AMERICAN ACADEMY of ACTUARIES

November 15, 2012

Via email to Alan.Seeley@state.nm.us
Via email to JBarr@naic.org

Mr. Alan Seeley
Chair, Solvency Modernization Initiative Risk-Based Capital (E) Subgroup
Capital Adequacy (E) Task Force
National Association of Insurance Commissioners
1100 Walnut Street, Suite 1500
Kansas City, MO 64106-2197

Dear Alan:

The Property and Casualty (P/C) Risk-Based Capital (RBC) Committee of the American Academy of Actuaries[1] is pleased to provide you with the attached report in response to the Solvency Modernization Initiative RBC Subgroup's request to identify risk correlation methodologies used to determine regulatory solvency capital requirements in advanced jurisdictions outside the U.S.

In your review of this material, please consider the limitations discussed in the Scope section of the report. This report does not constitute a recommendation regarding the type of correlation methodology that should be adopted by the National Association of Insurance Commissioners (NAIC). Given the interdependence of the elements of the P/C RBC formula, a methodology for determining risk-based capital requirements can be comprehensively evaluated only when all of its elements are considered.

[1] The American Academy of Actuaries is a 17,000-member professional association whose mission is to serve the public and the U.S. actuarial profession. The Academy assists public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

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With this understanding, we fully recognize the necessity of separately examining individual elements of the framework. The risk dependency structure is a critical part of RBC, and we hope your examination will benefit from the information and analysis we are providing.

We would be happy to discuss the attached report and to provide any additional information you may require. If you have any questions, please feel free to contact Lauren Pachman, the Academy's casualty policy analyst, at pachman@actuary.org.

Sincerely,

Alex Krutov
Chair, P/C RBC Committee
American Academy of Actuaries

cc: Peter Medley, Chair, NAIC Capital Adequacy (E) Task Force

Attachment

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DEPENDENCY STRUCTURES IN RISK-BASED CAPITAL:
Summary of Methodologies Used by a Variety of Jurisdictions to Reflect Risk Correlation in Property/Casualty Standard Formulas

November 2012

Subcommittee members with primary responsibility for drafting this report:

Navid Zarinejad, FCAS, MAAA, Chair
Allan Kaufman, FCAS, MAAA
Alex Krutov, FCAS, MAAA
Harvey Sherman, FCAS, MAAA

Property/Casualty Risk-Based Capital Committee
American Academy of Actuaries

Property/Casualty Risk-Based Capital Committee

Alex Krutov, Chair

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G. Christopher Nyce
Sean O Dubhain
Harvey Sherman
Achille Sime-Lanang
Paul Vendetti
Mark Verheyen
Xiaoying (Jenny) Yi
John Yonkunas
Navid Zarinejad

DEPENDENCY STRUCTURES IN RISK-BASED CAPITAL:

Summary of Methodologies Used by a Variety of Jurisdictions to Reflect Risk Correlation in Property/Casualty Standard Formulas

INTRODUCTION AND SCOPE

The American Academy of Actuaries' Property and Casualty Risk-Based Capital Committee was asked by the NAIC's Solvency Modernization Initiative (SMI) RBC (E) Subgroup to

> *…identify the risk correlation methodologies used in regulatory solvency capital requirements in other advanced regulatory jurisdictions, including Bermuda, Canada, Australia, EU, Switzerland, and any others deemed informative.*

The September 28, 2012 request continued,

> *Although we are not requesting an analysis of each method or a recommendation from the Academy on which to choose, any pros and cons (e.g., "simple to use" or "theoretically superior but difficult to use practically") to the applicability of individual methods for use in the U.S. RBC would be welcome.*

This report describes the risk correlation[2] methodologies used in standard formulas[3,4] in Bermuda (the Bermuda Solvency Capital Requirement or BSCR), Canada (Minimum Capital Test or MCT), Australia (Australian Prudential Regulation Authority or APRA), the European Union (Solvency II or SII), and Switzerland (the Swiss Solvency Test or SST). We also consider the U.S. RBC formula for the purpose of comparison.

The report is premised on the assumption that the reader has a basic understanding of the U.S. RBC formula and concepts of risk correlation. It addresses the correlation methodologies as they would affect P/C insurers, referred to in other countries as non-life or general insurers.

