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The Implications of Solvency II to Insurance Companies

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THE IMPLICATIONS OF SOLVENCY II TO INSURANCE COMPANIES

by

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ABSTRACT

Solvency II is a new regulatory standard for European insurance companies. It aims to establish a revised set of capital requirements and risk management standards that will replace the current solvency requirements within the European Union market and will take effect in 2014. The directive will impact companies located in countries beyond the European Union.

Compared with Solvency I, Solvency II requires insurers to hold 141% more capital. Under solvency II, market risk is the most important risk component, accounting for more than 60% of the capital requirement. Since the directive imposes a low risk charge on AAA rated EU sovereign bonds and short-duration and highly rated corporate bonds, these types of bonds will be favored by insurers. Insurance companies are expected to reduce their equity investments due to its high risk charge.

The US RBC system differs from Solvency II in its capital requirement, regulatory reporting, and information disclosure. The National Association of Insurance Commissioners (NAIC) is reviewing its capital requirement methodology and is considering adopting a similar correlation matrix among component risks as in Solvency II. This paper evaluates how the capital requirement for US insurers will change with the incorporation of a correlation matrix and estimates that US insurers will hold 15% more pre-tax capital or 11% more post-tax capital.

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CHAPTER 1

INTRODUCTION TO SOLVENCY II

As a continuous effort to improve the risk management practice in insurance companies, Solvency II Directive was adopted by the Council of the European Union and Parliament in November 2009. Solvency II is a fundamental and wide ranging review of the current insurance directives. It aims to establish a revised set of capital requirements and risk management standards that will replace the current solvency requirements within the European Union market and will take effect in 2014. The objective of the new regulation is enhanced policyholder protection, increased competition in the European Union insurance market, and an enhanced supervisory review process. The objectives are to be achieved by introducing a risk-based system in which risk is measured using consistent principles and capital requirements are aligned with the underlying risks of the company. The directive will bring dramatic changes to capital adequacy requirements, corporate governance, and public disclosures.

Solvency II is based on three guiding pillars that intend to offer better risk measurement and management in market, credit, operational, insurance, and liquidity risks. The pillars focus on minimum capital requirements, risk measurement and management, and information disclosure respectively.

Pillar I provides the quantitative requirements for capital adequacy, and defines the methods used to value assets and liabilities, to measure own funds, and to calculate capital requirements.

Solvency II outlines two levels of capital requirements, the Minimum Capital Requirement (MCR) and the Solvency Capital Requirement (SCR). Both the MCR and the SCR provide an early indicator to regulators and insurance companies as to whether or not action needs to be taken. MCR is the threshold that could trigger ultimate supervisory action. If an insurer's capital is below MCR, policyholders and beneficiaries are exposed to an unacceptable level of risk if the firm continues to operate. A capital level between SCR and MCR may lead to some supervisory actions. Capital at or above the SCR level gives reasonable assurance to policyholders and beneficiaries that the insurer to remain solvent.

MCR is defined as the amount of economic capital needed to limit the probability of insolvency over the coming year to no more than 15%. SCR is defined as the level of capital that results in no more than a 0.5% chance of failure over a one-year time horizon.

The Directive provides a standard formula to compute both MCR and SCR. The standard formula is a linear, factor-based model. The factors include:

1. Market risk, including interest rate, equity, property, spread, currency, illiquidity, and concentration risks;
2. Default risk;

3. Life risk, including mortality, longevity, disability, laps, expenses, revision, and catastrophe risks;
4. Non-life risk, including premium reserve, lapse, and catastrophe risks;
5. Health insurance risk, including short/long-term insurance, and all life risks.

Under the Directive, an insurer is allowed to use internal models to determine the capital requirement. If the internal approach is adopted, the company must meet a series of tests for the model and obtain approval from the regulator who would be receiving the results.

According to "Article 74(1), Draft Framework Directive", all assets and liabilities are evaluated on a market consistent approach. Insurance and reinsurance companies should value their assets at the amount for which they could be exchanged between willing parties. Liabilities should be valued at the amount for which they could be transferred, or settled between willing parties.

Own funds are the capital resources of the insurer and are composed of basic own funds and ancillary own funds. It is designed to ensure that companies have the right amount of capital to meet the regulatory requirement. Basic own funds are the excess of assets over liabilities plus subordinated debt[1]. Ancillary own funds consist items not covered in the basic own funds which can absorb losses[2]. Examples of ancillary own funds include letters of credit and guarantees. Basic own funds are reported on the balance sheet and the ancillary own funds are off-balance sheet.

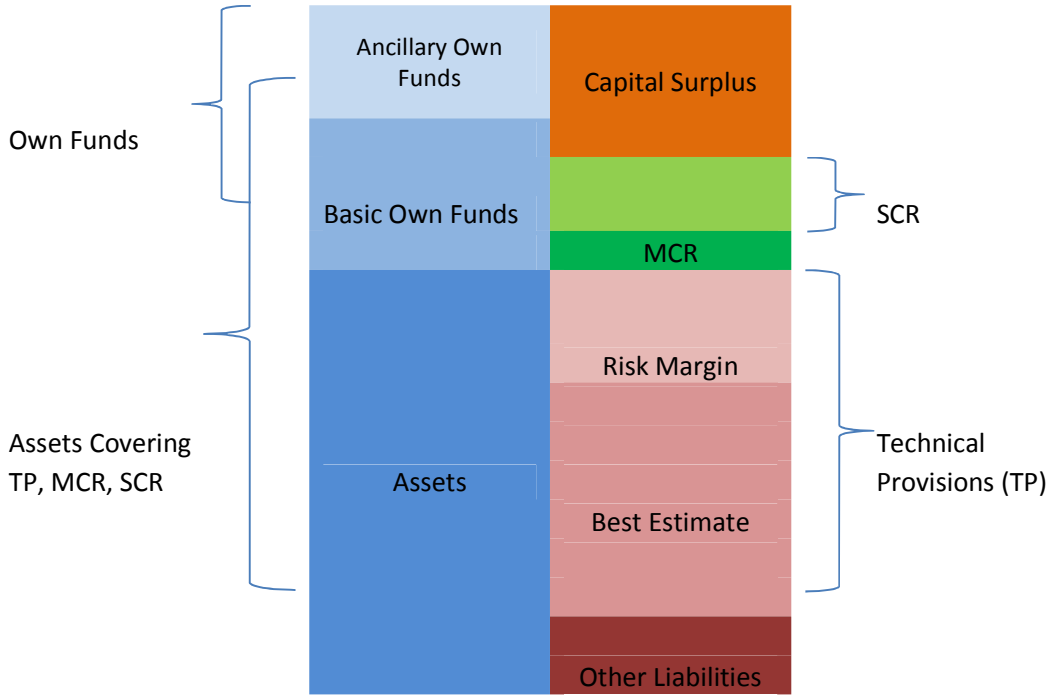
[1] See the definition in Article 88, Solvency II Directive
[2] See the definition in Article 89, Solvency II Directive

Liabilities are divided into technical provisions (insurance liabilities) and non-insurance liabilities. Technical provisions are an insurance company's contract obligations related to policyholders and beneficiaries. Under Solvency II, a technical provision is calculated as the sum of a best estimate (BE) and a risk margin (RM). The BE is the probability weighted average of the present value of future cash flows discounted by the risk-free yield curve. The risk margin is the amount "to ensure that the value of technical provision is equivalent to the amount that insurance and reinsurance undertakings would be expected to require in order to take over and meet the insurance and reinsurance obligations"[3]. Therefore, to calculate RM, an insurer needs first to project its annual insurance obligations until its extinction and then determine the SCR needed to meet the obligations in each year. The annual SCRs are then discounted by risk free rates. The sum of the discounted SCRs times the cost of capital, is called risk margin. In QIS 5 (The Fifth Quantitative Impact Study), the cost of capital is set as 6% for all participants.[4]

As discussed in the previous paragraphs, the key components in Pillar I include asset, liability, own fund, technical provision, SCR, and MCR. Figure 1 summarizes the relationship among these components. Capital surplus is the excess of assets over liability and capital requirement.

[3] See Item 3, Article 77 in the Solvency II Directive
[4] See TP.5.25 in QIS 5 Technical Specification

Figure 1: Relationship of Pillar I Components



Pillar II raises requirements on corporate governance and requires demonstration of an adequate system of governance. There are four blocks of governance under Solvency II which include the Own Risk and Solvency Assessment (ORSA), risk management system, policy processes and procedures, and key functions.

ORSA will serve as an internal assessment of overall solvency needs of an insurer. It is a unique characteristic of Solvency II since there are no comparable requirements in other regulations. It will make both the firm itself and the supervisory bodies better understand a firm's risk profile. All insurers will be required to produce an ORSA system regardless of whether they are working by their own internal model or by the standard

model. In either case, if a regulator believes a company's ORSA falls short, the regulator will have the ability to impose higher capital requirements. Since the regulator has the ability to impose capital add-ons, companies are incentivized to produce a robust and deeply embedded self-analysis. Indeed, of all the pillars, Pillar II is likely the most challenging in terms of implementation as it mandates what for many companies will be a broad overhaul of the risk culture that will reach all levels of the company.

The essential components of a risk management system include risk management strategies, policies, processes, and internal reporting procedures. Insurance companies are required to document the objectives of risk management, risk management principles, responsibilities, and internal risks and demonstrate the daily implementation of risk prevention. The procedures and processes must enable the firm to identify, manage, monitor, and report the current and future risks.

Pillar III centers on public disclosure and regulatory reporting requirements. As stated in CEIOPS' Advice to the European Commission, dated March 2007, on Supervisory Reporting and Public Disclosure in the Framework of the Solvency II Project (paragraph 2.2): "Supervisory reporting requirements in the Solvency II framework should support the risk-oriented approach to insurance supervision while public disclosure requirements should reinforce market mechanisms and market discipline."
In alignment with this discipline, the Directive requires two types of reports. The Regular Supervisory Report (RSR) is a report between an insurer and its national supervisory organization. This report contains narrative and quantitative information that is provided to the supervisory authority and kept confidential. The content includes

business performance, governance, risk profile, and capital management. The Solvency and Financial Condition Report (SFCR) is a report available to public. In SFCR, a firm should report information regarding business performance, governance, risk profile, capital management, asset and liability valuation.

To execute the reporting requirements, companies need to interpret the disclosure requirements, develop strategies for disclosure, and educate key stakeholders on the results. The disclosed information will not only be available to regulators but to financial analysts, rating agencies, and all other stakeholders. In addition, compliance will mean that companies must develop the internal processes and systems needed to produce said reports within the required time frames.

