The Actuarial Profession
making financial sense of the future

ESGs & Solvency II

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Agenda

- Need for this paper
- Market consistent valuation
- Solvency capital requirement
- ESG governance
- Discussion

Errata

- 5.5.2
  - “FSA Pillar 1 Peak 1” should read “FSA Pillar 1 Peak 2”

Motivation for ESGs & Solvency II

- Past Challenges
  - ESG Models have been widely used in UK & European Insurance
  - Commercial solutions are widely used
  - Models are used in various areas of the insurance business
- Today's Challenges
  - making market consistent valuation models reflect micro-market features such as illiquidity and transaction costs
  - making the real world ESG fit your company's in-house view
  - understanding the model risk
  - **<u>getting the ESG model embedding and understood in the company including within the governance structure</u>**

Uses of ESG Models

- Prudential Supervision
  - FSA Pillar 1 Peak 2 / Solvency II / PGN-110 / SST
- Financial Reporting
  - EEV / MCEV
- Asset Liability Management
- Dynamic Hedging (inc VA Business)
- Product Design
- Product Communication

Types of ESG Model

- Risk Neutral
  - Designed for market consistent valuations
  - Objective = infer a (quasi) market price for insurance liabilities.
- Real World
  - Designed for future economic projections (what-if scenarios)
  - Objective = capture true dynamics of market prices in order to understand the risks to the insurer.

Market Consistent Valuation

Frequent Misconceptions

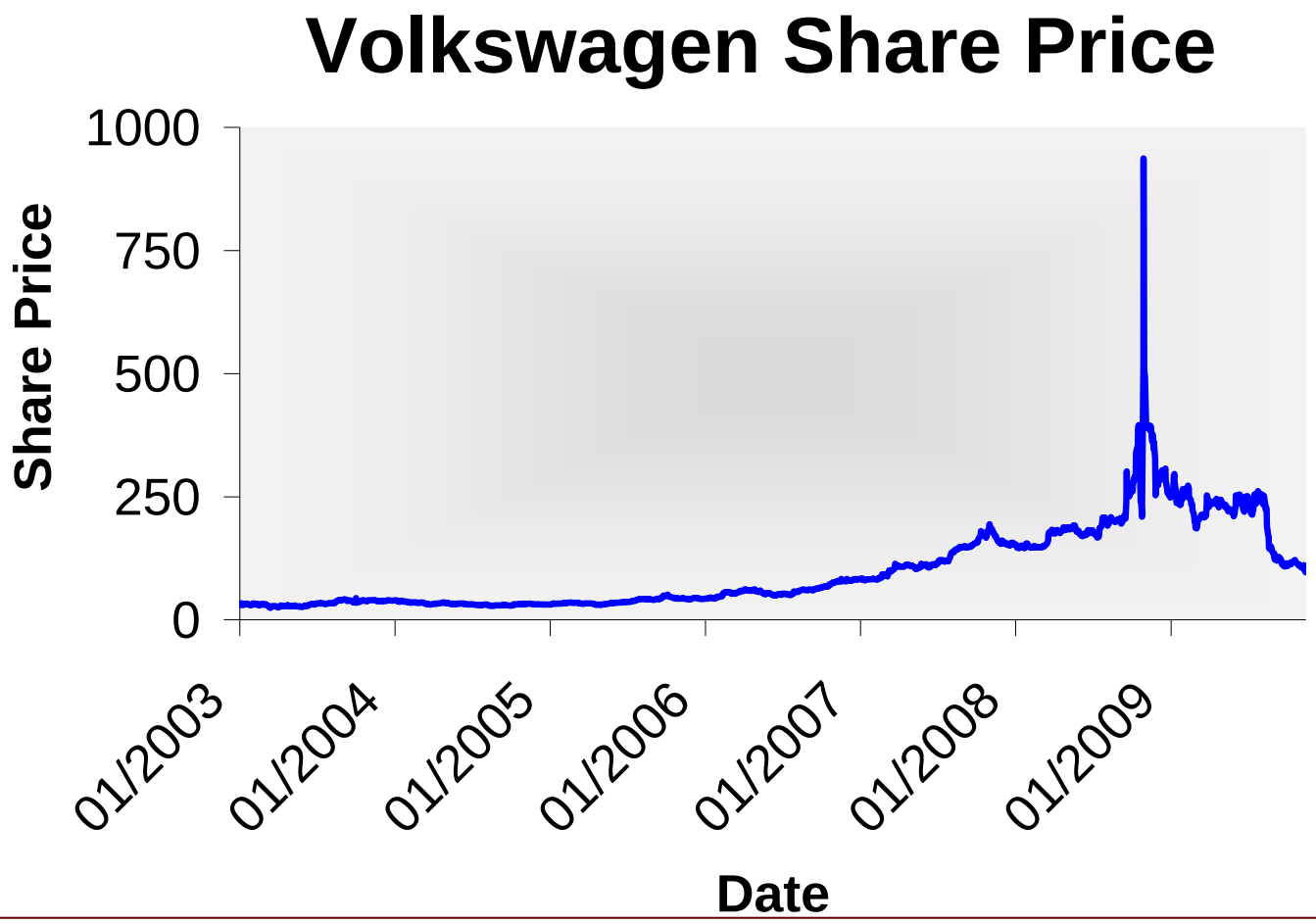
1. An arbitrage free ESG model will by itself give a market consistent valuation
2. An ESG model calibrated to deep and liquid market data will give a market consistent valuation
3. Market consistent valuation gives the *right* valuation
4. Market consistent valuation gives the amount a 3rd party will pay for a business
5. Market consistent valuation is no more objective than a traditional Discount Cash Flow (DCF) technique using long term subjective rates of return.

