Memorandum

To: NAIC Investment Risk Based Capital (RBC) Working Group (IRBCWG)
From: Kevin Fry – Illinois Department of Insurance
Date: July 10, 2013
Re: Life Insurer C-1 Asset Risk-Based Capital Requirement - Common Stock

Executive Summary

In support of the goals of the IRBCWG we applied the most relevant knowledge and experience to a review of RBC asset charges for life insurer investment in common stock. We held a series of working sessions of industry specialists, NAIC capital market experts and regulators. All of the components specific to common stock in the current RBC calculation were reviewed. It has been over 10 years since any elements of the life common stock RBC approach have been changed or updated.

The primary method of evaluating the risk was a stochastic analysis. In addition, the historical-based analysis that was used in the original factor development was updated. Key assumptions for both methods included how loss was measured and the desired confidence level. For the historical-based method, a key assumption was the data period.

Both the stochastic and historical analyses supported a recommended capital factor of 30% for unaffiliated common stocks. This capital requirement was set to cover the worst cumulative loss during a two year time period where quarterly intermediate returns were considered. The confidence level for the stochastic analysis was based on a 90\% conditional tail expectation (CTE90). This capital level was also sufficient to cover the 95\textsuperscript{th} percentile worst historical losses since 1946.

We also recommend the continued use of beta in order to distinguish insurers with public common stock portfolios with more volatility, from those with less.

Scope

The NAIC (C-1) asset risk based capital requirement for unaffiliated public and private common stocks is 30\% of statement value for life insurance companies. A beta adjustment is applied to the unaffiliated public common stock factor. Since beta for unaffiliated private common stocks cannot be calculated due to the lack of a suitable benchmark, no beta adjustment is made.

The risk-based capital factor is also adjusted for concentration of the 5 largest holdings, covariance, and taxes. These adjustments were not addressed by this subgroup.

This paper describes the analysis and proposes recommendations for unaffiliated public common stocks, unaffiliated private common stocks, assets with the characteristics of common stock held in partnerships or other entities reported on Schedule BA of the annual statement and for the beta adjustment.
A. Background on the 1993 Factor Development

The 30% factor was based on the following:

- **Data Used:** Historical Monthly S&P 500 Total Return Data from October 1960 to December 1991.
- **Loss Methodology:** Beginning each month in the historical period, the worst cumulative return over the next 24 months was determined. In other words, the worst cumulative loss was the capital amount needed so there would be sufficient assets after every month in the 24 month period. The same process was then used for the 24 month period beginning in the subsequent month. In total, there were 350 twenty-four month periods in the October 1960 to December 1991 data period.
- **Confidence Level:** The common stock equity factor was based on the 94th percentile worst loss over the 350 twenty-four month periods.

The result of the calculation was a 94th percentile loss of 29.65% which was rounded to 30%. Some documentation of the development was contained in the “Report on the Treatment of Common Stock in the Life Risk-Based Capital Formula” drafted by the American Academy of Actuaries Life Risk-Based Capital Task Force (December 6, 1997).

B. 2013 Review of Base Factor

A stochastic analysis was performed. The details of the stochastic analysis are described in Appendix A. In general, the risk was evaluated over sets of 10,000 scenarios using both the Academy Economic Scenario Generator (AAA ESG) and a two-regime switching log-normal scenario generator (RSLN2). The scenario sets from both generators met the NAIC calibration criteria.

The 1993 approach of basing the risk-based capital on a percentile loss of historical S&P 500 returns was also updated by the 2013 subgroup.

The main inputs for the calculations and the approaches considered were as follows:

- **Data Period for Historical Analysis:** (1) 1926-2012, (2) 1946-2012, (3) 1960-2012, and (4) 1982-2012
- **Loss Methodology:**
  - **Loss Horizon:** (1) 12 month and (2) 24 month
  - **Loss Interval:** (1) Worst return considering intermediate points (for this approach using monthly and three-month intervals were considered), (2) Return from beginning of period to end of period.
- **Confidence Level:** (1) 92%, (2) 94%, and (3) 95% percentiles were considered for the historical analysis. For the stochastic analysis, a range of confidence levels based on percentile losses and conditional tail expectations (CTE’s) were considered.

**Data Period Used for the Historical Analysis**

Table 1 outlines the pros and cons of each time period that were identified in the subgroup’s discussions.
### Table 1: Historical Data Period Discussion Points

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1926-2012</td>
<td>Longest time period where data is available.</td>
<td>The Great Depression and World War II years may not be representative of the modern stock market era. After the Great Depression, there was establishment of the Securities and Exchange Commission and a more active Federal Reserve.</td>
</tr>
<tr>
<td>1946-2012</td>
<td>Longest time period that excludes the two periods that may skew results (Great Depression and World War II years).</td>
<td>No strong concerns expressed.</td>
</tr>
<tr>
<td>1960-2012</td>
<td>This would use a starting date the same as the last study and include all data to the present.</td>
<td>Excludes the period from 1946-1960 (no strong reason to exclude).</td>
</tr>
<tr>
<td>1982-2012</td>
<td>Like the prior study, this would use the 30 years prior to the present.</td>
<td>This period represents a prolonged decreasing interest rate environment and may not robustly capture enough different economic cycles. If the approach of using the last 30 years prior to the study date is always used, risk based capital for common stocks could change significantly upon each review.</td>
</tr>
</tbody>
</table>

**Recommended Approach:** Use the historical period from 1946 to 2012. The main reasons were:

- The 1946-2012 period contains a variety of economic environments with both rising and falling interest rates. It is not dominated by one persistent interest rate trend as the period 1982 and later.