A complete description of any standard formula involves identifying the risk elements being considered, the correlation structure among those risk elements, and the methods used to

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[2]In this Report, we use the terms "dependency" and "correlation" interchangeably. In a strictly statistical sense, dependency between two risk factors describes the relationship between them. The term "correlation" is often used to refer to linear correlation that measures the degree of linear dependency between two risk factors. Approaches that are more sophisticated from a theoretical point of view include the use of copulas, which do not have the disadvantage of describing dependency between two variables (risk factors) using only one parameter. As used in this report, the term "correlation" does not refer to linear correlation.

[3]Some regulatory systems allow the use of individual company capital modeling tools for certain purposes. The discussion in this report relates only to the prescribed or standard formulas.

[4] See Bibliography for sources on which our comparison is based. A number of solvency formulas are under development, and our comparison is valid only for the sources listed.

parameterize the risk charges and correlation factors.

This report only addresses the risk correlation structure.[5] It does not address the approach to parameterization, and it identifies individual risk charges only to the extent necessary to illustrate the correlation structure. As such, the report is not a comprehensive description of any of these standard formulas, and some material presented in this report has been simplified. Also, while we have identified the main correlation approaches, other features within the standard formulas may also be viewed as correlation approaches. Finally, the report does not address the accuracy of the calibration of risk charges or the calibration of correlations in any of the standard formulas.

As your request indicated, we do not make a recommendation in this report regarding the type of correlation methodology that should be adopted by the NAIC. Given the interdependence of the elements of the P/C RBC formula, a comprehensive evaluation of a methodology for determining Risk-Based Capital requirements can be performed fully only when all of its elements are considered.

EXECUTIVE SUMMARY

Each of the standard formulas we examined begins with certain risk elements, which are consolidated into one or more higher-level risk elements using correlation methodologies. The correlation methodologies often vary from level to level. For example, in U.S. RBC, a premium risk charge by line of business is adjusted for a growth charge (assumed to be 100 percent correlated with the premium risk charge). This charge is consolidated into an all-lines premium risk charge using the "70 percent rule"[6] to produce[7] the top level risk called R_5. The top level risk R_5 is combined with the risks R_0 to R_4 using the "square root rule."

Most standard formulas begin with similar risk elements but combine them in different ways through one or more consolidation steps before reaching the top risk level. The standard formulas differ in the way the risk charges at the top level are constructed.

For example, for an exclusively P/C insurer, Solvency II has provides for three top level risks: market risk, default risk and underwriting risk (called non-life risk). These three risk charges are combined using a covariance formula. Charges for operational risk and other adjustments are

[5] The choice of correlation structure may also have different effects on the results, depending on what risk measure is used for calibrating solvency capital.

[6] For premium risk, the degree of diversification among lines of business is expressed by the "premium concentration factor" that is 70 percent plus 30 percent times premium for the largest Schedule P line of business divided by total premium. For reserve risk, the "loss concentration factor" is calculated based on the same formula, using reserves instead of premium. The result is 100 percent for a monoline company and approaches 70 percent for a hypothetical insurer evenly spread across an infinite number of lines. The minimum value for the factor is limited by the number of Schedule P lines. This is referred to as the 70 percent rule.

[7] Premium risk charge also reflects other adjustments for loss sensitive contracts and own-company experience.

added to the result of the covariance formula. U.S. RBC utilizes the five top level risks R_1-R_5, which are combined using a "square root rule." The R_0 risk charge is added to the result of applying the "square root rule." Thus, the treatment of risk elements is different, and the correlation structure is different.

Columns 1-3 of Exhibit 1, which appears at the end of this summary, show the jurisdiction, the correlation methods used for top level risks, and the main correlation methods used for intermediate level risks. Appendix 1 to this report describes the correlation methods used in the selected jurisdictions.

Columns 4-5 of Exhibit 1 provide comments, along the lines requested, on potential advantages and disadvantages of each of the correlation methods, considered in comparison to the current U.S. RBC approach. The advantages and disadvantages consider simplicity, risk sensitivity, and calibration accuracy, which are described in Appendix 2 to this report.

