



**The Actuarial Profession**

making financial sense of the future

# Life Conference and Exhibition 2011

## John Roe



# The Sting in the tail

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# A Foreword

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- The views represented are my own as are any errors
- I work for Legal and General Investment Management on strategic investment analysis and solutions
- I am not a regulatory actuary focused on Solvency II
- Analysis is approximate and to provide context, rather than to challenge others' more granular analysis
- Solvency II is not finalised
- New draft text is expected to introduce a matching premium for annuities and reduce capital volatility

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## Defining tail events

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# The Players

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## Swans of every colour

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“Contrary to conventional wisdom, crises are not black swans but white swans: the elements of boom and bust are remarkably predictable”

*Nouriel Roubini, Crisis Economics, 2011*



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# A simple definition of tail risks

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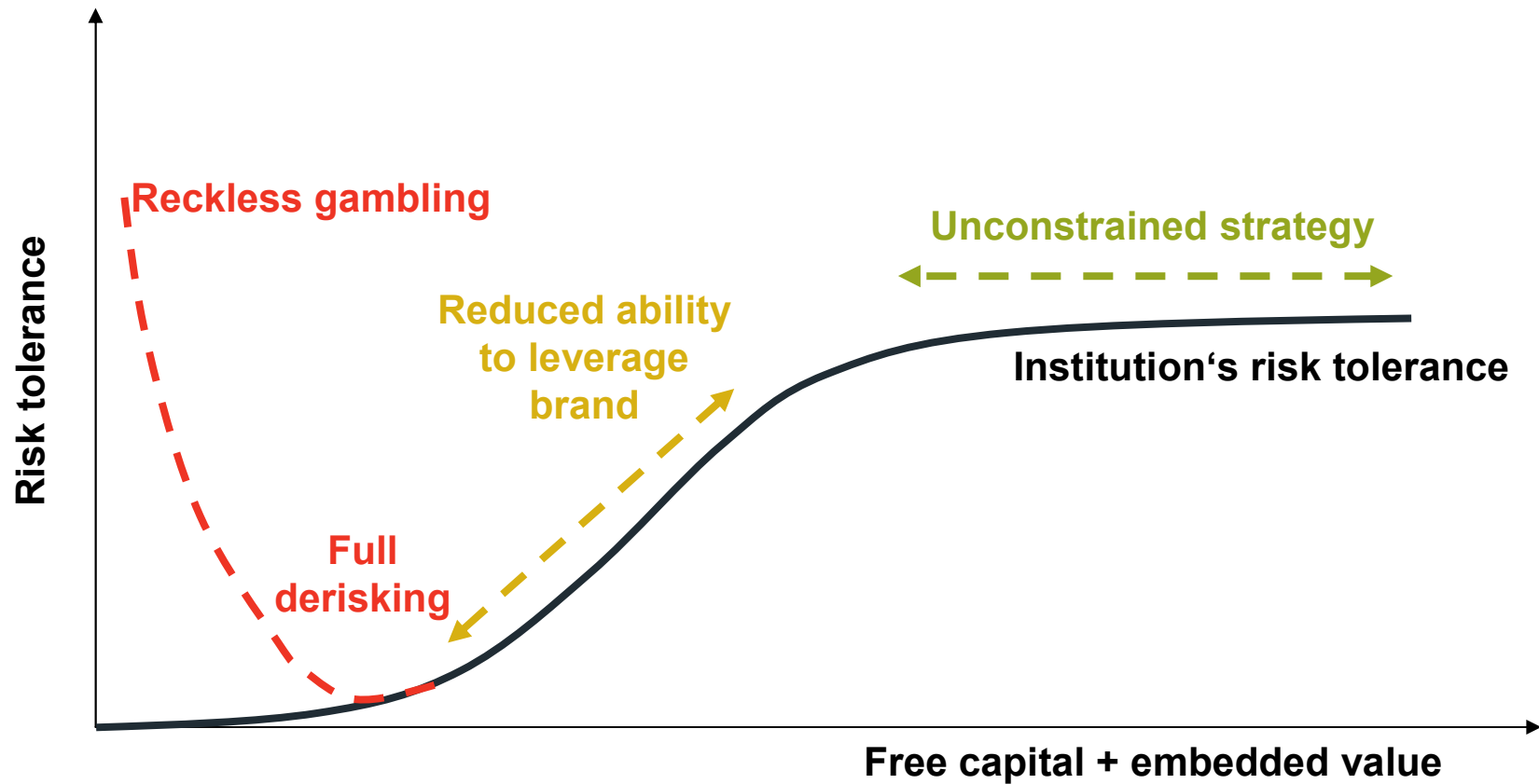
For senior management

An event which defines their lasting legacy

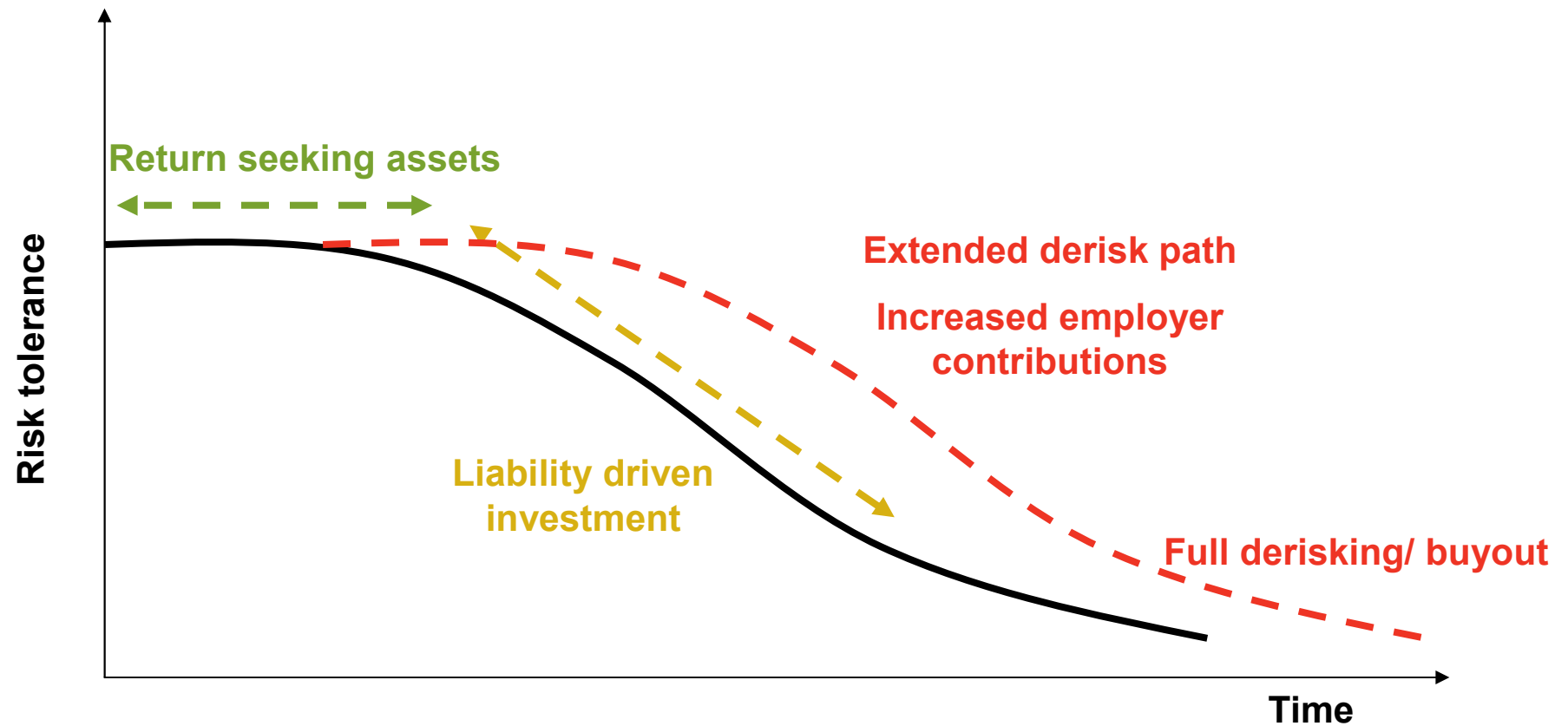
For insurers and pension funds

An event which recasts their future

# Franchise value destruction and derisking



# Pension funds have the opposite problem



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## Insurers' approach

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# The Set up

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## Risk management – rapid progress

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- GAO hedging c.25 years after Black-Scholes
- Rapid progress since
  - Realistic Balance Sheet
  - Individual Capital Assessment
  - Solvency II
- Stochastic and stresses
- Principles and rules

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## Draft Solvency II SCR – the year's must have slide?

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- Standard QIS 5 formula
- Equities: 39% for Global, 49% for Other
- Property: 25%
- FX: 25%
- Liabilities discounted based on swaps + illiquidity premium

	Non-EEA Govs	Corporates	Structure Products	Credit Derivs
	(%)	(%)	(%)	(%)
AAA	0.0	0.9	0.9	1.3
AA	0.0	1.1	1.1	1.5
A	1.1	1.4	1.4	2.6
BBB	1.4	2.5	2.5	4.5

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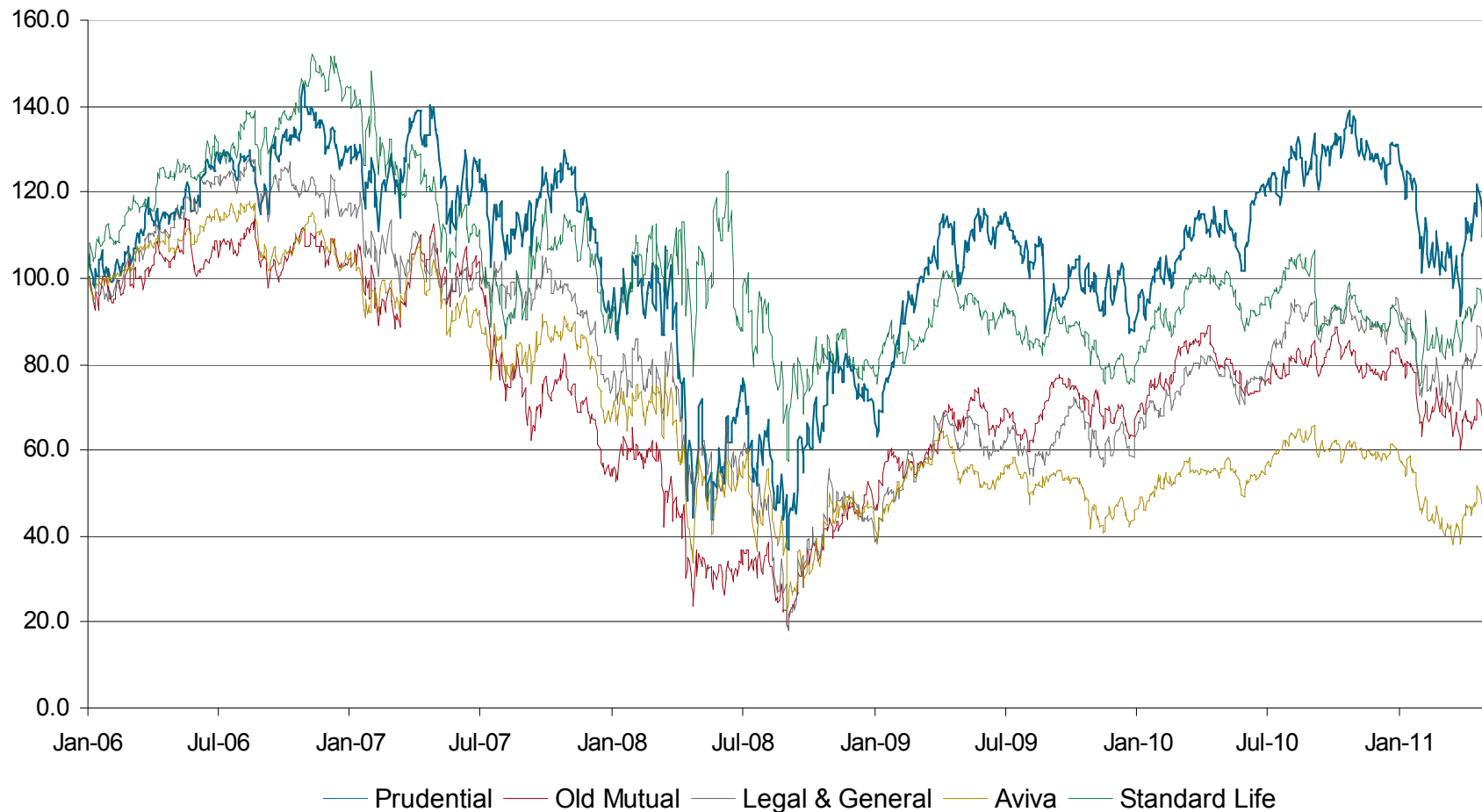
## Draft (QIS 5) SCR correlations

