Risk-Based Capital: So Many Models

CANE Meeting 2007

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Agenda

Capital Requirement Measurement

NAIC Risk-Based Capital Requirements

A.M. Best Capital Model

Standard & Poor's Current and Proposed Capital Model

FSA (United Kingdom) and Solvency II

Critique of Factor Based Models

Capital Requirement Measurement

- ## Formula Based Approach
  - NAIC Risk Based Capital (RBC)
  - A.M. Best Capital Adequacy Requirement
  - Standard & Poor's Capital Adequacy Requirement

- ## Formula + Stochastic Based Approach
  - Financial Services Authority (FSA) - UK
  - Solvency II

NAIC Risk Based Capital (RBC) Requirements

- **Goals of NAIC RBC**
  - Establish a standard capital requirement approach
  - Utilize quantitative analysis of capital and surplus requirements that reflect each insurer's inherent risks
  - Provide regulators with authority to enforce compliance with capital requirements

- **Supervisory Intervention Requirements**
  - No Action (RBC Ratio > 200%)
  - Company Action Level (RBC ratio 150-200%): Insurer files financial and business plan
  - Regulatory Action Level (RBC ratio 100-150%): Above plus, regulator must examine and require corrective action
  - Authorized Control Level (RBC ratio 70-100%): Above plus, regulator may take control of insurer
  - Mandatory Control Level (RPB ratio < 70%): Regulator required to take control unless corrected within 90 days

NAIC Risk Based Capital

- RBC Ratio = $\dfrac{\text{Adjusted Surplus}}{\text{Authorized Control Level RBC}}$

- Authorized Control Level RBC = 0.5 x Total RBC Requirement

- Total RBC Requirement =

$$R_0 + \bullet\sqrt{R_1^2 + R_2^2 + (0.5R_3)^2 + (0.5R_3+R_4)^2 + R_5^2}$$

- 6 categories of capital charges
  - R_0: Off Balance Sheet
  - R_1 : Fixed Income Securities
  - R_2 : Equity Securities
  - R_3 : Credit
  - R_4 : Loss and LAE Reserves
  - R_5 : Net Written Premium

NAIC Risk Based Capital

Categories of capital charges

- R_0: Off Balance Sheet
  - Investment in insurance affiliates
  - Guarantees for Affiliates
  - Contingent liabilities

- R_1: Fixed Income Securities
  - Cash, bonds
  - Mortgage loans
  - Collateral Loans
  - Bond size and asset concentration adjustment factors

- R_2: Equity Securities
  - Common stocks, preferred stocks, real estate
  - Aggregate write-ins for invested assets
  - Asset concentration adjustment factors

- R_3: Credit Risk
  - Reinsurance recoverables
  - Other receivables

NAIC Risk Based Capital

Categories of capital charges (continued)

- R_4 : Reserving Risk

  Basic reserving risk charge
  - Offset for loss-sensitive business
  - Adjustment for claims-made business
  - Loss concentration factor
  - Growth charge for reserving risk

  Reserving risk charge by line =

  Reported reserve * [(1+ RBC charge adjusted for company development) * adjustment for investment income – 1] * Offset factor

  Total reserving risk charge =

  Sum of reserving risk charge by line * loss concentration factor

- R_5 : Written Premium Risk

  Basic premium risk charge
  - Offset for loss-sensitive business
  - Adjustment for claims-made business
  - Premium concentration factor
  - Growth charge for premium risk

  Written premium risk charge by line =

  Net written premium * [(RBC charge adjusted for company average loss & expense ratio * adjustment for investment income) + company underwriting expense ratio – 1] * Offset factor

  Total written premium risk charge =

  Sum of written premium risk charge by line * premium concentration factor

A.M. Best Capital Model

- BCAR = $\dfrac{\text{Adjusted Surplus}}{\text{Net Required Capital}}$

- Net Required Capital =

$$B_7 + \bullet\sqrt{B_1{}^2 + B_2{}^2 + B_3{}^2 + (0.5B_4)^2 + (0.5B_4 + B_5)^2 + B_6{}^2}$$

- Formula Components
  - B_1 : Fixed Income Securities
  - B_2 : Equity Securities
  - B_3 : Interest Rate
  - B_4 : Credit
  - B_5 : Loss and LAE Reserves
  - B_6 : Net Written Premium
  - B_7 : Off Balance Sheet

S&P Current and Proposed Capital Model

- S&P Current

  Capital Adequacy Ratio

  $$= \frac{TAC - C_1 - C_2}{C_3 + C_4 + C_5}$$

- TAC: Total Adjusted Capital
  - Reserves adjusted for any deficiency and then discounted

- Formula Components
  - C_1: Asset Risk
  - C_2: Credit Risk
  - C_3: Underwriting Risk (Written Premium Risk)
  - C_4: Reserve Risk
  - C_5: Other Business Risk

*S&P Proposed Capital Model:

- Currently running both current and proposed models in parallel.

