Response to
Larry Gorski's Dec. 15, 1997 Memo
on Common Stock
and the Covariance Adjustment

Presented to
NAIC Life Risk-Based Capital Working Group
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by

Life Risk-Based Capital Task Force
of the American Academy of Actuaries

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Preface

The Life Risk-Based Capital Task Force of the American Academy of Actuaries presented its "Report on the Treatment of Common Stock in the Life Risk-Based Capital" to the NAIC Life Risk-Based Capital Working Group at the December NAIC meeting. The report recommended a revised covariance treatment for common stock in the life risk-based capital formula. Following the meeting Larry Gorski addressed a number of questions on the report to the Academy Task Force in a memo dated Dec. 15, 1997. The Academy Task Force has prepared the following responses to those questions.

Q1: Are the indices used in the analysis appropriate? For example, does the Moody's Index reflect the default activity of private placements? Please see the attached discussion of the Frank Russell Index and its deficiencies.

A1: As a general matter the AAA task force has opted to take a conservative approach to the treatment of covariance in its recommendation. Unless there is strong evidence to support the independence of two risks, the risks are treated as perfectly correlated. In particular, in the case of real estate and mortgage loans where the data is problematical and the correlations with bond defaults are relatively high, the AAA proposal is to treat the interest rate and bond default risks as being perfectly correlated with the mortgage loan and real estate risks. Overall we are still conservative. The correlation assumption of 1 within C1o and between C1o and C3 is certainly conservative. Since this is where the risk is concentrated for the great majority of life insurers, this conservative assumption has a big impact which outweighs any small lack of conservatism that may exist by assuming a 0 correlation between C1cs and the rest of the risk factors under the radical in the RBC formula. This issue is discussed in more detail in Appendix I.

The Moody's index covers industrial and transportation companies, utilities, financial institutions, and sovereigns that issued long term debt to the public. Municipal debt issuers, structured finance transactions and issuers with only short-term debt ratings are excluded. The unit of study is the issuer rather than individual debt instruments or outstanding dollar amounts of debt.

While an issuer with only private debt outstanding is excluded from Moody's calculations, an issuer with both publicly traded debt and privately placed debt is included in the statistics in exactly the same manner as an issuer with only public debt. Thus privately placed debt is reflected in Moody's statistics

to some extent. Furthermore, most of the underlying factors that affect the likelihood of default are common to public and privately placed bonds. Thus, there is little reason to expect that the year-by-year incidence of defaults on privately placed bonds will be substantially different from that on public bonds, and even if it is different there is little reason to suppose that the privately placed bonds will have higher correlations to the other classes of assets.

The exclusion of municipal debt from Moody's statistics is not likely to affect the recommended covariance treatment. Once again, there is little reason to believe that default experience on municipal debt will be more correlated to the stock market than that of corporate bonds. The corporate bond market and the stock market at least have many issuers in common, whereas there is no such overlap in the case of municipals.

Finally, the effect of the exclusion of structured finance transactions is hard to estimate. A structured security can expose its owner to any type of risk that can be spelled out in a contract. Certainly equity-linked notes are more likely to be correlated to the stock market than simple corporate debt. However, even equity-linked notes will exhibit less than perfect correlations to the stock market since NAIC accounting allows principal protected equity-linked notes to be valued at amortized cost rather than at market. On the other hand, most of the structured securities presently held by insurers are CMO's which generally expose the holders to various degrees of interest rate risk. Since the accounting for fixed income securities will generally spread the gains and losses from movements in interest rates over many years, the risk to statutory capital associated with interest rate movements will probably not exhibit significant correlation to the movements of the stock market. In any case, a project is already underway to improve the quantification of the interest rate risk which should improve the treatment of this largest class of structured security.

Q2: Is the analysis dependent on the length of period for which data is used?

A2: The conclusions would not be substantially different if the data were restricted to more recent periods.

The correlation between the excess return on the S&P 500 and bond defaults is 12.7% over the period 1940 to 1996 versus the -.2% correlation over the period 1926 to 1996. This is still a relatively weak correlation, which is not significantly different from zero. Furthermore, for the period from 1960 to 1996 the correlation is actually negative at -9.6%.

The correlation between the excess return on the S&P 500 and the ACLI delinquency rate was -.6% over the period 1977 to 1996 versus -8.2% over the period 1965 to 1996.