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- Solo entity diversification reduces SCR by c.35%
- Owning multiple asset classes reduces benefit of the illiquidity premium

Up (Down)	MKTint	MKTeq	MKTprop	MKTsp
MKTint	1	0 (0.5)	0	0 (0.5)
MKTeq	0 (0.5)	1	0.75	0.75
MKTprop	0 (0.5)	0.75	1	0.5
MKTsp	0 (0.5)	0.75	0.5	1

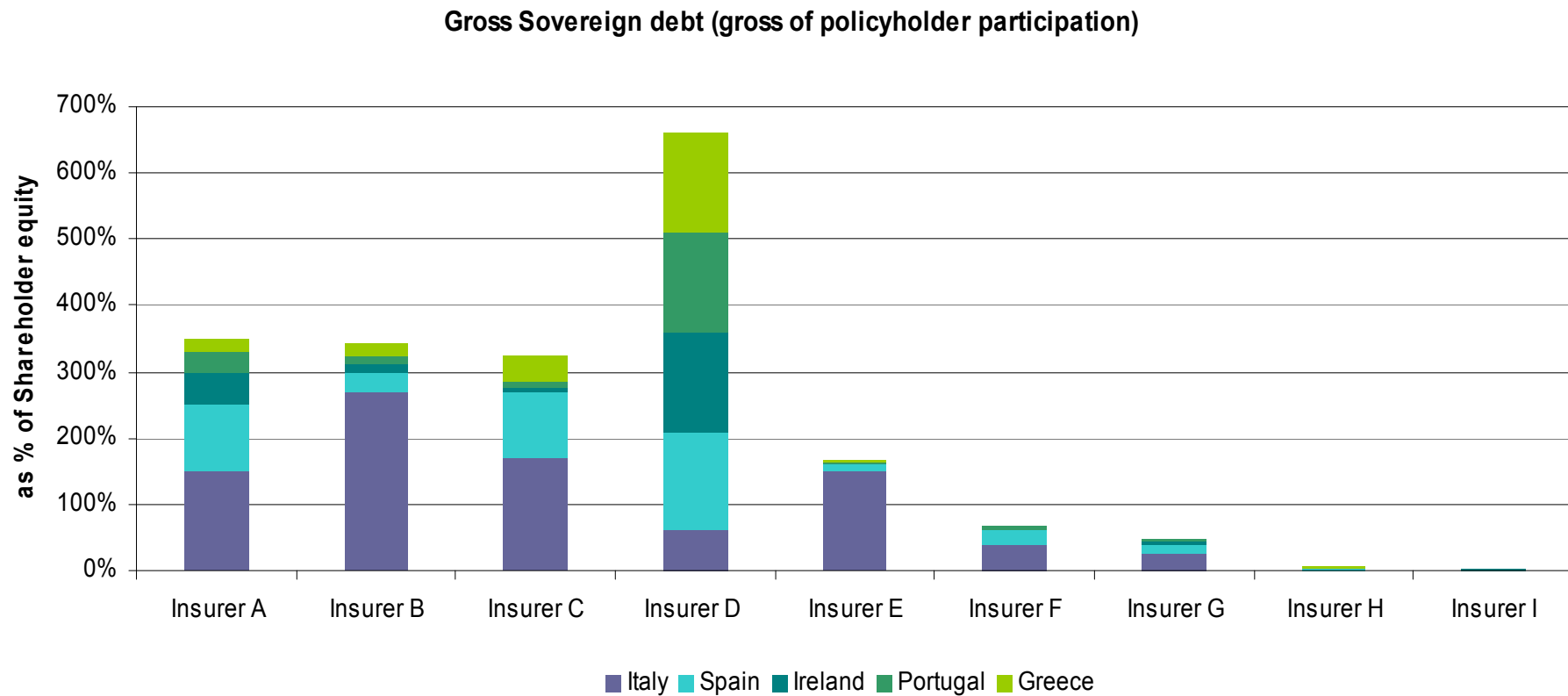
# Insurers financial strength through recent crisis



Source: Bloomberg LP

# European insurers' sovereign exposures

- Market storms are a long way from being weathered



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**Enough capital for a 1-in-200 year event ?**

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# **The Hook**

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# People judge books by covers

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Arbitrary coherence

“1-in-200” encourages risk measurement not management

Very hard to shift mindset once anchored

The impact can be extreme

It can double the price of (Neuhaus) chocolates<sup>1</sup>

So what if the risk calibration and time horizons are wrong?

<sup>1</sup> Source: Dan Ariely, George Lowenstein, and Drazen Prelec, “Tom Sawyer and the Construction of Value”, Journal of Economic Behaviour and Organization (2006)

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# Time horizons

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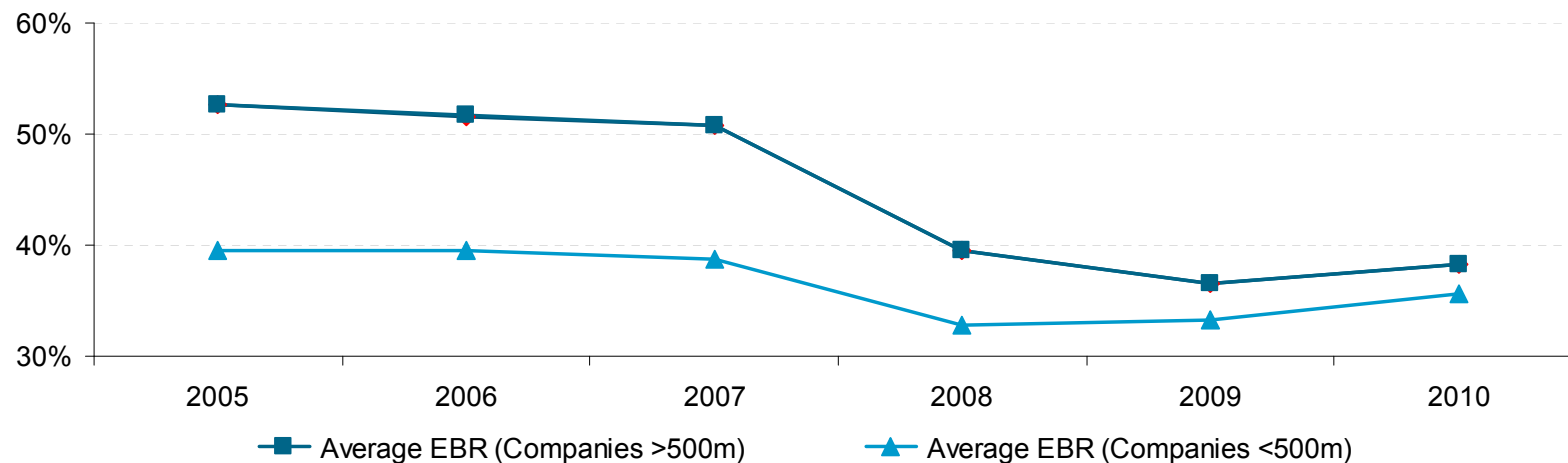
- Ever dwindling
- Mark to market a guiding Solvency II principle
- Longevity recognised as emerging over the long term
- Credit remains controversial
- Liability illiquidity is the key to the debate

Solvency II isn't really a one year time horizon

MTM only works if assets and liabilities share similar liquidity levels

# Experiments in mark to market liabilities – with profits

Equity backing ratios (2005 – 2010)



Source: 2010 – 2005 FSA Returns, Form 48, Column 2

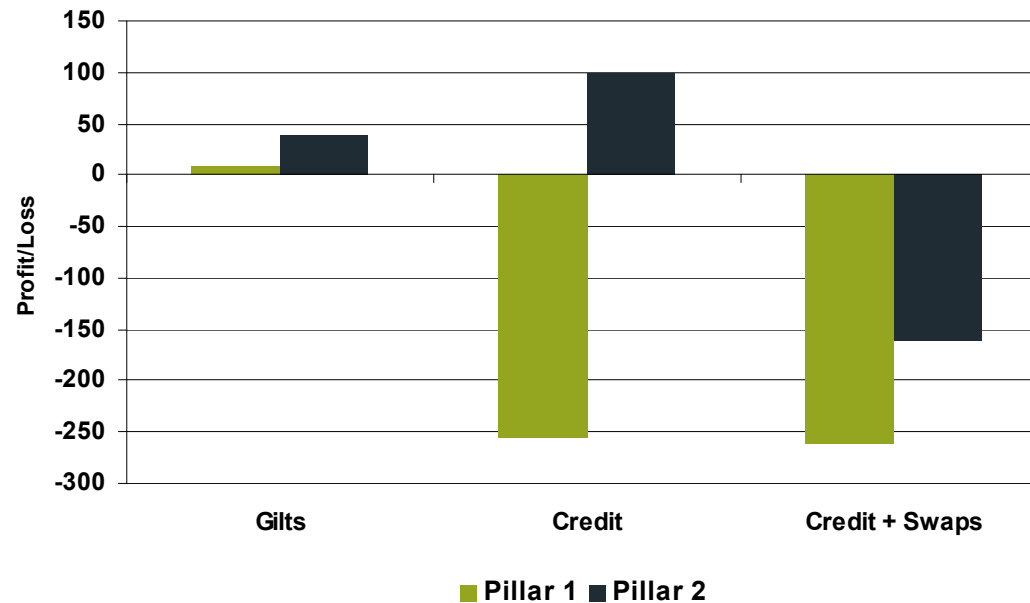
- Average EBR around 75% at end of 1991<sup>1</sup>
- Average EBR constant around 70% between 1990 and 2000<sup>2</sup>
- Average EBR rose steadily upwards from c.35% to c.70% between 1970 and 1990<sup>2</sup>

<sup>1</sup> Source: Asset and Liability Studies on a With Profit Fund, Tim Roff, Presented to the Staple Inn Actuarial Society, October 1992

<sup>2</sup> Source: Smashing With-Profits Business, Howard Froggatt and Icki Iqbal, Staple Inn Actuarial Society, October 2002

# Experiments in mark to market liabilities – annuities

## Net surplus emerging 2009



- 2009 Institute of Actuaries Working Party<sup>1</sup>
- £2bn starting liability portfolio

<sup>1</sup> Source: Unintended consequences and the avoidance of self-fulfilling prophecies, Impacts of regulation and market turbulence on annuity fund investment strategies working party, June 2010

