Forward-looking and Incentive-compatible Operational Risk Capital Framework

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Disclaimer

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Operational Risk Capital Framework

- Advanced Measurement Approach (AMA) still in effect for large, internationally active US banks
- In December 2017, the BCBS revised the operational risk capital framework introducing a new standardized approach (NSA)

\[ NSA \text{ Capital} = f(\text{IncomeStatement}, \text{AveragePastLosses}) \]

- H.R. 4296 would require the operational risk capital framework to be based on “current” risks, be forward-looking, and allow for operational risk mitigants
Criticisms of AMA and NSA

- **AMA**
  - Gameable
  - 99.9th percentile estimates have large uncertainty
  - Unclear whether risk sensitive
  - Lacks comparability across banks and jurisdictions
  - Burdensome for banks and regulators
  - Limited usefulness for risk management

- **NSA**
  - Lacks risk sensitivity
  - No forward-looking view
  - Not useful for risk management
Improving the Framework - Incentive Compatibility

• Incentive compatibility in this context means banks having the incentive to reveal their best estimates of future losses.

• The AMA is not incentive compatible:
  • To maximize ROE, banks have incentives to underestimate exposure (and thus capital).
  • AMA does not include mechanisms to automatically penalize underestimation.

• Market risk capital framework penalizes underestimation of exposure through back-testing requirements.
Incentive Compatibility (1/3)

• Gneiting and Raftery (2007) showed that the function $S$ can be used to provide incentive for estimation of any quantile $\alpha$ (under risk neutrality)

$$S(r; x) = \alpha \cdot s(r) + [s(x) - s(r)] \cdot 1\{x \leq r\} + h(x)$$

where $x$ is an observation of the variable of interest, $r$ is the quantile estimate, $s$ is a non-decreasing function, and $h$ is an arbitrary function.

• $S$ can be multiplied by $-1$ to turn it into a minimization problem (in this case, it will be a capital minimization problem)

$$S'(r; x) = -\alpha s(r) + [s(r) - s(x)] \cdot 1\{x \leq r\} - h(x)$$
Incentive Compatibility (2/3)

• If s is assumed to be the identity function, $S'$ can be re-written as follows

$$S'(r; x) = (1 - \alpha)r + \text{Max}\{-x, -r\} - h(x)$$

• If we want to break the capital requirement ($S'$) into a requirement at time t (corresponding to the quantile estimate) and a requirement in future periods, this can be accomplished by multiplying the expression by $1/(1 - \alpha)$ (assuming no time discounting)

$$S''(r; x) = r + \frac{\text{Max}\{-x, -r\} - h(x)}{1 - \alpha}$$
Incentive Compatibility (3/3)

• If $h$ was set to zero, the formula providing incentive compatibility would lead to capital decreases in future years. But if $h$ is set to $-x$, $S''$ becomes

$$S''(r;x) = r + \frac{\text{Max}\{x - r, 0\}}{(1 - \alpha)}$$

• Regulators may wish to increase conservatism by scaling requirements instead of increasing the estimation quantile (as is done in market risk). This can be done by scaling the whole expression

$$S'''(r; x) = \beta r + \beta \frac{\text{Max}\{x - r, 0\}}{(1 - \alpha)}$$
Example Framework (1/4)

• Assume $\alpha = 95\%$ and $\beta = 2$. Capital requirements could be given by:

$$OpRiskCapital_{Option1_t} = 2Q^{95}(t|t - 1) + 40\max\{Loss_{t-1} - Q^{95}(t - 1|t - 2), 0\}$$

• Assume that the annual operational losses of a bank are distributed according to a lognormal($20, 1$).

<table>
<thead>
<tr>
<th>Statistics of Total Annual Loss Distribution given by Lognormal($20, 1$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>$800\text{Mln}$</td>
</tr>
</tbody>
</table>
Example Framework (2/4)

• Assuming the bank estimates the quantile accurately, the distribution of capital requirements under Option 1 has the following statistics:

<table>
<thead>
<tr>
<th>Statistics of Capital Requirements (Option 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median &amp; 95th Percentile</td>
</tr>
<tr>
<td>$5,027Mln</td>
</tr>
</tbody>
</table>

• Capital would suffer from meaningful volatility in the 5% of years where losses are above the 95th quantile.
Example Framework (3/4)

- Incentive-compatibility can be achieved while spreading out the penalization over more years and limiting its size.

\[ \text{OpRiskCapital}_{\text{Option2}}_t = 2Q^{95}(t|t - 1) + \text{Penalty}_{t-1} \]

Where: \( \text{Penalty}_t = \min\{\text{ExceedenceStock}_t, 2\text{AvgLoss}_t + \text{Penalty}_{t-1}, 12\text{AvgLoss}_t\} \)

\( \text{ExceedenceStock}_t \)

\[ = \text{ExceedenceStock}_{t-1} - \text{Penalty}_{t-1} + 40\max\{\text{Loss}_t - Q^{95}(t|t - 1), 0\} \]

\( \text{AvgLoss}_t \)

\[ = \frac{\sum_{i=0}^{9} \text{Loss}_{t-i}}{10} \]
Under Option 2, the distribution of capital requirements would have the following statistics (and be much less volatile)

<table>
<thead>
<tr>
<th>Statistics of Capital Requirements (Option 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Median</td>
</tr>
<tr>
<td>$5,027Mln</td>
</tr>
</tbody>
</table>
Additional considerations

• Banks could reduce potential capital volatility further by overestimating the regulatory quantile
• Losses used on date of accounting to allow apples to apples comparisons with quantile estimates
• Predictable large losses (e.g., certain legal losses) should not lead to exceedances of the 95th percentile estimate because they should be included in estimate
• To comply with Basel III, capital would need to floored by the NSA, but the version of the NSA with no losses could be used
Advantages of this approach

• Forward-looking
• Modeling flexibility
• Risk sensitive
• Not gameable
• Should be useful for risk management
Conclusion

• AMA is gameable, complex, and not forward-looking enough
• NSA is not forward-looking, nor useful to risk management
• The US op risk capital framework should be risk sensitive/forward-looking, while limiting gaming opportunities
• The key is to adopt a framework that allows forward-looking inputs while maintaining incentive-compatibility