The period of data available for real estate is quite short, and correlations observed over still shorter periods have very little statistical significance.

Q3: Does the data exhibit serial correlations? Would the results be different if a random sample of data points was used?

A3: Yes, there is significant serial correlation in the default data. The Academy Task Force was able to confirm this by examining the effect of randomly~~izing~~ rearranging the time sequence of the asset returns ~~the data~~ before calculating the correlations over multi-year holding periods. These correlation dropped back to near zero confirming that the correlation over longer holding periods is a result of serial correlation between the various time series.

More detailed analysis showed that the correlation between default activity and movements of the stock market is significantly higher (almost 50%) if a trailing average of stock market movements over a five year period is used. While this is not of direct relevance to insurer solvency since the statutory return of the insurer's overall portfolio over a particular holding period is the salient item~~will be impacted by the returns over coterminous holding periods of each of the constituent elements~~, it does imply that the correlations over longer holding periods will be higher than is indicated by the correlations derived from one year holding periods. The graphs in the Appendix of the Academy's original report, showing the returns over a two and three year holding period were prepared to address this problem. The following two charts extend that analysis to longer holding periods showing the correlation between bond survival rates and common stock returns in excess of Treasury Bills for holding periods from one to ten years. The first chart has starts the holding periods as of Jan. 1, 1926, while the second chart arranges the holding periods so that they all end on Dec. 31, 1996.

The correlations for longer holding periods indicate a higher correlation than the near zero correlation for a one ~~h~~year holding period. Unfortunately, the data becomes more sparse as the holding period is increased resulting in rather wide uncertainty intervals for the longer holding periods.

By using the excess market return for corporate bonds instead of the default experience much of the serial correlation and delay can be removed from the bond data. Such data might be directly relevant to an insurer that actively trade its portfolio.

Approaching from this avenue is somewhat difficult in that the total returns on corporate bonds reflect not just credit changes but also movements in the overall level of interest rates. The risk-based capital formula includes only the credit component in the C1 section of the formula and assigns the interest rate risk portion to the C3 section of the formula which considers the liabilities as well as the assets. Thus, it is necessary to isolate the credit component of the market value movements of bonds and use that component to quantify the volatility and correlations of bonds to other types of risk.

Ideally, this would be calculated by determining the return on each corporate bond over the return on a matched series of riskless cash flows. Such a calculation would require a detailed analysis of all of the bonds in the Ibbotson universe which is a project beyond the Task Force's capabilities and budget. As an approximation a portfolio of long term and intermediate term governments that explains as much of the variation in corporate returns as possible was determined. If the returns on this portfolio are then subtracted from the returns on corporate bonds, the residual can be identified as the component of the return attributable to credit risk. ~~Once a~~ This proxy for the credit risk ~~has been identified it can be~~ is used to determine ~~its~~ correlations to the excess returns on common stock. Using annual returns for the period 1926-1996 this correlation is 36%.

Q4: Insurers hold varying amounts of mortgage backed securities (MBS). Write downs of MBS are not reflected in the default experience but do impact the insurer's statutory financial statement. Was this fact considered during the process of developing the recommendation.

A4: Nearly all of the risk associated with mortgage-backed securities is associated with the interest rate risk. About the only way to improve the quantification of this risk is through cash flow testing, and as mentioned before a project is already underway to use cash flow testing to quantify the C3 risk. The task force has taken the conservative approach to the covariance treatment of the C3 risk since it is assumed to be perfectly correlated with the C1o risk which is usually the largest risk in a life insurer's portfolio.

Q5: Insurers hold securities where principal is at risk for reasons other than credit. Examples are catastrophe bonds and equity-linked securities. Was this fact considered during the process of developing the recommendation?

A5: The task force did not devote much consideration to the issue of equity-linked notes (ELN's), since the task force judged them to be a relatively minor component of insurer portfolios. However, the task force recognizes that these investment classes may become more important in the future. The task force believes that the best way to address this issue and other similar issues is to assure the homogeneity of each category of risk within the risk-based capital formula. Homogeneity is important for the assignment of factors as well as the assessment of correlation. If assets with significant risk are placed in the low-risk bond category then RBC will be understated whatever the covariance formula.

