

Measuring and Managing Risk Capital in Practice

Session CS 5B

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Agenda

- Overview of Economic Capital
- Complications in Valuation of Credit-Sensitive Assets
- Implications for Aggregation and Risk-Based Capital
- Challenges of Product Growth and Increasing Model Complexity

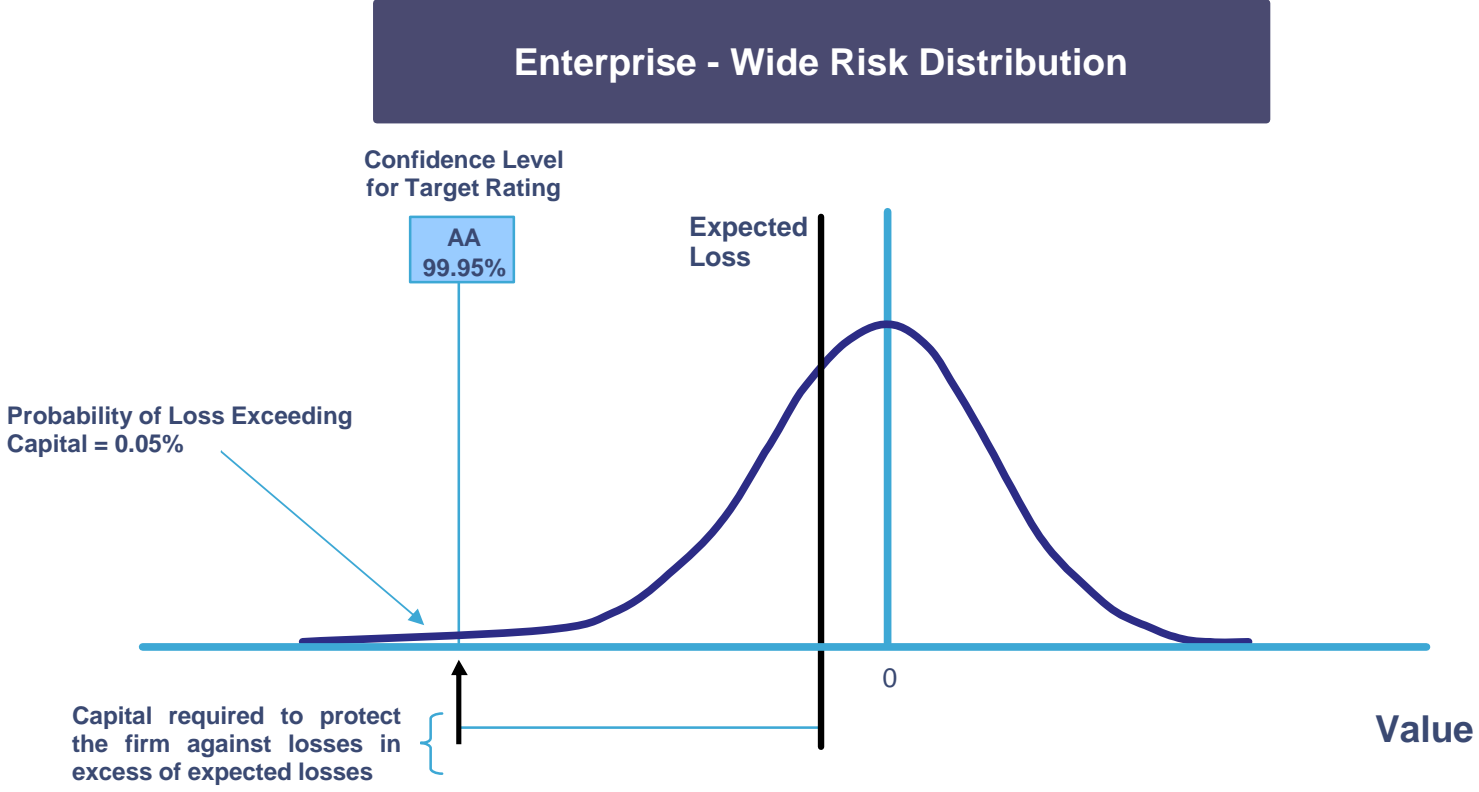
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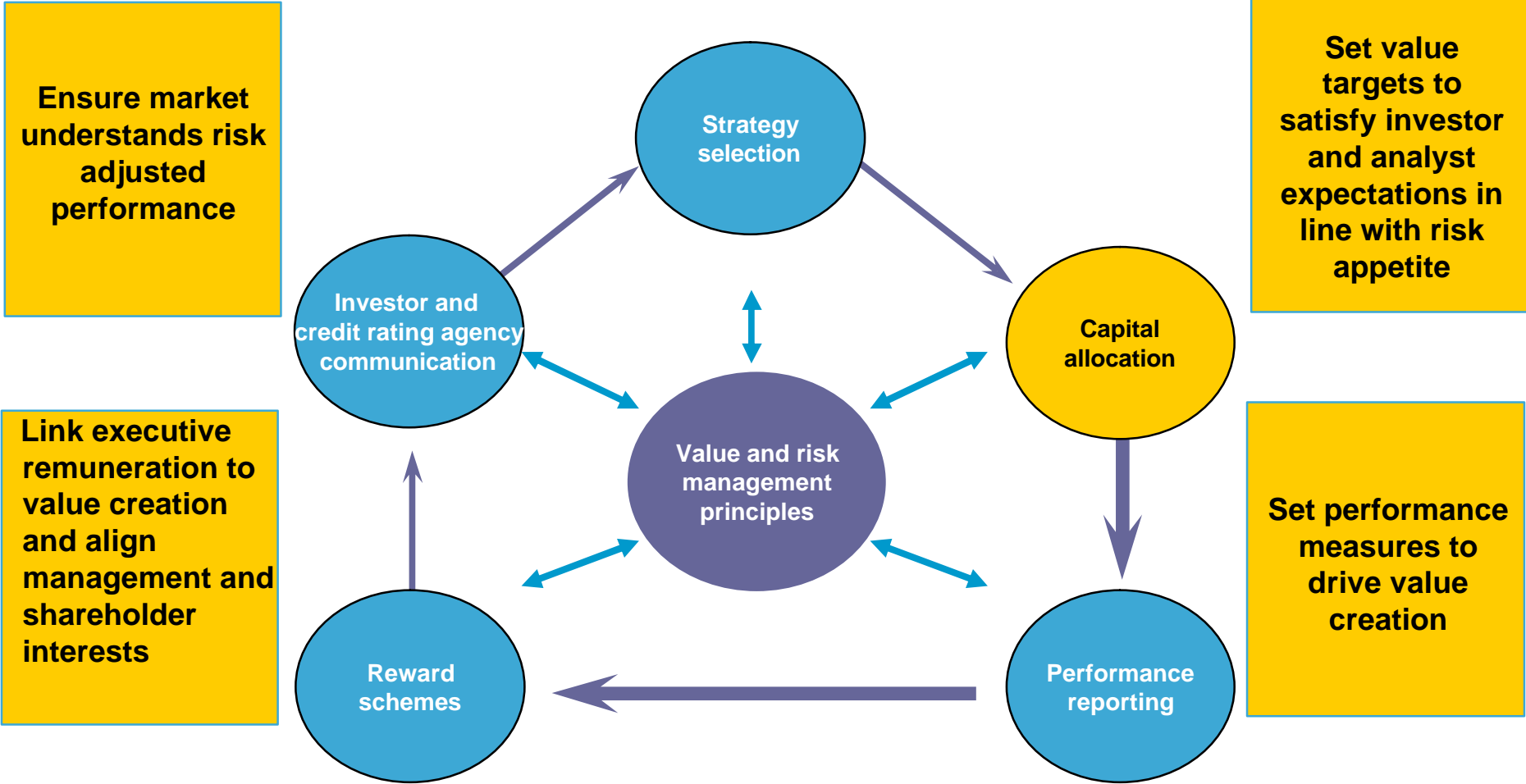
Economic capital is the amount of capital required to provide a cushion to absorb large losses, up to a confidence level, based on a firm-wide model of aggregated risks.

