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### ◆ INTRODUCTION

The use of internal models by financial institutions to measure and manage their risk exposures has grown considerably over the past decade. However, the recent global financial crisis (GFC) has raised concerns over the increased reliance on internal models. The financial crisis exposed the limitations of models and the way they failed to measure extreme financial events and particular risks (e.g., liquidity). Testifying before the U.S. Congress in 2008, former Federal Reserve Chairman Alan Greenspan said, “Had instead the models been fitted more appropriately to historic periods of stress, capital requirements would have been much higher and the financial world would be in far better shape today....”

The evolution toward internal models in the U.S. state-based system has been incremental. Internal models have been used for years in U.S. insurance regulation, but in controlled and prudent ways and with significant built-in safeguards. For example, the NAIC’s newly adopted principle-based reserving (PBR) method is essentially models-based, but has a number of features designed to control for possible misuse of models. This article will discuss the different ways internal models are used, and will be used, in U.S. insurance regulation.

### ◆ INTERNAL MODELS

The International Association of Insurance Supervisors (IAIS) defines an internal model as “a risk measurement system developed by an insurer to analyze its overall risk position, to quantify risk and to determine the economic capital required to meet those risks.” Internal models may also include partial models which capture a subset of the risks borne by the insurer using an internally developed measurement system used in determining the insurer’s economic capital.

The use of high-performance computing systems to measure and manage risk exposure has increased significantly. Many companies use customized internal models to determine regulatory capital, as well as for cash flow testing, pricing, fair value of liabilities calculation, economic capital calculation and business planning. These models can take many forms and vary from simple, even standardized, calculations to extremely complex models. There are many such models, but by far the most widely used is called VaR (value-at-risk). VaR calculates the worst expected loss over a given horizon at a given confidence level under “normal” market conditions. VaR estimates can be calculated for various types of risk: market, credit, operational, etc.<sup>1</sup>

VaR models were developed and popularized in the early 1990s by a handful of scientists and mathematicians (or “quants” as they are called in the business world).<sup>2</sup> J.P. Morgan is credited with developing VaR in the early 1990s and it quickly became an industry benchmark for risk management. The adoption of VaR by the Basel Committee on Banking Supervision (BCBS) in 1999 gave further impetus to the use of VaR. Banking regulators placed considerable weight on internal modeling. The Basel II Capital Accord allowed banks to choose between a prescribed standardized calculation and the use of their own internal VaR models to determine their regulatory capital requirement for market risk.

However, in the aftermath of the GFC, risk metrics such as VaR have been widely criticized. VaR failed to capture non-linear events in the markets and was highly susceptible to operator inputs.<sup>3</sup> VaR’s shortcomings and limitations in estimating risks left many large banks more exposed to losses in the financial market than expected. In a 2012 consultative document, the BCBS noted, “The financial crisis exposed material weaknesses in the overall design of the framework for capitalizing trading activities and the level of capital requirements for trading activities proved insufficient to absorb losses.” The report added, “In addition to the flaws in the overall design of the framework, risk measurement under both the models-based and the standardized approaches proved wanting.”<sup>4</sup> In response, the BCBS has proposed to remove VaR as the basis for modeling market risk capital requirements.<sup>5</sup>

### ◆ POST-GFC

The GFC has resulted in a plethora of studies examining its causes and has prompted significant global regulatory reforms in both the banking and insurance industry. Over the past few years, regulators and policymakers have taken a number of steps to enhance models by adding features that will cover previously unforeseen issues and generally speaking, to make them more complex. However, more complex models are not necessarily better. In a paper titled “The Dog and the Frisbee,” presented at the Jackson Hole conference

*(Continued on page 23)*

<sup>1</sup> J.P. Morgan. “Value-at-Risk: An Overview of Analytical VaR.” Retrieved from [www.jpmorgan.com/tss/General/email/1159360877242](http://www.jpmorgan.com/tss/General/email/1159360877242)

<sup>2</sup> Nocera, Joe. “Risk Mismanagement.” *The New York Times*. Jan. 2, 2009.