Assuming that factor for ELN's is appropriate, then the proposed covariance treatment, which assumes that the ELN risk is perfectly correlated to the other risks within the C1o plus C3 category, will be conservative for those insurers for whom this category of risk predominates. Almost all life insurers fall into this category.

Q6: Why was default frequency but not default cost considered in the analysis?

A6: Because the primary focus of the task force's recommendation is the correlation assumption, the task force needed a relatively long series of default data. Furthermore, the task force needed data that is broken down by rating in order to normalize the time series. The study produced by Moody's is the longest such series known to the task force. As noted in **A1** above, the unit of study in Moody's data is the issuer rather than individual debt instruments or outstanding dollar amounts of debt. Moody's justifies this procedure as follows:

> "Because Moody's intends its ratings to support credit decisions, which do not vary with either the size or number bonds that a firm may have outstanding, we believe this methodology produces more meaningful estimates of the probability of default. Because the likelihood of default is essentially the same for all a firm's public debt issues, irrespective of size, weighting our statistics by the number of bond issues or their par amounts would simply bias our results towards the characteristics of large issuers."

Moody's normalizes its data so as to use the actual or inferred rating of the issuer's senior unsecured debt to classify the issuer.

The task force has examined a shorter times series covering the time period 1971-1996 produced by Ed Altman which allows for the calculation of default losses by amount. Based on this data the correlation between the excess returns on common stock and the bond survival rate by amount is -9.4%.

Note that the credit component of the market returns on corporate bonds calculated in the answer to question 3 includes the effect of loss size and frequency as well as the effect of serial correlation. As noted earlier, the correlation between common stock and this credit component of the bond total returns is 36% over the period 1926-1996.

Q7: Why is the measure of gain/loss for common stock relative to the risk free rate and not on an absolute basis? If nothing else, the charts in Appendix I would appear different.

A7: The focus of any risk study is the fluctuations around the expected level. In the case of common stock a strong case can be made that the level of expected return moves in tandem with the level of interest rates. Furthermore, insurer obligations to policyholders tend to move up or down with the level of interest rates. Thus, the task force decided that the best measure of the risk associated with common stock is the return in excess of the risk free rate. Since the coupon on fixed income investments moves up or down with interest rates, no similar adjustment is necessary in the case of default data.

The use of raw stock returns does not significantly alter the results:

- the correlation between the unadjusted S&P 500 and bond survival rates is -2.67% using annual data over the period 1926 to 1996,
- the correlation between the unadjusted S&P 500 and mortgage loan survival rates is -4.41% using quarterly data over the period 1965 to 1996, and
- the correlation between the unadjusted S&P 500 and real estate returns is -6.81% using quarterly data over the period 1979 to 1996.

Q8: Since the risk profile of an insurer's common stock may differ from the S&P 500, why wasn't there an attempt to normalize the common stock risk measure similar to what was done for bonds.

A8: Variations in the average ratings of bonds held by an insurer are automatically picked up in the risk-based capital formula. Therefore the task force focused on the year-to-year variability of the risk normalized for the rating. At one point, the NAIC working group considered a beta adjustment to the factor used for common stock which would have caused an insurer RBC requirement to vary according to the relative riskiness of its common stock portfolio. (The original version of a proposed beta adjustment is contained in Appendix II.) However, the working group decided that the beta adjustment did not make a material difference in the results and no such adjustment was incorporated into the formula. In effect the current formula assumes that every insurer holds a portfolio similar to the S&P 500. The correlation calculations are consistent with this assumption.

Although the task force originally recommended that the issue of a beta adjustment be deferred until such time as the factor is reexamined, it is not opposed to a beta adjustment and thinks that the formula would be more accurate (albeit more complicated) with such an adjustment. Most companies are already making such an adjustment in the calculation of the AVR, and the remaining companies are willing to hold a relatively high AVR requirement rather than go through the details of the calculation. The task force's covariance recommendation would not be affected by the introduction of such an adjustment.

The Academy Task Force also examined a subsidiary question associated with the beta adjustments, namely, whether high beta portfolios exhibit different correlation characteristics with bond defaults than the S&P 500 does. The Task Force used the small stock series compiled by Ibbotson which has a beta of 1.36 over the period 1926-1996 as a representative high beta portfolio. The excess returns on this small stock series have a correlation of -2.64% with bond defaults which is not significantly different than the -.2% correlation between the S&P 500 and bond defaults.

