: NAV × F(default rate, collection rate)
Market risk	- Calculation: Market securities multiples * Multiples: Security 12%, bond: duration × 1.7%, Guaranteed option: 2%	- Calculation(related company risk): Asset × Multiples (US 100%, (Non US Insurance 50%, Non US other 23%)	- Calculation: Market securities multiples * Multiples: Security 12%, bond: duration × 1.7%, Guaranteed option: 2%
Operation risk	- Calculation: Insurance premium × Multiples * Multiples: 1%	- Calculation: Insurance premium × Multiples * Multiples: life/annuity 2%, health/accident 0.5%	- Calculation: Min (financial risk, insurance premium × 3%)

C. Integrated Risk

- Koreas RBC:

$\sqrt{insurance\ risk^2 + (interest\ risk + credit\ risk)^2 + market\ risk^2}$ +operation risk

- US RBC

$\sqrt{insurance\ risk^2 + asset\ risk^2 + interest\ risk^2}$ + Operation risk + Related company risk

- EU Solvency Margin Ⅱ

: The sum of individual risk including diversification effect with covariance except operation risk + Operation risk

Appendix3. Overview of Samsung Life Insurance Company

▣ Business Size

Year	Assets (bil.$)	Revenue (bil.$)	**Net Income (mil.$)**	M/S (%)	Number of Sales Force	Number of Employees
FY2009	120	29.0	**1,056**	34.7	32,698	6,410
2008	102	28.6	**642**	34.6	33,190	6,300
2007	93	24.5	**995**	36.2	31,856	6,282
2006	85	23.3	**735**	37.6	36,617	6,304
2005	75	24.5	**992**	40.3	32,321	6,278

▣ Global Position : Ranked 18th in the world insurance

— ranked 229th among Fortune Global 500 companies

(US$ mil.)

Rank	Company	Global 500 Rank	Revenues	Rank	Company	Global 500 Rank	Revenues
1	ING Group	13	158,274	11	Legal & General Group	162	38,574
2	AXA	15	139,738	12	Old Mutual	173	36,646
3	Assicurazoni Generali	30	101,811	13	China Life Insurance	192	33,712
4	Aviva	50	83,487	14	Prudential Financial	199	32,488
5	Prudential	79	66,134	15	Sumimoto Life	202	32,320
6	Nippon Insurance	107	56,624	16	Manulife Financial	219	30,137
7	CNP Assurance	108	55,584	17	Meiji Yasuda Life	220	29,979
8	Met Life	113	53,275	**18**	**Samsung Life Insurance**	**229**	**28,639**
9	Aeqon	133	45,939	19	New York Life	235	28,385
10	Dai-ichi Mutual Life	157	40,146	20	Standard Life Assurance	236	28,240

Source From Fortune (July 12, 2008 issue)

[Appendix4. Monthly return of the individual business lines]

