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Economic capital allocation

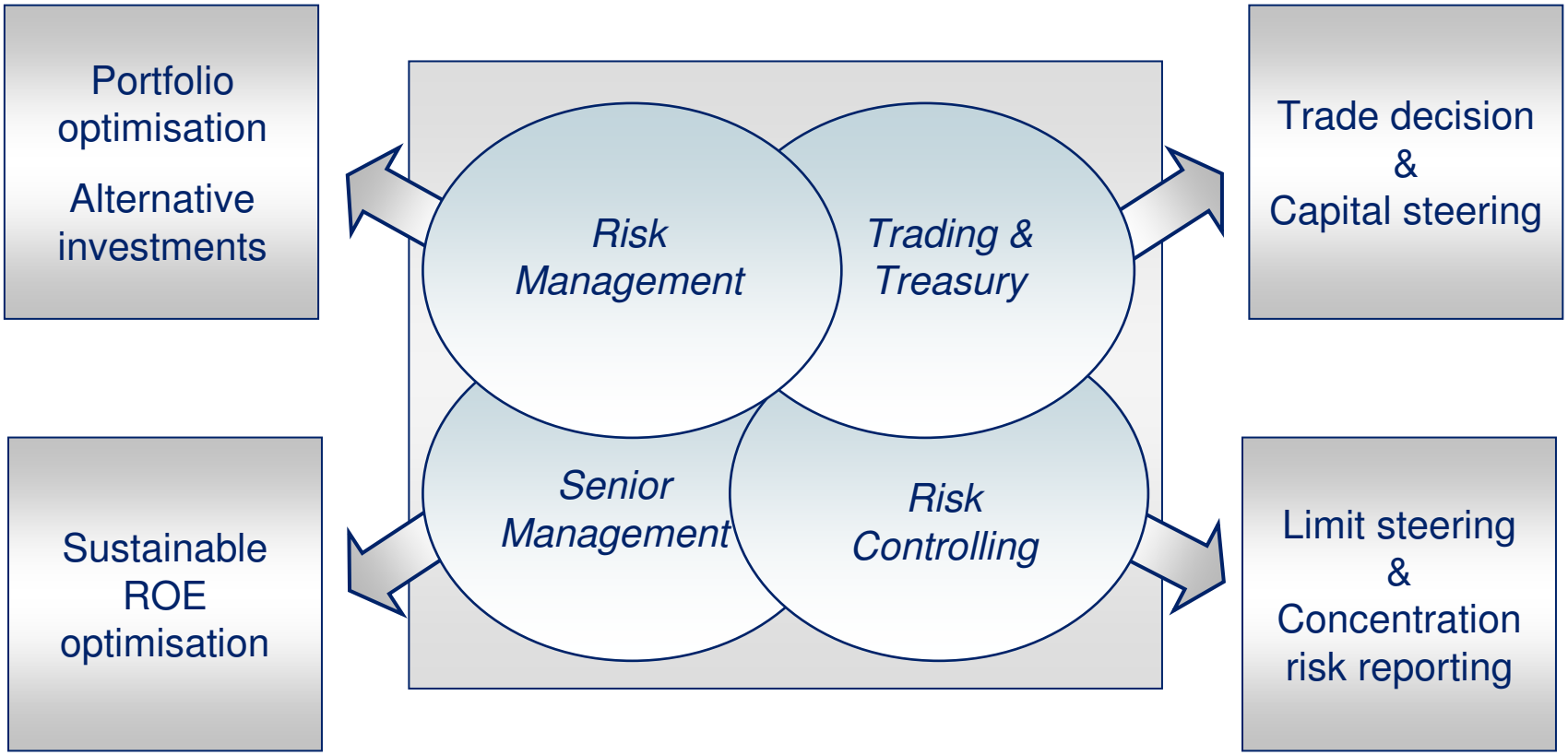
Energyforum, ERM Conference
London, 1 April 2009
Dr Georg Stapper

Agenda

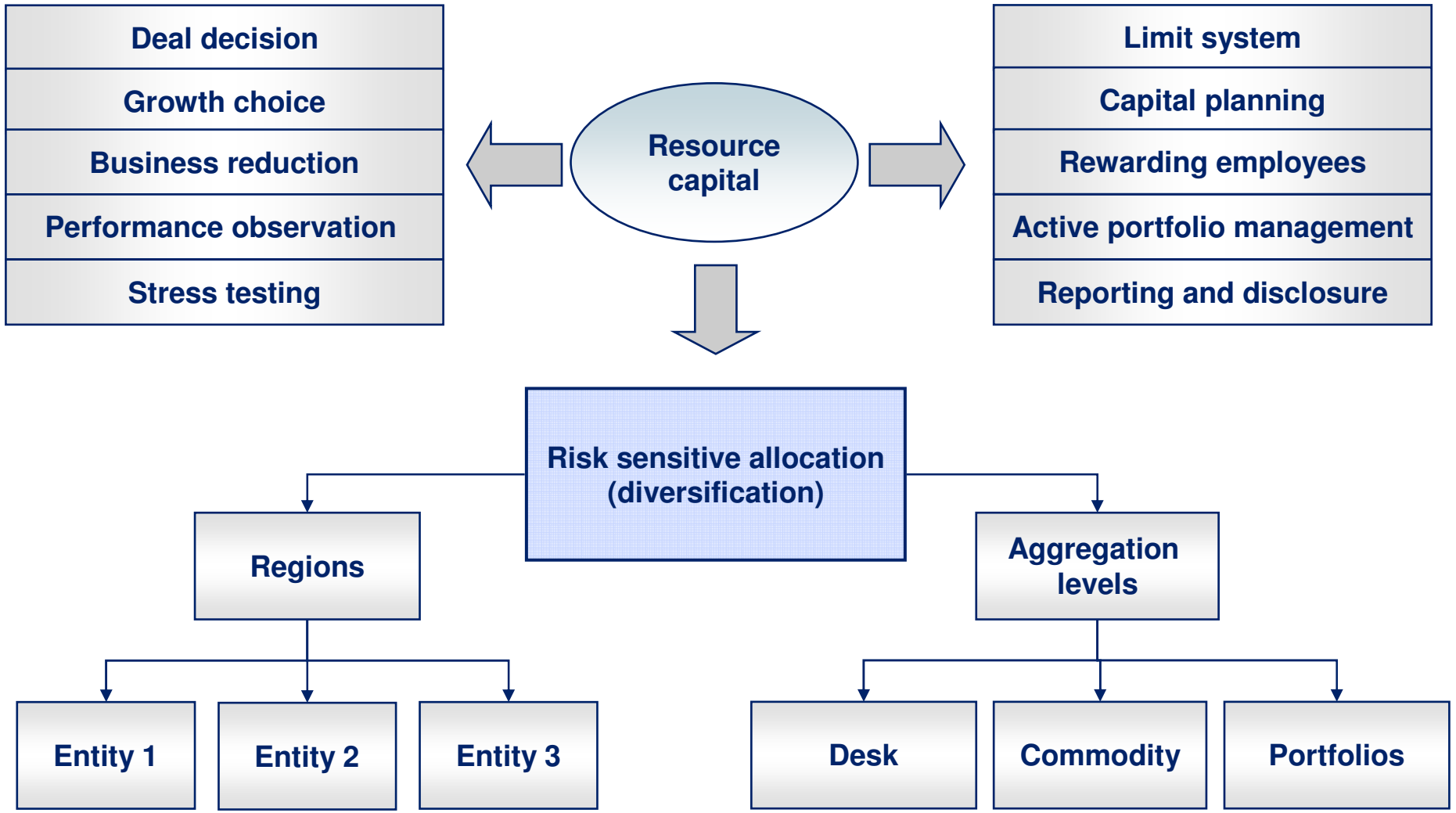
- ERM and risk-adjusted performance measurement
- Economic capital calculation
- Aggregation and diversification of risk types
  - Relevant risk types
  - Diversification benefits
  - Copula approach
  - Determining correlations
- Economic capital allocation

