Unit Linked Guarantees
Harnessing the value of recent experience

Presentation to Society of Actuaries in Ireland

Date 21 October 2010

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Contents

1. Introduction & Background Papers

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3. Paper 2 (Low Level/Technical)

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Introduction

- Long history of
  - Guarantee Provision
  - Mixed track record
- Crisis as an opportunity for learning
- Reducing the Actuarial "Anti Library"
- Achieving sustainable solutions
- Opportunity

Background Paper 1

- ## Motivation
  - Consolidating Recent Experience
  - Extending work of Corrie et al
  - Balcony View
  - Walker Review

- ## Approach
  - Descriptive
  - Linguistic

- ## Authors & Publication
  - Variable Annuity MIG
  - BAJ Publication

An executive's handbook for understanding and risk managing unit linked guarantees

By James Maher, Joshua Corrigan, Anthony Bentley, William Diffey

Variable Annuity Member Interest Group
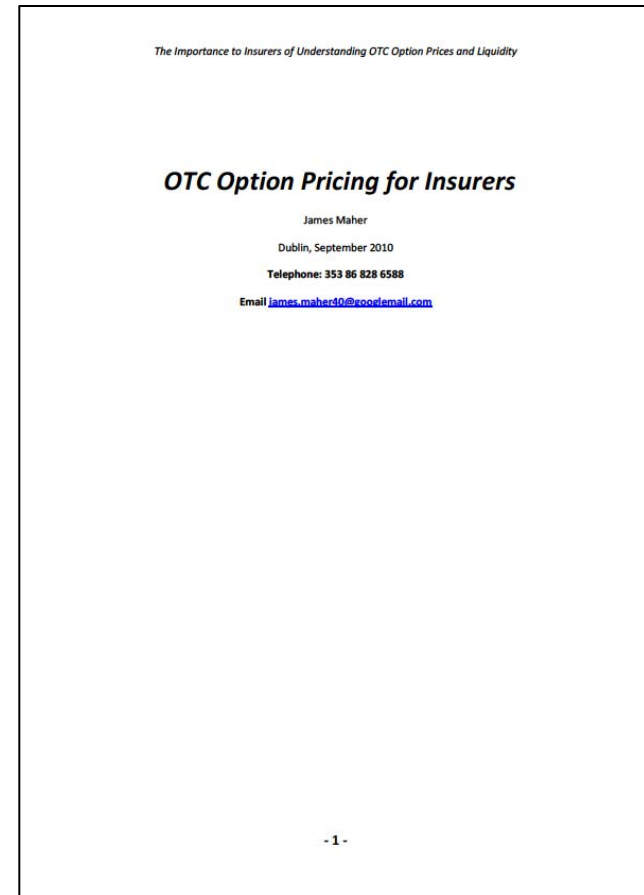UK Actuarial Profession

April 2010

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Background Paper 2

- ## Motivation
  - ### Illiquidity premiums in SII
  - ### Impact of crisis on hedging
  - ### Insurer V Banker
  - CP 42 & CEIOPS Task Force
- ## Approach
  - ### Descriptive
  - ### Linguistic
- ## Authors & Publication
  - Solo Run
  - SAI & Linkedin

The Importance to Insurers of Understanding OTC Option Prices and Liquidity

OTC Option Pricing for Insurers

James Maher

Dublin, September 2010

Telephone: 353 86 828 6588

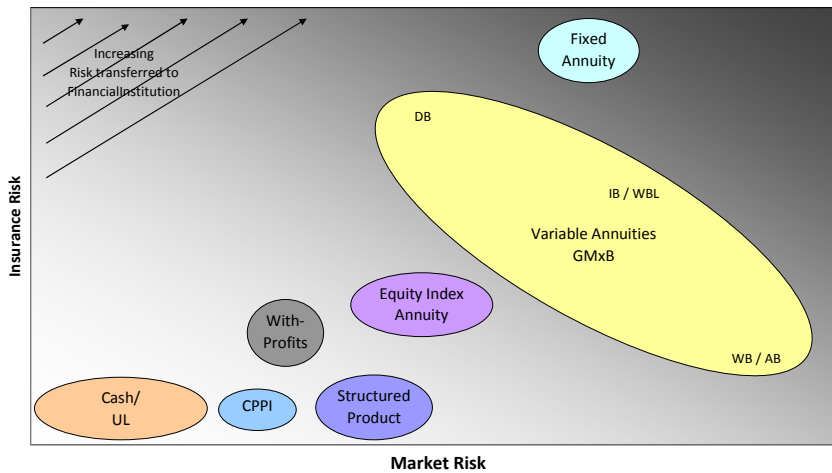Email james.maher40@googlemail.com

- 1 -

VIEW FROM THE BALCONY

- Scope & Definition of Products
- Operating Platforms and Group Architecture
- Risk & Capital

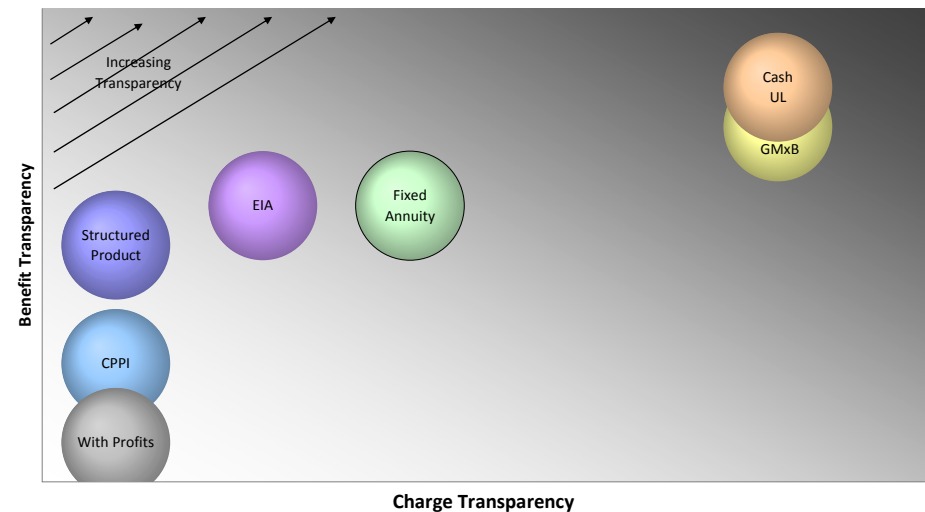# A Range of Alternatives

Risk Transfer from Customer to Financial Institution by Product Type

- Market Risk
- Insurance Risk
- Risk Mitigation

- Customer Centricity
- Explicit Risk Mitigation
- Transparency

Benefit vs Cost Transparency

Clarity of Purpose

Distributor
•Shelf space, Commissions, Simplicity
•Security of supply
•Ease of integration

Asset Gatherer
•Increase assets under manager
• Alpha/Added Value
• Flexibility (T-Vol/TRS etc)
•Cost sharing –AMC V Repo