- There is no clear reason (other than the Great Depression and World War II years) to exclude other historical data. Table 2 shows returns and volatility for different historical time periods since 1946. The historical returns since 1946 showed a robust range of returns and volatility.
Table 2: Historical Total Return and Volatility

<table>
<thead>
<tr>
<th>Period</th>
<th>Annualized Total return</th>
<th>Volatility of Rolling Annual Returns</th>
<th>Volatility of Calendar Year Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946 - 1959</td>
<td>15.08%</td>
<td>16.71%</td>
<td>18.73%</td>
</tr>
<tr>
<td>1960 - 1969</td>
<td>7.81%</td>
<td>12.29%</td>
<td>14.39%</td>
</tr>
<tr>
<td>1970 - 1979</td>
<td>5.86%</td>
<td>15.88%</td>
<td>19.21%</td>
</tr>
<tr>
<td>1980 - 1989</td>
<td>17.55%</td>
<td>17.71%</td>
<td>12.69%</td>
</tr>
<tr>
<td>1990 - 1999</td>
<td>18.20%</td>
<td>11.37%</td>
<td>14.17%</td>
</tr>
<tr>
<td>2000 - 2012</td>
<td>1.66%</td>
<td>18.93%</td>
<td>19.05%</td>
</tr>
<tr>
<td>1946 - 2012</td>
<td>10.67%</td>
<td>16.91%</td>
<td>17.30%</td>
</tr>
<tr>
<td>1960 - 2012</td>
<td>9.53%</td>
<td>16.83%</td>
<td>16.90%</td>
</tr>
<tr>
<td>1980 - 2012</td>
<td>11.20%</td>
<td>17.87%</td>
<td>17.15%</td>
</tr>
<tr>
<td>1991 - 2012</td>
<td>9.11%</td>
<td>17.93%</td>
<td>18.69%</td>
</tr>
</tbody>
</table>

- If risk-based capital was always based on 30 year periods, there could be significant changes each time the factor was reviewed. Using the 30 year periods ending over each of the last 5 years and the same methodology as the original factor development, the risk-based capital would vary from 27.1% to 40%. In Appendix B.1, risk-based capital factors are shown for the 30 year periods ending in 1991 through 2012.

Loss Method

Loss Horizon

Twelve and twenty-four month periods were considered. An argument for using a twelve month period was that since stocks are marked to market, the full surplus impact is reflected each reporting period. As such, a company may choose to reduce equity exposure as the market declines, well before a twenty-four month period has elapsed. An argument for using a twenty-four month period is that it adds a material margin of conservatism into the calculation by assuming that companies may choose to hold stock portfolios and not actively manage the risk positions in their portfolios over a full twenty-four month period.

We also considered holding periods longer than 24 months. In general, the risk based capital needs increased at a slowing rate after two years when basing the capital on the worst loss during the period. When considering only endpoints, the risk-based capital requirement decreases as the time period increases. Capital requirements
by loss horizon are shown for the stochastic and historical-based methods in Appendix A.3 and Appendix B.2, respectively.

**Recommended Approach:** Continue to use a two year loss horizon. The objective of allowing a margin of conservatism was still considered valid. Extending the period beyond two years was not considered necessary since the capital requirement increases slow considerably for longer periods when intermediate losses are considered or decline if only endpoints are considered.

*Loss Interval*

This refers to how often the capital need is measured in each of the time periods. The approaches considered were as follows:

- Base the capital requirement on the capital needed to have no deficiencies at any month over the 24 month period. This was the approach used in the 1993 factor development.
- Base the capital requirement on the capital needed to have no deficiencies measured at every three month period over the loss horizon. This approach was considered because statutory reporting is done no more frequently than quarterly.
- Base the capital requirement on the capital needed to have no deficiencies measured from the beginning to end of the loss horizon (i.e. intermediate losses are not considered).

**Recommended Approach:** Use three month intermediate loss intervals. Considering only the beginning to the end of the loss horizon may result in insufficient capital at some intermediate quarterly periods. However, it was thought that considering monthly intervals was too conservative since it captures very short term volatility that likely would not impact a company’s reported capital position.

In Appendix B.3, the arguments considered in the development of the 1993 methodology are provided.

*Confidence Level*

The original 1993 work based the capital requirement on the 94th percentile. In the 2013 review, various confidence levels were considered. For the historical analysis, the 92nd, 94th, and 95th percentile confidence levels were considered. Several percentile and CTE measures were considered for the stochastic analysis.

**Recommended Approach:** Base the risk-based capital requirement on CTE90 of the stochastic scenarios. This standard has been used in determining capital requirements under C3 Phase 2. The capital requirement set based on CTE90 was also sufficient to cover the 95th percentile loss of the historical analysis. The 95th percentile confidence level was thought to be a more standard statistical measure (two standard deviations event) versus the original 94th percentile confidence level.
Results Summary

Stochastic Analysis

Table 3 below shows the capital requirement under the two different scenario generation methods for the time horizon and loss intervals considered. The capital needs shown use a 90% conditional tail expectation. How the capital requirement changes by confidence level, loss horizon, and loss interval is provided in Appendix A.