CHAPTER 2

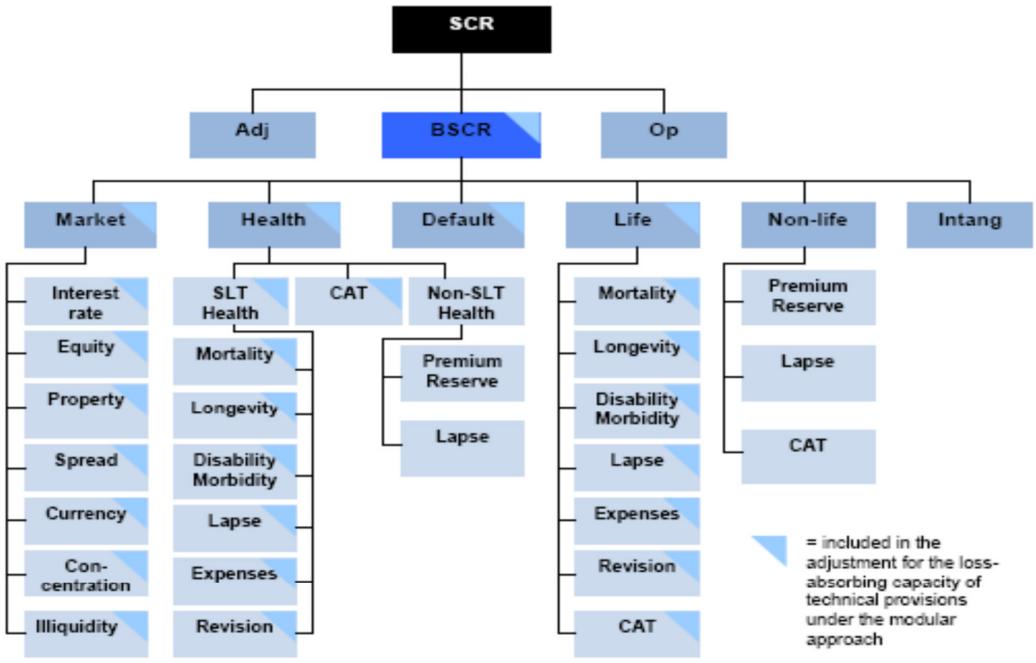
SOLVENCY CAPITAL REQUIREMENT

Solvency Capital Requirement (SCR) and Minimum Capital Requirement (MCR) are the two levels of capital requirements outlined in Solvency II. MCR is the minimum requirement for an insurer and the standard is less strict than SCR. Therefore, as long as an insurer meets the SCR, MCR will not be a concern. In this paper, the MCR will not be discussed in detail. The detailed requirements for MCR can be found in the section 6 of QIS 5 Technical Specification.

The Solvency Capital Requirement (SCR) is the risk-based capital requirement for insurers under Solvency II. It is the 99.5% Value at Risk confidence level over one year. In structure the SCR is composed of a number of 'modules' which in turn are composed of 'sub-modules'. The structure of the SCR modules is shown in Figure 2.[5] As shown in the chart, the calculation of SCR is a bottom-up process. One needs to calculate the SCR for each sub-module and then aggregate to total SCR. The calculation of the SCR for each sub-module is defined in the QIS 5 Technical Specifications. The capital requirements arising from these sub-modules and modules are aggregated using a correlation matrix[6].

[5] See SCR.1.1 on page 90 in the QIS Technical Specifications
[6] The correlation matrixes are available in each sub-module section in the QIS 5 Technical Specification

Figure 2: SCR Modules



Solvency II directive defines the standard formula for both SCR and MCR. SCR is determined as follows:

$$SCR = BSCR + Adj + SCR_{op}^{7} \qquad (1)$$

$BSCR$ is the basic solvency capital requirement. Adj is the adjustment for the risk absorbing effect of technical provisions and deferred taxes. SCR_{op} is the capital requirement for operational risk.

$BSCR$ captures the correlation relations among market, counterparty default, life underwriting, non-life underwriting, health underwriting risks, and intangibles. The formula for $BSCR$ is :

$$BSCR = \sqrt{\sum_{i,j} Corr_{i,j} \times SCR_i \times SCR_j} + SCR_{intangibles}^{8} \qquad (2)$$

[7] SCR.1.27, QIS5 Technical Specifications

$Corr_{ij}$ is the (i,j)th element of correlation matrix of the entry risks mentioned above. $SCR_i \ and \ SCR_j$ are the capital requirements for the individual SCR risks in the row and column of the correlation matrix. The directive defines the method to calculate the capital requirement for individual risk. In the Technical Specification, the Directive defines the methods for each of the SCR risk.

$SCR_{intangibles}$ is the capital requirement for intangible asset risk and is equal to the value of intangible assets times 0.8.[9]

Adj is composed of two parts and the standard formula is:

$$Adj = Adj_{TP} + Adj_{DT}^{10} \qquad (3)$$

Adj_{TP} is the adjustment for loss absorbency of technical provisions. Adj_{DT} is the adjustment for loss absorbency of deferred taxes. They reflect the potential compensation of unexpected losses through a simultaneous decrease in technical provisions or deferred taxes or a combination of them.[11] The loss absorbing effect arises from the fact that in a stress situation some technical provision items values and at the same time deferred tax liabilities decrease.

In the standard method, Adj is allowed to be computed in two approaches- the equivalent scenario and the modular approach. These methods are defined in the SCR 2 of Technical Specification.

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[8] SCR.1.3.1, QIS5 Technical Specifications
[9] SCR.4, QIS5 Technical Specifications
[10] SCR.2.9, QIS5 Technical Specifications
[11] See Article 108, 2009 Solvency II Directive

SCR_{op} is the risk of loss due to inadequate or failed internal processes, or from personnel and systems, or from external events. Operational risk should include legal risks, and exclude risks arising from strategic decisions, as well as reputation risks.

The capital requirement for the operational risk is determined by:

$$SCR_{op} = \min(0.3 \times BSCR, Op) + 0.25 \times Exp_{ul}^{12} \qquad (4)$$

Op is the basic operational risk charge for all business other than life insurance. It equals the larger of premium operational risks or operational risks arising from insurance obligations. Premium operational risk is the sum of premium earnings, and operational risks due to insurance obligations is the sum of technical provisions. Solvency II defines the formula to calculate the two components the Op in SCR 3 of the Technical Specification.

Exp_{ul} is the amount of annual expenses incurred during the previous 12 months in respect life insurance where the investment risk is borne by the policy holders.

[12] SCR.3.6, QIS5 Technical Specifications

CHAPTER 3

IMPACT ON CAPITAL REQUIREMENTS AND INSURER RISK PROFILES

To obtain the detailed information on the quantitative impact of Solvency II on insurance companies' balance sheets and to encourage insurers and supervisory authorities to prepare for the implementation of Solvency II, European Insurance and Occupational Pensions Authority (EIOPA) launched five quantitative impact studies (QIS) in the period of 2005 to 2010. In the series of studies, insurers used the tools designed by EIOPA and based on the principles and standard formula defined in the Solvency II to carry out simulations to test the practicability of the Directive approach and to measure the impact of the proposed calculation methods on insurance companies' balance sheets. In addition, EIOPA allowed insurers to apply their own internal models to calculate the capital requirements. EIOPA used the results of the studies to assess and adjust the suitability of the standardized formula of the capital requirements under Solvency II and to compare the results under the internal models. The latest test was the 5^{th} quantitative impact study (QIS 5) conducted in 2010.

3.1 Overall Impact

QIS 5 is the most comprehensive study compared with other four previous studies. A total of 2,520 (re)insurers and 167 groups, nearly 80% of the industry, participated in the study. More than 95% of the value of technical provisions and 85% of the premiums

of the insurers subject to Solvency II are covered in the test. The small insurers[13] were more active in this study than in previous studies with more than double the number of participants.

Under the Solvency II, the asset valuation for solo participants decreased by more than 0.3%, from €7,456.6 billion to €7,432.4 billion. For group participants, the asset valuation decreased by 1.3%, from €6,543.1 billion to €6,454.9 billion.[14] Compared with Solvency I, Solvency II increased liabilities valuation. Life insurance net provision increased by 3% and the ratio for non-life insurance was 8%.[15]

Overall, the standard model based on the Solvency II requirements reduces the capital surplus, including both solo and group participants, compared with Solvency I. The reduction in surplus was driven by an increase in capital requirements. For example, under Solvency I, the capital requirement was €227 billion in 2009. In contrast, the SCR in the same year was €547 billion, a 141% increase.[16] Capital surplus under the Solvency I and the Solvency II is illustrated in Figure 3.

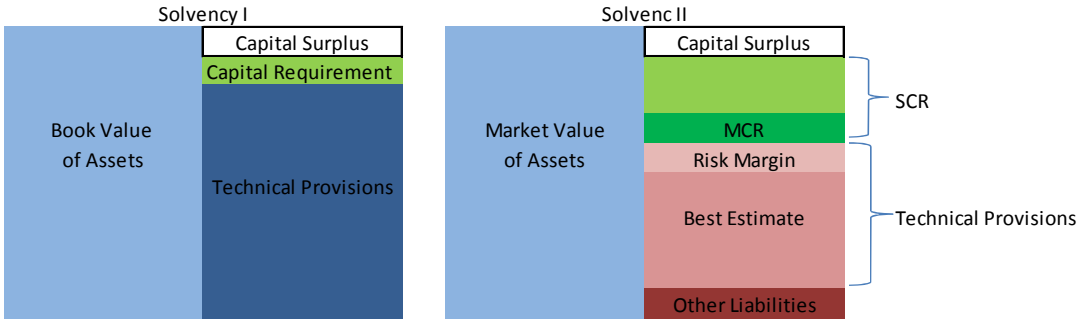
[13] A non-life insurance company with less than €0.1 billion written premiums is categorized as a small company, with between €0.1 billion and €1.0 is a medium company, with greater than €1.0 billion is a large firm. A life insurance company with less than €1.0 billion gross technical provisions is categorized as a small company, with €1.0 billion-€10 billion is a medium company, and with greater than €10 billion is a large company.

[14] See section 3 in the "EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II", EIOPA, March 2010

[15] See section 4.1 in the "EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II", EIOPA, March 2010

[16] See Table 6, Report on the fifth Quantitative Impact Study (QIS 5) for Solvency II

Figure 3[17]: Capital Surplus Under Solvency I and Solvency II

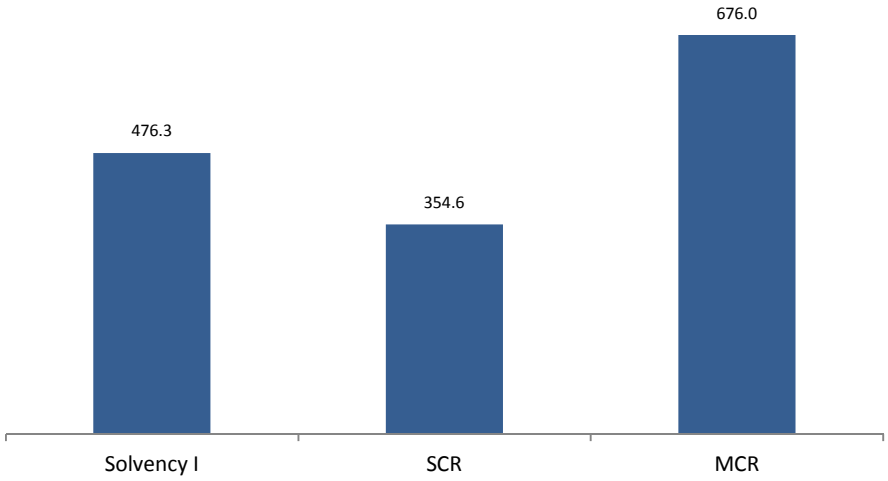


15% of the participants couldn't meet the Solvency Capital Requirement (SCR) and 5% failed to meet the Minimum Capital Requirement (MCR).