Insurance mindset
•Policyholder View
•Return on "risk" capital
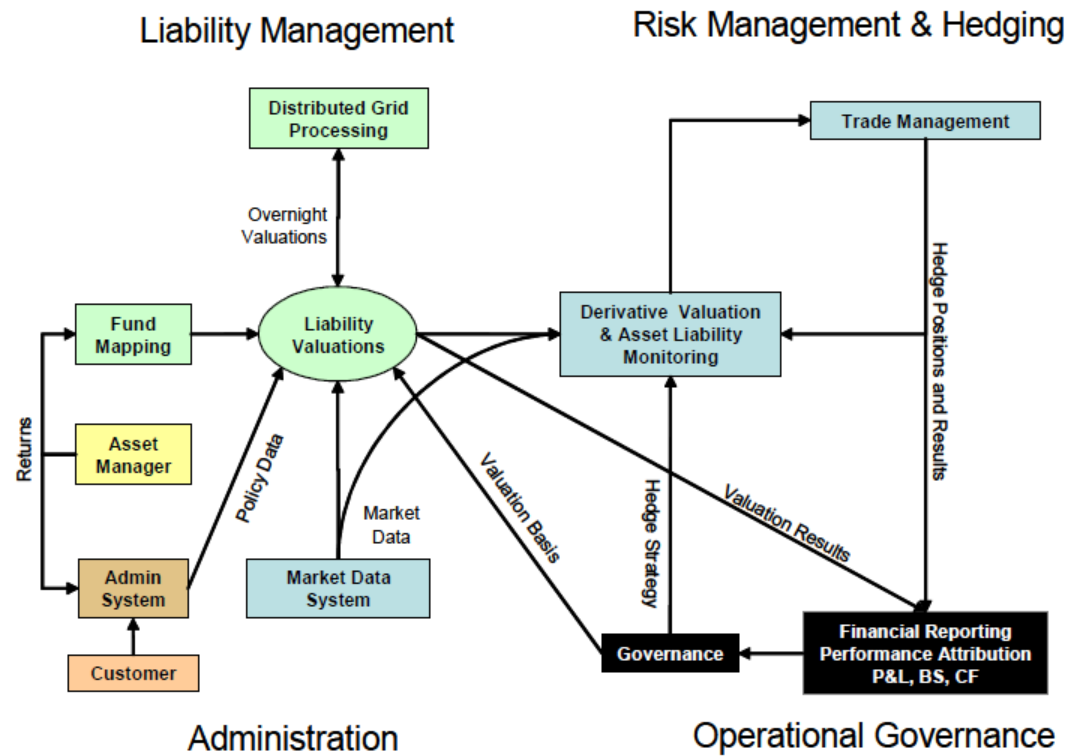•Cheap "beta" & "beta" hedging

Reinsurer/Investment Bank
•Rider Only => No cross subsidy => full replication cost
• Beta Hedge + Basis Risk V Integrated Hedge
•Fair Values, Collaterals and Realisable Value
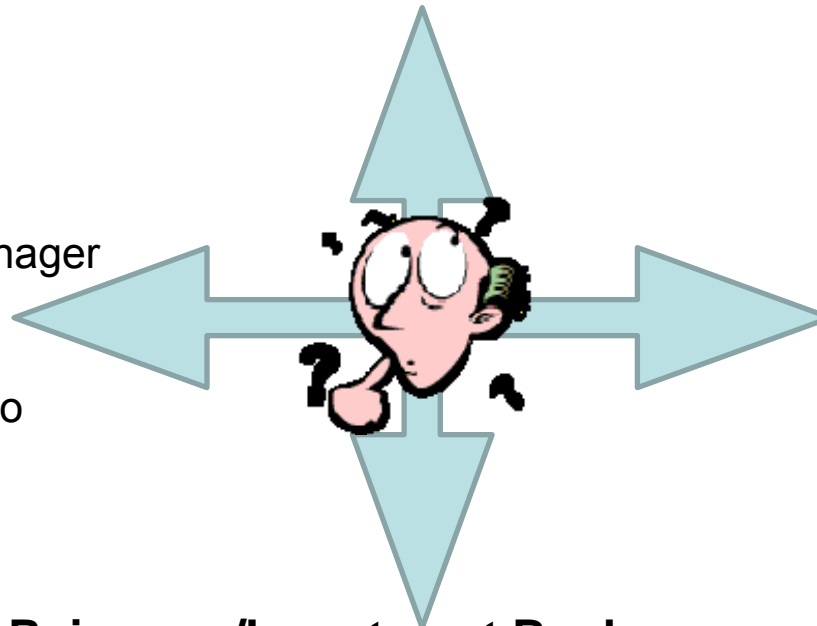
What's inside the Black Box ?

Figure 1: Operational Manufacturing Activities

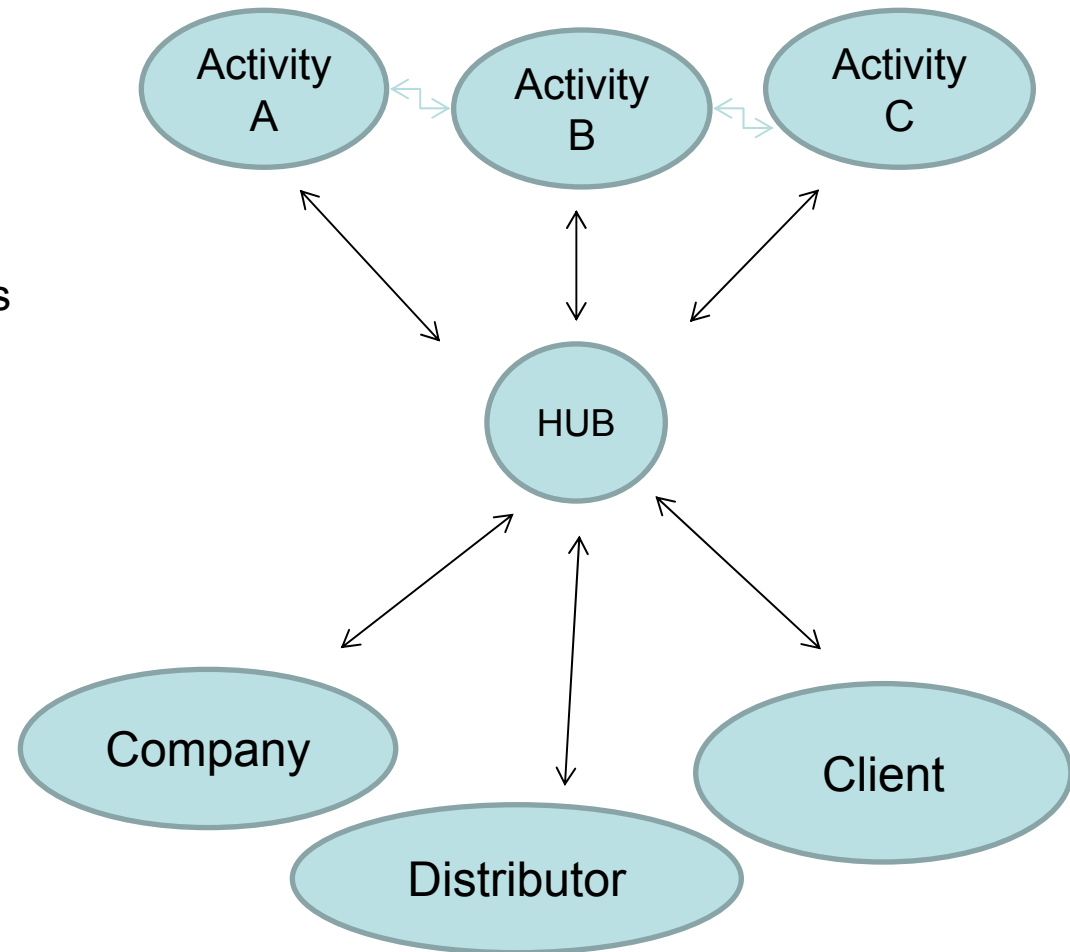(Source: Milliman presentation at 2008 Infoline VA Seminar)

Management Challenges

- ## Elements
  Expertise, Infrastructure
  Capital, Markets
  Governance
  Agents, Distributors &Clients