Table 3: Unaffiliated Common Stock Capital Need (as a % of asset value) based on CTE90

<table>
<thead>
<tr>
<th>Loss Horizon</th>
<th>Loss Interval</th>
<th>AAA ESG</th>
<th>RSLN2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year</td>
<td>Monthly</td>
<td>23.4%</td>
<td>25.7%</td>
</tr>
<tr>
<td></td>
<td>Quarterly</td>
<td>22.0%</td>
<td>24.5%</td>
</tr>
<tr>
<td>2 years</td>
<td>Monthly</td>
<td>29.0%</td>
<td>32.4%</td>
</tr>
<tr>
<td></td>
<td>Quarterly</td>
<td>27.5%</td>
<td>31.0%</td>
</tr>
</tbody>
</table>

Historical Analysis

Table 4 shows the capital requirement using the various approaches considered for the four historical time periods as well as the time period used for the 1993 factor development.

Table 4: Unaffiliated Common Stock Capital Need (as a % of asset value)

<table>
<thead>
<tr>
<th>Data Range (1)</th>
<th>Time Horizon</th>
<th>Monthly Loss Interval</th>
<th>Quarterly Loss Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>92nd p-tile 94th 95th</td>
<td>92nd p-tile 94th 95th</td>
</tr>
<tr>
<td>1960-1991</td>
<td>1 year</td>
<td>19.38% 20.87% 22.86%</td>
<td>16.04% 17.81% 19.47%</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td>26.02% 29.20% 30.83%</td>
<td>22.26% 25.16% 26.31%</td>
</tr>
<tr>
<td>1946-2012</td>
<td>1 year</td>
<td>19.38% 21.84% 23.24%</td>
<td>17.07% 19.47% 20.49%</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td>28.16% 32.74% 36.13%</td>
<td>25.68% 29.26% 30.83%</td>
</tr>
<tr>
<td>1960-2012</td>
<td>1 year</td>
<td>21.52% 23.38% 25.66%</td>
<td>18.66% 20.91% 22.68%</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td>32.29% 36.39% 38.87%</td>
<td>29.20% 32.16% 34.57%</td>
</tr>
<tr>
<td>1982-2012</td>
<td>1 year</td>
<td>21.98% 24.39% 26.96%</td>
<td>19.54% 21.98% 23.63%</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td>34.24% 40.05% 41.48%</td>
<td>32.16% 36.35% 38.09%</td>
</tr>
<tr>
<td>1926-2012</td>
<td>1 year</td>
<td>24.39% 28.36% 32.36%</td>
<td>21.91% 24.97% 29.58%</td>
</tr>
<tr>
<td></td>
<td>2 years</td>
<td>37.31% 42.01% 44.88%</td>
<td>33.95% 38.95% 41.32%</td>
</tr>
</tbody>
</table>

Notes:
1. 1960 to 1991 data range is October 1960 to December 1991, the range used in the 1991 study. For data ranges ending in 2012, we used values up to September 2012.
2. This value represents the value from the 1991 study. Note that the value is slightly different from 29.65%, the reported value for the 1991 study.
The formulas used to determine the capital amount, the historical S&P 500 returns, and an illustration of how the capital requirement varies by time horizon is provided in the Appendix A.

C. Recommendation for Base Factor

Maintain the capital requirement at 30%. The stochastic analysis produced a range of 27.5% to 31.0% for the CTE90 measure. This is based on the two year loss horizon and quarterly loss intervals. The 30% requirement is also consistent with a 95th percentile loss, a two-year loss horizon and quarterly loss intervals using the 1946 to 2012 historical period. (Based on the above assumptions, the factor from the historical analysis was 30.83% but was viewed as not materially different from the current 30% factor.)

Supporting observations:

- The capital factor covers losses over a two year period. While there were strong arguments to use a one-year period, using a two year period provides a safety margin to withstand market downturns lasting longer than a year and does not force liquidation of a common stock portfolio. These advantages were also noted in the original factor development.
- A CTE measure more fully reflects the tail risk of the distribution. CTE90 is also the measure used in determining regulatory capital requirements under C3 Phase 2.
- Using a three month interval for measuring losses is consistent with the frequency of statutory reporting.
- A capital factor of 30% exceeds the one-year 95th percentile losses based on any of the post Great Depression data ranges that were considered. This is another way to note a margin of safety over a capital requirement based on a one-year period.
- Using the 1946-2012 data range for the historical analysis, the 95th percentile results across the different loss horizons and intervals considered ranged from 20.49% to 36.13%. A 30% factor is on the conservative side of this range.

D. Review of Beta Adjustment

The base factor measures the risk in S&P 500 investments. A company’s portfolio may be different than the S&P 500, and can have a higher or lower risk. This risk can be measured by the beta of that company’s portfolio. Beta measures how sensitive the return of a specific portfolio is to changes in market return on a historical basis. Here ‘market’ is represented by S&P 500, for which, by definition, beta is one.

In the current RBC calculations, the factor for a company-specific portfolio is the base factor multiplied by its beta. This adjusted factor is then capped at 45% and floored at 22.5% before being applied to financial statement values.

We reviewed two main aspects of the beta adjustment. The first was to determine if the beta adjustment creates a meaningful range across companies’ common stock factors. The second aspect was is to determine if the cap and floor on the factor needed any adjustment.
To study these, we used data provided by the NAIC for 2011. The data consisted of the statement value and public common stock risk-based capital amounts for 363 unidentified companies. To determine the beta reported by each company, the ratio of the public common stock risk-based capital to the statement value was calculated. A scatter plot of this ratio against the total public common stock statement value of each company showed how the beta values varied by company size. This plot is shown in Graph 1 of Appendix C. The scatter plot exhibits a range of factors between the limits of 22.5% and 45% with clustering at the upper and lower limits of 45% and 22.5%, and at the base factor of 30%. At the upper limit, the clustering is mostly from companies with smaller portfolios, and may be the result of these companies choosing not to calculate beta because of the less material nature of their stock portfolios. Notwithstanding the clustering at the limits, from the range of factor values, one can reasonably conclude that the beta adjustment does add meaningful differentiation to the companies’ risk-based capital requirement for public common stock.