<sup>3</sup> For example, UBS removed its toxic CDO portfolio from VaR calculations. “...because they were treated as fully hedged, the Super Senior [CDO] positions were netted to zero and therefore did not utilize VaR and Stress limits.” “Shareholder Report on UBS’s Write-Downs.” April 18, 2008, p. 30.

<sup>4</sup> Basel Committee on Banking Supervision. “Consultative Document: Fundamental Review of the Trading Book.” May 2012.

<sup>5</sup> Carver, Laurie. “Basel Committee proposes scrapping VAR.” *Risk Magazine*. May 3, 2012.

ence in 2012,<sup>6</sup> Andrew G. Haldane, Executive Director for Financial Stability at the Bank of England notes: “Complex regulation developed over recent decades might not just be costly and cumbersome but sub-optimal for crisis control ... in financial regulation, less may be more.” He goes on to note models are so complex the banks themselves do not adequately understand them.

Following the GFC, questions have been raised as to whether the use of complex internal models is more effective at preventing insolvencies. Concerns have been raised about the over-reliance on an internal model’s results which can create a false sense of security. Earlier this year, Moody’s Investors Service noted providing companies “with the option to determine required capital via complicated internal models will reduce transparency of capital adequacy calculations and leave the system more susceptible to gaming.” Moody’s added, “Complex capital adequacy models, no matter how robust, may not be sufficient to identify and prevent the next crisis.”<sup>7</sup> In addition, the U.S. Government Accountability Office has noted the increased complexity of regulatory capital calculations, “heightens the challenge of effective oversight.”<sup>8</sup>

### ◆ HOW MODELS ARE USED IN U.S. INSURANCE REGULATION

In contrast to the banking industry, state insurance regulators have adopted a cautious and targeted approach to the use of internal models and are taking steps to introduce internal models incrementally, while maintaining a number of controls as they are introduced. The NAIC first introduced models more than 20 years ago in its risk-based capital (RBC) regime. The NAIC RBC regime limits the use of modeling to specific products and risk models within an otherwise standardized approach. Partial models are limited currently to life and annuity products with guarantees subject to interest rate or market fluctuation risk.<sup>9</sup>

Models are also used for cash flow testing, stress and scenario testing, and, in the future, RBC for catastrophe risk will use internal models. The following outlines the many ways state insurance regulation allows, requires or will require the use of internal models for business and risk management.

#### Risk-Based Capital

RBC is a method of measuring the minimum amount of capital appropriate for a reporting entity to support its overall business operations in consideration of its size and risk profile. The NAIC RBC regime began in the early 1990s and separate formulae have been developed for each of the prima-

ry insurance types: life, property/casualty, health and fraternal. The formula used is factor-based, generated from historical industry-wide data experience, with some use of internal models regarding interest rate and market risk.<sup>10</sup>

The NAIC introduced additional internal models-based components into its RBC system for life insurers in the late 1990s. The first phase (known as C-3 Phase I) was implemented Dec. 31, 2000 and specifically targeted interest rate risk associated with fixed annuities. The second phase (C-3 Phase II) was implemented Dec. 31, 2005 and introduced a new capital requirement for equity risk associated with variable annuities. This was motivated in large part by the recognition insurers were developing products with increasingly complex guarantees, and the risks embedded in these guarantees were not captured by the basic factor-based capital requirements.<sup>11</sup>

One significant safeguard built into internal models is the incorporation of a standard scenario in capital requirements and reserving standards for variable annuities. State insurance law requires the RBC component for variable annuities be calculated using an internal model. The law requires the RBC component is the higher of the standard scenario reserve or the 90% conditional tail expectation of the distribution of the RBC component run under a set of randomly generated economic scenarios. The standard scenario reserve is the reserve that results from running the model using the standard scenario. The standard scenario is prescribed by state law and it is a single economic scenario whose parameters are defined by law. The rules governing the use of these models are fairly prescriptive, as companies use prescribed statistical parameters and time horizons, including discount rates, lapse and withdrawal rates, mortality rates, treatment of hedging strategies, etc. This standard scenario serves as a floor for the reserves and required capital.