Column 1 of Table 1 below shows the different types of correlation treatments used for top level risks reflected in Exhibit 1. Column 2 shows examples of jurisdictions that use each of these approaches.

Table 1 – Top Level Risks

(1) Treatment of Risk Correlation	(2) Illustration
Additive (sum of) charges[8]	Canada U.S. RBC – R_0 added to the other risks BSCR – Operational risk added to the other risks
Square root of sum of squares of charges[9]	U.S. RBC (except R_0); BSCR (except BSCR-operational risk)
Square root of sum of squares of charges with covariance[10] factors	Solvency II; Australia; SST
SST approaches	SST – Use of convolutions to measure joint risk distributions

All of the systems include intermediate consolidations based on a variety of correlation methods. Column 1 of Table 2 lists the main types of intermediate correlation methods. Column 2 identifies one or more systems within which that method is used. Column 2 provides examples of where each method is used, but it is not an exhaustive list.

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[8] As if individual risks are fully correlated or individual risk charges are calibrated (by reducing them) so that the sum of the charges achieves the desired result for the typical company

[9] As if individual risks are fully uncorrelated or individual risk charges are calibrated (by increasing them) so that applying the square root rule to the charges achieves the desired result for the typical company

[10] Solvency II covariance factors are intended to reflect the dependency relationship at the tail of the risk distribution, reflecting a view of the aggregate risk distribution. These are not correlation matrices according the assumptions required of linear correlation. These covariance factors could also be described as "weighting factors."

Table 2 – Risks within the Top Level Risks

(1) Treatment of Risk Correlation	(2) Illustration
U.S. RBC "70 percent rule" and similar Solvency II rule	U.S. RBC – diversification credit for lines of business within R_4 and R_5- "70 percent rule" Solvency II – geographical diversification credit –"75 percent rule"
Scenarios	Solvency II – correlation by line of business in catastrophe risk is determined by applying common catastrophe scenarios to all affected lines of business; certain market risk charge components are correlated by using common interest rate scenarios.
Square root of sum of squares of charges with covariance factors	Solvency II – diversification credit by line of business and between premiums and reserves, within the non-life underwriting risk component
Concentration charges	U.S. RBC – asset concentration charge to the extent fixed income or equity risk is concentrated in a smaller number of investments
Additive (sum of) charges	All standard formulas use the "additive charges" approach to some degree. -Explicitly in U.S. RBC, for example, when credit risk charges for different receivables are multiplied by risk charge factors and the results are added together -Implicitly in other systems, for example, when a single credit risk charge is applied to a balance sheet item like "receivables," which implicitly contains sub-items like agent balances, interest due, etc.

Tables 1 and 2 should be interpreted in light of the notes to the tables and the remainder of this report.

Exhibit 1

Summary Table: Regulatory Capital – Standard Formulas and their Dependency Structures by Jurisdiction				
(1) Jurisdiction	**(2) Overall Approach for Aggregating Risk Charges**	**(3) Other Correlations Used Within Risk Modules**	**(4) Potential Advantages**	**(5) Potential Disadvantages**
U.S./NAIC	Sum of squares under square root; Insurance affiliate risk is added outside the square root, as is deferred tax asset risk	Diversification of premiums and reserves by line of business (70 percent rule); Half of reinsurance credit risk spread to reserve risk (see footnote 11); Concentration charge for bonds/equities based on ten largest exposures	Well understood by U.S. users; Somewhat risk sensitive	Would benefit from being more risk sensitive
Bermuda	Sum of squares under square root; Operational risk is added outside the square root	Half of reinsurance credit risk spread to reserve risk; Credit for diversification by line of business (60 percent rule)	Somewhat risk sensitive	Would benefit from being more risk sensitive
Canada	Additive charges	Interest rate risk charge reflects correlation between assets and liabilities when interest rate shock factor is applied to both.	Simple to understand	Would benefit from being more risk sensitive Provides no explicit diversification benefit
Australia	Sum of squares under square root with a covariance term; Operational risk and asset concentration risk are added outside the square root	Some dependence within risk modules like sum of squares, with adjusted covariance terms based on stress scenarios, under square root, for example, in the asset risk charge.	Relatively straightforward Somewhat risk sensitive	Would benefit from being more risk sensitive
Solvency II (Quantitative Impact Study 5 [QIS 5])	Sum of squares under square root with covariance terms; Operational risk is added outside the square root. Additional layers of covariance formulas for sub-risk aggregation	Risk modules for non-life (premium and reserve) and market risk aggregate sub-risks via covariance terms; 75 percent rule for geographic diversification for non-life premium risk; Concentration risk charge for lack of diversification in assets or large credit risk from individual counterparties	Risk sensitive	Calibration of correlation matrices relies extensively on expert judgment; Estimation of numerous correlation parameters adds to the need to rely on expert judgment
Swiss Solvency Test	Sum of squares under square root with covariance terms; Convolutions	Premium risks (attritional) for lines of business are combined using covariance terms; Premium risk (large claims) aggregated via convolutions; Reserve risk for lines of business combined using covariance terms	Technically sophisticated; Considers many areas of risk not considered in other formulas	Relatively difficult to understand; Difficult to calibrate appropriately; Extensive use of convolutions, which potentially introduces possibility of providing too much diversification credit