To understand the extent to which the maximum and minimum factors are impacting common stock risk-based capital, in addition to 2011 we graphed the industry-wide common stock exposure at the limits for 2009 and 2010. This graph is shown in Appendix C, Graph 3.

The graph shows that there is a large proportion of total exposure at the lower limit of 22.5%. This suggests that the lower limit may be increasing risk-based capital over and above what it would be without the lower limit, thus adding a level of conservatism. Continuing with the same lower limit and resulting conservatism seemed reasonable, so no change was recommended.

At the upper limit, the proportion of exposure is relatively small. As mentioned before, this portion consisted of several smaller exposures possibly defaulting to the upper limit because beta is not being calculated. One view, in such cases, is to think of the limit as a penalty for not calculating beta. Increasing the limit would arbitrarily increase this penalty; therefore, continuing with the same upper limit was thought to be valid.

E. Recommendation for Beta Adjustment

Maintain the beta adjustment for public unaffiliated common stocks with a minimum of 22.5% and a maximum of 45%. The beta adjustment provides meaningful differentiation of companies’ risk-based capital for common stock with the limits providing reasonable minimum and maximum capital requirements.

F. Review of assets with the characteristics of common stock (Schedule BA)

To get an understanding of the risk, we looked at the volatility of a custom private equity portfolio. This portfolio consisted of US limited partnership funds, foreign limited partnership funds, US direct private equity, and foreign direct private equity. This portfolio had index data available on a quarterly basis. The annualized standard deviation of this portfolio, corrected for lag 1 serial correlation, was not significantly different from that of the S&P 500. A lag was considered because private equity returns often are based upon the partnership’s financially reported results on a quarterly lagged basis. The details of this comparison are shown in Appendix D. This suggests a private equity portfolio has risk consistent with the S&P 500 with a beta of one.
There was also some discussion of basing the unaffiliated private equity factor on an industry-wide weighted average of unaffiliated public common stocks. Such an approach differs from the above in that it does not assume a beta of one, but it assumes that the industry as a whole would behave such that the private equity risk would equal that of public equity. The weighted average for 2011 was 31.8%. The positive beta adjustment may be influenced by companies electing to forego the beta calculation and opting to default to the upper cap.

The following concerns were discussed regarding the use of an industry-wide weighted average approach. (1) would penalize large companies who likely have betas close to one because of the size of their portfolios, (2) wouldn’t differentiate between companies, and (3) there’s no basis to conclude that the insurance industry purchases riskier private equity than what is generally available in the marketplace. Because of these concerns, it was decided not to pursue this approach.

G. Recommendation for assets with characteristics of common stocks (Schedule BA)

Continue to use the factor for unaffiliated public common stocks with a beta of 1. The analysis of public versus private common stocks did not show an asset risk for private common stock different than the market. There also has not been evidence that companies try to use Schedule BA to avoid a beta adjustment. Additionally, the portion of schedule BA assets has not changed dramatically for the industry since 2008.
Appendix A - Stochastic Analysis

1. Results By Confidence Level

This appendix highlights the analysis that has been completed using stochastically generated scenarios. Two different stochastic generators were used:

1. The Academy Economic Scenario Generator (AAA ESG) (version 7.0.4). The stochastic scenarios used were based on US diversified equity returns.
2. A regime switching lognormal distribution with two regimes (RSLN2). Historical S&P returns from 1946-2012 were used to develop the regime parameters.

Using each generator, ten thousand scenarios were produced. Based on the methodology described in memo, the worst cumulative loss was determined over a two year period where returns were measured in quarterly intervals.

The table below shows the percent loss factors by confidence level under both stochastic generators. Losses are shown on a percentile and conditional tail expectation (CTE) basis:

<table>
<thead>
<tr>
<th>Confidence Level</th>
<th>Using AAA ESG v7.0.4</th>
<th>Using RSLN2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentile</td>
<td>CTE</td>
</tr>
<tr>
<td>60.00%</td>
<td>5.4%</td>
<td>15.3%</td>
</tr>
<tr>
<td>65.00%</td>
<td>7.1%</td>
<td>16.7%</td>
</tr>
<tr>
<td>70.00%</td>
<td>8.8%</td>
<td>18.1%</td>
</tr>
<tr>
<td>75.00%</td>
<td>10.8%</td>
<td>19.8%</td>
</tr>
<tr>
<td>80.00%</td>
<td>13.0%</td>
<td>21.7%</td>
</tr>
<tr>
<td>85.00%</td>
<td>15.8%</td>
<td>24.2%</td>
</tr>
<tr>
<td>90.00%</td>
<td>19.6%</td>
<td>27.5%</td>
</tr>
<tr>
<td>92.00%</td>
<td>21.5%</td>
<td>29.2%</td>
</tr>
<tr>
<td>95.00%</td>
<td>25.8%</td>
<td>32.6%</td>
</tr>
<tr>
<td>97.00%</td>
<td>29.4%</td>
<td>36.1%</td>
</tr>
<tr>
<td>98.00%</td>
<td>32.2%</td>
<td>38.8%</td>
</tr>
<tr>
<td>99.00%</td>
<td>37.2%</td>
<td>43.2%</td>
</tr>
</tbody>
</table>