ERM: Market demand

Market demand for EC modelling and capital allocation exists in all profitability oriented departments and at all levels of management attention



Benefits of a risk capital based allocation approach



Risk adjusted performance measurement (RAPM)

- General approach:

$$\text{performance} = \frac{\text{revenues - costs}}{\text{risk}} \text{ - target return}$$

- Components
  - **target return**: Cost of Equity (CoE) for trading unit rather than WACC, since
    - trading is not based on capital investment, but highly leveraged
    - unlike operating business trading performance includes funding costs
    - ⇨ WACC approach would underestimate cost of capital, not suitable for trading unit
  - **revenues**
    - backward looking: accrued profit and loss
    - forward looking: depends on deal character
  - **costs**: should cover operational expenses and expected losses
  - **risk**: suitable @risk figure covering all relevant risk types

Perspectives of RAPM

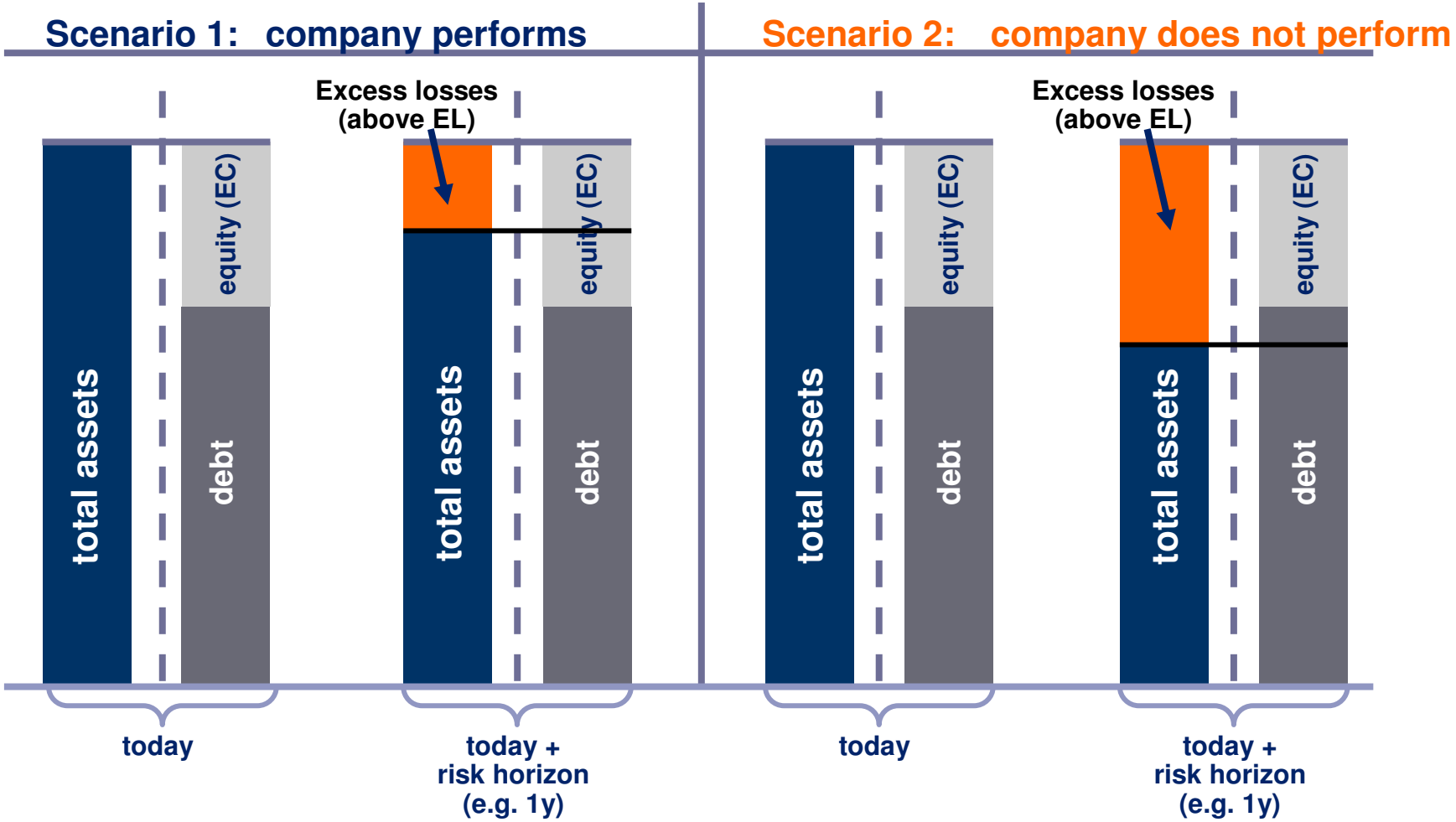
- Forward looking: steering
  - capital planning
  - impact of new acquisitions

$$\text{RAROC} = \frac{\text{Revenues} - \text{Costs} - \text{Expected Loss}}{\text{Allocated Economic Capital}} \quad \text{(Steering)}$$

- Backward looking: measurement
  - performance measurement of business units on a common basis
  - impact of hedging

$$\text{RoE} = \frac{\text{Revenues} - \text{Costs} - \text{Realised Loss}}{\text{Book Equity} \quad \text{Allocated EC} * \text{CAF}} \quad \text{(Measurement)}$$

Economic Capital as a safety cushion



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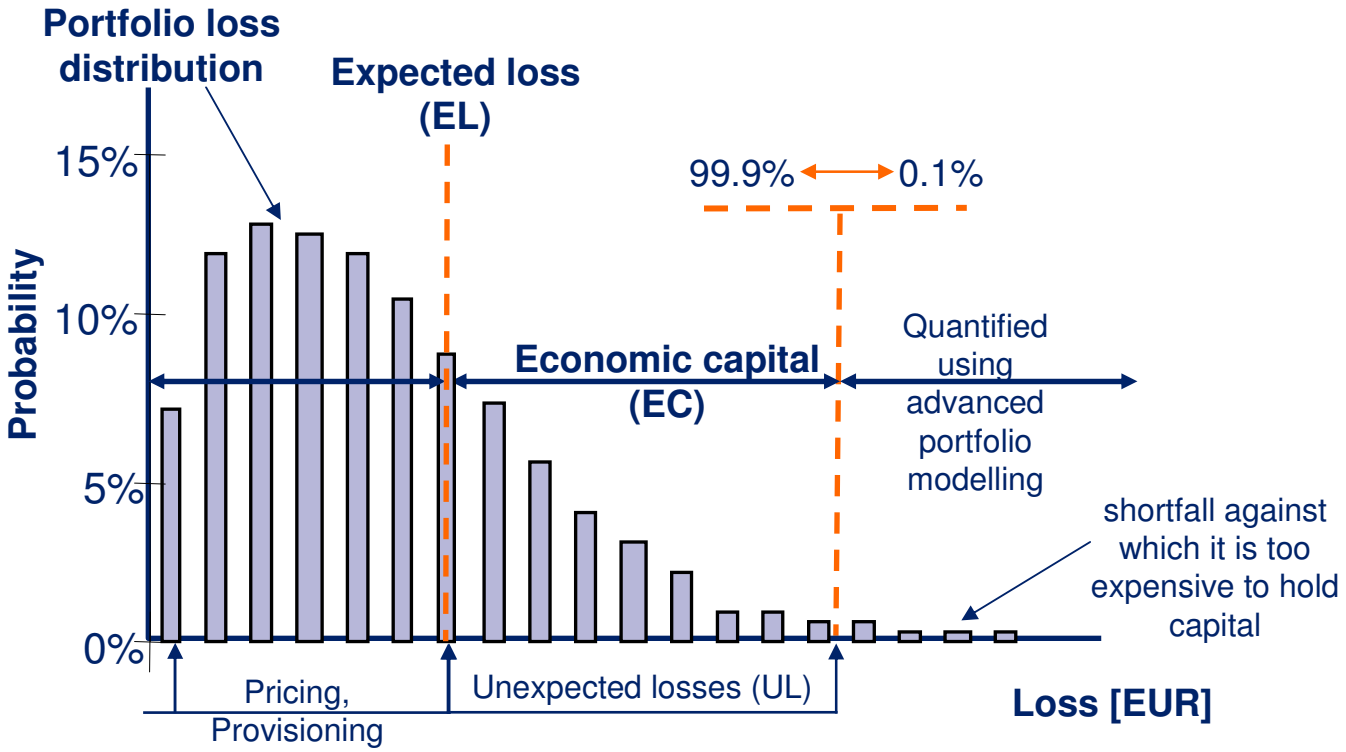
Economic Capital revisited