Weight	2.8%	50.2%	8.4%	5.1%	28.3%	5.3%	100.0%
Date	MMF	Domestic Bond	Foreign Bond	Stock	Loan Portfolio	Real estate	Company
2004-01-01	0.16%	0.39%	0.80%	2.35%	0.39%	-1.61%	0.41%
2004-02-01	0.17%	0.10%	1.22%	2.05%	0.10%	-1.48%	0.21%
2004-03-01	0.14%	0.68%	0.39%	-0.15%	0.68%	-1.75%	0.47%
2004-04-01	0.02%	0.21%	-2.17%	-1.00%	-0.93%	-0.30%	-0.41%
2004-05-01	0.01%	0.58%	-1.78%	-3.40%	-0.67%	-0.85%	-0.27%
2004-06-01	-0.01%	0.42%	1.52%	-1.10%	0.63%	1.10%	0.52%
2004-07-01	0.00%	0.37%	0.31%	-3.20%	1.13%	1.54%	0.45%
2004-08-01	0.20%	1.09%	1.02%	4.65%	1.84%	3.13%	1.53%
2004-09-01	0.17%	0.74%	-0.20%	1.95%	0.40%	0.75%	0.61%
2004-10-01	0.00%	0.24%	0.04%	0.00%	0.37%	1.13%	0.29%
2004-11-01	0.10%	0.40%	-0.35%	2.60%	0.03%	-0.20%	0.30%
2004-12-01	0.03%	0.35%	0.67%	1.00%	0.21%	1.26%	0.41%
2005-01-01	-0.08%	-1.00%	-0.90%	2.05%	0.37%	0.82%	-0.33%
2005-02-01	-0.12%	-1.36%	1.10%	4.20%	-1.36%	-2.93%	-0.92%
2005-03-01	0.04%	0.40%	-1.90%	-2.25%	0.40%	-1.73%	-0.05%
2005-04-01	0.03%	0.53%	0.51%	-2.80%	-0.63%	0.27%	0.00%
2005-05-01	0.01%	0.42%	0.43%	3.25%	-0.84%	-0.77%	0.14%
2005-06-01	0.00%	-0.16%	2.21%	1.95%	0.05%	0.08%	0.22%
2005-07-01	0.00%	-0.89%	-1.37%	5.10%	-0.13%	-0.50%	-0.37%
2005-08-01	0.01%	-0.60%	-0.12%	-1.25%	0.18%	0.66%	-0.29%
2005-09-01	-0.19%	-0.45%	-0.55%	6.35%	-0.78%	-0.99%	-0.23%
2005-10-01	-0.22%	-0.73%	-1.17%	-2.60%	-0.60%	-0.04%	-0.77%
2005-11-01	-0.03%	-0.78%	-0.19%	6.00%	-1.13%	-2.04%	-0.53%
2005-12-01	-0.08%	0.03%	1.06%	3.15%	-0.10%	1.07%	0.29%
2006-01-01	-0.11%	-0.03%	-0.74%	0.75%	1.34%	2.91%	0.49%
2006-02-01	-0.10%	0.44%	0.27%	-1.00%	0.45%	-1.04%	0.26%
2006-03-01	-0.02%	0.08%	-1.16%	-0.45%	0.08%	-2.48%	-0.19%
2006-04-01	-0.06%	0.16%	-1.24%	2.20%	-0.98%	-0.30%	-0.21%
2006-05-01	-0.03%	0.50%	-0.31%	-3.60%	-0.75%	-0.96%	-0.22%
2006-06-01	-0.11%	-0.31%	1.17%	-0.85%	-0.10%	-0.07%	-0.14%
2006-07-01	-0.15%	-0.03%	-0.54%	0.10%	0.73%	0.95%	0.20%
2006-08-01	-0.05%	0.21%	1.01%	2.10%	1.00%	2.06%	0.69%
2006-09-01	0.04%	0.21%	-0.16%	0.70%	-0.13%	-0.08%	0.09%
2006-10-01	0.07%	0.24%	-0.16%	-0.25%	0.37%	1.29%	0.27%
2006-11-01	-0.03%	-0.31%	0.58%	2.50%	-0.68%	-1.36%	-0.25%
2006-12-01	-0.15%	-0.34%	0.90%	0.10%	-0.47%	0.50%	-0.20%
2007-01-01	-0.15%	-0.37%	-5.50%	-2.60%	1.00%	2.31%	-0.38%
2007-02-01	-0.03%	0.10%	1.86%	2.10%	0.10%	-1.42%	0.27%
2007-03-01	0.01%	0.21%	0.43%	1.25%	0.21%	-2.27%	0.14%
2007-09-01	-0.12%	-0.39%	-0.16%	1.95%	-0.72%	-0.96%	-0.37%
2007-10-01	0.00%	-0.34%	-0.12%	3.05%	-0.21%	0.64%	-0.05%
2007-11-01	-0.09%	-0.47%	1.57%	-3.85%	-0.82%	-1.71%	-0.62%
2007-12-01	-0.28%	-1.46%	0.94%	-0.25%	-1.57%	-0.80%	-1.16%
2008-01-01	-0.08%	0.23%	-3.39%	-7.20%	4.22%	3.76%	0.86%
2008-02-01	0.50%	0.96%	0.00%	2.70%	0.52%	-0.67%	0.74%
2008-03-01	0.03%	0.36%	0.94%	-0.20%	0.37%	-2.45%	0.23%
2008-04-01	-0.12%	0.57%	-0.62%	3.55%	1.03%	0.18%	0.71%
2008-05-01	0.02%	-0.80%	-0.85%	0.75%	-0.81%	-3.03%	-0.82%
2008-06-01	0.00%	-1.18%	-0.81%	-4.80%	-1.62%	2.33%	-1.24%
2008-07-01	-0.15%	-0.79%	0.43%	-2.40%	-0.80%	0.11%	-0.71%
2008-08-01	-0.24%	-0.31%	0.35%	-3.90%	0.13%	1.84%	-0.19%
2008-09-01	-0.02%	-0.89%	0.78%	-0.90%	-0.90%	-1.73%	-0.77%
2008-10-01	-0.23%	-1.24%	-0.39%	-11.55%	-1.67%	-0.29%	-1.73%
2008-11-01	0.39%	-1.53%	1.17%	-1.65%	-1.53%	-1.69%	-1.27%
2008-12-01	0.90%	0.53%	4.33%	2.25%	0.97%	0.40%	1.07%
2009-01-01	1.41%	2.60%	-0.28%	1.65%	2.64%	3.33%	2.33%
2009-02-01	0.51%	0.69%	0.16%	-4.25%	0.26%	-1.09%	0.18%
2009-03-01	0.24%	2.43%	0.04%	6.75%	0.21%	0.00%	1.66%
2009-04-01	0.03%	1.20%	0.20%	6.75%	0.05%	1.12%	1.04%
2009-05-01	0.01%	1.37%	0.08%	0.95%	0.10%	0.37%	0.79%
2009-06-01	0.00%	-0.13%	0.04%	-0.20%	0.08%	0.00%	-0.05%
2009-07-01	0.00%	-0.65%	0.04%	6.00%	0.10%	0.00%	0.01%
2009-08-01	-0.07%	-0.73%	0.00%	1.10%	0.05%	1.14%	-0.24%
2009-09-01	-0.16%	0.42%	-0.08%	2.55%	0.08%	0.00%	0.35%
2009-10-01	-0.15%	-0.05%	0.00%	-2.75%	0.08%	1.15%	-0.09%

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