Market Consistent Valuation
Criticisms

- Pro-cyclicality
  - In a crisis asset values fall – liabilities value rise as own funds are squeezed from both sides
  - Marginal traded prices on stressed assets are imported to insurers balance sheets
  - Asset fire sales to reduce risk capital further depress markets
- Liquidity Premiums
  - Liquidity Premiums and other micro-market features are not reflected in market consistent ESG models.
  - Other models are needed to calculate Liquidity Premiums and their results are exogenous inputs to the ESG.

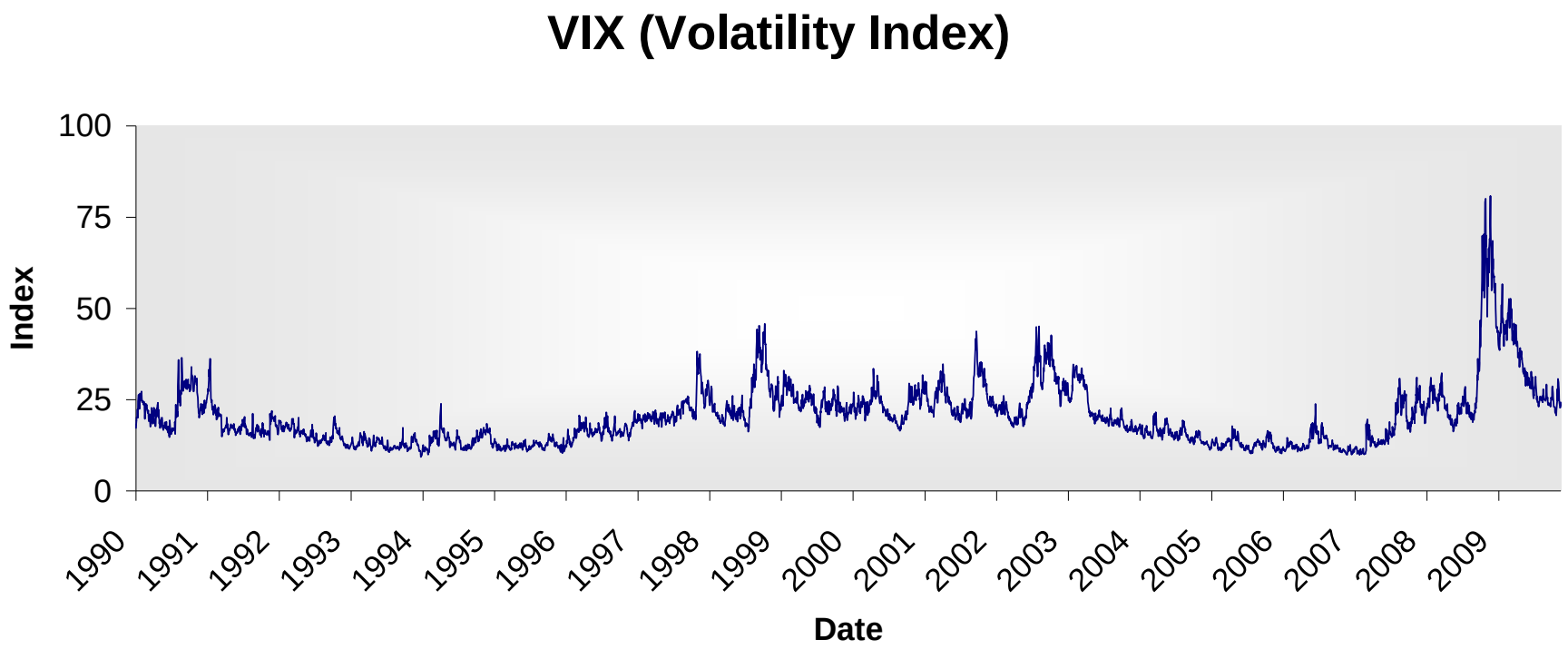
Market Consistent Valuation

Perils of Marginal Valuation



Market Consistent Valuation

Coping with volatility



Market Consistent Valuation

Why Use An ESG

- Closed Form Solutions
  - Formulae are often too simple
  - Underlying models can be too simple
- Replicating Portfolios
  - Good for fast recalibrations / optimal hedging
- Stochastic ESGs Best Solution When ..
  - It matters *how* the markets moved during the life of the contract not just *where* they ended up. (Path-Dependency)
  - The policy payout depends on *many* economic variables (High-Dimensionality)
  - There are feedback loops through *policyholder behaviour* or *management actions.*