Economic Capital (EC) is the amount of capital used to cover accumulated excess (“unexpected”) losses over a fixed risk horizon with a certain degree of belief (confidence level)

Risk horizon usually 1 year

Confidence level according to target rating of the corporation.
E.g. 99.98% targeting AA+ rating (1 default in 5000 years)

Calculation of Economic Capital



- Economic capital (EC) is the difference between the quantile (e.g. 99.90%) and the expected value of the portfolio loss distribution

⇒ Capital is used to absorb unexpected losses in the portfolio

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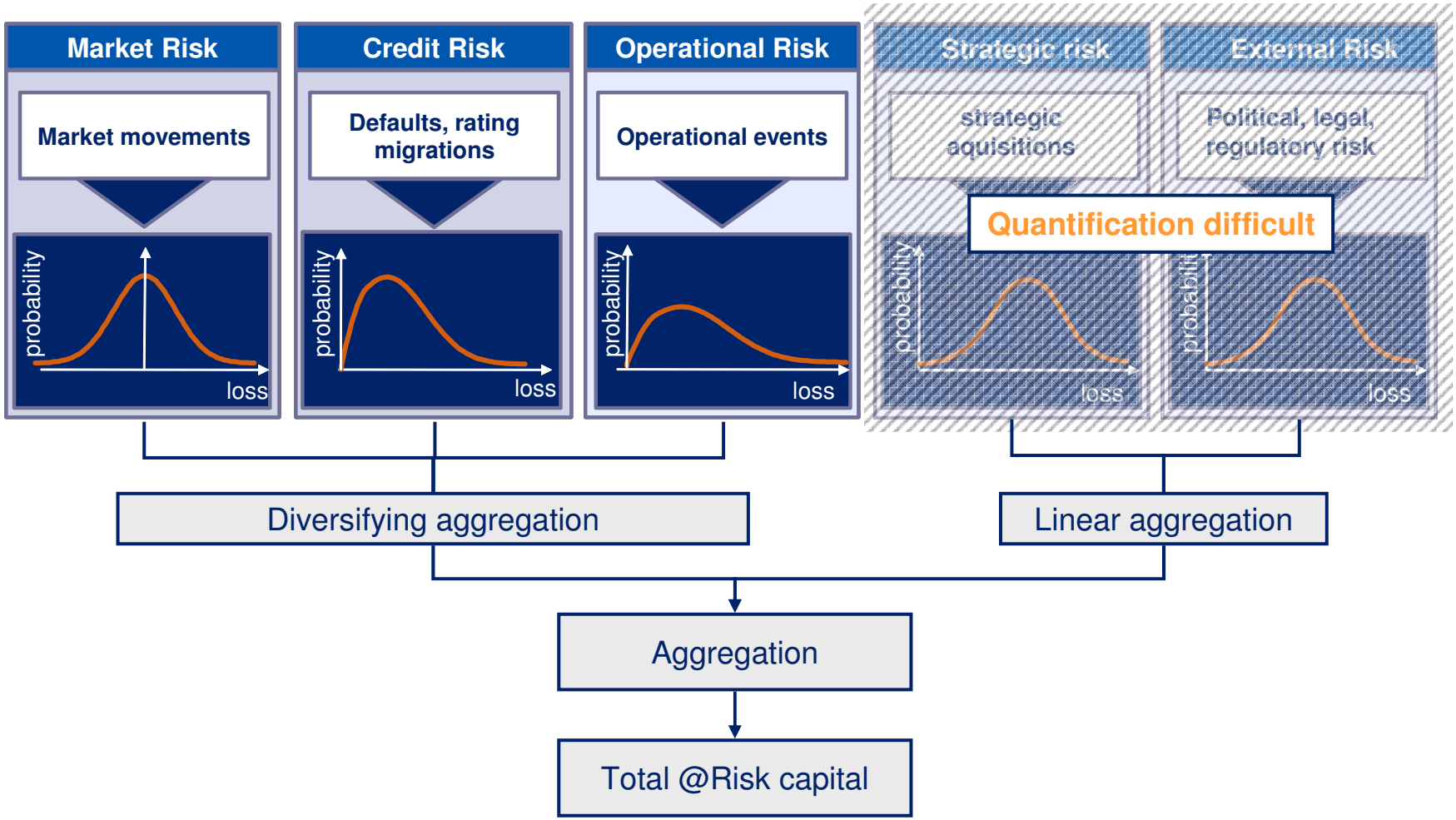
Modelling Approach: Risk Classes and Risk Aggregation