2. Stochastic Analysis Calibration

As prescribed in C3 Phase II, the calibration is based on the comparison of the Gross Wealth Ratios to those of the S&P 500 total gross returns. Gross wealth ratios are defined as gross accumulated values with complete reinvestment of

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1 Maximum likelihood estimates were used based on "A Regime Switching Model of Long Term Stock Returns" by Mary Hardy. North American Actuarial Journal, Volume 5 Number 2. For 1946-2012, regime 1 parameters are $\mu = .013$, $\sigma = .03379$, regime 2 parameters are $\mu = -.01258$, $\sigma = .06365$, and transition probabilities are .0433 from regime 1 to regime 2, and .18493 from regime 2 to regime 1.
income and maturities, starting with a unit investment. Under the prescribed calibration criteria, Gross Wealth Factors for percentiles less than 50% may not exceed the calibration value corresponding to the percentile. Gross Wealth Ratios for percentiles greater than 50% may not be less than the calibration value corresponding to the percentile.

The scenarios generated from the Academy Economic Scenario generator met the calibration criteria. The scenarios generated for the regime switching model also met the calibration criteria after an adjustment was made to the mean of the regime one (through a drift parameter)\(^3\). Before the adjustment, there were three points that did not meet the criteria by a small amount\(^4\).

### Scenario Calibration

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Calibration Value</th>
<th>AAA ESG</th>
<th>Regime-Switching</th>
<th>Regime-Switching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before Adjustment</td>
<td>After Adjustment</td>
<td></td>
</tr>
<tr>
<td><strong>1-year Gross Wealth Ratios</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5%</td>
<td>0.78</td>
<td>0.78</td>
<td>0.74</td>
<td>0.73</td>
</tr>
<tr>
<td>5.0%</td>
<td>0.84</td>
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<tr>
<td>10.0%</td>
<td>0.90</td>
<td>0.88</td>
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</tr>
<tr>
<td>90.0%</td>
<td>1.28</td>
<td>1.30</td>
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<tr>
<td>95.0%</td>
<td>1.35</td>
<td>1.36</td>
<td>1.39</td>
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</tr>
<tr>
<td>97.5%</td>
<td>1.42</td>
<td>1.42</td>
<td>1.45</td>
<td>1.44</td>
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<tr>
<td>Mean</td>
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<td>1.11</td>
<td>1.11</td>
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<tr>
<td><strong>5-year Gross Wealth Ratios</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5%</td>
<td>0.72</td>
<td>0.71</td>
<td>0.68</td>
<td>0.67</td>
</tr>
<tr>
<td>5.0%</td>
<td>0.81</td>
<td>0.80</td>
<td>0.80</td>
<td>0.79</td>
</tr>
<tr>
<td>10.0%</td>
<td>0.94</td>
<td>0.93</td>
<td><strong>0.95</strong></td>
<td>0.93</td>
</tr>
<tr>
<td>90.0%</td>
<td>2.17</td>
<td>2.21</td>
<td>2.55</td>
<td>2.48</td>
</tr>
<tr>
<td>95.0%</td>
<td>2.45</td>
<td>2.50</td>
<td>2.86</td>
<td>2.77</td>
</tr>
<tr>
<td>97.5%</td>
<td>2.72</td>
<td>2.76</td>
<td>3.16</td>
<td>3.04</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>1.53</td>
<td>1.70</td>
<td>1.66</td>
</tr>
<tr>
<td><strong>10-year Gross Wealth Ratios</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.5%</td>
<td>0.79</td>
<td>0.79</td>
<td>0.76</td>
<td>0.74</td>
</tr>
<tr>
<td>5.0%</td>
<td>0.94</td>
<td>0.92</td>
<td><strong>0.95</strong></td>
<td>0.92</td>
</tr>
<tr>
<td>10.0%</td>
<td>1.16</td>
<td>1.12</td>
<td><strong>1.19</strong></td>
<td>1.16</td>
</tr>
<tr>
<td>90.0%</td>
<td>3.63</td>
<td>3.82</td>
<td>4.92</td>
<td>4.74</td>
</tr>
<tr>
<td>95.0%</td>
<td>4.36</td>
<td>4.48</td>
<td>5.81</td>
<td>5.59</td>
</tr>
<tr>
<td>97.5%</td>
<td>5.12</td>
<td>5.21</td>
<td>6.62</td>
<td>6.37</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>2.33</td>
<td>2.85</td>
<td>2.75</td>
</tr>
</tbody>
</table>

In the results above, the lowest and highest percentile losses from RSLN2 are more extreme than the AAA scenarios. One contributor to this may be that the AAA economic scenario parameters are based on 1956 to 2003 historical data, while the RSLN2 parameters are based on the 1946 to 2012 historical data.

---


\(^3\) From an original set, the mean for regime 1 was reduced (through a drift parameter) from .01336 to .013 to meet the calibration criteria.

\(^4\) The 95\(^{th}\) percentile loss was 28.9% for the original set and 29.1% for the adjusted set that was used for this analysis.
3. Results By Loss Horizon

In order to understand how risk changes by time horizon, the 95\textsuperscript{th} percentile and CTE90 worst loss for different time horizons are provided below for the two scenario sets. The worst loss increases but at a slowing rate when the worst loss is based on quarterly time points. When only end point to end point is used, the loss decreases after an initial increase.