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# Calibration

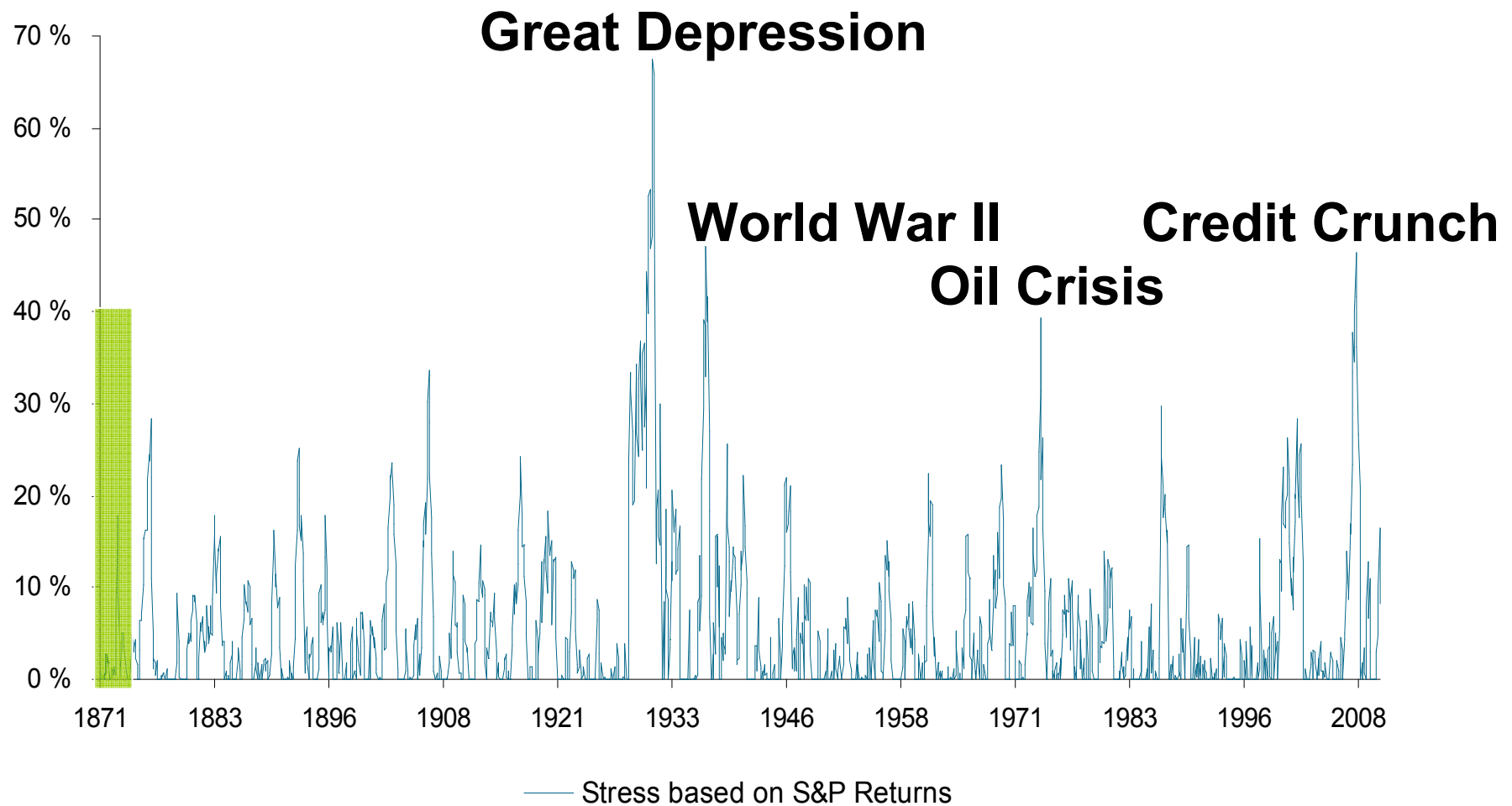
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By necessity standard formula simplifies  
FSA paper

Calibration of the Enhanced Capital Requirement for with-  
profit life insurers, June 2004

Test the calibration (and that of Solvency II)

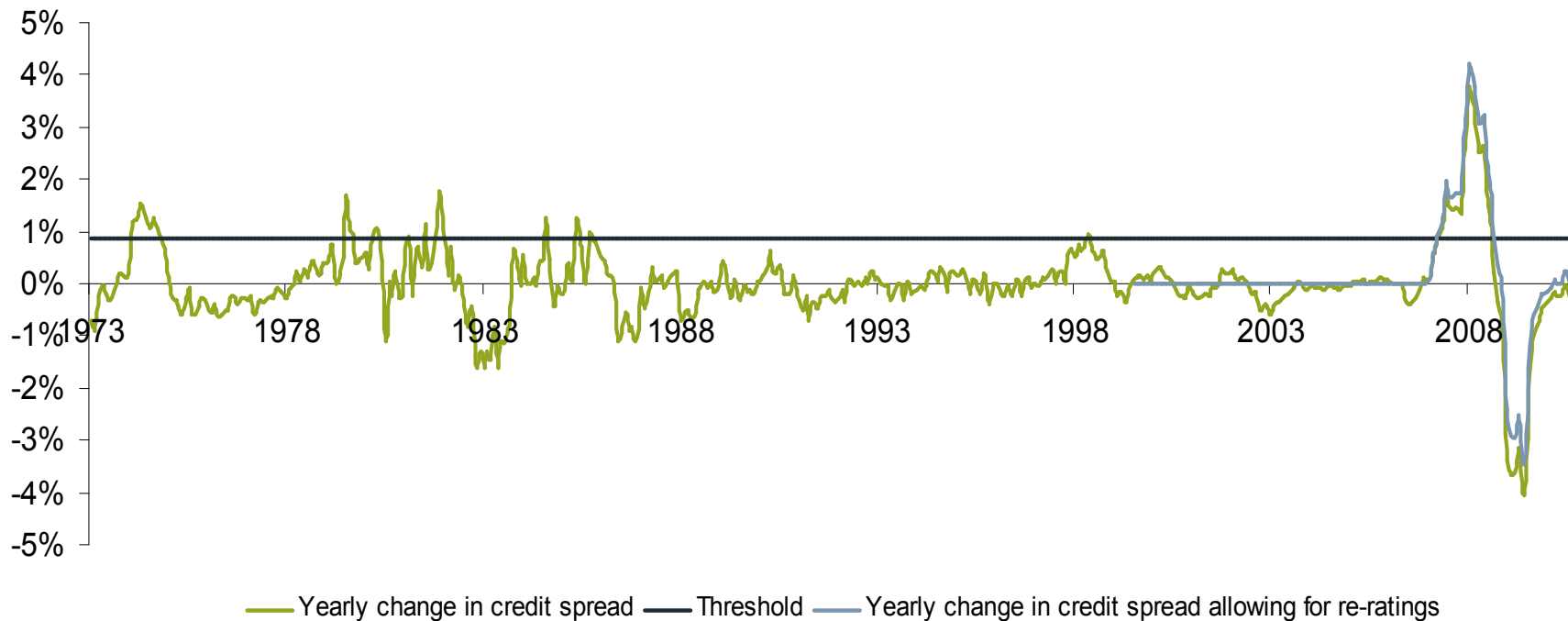
# Realised historical equity volatility



Source: Reuters Ecowin

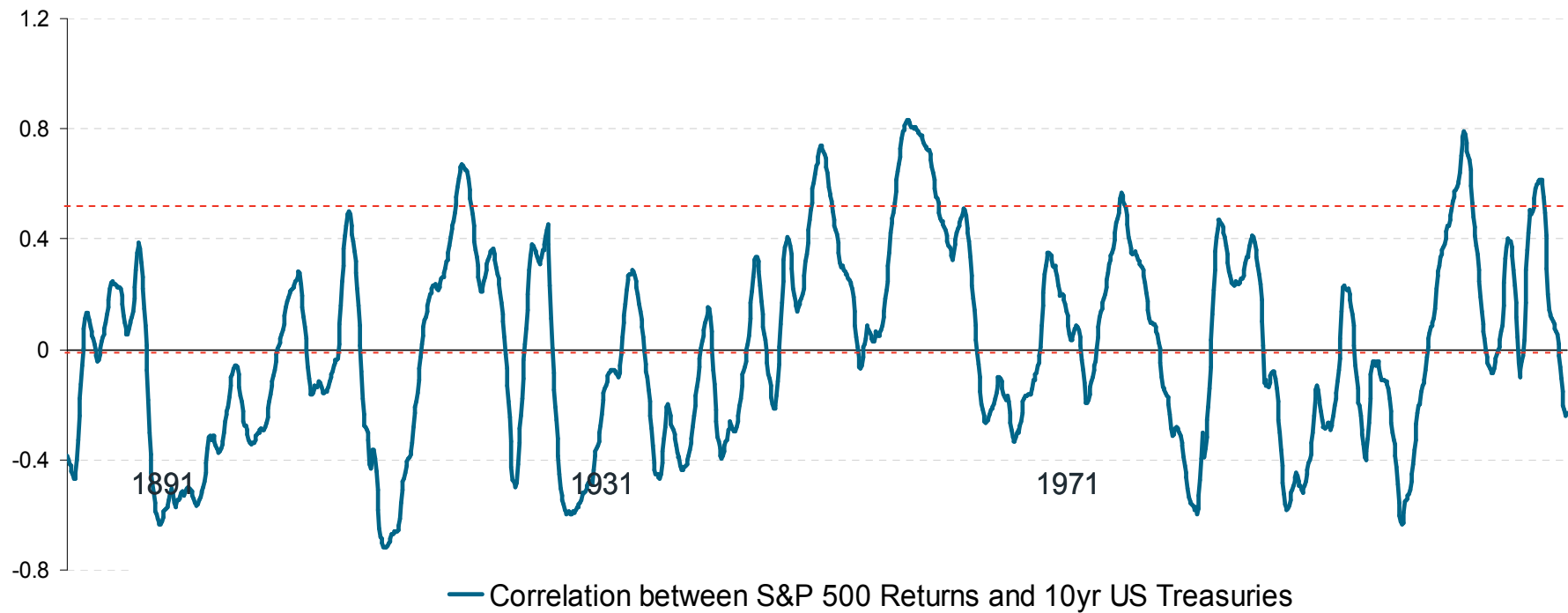
# Credit Stresses

## Year Change in Credit Spread<sup>1,2</sup>



1. Source: Bloomberg for data from 1999 onwards. Based on iBoxx spreads. Prior to Jan 1999 only proxy BBB spreads available - these were dampened to allow for greater volatility of BBB relative to overall portfolio. From October 2007 BarCap data used to infer impact on credit-spreads of re-ratings.
2. Threshold represents 1 in 200 event as implied by table in paragraph 8.8 of the June 2004 FSA paper 'Calibration of the Enhanced Capital Requirement for with-profit life insurers' by Watson-Wyatt and fitting a Gaussian distribution to extrapolate the tail.

# Correlation between US equities and Treasuries



Source: DataStream

## **“Tail Events” more common than consensus**

<b>Crimean War, 1853</b>	<b>Formation People's Republic of China, 1949</b>	<b>Black Monday, 1987</b>
<b>American Civil War, 1861</b>		
<b>Global Flu Epidemic, 1890</b>	<b>Korean War, 1950</b>	<b>September 11, 2001</b>
<b>Spanish Civil War, 1936</b>	<b>World War II, 1939</b>	
	<b>Vietnam War, 1955</b>	<b>Lehman fall, 2008</b>

**1811**

**1211**

**1411**

**1611**

**1811 2011**

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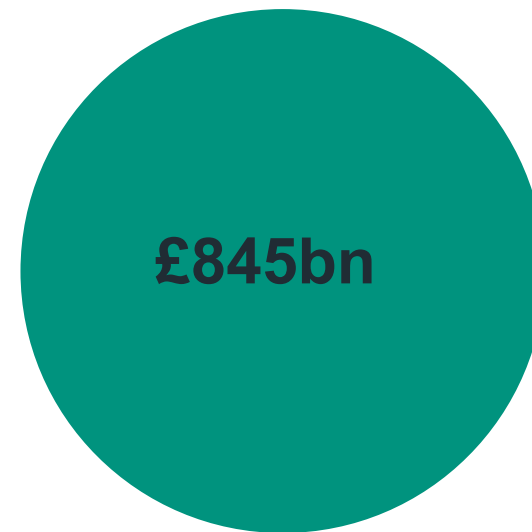
# The UK annuity and DB pension market

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**Top ten UK annuity funds**



**Total UK DB Market**



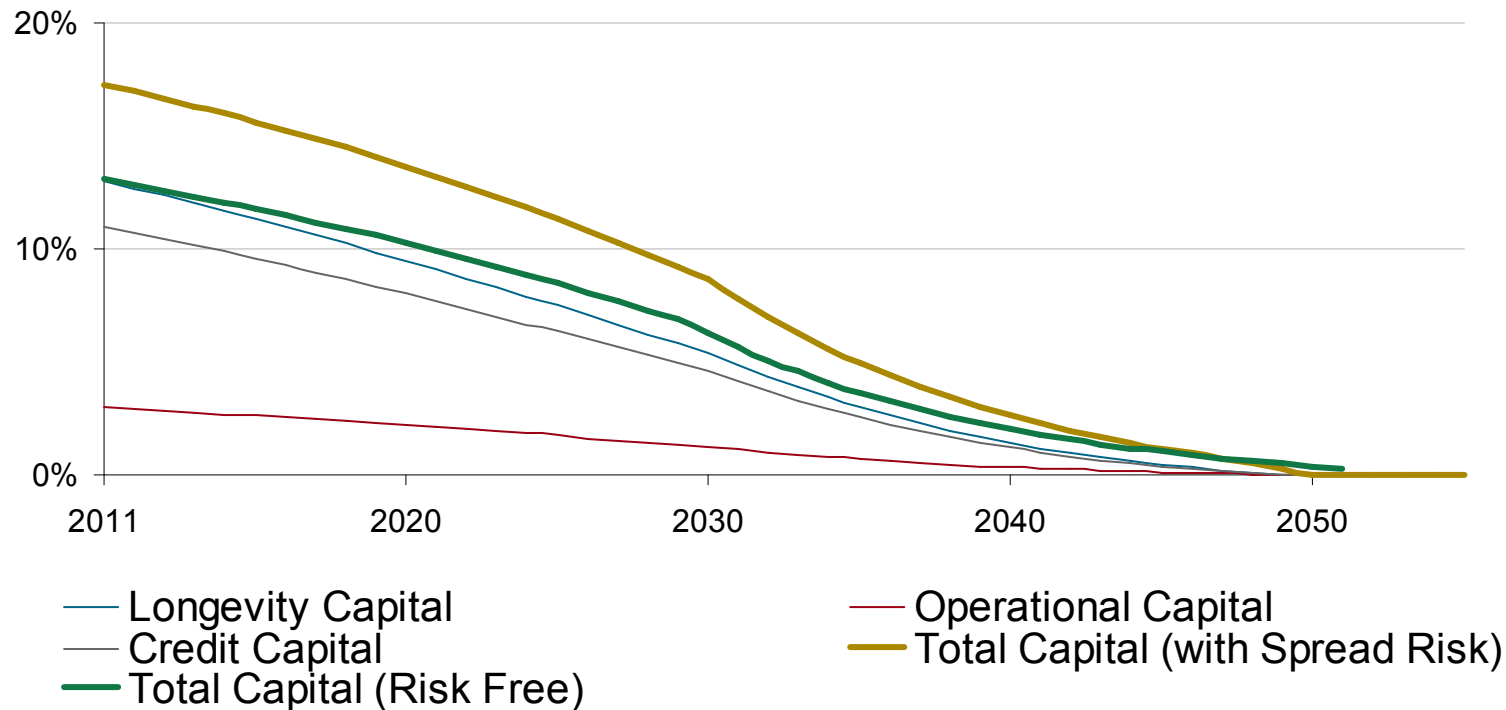
Standard 65 year old male/female fixed annuity rate<sup>2</sup>:  
Male: 6.1%, Female: 5.7%