- ## Alternatives
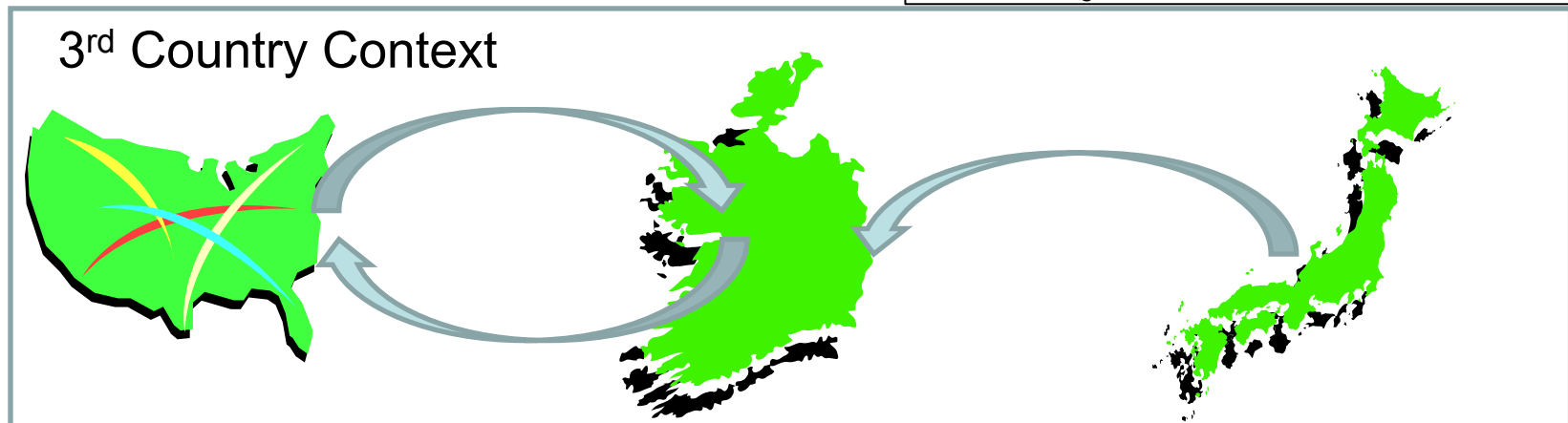 Decentralised
  Centralised
  Out/In Source/Sharing

Activity A ⟷ Activity B ⟷ Activity C

HUB

Company

Distributor

Client

Other Stuff

- ## Environmental Issues

  Tax/Capital

  Cost/Infrastructure

  Regulations & Regulators

- ## Internal Issues

  Under/Over Lap

  Culture & Communication

  Management & Ability

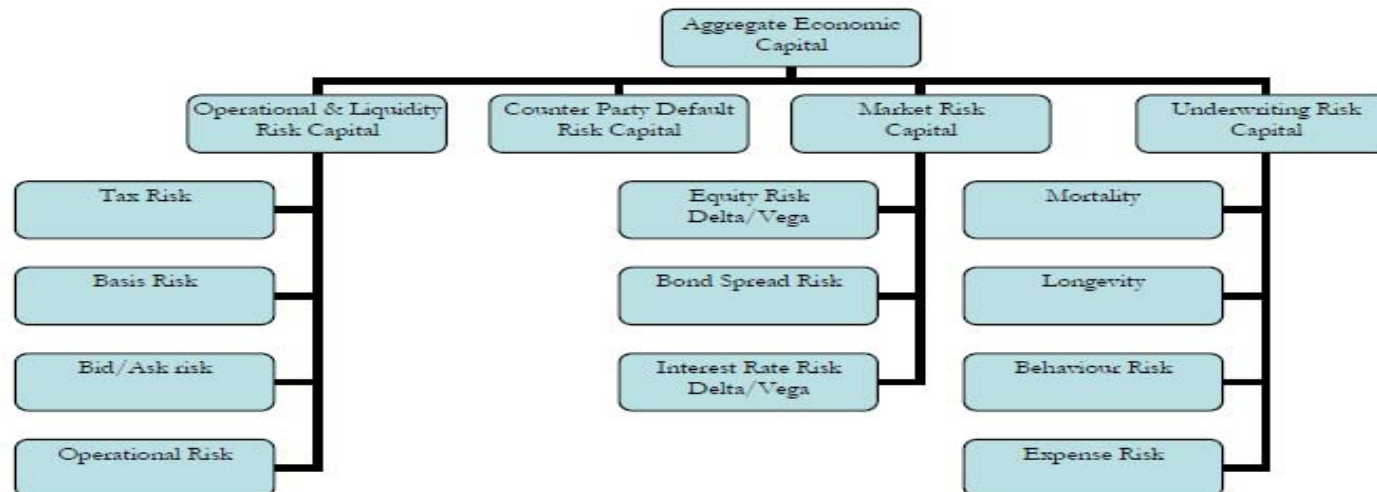EU Internal Market

3rd Country Context

# Mapping/Decomposing Risk
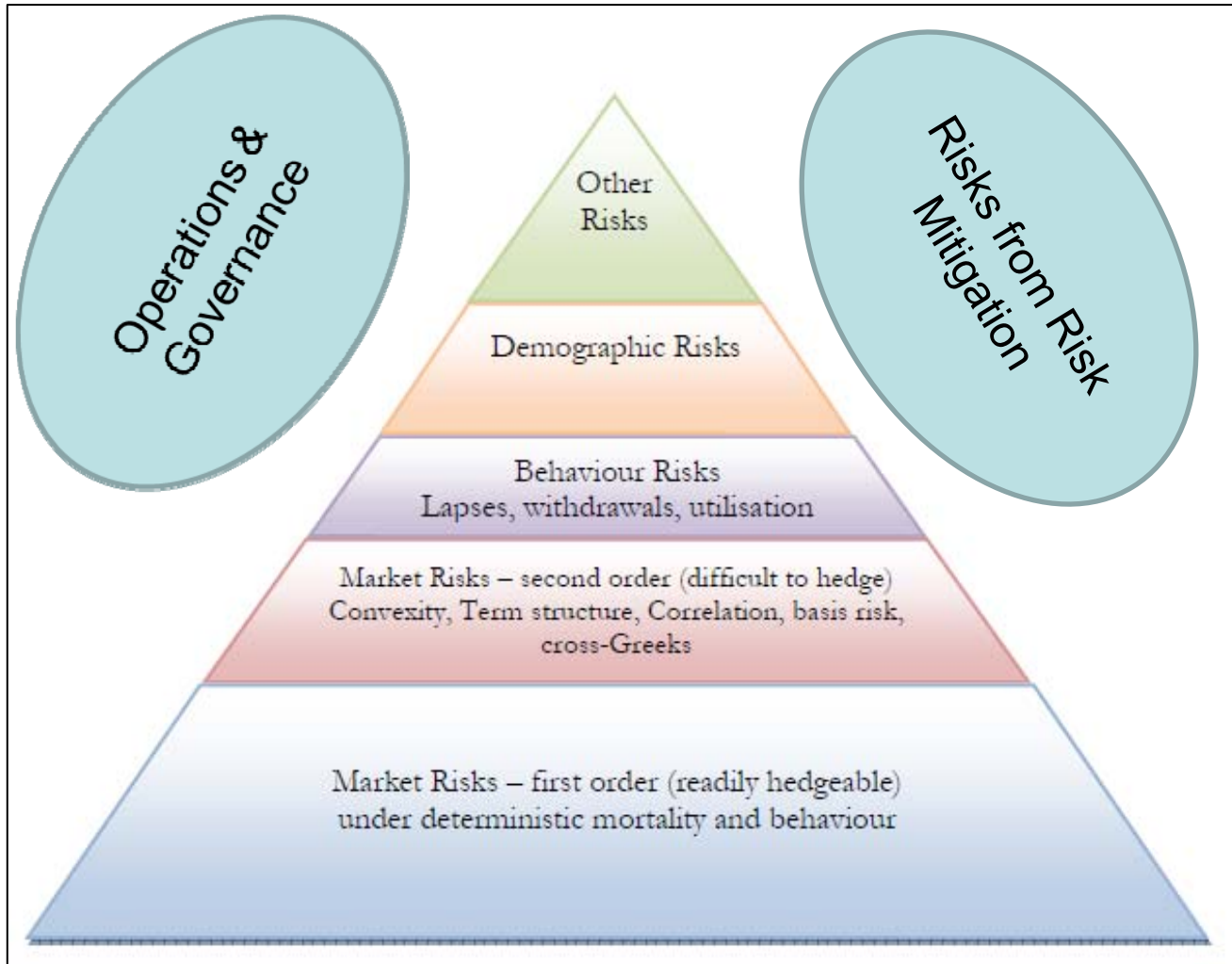
From Risk to Capital

- ## Extending the Standard Formula
  - **New Risks** - Liquidity, Basis Risks
  - **Amplified/Extended Risks** - Default, Market, Operations, Expense
  - **Altered Risks** - Behavioural