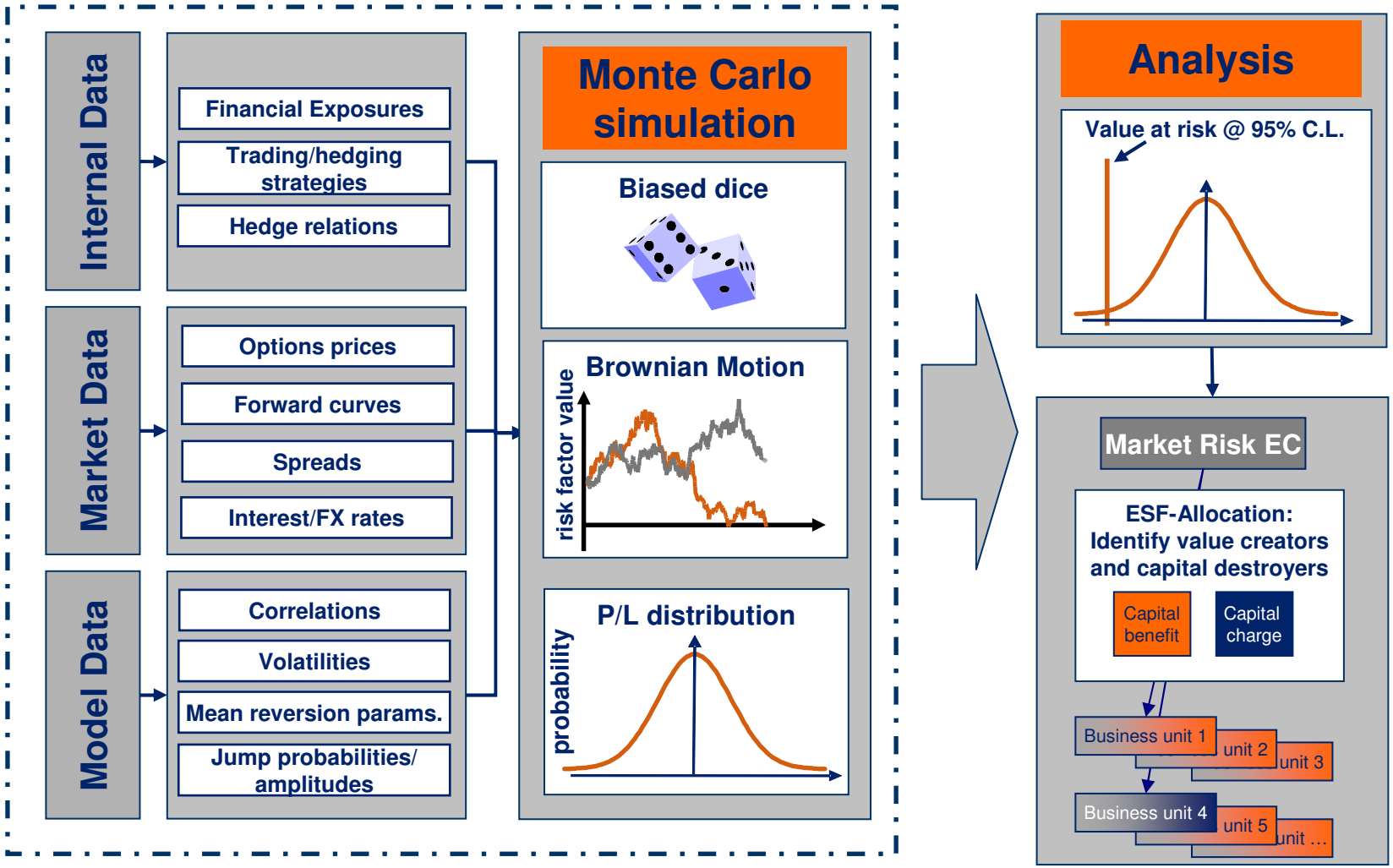


Business motivation for risk aggregation

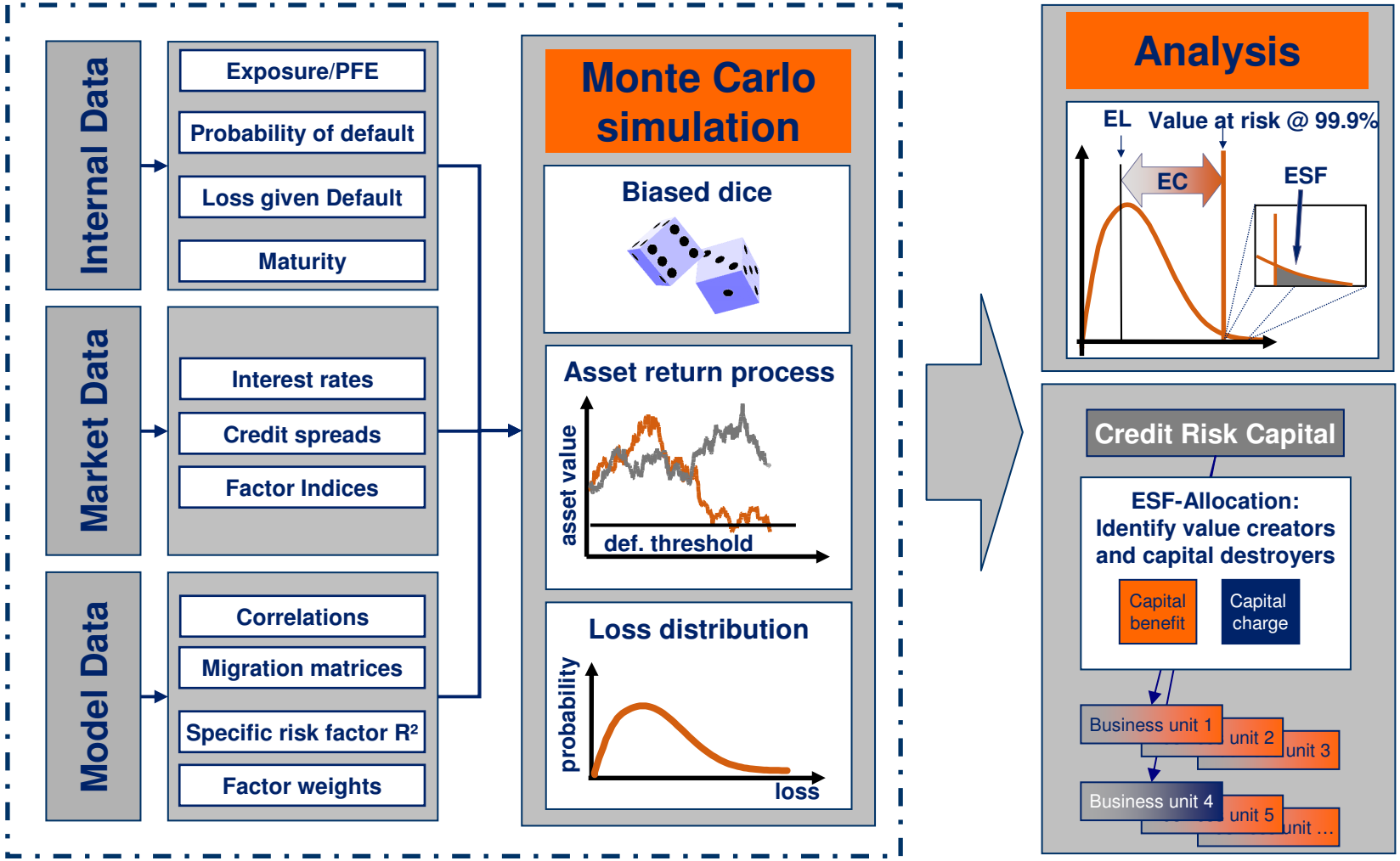
Value based management

- Obtain overall risk figure taking into account full diversification
  - All quantifiable risks have to be aggregated across all portfolios, departments, business units and across all risk types
  - Capital relief according to diversification between risk types is in the range of 20-30% compared to the “simple” addition of risk capital figures
- True risk profile to perform meaningful risk-return analysis
  - Re-allocation of diversification effects between risk types affects risk-return performance of business units