- Risk variables are stressed using confidence levels varied by the company's targeted rating category and cumulative five-year defaults across ratings.

- Explicit credit for diversification within the capital model, albeit at more conservative levels than generally observed within the market.

Outcome => Model more reflective of specific company.

Comparison of Models

Risk Categories		NAIC	A.M. Best	Standard & Poor's
Asset Risk	Debt	R_1	B_1	C_1
	Equity	R_2	B_2	
Interest Rate Risk		Not Included	B_3	Explicitly Included
Credit Risk		R_3	B_4	C_2
Underwriting Risk	Reserve Risk	R_4	B_5	C_4
	NWP Risk	R_5	B_6	C_3
Other Risk		R_0	B_7	C_5

Resource: Midwestern Actuarial Forum, Barry Zurbuchen, Spring 2002

Comparison of Risk Charges

Risk Categories	NAIC	A.M. Best	S & P (Current)	S & P (Proposed)
Asset Charges				
Bonds	0 - 30%	0 - 30%	0 - 30%	0 - 30%
Common Stock	15%	15%	15%	20 - 43%
Real Estate	10%	20%	10%	18 - 29%
Credit Risk Charge				
Reinsurance Recoverables	10%	Vary by Reinsurer's Rating		
Written Premium Risk Charges				
Homeowners	Vary by line of business with initial industry factor adjusted for company experience	37 - 54%	27%	21 - 35%
Other Liablity Occurance		32 - 40%	33%	30 - 49%
CMP		29 - 37%	14%	13 - 21%
Personal Auto		25 - 40%	7%	9 - 14%
Property		33 - 51%	18%	9 - 14%
Reserve Risk Charges				
Homeowners	Vary by line of business with initial industry factor adjusted for company experience	19 - 39%	21%	11 - 19%
Other Liablity Occurance		26 - 48%	13%	14 - 23%
CMP		25 - 45%	14%	5 - 9%
Personal Auto		20 - 48%	11%	10 - 16%
Property		26 - 47%	28%	28 - 46%

Resource for A.M Best and S&P current model: Midwestern Actuarial Forum, Barry Zurbuchen, Spring 2002

Financial Services Authority (FSA) - UK

- Two components for Capital Requirement

- Enhanced Capital Requirement (ECR): standard formula is utilized with different percentage charges for assets, liabilities and premiums

- Individual Capital Assessment (ICA): Additional requirement for insurers to develop internal view of capital requirements using scenario testing or internal models
  - 99.5% confidence level for 1 year
  - Results discussed with regulators and capital requirements agreed

Solvency II

- Currently targeting 2012 to have the new system in place

- Two capital measures to be introduced

- Minimum Capital Requirement (MCR) – Formula approach calculation.
  - If company falls below MCR threshold, regulators will have requirement to stop operations.

- Solvency Capital Requirement (SCR) - The SCR is based on a Value-at-Risk measure calibrated to a 99.5% confidence level over a 1-year time horizon.
  - Covers all risks and risk mitigations for company
  - The SCR may be calculated using either a new European Standard Formula (to be finalized in 2009) or an internal model validated by the supervisory authorities.
  - If company falls below SCR threshold, regulators will have requirement to intervene.

A Brief and Painful History of Models Leading Us Astray

- October 1987 – Black Monday stock market crash
- September 1998 – Long Term Capital Markets
- Fall 2001 – Enron
- September 2005 – Katrina
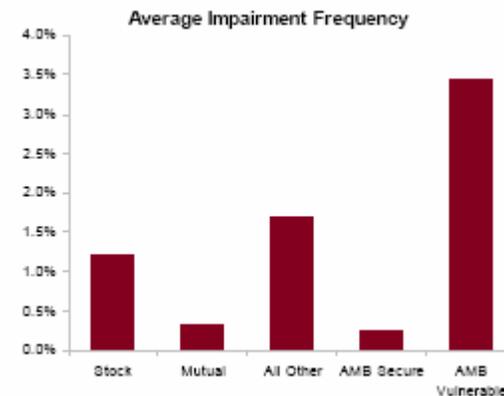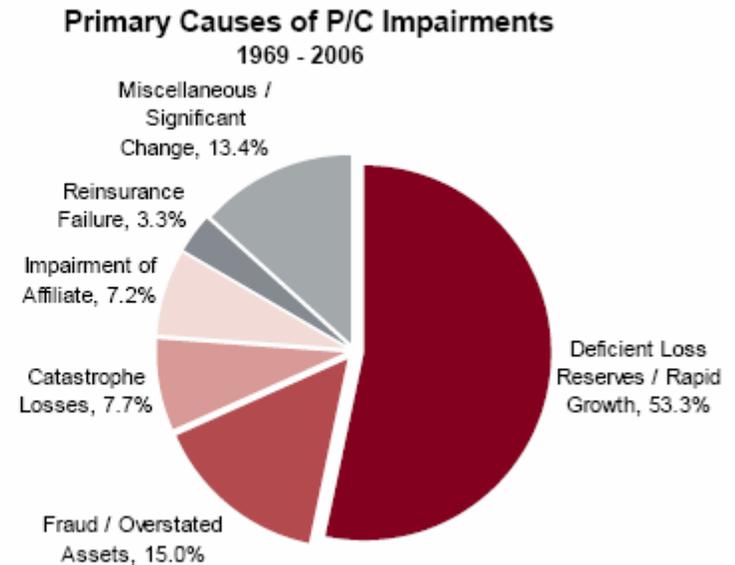- August 2007 – Subprime mortgage crisis