Risk Mitigation & Capital

- **Illustrative GMWB**

- **QIS 4.5 Calibrations**
  - Dampener
  - Correlated Vega

- **Dynamic Hedge**
  - <u>Need</u> 3 Greek hedge

- **Static Solutions**
  - Credit Risk
  - AAA to A - effective
  - BBB - marginal

Indicative Day One Capital Charges
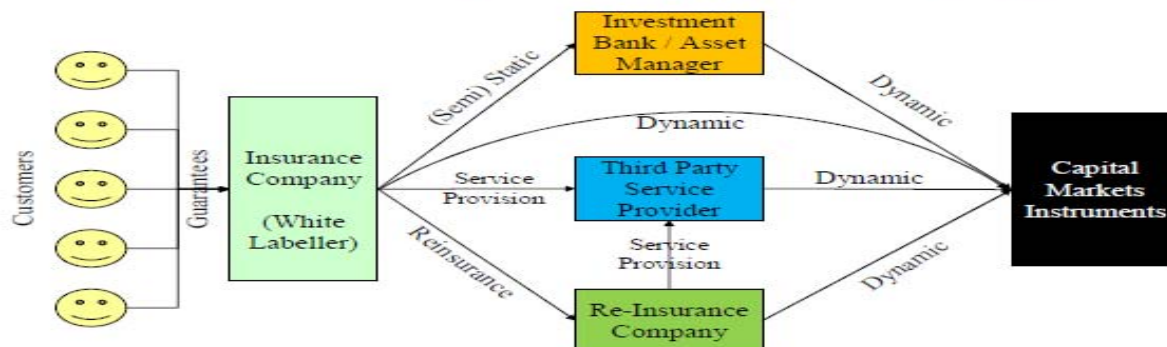

Comparative Static Solutions
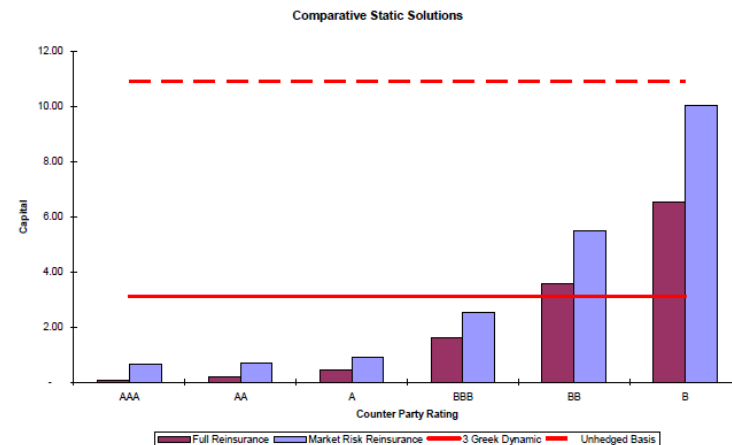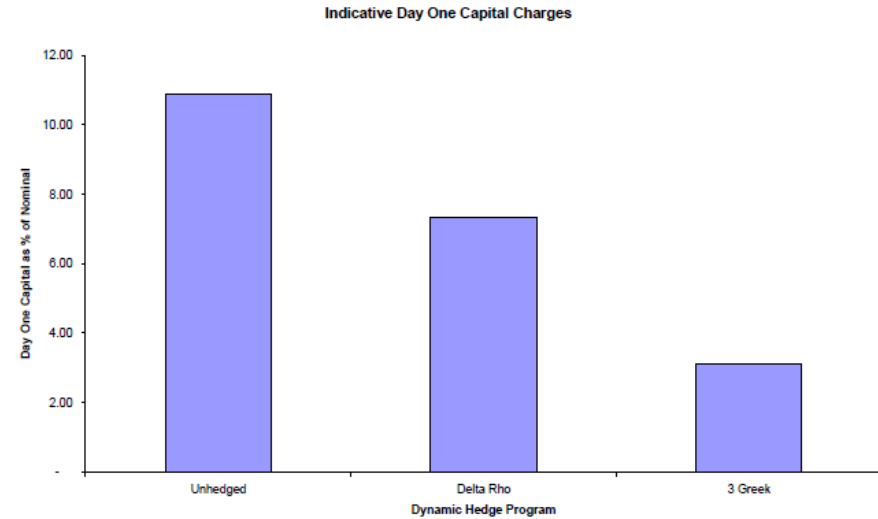
RISK NEUTRAL IN THE REAL WORLD

Risk Transformation

- Market Risk can be
  - Held, Transformed or Transferred
- Transformation (replication) pricing and insurance pricing <u>are different</u>
- Transformation <u>shortens liability profile</u> and <u>introduces liquidity risk</u>

All roads lead to dynamic hedging (or no hedging!)

BS in the Ideal World

The Black Scholes formula for a European put is as follows:

- $\text{Exp}(-T*R_f)*\{\text{Strike}*N(-d2) - \text{Forward}* N(-d1)\}$

- For $d1 = \{ \text{Ln(Spot/Strike)}+ (R_f +.5*\sigma^2)*T\} /\{ \sigma*\sqrt{T}\}$, $d2 = d1-\sigma*\sqrt{T}$

  - R_f = Risk Free Rate (based on N month Interbank Swap Rate)

  - σ = Volatility

  - Strike = Forward = $\text{Spot}*\text{Exp}(R_f*T)$ = "At The Money" Forward

BS in the Real World

$Exp(-T*R_c)*\{Strike*N(-d2) - Forward*N(-d1)\} + RP$

For $d1 = \{ Ln(Spot/Strike) + T*(R_r + .5*IVOL^2)\} /\{ IVOL*\sqrt{T}\}$, $d2 = d1 - IVOL*\sqrt{T}$

$Forward = Spot*Exp(R_r*T)$

In this we exchange

1. $IVOL$ for σ to reflect the adjusted statistical volatility

2. R_r for R_f to reflect the "repo rate" as the appropriate no arbitrage drift

3. R_c for R_f to reflect the earning rate for positive cash.

Additionally we will add to this amount an idiosyncratic adjustment "RP" being a risk premium to reflect the market participants' level of risk aversion or expected excess margin. In the absence of two way prices (Bid/Ask) this will include the ask margin over the mid price.