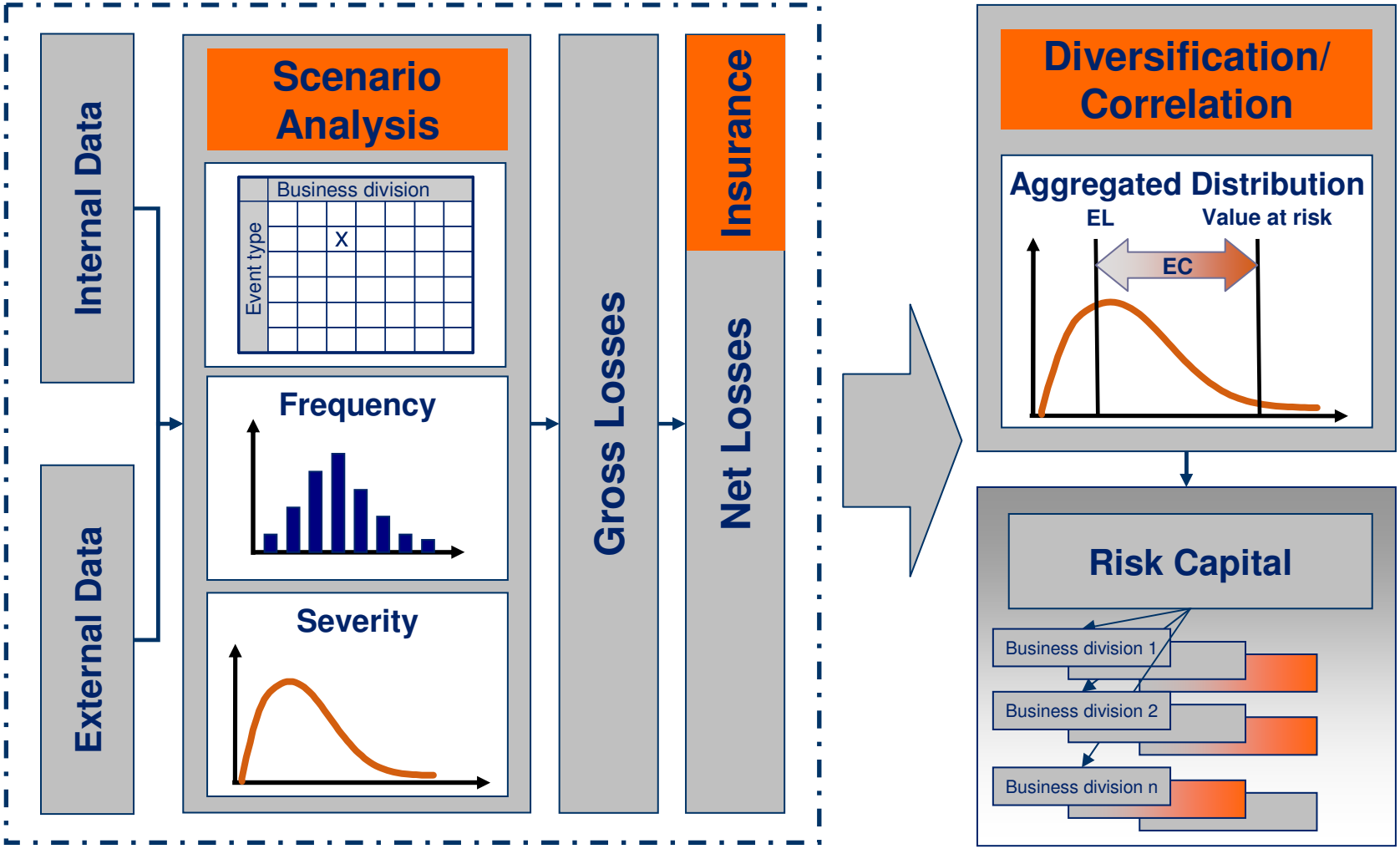
Modelling Framework for Market Risk: VaR(1d)



Modelling Framework for Credit Risk: CVaR(1y)

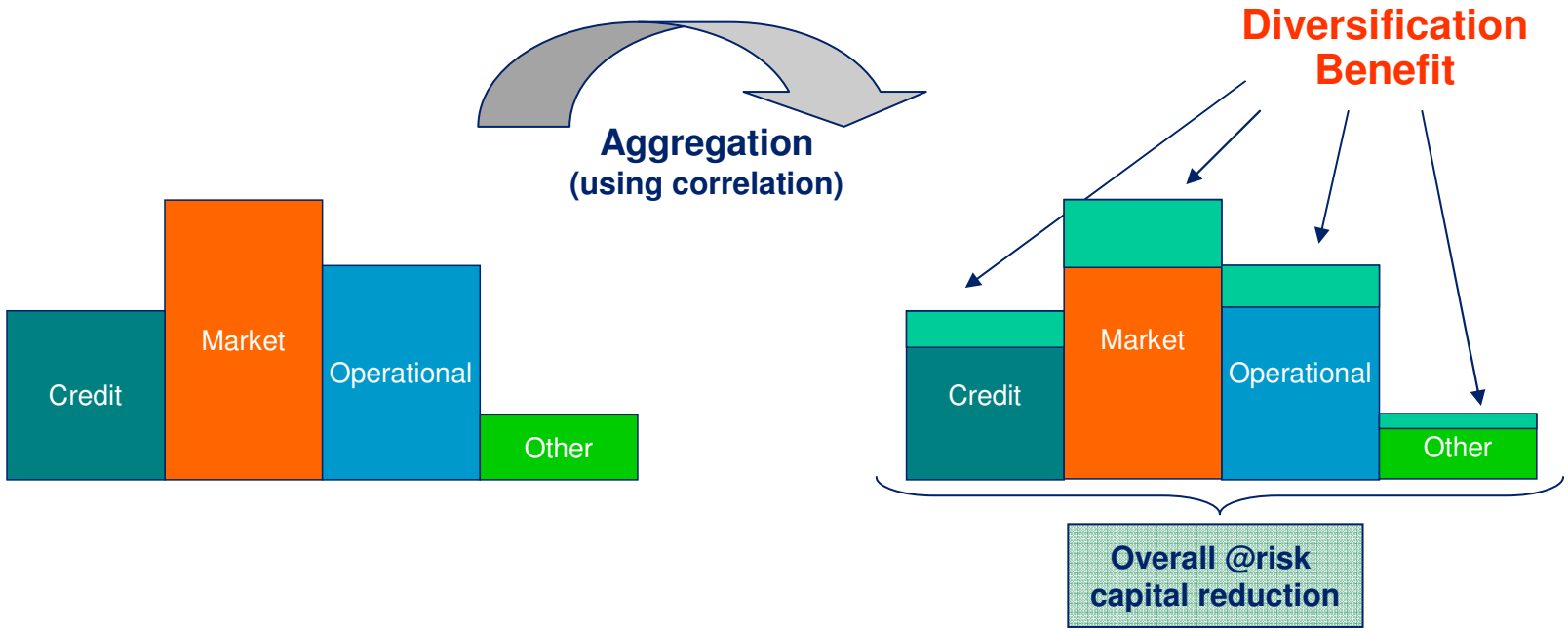


Modelling Framework for Operational Risk: OpVar(1y)