Figure 4 shows the overall quantitative effect of the switch from the current requirements to the Solvency II. This figure demonstrates the capital surplus under Solvency I and the capital surplus over SCR and MCR under Solvency II for solo participants. It indicates that capital surplus over SCR decreased from €476.3 billion to €354.6 billion. At the same time, the margin over the MCR increased by €200 billion.

[17] Illustrated based on "Solvency II Technical Provisions", Deloitte, April 2010

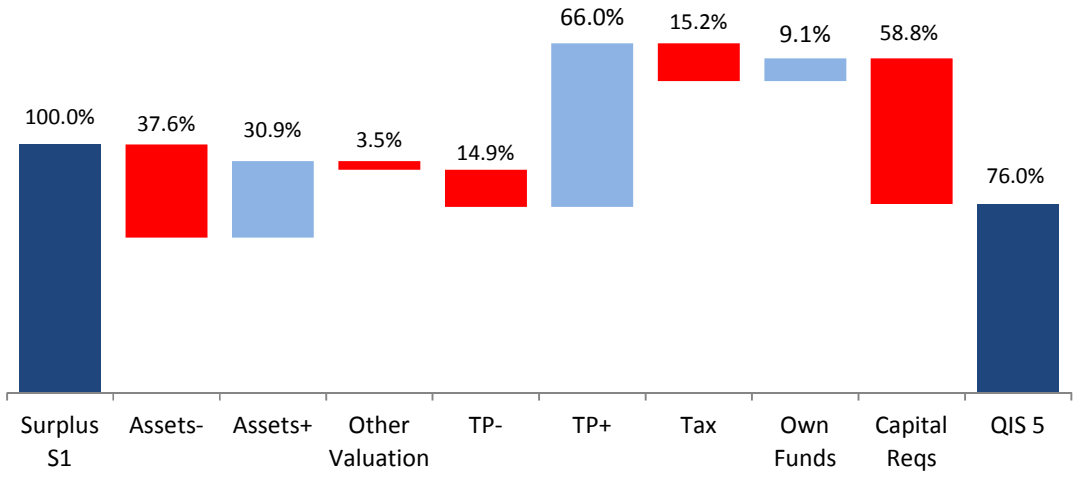
Figure 4: Capital Surplus for Solo Participants (€billion)



Source: Graph 3, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

The drivers that explain the change in the surplus from the current regime to the Solvency II framework include the shift in balance sheet, the change in the capital requirements, and the differences in the own funds elements allowed to cover the requirements. Figure 5 shows the respective influence of these drivers by splitting the valuation impacts into positive (light blue column) and negative effects (red column). The height of the bars represents the changes relative to the required surplus under Solvency I. The left most column in the chart represents the surplus under Solvency I. The right most column represents the surplus under Solvency II. Other columns represent the factors that affect the change of the surplus. These factors reflect the impact of changes in asset and liability valuation, changes in capital requirement definition, own funds, and tax on the capital surplus. All factors including Solvency II surplus are measured as a percentage of the Solvency I surplus.

Figure 5: Drivers of the Surplus Changes



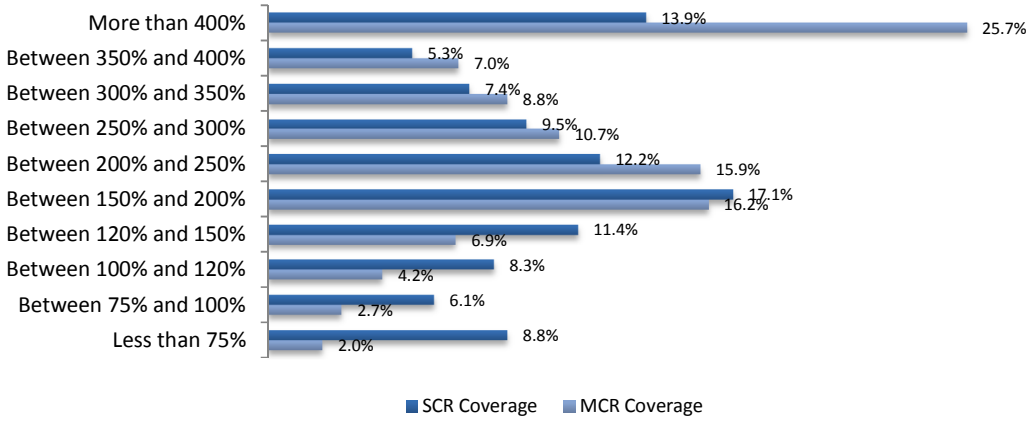
Source: Graph 8, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

As shown in the figure, the negative and positive effects of asset valuation almost offset each other. The positive effect of technical provision significantly out-weighted the negative effect. Capital requirement under the Solvency II significantly reduced the surplus.

Solvency ratio, measured by the ratio of own funds to SCR or MCR, is a critical indicator of how close an insurer meets Solvency II's benchmark capital requirement. The QIS 5 results show that solvency ratio under Solvency II changes greatly compared with that under Solvency I. Under the current regime, the average solvency ratio of European insurers is 310%. In comparison, the ratio based on SCR is 165% and based on MCR is 466%.

Compared with Solvency I, Solvency II introduced the ancillary own fund that allows off balance items to be counted as own funds.[18,19] As a result, the own funds value under Solvency II increases significantly from € 703 billion to €902 billion. Figure 6 demonstrates the distribution of the solvency ratios.

Figure 6: Distribution of SCR and MCR Coverage



Source: Graph 4 and Graph 6, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

20% of the participants have SCR coverage between 120% and 200% and nearly half of the firms hold more than twice their capital requirements. 15% of the insurers hold capital less than the solvency capital requirement.

3.2 Risk Profile

Under Solvency II, SCR is a risk based measurement and is composed of multiple risk charges. Therefore, the directive might reshape insurers' risk profiles significantly by adopting this new capital requirement definition. The impact study results show that market risk is the dominant risk across all insurers. Equity risk, spread risk, and interest

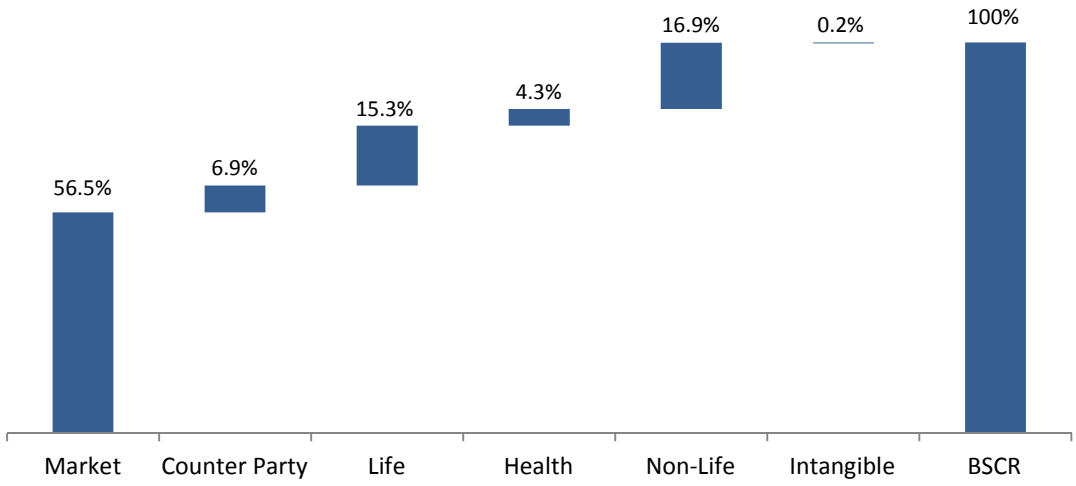
[18] Section 3.17 in "CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Own Funds-Article 97 and 99-Classification and Elligibility, CEIOPS, October 2009

[19] Page 25, "EIOPA Report on the fifth Quantitative Impact Study (QIS5) for Solvency II", EIOPA, March 2010

rate risk are the three driving components of market risk. In addition to the market risk, life insurance firms bear significant large underwriting risks arising from life insurance contracts, of which longevity and lapse risks are the two dominant components[20]. For the non-life insurance companies, non-life underwriting risk is the second largest risk next to market risk of which premium and reserving risk is largest risk component.[21]

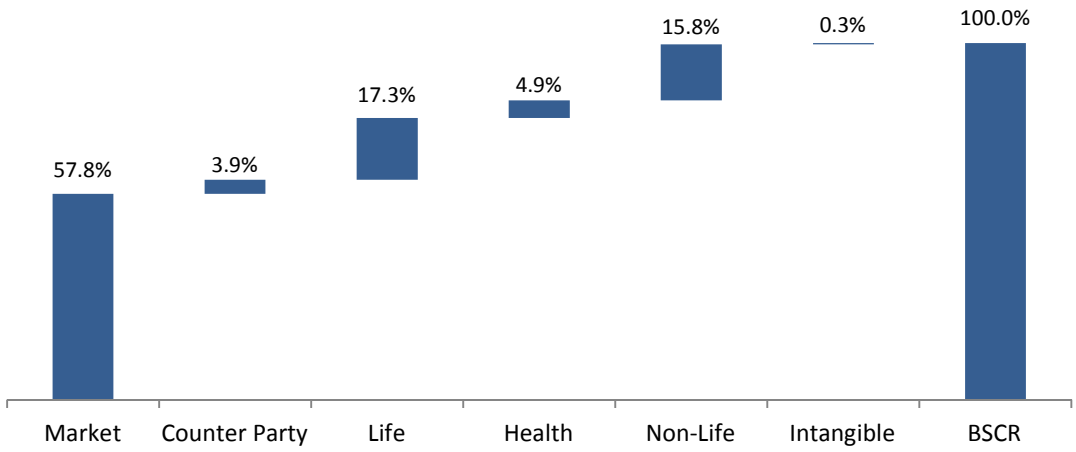
Since BSCR is the sum of all risks except for operational risk, decomposition of BSCR will uncover the most important source of risks. Figure 7.1 and Figure 7.2 illustrate the composition of the BSCR for solo companies and group companies.

Figure 7.1: BSCR Breakdown-All Solo Participants



[20] See Graph 35 and page 77 in EIOPA Report on the Fifth Quantitative Impact Study (QIS 5) for Solvency II
[21] See Graph 36 and 46 in EIOPA Report on the Fifth Quantitative Impact Study (QIS 5) for Solvency II

Figure 7.2: BSCR Breakdown-All Group Participants



Source: Graph 33, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

The solo companies and group companies demonstrate the similar pattern in the composition of BSCR. The market risk accounts for 57% of the total requirements, indicating that marketing risk is the dominant risk for European firms.

Figure 8.1 and Figure 8.2 break down the market risk into various sub-type risks for solo and group participants respectively. As shown in the figures, the equity, spread, and interest rate components are the largest elements of market risk.

