Economic Capital for Life Insurers

Arnold Dicke
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Economic Capital…

• How is it defined?
• What are its components?
• How are the components calculated?
• How is diversification taken into account?
Definition of Economic Capital

Economic Capital (EC)…

- EC equals Required Total Assets (RTA) less Value of Liabilities (VL)
- RTA is the value of assets required to assure that the NPV of net cash flows is positive with a given probability (e.g., 99.95%) for a set of scenarios
- Both RTA and VL may change with the scenario – and so will EC
Ruin Theory Approach

- Required Total Assets (RTA)
- Value of Liabilities
- Economic Capital

Probability of Survival

99.95%
Components of Economic Capital
Economic Capital covers 7 different risk types

- Credit Risk
- Transfer Risk
- Market Risk
- Business Risk
- Operational Risk
- Life Risk
- P&C Risk

Inter-risk diversification

Total Economic Risk
Risks for A Diversified Financial Services Firm

Management of a diversified financial services firm wants to know the risks and returns of all its businesses.

<table>
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<tr>
<th>RISK MAP</th>
<th>CREDIT</th>
<th>TRANSFER</th>
<th>MARKET*</th>
<th>BUSINESS</th>
<th>OPERATIONAL</th>
<th>LIFE</th>
<th>P&amp;C</th>
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Value of Liabilities

Economic Return = change in market value of assets less change in market value of liabilities

Market Value is an estimate of price – easy to determine if complete markets with readily available and observable values exist. This holds for example for trading, treasury and investment banking businesses. More difficult for incomplete markets such as insurance.

For a block of life insurance, market value of liabilities is taken to be the present value of cash flows equal to best estimate cash flows increased by a Market Value Margin (MVM) for each of the risks; e.g., an actuarial proxy of market value of the cash flows.
What is Market Value Margin (MVM)?

- MVM reflects the market estimate of the price a willing buyer would pay above the best estimate of liability cash flows e.g., the risk premium for uncertainty (systematic, undiversifiable)
Value of Liabilities

Economic Capital…

- Is usually based on market value of liabilities
- Could theoretically be calculated based on other liability valuations
- Calculations would be different
- Following assumes Market Value of Liabilities (MVL)
Seven Risk Types – Credit Risk

1. Credit Risk

Credit Risk is driven by 5 factors

- Expected default frequency: issuer/counterpart creditworthiness
- Severity: offset by collateral
- Exposure: size of exposure at default
- Maturity: contract & cash flow maturity
- Correlations: diversification
Seven Risk Types – Transfer Risk

2. Transfer Risk – Inconvertibility Risk

• Local book capital can in some emerging countries not be repatriated when required
• Solvent foreign partners cannot meet their obligations because of emerging government restrictions
ALM Risk

• ALM risk is the uncertainty in economic value caused by uncertainty/volatility in interest rates, equity prices, real estate prices, foreign exchange rates and other factors

• ALM risk cannot always be fully diversified/hedged due to, for example, complexity of embedded options and long-term structure of some businesses

• ALM risk involves both market risk (hedgeable) and business risk (unhedgeable)
ALM Risk

ALM Risk – Replicating Portfolio

- Replicating portfolio contains assets which match the liability cash flows as closely as possible
- Actual asset portfolio versus replicating portfolio performance is attributable to investment activity
- Replicating portfolio versus liability portfolio performance is attributable to (insurance) business line

'Verifiable' Market Risk

Actual investment return

Business Risk (ALM) of (insurance) business line due to unhedgeable liability ALM risk
Seven Risk Types – Market Risk

3. Market Risk
   - Market risk is defined as hedgeable market price or rate changes on open positions
   - Responsibility of investment area
ALM Market Risk – Practical Method

• Method only applicable where there is no ALM Business Risk
• Asset cash flows will come from existing assets
• Select a set of stochastically-generated scenarios (say 100)
• Project asset cash flows without reinvestment and solve for an option adjusted spread (OAS) over the 90-day Treasuries such that the average of the present value of these cash flows over the 100 scenarios equals the (known) market value of the existing assets
• Use the 90-day Treasuries from each scenario increased by the OAS to discount the liability cash flows (including the MVM). The PV is the value of the replicating portfolio
• Rank each scenario by the excess (or deficiency) of the PV of the existing asset cash flows over the PV of the liability cash flows for that scenario
• RTA will be the average of the market values of the assets that must be added to the existing assets to avoid ruin for the 99th and 100th scenarios
• The Economic Capital for the ALM market risk is the excess of the RTA over the market value of the existing assets
Seven Risk Types – Business Risk

4. Business Risk

*Business risk consists of two parts:*

- ALM Business Risk
- Non-ALM Business Risk
Seven Risk Types – Business Risk

4. Business Risk *continued*

*Business risk consists of two parts:*

**ALM Business Risk**

- Unhedgeable (price or interest rate) mismatch risk due to product design and/or market
  - Life policies with interest guarantees with maturities which cannot be closed out or hedged in the financial markets
  - Insurance liabilities sold in emerging market countries with maturities which are not traded