<table>
<thead>
<tr>
<th>Horizon (months)</th>
<th>Using AAA ESG v7.0.4</th>
<th>Using RSLN2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95th p-Tile Loss</td>
<td>CTE90 Loss</td>
</tr>
<tr>
<td></td>
<td>Quarterly Points</td>
<td>End Points</td>
</tr>
<tr>
<td>3</td>
<td>11.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>6</td>
<td>15.2%</td>
<td>14.3%</td>
</tr>
<tr>
<td>9</td>
<td>17.9%</td>
<td>16.1%</td>
</tr>
<tr>
<td>12</td>
<td>20.1%</td>
<td>17.3%</td>
</tr>
<tr>
<td>15</td>
<td>22.0%</td>
<td>18.3%</td>
</tr>
<tr>
<td>18</td>
<td>23.4%</td>
<td>18.5%</td>
</tr>
<tr>
<td>21</td>
<td>24.6%</td>
<td>18.9%</td>
</tr>
<tr>
<td>24</td>
<td>25.8%</td>
<td>19.6%</td>
</tr>
<tr>
<td>36</td>
<td>28.9%</td>
<td>20.4%</td>
</tr>
<tr>
<td>48</td>
<td>30.7%</td>
<td>19.9%</td>
</tr>
<tr>
<td>60</td>
<td>32.6%</td>
<td>19.9%</td>
</tr>
<tr>
<td>72</td>
<td>33.5%</td>
<td>17.4%</td>
</tr>
<tr>
<td>84</td>
<td>34.3%</td>
<td>15.4%</td>
</tr>
<tr>
<td>96</td>
<td>35.1%</td>
<td>12.8%</td>
</tr>
<tr>
<td>108</td>
<td>35.7%</td>
<td>10.7%</td>
</tr>
<tr>
<td>120</td>
<td>36.0%</td>
<td>8.4%</td>
</tr>
</tbody>
</table>

**CTE90 of Worst Loss Versus Horizon**

- Using AAA ESG v7.0.4. Quarterly Time Points
- Using AAA ESG v7.0.4. End Points Only
- Using RSLN2. Quarterly Time Points
- Using RSLN2. End Points Only
4. Calculation of Loss for Stochastic Analysis

S = Set of economic scenarios for total equity returns.

\( r_{t,\text{scen}} \) = Return in month \( t \) in scenario \( \text{scen} \).

H = Time horizon in months.

T = How intermediate time points are factored in the loss. It can be thought of as the frequency of loss measurement within the time horizon. For monthly time points, \( T = 1 \), quarterly \( T = 3 \), and for end points \( T = \text{End time point} \) – \( \text{Starting time point} \).

\( L_{t,\text{scen}} \) = Loss from month 0 to month \( t \) in scenario \( \text{scen} \).

\( L_{\text{scen}} \) = Maximum loss over the time horizon in scenario \( \text{scen} \) measured in steps of \( T \) months

\( \alpha \) = Percentile level

\( C \) = Loss at \( \alpha \)-percentile level

\[
L_{t,\text{scen}} = 1 - \sum_{s=0}^{t} 1 + r_{s,\text{scen}}
\]

\[
L_{\text{scen}} = \max_{\text{in steps of } T} L_{t,\text{scen}}
\]

\[
\Pr_{\text{scen} \in S} (L_{\text{scen}} \leq C) = \alpha
\]
5. Results By Loss Interval (Monthly vs. Quarterly)

Stochastic Analysis - Conditional Tail Expectations

<table>
<thead>
<tr>
<th>Time Points</th>
<th>AAA ESG</th>
<th></th>
<th></th>
<th>RSLN2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Monthly</td>
<td>Quarterly</td>
<td>Monthly</td>
<td>Quarterly</td>
<td>Monthly</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Horizon</td>
<td>1 yr</td>
<td>2 yr</td>
<td>1 yr</td>
<td>2 yr</td>
<td>1 yr</td>
<td>2 yr</td>
</tr>
<tr>
<td>CTE85</td>
<td>20.6%</td>
<td>25.8%</td>
<td>19.2%</td>
<td>24.2%</td>
<td>22.2%</td>
<td>28.3%</td>
</tr>
<tr>
<td>CTE86</td>
<td>21.1%</td>
<td>26.4%</td>
<td>19.7%</td>
<td>24.8%</td>
<td>22.8%</td>
<td>29.0%</td>
</tr>
<tr>
<td>CTE87</td>
<td>21.6%</td>
<td>27.0%</td>
<td>20.2%</td>
<td>25.4%</td>
<td>23.4%</td>
<td>29.8%</td>
</tr>
<tr>
<td>CTE88</td>
<td>22.1%</td>
<td>27.6%</td>
<td>20.7%</td>
<td>26.0%</td>
<td>24.1%</td>
<td>30.6%</td>
</tr>
<tr>
<td>CTE89</td>
<td>22.7%</td>
<td>28.3%</td>
<td>21.3%</td>
<td>26.7%</td>
<td>24.9%</td>
<td>31.4%</td>
</tr>
<tr>
<td>CTE90</td>
<td>23.4%</td>
<td>29.0%</td>
<td>22.0%</td>
<td>27.5%</td>
<td>25.7%</td>
<td>32.4%</td>
</tr>
<tr>
<td>CTE91</td>
<td>24.1%</td>
<td>29.8%</td>
<td>22.7%</td>
<td>28.3%</td>
<td>26.6%</td>
<td>33.4%</td>
</tr>
<tr>
<td>CTE92</td>
<td>24.8%</td>
<td>30.7%</td>
<td>23.5%</td>
<td>29.2%</td>
<td>27.6%</td>
<td>34.5%</td>
</tr>
<tr>
<td>CTE93</td>
<td>25.7%</td>
<td>31.7%</td>
<td>24.4%</td>
<td>30.2%</td>
<td>28.7%</td>
<td>35.7%</td>
</tr>
<tr>
<td>CTE94</td>
<td>26.7%</td>
<td>32.8%</td>
<td>25.4%</td>
<td>31.4%</td>
<td>29.9%</td>
<td>37.1%</td>
</tr>
<tr>
<td>CTE95</td>
<td>27.8%</td>
<td>34.0%</td>
<td>26.6%</td>
<td>32.6%</td>
<td>31.4%</td>
<td>38.6%</td>
</tr>
</tbody>
</table>
Appendix B - Historical Analysis