- A few quotes:
  - 1998: "Theoretically, the odds against such a loss had been prohibitive; such a debacle was, according to mathematicians, an event so freakish as to be unlikely to occur even once over the entire lifetime of the universe"
  - 2001: "No company has a better handle on its enterprise risk than _____"
  - 2005: "The odds of an event exactly like Katrina striking are less than 1 in 500"
  - 2007: "Our risk models failed to pick up that we were due for a correction. We were highly diversified. It was the perfect negative storm"
  - 2007:   " [Company X] said that's its funds had been hit by moves that its models suggested were 25 standard deviations (1 in 10^{136} probability) away from normal

Source: "So Many Models – Part III – Critique of Capital Modeling Approaches" by Stephen Mildenhall at 2007 CAS Annual Meeting

Drivers of Impairment – 2007 AM Best Impairment Study

- 658 impairments (defined as restrictive regulatory action) in 38 year period 1977 – 2006

Cause (1969-2006)	Pct Total
Deficient Loss Reserves	37.6%
Rapid Growth	15.7%
Alleged Fraud	8.1%
Catastrophe Losses	7.7%
Impairment of Affiliate	7.2%
Overstated Assets	6.9%
Significant Change	4.4%
Reinsurance Failure	3.3%
Miscellaneous	9.0%

Primary Causes of P/C Impairments
1969 - 2006

- Miscellaneous / Significant Change, 13.4%
- Reinsurance Failure, 3.3%
- Impairment of Affiliate, 7.2%
- Catastrophe Losses, 7.7%
- Fraud / Overstated Assets, 15.0%
- Deficient Loss Reserves / Rapid Growth, 53.3%

Average Impairment Frequency

(Stock, Mutual, All Other, AMB Secure, AMB Vulnerable)

How Effective is the RBC Formula in Predicting Insolvency?

- Two insurance industry studies:
  - Insolvency Experience, Risk-Based Capital and Prompt Corrective Action in Property-Liability Insurance (Cummins, Harrington, Klein – 1995)
  - Analysis of RBC data from 1989-1991 capturing failures through Q3 1993, just prior to introduction of P&C RBC in March 1995
- Main findings:
  - Problem: Less than 50% companies that later failed had RBC ratios within the Regulatory or Compliance action levels
  - Possible silver lining:
    - total and component RBC ratios were generally significantly different for failed and surviving firms based on univariate tests
    - Logistic regression indicates that allowing the weights of the RBC components to vary and including entity size (i.e. log of entity assets) and organizational form (mutual vs. stock company) materially improved the regression fit between RBC ratios and subsequent failure – but even so, the RBC model is less successful at predicting large firm insolvencies than smaller insolvencies

Source: "So Many Models – Part III – Critique of Capital Modeling Approaches" by Stephen Mildenhall at 2007 CAS Annual Meeting

How Effective is an AM Best Rating in Predicting Insolvency?

- AM Best ratings do differentiate, but are far from infallible

Impaired Companies in Each Rating Category
By Years Before Impairment
U.S. life/health and property/casualty data from 1977 to 2006.

Rating Category	<----- No. of Years Before Impairment ----->					In Year of Impairment
	5 Years	4 Years	3 Years	2 Years	1 Year	
A++/A+	32	35	34	29	14	1
A/A-	132	126	132	110	58	10
B++/B+	122	126	110	115	90	25
B/B-	77	79	96	111	116	92
C++/C+	30	37	41	36	58	54
C/C-	16	16	16	24	48	62
D/NA-7	67	70	83	92	147	208
Not Formally Followed*	202	189	166	161	147	226
All	678	678	678	678	678	678

* The "Not Formally Followed" category represents companies that did not have a Best's FSR at the time period in question but had a Best's FSR at some time after Dec. 31, 1977.
Source: A.M. Best Co.

Ratings Prescience

Rating	Average	2 Years	1 Year	Year of
A's	69.3%	20.5%	10.6%	1.6%
A or B's	93.6%	53.8%	41.0%	18.9%

Source: "So Many Models – Part III – Critique of Capital Modeling Approaches" by Stephen Mildenhall at 2007 CAS Annual Meeting

Do factor based models have anything worthwhile to tell us?

What else is out there?

Deloitte.