**Non-ALM Business Risk**
Seven Risk Types – Business Risk

4. Business Risk continued

Business risk consists of two parts:

ALM Business Risk

Non-ALM Business Risk

• New business variations from plan (usually as a result of regulatory or fiscal changes)
• Existing business variations from plan (lapses and renewals)
• Expense risk
• Moral hazard
Seven Risk Types – Operational Risk

5. Operational Risk

Operational risk is the risk of loss due to one-off events

- System failures
- Processing & control failure
- Litigation mis-advice
- Unplanned litigation
- Regulatory breach
- Fraud
- External disruption
Seven Risk Types – Operational Risk

5. Operational Risk *continued*

Operational risk can be traded off for lower return

- Company decides on protection, but protection has a price (reduced return)
- A safer company needs lower capital (buffer) – again, a “risk versus reward” decision
- Expansion of internal control procedures implies quantified operational risk capital savings are factored into (financial) performance measurement (higher costs with simultaneous decrease in operational risk capital)
Capital for Insurance Risks

• **Volatility capital** – To provide for random fluctuations where risk probability distribution is known
• **Uncertainty capital** – To provide for incorrect estimates of risk probability distribution
• **Calamity capital** – To provide for short-term increases in claims due to extreme conditions
Seven Risk Types – P&C Risk

6. P&C Risk

- Volatility risk: Major windstorm
- Uncertainty risk: Mis-estimation of the period between storms
- Calamity risk: Windstorm of size that occurs once in 2000 years

Often short term contracts, possibly with long tail
Seven Risk Types – Life Risks

7. Life (Morality and Morbidity) Risks

Longer term contracts
Life Risk Factors

Needed

Practical methods to determine economic capital for life risk and life market value margins
Life Risk Factors

Reinsurance Advantage

• Data from a collection of independent sources
• Knowledge of deals done at market value
Life Risk Factors

Market Value Margin (MVM)

Look at pure mortality reinsurance deals in the marketplace
Life Risk Factors

Determine MVM to equalize present values of expected cash flows

- With pricing discount rate and pricing (expected) mortality
- With risk-free discount rates and pricing mortality multiplied by (1+MVM)
Life Risk Factors

Volatility Capital

Can be calculated from expected mortality rates
Life Risk Factors

Uncertainty Capital – *First Try*

Calculate sample standard deviation of A/E ratios for collection of client companies
Life Risk Factors

Problems

- Unweighted result: very high – unrealistic
- Weighted by exposure: still unrealistic
- Surmise: should weight by credibility and discount for diversification across ceding companies
Life Risk Factors

Uncertainty Capital – *Second Try*

Calculate sample standard deviation of A/E time series for entire block
Life Risk Factors

Calamity Risk – Conditional Tail Expectation

Loss Distribution

1 in 2000 years event

Capital Cushion

Increasing Loss
Life Risk Factors

Calamity Capital – *Example 1918 Influenza*

- 500,000 deaths in US (would be more than 1,000,000 today)
- 20,000,000 deaths worldwide
- W-shaped age distribution
- 9-month lead time for vaccine
- Estimate 50% increase in mortality for the year
- Frequency? Black Plague (1400s) was longer lasting; less intense
Life Risk Factors

Calamity Capital – *MRC “Delphi” study*

- Earthquake
- Infectious diseases
- Bioterrorism
  - Mortality increase <<50%
Life Risk Factors

Life Economic Capital

- Volatility: 5%
- Uncertainty: 75%
- Calamity: 20%

- Would vary significantly by book of business
- Diversification impact can be large
Credit for Diversification

Diversification and Economic Capital

- Risks are not always fully correlated
- Total risk is therefore not the same as the sum of the risks
- This is called diversification and reduces the economic capital buffer
- However, for a 99.95% probability of ruin (AA-rating starting-point), the diversification tends to break down and many correlations move to 1 again
- Can distinguish 3 diversification levels

1 = within a risk, within a BU
2 = within a risk, between BU’s
3 = between risks, between BU’s
Credit for Diversification

Three Diversification Levels – Many Correlation-Matrices

Calculated by the BU:

- Credit
- Transfer
- Market
- Business ALM
- Bus. non-ALM
- Operational
- Life: Volatility
- Uncertainty
- Calamity
- P&C

1. Credit
   - Credit
   - Transfer
   - Market
   - Business ALM
   - Bus. non-ALM
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   - Life: Volatility
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2. Transfer
   - Transfer
   - Market
   - Business ALM
   - Bus. non-ALM
   - Operational
   - Life: Volatility
   - Uncertainty
   - Calamity
   - P&C Risk

3. Firm Economic Capital
   - CREDIT RISK
   - TRANSFER RISK
   - MARKET RISK
   - BUSINESS RISK
   - OPERATIONAL RISK
   - LIFE RISK
   - P&C RISK
Use of EC for Pricing

In pricing (or embedded value accounting), Economic Capital is needed for all years, so must be based on a formula.
Practicality

How do we calculate Economic Capital?

Very carefully!