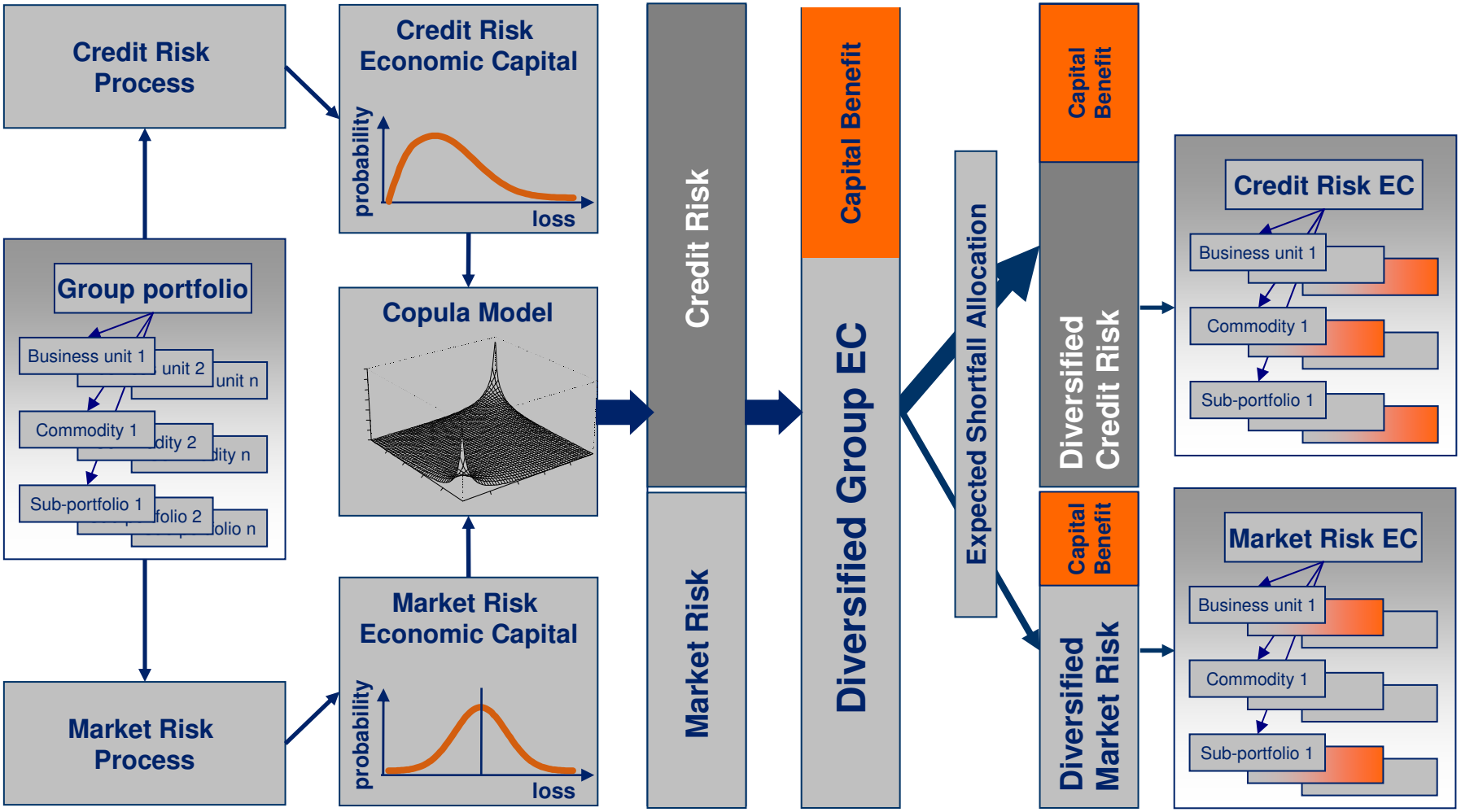


Diversification across risk types

- Adding up standalone risk capital for individual risk types overestimates total risk because diversification effects between the risk types are not reflected
- Model for risk type diversification combines loss distributions for credit, market, operational and other risk using correlations between these risk types



Modelling Framework for Risk Aggregation



Modelling Framework for Risk Aggregation

- Linear combination of standalone risk figures for each risk type

  Total risk capital: RC(total) = RC(MR) + RC(CR) + RC(OR) + …

  - No diversification benefit at all
  - Worst case scenario (useful stress scenario case)
  - Overestimates total risk => not suitable for risk-reward based steering

- Correlation matrix approach

  Total risk capital:

$$\mathrm{VAR}_{all} = \sqrt{\sum_i \sum_j \rho_{ij} \mathrm{VAR}_i \cdot \mathrm{VAR}_j}$$

  - All loss distributions are assumed to be normally distributed
  - Underestimates total risk => not suitable for risk-reward based bank steering

- Copula approach
  - Free choice of dependence structure between risk types (Gauss-copula, student t-copula, others)
  - Marginal (asymmetric) loss distributions are taken into account

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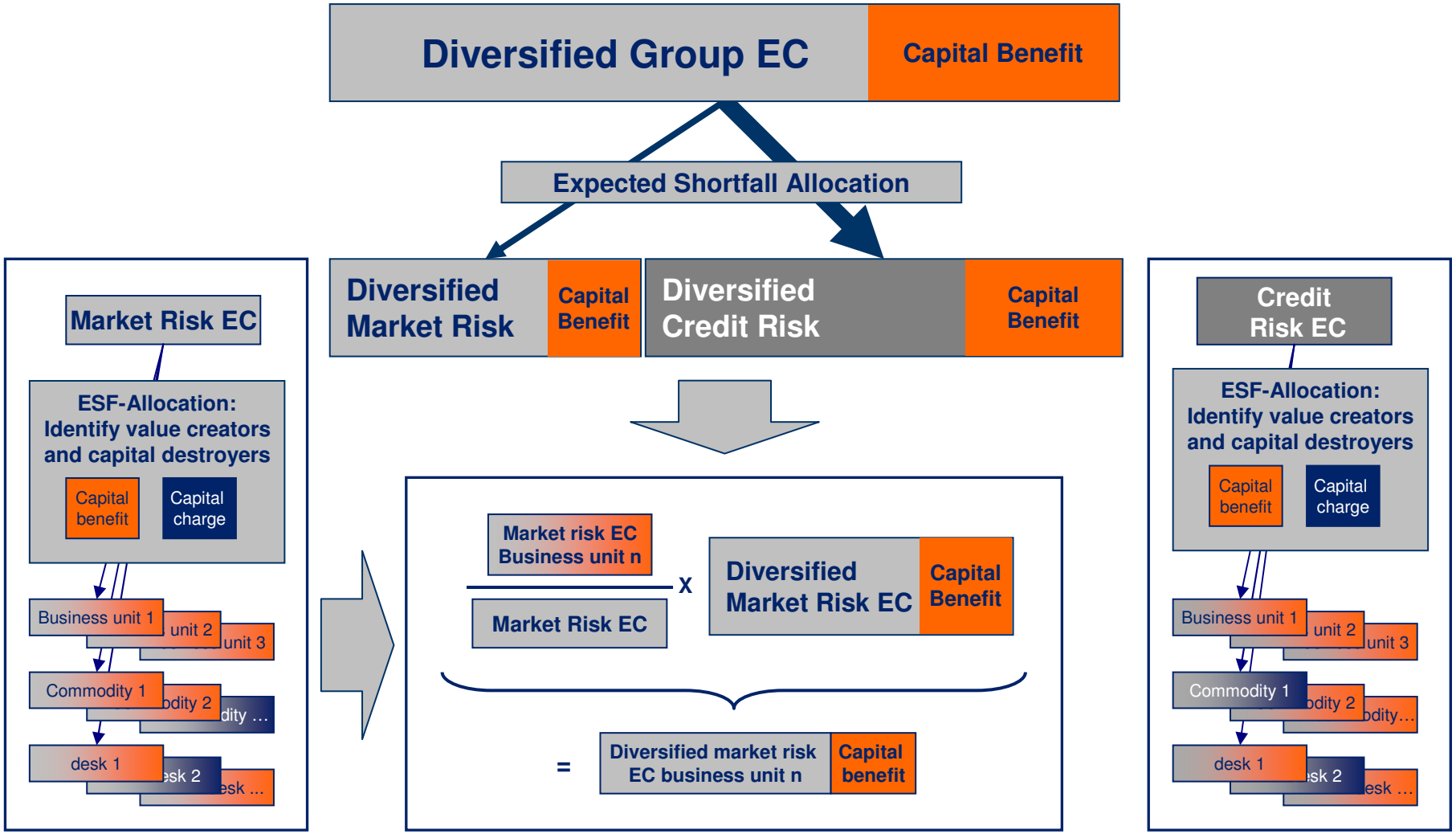
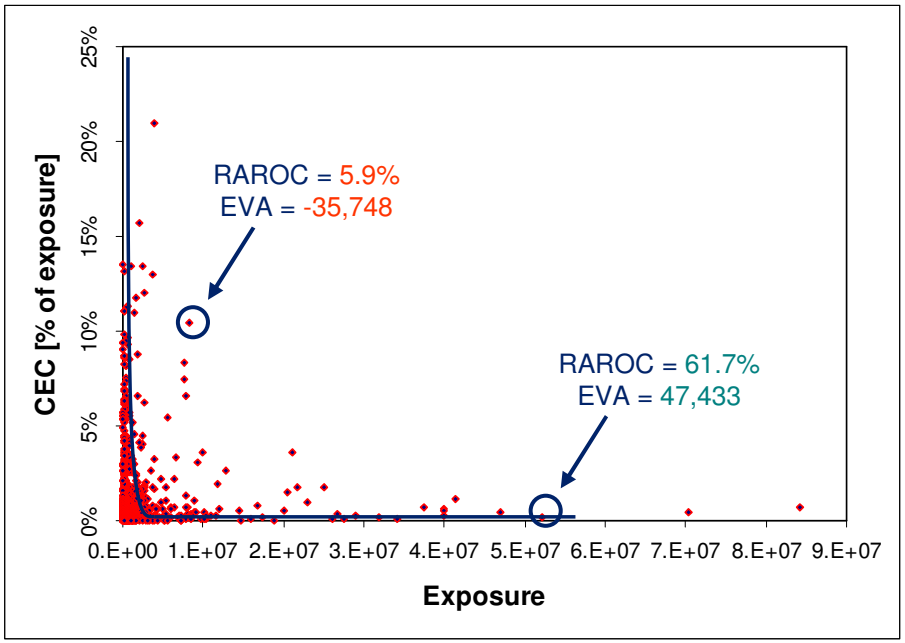
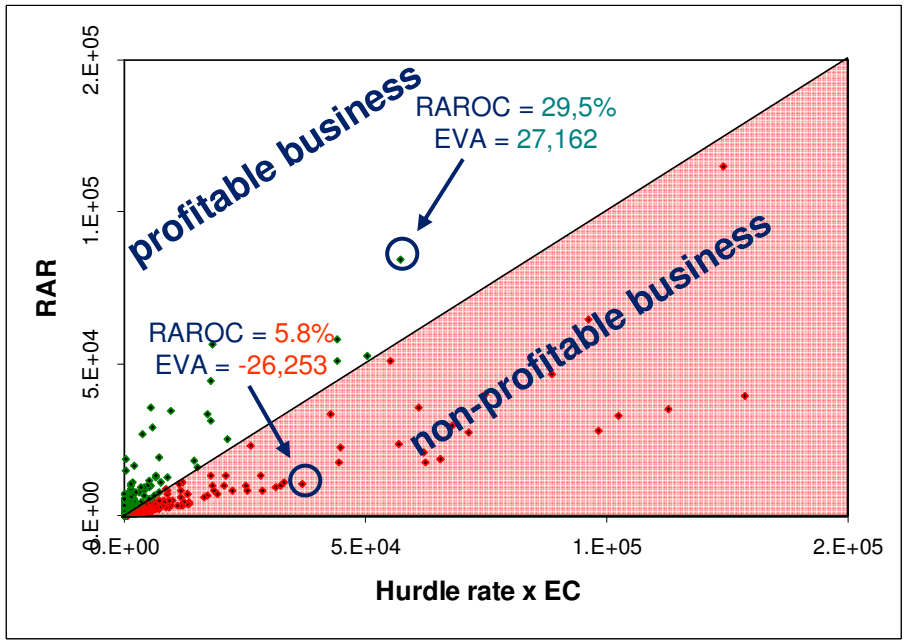
Risk capital allocation scheme