Figure 8.1: Composition of Market Risk-All Solo Participants

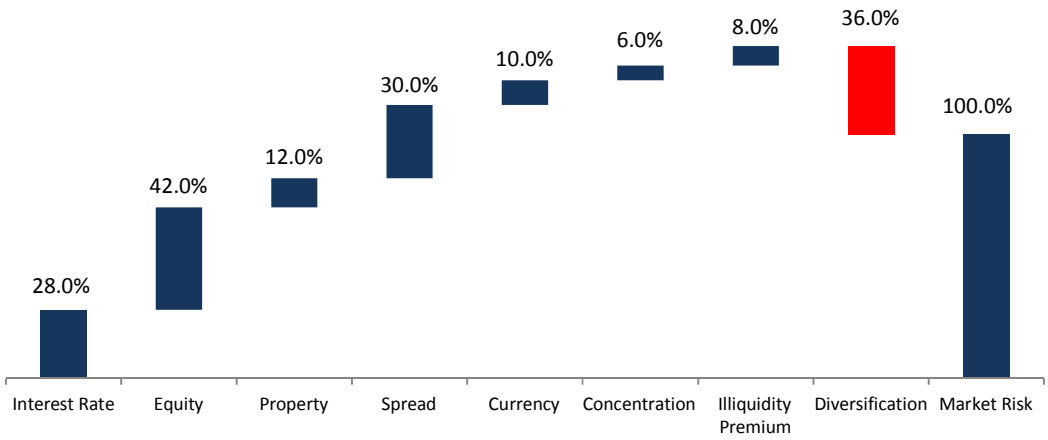
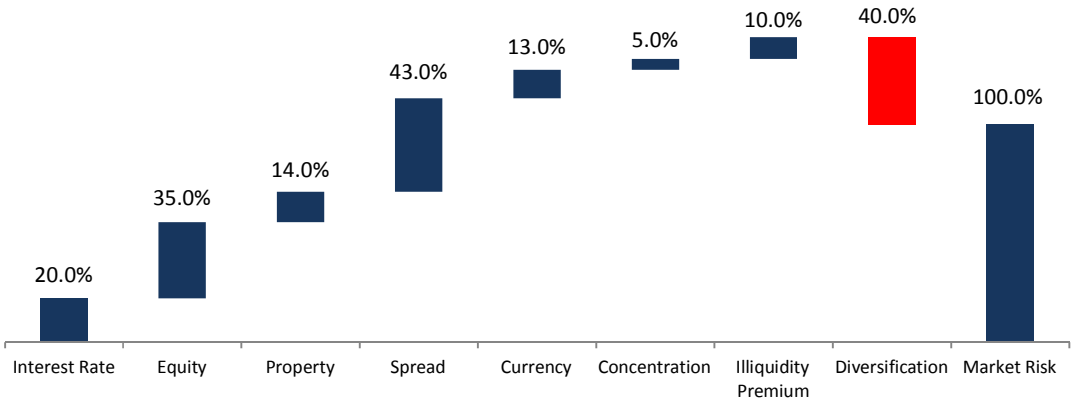


Figure 8.2: Composition of Market Risk-All Group Participants



Source: Graph 37, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

If one divides the firms into life insurance and non-life insurance, the risk profiles are somewhat different between the two groups. As shown in Figure 9.1 and Figure 9.2, life insurance firms bear over 67% of market risk, significantly higher than that of 32.8% for non-life insurance. As expected, nearly 24% of risk comes from underwriting of life contract in life insurance group while only 0.5% of life insurance risk in non-life group.

On the contrary, non-life insurance risk accounts for 52% of the total risk of non-life firms compared with zero in the life group.

Figure 9.1: Breakdown of BSCR-All Solo Life Insurance Participants

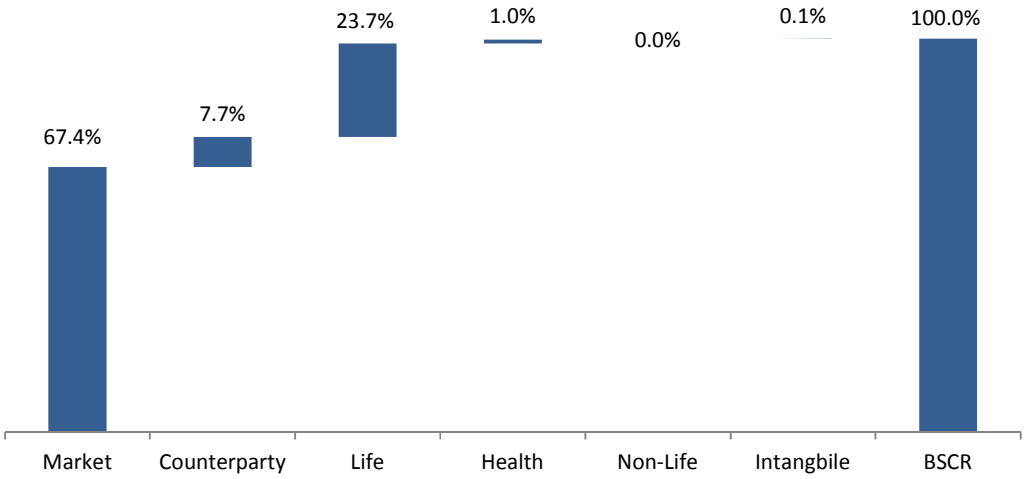
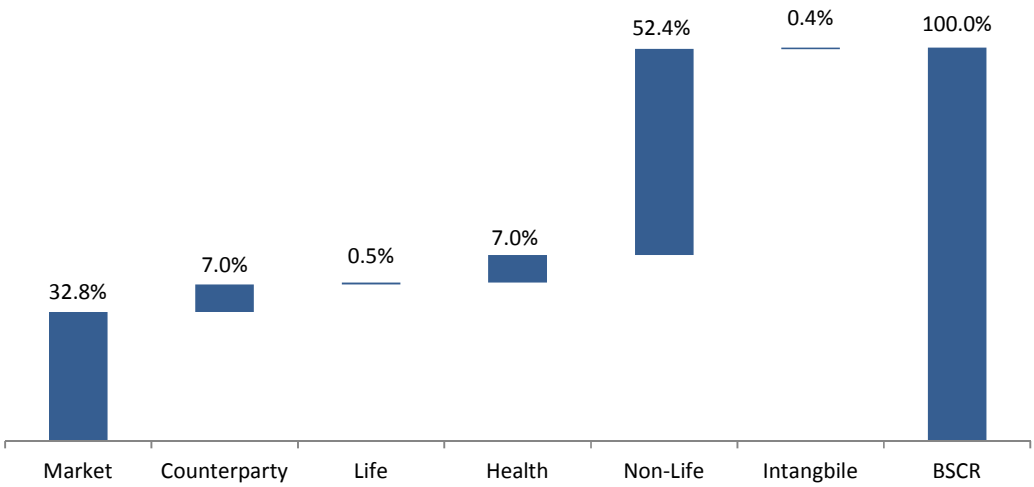


Figure 9.2: Breakdown of BSCR-All Solo Non-Life Insurance Participants



Source: Graph 35 and Graph 36, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

As shown in the previous chart, life underwriting risk is the dominant risk for life insurers. Figure 10.1 and Figure 10.2 illustrate the components of life underwriting risk for solo participants and group participants respectively. The longevity and lapse risks are the two most material components for both solo participants and group participants.

Figure 10.1: Components of Life Underwriting Risk-All Solo Participants

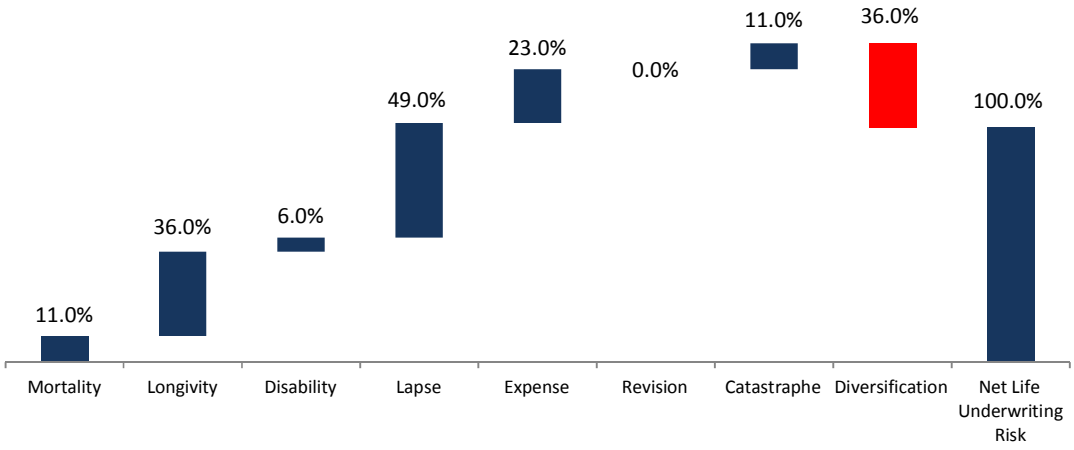
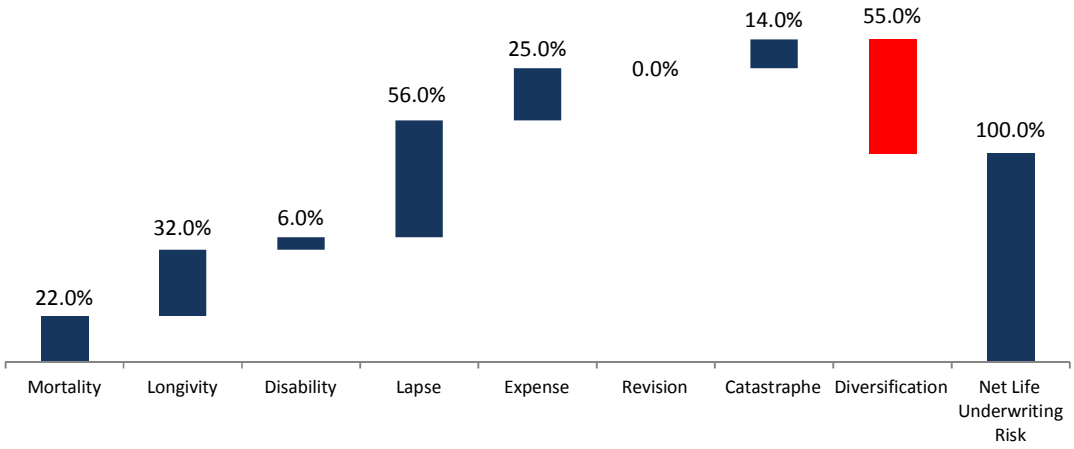


Figure 10.2: Components of Life Underwriting Risk-All Group Participants



Source: Graph 40, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

The Figure 9.2 shows that non-life underwriting risk is the main risk for non-life insurance companies. Figures 11.1 and 11.2 decompose the non-life underwriting risk into several components for solo and group non-life insurance. The premium & reserve and catastrophe are the two dominant components of the underwriting risk, both accounting for more than half of the risk premium.