Source: FSA Returns End 2010, From 48, 2: As at 15/1//2011

Source: Calibration of the Enhanced Capital Requirement for with-profit life insurers by Watson Wyatt as at June 2004

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# Extreme risk aversion in annuities – QIS 5 vs Gilt only strategies



Longevity 13%, Operational 3%, Credit 11%, Total Expenses 50bps  
6% Cost of Capital  
1% liquidity premium, additional 0.75% credit return post haircuts

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# Potential impacts of Gilt only investments

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All results vs a QIS 5 capital treatment

Annuity pricing worsens by c.10-15%

Impacts of government substitution

Liabilities affected	MTM impact on UK public debt (£bn:%)
1 year of annuities	£1.4bn:0.1%
All existing annuities	£17bn:1.8%
All DB pensions	£110bn:11.3%

Insurer shareholders lose c.60%

Corporate funding costs rise, c.£80bn Sterling corporate debt

Increased borrower reliance on short term financing

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**Risk had been tamed**

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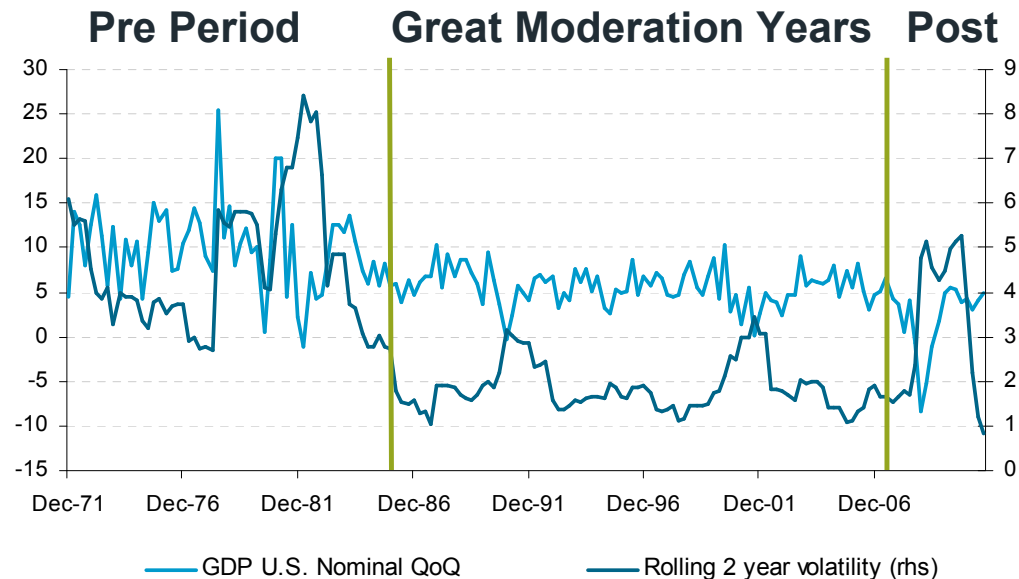
# **The Tale**

# The Great Moderation 1985 - 2007

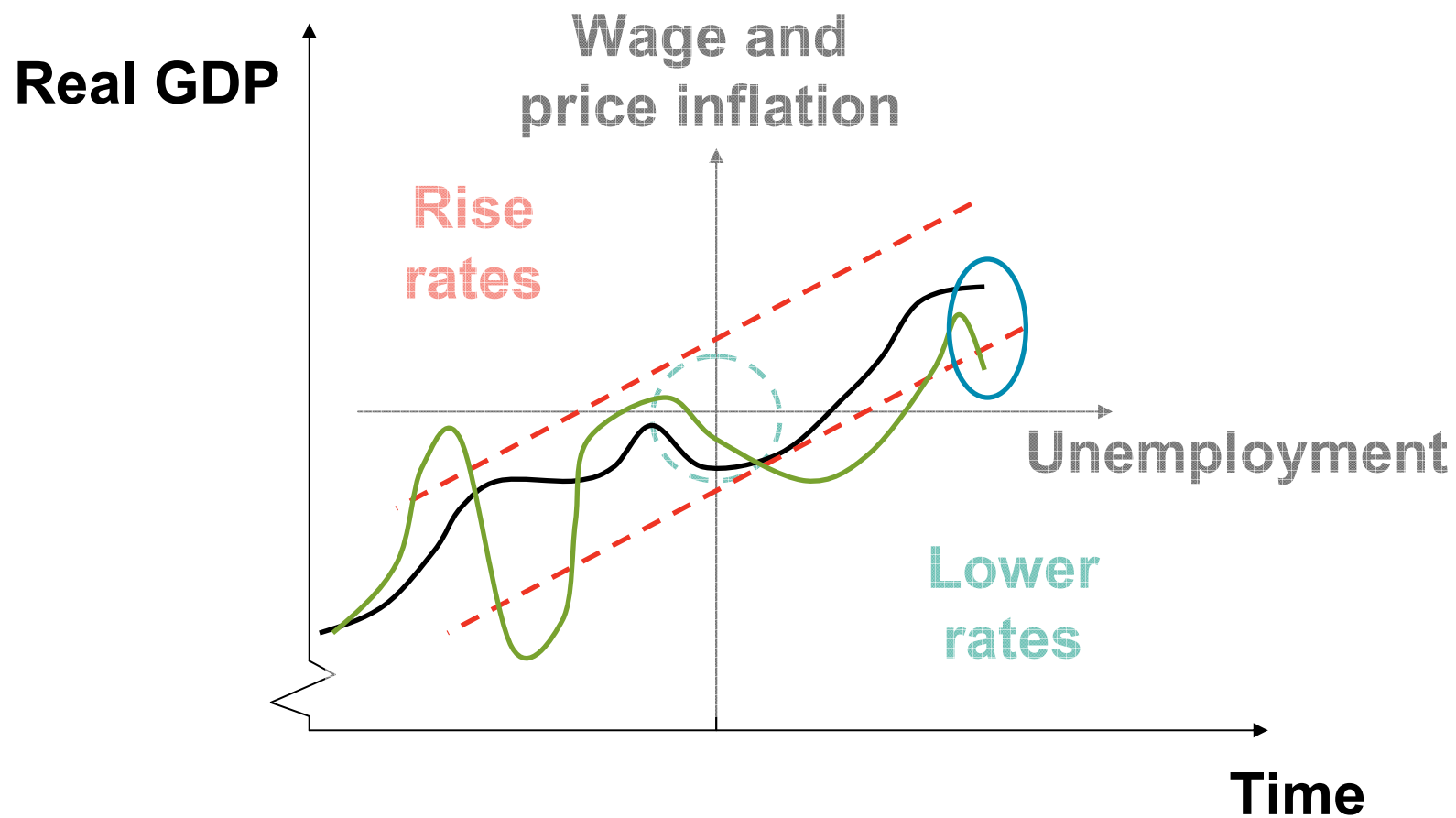
“potential gains from improved stabilization policies are on the order of hundredths of a percent of consumption”

*Robert Lucas,  
presidential address to  
the American Economic  
Association, January  
2003*

## U.S. GDP change and volatility



# The monetary policy tools



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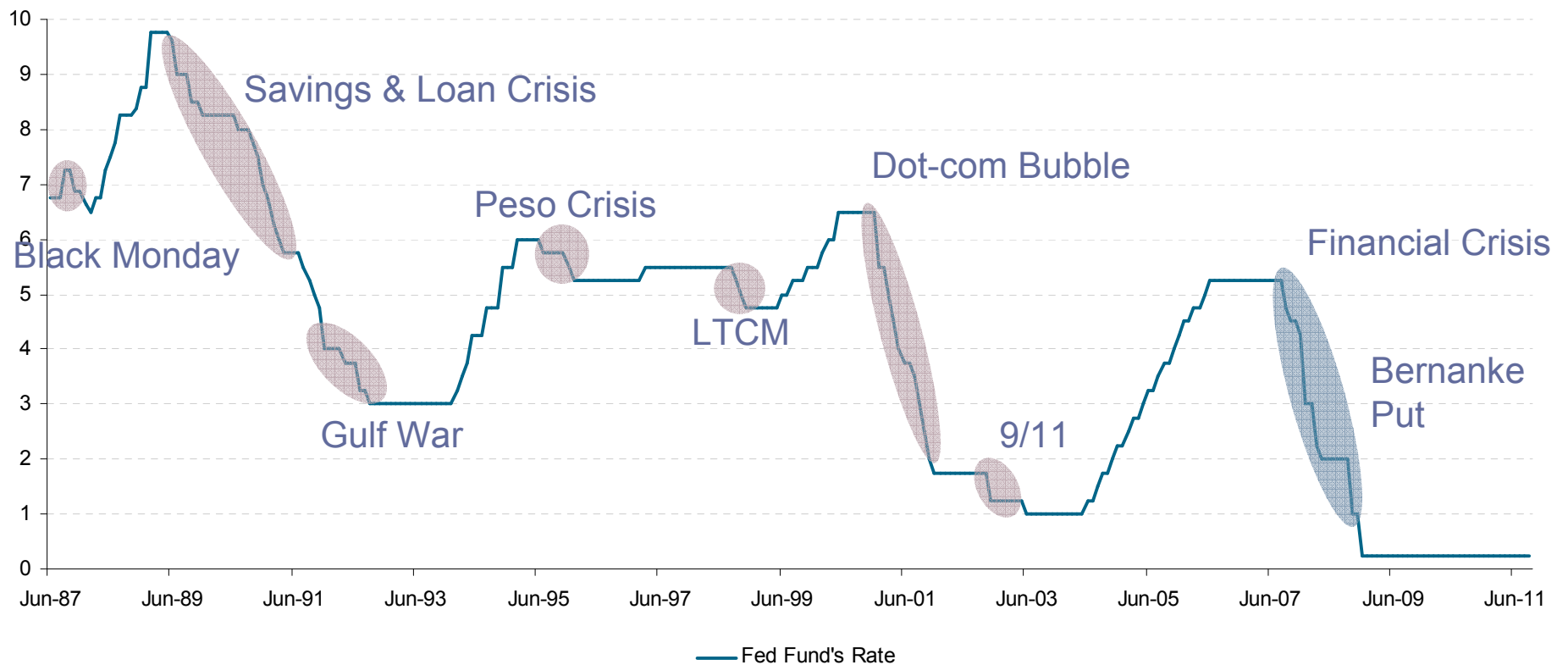
**Realised volatility was lower**