APPENDIX 1 – CORRELATION METHODS USED IN SELECTED JURISDICTIONS

U.S. P/C Risk-Based Capital

The U.S. P/C RBC formula has six main risk categories, R_0-R_5. The dependency among these six categories is expressed in a "square root rule," with a constant term, as follows:

$$RBC = R_0 + \sqrt{R_1^2 + R_2^2 + R_3^2 + R_4^2 + R_5^2},$$

where R_0 represents affiliate risk; R_1 represents fixed income risk; R_2 represents equity risk; R_3 represents non-investment credit risk; R_4 represents reserve risk; and R_5 represents premium risk. Adjustments are made to some of these risks prior to their use in this formula. One such adjustment is that the original reinsurance credit risk charge is divided evenly between R_3 and R_4 (reserve risk).[11] U.S. regulators are working on introducing R_6 and R_7 charges to the formula to account for the risks of earthquakes and hurricanes, respectively. R_6 and R_7 are expected to be separate terms in the square root formula.

The aggregation of R_1 - R_5 using the "square root rule" can be interpreted as an assumption that there is zero correlation among the various risk charges.[12] The treatment of R_3 reflects an expected dependency (before adjustment) between R_3 risk and R_4 risk.

Other dependency features within the U.S. RBC formula include:

- 70 percent rule[13] - to reflect diversification among lines of business, and
- Asset concentration factors – increase in otherwise applicable charges when asset risk is concentrated in a small number of counterparties.

[11] However, if R_3-reinsurance is larger than R_4, which could be the case for a company with high ceded reinsurance, then R_3-reinsurance remains in R_3. This rule puts R_3-reinsurance either 100 percent in R_3 or 50 percent in R_3, depending on which produces the larger total RBC.

[12] While not contemplated in the NAIC RBC formula, in theory, this approach can also be interpreted as meaning that the separate risk charges have been calibrated (higher), so that, for the "typical" insurer, the square root rule applied to the individual risk charges yields the appropriate result.

[13] For premium risk, the concentration factor is 70 percent plus 30 percent times (premium for largest Schedule P line of business/total premium). For reserve risk, the concentration factor is the same formula but using reserves instead of premium. The result is 100 percent for a monoline company and approaches 70 percent for a hypothetical insurer evenly spread across an infinite number of lines. The minimum value for the factor is limited by the number of Schedule P lines.

Bermuda Solvency Capital Requirement

The Bermuda Solvency Capital Requirement (BSCR) is roughly similar to U.S. RBC. The P/C BSCR formula is:

$$BSCR = \sqrt{C_{fi}^2 + C_{eq}^2 + C_{int}^2 + C_{prem}^2 + (C_{cred}/2 + C_{rsvs})^2 + (C_{cred}/2)^2 + C_{cat}^2} + C_{op},$$

where C_{fi} represents fixed income risk; C_{eq} represents equity risk; C_{int} represents interest rate risk; C_{prem} represents premium risk; C_{cred} represents credit risk; C_{rsvs} represents reserve risk; C_{cat} represents catastrophe risk; and C_{op} represents operational risk.