Required economic capital is calibrated so that the probability of large losses is less than or equal to a confidence interval consistent with the firm's desired rating level and solvency objectives.

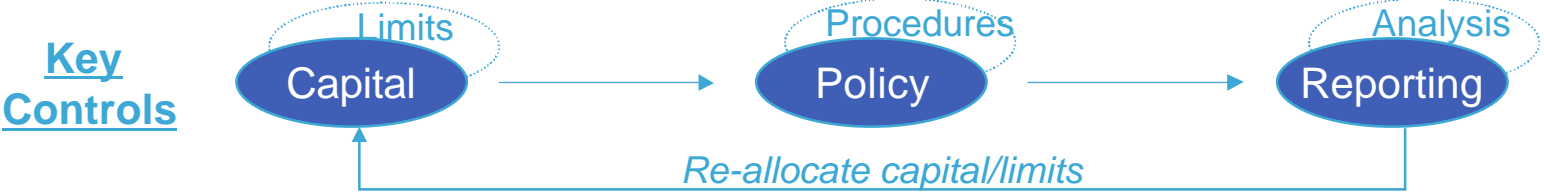


An ERM framework that is based on a robust risk capital model identifies the relationships between approved risk-taking and the returns delivered.

➤ Risk-based capital is a measure of the equity necessary to support the business, based on a modeled assessment of possible returns over a specified time horizon.