1. Risk-based capital factor for 30 year historical periods using the 1993 methodology*

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/1960</td>
<td>12/1990</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1961</td>
<td>12/1991</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1962</td>
<td>12/1992</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1963</td>
<td>12/1993</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1964</td>
<td>12/1994</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1965</td>
<td>12/1995</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1966</td>
<td>12/1996</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1967</td>
<td>12/1997</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1968</td>
<td>12/1998</td>
<td>29.20%</td>
</tr>
<tr>
<td>01/1969</td>
<td>12/1999</td>
<td>28.25%</td>
</tr>
<tr>
<td>01/1970</td>
<td>12/2000</td>
<td>28.25%</td>
</tr>
<tr>
<td>01/1971</td>
<td>12/2001</td>
<td>28.25%</td>
</tr>
<tr>
<td>01/1972</td>
<td>12/2002</td>
<td>32.29%</td>
</tr>
<tr>
<td>01/1973</td>
<td>12/2003</td>
<td>32.29%</td>
</tr>
<tr>
<td>01/1974</td>
<td>12/2004</td>
<td>28.16%</td>
</tr>
<tr>
<td>01/1975</td>
<td>12/2005</td>
<td>27.10%</td>
</tr>
<tr>
<td>01/1976</td>
<td>12/2006</td>
<td>27.10%</td>
</tr>
<tr>
<td>01/1977</td>
<td>12/2007</td>
<td>27.10%</td>
</tr>
<tr>
<td>01/1978</td>
<td>12/2008</td>
<td>27.64%</td>
</tr>
<tr>
<td>01/1979</td>
<td>12/2009</td>
<td>33.36%</td>
</tr>
<tr>
<td>01/1980</td>
<td>12/2010</td>
<td>40.05%</td>
</tr>
<tr>
<td>01/1981</td>
<td>12/2011</td>
<td>40.05%</td>
</tr>
<tr>
<td>01/1982</td>
<td>12/2012</td>
<td>40.05%</td>
</tr>
</tbody>
</table>

* Values shown are the 94th percentile worst loss over each 24 month horizon in the 30 year data period using monthly loss intervals.
2. Impact of Horizon on the 94th Percentile

The graph below shows the effect of increasing the time horizon on the 94th percentile value. This graph uses the data from 1960 to 2012. It shows two lines – one considering all monthly time points (top line) and one considering only the end points (lower line). Of note are the following:

i. Considering monthly intermediate losses, the factor increases through three years and then stays fairly level. This is reasonable since stock market worst losses generally occur over periods less than two years.

ii. Considering only endpoints, the factor increases over the first two years and then decreases. This is reasonable since when considering only the endpoints, a longer period allows time for the market to recover.
3. 1997 Comments on Common Stock Risk Based Capital Factor


Discussion of the Recommendation of the Task Force

“Although the task force agreed that the current 30% factor is conservative, we split over the level of conservatism. The disagreement centered on the premises underlying the original factor. Those arguing for a lower factor took issue with two of these premises: the assumption of a two year holding period, and the requirement that the insurer have enough capital to survive the worst intermediate monthly result during the holding period.

The original two year holding period was used as being typical of the holding period for common stock. Since risk-based capital reports are produced on an annual basis, any company finding itself with a capital deficiency at the end of the year would be under considerable pressure to reduce its risk profile and the easiest way of doing so is to dispose of its common stock. However, the proponents of a two year holding period pointed out that such a sale would lock in the company’s losses and that therefore the company would try to avoid it.

The proponents of a change in the task force’s philosophy regarding the use of intermediate results cited two reasons. First, if an insurer has enough assets that it can meet its cash flow requirements over the life of its obligations then it is solvent on an economic basis even if it fails some solvency test at intermediate points. Second, even if one focuses on such intermediate results there is no need to do so any more frequently than the company files its risk-based capital report. The opponents of the change continue to believe that intermediate results are important, especially if the company is exposed to a disintermediation risk. Runs on an insurer tend to occur when the insurer’s financial position is at its weakest.

Given the differences of opinion with our group, the task force decided to recommend no change be made in the current base factor. This recommendation is based on the factor’s inherent conservatism and the recognition that the covariance recommendation has a larger effect on the ultimate risk-based capital requirement. In view of the conservative nature of the factor the task force also decided that no beta adjustment is necessary. However, the task force recommends that introduction of a beta adjustment be reconsidered if the factor for common stock is ever reduced.”
4. Methodology used to calculate loss for historical analysis:

\[ r_t = \text{S&P 500 Total return in month } t. \]

\[ H = \text{Time horizon in months.} \]

\[ T = \text{How intermediate time points are factored in the loss. It can be thought of as the frequency of loss measurement within the time horizon. For monthly time points, } T = 1, \text{ quarterly } T = 3, \text{ and for end points } T' = \text{End time point – Starting time point.} \]

\[ L_{t_1, t_2} = \text{Loss from month } t_1 \text{ to month } t_2 \text{ measured in steps of } T \text{ months.} \]

\[ L_t = \text{Maximum loss over the time horizon starting at month } t \]

\[ P = \text{Time period of historical data considered.} \]

\[ \alpha = \text{Percentile level} \]

\[ C = \text{C-1 factor} \]

\[
L_{t_1, t_2} = 1 - \frac{t_2}{\log(1 + r_t)}
\]

\[ L_t = \max_{1 \leq s \leq H} L_{t, t+s} \]

\[ \Pr_{t \in P} L_t \leq C = \alpha \]
| Page | First cell is for January 1926 and each successive month, read values left to right, top to bottom. |
Appendix C- Observations on RBC Common Stock Portfolio Book Values and Factors