Thus, the formula considers fixed income risk, equity risk, interest rate risk, premium risk, credit risk, reserve risk, and catastrophe risk within the square root. As in the U.S. RBC formula, credit risk is spread across reserve risk and other credit risk.

Like the NAIC RBC formula, this square root formula assumes zero correlation among different risk types.[14]

Canada – Minimum Capital Test

The Canadian Minimum Capital Test (MCT) used for regulatory capital purposes does not account for any diversification among major risk categories for property/casualty insurance companies. It is specifically noted[15] that it is difficult to appropriately measure correlation among risks in stress situations, which is why the MCT does not include diversification among risk categories at this stage. At this point, the formula does not provide explicit credit for diversification by line of business either.

While it appears that no diversification benefits are reflected in the formula, it has been pointed out[16] that the reserve and premium risks in the U.S. RBC formula and in Solvency II usually have higher capital charges than in Canada, and the net effect of applying the diversification credit to these higher charges reduces the total capital requirements, bringing them closer to the results of the MCT calculation.[17]

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[14] It can also be interpreted as meaning that the separate risk charges have been calibrated (higher) so that, for the "typical" insurer, the square root rule applied to the individual risk charges yields the appropriate result.

[15] Office of the Superintendent of Financial Institutions, MCT Advisory Committee, Canadian Vision for Property and Casualty Insurer Solvency Assessment, December 2011.

[16] Ishmael Sharara, Mary Hardy, and David Saunders. Regulatory Capital Standards for Property and Casualty Insurers under the U.S., Canadian and Proposed Solvency II (Standard) Formulas. CAS, CIA, and SOA Joint Risk Management Section, November 2010.

[17] The same is true of the UK Individual Capital Assessment Standards, not discussed in this Report.

Australia – Required Capital

The Australian P/C standard formula is given below:

Required Capital = Insurance risk + Insurance risk concentration charge + Asset risk + Asset risk concentration charge + Operational risk – Aggregation benefit

The "Aggregation benefit" equals $A + I - \sqrt{A^2 + I^2 + 2 \times \rho \times A \times I}$,

where A = Asset risk charge; I = Insurance risk charge + Insurance risk concentration charge; and ρ is 20 percent for most insurers (but higher for certain mortgage insurers).

The formula also incorporates some additional dependence levels within risk modules. The calculation of the top level asset risk charge (A) uses the sum of squares of stress scenario asset risk charges for individual asset categories, with adjusted covariance terms, under the square root.

This formula is similar to the Solvency II square root formula with covariance function; however, only asset risk and insurance risk are combined with the correlation term.

Solvency II (QIS 5)

The Solvency II standard formula used in the fifth quantitative impact study (QIS 5) calculates its solvency capital requirement in accordance with the following formula:

$$SCR = \sqrt{\sum_i \sum_j Corr_{i,j} \times SCR_i \times SCR_j} + SCR_{op} + Adj$$

The term Adj is an adjustment for the risk-absorbing effect of technical provisions and deferred taxes. SCR_i denotes the risk module i, and SCR_j denotes the risk module j where "i, j" means that the sum of the different terms should cover all possible combinations of i and j. In the calculation, SCR_i and SCR_j are replaced by $SCR_{non\text{-}life}$, SCR_{life}, SCR_{health}, SCR_{market} and $SCR_{default}$.

This formula shows that the various risk modules are aggregated using a square root formula along with correlation matrix $Corr_{i,j}$. The correlation matrix used in QIS 5 is shown below:

i, j	**Market**	**Default**	**Life**	**Health**	**Non - life**
Market	1	0.25	0.25	0.25	0.25
Default	0.25	1	0.25	0.25	0.5
Life	0.25	0.25	1	0.25	0
Health	0.25	0.25	0.25	1	0
Non - life	0.25	0.5	0	0	1

In addition to this formula for the solvency capital requirement (SCR), some of the risk modules use similar square root formulas with correlation matrices. For instance, the formula used for non-life SCR is shown below:

$$SCR_{non-life} = \sqrt{\sum_i \sum_j Corr_{NONLIFE\ i,j} \times SCR_i \times SCR_j},$$

where SCR_i denotes the sub-module i; SCR_j denotes the sub-module j; and where "*i, j*" means that the sum of the different terms should cover all possible combinations of i and j.