As RBC has been updated, it has been done so incrementally, with new factors aimed at specific risk and/or lines of business. Updates are targeting missing risks or outdated

*(Continued on page 24)*

<sup>6</sup> Given at the Federal Reserve Bank of Kansas City’s 36th economic policy symposium, “The Changing Policy Landscape”, Jackson Hole, Wyoming.

<sup>7</sup> Moody’s Investors Service. “Global Insurance Regulators Battle Doubts and Delays over Solvency Modernization.” May 9, 2013.

<sup>8</sup> U.S. Government Accountability Office. “Risk-Based Capital: Bank Regulators Need to Improve Transparency and Overcome Impediments to Finalizing the Proposed Basel II Framework.” February 2007.

<sup>9</sup> EU-U.S. Dialogue Project Technical Committee Reports. December 2012. Retrieved from [www.naic.org/documents/eu\\_us\\_dialogue\\_report\\_121220.pdf](http://www.naic.org/documents/eu_us_dialogue_report_121220.pdf)

<sup>10</sup> Ibid.

<sup>11</sup> Vaughan, Therese M., Ph.D. “The Implications of Solvency II for U.S. Insurance Regulation.” *Networks Financial Institute: Policy Brief*. February 2009.

factors. In addition, new internal models-based requirements often supplement, rather than replace, existing factor-based requirements.<sup>12</sup> Internal models will not fully replace RBC requirements; they are used only when a more simple formula will not suffice. One area of focus for the NAIC's Solvency Modernization Initiative (SMI)—which was initiated in June 2008 as a critical self-examination to update the U.S. insurance solvency regulation framework—is reevaluating areas of the RBC formula that may need updating. Work is under way to develop a new RBC requirement for life products (C-3 Phase III).

### Asset Valuation

In 2009, the NAIC initiated its Structured Securities Project to assist state insurance regulators in establishing a new methodology to determine RBC requirements for residential mortgage-backed securities (RMBS) and commercial mortgage-backed securities (CMBS) held by insurers. During this time, the financial crisis and the collapse of the housing market greatly impacted the mortgage-backed market, as delinquency and loss performance of RMBS rapidly deteriorated to a degree that far exceeded the level of default expectations of credit rating agencies. Aggressive downgrades by credit rating agencies directly impacted insurers' RMBS investment portfolios and the assessment of their RBC charges, which are tied to NAIC designations mapped to nationally recognized statistical rating organization (NRSRO) credit ratings.

Accordingly, the NAIC retained third-party financial modelers to undertake the modeling of expected losses for more than 20,000 non-agency RMBS held by the insurance industry. In 2010, the project was expanded to include CMBS holdings. The regulators' goal in adopting this new process was to increase the accuracy in assessing expected losses, and to use the improved assessment to determine a more appropriate capital requirement for these securities. The new approach reduces regulatory reliance on credit rating agencies and allows for greater regulatory input into the modeling process and the assumptions used. This process supplements the existing factors used, by updating the structure for assigning designations with the matrix with current expected recovery values. This modeling will continue in 2013 and is expected to continue for the foreseeable future.

### Principle-Based Reserving

Reserve calculations for life insurance have been unchanged for many decades. Currently, insurers use a formula-based static ("one-size-fits-all") approach to calculate reserves for products. However, insurance products have increasingly grown in sophistication and complexity which has led to a need for a new reserve method. The NAIC adoption of revi-

sions to the Standard Valuation Law (#820) in 2009 introduced a new method, referred to as principle-based reserving (PBR), for calculating life insurance policy reserves.

PBR would introduce the calculation of reserves under a variety of economic conditions using justified company experience factors, such as for mortality, policyholder behavior and expenses. Companies will "book" the higher of the formulaic reserve and the modeled reserve calculated using those justified company experience factors. A *Valuation Manual* was established by the Model #820 and will be used to detail the reserve calculation requirements. Variable annuity reserves are the exception to the formulaic approach where reserves must be set at the higher of: 1) standard scenario reserve (a single economic scenario with prescribed parameters defined in law); or 2) an internal model.