Q9: Since the risk measure for RBC is the impact on statutory surplus, why wasn't the smoothing effect of the AVR considered? Unrealized gains and losses on bonds were not considered because they generally do not affect statutory surplus. Shouldn't this same thinking apply to common stock and the AVR?

A9: The decision to exclude the smoothing effect of the AVR is part of the decision of the designers of the RBC formula to treat the AVR as a part of Total Adjusted Capital (TAC). Therefore risk was defined to be the risk to TAC, not statutory surplus. Generally market gains and losses on bonds do not affect TAC unless they are recognized (either at the time of sale or

impairment) and classified as credit-related. Therefore the risk associated with bonds is limited to default losses. On the other hand, unrealized gains and losses on common stock do affect TAC and are considered part of the risk associated with common stock.

Appendix I - Simplified Covariance Models

The risk-based capital formulas for both property/casualty insurers and life insurers have taken a simplified approach to the quantification of the effect of covariance on risk capital requirements. This appendix will attempt to demonstrate that the simplifications implicit in the current approach to the life formula are conservative in nature.

Theoretical Model of Covariance

For the sake of generality assume that there are *n* different components of an insurer's profits over the time period chosen for risk-based capital purposes: x_1, x_2, ..., x_n. The profit over that period is simply the sum of the individual profit components.

For instance, x_1 might be the excess of the spread available to fund defaults over the actual default loss in any given year, x_2 might be the excess of the actual return on common stock over the amount needed to support the liabilities, etc. The design goal of risk-based capital is to determine the amount of capital that provides an approximately a 95% level of confidence that the capital will be sufficient to absorb any losses over the relevant time period. Thus,

It is impractical to calculate this requirement for each insurer directly from the data for the individual profit components. Instead a determination is made of the 95% confidence level for each individual profit component and then these individual capital requirement are combined in the same manner as they would be combined under the assumption that the profit components are distributed according to a joint normal distribution. We make the simplifying assumption that the 95th percentile is *f* standard deviations above the sample mean. (In the case of normal distributions *f* is approximately 1.65) Thus

where is the expected profit from the i^{th} component and is the standard deviation of the total profit which can be derived from the standard deviations and correlations of the individual components as follows:

where is the standard deviation of component *i* and is the correlation between the component *i* and component *j*. Substituting this last equation in the expression for RBC gives:

Expected Profits

Any insurer conducting a reserve adequacy analysis would almost certainly have to strengthen its reserves if it projects negative expected profits. Furthermore, even those insurers exempt from an asset adequacy analysis would likely charge for placing their capital at risk and in addition set up reserves that are more conservative than their pricing basis. Thus, the designers of the risk-based capital

formula decided to make the conservative assumption that is zero for every risk other than the C0 and C4 which were both treated as though they were certain losses. Under these assumptions the formula for risk-based capital reduces to:

Furthermore, on a standalone basis the risk-based capital requirement for any risk

other that C0 and C4 becomes . This relationship can be substituted into the RBC formula to give:

Sample Calculation Using Industry Data

We will now use the risk-based capital data for the industry in 1993 to estimate the effect of the simplified assumptions used in the proposed life formula.

The following table gives a breakdown of the risk based capital requirement before adjustment for covariance.

Affil. Ins Stock	C0	21%
Bonds and Unaffiliated Pref. Stock	C1o	14%
Mortgage Loans	C1o	10%
Real Estate (incl. RE on Sch. BA)	C1o	10%
Unaffil. and Affil. Non Ins. CS (incl. CS on Sch. BA)	C1cs	13%
Interest Rate Risk	C3	11%
Mortality and Morbidity	C2	18%
General Business Risk	C4	3%
Total		100%

To obtain the correlations between various asset categories for use in the above formula, we used annual data for the period 1978 to 1996, which is the longest period for which data is available for all of the asset categories. The sources of the data are as follows:

Risk Category	**Source**
Bond Survival Rates	Moody's
Mortgage Loan Survival Rates	ACLI
Real Estate Returns over T-Bills	Frank Russell Index
Common Stock Returns over T-Bills	Ibbotson
Interest Rate Risk - Intermediate Gov't Returns over T-Bills	Ibbotson