Figure 11.1: Components of Non-Life Underwriting Risk-All Solo Participants

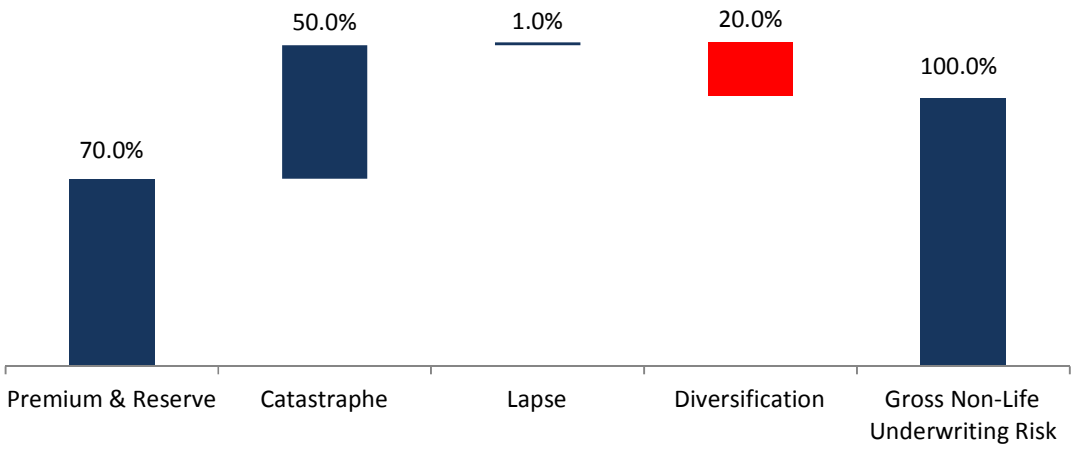
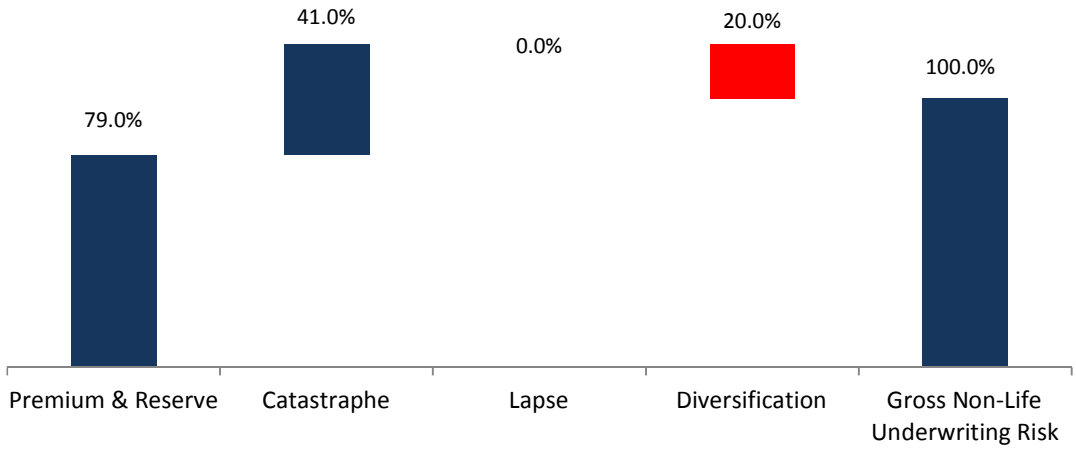


Figure 11.2: Components of Non-Life Underwriting Risk-All Group Participants



Source: Graph 46, EIOPA Report on the Fifth Quantitative Study (QIS 5) for Solvency II

3.3 Internal Models

In the Solvency II regime, an insurer can choose to use its own internal model to calculate the capital requirement if the model is approved by the regulatory authority. In order to compare the impact of the standard formula and the internal models on the capital requirement, the QIS 5 allowed the participants to compute the SCR using their internal models and standard formula.

A total of 234 participants (about 10% of all participants) provided the SCR results calculated by the internal models. Generally speaking, internal models return lower SCR compared with the standard formula. The median ratio of internal model SCR to standard formula SCR is 0.91 for solo participants. For the group participants, the median ratio is 80% and the 90^{th} percentile is 100%. For the 13 out of 19 countries that provided internal model SCRs, the median ratio was below 100%. 42% of the

participants that provided internal model results used partial internal models[22] to calculate the SCR. The median ratio for this group of participants was 86%. For large and medium participants, the median ratio was 93% compared with 101% for the small participants. Therefore, the internal model may be an attractive option for large and medium insurers while small insurers may be more likely to adopt the standard formula.

3.4 Impact on Insurer's Investment Strategies

The quantitative impact study results show that the Solvency II applies differential capital charges to insurers based on their actual risks they run. This feature could lead to significant changes in insurers' investment and asset liability matching (ALM) strategies.

Since SCR is composed of multiple risks charges, an obvious strategy for insurance companies will be to decompose the aggregate risk of portfolio and set limits to each risk component in accordance to the risk charge. This strategy is convenient for insurance firms and will gradually gain popularity because each of the risk charges will be calculated before insurers report their SCR.

The market risk module and its sub-modules elaborated in the QIS 5 technical specification provides clues about how insurers will change their investment strategies. Ideally, mathematical verification will better predict the changes. However, this is beyond this paper. This paragraph will do the predictions intuitively based on the

[22] Source: "According to Article 112(2) of the Level 1 Text, undertakings may use partial internal models for the calculation of: one or more risk modules, or sub-modules of the Basic SCR; the capital requirement for operational risk and the adjustment for the loss-absorbing capacity of technical provisions and deferred taxes. In addition, partial modelling may be applied to the whole business of undertakings, or only to one or more major business units." Section 3.1, CEIOPS' Advice for Level II Implementing Measures on Solvency II: Partial Internal Models.

information in the market risk modules. The directive imposes charges on interest rate risks. Since the expected return on these risks is usually lower than equity and credit[23], insurers are expected to reduce their exposure to interest rate. Spread risk is subject to capital charges based on credit quality and duration. This will discourage companies from taking on high level of credit risk or longer-dated credit risk because long-duration corporate bonds will attract a significant capital charge for spread risk[24]. This will make short duration and highly rated corporate bonds popular for insurers. In addition, the Solvency II gives a zero spread weight to all AAA/AA- rated sovereign debt. Therefore, insurers will reduce long-term corporate bond holdings and increase the sovereign debt.[25] Solvency II imposes significant capital charge on equity risk as 39% of base level is assigned to global equity and 49% to other equity[26]. This will make insurers reduce investment into equities.

Asset-liability matching has long been a challenging issue facing insurance firms. Under Solvency II, ALM will become more complex and uncertain. Since the directive will place a lower capital charge on derivatives and short-dated bonds, especially on European Economic Area (EEA) sovereign debt, short-duration, highly rated credit will be favored and use of derivatives to achieve duration matching will increase. A survey conducted by Black Rock in 2011 finds that 64% of the survey respondents will allocate

[23] See http://www.bonddeskgroup.com/main/market-data/historical-returns/bond-vs-equity-returns; 20-year bond and S&P 500 return, the latter significantly higher than the former

[24] See SCR.5.9 Market Spread Risk, QIS 5 Technical Specification

[25] See SCR5.9 Market Spread Risk, QIS 5 Technical Specification

[26] See SCR5.31 and SCR5.34, QIS 5 Technical Specification. Equity investment is divided into Global equity category and Other equity category. The Global category refers to the equities listed in countries which are member of EEA or OECD. The Other category refers to the equities listed in emerging market, non-listed equity, hedge fund, and any other investments not included elsewhere in the market risk module.

more assets towards fixed income, especially government bonds. A joint study conducted by Oliver Wyman and Morgan Stanley in 2011 finds that short-duration, high quality, investment grade credit assets and real estate lending are the most attractive risk asset classes.

CHAPTER 4

IMPLICATION TO US INSURERS AND REGULATIONS

Although Solvency II is a European regulation, its influence extends far beyond the EU because EU insurance companies have subsidiaries in other markets and insurers from other markets have subsidiaries in the EU. Many countries are considering adopting the directive or modifying existing regulations to be consistent with the directive. Solvency II recognizes the regulatory regimes in other countries if they meet the "equivalence" principles. The directive outlines 6 principles that need to be met in order for the capital standards of a jurisdiction to be considered "equivalent" to Solvency II. They include:

1. Powers and responsibilities of the supervisory authority;
2. Authorization requirements to undertake (re)insurance business;
3. System of governance and its regulatory oversight;
4. Business change assessment;
5. Solvency assessment; and
6. Supervisory cooperation, exchange of information, and professional secrecy.

If a country is certified by EU against the six principles as an "equivalence" jurisdiction, then EU subsidiaries in the country will only need to meet local capital requirements. The US regime does not meet all of these principles and the two systems

have many differences in their capital requirements, supervisory reporting, data collection and analysis, and information disclosure.

4.1 Different Capital Requirements Between Solvency II and US Regulation

Solvency II and the US regulations have two different approaches in defining capital requirements.[27] Under the US regime, life, property & casualty (P&C), and health have a separate RBC formula, each containing own set of risk factors that focus on the most material risks at the industry level while SCR and MCR formula are the same across different insurance types and SCR and MCR takes into account all quantifiable risks. In the RBC formula, risk factors are multiplied to produce RBC charges to each item and then the charges are summed into several baskets and subjected to a covariance adjustment to reflect the assumed independence of risks. Currency risk and catastrophe risk are not included in the RBC formula. Operational risk is covered in the Life RBC formula but not in the P&C formula.

[27] The Tail VaR (T VaR) provides the conceptual foundation for the US risk-based capital system, while Solvency II defines two levels of capital requirements, SCR and MCR, calibrated based on 99.5% and 85% confidence levels respectively.

Under Solvency II, the internal models must be approved by supervisory authorities before they can be used and are subject to continuing monitoring. Under the US RBC system, the application of internal models is limited to specific products and risk modules and prescribed parameters and time horizons,[28] while internal models under Solvency II can be used for calculating SCR for all or some of the risks.

In the US, insurance regulatory reporting is based on Statutory Accounting Principles (SAP). Although SAP is based on US GAAP, it is more conservative in asset valuation in that SAP only considers assets that would be available to pay claims at the reporting date. In the EU, assets are valued on fair market value. Expected profit in future premiums are allowed to reduce technical provision under Solvency II but not under RBC. Another difference is that goodwill is allowed to be recognized under SAP as up to 10% of an insurance company's adjusted capital and surplus but is not recognized under Solvency II.

As discussed in previous paragraphs, technical provisions are based on a market-consistent basis under Solvency II and consist of the best estimate and risk margin. The best estimate represents the probability weighted average of all future cash flows discounted using a risk free term structure. The risk margin represents the cost of capital to support the product until liabilities are fully covered. As a comparison, there is

[28] See the second paragraph on page 48 in "Comparing Certain Aspects of the Insurance Supervisory and Regulatory Regimes in the European Union and the United States", September 27, 2012

no equivalent concept of risk margin in the RBC regime and liabilities are discounted on own corporate bond yields[29].

4.2 Difference in Supervisory Reporting, Data Collection, Analysis, and Disclosure

Regarding reporting and information disclosure, the two regimes share many commonalities. For example, both regimes require insurers to identify key risks and both have comprehensive databases to facilitate analysis and monitor regulatory compliance. The two regimes differ in that Solvency II requires groups, as well as individual companies, to report to the regulatory authority, reporting in the US is done only at the company level.