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**The Wire**

# Moderation in action – the Greenspan Put

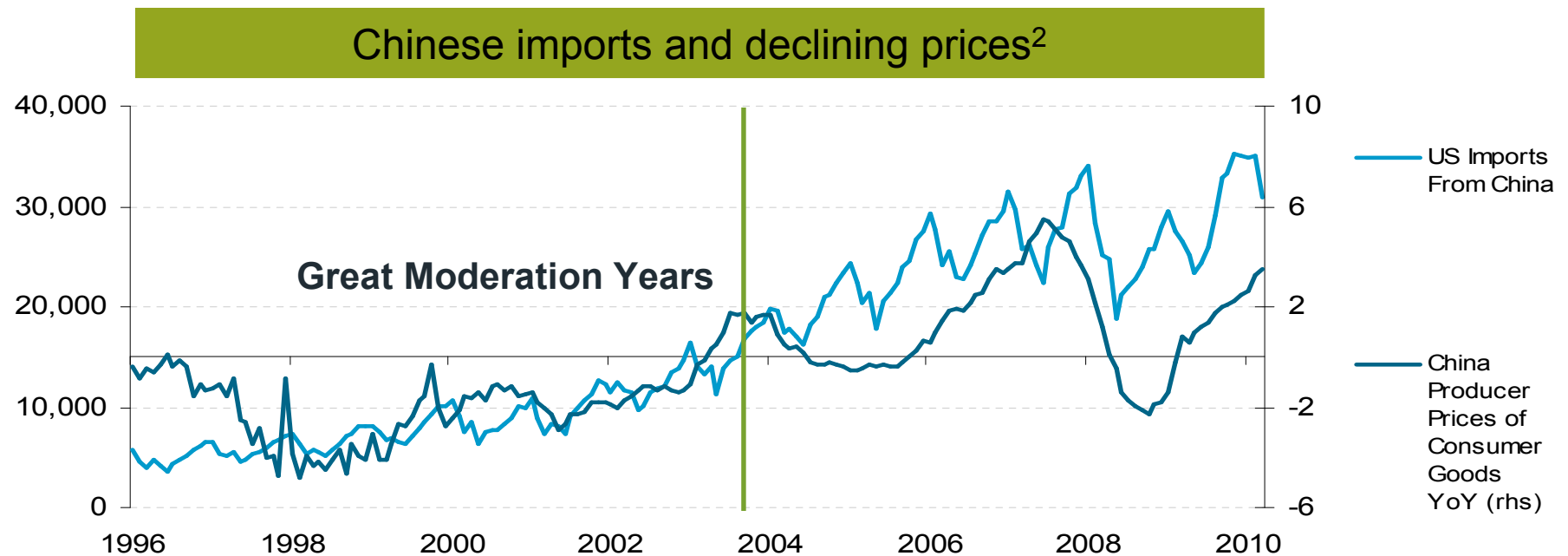
## The fed funds rate and identifiers of Greenspan put



Source: Bloomberg LP

# Imported deflation

- Improving Emerging market labour productivity
- Controlled exchange rates
- China lowered U.S. import inflation by c.80bp p.a between 1993 to 2004<sup>1</sup>



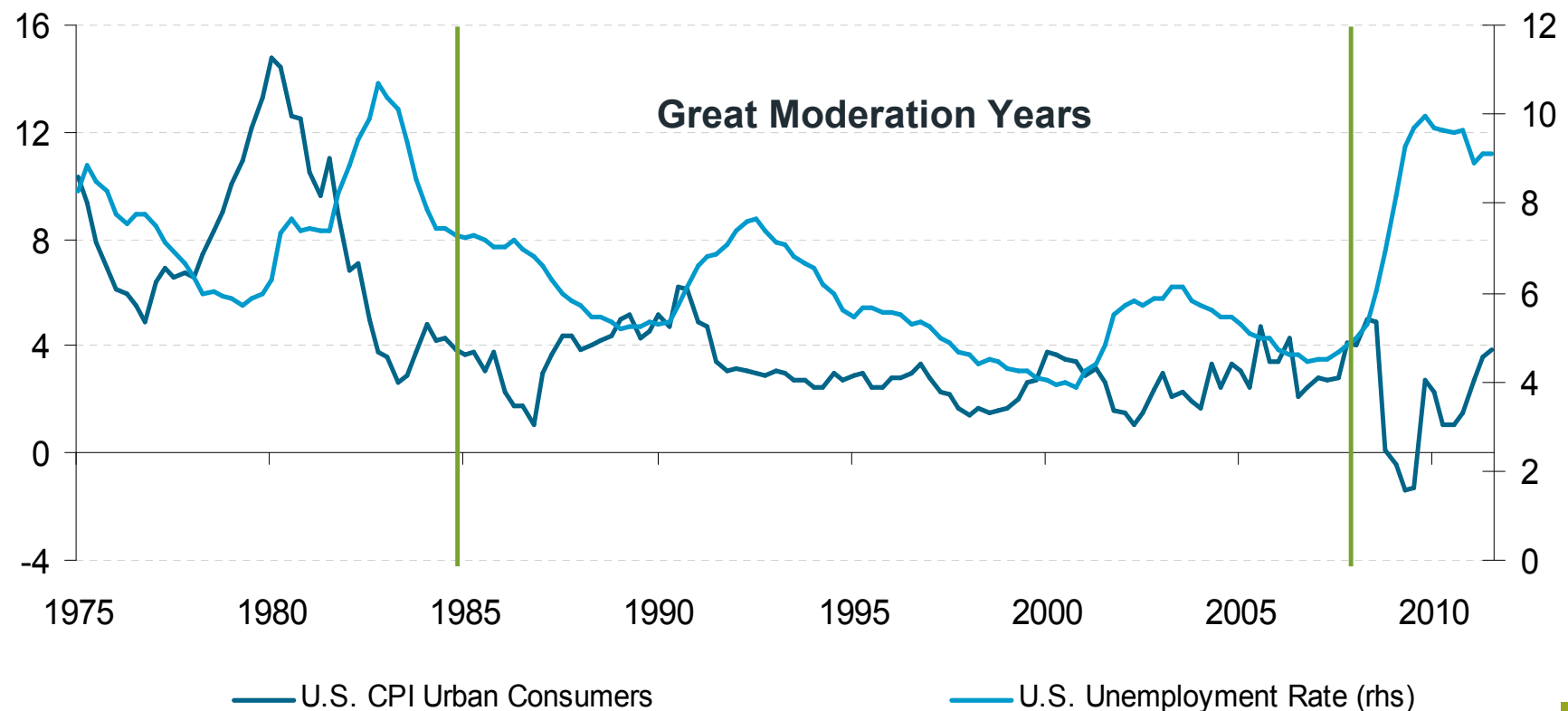
<sup>1</sup> Source: Board of governors of the federal reserve discussion paper, Is China "Exporting Deflation"?, 2004

<sup>2</sup> Source: Data source Bloomberg L.P. , National bureau of statistics of China

# Focus on full employment through cycles

- Supercharged economy

U.S. annualised QoQ inflation and unemployment<sup>3</sup>



<sup>3</sup> Source: Data source Bloomberg L.P.

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## Traders – set up

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- Bank bonuses encourage short-term outlook.
- Principal-agent problem: downside consequences not fully passed to traders.
- Example

**A** – good/usual year, probability 95%

**B** – very bad year (tail-risk), probability 5%

Payoff for Trader (remuneration) is 10% of profit made by Bank but with a lower limit of zero.

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## Traders – payoffs

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Payoffs for Bank and for Trader (arbitrary units):

Case	Probability	Bank's Profit		Trader's remuneration	
		Bets on A	Bets on B	Bets on A	Bets on B
A	95%	105	-80	10.5	0
B	5%	-1,515	2,000	0	200
<i>Expected payoff:</i>		24.0	24.0	10.0	10.0
<i>Volatility of payoff:</i>		353	453	2.3	44

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## Traders – behaviour

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**Bank best<sup>1</sup> strategy** : c.55% bet on A, 45% bet on B  
→ Bank has expected payoff of 24.0 and volatility of 9.8.

**Trader best<sup>1</sup> strategy**: c.95% bet on A and 5% bet on B  
→ Trader has expected payoff of 10.0 and volatility of 0.005.

If Trader bets 95% on A and 5% on B the Bank suffers volatility of profit of 313, rather than 9.8.

Severe multi-period repercussions if risk-seeking individuals rewarded/promoted

1. Lowest standard deviation combination of bets; in this example split doesn't impact expected payoff.

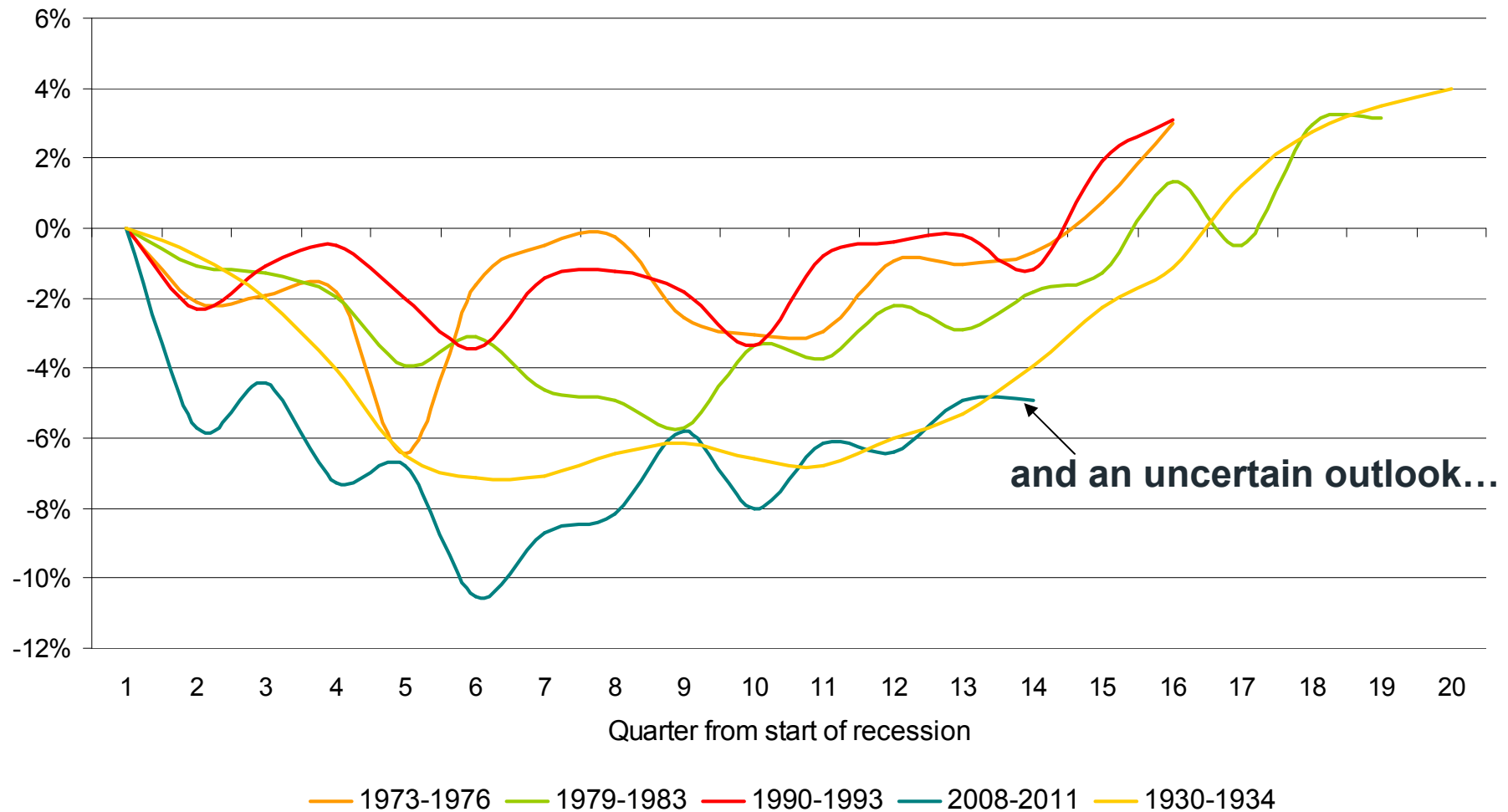
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## The problem of induction