Market Value Balance Sheet

- ESGs lend themselves to valuation of ..
  - With-Profits
  - Continental Participating Products
  - Variable Annuities
- ESGs lend themselves *less* to valuation of ..
  - Pension Products
  - Unit Linked Products
  - General Insurance Products
- Asset Liability Coherence
  - ESG Valuation of Derivatives vs. Actual Valuation
    - Approximations
  - Swap Assets vs. Gilt Liabilities (former CP40)
  - Historic vs. Market Implied Volatility (former CP39)

CP39 Final Advice

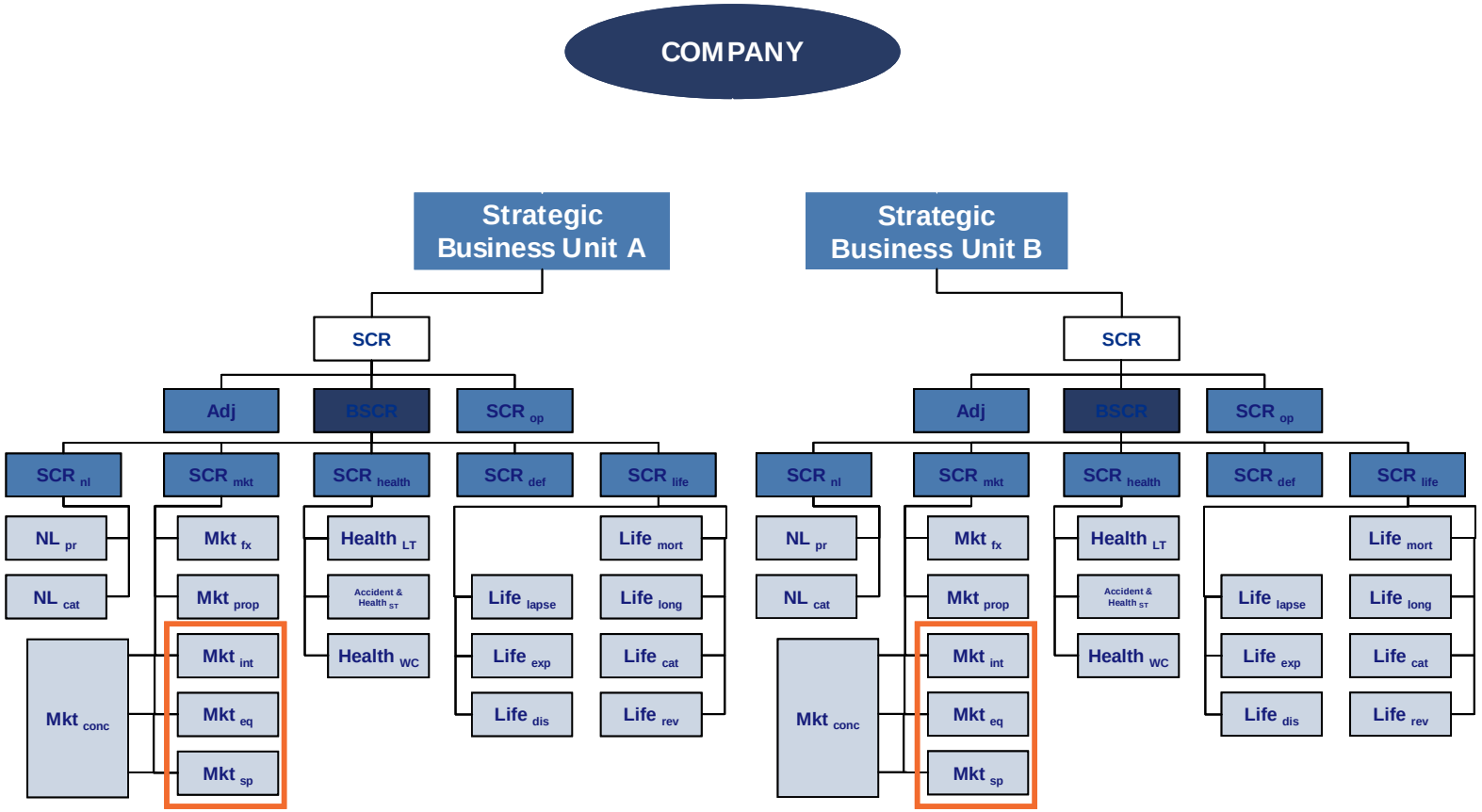
ESG Calibration for Technical Provisions