The EU currently does not have a centralized database to warehouse the reporting data; instead, each nation maintains its own database. However, Solvency II requires that a centralized data warehouse administered by EIOPA be created. In the US, a centralized database has been under NAIC's (National Association of Insurance Commissioners) administration for over 15 years. The database captures all quantitative disclosures and some qualitative disclosures. Under Solvency II, supervisory bodies and EIOPA will use the data to perform risk assessment and financial stability analysis and will issue a semi-annual financial stability report. In the US, the centralized database is accessible to NAIC and all state insurance regulators. Many tools have been available for use over 15 years. Each state can also develop its own tools to address unique needs in the state.

[29] Refer to page 52 in "Comparing Certain Aspects of the Insurance Supervisory and Regulatory Regimes in the European Union and the United States", September 27, 2012

Regarding the difference in disclosure, public disclosure concerns the Solvency Financial Condition Report (SFCR) in the EU while it refers to the financial statement, management's discussion and analysis (MD&A), and actuarial opinion in the US. The contents of SFCR, including the detailed information on capital requirements and management, are publicly available while RBC filing contents are largely private except for the risk-based capital[30].

Solvency II requires insurers to disclose risk management via the Own Solvency and Risk Assessment (ORSA) report, while the US regime does not have a comparable requirement.

4.3 Implications to US Insurers

The difference between the RBC and Solvency II has implications and challenges to US insurers.

On one hand, European insurers are required to report the consolidated capital requirements covering their overseas operations including US subsidiaries. This requires that the US subsidiaries provide MCR and SCR calculations and must meet Pillar II requirements in regarding to risk management practices and structure. The overall effect is that US subsidiaries will have material extra reporting work to perform for European parents. Since Solvency II is based on market-consistent principles and gives no current credit for anticipated future credit spread, the value of liabilities may increase, which in turn would decrease reported capital. As a result, US subsidiaries

[30] See page 97 in "Comparing Certain Aspects of the Insurance Supervisory and Regulatory Regimes in the European Union and the United States", September 27, 2012

might find themselves in a weaker financial position if they adopt Solvency II[31,32]. Therefore, the European parents may have to hold extra capital to cover the subsidiaries in the US. In extreme cases where a large amount of additional capital is required, the European parent may have an incentive to spin off the subsidiaries.

On the other hand, European subsidiaries of US insurers are required to submit Solvency II filings in the same way as if they were an EU firm. If a US insurer owns multiple subsidiaries in EU, each of them must report under Solvency II regime. This may motivate the US parent to consolidate its EU operation into one EU entity.

4.4 Future Regulatory Changes in the US

Given the potential impact on insurance business in and outside EEA, many non-EU countries are seeking the equivalence either by adopting Solvency II or by revising its own regulations. In the US, the National Association of Insurance Commissioners (NAIC) formed the Solvency Modernization Initiative (SMI) task force to work through a critical self-examination to update the solvency regulations in the nation. In addition to the review of international developments regarding insurance supervision, banking supervision, international accounting standards, and their potential use in US, the SMI will focus on capital requirements, international accounting, insurance valuation, reinsurance, and group regulatory issues.

[31] US regulation allows anticipated credit spreads to be included in the rate to discount liabilities. Therefore gives lower liabilities

[32] Capital requirement for US firms could double under Solvency II, estimated by Morgan Stanley and Oliver Wyman Research "Solvency 2: The Long and Winding Road"

According to the latest update on the progress of SMI[33], the US version of ORSA has been developed and will be incorporated into the future regulation. Another significant achievement is that the group supervision which is missing in current regulation has been developed. This is an important step to reinforce insurers' corporate risk management in the US.

Besides, the SMI continues to improve other issues in the RBC formula and governance and risk management. The SMI is considering adding the missing risks in current RBC formula such as catastrophic risk and currency risk. SAP and the method to combine risk charges are under evaluation.

In the efforts to improve the corporate governance side of the regulations, the SMI is revising the guidelines based on the review of financial examinations conducted among the insurers, lessons learned in the recent financial crisis, studies of current case law in various US states, and the governance principles & standards placed by the International Association of Insurance Supervisors (IAIS) and authorities in other countries. This task is expected to be completed in December 2012.[34]

The task force is trying to transition the valuation principles from current SAP based to principle-based. The Valuation Manual which is a new valuation guideline is under development. According to the new provision, the principle-based valuation requirements will become effective after at least 42 states adopt the Valuation Manual. This task is projected to complete in 2013.

[33] Solvency Modernization Initiative Roadmap, August 2012
[34] See item 3 in "Solvency Modernization Initiative Road Map", March 29,2012

4.5 Implications to Credit Rating

Solvency II is built around risk based capital requirements and the emphasis on enterprise risk management (ERM). Therefore, with the application of the regulation, insurers will gain better credit rating because capital is an important quantitative element and ERM is an important qualitative element of credit rating.

Solvency II will result in an enhanced ERM system in insurers because the directive imposes higher standards of corporate governance and risk management. The Pillar II creates the Own Risk and Solvency Assessment (ORSA), under which firms must evaluate its own risks, capital requirements, and adequacy of capital resources. Consequently, companies must develop a robust risk management strategy that will focus on both regulatory and economic capital.

ERM has been part of S&P rating equation since 2008. The ERM assessment includes risk management culture, risk control, risk model, emerging risk management, and strategic risk management. The adequate implementation of Solvency II will require an insurer to meet the rating agency's ERM requirements. For example, ORSA will help the firm to set up a forward-looking system to monitor the firm's risk profile, control the risk, and ensure the proper level of capital. The standard formula of SCR covers all critical risks and could support business decisions. Internal models must include sufficient risks, integrated with risk management system, and update regularly.

Solvency II imposes a relatively higher standard on capital requirements. The standard formula of SCR is calibrated to a 99.5% value at risk over a one year period. As

a comparison, S&P BBB rating is calibrated to 97.2% over one year, A on 99.4%, AA on 99.7%, and AAA on 99.9%. The standard formula has at least the same or even higher capital requirement for other important risks compared with S&P's capital model. The overall non-life and reserve capital requirements could be 10% to 15% higher under the standard formula than under S&P's capital model. For the longevity risk, S&P capital model assumes about 15% permanent decrease in mortality while the Solvency II standard formula assumes 20% decrease. Operational risk and currency risk are not included in S&P model but covered in the Solvency II standard model.[35] The higher standard in capital requirement under the Solvency II translates into more capital held by the insurance firms, thus, the lower leverage.

[35] These data come from "Impact of Solvency II on The European Insurance Industry and S&P Rating Analysis", S&P June 8 2012

CHAPTER 5

INCORPORATING A CORRELATION MATRIX INTO THE US RBC CALCULATION

This chapter examines how the capital requirement will change for life insurers in the US if the US regime adopts a correlation matrix in the calculation of the capital requirement that is similar to that used in Solvency II.

The current version of the formula to calculate the capital requirement for a life insurance company under the US system is:

$$RBC = C_0 + C_{4a} + \sqrt{(C_{1o} + C_{3a})^2 + (C_{1cs} + C_{3c})^2 + {C_2}^2 + {C_{3b}}^2 + {C_{4b}}^2} \quad [36] \quad (5)$$

C_0 is the capital requirement for asset risk due to affiliated insurance companies

C_{4a} is the capital requirement for business risk

C_{1o} is the capital requirement for asset risk due to other assets that are not categorized in C_0 and C_{1cs}

C_{3a} is the capital requirement for interest rate risk

[36] See "Risk Based Capital General Review (7/15/2009)"; internet access: http://www.naic.org/documents/committees_e_capad_RBCoverview.pdf

C_{1cs} is the capital requirement for asset risk due to unaffiliated common stock and affiliated non-insurance stock

C_{3c} is the capital requirement for market risk

C_2 is the capital requirement for insurance risk

C_{3b} is the capital requirement for health credit risk

C_{4b} is the capital requirement for health administrative expense risk

Each component of life RBC is calculated by multiplying financial statement items, for example, assets, premiums, expense, reserve etc., by risk factor charges.[37] RBC is the aggregation of the capital requirements for the component risks with covariance adjustment. The correlation among the risks is assumed either 0 or 1 in the current formula. For example, risk components in the parentheses are assumed perfectly correlated while those between parentheses are assumed not correlated. This is a major difference in the way to aggregate capital requirement under the two systems.

Compared with the covariance adjustment in RBC formula, the correlation relationship among the risks under Solvency II is not assumed to be either zero or one.

The correlation coefficients are actually selected "in such a way as to achieve the best approximation of the 99.5% VaR for the aggregated capital requirement".[38]

[37] For calculation details, see 2012 Life Risk-Based Capital Forecasting & Instructions

[38] See Section 3.15, "CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: SCR Standard Formula Article 111 (d) Correlations", January 29, 2011

NAIC's SMI task force is investigating whether to adopt a correlation matrix to improve the current RBC square root formula.[39]The adoption of a correlation matrix is believed to significantly change the capital requirement for US insurers. In the following paragraphs, the impact will be evaluated quantitatively.

To evaluate how the adoption of correlation matrix will change US insurers' capital requirement, the author creates a representative life insurance company. Then the capital requirement will be calculated by using the current formula and using the Solvency II approach.

The representative life insurance company's RBC for each risk component is selected using the "Life Industry RBC Results for 2011" issued by NAIC. This document reports the aggregated RBC for each risk component from 2007 to 2011 as well as the total number of life insurers in each year. The document reports both pre-tax and post-tax RBC. The average RBC by risk component for each insurer in each year is calculated. The RBC profile of the fictitious life insurance company is the five year average of the calculated average RBC. The risk profile is shown in Table 1.

[39] See Item 82, "The U.S. National State-Based System of Insurance Financial Regulation and the Solvency Modernization Initiative", March 2012

Table 1: Risk Profile of the Representative Life Insurance Company

Risk Component	RBC (Thousand $) (Pre-Tax)	RBC (Thousand $) (Post-Tax)
C0	$34,602	$22,924
C1cs	$34,351	$22,330
C1o	$64,469	$46,356
C2	$36,244	$26,343
C3a	$21,362	$13,885
C3b	$2	$2
C3c	$2,769	$2,881
C4a	$11,248	$7,311
C4b	$772	$772

Source: Author calculation based data in "Life Industry RBC Results for 2011", *NAIC*, 2012

With the representative company created, the next step is to decide the correlation matrix. There are two ways to determine it. The first one is to match the risk components in US system to the components under Solvency II and then use the correlation matrix developed for Solvency II. The second way is to calculate the correlation coefficients among the RBC risk components using the historical RBC data reported in the "Life Industry RBC Results for 2011". Unfortunately, matching the risk components under the two systems proved too difficult, and so I use the second method.