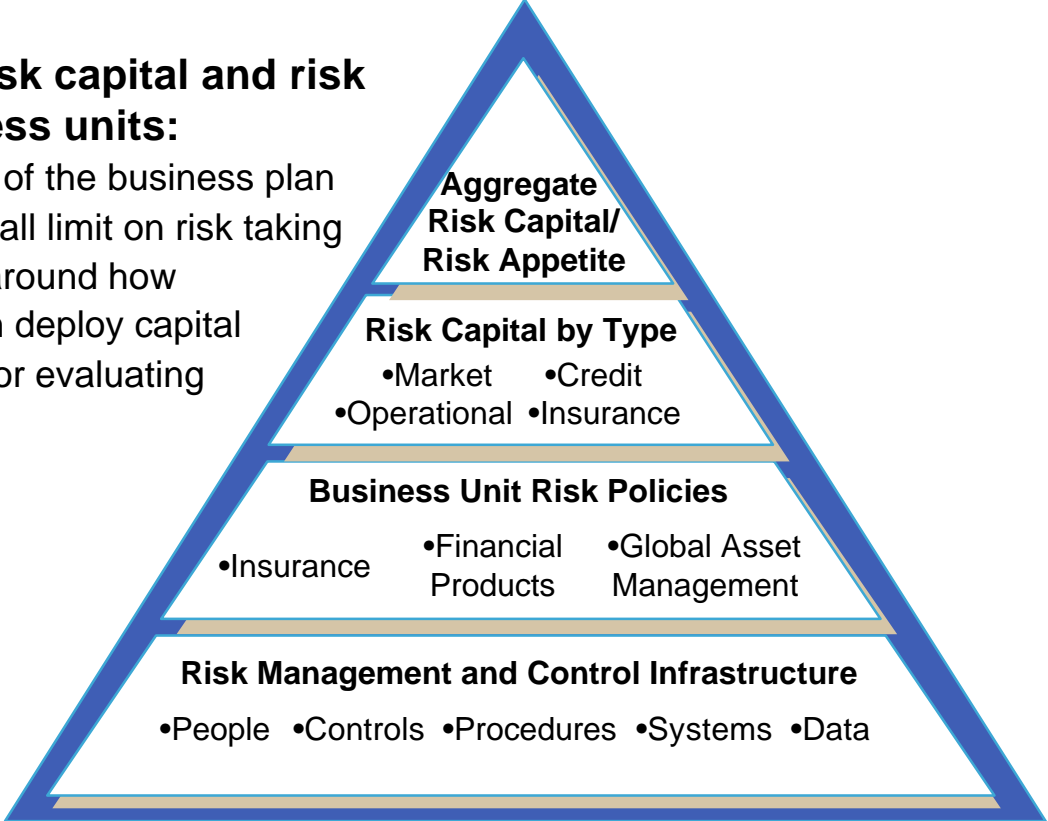


In advanced ERM implementation, risk capital requirements are assessed in the business plans and evaluated in performance reviews.



The allocation of risk capital and risk limits to the business units:

- Signifies approval of the business plan
- Serves as an overall limit on risk taking
- Sets parameters around how business units can deploy capital
- Provides a basis for evaluating value creation



Most practitioners agree on the definition of RAROC, but gaining confidence in the calculation depends on the quality of the data, much of which requires extensive computations.


The RAROC Equation

$$\text{RAROC} = \frac{\text{Risk-adjusted return}}{\text{Risk-adjusted capital}} = \frac{\text{Revenues} - \text{expenses} - \text{expected losses} + \text{equity credit} \pm \text{transfer prices}}{\text{Capital}}$$

Revenues
- expenses
- expected losses
+ equity credit
+/- transfer prices

Capital
capital required to cover large losses in excess of expected loss (expected losses are accounted in the numerator) at a confidence level (eg. 99.95%) for market, credit, operational, business, and other risks