Reporting:
Identification of value creators and capital destroyers

Concentration risk reports for each risk type at transaction level:
Hurdle rate is set to 20%.





Risk aggregation, capital allocation & profitability

Financial Institutions	Corporates
ICAAP, RAROC, deal decision for capital market portfolio – Concept for risk sensitive top level aggregation methodology of market, credit & operational risk (copula approach, correlations between risk types) – Allocation of diversified group EC to business unit level – RAROC concept (hurdle rate, cost function of operational and administrative costs for different products, standard risk costs etc.) – Reporting (process and design) – Evaluation and analysis of the risk profile of the bank (capital market portfolio) – Specification of methodological and technical requirements – Model selection: Internal solution vs. commercial software solution	cash flow at risk, earnings at risk, profit at risk, EBIT at risk, RoE, exposure at horizon (EPE, PFE) – Concept for risk sensitive top level aggregation methodology of market, credit & operational risk (copula approach, correlations between risk types) – Allocation of diversified group risk capital to business unit level – RoE concept (based on RAROC concept, hurdle rate, cost function of operational and administrative costs for different products) – Reporting (process and design) – Evaluation and analysis of the risk profile (Concentration risk, what if analysis, etc.) – Specification of methodological and technical requirements – Model selection: Internal solution vs. commercial software solution

Summary

- Enterprise wide risk and capital management should be based on **risk sensitive** methods to identify concentration risk and to identify the true value creators and capital destroyers within the portfolio to enable according action.
- Best practice approach for risk aggregation is based on a **copula** method to model the dependence structure between risk types.
- Best practice approach for risk capital allocation is based on the method of **expected shortfall**.
- Risk capital reports should be available within each risk type at **transaction level** and across **all risk types**.

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Profitability: RoE on the basis of RAROC

RAROC =

Steering

$$\frac{\text{Revenues} - \text{Costs} - \text{Expected Loss} + \text{Capital Benefit}}{\text{Allocated Economic Capital}}$$

RAROC

Customer X	
Customer Rating	A
Exposure	10,000,000
Margin	0.62%
+ Revenue	62,000
- Administrative Expenses	30,000
- Product Expenses	10,000
- Expected Loss	5,400
+ Capital Benefit @ 4.9%	4,498
/ Economic Capital	91,800
RAROC	**23.0%**

RoE =

Measurement

$$\frac{\text{Revenues} - \text{Costs} - (\text{Write Offs} + \text{Provisions}) + \text{Capital Benefit}}{\cancel{\text{Book Equity}}\ \text{Allocated EC} * \text{CAF}}$$

RoE

Customer X	
Customer Rating	A
Exposure	10,000,000
Margin	0.62%
+ Revenue	62,000
- Administrative Expenses	30,000
- Product Expenses	10,000
- Expected Loss	5,400
+ Capital Benefit @ 4.9%	4,498
/ (Economic Capital * CAF)	137,700
RoE	**15.3%**

$$\text{If Provisions} = \text{Expected Loss} \Rightarrow \text{RoE} = \frac{\text{RAROC}}{\text{CAF}}$$

CAF in this example = 1.5

General Construction principle of EC Allocation

Unexpected Loss (Standard Deviation):

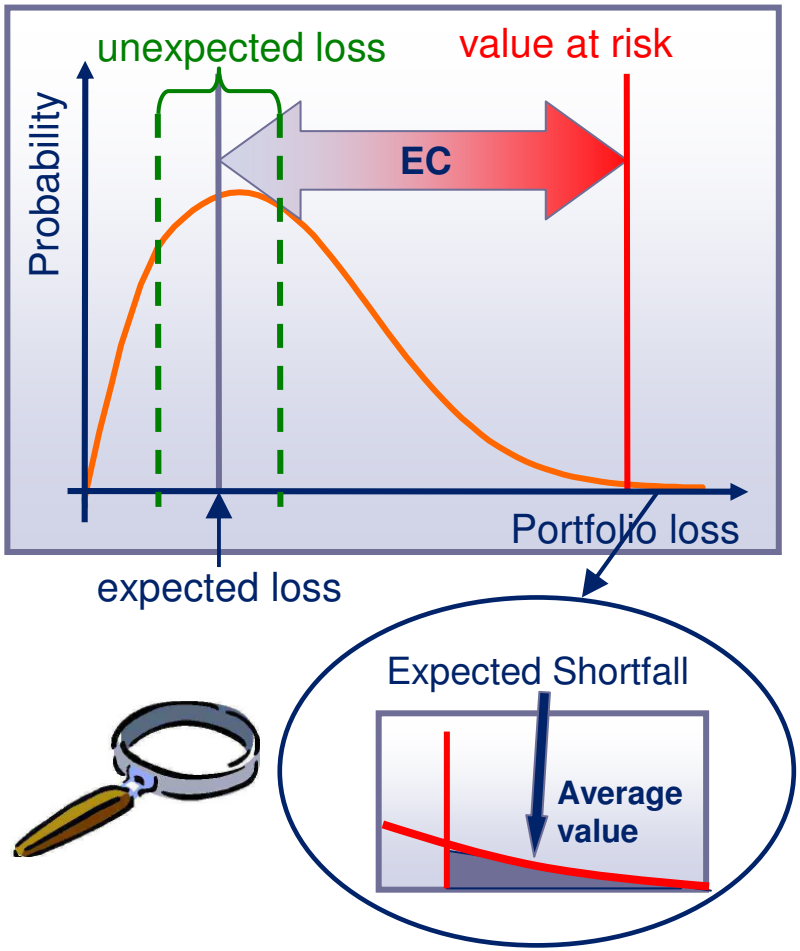
- Covariance Allocation:
  $Cov[L_{facility}, L_{portfolio}] / Var[L_{portfolio}]$
- distributes loss volatility