- 3.257.Further guidance on the following areas of the calibration (of an ESG) may be provided at Level 3:
  - The types of assets which reflect the nature and term of different liabilities and to which the asset model may be calibrated.
  - The appropriate derivation of correlation assumptions.
  - The appropriate volatility measure including how volatility may be estimated in cases where there is limited market data.
  - Interpolation or extrapolation of market data, provided that according this advice there are sufficient reliable points, to base this calculation (i.e. intermediate volatilities, credit derivatives spreads...).
  - **Calibration in cases where market volatilities and market prices are not consistent.**

Solvency Capital Requirement
Where Real-World ESG Models Get Used

- Real World ESGs Used
  - Risk Premiums, Realistic Volatilities
  - *perhaps also* Tail Correlations and Fat-Tails
- Standard Formula
  - Recalibration of MC ESG under single stresses
  - Calibration challenges for ESG models
- (Partial) Internal Model - Balance Sheet Projection
  - Surface Fitting (Sensitivities)
  - Replicating Portfolio Fitting
  - Full (or Partial) Nested Stochastic

ESG Oriented Partial Internal Model



Solvency Capital Requirement

Passing the Tests

- Use Test
- Documentation Test
- Statistical Quality Test
- Calibration Test
- Validation Test
- External Models and Data
- Profit & Loss Attribution

Solvency Capital Requirement

Internal Model Tests

- Use Test
  - Use Test vs. Validation / Statistical Quality Tests
    - Is it understood? vs. Is it accurate?
    - Foundation Principle : Pressure to Improve Model
- Statistical Quality
  - Consideration of all ESG risks, including validation and documentation of the choice of data, distribution and use of expert judgement.
  - Outsourcing doesn't waive the responsibility.
- Validation
  - Back-testing a key requirement.
    - How do you back-test an ESG model?
  - Reverse Stress Test
    - Understanding the *Path to Ruin* as well as the S*tress to Ruin*.

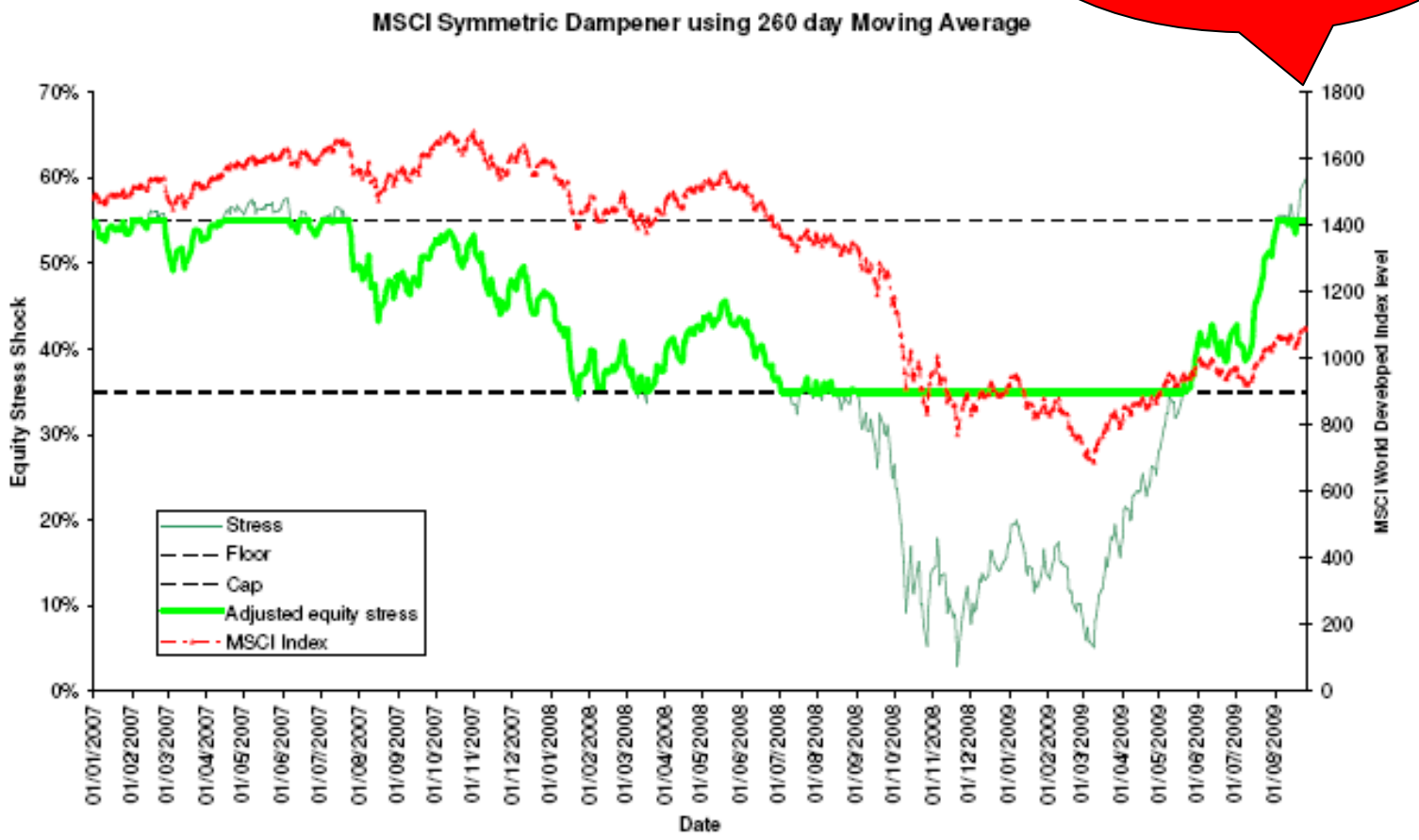
Solvency Capital Requirement
Documentation Standards