Figure 11: Life Insurance RBC Components

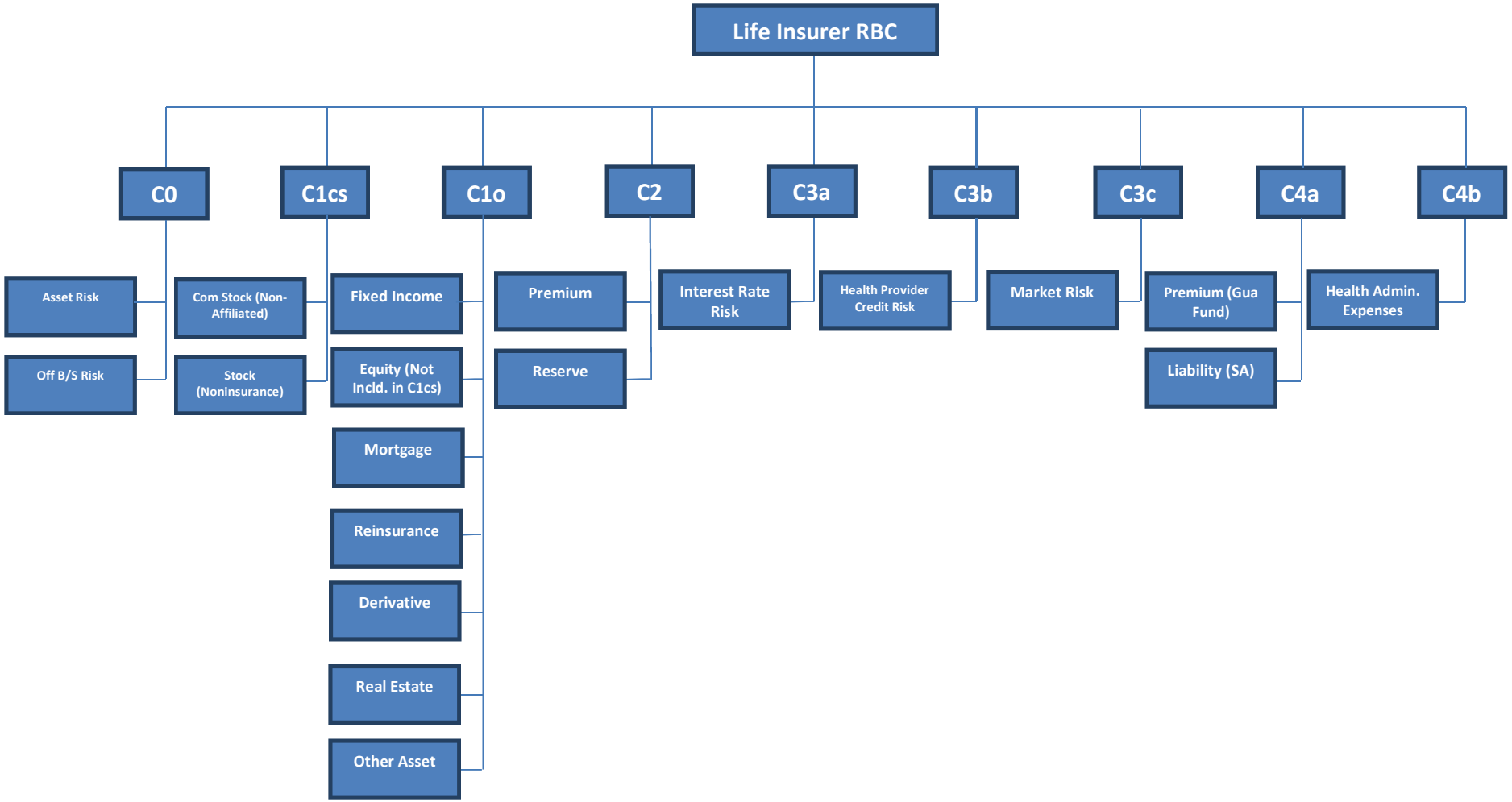


Figure 11 shows the RBC components and the individual risks that comprise each RBC components. This figure is developed based on various references.[40] Under RBC system, the sum of the RBC for each individual risk equals the RBC of each component which is aggregated to the total RBC by using the current RBC formula.

Table 2 compares the risk components in both systems. The health administrative expense risk under RBC and the expense risk of the life insurance module in Solvency II are similar risks in both systems. The other common risks are the health provider credit risk under RBC and the default risk under Solvency II.

It is obvious that some individual risks are available in one system but missed in the other. For example, operational risk, deferred tax, spread risk, currency risk, concentration risk, illiquidity risk, revision risk, lapse risk, and longevity risk are included in Solvency II but are not covered in RBC. Asset risks, such as C_0 and C_{1cs} , premium risk, and reserve risk are captured in RBC but not in Solvency II. In addition, separate account items are not included in Solvency II.

In some cases, risks at first appear comparable in both systems, but one further analysis indicates that they are measuring different risks. For example, interest risk is measured separately in RBC. It considers the risk of loss in life insurance due to interest rate change (C_{3a}), which is also part of interest rate risk under Solvency II. However, interest rate risk under the US system also includes the risk of loss in variable annuities

[40] References include SMI RBC Report by American Academy of Actuaries, January 31, 2011, Risk-Based Capital General Overview (July 15, 2009), and Life Industry RBC Results for 2011

products with guaranteed benefits (C_{3c}),[41] but this is not considered in Solvency II. Mortgage risk in RBC and property risk in Solvency II seem to both measure property risks. However, the former is about the default of mortgage principle or interest payment and the latter is about how the value of a company's asset and liability value change with the change of property price.

Table 2: Comparison of the Risk Components under RBC and Solvency II

Item No.	Risk	US RBC[42]	Solvency II[43]
1	Asset Risk-Affiliate	The risk of default of assets for affiliated investments	None
2	Off Balance Sheet Risk	The risk of default of certain off-balance sheet items including non-controlled asset, derivative instruments, guarantees for affiliates, and contingent liabilities	None
3	Common Stock (Non-Affiliated)	The risk of fluctuation in fair value of the common stock	None
4	Stock (Non-insurance)	The risk of fluctuation in fair value of the common stock	None
5	Fixed Income	The risk of default of principles or interest of fixed income assets, including bonds, collateral loans, mortgage loans, short-term investments, cash, and other long-term invested assets	None
6	Equity Risk (Not Included in 3 and 4	The risk of fluctuation in fair value of unafiliated common and preferred stock, real estate, and some long-term assets reported in schedule BA	None
7	Mortgage Risk	The risk of default of principles or interest of	Called Property Risk under Solvency II. The sensitivity of the

[41] See the definition of C3c on the page 3 in "Recommended Approach for Setting Regulatory Risk-Based Capital Requirements for Variable Annuities and Similar Products, June 2005

[42] The description of the risks are developed based on "SMI RBC Report by American Academy of Actuaries, January 31, 2011"

[43] If not specified, the description is based on the "2009 Solvency II Directive"

		mortgage loans	values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of real estate
8	Reinsurance Risk	The risk of default of reinsurance counterparties	None
9	Derivative Risk	The risk of default of derivative counterparties	None
10	Real Estate Risk	The risk of fluctuation in fair value of company owned real estate	None
11	Other Asset Risk	The risk of default of assets that are not categorized in 1	None
12	Premium Risk	The risk of improper pricing assumptions, mortality, morbidity, random fluctuation, and catastrophic events	None
13	Reserve Risk	The risk of statistical fluctuations in claim levels	None
14	Interest Rate Risk	The risk of life insurance loss due to change in interest rate level	The sensitivity of the values of assets, liabilities and financial instruments to changes in the term structure of interest rates, or in the volatility of interest rates
15	Health Provider Credit Risk	The risk that health benefits prepaid to providers become the obligation of the health insurer	Called Default Risk under Solvency II. The risk of possible losses due to unexpected default, or deterioration in the credit standing, of the counterparties and debtors of insurance and reinsurance undertakings over the following 12 months
16	Market Risk	The risk of loss in variable annuities products with guaranteed benefits due to change in interest rate level	The market risk under Solvency II is an aggregated risk of other risks
17	Premium (Guarantee Fund)	The risk of mis-assessment of gurantee fund	None
18	Separate Account Liability	The risk of mis-assessment of separate account liability	None

19	Health Administrative Expenses Risk	The risk related to the administrative expenses of certain types of health insurance exceeding the portion of the premium allocated to cover these expenses	Called Expense Risk under Life Insurance Risk Module. It is the risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of the expenses incurred in servicing insurance or reinsurance contracts
20	Adj	None	The risk of unexpected losses through a simultaneous decrease in technical provisions or deferred taxes or a combination of the two
21	Operational Risk	None	The risk of loss arising from inadequate or failed internal processes, or from personnel and systems, or from external events.
23	Equity Risk	see 3,4,6	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of market prices of equities
24	Spread Risk	None	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of credit spreads over the risk-free interest rate term structure
25	Currency Risk	None	The sensitivity of the values of assets, liabilities and financial instruments to changes in the level or in the volatility of currency exchange rates
26	Concentration Risk	None	The risks to an insurance or reinsurance undertaking stemming either from lack of diversification in the asset portfolio or from large exposure to default risk by a single issuer of securities or a group of related issuers
27	Illiquidity Risk	None	The risk of increase of the value of technical provisions due to a decrease in the illiquidity

			premium[44]
28	Mortality Risk	Included in Premium Risk	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates, where an increase in the mortality rate leads to an increase in the value of insurance liabilities
29	Longevity Risk	None	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend, or volatility of mortality rates, where a decrease in the mortality rate leads to an increase in the value of insurance liabilities
30	Disability Morbidity Risk	Included in Premium Risk	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level, trend or volatility of disability, sickness and morbidity rates
31	Laps Risk	None	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from changes in the level or volatility of the rates of policy lapses, terminations, renewals and surrenders
32	Revision Risk	None	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from fluctuations in the level, trend, or volatility of the revision rates applied to annuities, due to changes in the legal environment or in the state of health of the person insured
33	CAT Risk	Included in Premium Risk	The risk of loss, or of adverse change in the value of insurance liabilities, resulting from the significant uncertainty of pricing

[44] See SCR.5.11 in the "QIS 5 Technical Specification"

			and provisioning assumptions related to extreme or irregular events
34	Intangible Risk	None	The risk of decrease in assessment value of intangible assets due to internal risks and market risks that are derived from the decrease of prices in the active market, and also market risks derived from unexpected lack of liquidity of the relevant active market, that may result in an additional impact on prices, even impeding any transaction.[45]

Another scenario is that some risks are partially shared. For example, both systems consider equity risk. However, the equity risk under RBC is evaluated separately based on whether they are held by affiliated organizations or un-affiliated ones. The mortality risk and morbidity risk are covered by premium risk in RBC system but they are categorized as an individual risk category under Solvency II.

In summary, the comparison of the risk components in the two systems in Table 2 proves that the risk components of the two systems are not matched. Therefore, the correlation matrix of RBC cannot be derived from the ones in Solvency II. As a result, the historical RBC data are used to obtain the correlation relationship among the risks. The pre-tax and post-tax correlation matrix is demonstrated in Table 3 and Table 4 respectively.