Implied Volatility

- Inferred parameter given known option price
- Related to expected stock price process
- **But** Includes adjustments
- Transaction costs
  - Round Trip Cost of Rebalance
  - Impact of "slippage"
- Discrete time hedge error
  - Function of time step, volatility and "gamma"
  - "Expected" ultimate cost is nil – but not deterministic
  - "utility" cost for interim noise and ultimate outturn
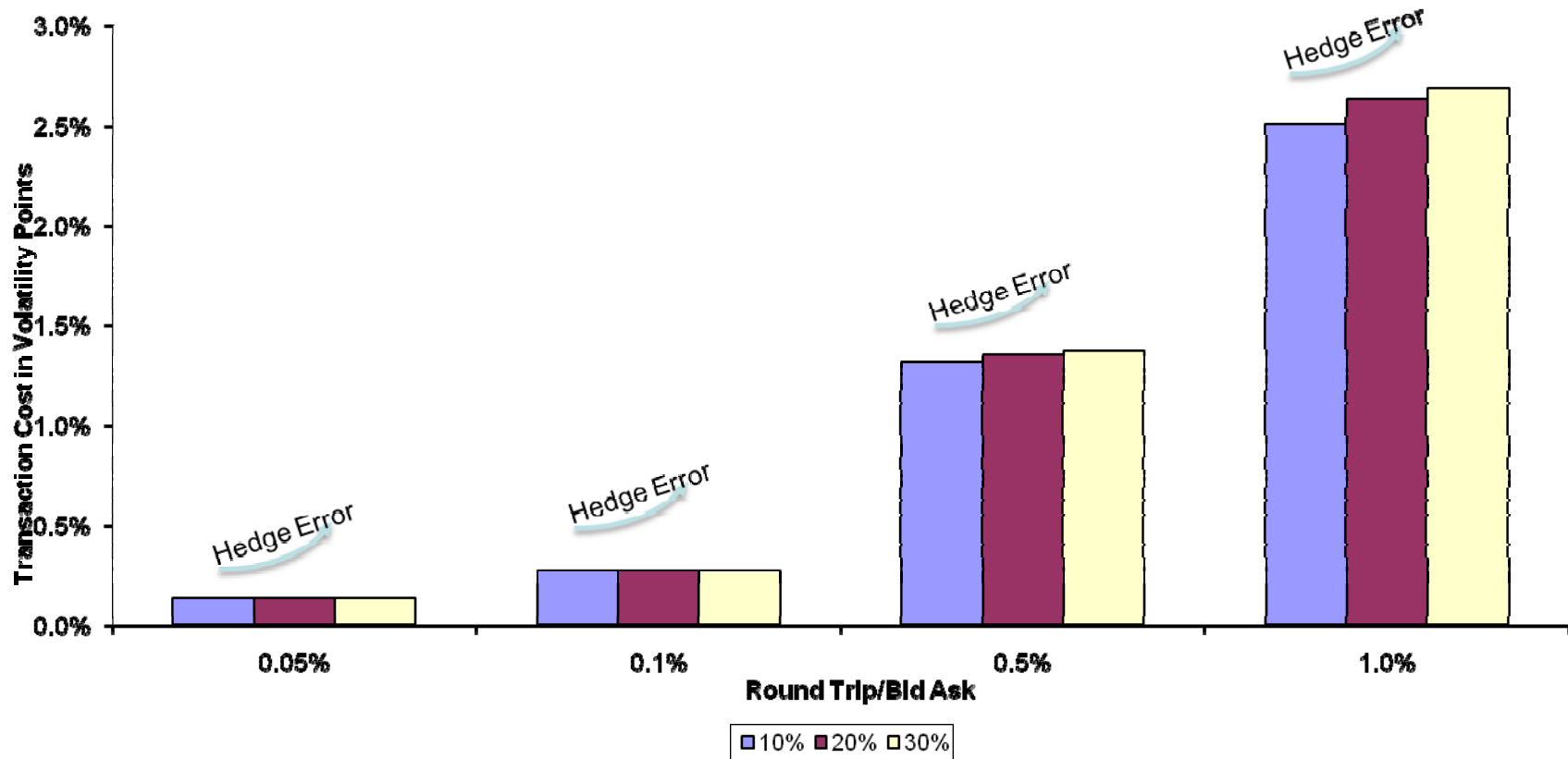- Market Equilibrium

Bid/Ask Transaction Costs

Impact of Liquidity and Trade Frequency on Hedge Cost
(Excluding Commission, Slippage and Admin Costs)
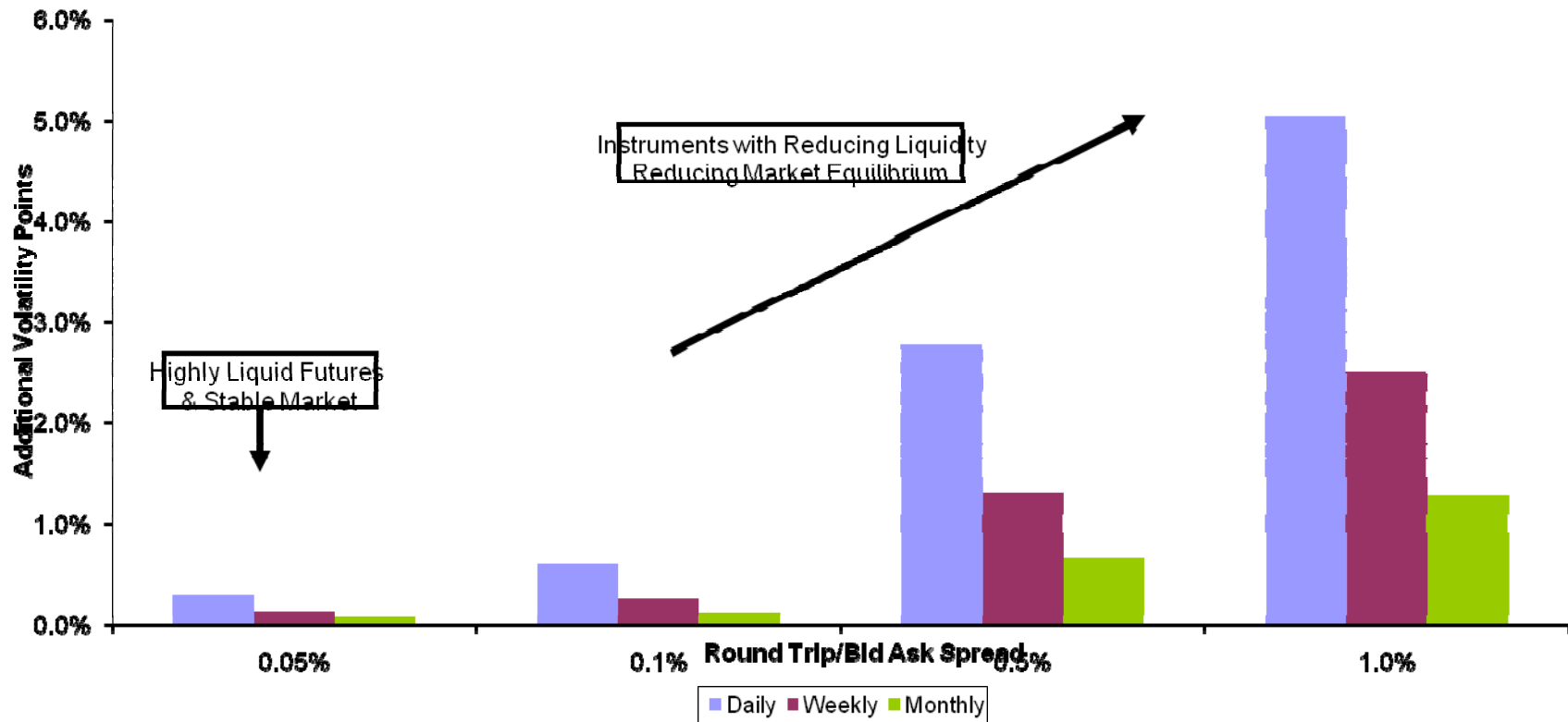
TC & Volatility, Hedge Error