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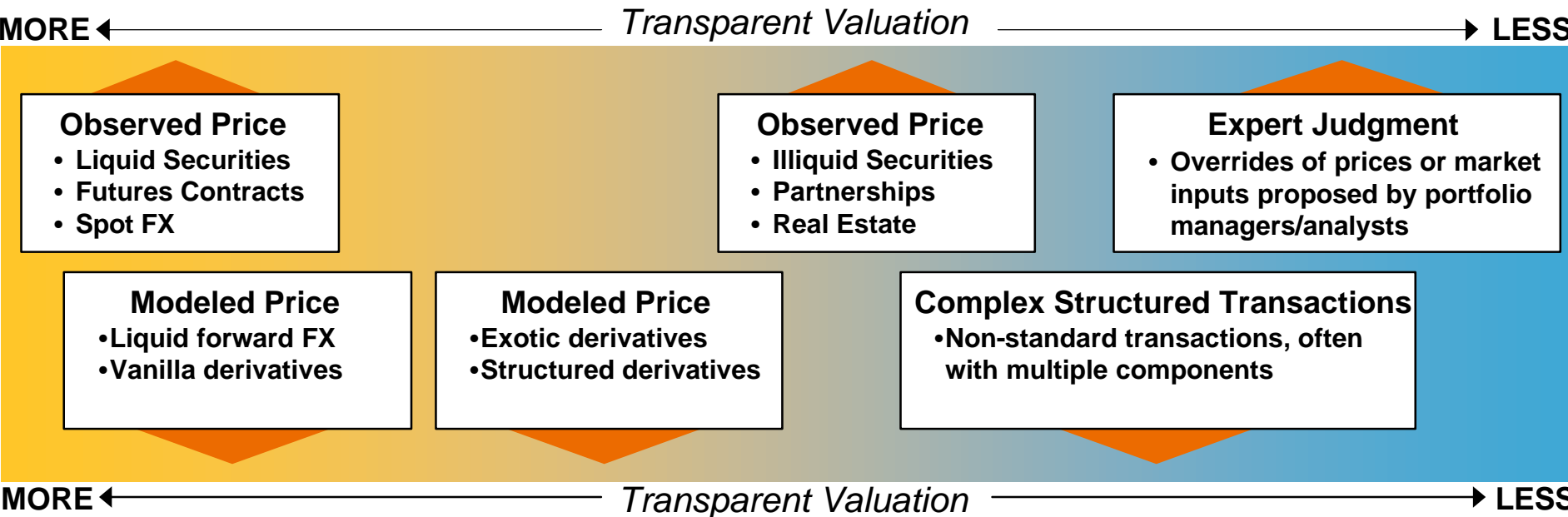
- Overview of Economic Capital
-  ➤ **Complications in Valuation of Credit-Sensitive Assets**
 - *Private Placements*
- Implications for Aggregation and Risk-Based Capital
- Challenges of Product Growth and Increasing Model Complexity

Risk quantification is based on the valuation of assets and liabilities and the history of returns generated from each risk category.

- Many insurance company assets and liabilities are carried at amortized cost, less applicable reserves.
- The design and implementation of a risk capital framework requires policies and methodologies for calculating these balance sheet values and the related time series of their evolution.
- Completely objective valuation of financial instruments requires market observable values for all inputs necessary to the valuation model.
- There are several classes of instruments (both on and off the balance sheet) for which there are multiple estimates for the values of market inputs (e.g., prepayment speeds, impact of seasoning, volatility skew, “last trade”).
- There are other classes of instruments for which valuations must be estimated by using “comparables,” usually relying on a scheme for matrix pricing.

Within the investment portfolio, there are several credit-sensitive product groups for which valuation is not straightforward.

➤ The full complement of market inputs is observable and available only for the most liquid securities and vanilla contracts.



➤ Many product groups are subject to “valuation adjustments” to allow for possible inaccuracies in model performance or changes in credit rating and bid/offer spreads observed in the market.

Private placements is a product group of illiquid securities for which matrix pricing is typically employed.

- The process should be grounded in a comprehensive enterprise-wide credit risk rating methodology for evaluating both the risk of the issuer and the transaction, with heavier weighting allocated to the more important criteria.
- The risk rating scale should be benchmarked against explicit default and/or expected loss ranges.
- The collection of credit spread data should involve multiple sources and should support premiums/discounts at the industry level instead of just by rating category.
- Secured/unsecured and/or senior/subordinated information should be carefully checked to ensure that transaction ratings/spread data are properly aligned.
- Risk ratings should be analyzed and reviewed by credit analysts independent of the investment management function.
- Group of 30 recently reiterated the importance of rigorous price verification performed by a unit independent of risk taking.

Documentation of valuation procedures is often incomplete or out-dated and testing of those procedures is not always performed with sufficient frequency.

➤ Samples of insurance company practices for private placements are discussed below:

Approach A

- Internal rating model to used to assign ratings to each issue
- Investment-grade credit spread matrix constructed using average spreads for all tenors from a monthly survey of several investment banks
- For BB+ and lower, one investment bank's public index spreads are used to construct a high yield curve
- Spreads are adjusted by sector
- Models such as the CIR option pricing model are used to price embedded options

Approach B

- Initial credit ratings are assigned by the credit research group and are examined quarterly
- Yield curves are updated bi-weekly and sector spreads are obtained monthly from an investment bank
- Subjective adjustments of a few bps based on current market conditions and activity can be made by the PM
- Liquidity discount of 10 bps
- For high yield securities, internal prices are reviewed quarterly by an independent party
- Prices may be overridden by PM based on current market conditions


Approach C

- Ratings are assigned primarily through expert judgment instead of a model based approach
- Credit spread matrix constructed relying on one investment bank's data
- For BB+ and lower, a manual spreads database is maintained by the analyst
- Asset class spreads used to create the spread matrix
- Model documentation is incomplete
- Pricing overrides are common, often without independent verification

Valuations of private placements are estimates and the resultant periodic returns are also approximations.