[45] See SCR.4 in "QIS 5 Technical Specification"

Table 3: Pre-tax Correlation Matrix of RBC Risk Components

	C0	C1cs	C1o	C2	C3a	C3b	C3c	C4a	C4b
C0	1								
C1cs	0.93	1							
C1o	0.31	0.54	1						
C2	0.06	0.34	0.96	1					
C3a	0.44	0.61	0.97	0.87	1				
C3b	0.00	0.00	0.00	0.00	0.00	1			
C3c	0.48	0.61	0.67	0.67	0.61	0.00	1		
C4a	-0.15	0.00	0.80	0.88	0.74	0.00	0.55	1	
C4b	0.07	0.20	0.78	0.85	0.72	0.00	0.80	0.93	1

Source: Author calculation based data from 2007 to 2011 reported in "Life Industry RBC Results for 2011", *NAIC*, 2012

Table 4: Post-tax Correlation Matrix of RBC Risk Components

	C0	C1cs	C1o	C2	C3a	C3b	C3c	C4a	C4b
C0	1								
C1cs	0.92	1							
C1o	0.27	0.54	1						
C2	-0.17	0.15	0.88	1					
C3a	0.40	0.61	0.97	0.75	1				
C3b	0.00	0.00	0.00	0.00	0.00	1			
C3c	0.42	0.17	-0.03	-0.15	-0.01	0.00	1		
C4a	-0.19	0.00	0.82	0.91	0.74	0.00	0.12	1	
C4b	0.05	0.20	0.81	0.85	0.72	0.00	0.38	0.93	1

Source: Author calculation based data from 2007 to 2011 reported in "Life Industry RBC Results for 2011", *NAIC*, 2012

The total RBC for the fictitious life insurer is then calculated by applying the standard RBC formula and the Solvency II SCR aggregation formula which is as following:

$$RBC = \sqrt{\sum_{i,j} Corr_{i,j} \times RBC_i \times RBC_j} \qquad (6)$$

Where: $Corr_{i,j}$ is the correlation matrix of the RBC risk components

RBC_i is the capital requirement for each component risk

The results are reported in Table 5.

Table 5: Capital Requirements

	Standard Formula	Correlation Matrix Adjusted	Pct. Change
Pre-Tax RBC	$146,145,063	$168,639,084	15%
Post-Tax RBC	$100,656,035	$111,709,224	11%

Source: Author calculation based data in "Life Industry RBC Results for 2011", *NAIC*, 2012

The comparison of the capital requirement using both methods shows that the adoption of Solvency II method would raise the pre-tax capital requirements by 15% and post-tax capital requirements by 11%. Therefore, adoption of Solvency II method will lead to higher capital requirements for life insurance companies in the US.

CHAPTER 6

SUMMARY

Solvency II is a new EU-wide solvency regime and substantively changes the amount of capital that insurers will hold and the risk management practices that insurers need to follow. The objectives of this paper are to briefly describe the Solvency II directive, discuss its impact on European insurers' capital holdings, examine its implications for insurers' investment strategies, and evaluate its influence on US insurers.

Solvency II is built on three pillars which focus on capital requirements, risk management, and public disclosure, respectively. Pillar I defines two levels of capital requirements, the Solvency Capital Requirement (SCR) and the Minimum Capital Requirement (MCR). SCR is defined as the level of capital that results in no more than a 0.5% chance of failure over a one-year time horizon. MCR is defined as the amount of economic capital needed to limit the probability of insolvency over the coming year to no more than 15%. Pillar II raises requirements on corporate governance and requires demonstration of an adequate system of governance.

A unique characteristic of Solvency II is that insurers are required to perform Own Risk and Solvency Assessment (ORSA) which will make both the firm itself and the supervisory bodies better understand a firm's risk profile. Pillar III requires two types of reports, The Regular Supervisory Report (RSR) and The Solvency and Financial Condition Report (SFCR). The former is a confidential report between an insurer and its national supervisory organization, providing narrative and quantitative information regarding business performance, governance, risk profile, and capital management. The latter is a report available to public and contains information regarding business performance, governance, risk profile, capital management, and asset and liability valuation.

Compared with Solvency I, Solvency II significantly affects insurers' assets and liabilities and therefore capital. Under the Solvency II, in 2009, the asset valuation for solo participants decreased by more than 0.3%, from €7,456.6 billion to €7,432.4 billion. For group participants, the asset valuation decreased by 1.3%, from €6,543.1 billion to €6,454.9 billion. Life insurance net provision increased by 3% and the ratio for non-life insurance was 8%. EU insurers held 141% more capital under Solvency II than if under Solvency I in 2009, increasing from €227 billion to €547 billion. As a result, capital surplus under Solvency II decreased by €121.7 billion compared with that under Solvency I, down from €476.3 billion to €354.6 billion. In addition, the average solvency ratio also decreased from 310% under Solvency I to 165% under Solvency II.

Solvency II also reshapes insurers' risk profiles. Under Solvency II, market risk is the dominant risk across all insurers. Equity risk, spread risk, and interest rate risk are

the three driving components of market risk. Besides the market risk, life insurance firms bear significant large underwriting risks arising from life insurance contracts, of which longevity and lapse risks are the two dominant components. In contrast, non-life underwriting risk is the second largest risk next to market risk for non-life insurance companies.

The US RBC system is different from Solvency II in all the three pillars. The difference brings challenges to both US businesses and regulation. Solvency II requires consolidated capital requirement. Therefore, an EU insurer's US subsidiary must adopt Solvency in addition to the US RBC requirement. This will add significant paperwork to the US subsidiary. Likewise, a US insurer's subsidiary in the EU must conform to Solvency II requirement.

From the regulatory side, NAIC is reviewing the difference between the two systems and working on closing the gaps. NAIC has made changes in capital requirements, international accounting, insurance valuation, reinsurance, and group regulatory issues. An important difference in the capital requirement under both systems is that the RBC system assumes the correlation coefficients among the component risks are either zero or one while Solvency II does not do so. NAIC is considering adopting a similar correlation matrix. This paper performs a numerical analysis to evaluate the impact on US insurers' capital requirement by creating a fictitious life insurance. The result shows that US insurers will hold 15% more pre-tax capital or 11% more post-tax capital if a correlation matrix that is similar to those under Solvency II is included in the computation.

Solvency II has implications to insurers' investment strategy since it imposes different charges on different types of assets. AAA/AA- EU sovereignty bond will gain in popularity because the risk charge on this type of bond is zero. In the same way, short-duration and highly-rated corporate bonds will be more favored by insurers than other types of corporate bonds. Insurance companies are also expected to reduce their equity investment because Solvency II imposes a high risk charge on equity.

REFERENCES

1. "EIOPA Report on the Fifth Quantitative Impact Study (QIS 5) for Solvency II", March 2011

2. "QIS 5 Technical Specifications", July 2010

3. "Directive 2009/138/EC of the European Parliament and of the Council (Solvency II Directive)", November 2009

4. "Life RBC (Risk-Based Capital) Forecasting & Instructions", NAIC, 2012

5. "Life RBC (Risk-Based Capital) Forecasting & Instructions", *NAIC*, 2009

6. "Life Industry RBC Results for 2011", NAIC, 2012

7. Cummins, J. David, and Phillips, Richard D., "Capital Adequacy and Insurance Risk Based Capital Systems", October 2009

8. Vaughan, Theresa M., "The Implications of Solvency II for U.S. Insurance Regulation", February 2009

9. Siegel, Caroline, "Solvency Assessment for Insurance Groups In the United States and Europe-A Comparison of Regulatory Frameworks", *Working Papers on Risk Management and Insurance No. 110*, February 2012

10. Holzmuller, Ines, "The United States RBC Standards, Solvency II, and the Swiss Solvency Test: A Comparative Assessment", *Working Papers on Risk Management and Insurance No. 59*, August 2008

11. "CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Valuation of Assets and "Other Liabilities"", *CEIOPS*, October 2009

12. "CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Own Funds-Article 97 and 99-Classification and Eligibility", *CEIOPS*, October 2009

13. "Final CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Technical Provisions-Article 86(d) Calculation of the Risk Margin", *CEIOPS*, October 2009

14. “CEIOPS’ Advice for Level 2 Implementing Measures on Solvency II: SCR Standard Formula Loss-Absorbing Capacity of Technical Provisions and Deferred Taxes”, *CEIOPS*, October 2009

15. “CEIOPS’ Advice for Level 2 Implementing Measures on Solvency II: Partial Internal Models”, *CEIOPS*, January 2010

16. “CEIOPS’ Advice for Level 2 Implementing Measures on Solvency II: Supervision of Group Solvency for Groups with Centralized Risk Management”, *CEIOPS*, January 2010

17. “CEIOPS’ Advice for Level 2 Implementing Measures on Solvency II: SCR Standard Formula Article 111(d) Correlations”, *CEIOPS*, January 2010

18. “Official NAIC Annual Statement Instructions: Life, Accident & Health”, August 2008

19. “American Academy of Actuaries’ C3 Life and Annuity Capital Work Group Response to Comment Letters regarding September 2009 C3 Phase III Report”, December 2009

20. “C3 Phase II Risk-Based Capital for Variable Annuities: Pre-Packaged Scenarios”, March 2005

21. “Recommended Approach for Setting Regulatory Risk-Based Capital Requirements for Variable Annuities and Similar Products”, June 2005

22. “The U.S. National State-Based System of Insurance Financial Regulation and the Solvency Modernization Initiative”, *NAIC White Paper*, March 16 2012

23. “Comparison of the NAIC Life, P&C and Health RBC Formula”, February 12, 2002

24. “Comparing Certain Aspects of the Insurance Supervisory and Regulatory Regimes in the European Union and the United States”, September 27, 2012

25. Accounting/Valuation Issues for the Solvency Modernization Initiative”, *NAIC*, December 2, 2009

26. “Solvency Modernization Initiative Roadmap”, *NAIC*, August 31, 2012

27. Farr, Ian, Mueller, Hubert, Scanlon, Mark, Stronkhorst, Simon, “Economic Capital for Life Insurance Companies”, February 2008

28. Lyun, Yom, “Risk Based Capital in the US and Elsewhere”, *Swiss Re*, May 23, 2005

29. Corrigan, Joshua, Decker, Jethro De., Hoshino, Takanori, Delft, Lotte van, Verheugen, Henny, “Aggregation of Risks and Allocation of Capital”, *Milliman Research Report*, September 2009

30. Nguyen, Tristan, Molinari, Robert Danilo, “Risk Aggregation by Using Copulas in Internal Models”, *Journal of Mathematical Finance*, 2011, 1, 50-57

31. “Solvency Modernization Initiative Roadmap”, *NAIC*, March 29, 2012

32. “Impact of Solvency II on The European Insurance Industry and S&P Rating Analysis”, *S&P*, June 8 2012

33. “SMI RBC Report by American Academy of Actuaries”, January 31, 2011

34. “Risk Based Capital General Review” (7/15/2009); internet access: http://www.naic.org/documents/committees_e_capad_RBCoverview.pdf

35. Horing, Dirk, “Will Solvency II Market Risk Requirements Bite? The Impact of Solvency II on Insurers’ Asset Allocation”, *Working Paper*, March 8, 2012

36. “Balancing Risk, Return and Capital Requirement”, *Economist Intelligence Unit of BlackRock*, 2011

37. Hocking, Jon, Hanif, Farooq, Rivaldi, Marcus, etc., “Solvency 2: The Long and Winding Road”, *Morgan Stanley and Oliver Wyman*, March 23, 2012

38. Hanif, Farooq, Hocking Jon, Jaekel, Astrid, Ziewer, Lukas, “Solvency 2: Quantitative & Strategic Impact: The Tide is Going Out”, *Morgan Stanley and Oliver Wyman*, September 22, 2012