- Methodology
  - Mathematical basis
  - Empirical basis
  - Assumptions
  - Application of expert judgement
  - Where it doesn't work
- Formulas & Parameters
  - Method for estimating parameters
  - Data policy
  - Source code
- Future Developments
- IT Integration

Calibration Test Challenges

CP69 Equity Stress Test Dampener

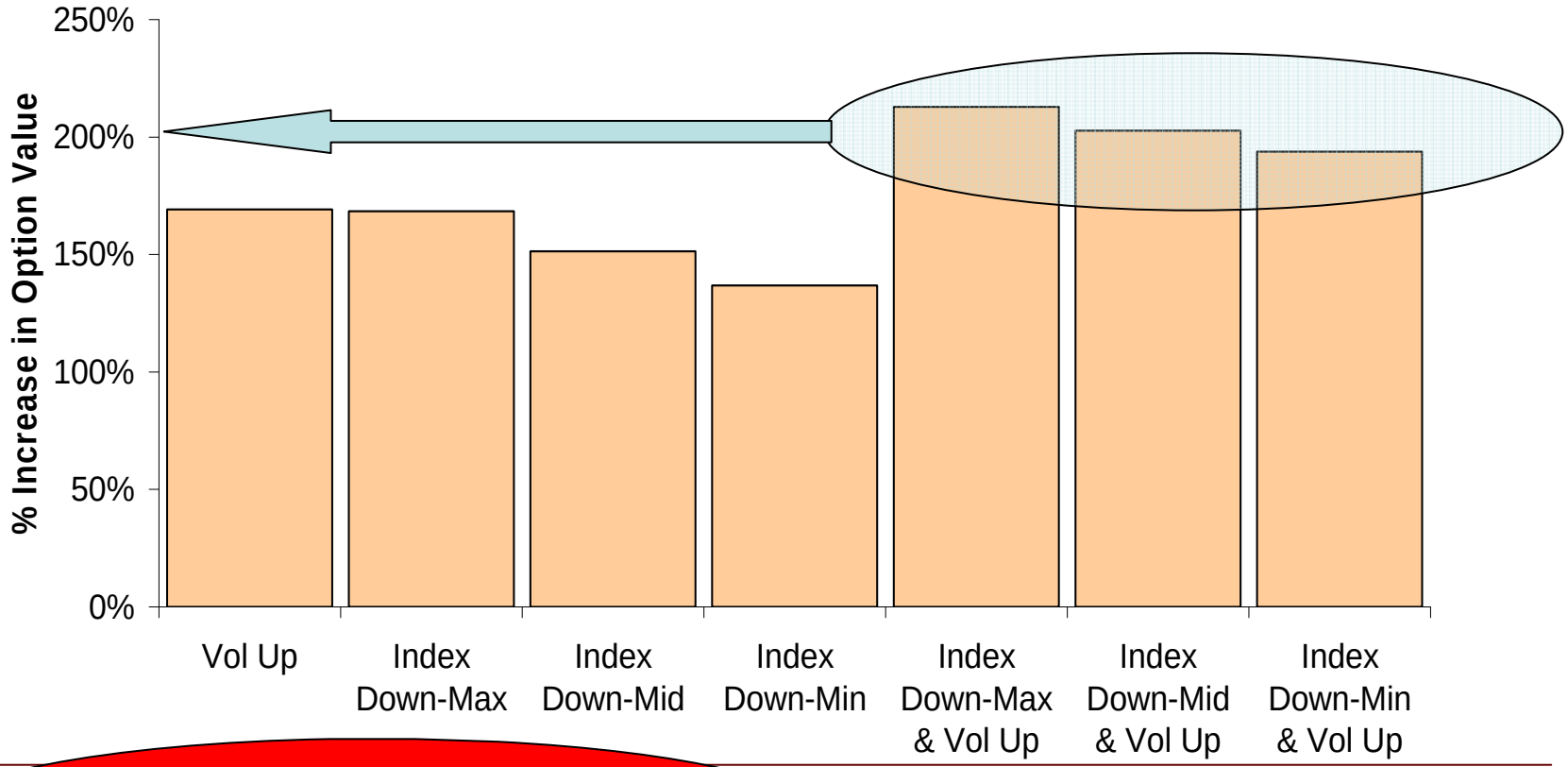
Retained as is in Final CEIOPS Advice issued 29/01/2010!