Depending on the relationship between a company's assets and liabilities it may be exposed to the risk of either rising or falling interest rates. Therefore we use two different correlation matrices one assuming a long position in Government bonds and the other assuming a short position. The correlations are displayed in the following table:

Correlations for Period 1978-1996

Annual Data

	Bonds and Unaffiliated Pref. Stock	Mortgage Loans	Real Estate (incl. RE on Sch. BA)	Unaffil. and Affil. Non Ins. CS (incl. CS on Sch. BA)	Interest Rate Risk Long (Short)	Mortality and Morbidity[1]
Bonds and Unaffiliated Pref. Stock	1.0000	0.2322	0.7945	-0.1015	-0.4829 (.4829)	0.0000
Mortgage Loans	0.2322	1.0000	0.6472	-0.0258	-0.1041 (.1041)	0.0000
Real Estate (incl. RE on Sch. BA)	0.7945	0.6472	1.0000	0.0527	-0.4614 (.4614)	0.0000
Unaffil. and Affil. Non Ins. CS (incl. CS on Sch. BA)	-0.1015	-0.0258	0.0527	1.0000	0.4297 (-.4297)	0.0000
Interest Rate Risk Long (Short)	-0.4829 (.4829)	-0.1041 (.1041)	-0.4614 (.4614)	0.4297 (-.4297)	1.0000	0.0000
Mortality and Morbidity[1]	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000

With the above assumptions for risk distribution and correlations the theoretical RBC formula derived above gives risk-based capital requirements of 59% of the simple sum of the risks assuming the insurer's assets are longer than its liabilities and 63% assuming its assets are shorter. In contrast, the current risk-based capital formula gives a requirement of 85%, and the proposed formula which treats common stock as a risk independent of C1o plus C3 gives a requirement of 74%.

The rather large margin between the result under the proposed formula and the result under the theoretical formula means that the risk-based capital requirements under the proposal are likely to be conservative even if some of the correlations have been underestimated. For instance, if common stock has a 40% correlation with bonds and mortgage loans the theoretical formula still predicts a requirement of 63% when assets are longer that liabilities and 67% when assets are shorter.

Appendix II - Beta Adjustment for Common Stock
(From 1994 Workpapers of Academy Life RBC Task Force)

The following presents a recommendation of a basis for a beta adjustment for the Life RBC unaffiliated, publicly-traded common stock, including those issues listed in Schedule BA:

1. For each company whose unaffiliated, publicly-traded common stock represents 1% or more of total invested assets, Beta is calculated for the unaffiliated common stock portfolio using the approach now in place for the AVR beta calculation. The adjustment developed from this calculation is applied to the current Life RBC unaffiliated common stock factor of 30% subject to a minimum beta adjusted factor of 22.5% and a maximum of 100%.

   The minimum, 22.5%, is 75% of the current 30% factor, the same relative minimum level as that specified for the AVR beta adjustment. The maximum, 100%, represents the largest loss amount that a company could experience with respect to this asset.

2. Companies whose unaffiliated common stock holdings are less than 1% of total invested assets (line 10A in the annual statement blank) have the option of calculating beta, as described in paragraph 1, above or using the following formula-based factor which depends upon the number of different stock issues included in the portfolio:

(a) for company investments in stock mutual funds holding unaffiliated publicly-traded common stock the RBC factor is 30%

(b) for the aggregate of individual issues of unaffiliated, publicly- traded common stock other than those held in a mutual fund

Life RBC Factor = larger of

50% minus 0.1%x(# issues)

and

30%

This formula approximates the dampening effect of diversification on the standard deviation of market value changes. It is proportional to 1 divided by the square root of n, where n is the number of issues included in the portfolio. The maximum of 50% was chosen as representative of the level of RBC needed to cover all but a very small proportion of potential variations in typical insurance company unaffiliated, publicly-

traded common stock portfolios. The minimum of 30% was chosen as an adequate requirement based upon 2,000 randomly determined portfolios each containing 200 issues of all stocks available in the United States.

The following abbreviated table illustrates the factors which result from using this formula for various, selected portfolio sizes:

# Issues	Factor
20	48%
100	40
150	35
200 & more	30

[0] Mortality and morbidity are assumed to be independent of the other risks.