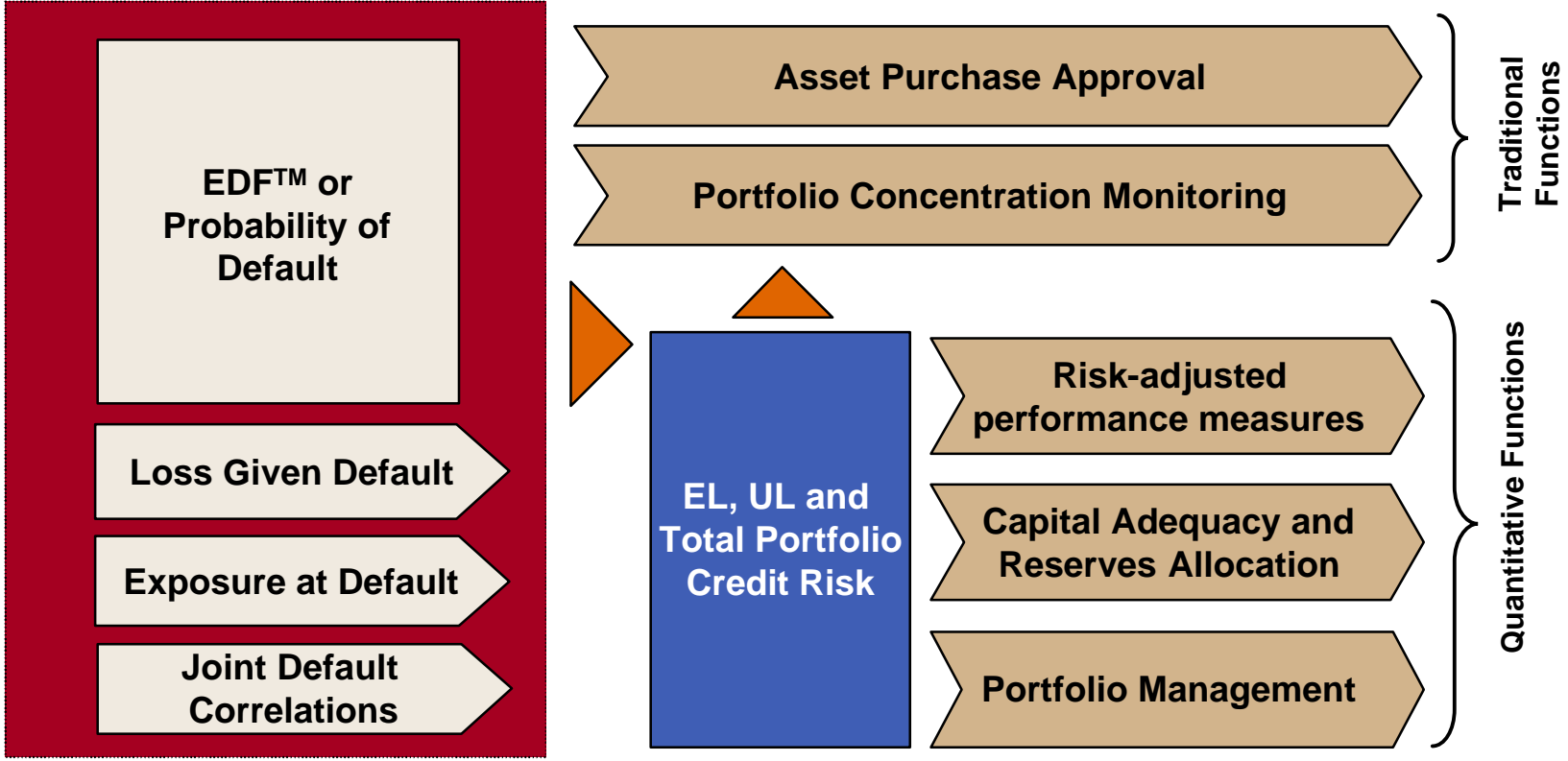
- Consistent matrix pricing should eliminate the problem of stale pricing.
 - However, the discontinuity in observed prices and changes in yield spreads for lesser-rated securities is masked by this approach.
 - What do you do when the occasional observed price suggests that the matrix might need to be recalibrated?
 - Even more broadly, how do you allow for large differences between last recorded unrealized value and final realized value?
- This problem is exacerbated by the “stickiness” in credit ratings, even if there is diligent monitoring and the use of a watch list to focus extra attention on potential emerging problems.
 - The valuation price generated from the matrix will not change until the final decision is made to change the rating.
 - Risk rating trends over time (migrations) should be tracked and used as part of the analysis for updating default and loss assumptions both for reserving and risk capital allocation.

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Total portfolio credit risk is an aggregation across product types that depends on consistent valuation methodologies and accurate calculations of default correlations.

