

ENTERPRISE RISK MANAGEMENT

ERM

Symposium

Where Cutting Edge Theory Meets State of the Art Practice

2011 ERM Symposium
March 14-16, 2011

Swissôtel Chicago
Chicago, IL

Some Challenges When Using Economic Capital

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Some Challenges With Using Economic Capital

Discussion Items

- EC and its role in ERM
- Use of EC requires an understanding of its calculation
- Some challenges:
 - Scenarios
 - Replication
 - MVL
 - Shock period

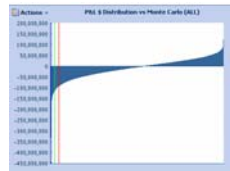
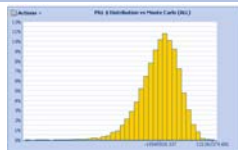


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Economic Capital System is In Production

You've done all the dirty work:

- System up and running
- Market database
- Documentation:
 - User guide
 - Technical manual
 - Governance procedures
 - Audited process
- Help desk for users
- You've got numbers and fancy reports...
- What's next?



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Key Benefits of ECAPS

Auditability	<ul style="list-style-type: none"> • Clear control procedures and documentation leading to auditable and SOXable EC and CaR reporting • Many automated processes and IT controls • Supports auditable Risk Dashboard reporting
Timeliness	<ul style="list-style-type: none"> • Timely results in the quarterly reporting cycle
Consistency	<ul style="list-style-type: none"> • Standardised methodology and reporting format • Enhanced comparability of results across entities
Functional Improvements	<ul style="list-style-type: none"> • Improved methodologies, particularly on market risk calculations and diversification • EC attribution analysis • MVBS attribution analysis
Market Risk Analysis	<ul style="list-style-type: none"> • Much faster and improved Group-wide market risk analysis of specific risks • Improved ability to analyse insurance and banking diversification • Increased analysis & communication – move from getting the numbers to using the numbers



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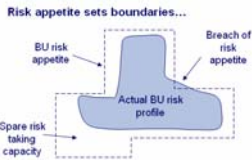
Many Metrics for Risk and Business Management

- There are many metrics besides EC for managing a business
 - GAAP/IFRS earnings and ROE
 - Statutory capital
 - Market Value Balance Sheet (MVBS)
 - Market surplus (MVS or MCEV)
 - Ratio of MVS (pretax and after tax) to EC
- EC at one or more levels (business unit, product, portfolio)
 - "Reverse engineer": What event triggers market shifts at a certain level?
 - Rather than recognizing a level of EC, define the event that gives the EC you want to hold
 - MVM/risk margin: risk in current book of business
- Predefined stress scenarios
 - Exposure to known risk situations
- Metrics can suggest distinct and contradictory paths of management



Enterprise Risk Management: EC a Key Ingredient

- ERM process
 - Identify risks
 - Measure (or assess) risks
 - Monitoring risks
 - Controlling risks
 - Mitigating risks
 - Culture: Job responsibilities, objectives, incentive compensation
- ORSA – Own Risk and Solvency Assessment (formerly IRMA – Internal Risk Management Assessment)
 - Formal statement of risk management policy
 - Board and Senior management accountability
 - NAIC requirements under discussion
 - Solvency II: a formal requirement, part of Pillar 2 on Governance



•Rating agencies: ERM reviews, including EC models
•EC is part of all of these applications



Economic Capital Is Used in Many Processes

- Asset Liability management
- Pricing (risk margins in pricing/MCVNB)
- Market consistent framework: compare EC to available capital on MCEV valuation (MVBS)
- Hedging programs
- Place limits on the type of liabilities that you sell
- Purchase/sale of blocks, both assets and liabilities
- Other "what if" analyses



EC: Important to Understand the Calculation

- If EC is to be used in risk management, then it is necessary to understand the process and the assumptions
- This understanding sets the stage for the proper use of EC
- EC is the end result of a process:
 - Assumptions from across the organization
 - Market scenario generation: need a vast data warehouse
 - Insurance and business assumptions: persistency, mortality, morbidity, expenses, operational risk
 - Default risks
 - Correlations among risks
 - Models: asset, liability, real world scenarios
- For most companies, EC is based on market consistent principles
 - Liability valuation based on Risk Free rates
 - Illiquidity adjustment
- VaR and time horizon



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EC Calculation - Simplified

- Process at ING - simplified:
 - Generate risk neutral scenarios
 - Cash flows for each scenario are generated by asset and liability models
 - Those cash flows are in turn used to develop replicating portfolios consisting of financial instruments
 - Other choices (trade penalties, bucketing, value constraints)
 - Alternate approach: enter duration and convexity into the EC engine
- Monte Carlo simulation of the replicating instruments: EC at 99.95% VaR



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EC Drivers: How Are These Reflected in EC and MVL Values?