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# The Shut-out

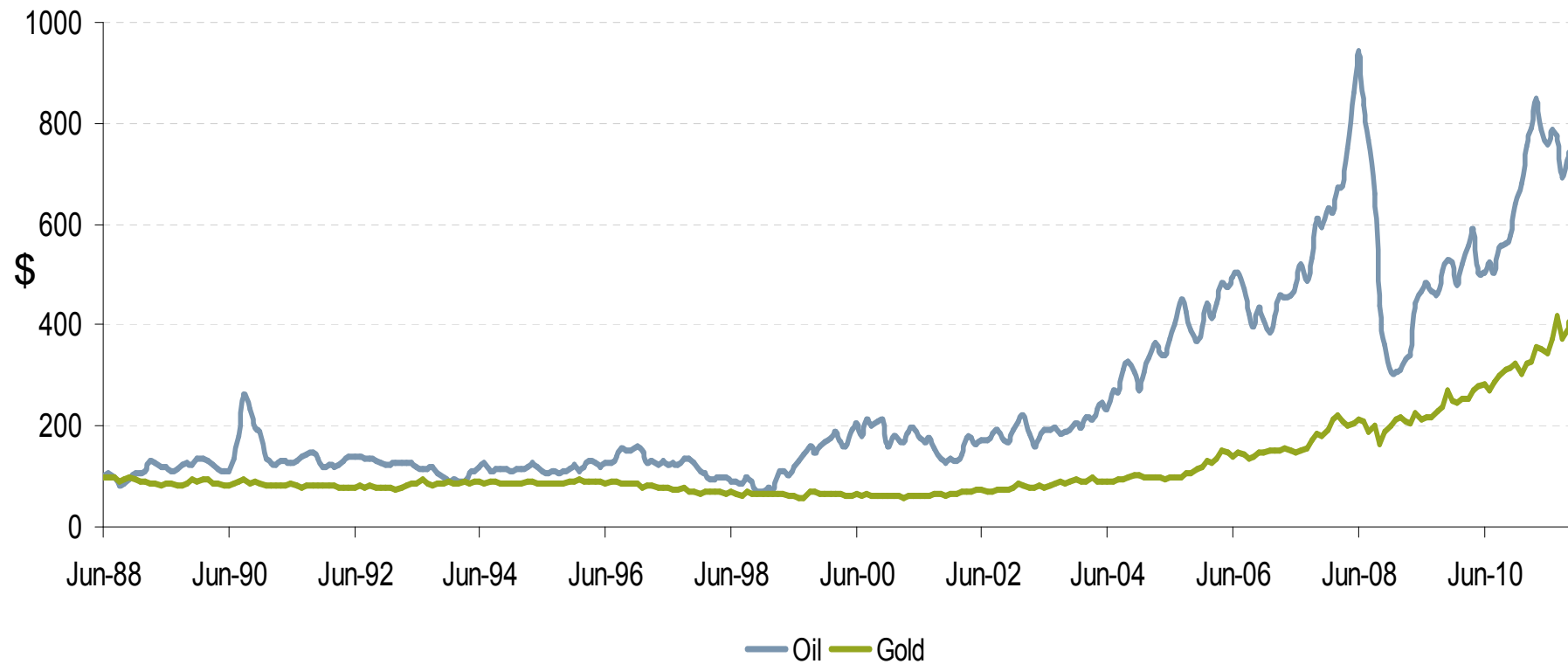
# How recessions compare – cumulative real GDP growth



Source: Reuters Ecowin

Source: Monthly and quarterly GDP estimates for interwar Britain by J Mitchell, S Solomou, and M.Wale as at November 2009

# Commodity prices booming



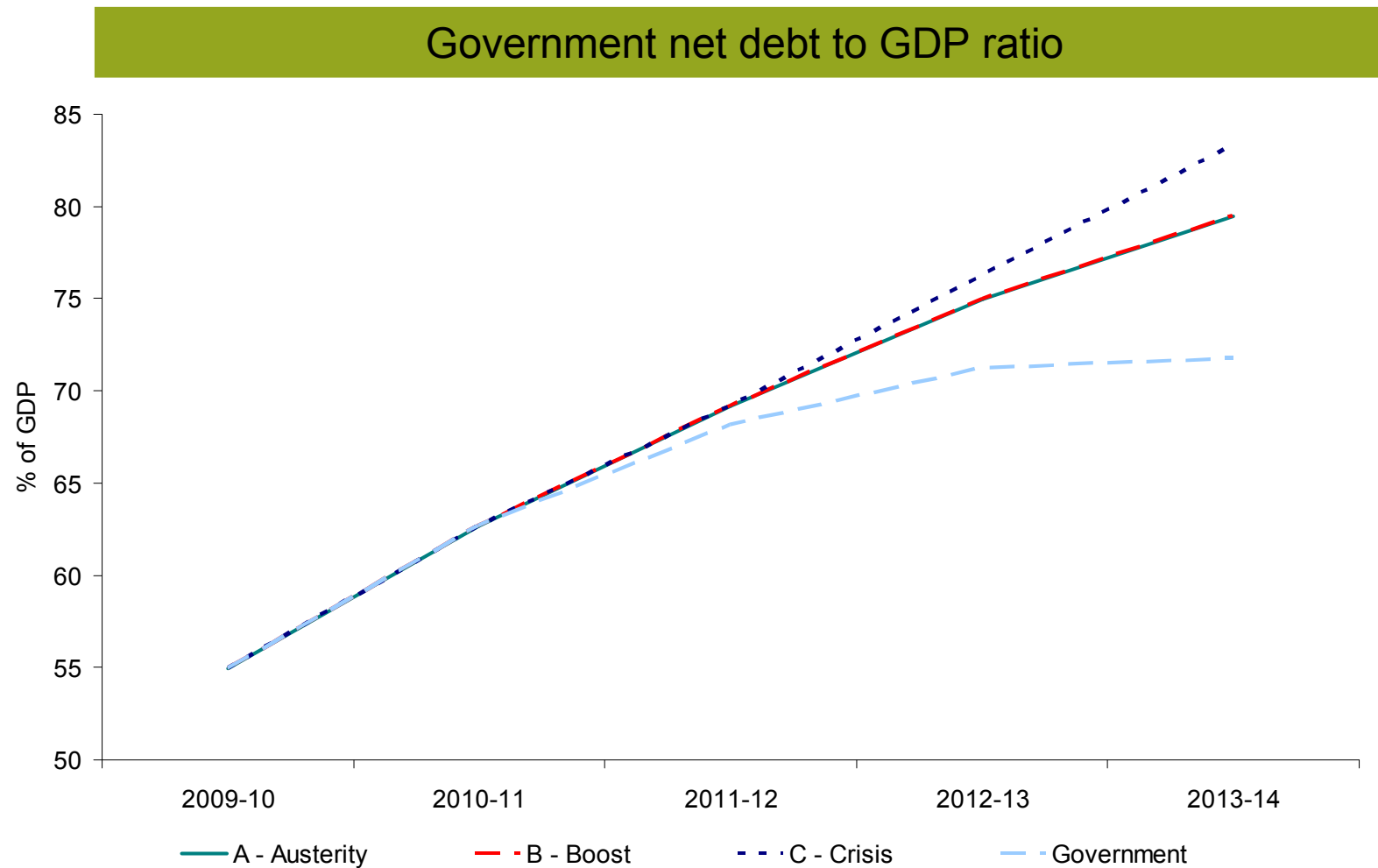
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## Avoiding the pitfalls

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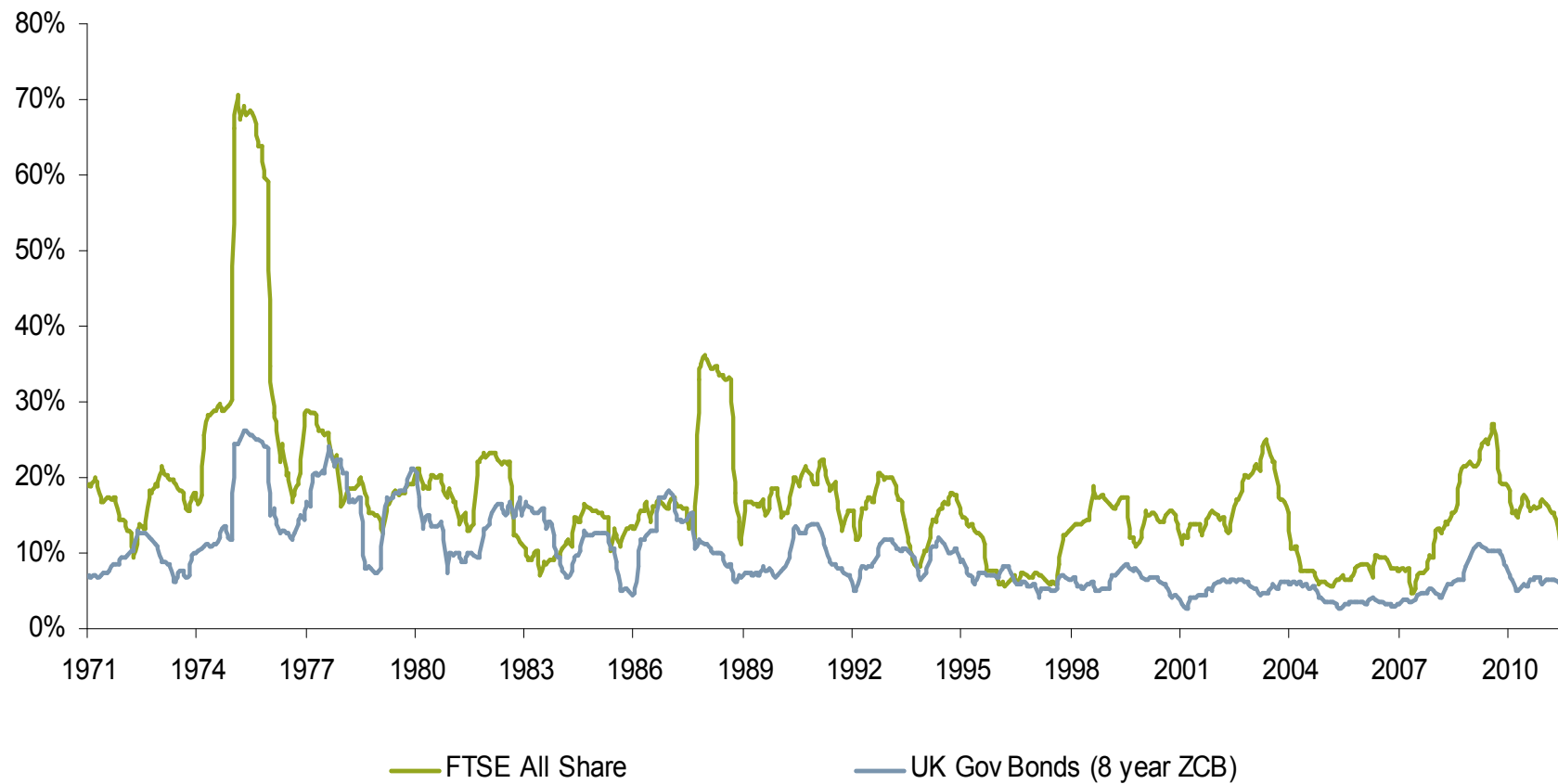
# The Sting