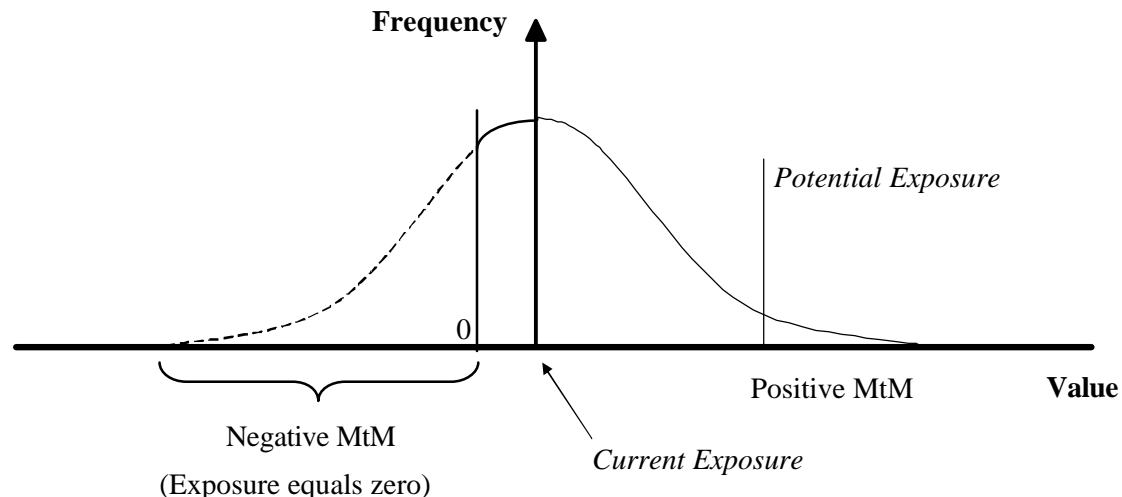
Basis of Robust Credit Risk Management



Credit portfolios with significant financial derivatives require a robust process to compute expected exposure at the time of default and its volatility.

Statistical models provide a forward-looking estimate of both expected exposure and potential exposure on financial derivatives. These measures are more appropriate estimates of the exposure from financial derivatives than relying solely on today's mark-to-market (current exposure).

- Current exposure Today's value of derivative (if positive)
- Expected exposure The mean exposure under a full range of scenarios
- Potential exposure Possible exposure value of the transaction, usually based upon a particular confidence interval



Regardless of methodology, credit risk quantification requires data determination processes to derive default probability, loss given default and exposure at default.

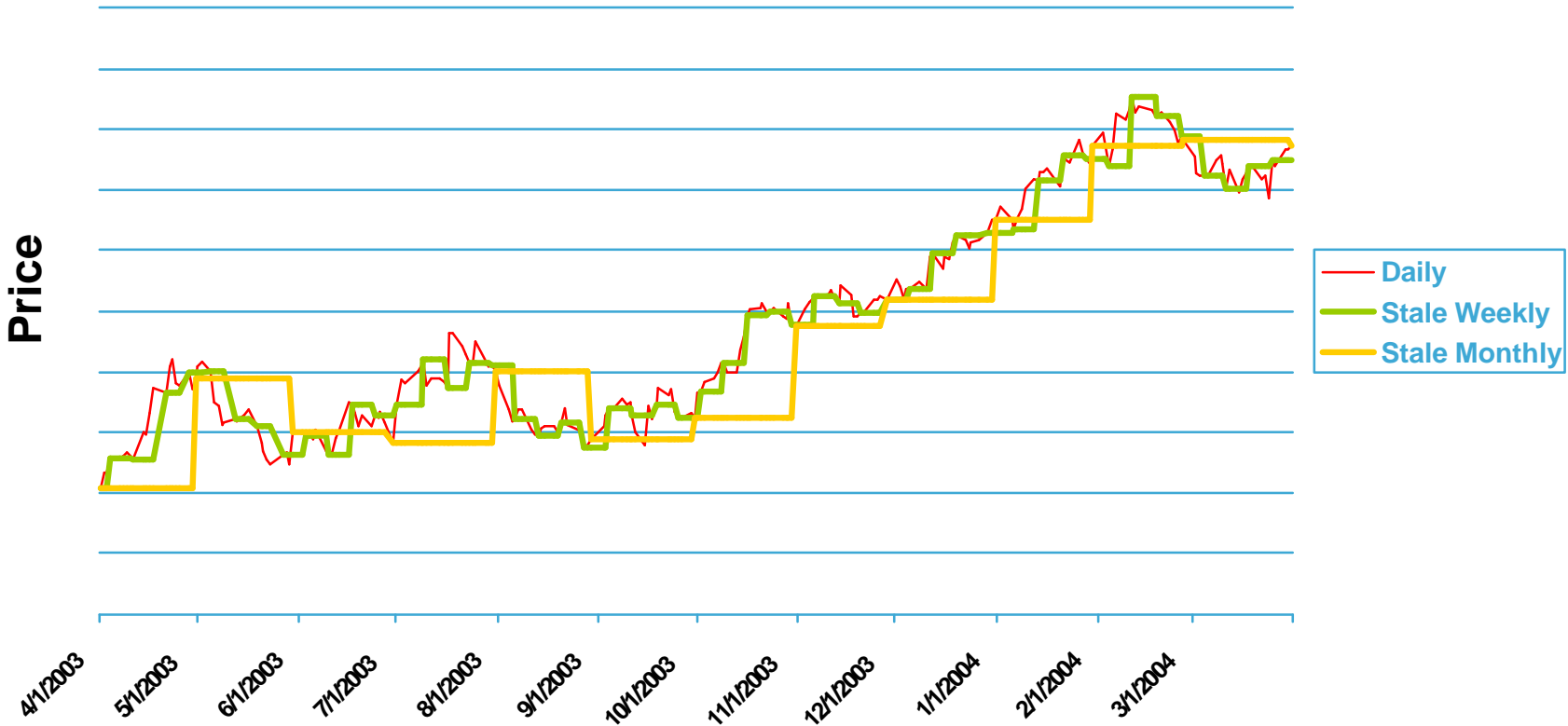
	Investment Portfolio	Reinsurance Portfolio
Default Probability (EDF™)	Credit Analysis EDF™ Models Rating Agency Default Statistics	
Loss Given Default (LGD)	Public Studies??? Internal Data	
Joint Default Correlations	Equity Markets??? Credit Default Swaps	
Exposure at Default	For derivatives requires the calculation of potential exposure	Calculation of Exposure to Insurance Products