SCR – Standard Formula – Equity Risk

Effect of the Equity Implied Volatility Stress Test (CP70)

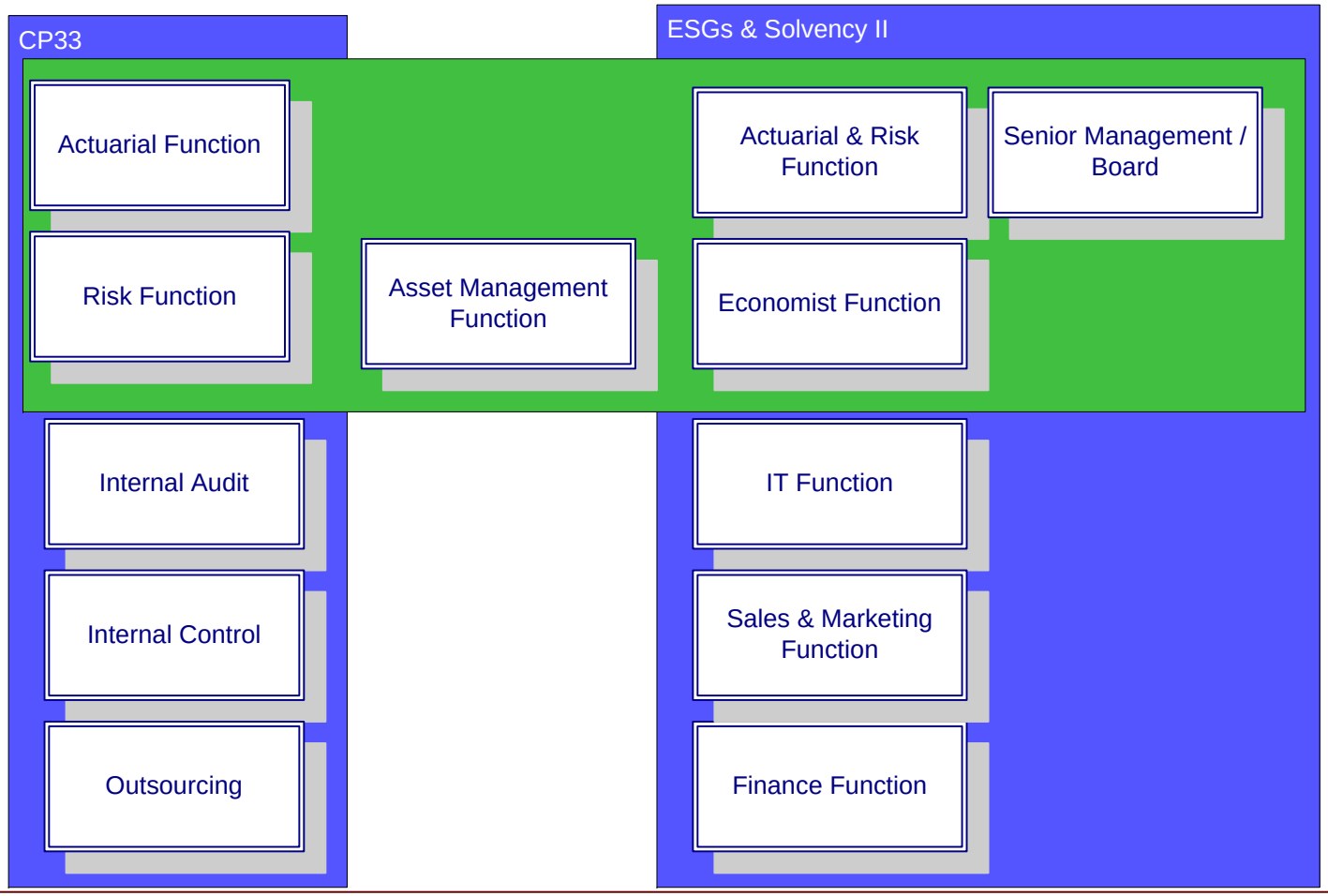
Percentage Increase in an 10 Year ATM Put Option Value at 31/12/2008



Not adjusted for Final CEIOPS Advice issued 29/01/2010.