# UK debt outlook



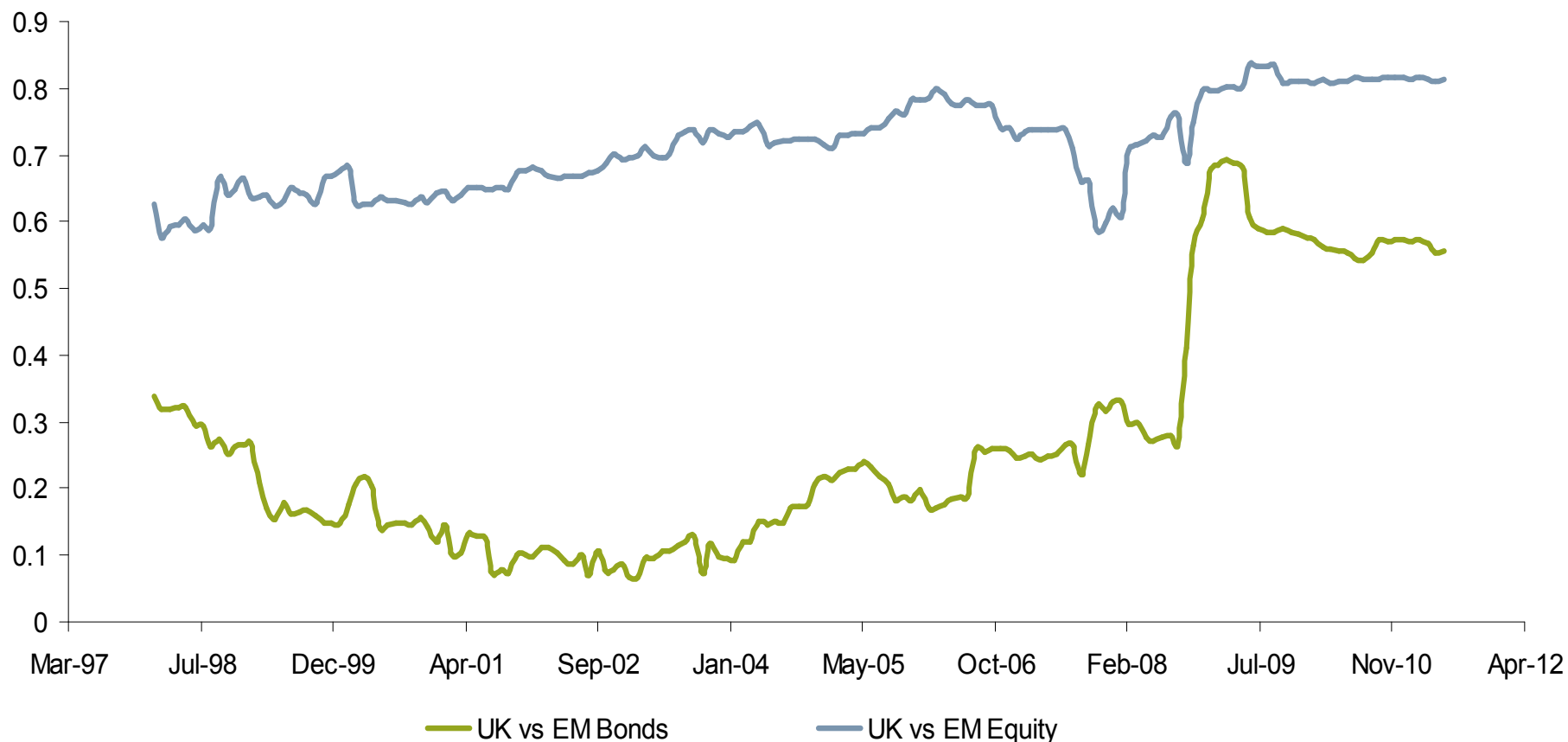
Source: LGIM Fundamentals Economic and Investment Commentary as at October 2011

# Volatilities of asset classes<sup>1</sup>



1. Source: Bloomberg. Volatility of FTSE All Share and UK Govt bonds based on rolling one year of monthly returns.

# Correlations of asset classes<sup>1</sup>



Developed/developing economies are now more connected.

1. Source: Bloomberg. UK Equity: FTSE All Share. Based on rolling 5 years of monthly data.  
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## SCR volatility – proxy methodology

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- All on standard formula from QIS 5
- Assets = 65% credit, 20% Gilts, 10% property, 5% equity
- Capital = 150% SCR at outset
- Interest rate matching liabilities
- Rebalance assets monthly
- Annual dividend if capital > 150% SCR

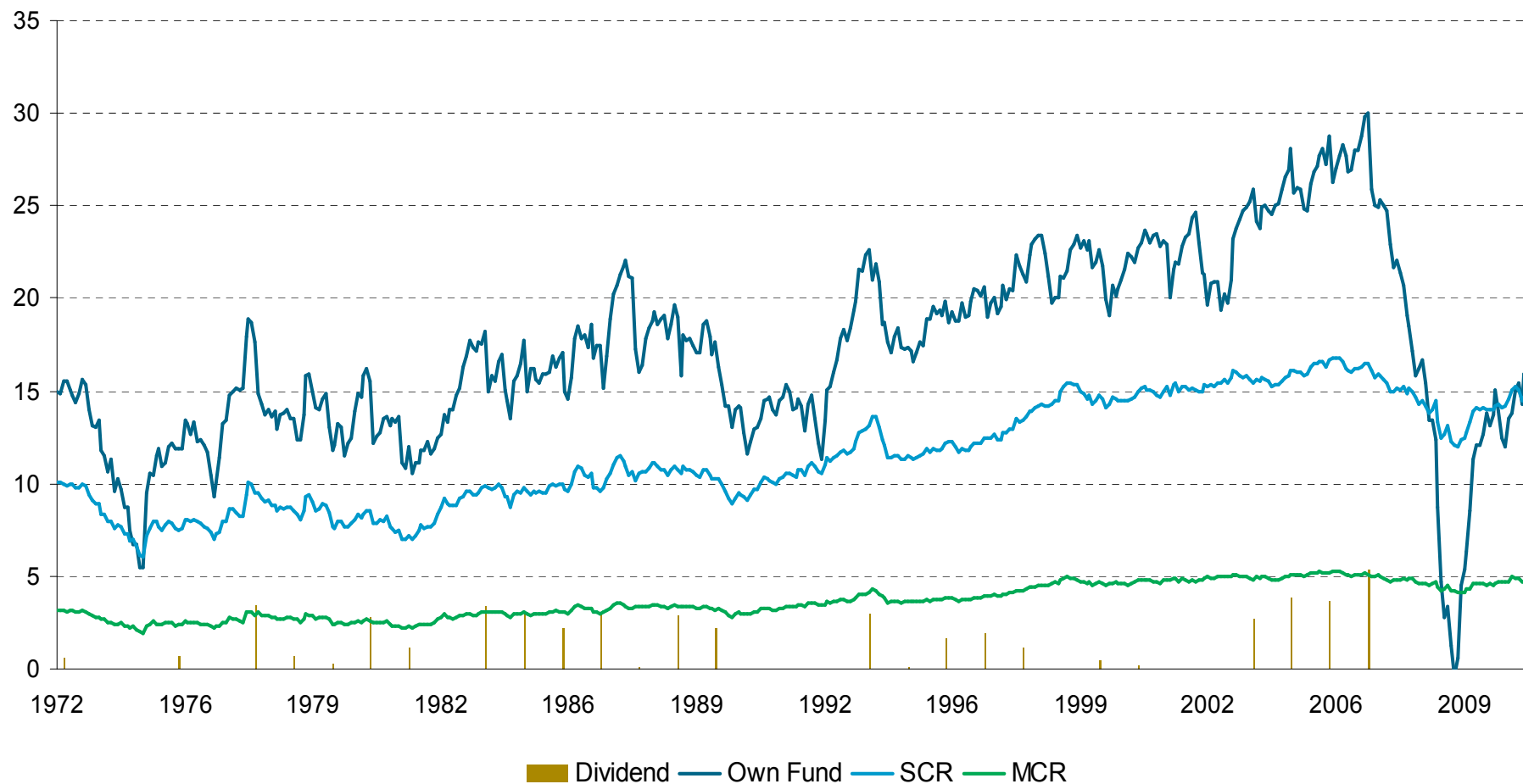
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## Solvency II is a moving feast

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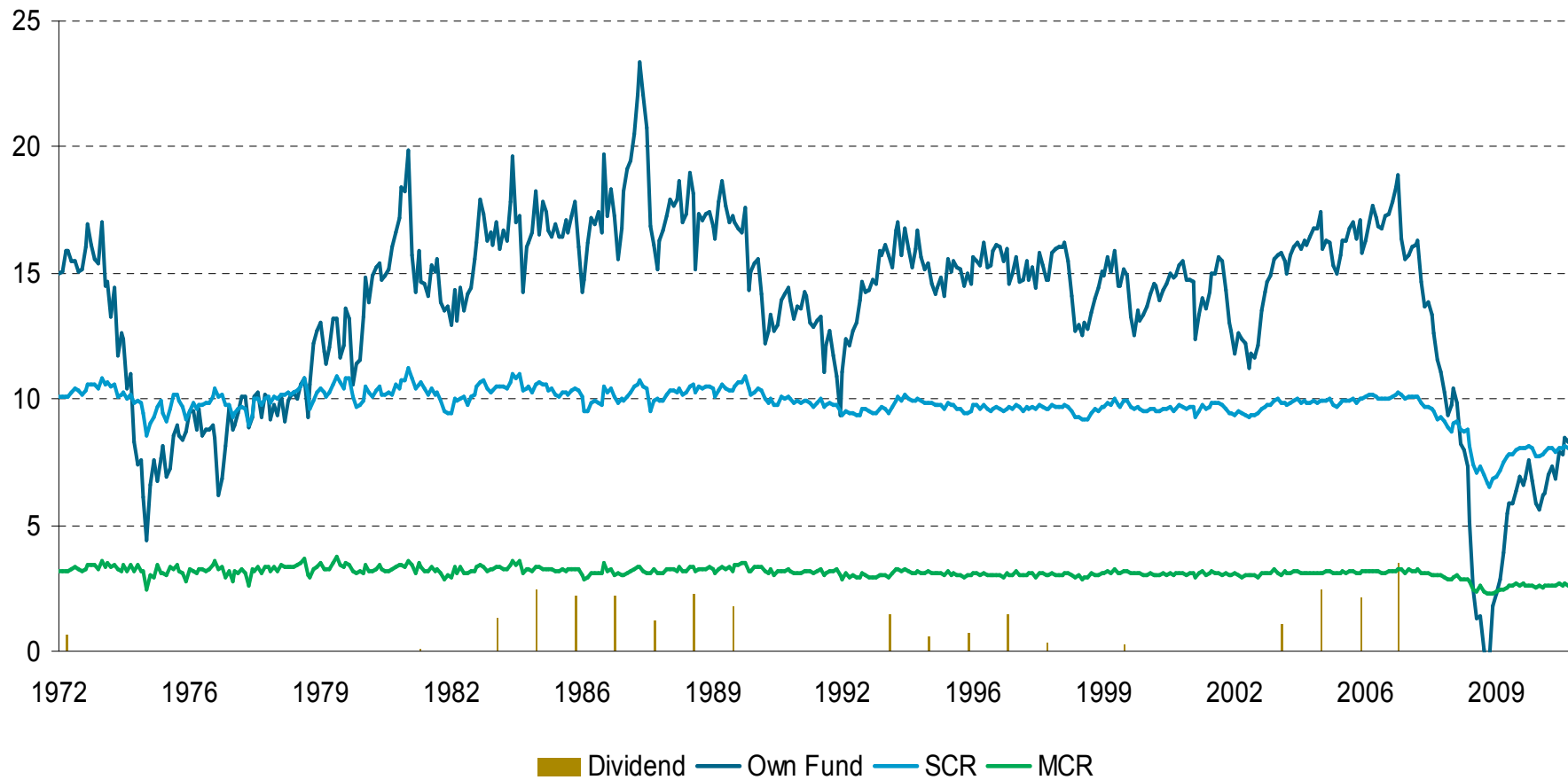
- Annuity results presented are based on QIS5
- They do not reflect lower and more stable capital requirements for annuities generated by the Matching Premium included in the latest Level 2 text
- These results do not therefore reflect the expected impact of Solvency II on UK annuity business