At higher levels of aggregation within the company, the reliability of the estimate of the covariance between returns depends on the accuracy of the time series.

- If the time series database has errors in values or synchronization, all levels of risk aggregation will be prone to error.
 - Simple addition of positions/exposures per selected historical date will be wrong.
 - Computed volatilities and correlations will be inaccurate and potentially misleading.
 - Assumptions of diversification effects over typical investment horizons will be misleading.
 - Calculations of diversification impact from real-time modifications to the portfolio might also be inaccurate.
- The time series database grows in complexity as the content and format of daily inputs for valuation changes.
 - The value and price sensitivity of fixed income securities and derivatives contracts change with the passage of time.
 - Standard risk models accommodate these characteristics, but only when supplied with the appropriate additional historical market data.

Stale prices need to be replaced in the database by actual or estimated prices synchronized to the exact correct quotation date.

- Without appropriate standards for data quality and verification, stale prices can distort the calculation of key risk statistics.



Seemingly minor errors in synchronizing time series data can have significant impact on computed correlations.

- We selected five hypothetical time series of returns and calculated pair-wise correlations and portfolio standard deviation.
- These statistics change significantly as prices and returns become stale.

Using Daily Returns

	1	2	3	4	5
1	1.00				
2	0.21	1.00			
3	0.19	0.45	1.00		
4	0.35	0.36	0.56	1.00	
5	0.26	0.42	0.64	0.58	1.00



Using Stale Weekly Returns

	1	2	3	4	5
1	1.00				
2	0.10	1.00			
3	-0.02	0.49	1.00		
4	0.16	0.42	0.45	1.00	
5	0.00	0.46	0.68	0.62	1.00




Using Stale Monthly Returns

	1	2	3	4	5
1	1.00				
2	-0.06	1.00			
3	0.10	0.55	1.00		
4	0.03	0.29	0.22	1.00	
5	-0.02	0.58	0.44	0.60	1.00

	Daily Liquid Pricing	Stale Pricing Weekly	Stale Pricing Monthly
Annual volatility	16%	14%	11%

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Multiple valuation methodologies increase the data requirements for the computation of risk capital.

- Institutional investors have long struggled to reconcile inconsistent security master descriptive data and perfect the reliable capture of prices and corporate actions from outside vendors.
- Risk capital requires the preparation and maintenance of synchronized time series for a wide array of static and derived data, much of which is generated from internal sources and is not downloadable from data vendors.
- The source of a valuation can alter between a matrix price, a broker quote, average of a dealer survey or trader override. Do you keep histories of all sources from each valuation?
- How do you handle the occasional larger adjustment that might occur, especially via override for a major reporting date?
- Especially in a declining market where a higher proportion of underperforming assets are liquidated prior to maturity, the final realized value may be substantially different from the last reported unrealized value – very difficult to find data to measure this.

Modelers are accustomed to making choices between tractability and granularity.

- Conservative managed pricing of illiquid assets might be considered a “best practice.” But it can lead to understatements of betas and correlations.
- A common solution is to lengthen the observation period in the risk calculation, especially to include both up markets and down markets.
 - But this contradicts the conventional wisdom of exponential weighting to improve short-run accuracy of risk measures.
- Another common solution is to proxy holdings to broad market benchmarks and/or bellwether securities.
 - But this masks concentration risk as well as convexity and other risks that proliferate in today’s markets.
 - It also tends to mask spread risk, if you do not maintain a sufficiently granular set of proxies.
- Most lessons learned at financial institutions caution us against aggregating customer data and risk statistics without starting from a low level of detail.