Expected Shortfall:

- Expected Shortfall Allocation: contributory EC is the average loss of a subportfolio in the "extreme loss scenarios" of the portfolio:
  $ESF(facility) =$
  $E[L_{facility} | L_{portfolio} > quantile_Q] - E[L_{facility}]$
- distributes extreme losses

Value-at-Risk:

- Capital allocation by breakdown of VaR according to Covariance or Expected Shortfall contribution



@risk capital (EC) allocation requirements

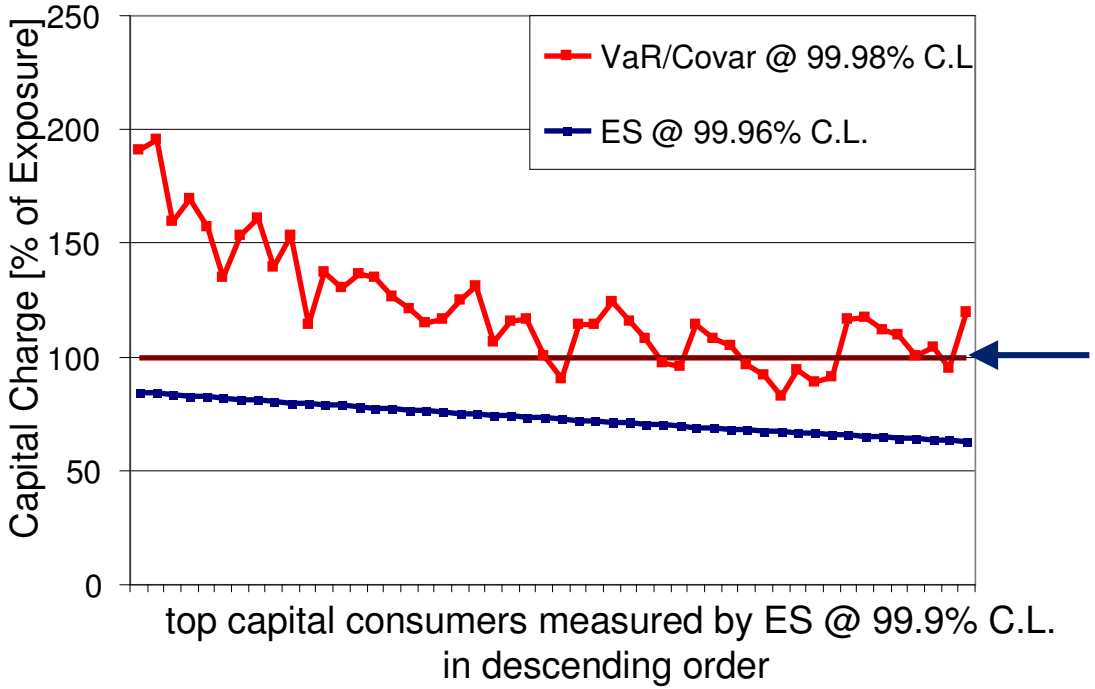
Risk capital contribution should scale with the “riskiness” of the transaction/sub-portfolio

- Transactions/sub-portfolios with lower credit quality should consume more capital
- Transactions/sup-portfolios with higher correlations/concentration risk should consume more capital

  Fulfilled by **Coherent Risk Measure Expected Shortfall**
  but not by Var/Covar allocation
  (Artzner, Delbaen, Eber & Heath, 1997/99)

Comparison Expected shortfall vs. Var/Covar allocation

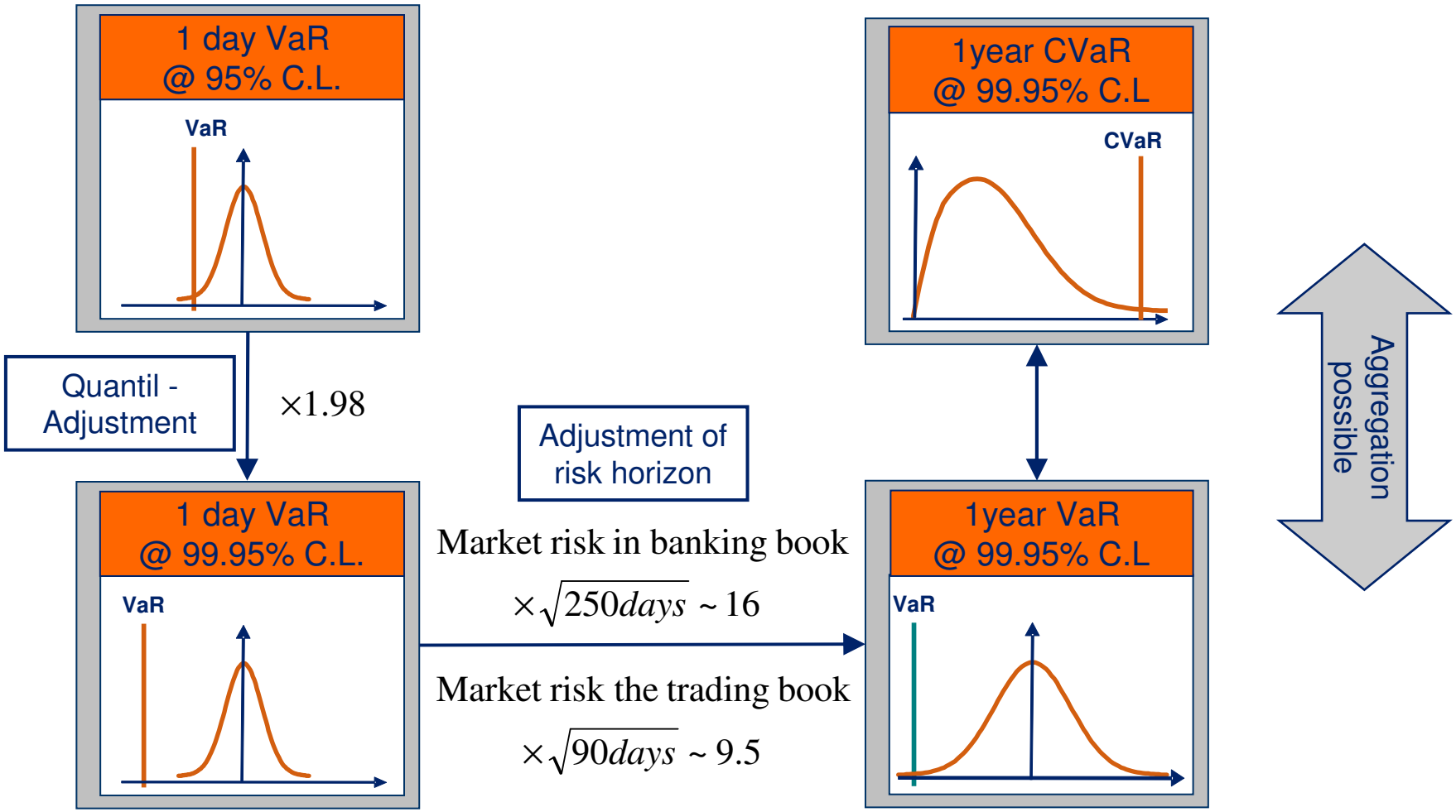
Capital charge of top capital consumers



Capital charge 100%: Economic capital equals exposure

- Var/Covar Allocation: Capital charge > Exposure
- Related to non-normality of the credit loss distribution

Scaling of Market-VaR to Risk Horizon of Credit Risk



Determination of correlations

Calibration of correlations reflecting specific risk profile of company