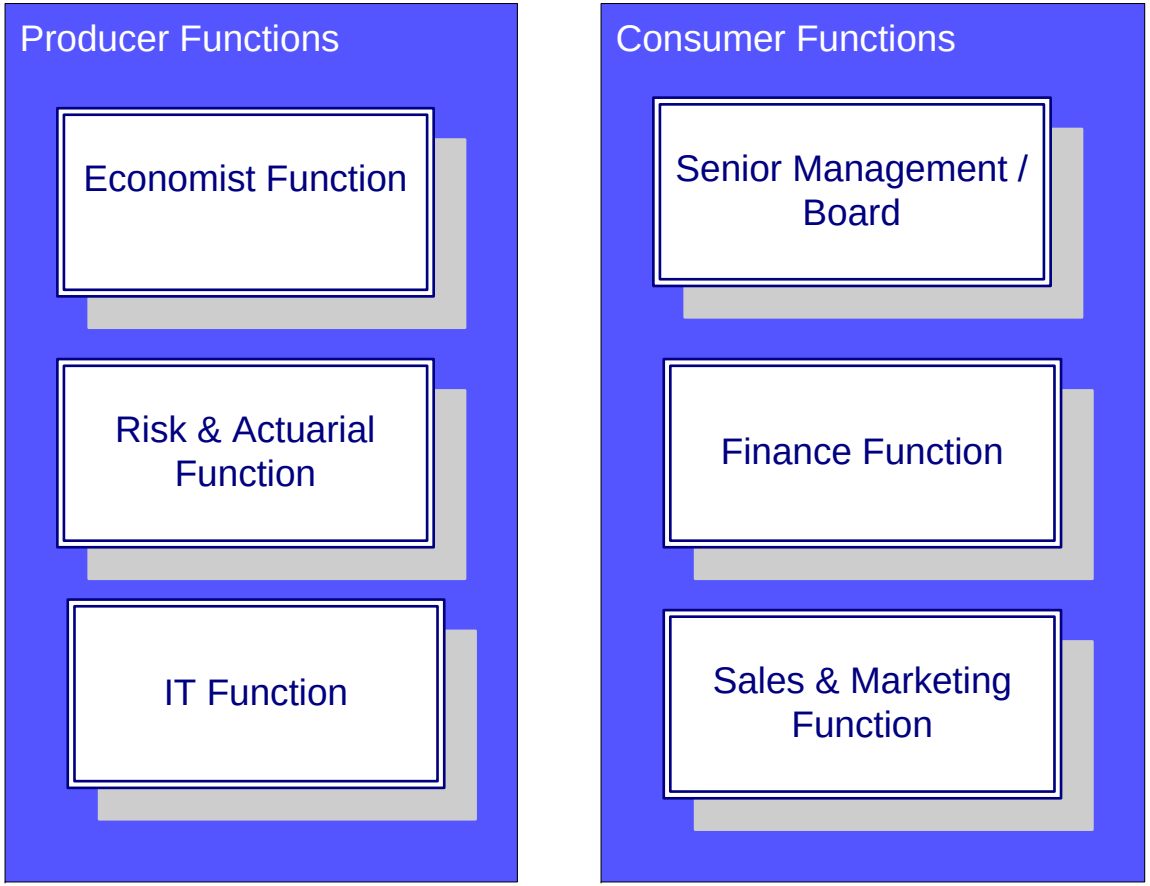
Governance

Comparing ESG Governance with CP33



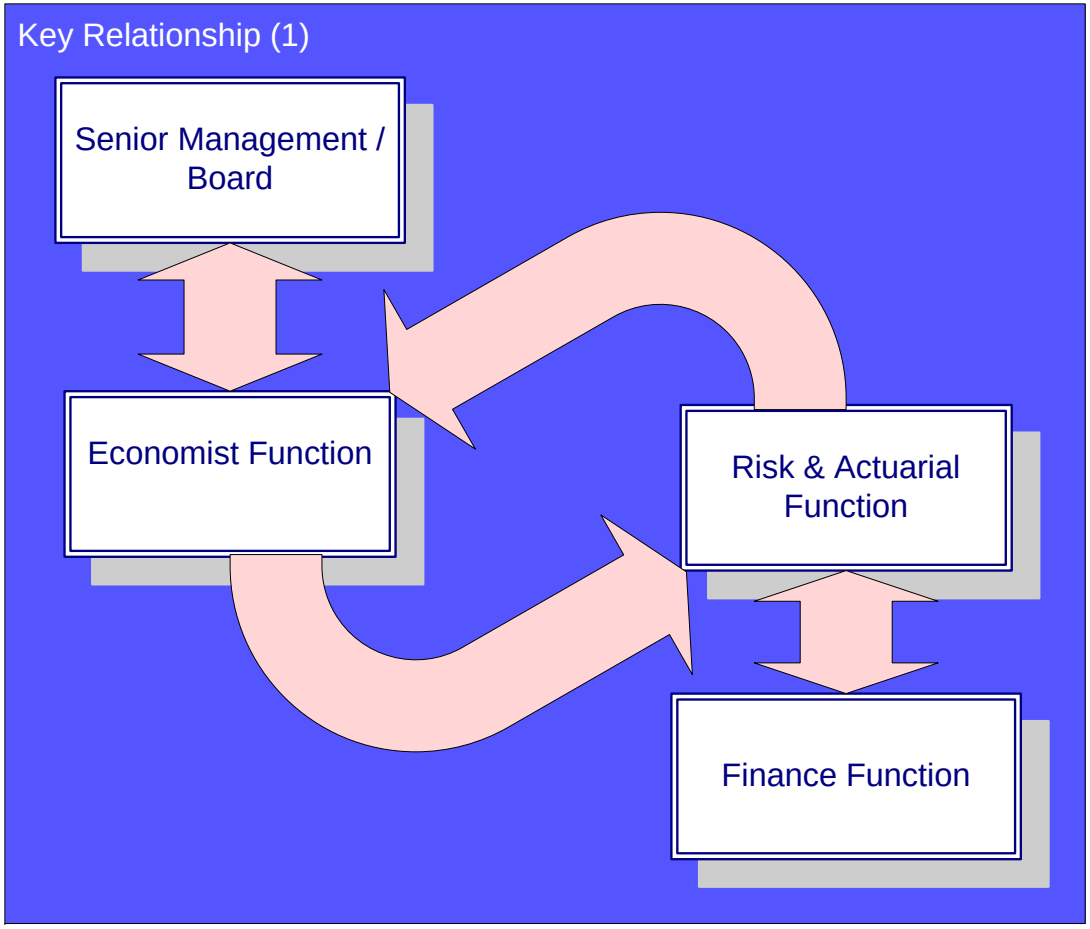
Governance

ESG Governance Roles



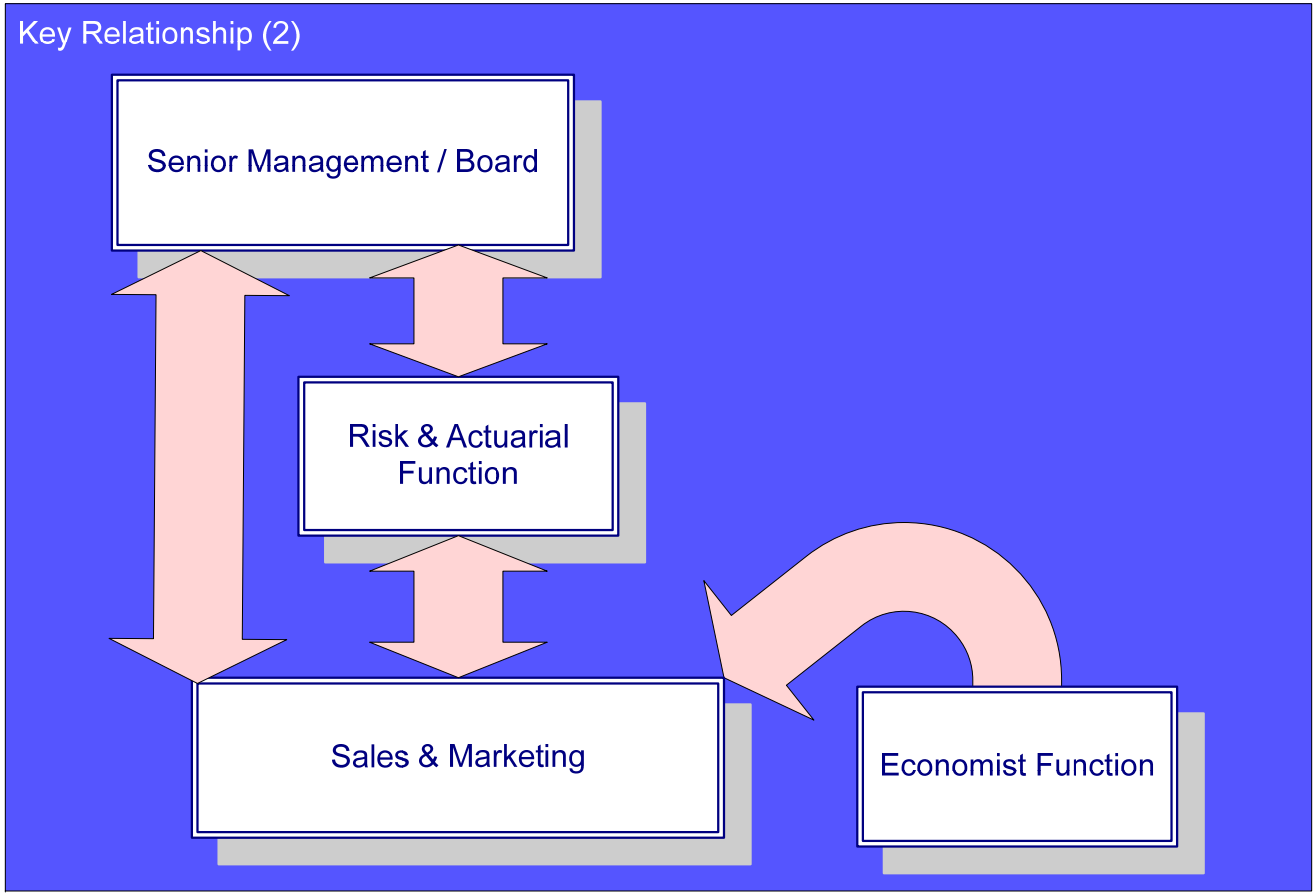
Governance

Key Relationships – Financial & Risk Reporting



Governance

Key Relationships – Manufacturing Process



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