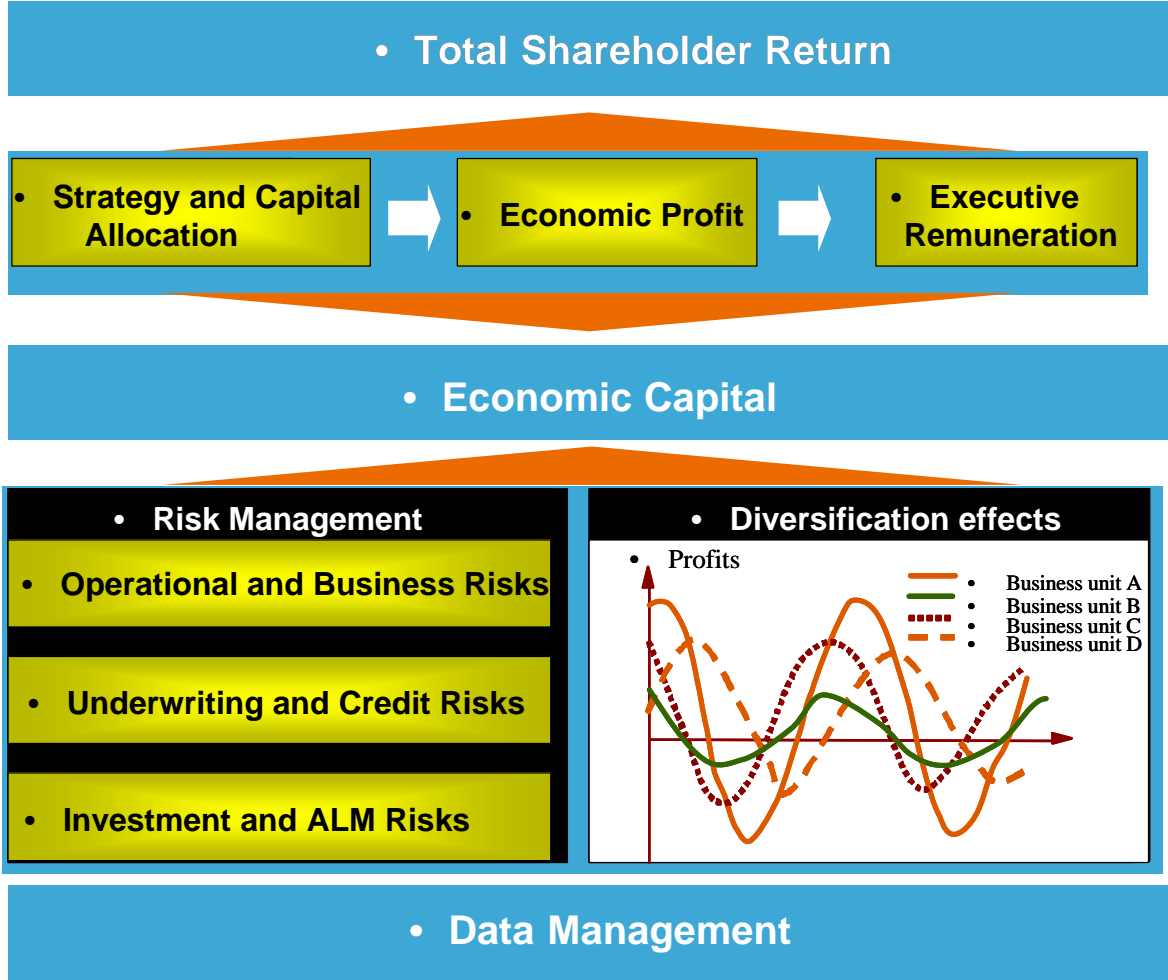
Given the global reach of several insurers, efforts to avoid stacking are complicated by the proliferation of new investment products.

- On the product side, are all entity “children” that are domiciled in different countries from the “parent” properly tracked and aggregated.
 - Across all products?
 - Across all geographies?

- On the investment side, are exposures from all instruments properly mapped into the corporate parent?
 - Securities (equities, fixed income, investment contracts)?
 - Derivatives (counterparties, reference entities)?
 - Structured products?

- In all instances, is the enforceable documentation properly reflected in both the accounting records and risk systems?

Data management standards and processes must enable the capture and quantification of performance and risk metrics at all levels of the organization.



Top down risks

- Stress test Credit Risk based on internal risk ratings, linked with historical default frequencies and loss severities
- Stress test Investment Risk based on market curves and multiple simulations
- Stress test Underwriting Risks based on probable maximum loss scenarios
- Begin with approximations to quantify the more subjective risk elements
- Identify correlations between and across risk categories

Bottom up risks

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