1. The data shows a wide range of factor values, some clustered at 0.3 and several at the limits (Graph 1).

2. Several companies (46%) have a factor at the upper limit of .45 (Graph 2, Table 1). While most are relatively small in size, there are five that are relatively large. For the smaller companies, the use of the higher factor could be due to choosing not to calculate beta because of the relative immateriality on their risk-based capital ratio.

3. The companies with the smallest 20% of common stock portfolios have a higher average factor (Table 2). Larger companies by portfolio size have factors closer to the 30% base factor (Table 3). As the size of portfolios increases, risk may tend toward market levels.

4. Multiple years of data show that the proportion of value at the limits does not change significantly (Graph 3).

Graph 1: The scatter plot of stock portfolio value versus factor. The plot shows clustering at the middle and limits.

Source: NAIC Data for 2011.
Graph 2: Distribution of Total Value versus Factor

Source: NAIC Data for 2011.

Table 1: The number of companies and the common stock portfolio value for different ranges of factor.

| Factor less than 0.225: | 8 companies (2% of all) have a value of $43 million (0.2%) |
| At the lower limit:    | 83 (23%) have $555 million (2%) |
| Low range (<.3):       | 19 (5%) have $9.9 billion (44%) |
| At base factor level (=.3): | 23 (6%) have $0.7 billion (3%) |
| High range (<.375):    | 42 (12%) have $7.3 billion (32%) |
| Highest range (<.45):  | 17 (5%) have $1.8 billion (8%) |
| At the upper limit:    | 164 (46%) have $2.2 billion (10%) |

Table 2: The average factor versus common stock portfolio size.

<table>
<thead>
<tr>
<th></th>
<th>Number of Companies</th>
<th>Average factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smallest 20% by portfolio size</td>
<td>71</td>
<td>0.43</td>
</tr>
<tr>
<td>Next 20%</td>
<td>71</td>
<td>0.36</td>
</tr>
<tr>
<td>Middle 20%</td>
<td>71</td>
<td>0.36</td>
</tr>
<tr>
<td>Next 20%</td>
<td>71</td>
<td>0.35</td>
</tr>
<tr>
<td>Largest 20%</td>
<td>71</td>
<td>0.34</td>
</tr>
<tr>
<td>Total</td>
<td>355*</td>
<td>0.37</td>
</tr>
</tbody>
</table>

* Companies with zero factor are excluded.
Table 3: The weighted average factor by common stock portfolio size.

<table>
<thead>
<tr>
<th>Quintiles of Cumulative Book Value</th>
<th>Number of Companies</th>
<th>Weighted Average factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Quintile</td>
<td>346</td>
<td>0.34</td>
</tr>
<tr>
<td>Second Quintile</td>
<td>11</td>
<td>0.38</td>
</tr>
<tr>
<td>Third Quintile</td>
<td>3</td>
<td>0.26</td>
</tr>
<tr>
<td>Fourth Quintile</td>
<td>2</td>
<td>0.31</td>
</tr>
<tr>
<td>Fifth Quintile</td>
<td>1</td>
<td>0.29</td>
</tr>
<tr>
<td>Total</td>
<td>363</td>
<td>0.318</td>
</tr>
</tbody>
</table>

Graph 3: Common Stock Exposure Distribution for three years 2009-2011.

Source: ACLI Data on Aggregate size of unaffiliated common stock holdings, as well as asset classes that have a common stock-like RBC charge (Schedule BA) for LIFE, 2009-11. All implied factors of less than .225 are grouped together.
Appendix D- Public Equity vs. Private Equity Volatility

Based on Quarterly Returns from Q4 1996 to Q2 2012

<table>
<thead>
<tr>
<th></th>
<th>S&amp;P 500 Index</th>
<th>Custom Private Equity Index*</th>
<th>Custom Private Equity Index Corrected for lag 1 Serial Correlation**</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annualized Standard Deviation</strong></td>
<td>18.56%</td>
<td>11.04%</td>
<td>18.19%</td>
</tr>
</tbody>
</table>

* Weighted Components of Custom Private Equity Index
  - US Limited Partnership Funds: 49%
  - Foreign Limited Partnership Funds: 21%
  - US Direct Private Equity: 21%
  - Foreign Direct Private Equity: 9%

Index data are available on quarterly basis.

**To remove serial correlation, we use a variation of Fisher-Geltner-Webb methodology


First, we run a regression \( R_t = \alpha + \beta R_{t-1} \) to find a correlation coefficient at lag 1

Second, we calculate unsmoothed return series \( R_{t\text{ (corrected)}} = (R_t - \beta R_{t-1}) / (1 - \beta) \)

Finally, we calculate standard deviation using unsmoothed return series.

**Observations**
1) Since serial correlation masks volatility and understates risk, the estimate of volatility for Private Equity should be developed from unsmoothed return series.
2) No significant difference in volatility of Private Equity Index returns and S&P 500 Index returns.