Although PBR is mostly models-based, it contains numerous safeguards designed to control for possible misuse: prescriptive and limiting elements have been introduced into the *Valuation Manual* that will limit the extent to which reserves will be reduced from the current levels; if the new PBR method produces higher reserves than the minimum reserve floor, that higher reserve must be booked; PBR will be phased-in over three years after the *Valuation Manual* is in effect so to allow the industry time to comply with the new approach; and PBR only applies to new policies issued after the revised Model #820 and *Valuation Manual* are in effect.

### Reserve Adequacy Testing

Reserves for life insurance and fixed annuities are currently calculated on a formula basis, and state insurance law establishes the valuation interest rate and the valuation mortality tables that must be used in the formula reserve calculation. The formula-based reserve establishes a minimum reserve. Because this formula reserve is a "one-size-fits-all" minimum reserve, insurance companies are required to test the formulaic reserves for adequacy given the assets the insurance company owns, by projecting cash flows over numerous economic scenarios, which may be generated by internal models. If for any economic scenario the aggregate results of these projections show the ending surplus is not positive, then additional capital must be held.

### Catastrophe Modeling

Catastrophe (CAT) risk is currently not adequately addressed in the RBC calculations. In the future, a property/casualty catastrophe charge for earthquakes and hurricanes will be introduced into the RBC. To accomplish this, models

*(Continued on page 25)*

<sup>12</sup> Ibid.

of the proven CAT modeling companies will be used with some stipulations added around the models. The CAT charge will be based on the results of one of the approved commercially available catastrophe models—AIR Worldwide, EQECAT, RMS, ARA HurLoss (hurricane only) or the Florida Public Model (hurricane only)—and using the insurance company’s own insured property exposure information as inputs to the model. Insurers may elect to use the modeled results from any one of the models, or any combination of the results of two or more of the models. Each insurer will not be required to utilize any prescribed set of modeling assumptions, but will be expected to use the same data, modeling and assumptions that the insurer uses in its own internal catastrophe risk-management process.

Recent advances in technology have enabled insurers and reinsurers to apply computer modeling to estimate the effect catastrophe losses could have on their book of businesses. The results of these models are used to assist with decisions about where an insurer will choose to write business and how much to charge for business written. Insurers have replaced the traditional catastrophe loading in rate filings with numbers supported by computer models.

### Own Risk and Solvency Assessment

Resulting from the NAIC’s SMI, in an Own Risk and Solvency Assessment (ORSA), large- and medium-size U.S. insurers and/or insurance groups<sup>13</sup> will be required to provide state insurance regulators with an internal assessment of the material and relevant risks identified by the insurer associated with an insurer’s current business plan and the sufficiency of capital resources to support those risks. Insurers are not required to use an economic capital model(s) to complete this assessment, but they are required to make this determination of risk capital based on the nature, scale and complexity of risk within the group.

Companies will be required to regularly conduct an ORSA starting in 2015. *The Risk Management and Own Risk and Solvency Assessment Model Act (#505)* provides the requirements for completing an ORSA and provide guidance

and instructions for filing an ORSA Summary Report. The information an ORSA contains will supplement the risk focused examination process and provide regulators with a more dynamic view of each company’s risk profile.

### ◆ CONCLUSION

The GFC has underscored the critical importance of effective risk management systems. While internal models are a useful and important tool for risk management, they should be subject to a rigorous and verifiable process and supported by sound risk management practices. Regulators should evaluate a company’s model, but not overly rely on the output. In the paper titled *The Implications of Solvency II for U.S. Insurance Regulation*, former NAIC CEO Therese M. Vaughan, Ph.D., recommends: “The use of internal models to establish regulatory capital requirements cannot and should not disappear. However, they must be used appropriately, with recognition of their significant limitations.”

### ABOUT THE AUTHOR



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*\* The author would like to thank NAIC staff (Larry Bruning, Dan Daveline, Kris DeFrain, Dave Fleming, Jeff Johnston, Eric Kolchinsky, Reggie Mazyck and Eva Yeung) for their edits and contributions to the article.*

<sup>13</sup> The ORSA will apply to any individual U.S. insurer that writes more than \$500 million of annual direct written and assumed premium, and/or insurance groups that collectively write more than \$1 billion of annual direct written and assumed premium.



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