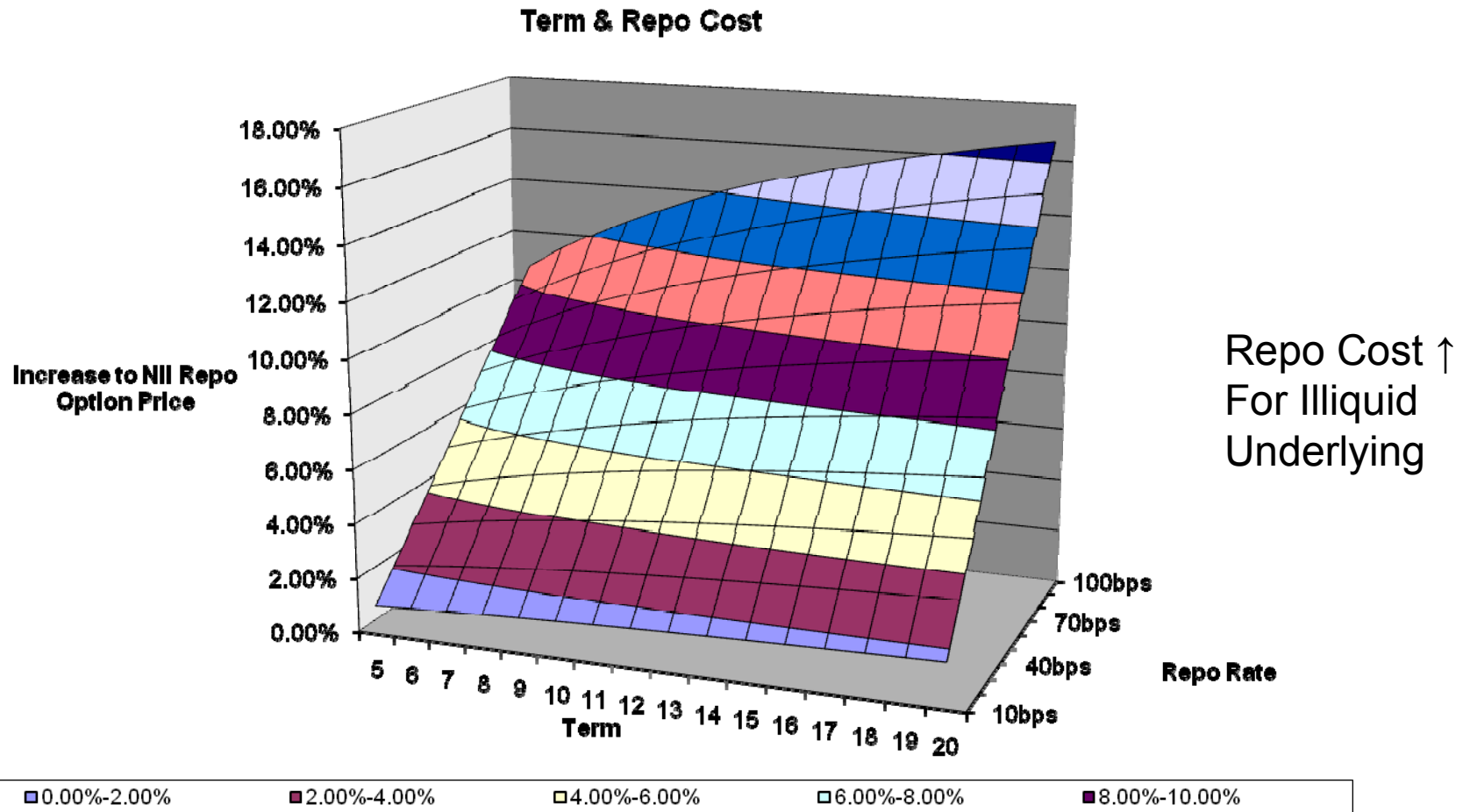**Transaction Costs and Volatility**
Weekly Rebalancing

What is Repo ?

- ## Repo = Repurchase Agreement
  - Term to reference a collateralised lending agreement where an asset is temporarily sold with requirement to repurchase at a later date

- ## Repo Rate
  - Refers to the rate of interest on the loan agreement

- ## Application
  - Liquidity
  - Balance sheet management (Repo 105)

- ## Stock Lending
  - Covered "Short" Sales

- ## Related Concepts
  - Futures "Implied Repo Rate"
  - Total Return Swap

Repo Cost & Option Price

Term & Repo Cost

Increase to NII Repo Option Price

Repo Cost ↑
For Illiquid
Underlying

Term

Repo Rate

100bps
70bps
40bps
10bps

☐ 0.00%-2.00%   ■ 2.00%-4.00%   ☐ 4.00%-6.00%   ☐ 6.00%-8.00%   ■ 8.00%-10.00%

Discount Rates ?

- ## Discount Future Claims = Exp(-r*t)
  - – Risk Free = Overnight Interest, N month Libor, Treasury, Other ?

- ## (Pre Crisis) Industry Standards
  - – Exchange Trades = Overnight Interest Swaps
  - – OTC = LIBOR Swap
  - – LIBOR Swap ≈ OIS Swap (circa 10bps)

- ## Crisis
  - – Bank Credit Risk/Liquidity Crisis
  - – Libor >> OIS

  - ## Post Crisis
  - – New equilibrium - LIBOR > OIS

- ## Situational Discount Rate ?
  - – Collateral and Collateral Structure Count
  - – Discount rate follows own investing freedom adjusted for risk

Scale of Treasury Effects

Treasury Exposure Amounts
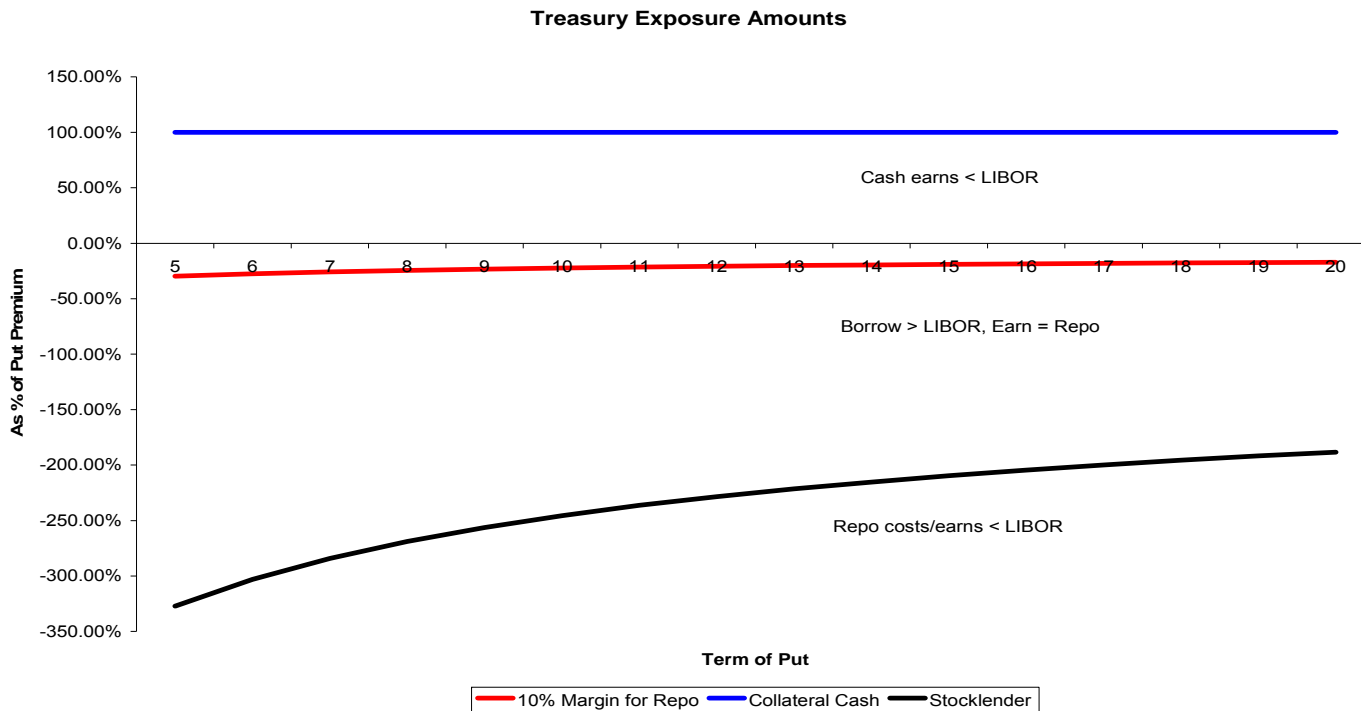
- Discount rate based on Price of Option
- Repo Rate applied to Delta of Units protected
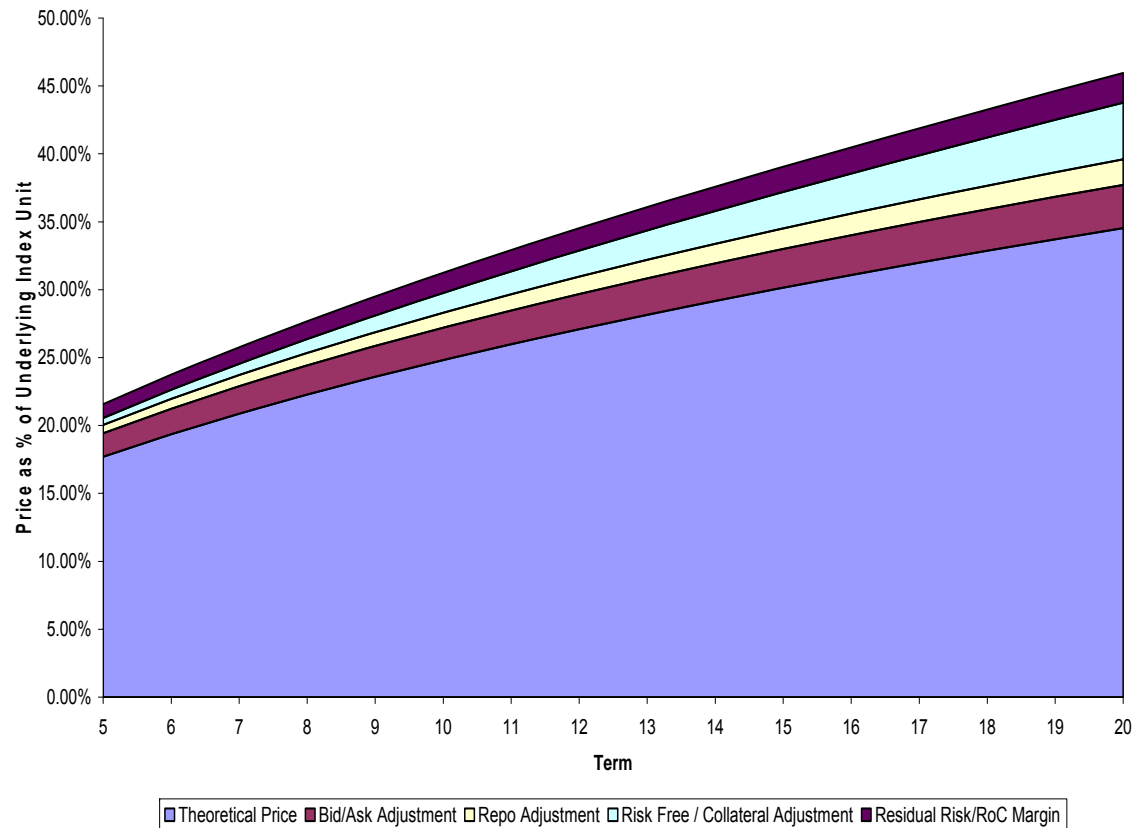- Borrow cost depends on margins/haircuts for repo