In the calculation, SCR_i and SCR_j are replaced by $SCR_{non\text{-}life\ premium\&reserve}$ and $SCR_{non\text{-}life\ cat}$.

Similar square root formulas with correlation exist for Solvency II's life insurance risk, health insurance risk, and market risk modules.

Within the sub-risk elements, the formula sometimes uses scenarios to produce risk charges and correlations between risk elements. For example, correlation by line of business in the catastrophe risk component is determined by applying common catastrophe scenarios to all affected lines of business.

Swiss Solvency Test

The Swiss Solvency Test (SST) is not easily categorized as a standard formula. It is perhaps better described as a regulatory system that uses a number of standard models. The SST prescribes standard models for market risk, life insurance risk, nonlife insurance risk, health insurance risk, and credit risk. The results of these standard models are not single risk charges, but, rather, probability distributions (although credit risk is an exception). Within the SST, there are a number of layers of correlation designed to combine risks and sub-risks.

Focusing on nonlife insurance risk, a correlation matrix is used to combine the attritional claims risk across lines of business, producing an overall mean and variance. The attritional claims and claim reserve distributions (i.e., mean and variance) are then aggregated using another correlation matrix. The resulting distribution is then aggregated with a large claim distribution by using convolution to produce the total nonlife insurance risk distribution. Similar calculations are used for life and health insurance risk.

The market risk model also uses a dependency structure. There are 23 normally distributed risk factors that are combined into a single market risk distribution using a correlation matrix. Convolution is then used to combine the market risk and insurance risk modules to produce an overall risk distribution.

Another important element of the SST is the application of various quantitative risk scenarios and stress tests. Although these tests do not use traditional "correlations," they do have the effect of shifting the overall risk distribution and occasionally changing the shape of that distribution. The scenario distributions are aggregated with the standard model distribution described above by using a weighted average, where weights are defined by the assumed probabilities of various scenarios.

APPENDIX 2 – POTENTIAL ADVANTAGES AND DISADVANTAGES

As requested by the SMI RBC Subgroup, this section provides a limited comparison of theoretical and practical features of the correlation components of the formulas that could be considered as advantages and disadvantages. This is not an assessment of the overall US P/C RBC formula, nor is it a complete assessment of the correlation component of the formula.

Characteristics of Potential Advantages and Disadvantages

Advantages and disadvantages of the correlation component of the standard formulas can be subjective. In this report, we considered only the features described below. We would be happy to assist the SMI RBC Subgroup in adding to and/or refining the list to maximize its suitability for NAIC purposes.

1. ***Simplicity*** **–** Simple/difficult to understand and use
2. ***Risk Sensitivity*** **–** Degree of "risk sensitivity" if properly calibrated
3. ***Calibration*** – Extent to which the accuracy of calibration can be demonstrated by experience

Below we provide an overview of these features.

Simplicity

In our consideration of a formula's simplicity, we looked at several aspects:

a. **Familiarity** – Simplicity in that its users are familiar with its operation and implications. A change to the formula would present learning curves and other costs.
b. **Data –** The extent to which currently available data is adequate to apply the formula.
c. **Calculation –** The ease with which the formula is implemented in spreadsheets or, by contrast, may require special macros, non-spreadsheet code, or other tools
d. **Concepts –** The extent to which concepts within the formula may be within the current skill set of most members of the regulatory and business community.
e. **Ease of use –**Familiarity, availability of calculation tools, and/or intrinsic characteristic(s) of the correlation approach.
f. **Transparency –** Largely a combination of the above characteristics.

Risk sensitivity

The correlation component of one formula is more risk sensitive than the correlation component of another formula if the first produces risk charges that more appropriately reflect the differences in risk between two companies. For example, a formula is more risk sensitive if it can reflect the likelihood that the private passenger automobile loss ratios are less correlated to medical malpractice loss ratios than to commercial automobile loss ratios. This could also be described as "reasonably accurate," although we use the term "risk sensitive" to specify accuracy for a particular purpose.