# Draft Solvency II (QIS 5) applied from 1972



- EIOPA is working to ensure more appropriate SCR volatility

## And with stable Gilt yields



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# How to analyse tail risks

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Think macro

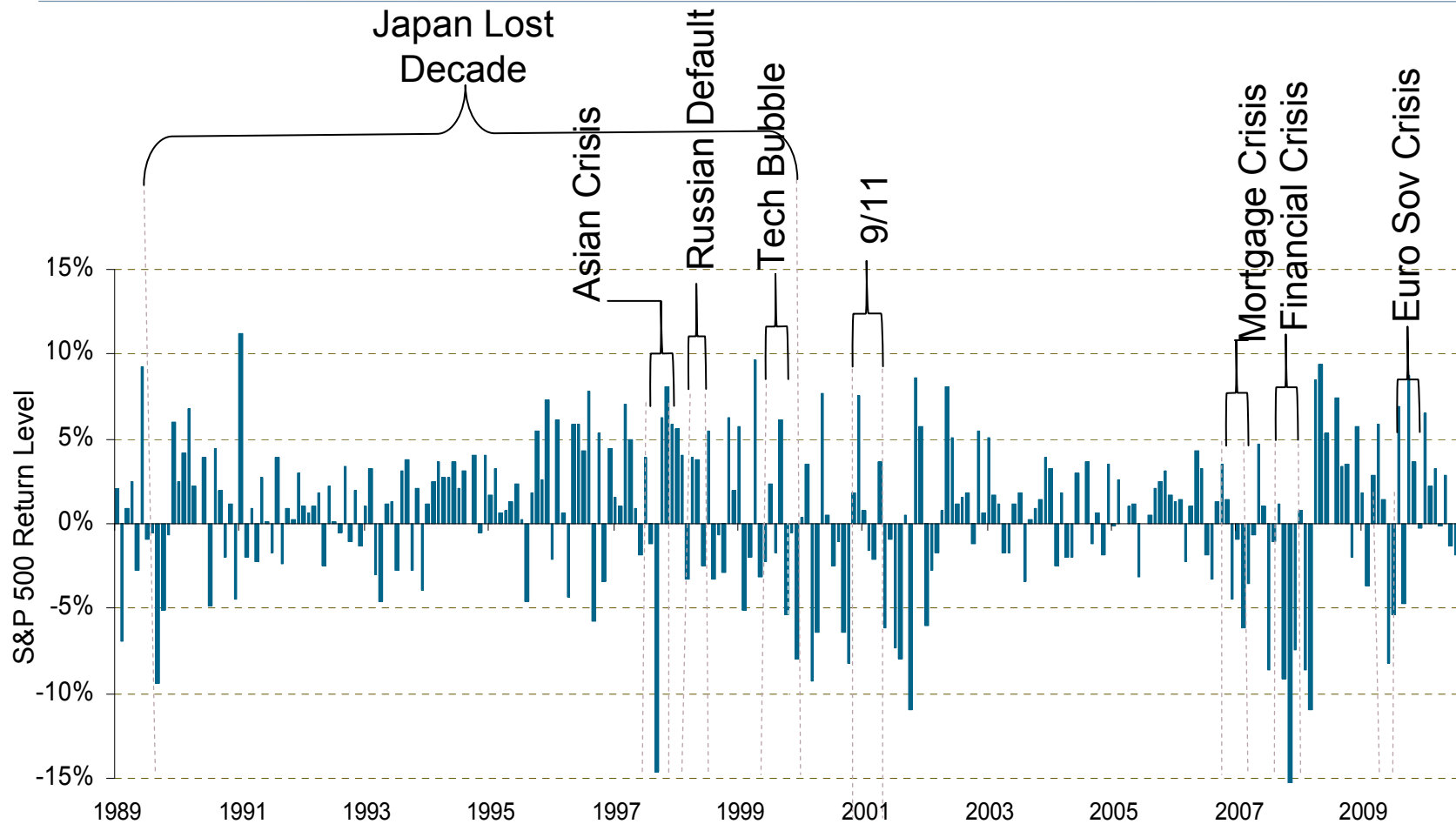
Minimal assumptions

Maximise debate

Mitigate behavioural finance issues

Multiple angles of attack are essential – we're building a safety net, so knit the threads from every direction

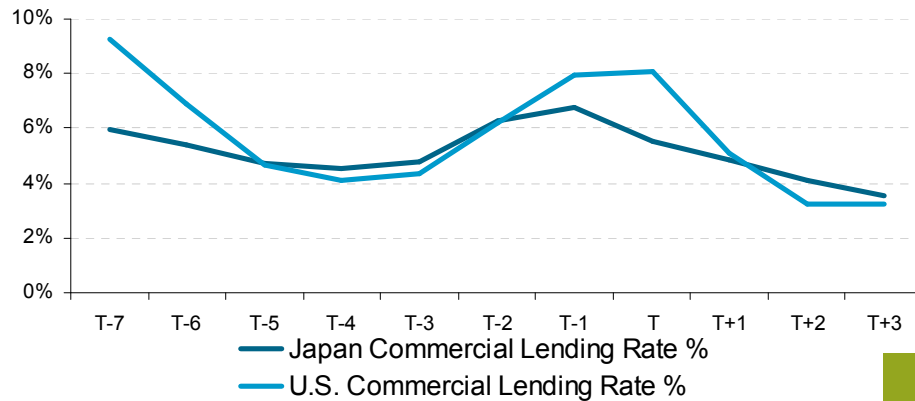
# Historical scenarios - recalibrated



Data source Bloomberg L.P.

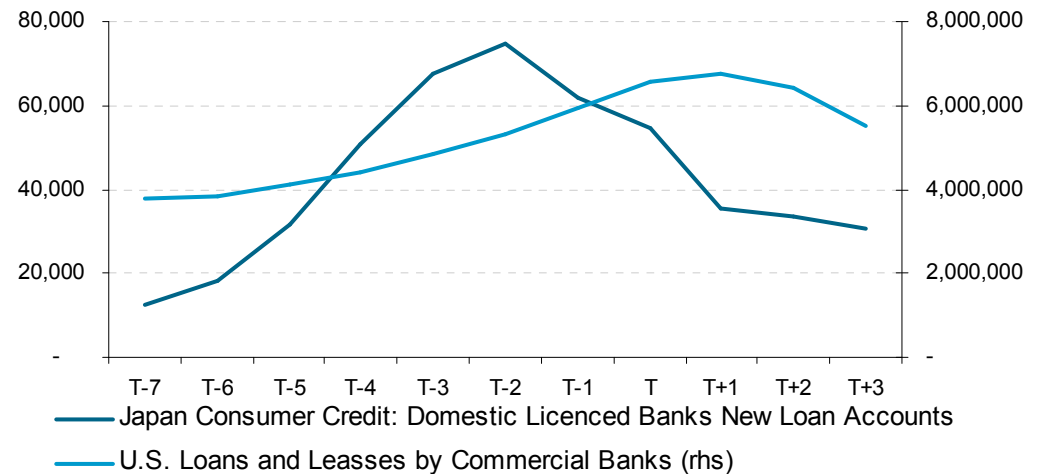
# Learning from the past – the Japanese example

## Japan and U.S. commercial lending rates<sup>1</sup>



**T = 1992 for Japan and 2007 for U.S.**

## Japan and U.S. YoY lending changes<sup>2</sup>

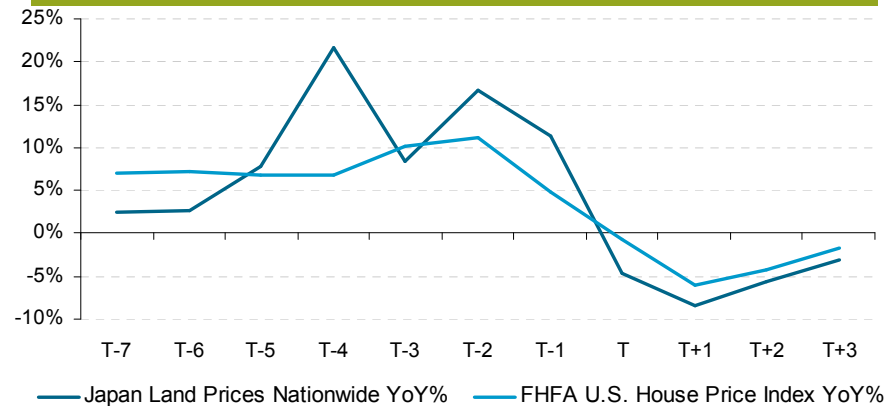


<sup>1</sup> Source: World Bank: World Development Indicators via Thomson Reuters DataStream

<sup>2</sup> Source: Data source Bloomberg L.P.

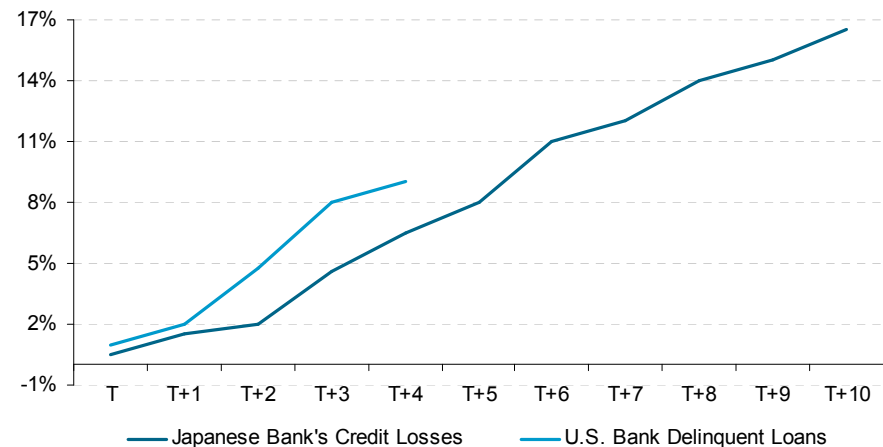
# Learning from the past – the Japanese example

Japan and U.S. YoY real estate price change<sup>1</sup>



**T = 1992 for Japan and 2007 for U.S.**

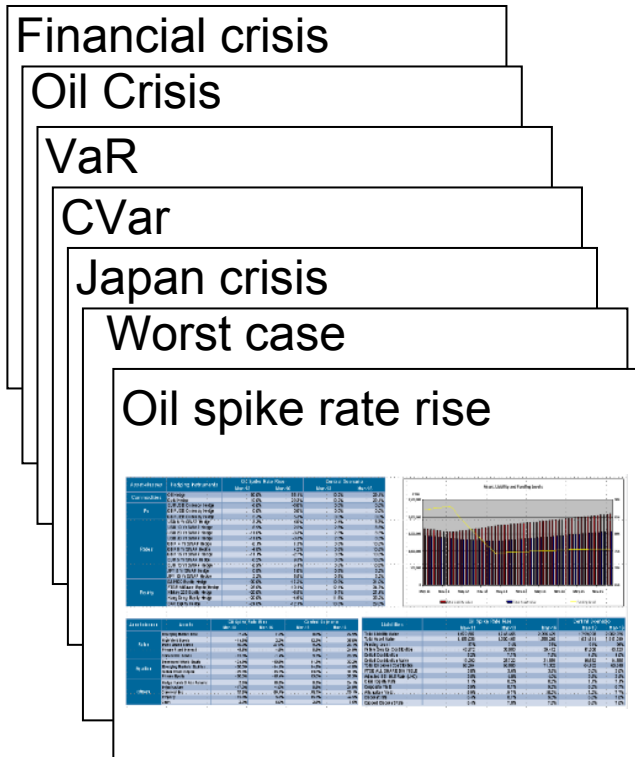
Japan and U.S. cumulative non-performing loans<sup>2</sup>



<sup>1</sup>Source: Bank of Japan via Thomson Reuters DataStream, Data source Bloomberg L.P.

<sup>2</sup>Source: FDIC (Federal Deposit Insurance Corporation), Japan Bankers Association via Nomura Bank Research

# Separate the white swans from ugly ducklings

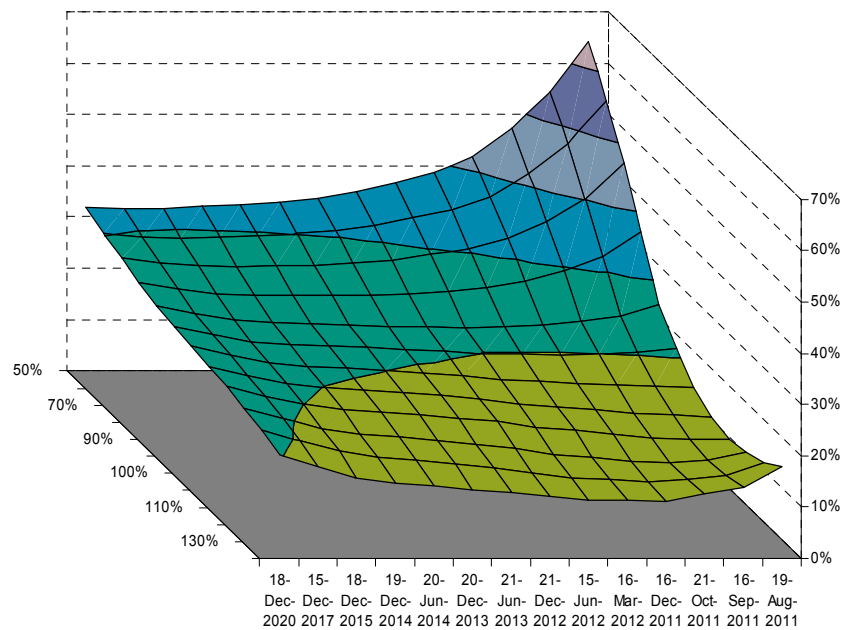


- Set risk threshold
- Macro perspective

Scorecard combining scenario impacts and hedge payouts				
	Scenarios			
	Scen 1	Scen 2	Scen 3	Scen 4
Severity weighting of scenario	20%	30%	35%	15%
Rates				
Equities				
FX				
Commodities				

# Hedge effectiveness differ over time

Equity volatility surface



FTSE 100 volatility over time



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# Summary

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Insurers have advanced risk management approaches  
However, 1-in-200 year capital is a mirage

We won't find all the tail risks, but

- we might identify the white swans and mitigating those...
- ...may also indirectly reduce exposure to the black ones

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# Questions or comments?

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Expressions of individual views by members of The Actuarial Profession and its staff are encouraged.

The views expressed in this presentation are those of the presenter.