Illustrative Price

Element of the Basis	Stable Market
Statistical Volatility	20%
Risk Free Rate*	5%

Element of the Basis	Stable Market
Transaction Costs (Volatility)	+ 2% (20%+2% = 22%)
Uncollateralised Borrowing	5%
Repo Rate	30bps
Overnight Investment	20bps
Risk Margin/Profit Loading	+5% (Price*105%)

Fully Loaded OTC Price

Legend: Theoretical Price ■ Bid/Ask Adjustment ■ Repo Adjustment □ Risk Free / Collateral Adjustment ■ Residual Risk/RoC Margin
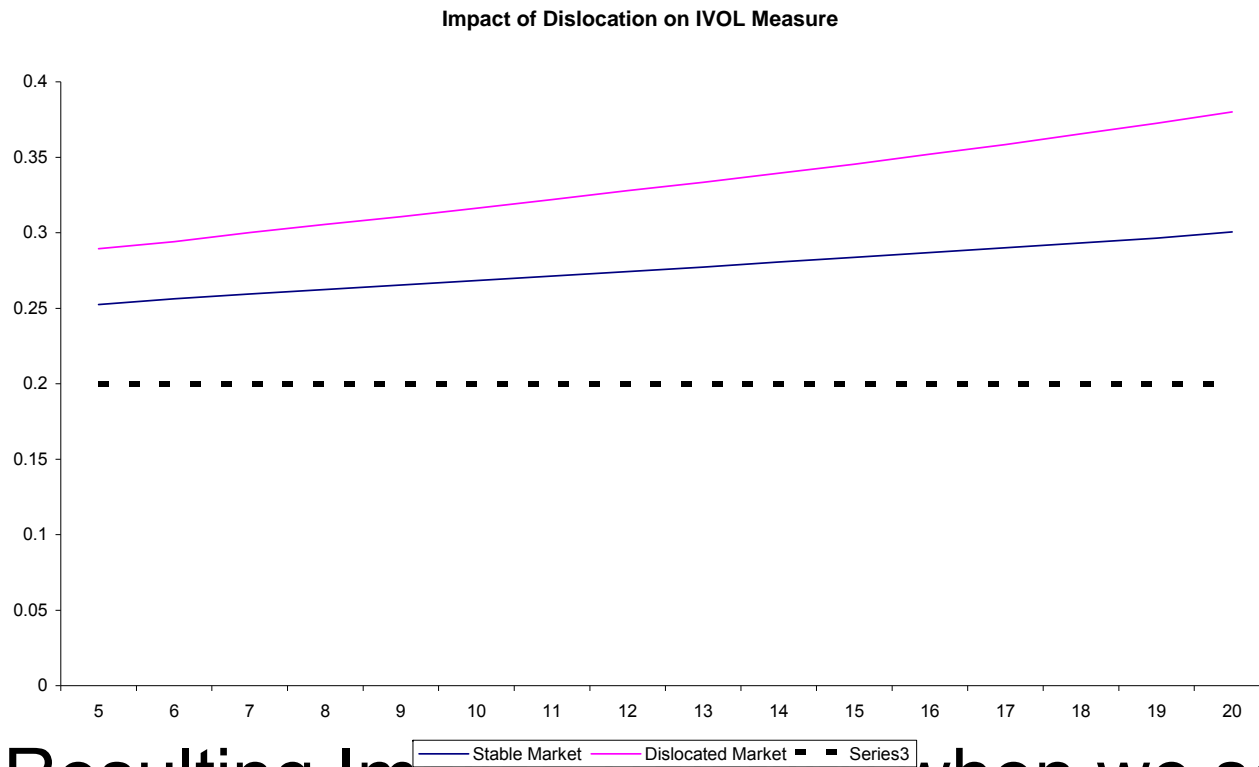
Increased Transaction Costs