Calibration

Achieving risk sensitivity requires that individual risk charges and the correlation among those risk charges be properly calibrated. Confirming that individual risk charges are properly calibrated is technically challenging. The calibration of correlations is even more difficult. Challenges associated with the calibration of correlations include the following:

a. **Data –** The extent to which data is available

b. **Uncertainty –** Data is likely to indicate a range of calibrations. This might be due to the low volume of information relevant to the safety targeted by the standard formula, e.g., 1/200 or 1/20. This might be due to use of data over long time periods, during which the correlations may not be stable. The important issue is the extent to which the range of indications is narrow enough to achieve the desired results.

To the extent that data is limited or uncertainty is high, calibration has to be based on expert opinion. One of the important deliberations underlying any formula is the tradeoff between increasing risk sensitivity in theory and the extent to which data-based correlations can be calibrated in practice.

The impact of a decision to limit the use of certain correlation features can be mitigated somewhat by selecting risk charges that consider the correlation structure within which they might be applied. The result of that approach is that the formula is appropriately risk sensitive for "typical" companies, for which the formula is calibrated, but less appropriately risk sensitive to the extent that a company differs from that norm.

Other Considerations

Other characteristics that are considered in establishing a risk-based capital standard formula include creating the right incentives, avoiding disincentives, and understanding the impact of the formula in specific markets (geographic area, size, presence of specialty companies, etc.). Such considerations are largely market-specific, and we have not addressed them in this report.

U.S. Risk-Based Capital

The U.S. P/C RBC formula is simple to use, as defined above. To an outsider, however, the U.S. RBC formula is not easy to understand and requires a significant amount of data, including some that is not available in the NAIC Annual Statement.

The current RBC correlation structure, notably, the “square root rule,” the 50 percent “spread” of R_3 reinsurance risk, the asset concentration charge, and the 70 percent rule for line of business diversification all constitute judgments that were made when the formula was introduced.

If correlation factors could be calibrated with sufficient accuracy, the use of non-zero correlations, for example, between different top level risk charges and within the premium and reserve risk charges, might make the U.S. RBC formula more risk sensitive.[18]

Bermuda

The overall correlation structure in the current BSCR is similar to the U.S. RBC formula, and thus has similar potential advantages and disadvantages.

Canada

The Canadian correlation method is easy to understand. On the other hand, it is less risk sensitive than other systems in that it has a limited treatment of correlation with no explicit diversification calculation.

Australia

The Australian formula appears to take risk dependency into account to a greater degree than jurisdictions like Canada but less than Solvency II.

Solvency II (QIS 5)

Using the correlation structure within the square root can be risk sensitive, and evidence suggests that some of these risks are positively correlated. However, the calibration of the correlation matrices relies heavily on expert judgment and has not been validated.

Swiss Solvency Test

The SST is technically sophisticated, but it is also difficult to calibrate, to understand, and to explain to outsiders. Additionally, because it is substantially different from the other formulas, it is difficult to compare regulatory capital levels for Swiss entities to other entities in insurance groups located in other jurisdictions.

[18] Additionally, it is difficult to revise the correlation structure in the absence of aggregate calibration or calibration of individual charges to a specific level of a chosen risk measure.

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Friday, September 28, 2012

Alex Krutov
Chair, P/C Risk-Based Capital Committee
American Academy of Actuaries

Re: Methodologies for Combining Risk Charges

Dear Alex,

While much of the RBC research is on-going, the SMI RBC Subgroup would like to request the following more immediate output from the Academy's P/C RBC Committee. Would you please identify the risk correlation methodologies used in regulatory solvency capital requirements in other advanced regulatory jurisdictions, including Bermuda, Canada, Australia, EU, Switzerland, and any others deemed informative. Although we are not requesting an analysis of each method or a recommendation from the Academy on which to choose, any pros and cons (e.g. "simple to use" or "theoretically superior but difficult to use practically") of the applicability of individual methods for use in U.S. RBC would be welcome.

Would you be able to provide this information mid-November? The Subgroup will then discuss the alternatives and narrow the focus on methodologies to those with the best fit for U.S. RBC purposes, which may lead to a subsequent request for further Academy analysis and discussion.

Sincerely,

Alan Seeley, Chair, NAIC SMI RBC Subgroup

Cc: Peter Medley, Chair, NAIC Capital Adequacy Task Force