- What are some drivers of EC?
- Level of rates and equity markets
- Volatility of rates
- Duration, convexity
- Moneyness of options and guarantees
 - Liability side:
 - Guarantees: Minimum crediting/purchase rates
 - Dynamic policyholder behavior
 - Asset side:
 - Calls on bonds
 - Prepays with structured assets
- Point in pricing cycle for Group Life, Health, and P&C coverages



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Potential Issues with Using the Results

Some issues and their resolution:

- Risk neutral scenarios are used to develop cash flows and replication
 - What is the role of the scenarios in the results?
- EC starts with an MVBS and shocks it
 - Are the replicating portfolios appropriate to use as liabilities on the MVBS?
- Alignment of the horizon value for the EC and the actual period of the shocks
 - How should the values be adjusted if the periods do not align?

Scenario Generation

Risk neutral scenarios:

- Need to capture volatility
 - Price guarantees and embedded options in insurance contracts
 - Price derivatives or instruments that contain embedded derivatives
 - Economic cost of financial options and guarantees
 - Since scenarios pick up tail risk and measure the plausibility of those risks, they can help determine the range and distribution of plausible outcomes
- Option costs increase with volatility
 - These have negative consequences with insurance contracts that have interest or equity guarantees
 - Reduced returns on invested assets
 - Increased economic value of liabilities

Call Option Cost as Function of Current Asset Price
Various Volatility Levels



Full Range of Optionality Can Be Difficult to Capture

- Replication is subject to various errors
 - These reduce the goodness of fit
 - Calibration error: deviation from market prices at certain points on the yield curve
 - Replication error: optimization produces replicating instruments that do not reproduce the cash flows of the liability model
 - Sampling or Simulation error: standard error from limited convergence in scenarios
 - Full range of optionality can be difficult to capture
 - Especially true for products with options/guarantees that have a wide range of in-at-out of the money options that vary with equity and interest rates and also with policyholder behavior
- Under most economic scenario generators now in use, rates follow either a normal or a lognormal distribution, with mean reversion
 - Normal distribution: rates can be negative, volatilities typically are not high enough when rates rise
 - Errors arise if negative interest rates are not consistently modeled in liability projections and replications
 - Lognormal distribution: volatilities typically are too high when rates rise

Reducing the Sampling Error in the MVL: Control Variate Adjustment

- Improve fit by valuing a liability's fixed cash flows on the deterministic curve, rather than stochastically
- Effectiveness depends on the relative proportions of fixed and variable cash flows
 - Liability model might posit no fixed cash flows because of policyholder lapse assumptions, premium collection assumptions, etc.
- Rerun cash flows based on the deterministic replicating instruments, the ZCB
- New value for each scenario is
 - The original scenario value + coefficient * (PV rerun cash flows for the scenario – actual MV of the ZCB)
 - Coefficient is: - [covariance (rerun cash flows, original cash flows)] + variance of rerun cash flows
 - Standard deviation drops from the original run's 22,421 to 3,702

Control variate method	
Original value	-53,666
ZCB projection	-54,502
MV of ZCB	-55,235
Covariance	640,940,046,294,759
VaR ZCB projection	841,807,607,642,119
Coefficient	-76,14%
New value	-54,225



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Alignment of the EC Horizon and Period of the Shock

- EC is often an annual measure
- Actual calculation period might be shorter
 - The annual period misses the impact of dynamic hedging strategies
 - Risk management strategies typically employ a shorter horizon
 - Reporting cycles are monthly or quarterly
- If a shorter period is used for the calculation of EC, then an adjustment is needed to translate the shorter period's EC to an annual measure
- The adjustment is easy if it is assumed that values are normally distributed
- Then annual EC = EC for one period x $\sqrt{\text{periods per year}}$
- The adjustment becomes more complicated if values are assumed to be lognormally distributed
 - Adjustment varies with the level of volatility and confidence interval
 - Using Excel formulas: multiply the EC adjustment above by

$$\frac{1}{\text{number of periods per year}} \times \frac{(\text{LOGINV}(C1,0,\text{Variance})-1)}{(\text{LOGINV}(C1,0,\text{Variance}/\text{number of periods per year})-1)}$$

Conf. Interv.	Volatility					
	5%	10%	15%	20%	25%	30%
99.95%	104%	109%	114%	119%	125%	132%
99.50%	103%	107%	111%	115%	119%	124%
90.00%	102%	103%	105%	107%	109%	111%



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Concluding Remarks

- EC at ING has a well defined role
 - Product design, pricing and approval
 - Setting risk/reward strategy
 - Risk, capital and value management and reporting
 - Provides results that reflect the economics of the business
- Refinements to the calculations
 - Replicating instruments
 - Replicating constraints
- Future IPO: Adaptations of EC to US environment



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