**Impact of Aversion and Micro Structure on Price**
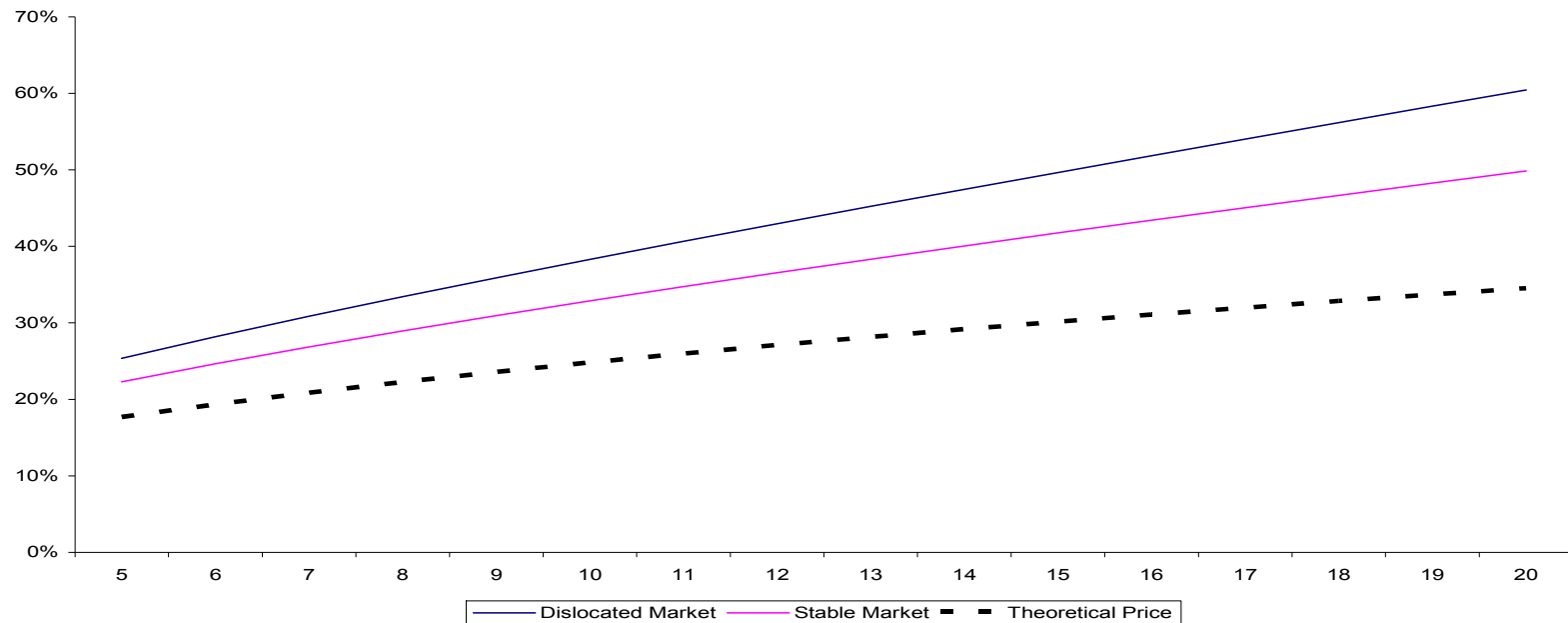
- Not stable over time
- Correlated (Level of Rates, Markets, Each Other)
- Adjusted Vol & Repo a proxy for basis risk
- Implicit price adjustment for hedging "illiquid" funds

Presentation as Volatility

Impact of Dislocation on IVOL Measure

- Resulting Implied Volatility when we solve price against the Libor Curve with no other loadings
- Material, upward sloping,volatile
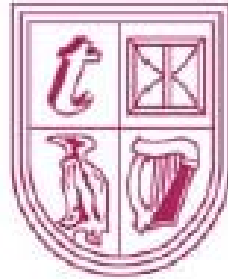
Regulatory Developments

CP42

Solvency II

CP 42 & SAI Response

FINANCIAL REGULATOR
Rialtóir Airgeadais

Investment Guarantees -
Guidance on Reserving
and Risk Governance

May 2010

Consultation Paper | CP42

THE SOCIETY OF ACTUARIES IN IRELAND

Submission on the Financial Regulator's Consultation Paper
"Investment Guarantees – Guidance on Reserving and Risk
Governance" (CP42)

July 2010

Observations

- Motivation
- Risk **&** Governance Framework
- Convergent with Solvency II
- Progressing the Discussion
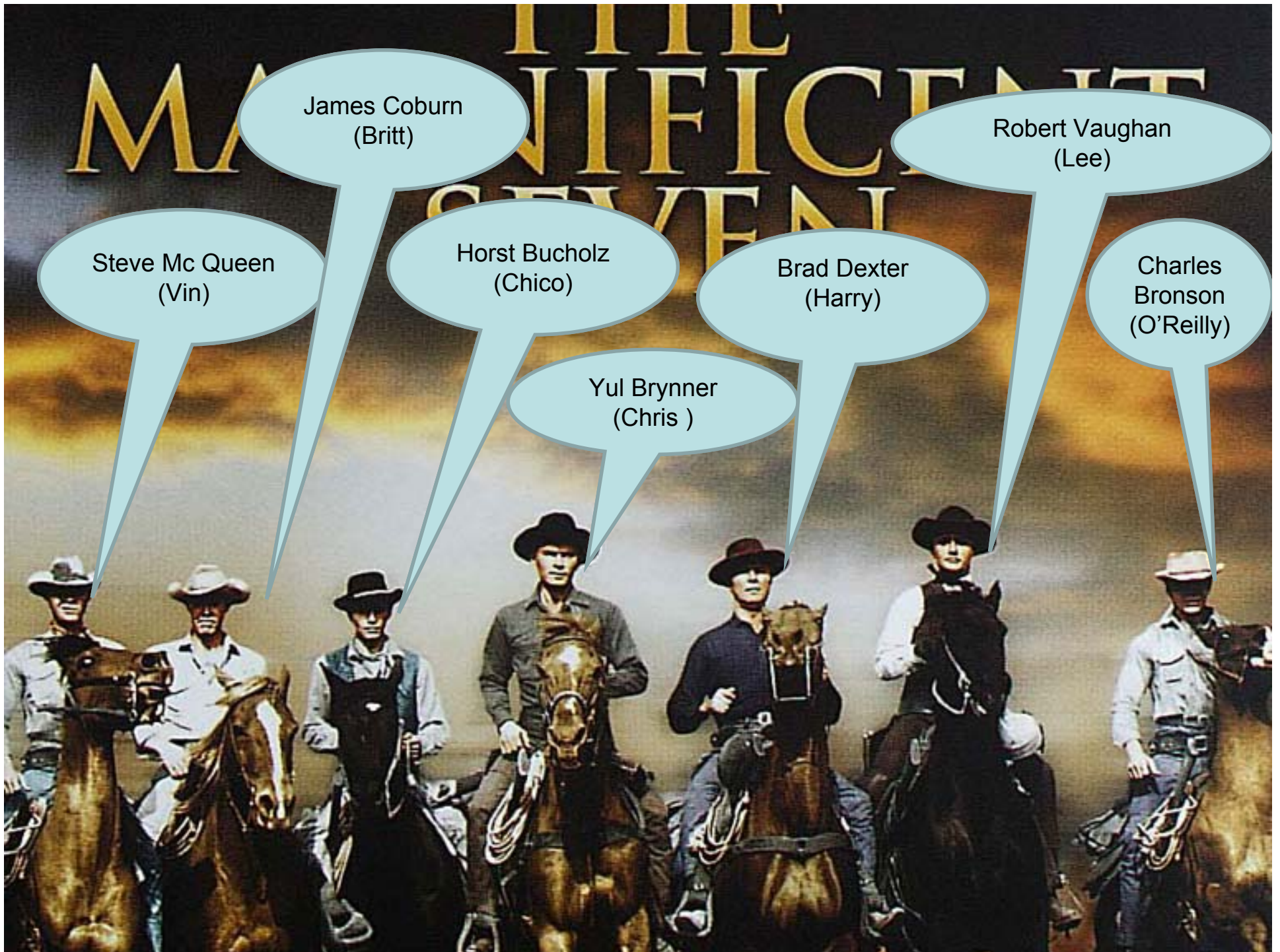- CEIOPS Task Force
- Time and Timing

S II-Interpretations

- ## Dynamic Hedging V Rolling Hedges
  - Jump before the crash/Rebalance during crisis
  - Clearly Defined, Basis Risk, Liquidity

- ## Counterparty Risk
  - Collateral V Cash Settled
  - Contingent Risk (impact of mitigation)
  - Cash at Bank V Cash Equivalents
  - Internal Unrated V External Unrated

- ## Market Consistent Pricing
  - Calibrate to Market V Illiquidity Premium
  - Historic Volatility V Implied Volatility
  - Separating the Reference Rate from Volatility

- ## Definition of "Bank"
  - Regulated under CRD V Deposit Lending