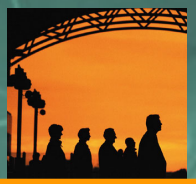
Realistic Balance Sheets – a beginners guide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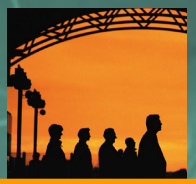
Birmingham, 9-11 November

Agenda

- The realistic balance sheet
- Draft rules & guidance
- Possible valuation approaches
- Management action & policyholder behaviour
- Reasonableness testing
- Practical pitfalls

The realistic balance sheet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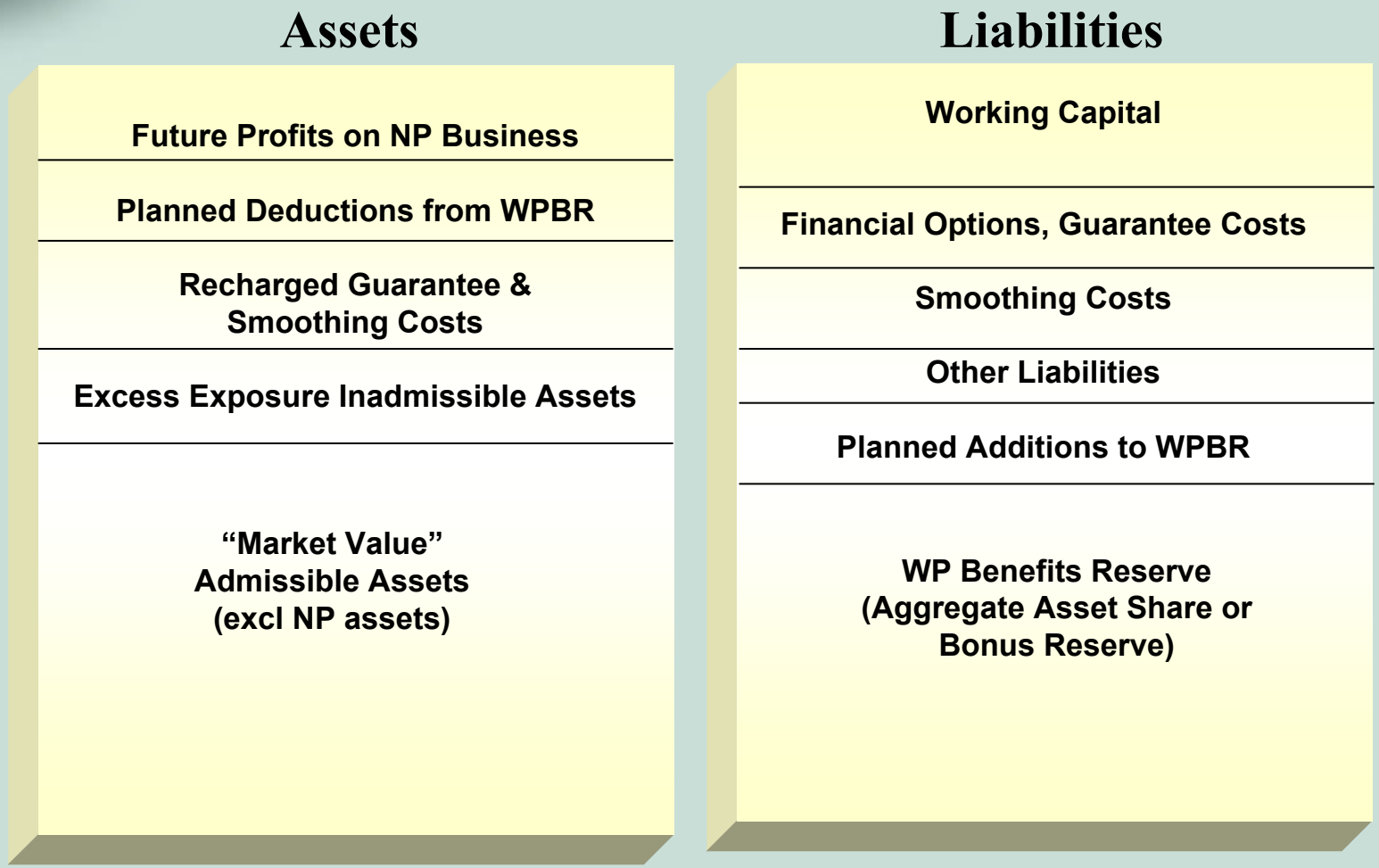
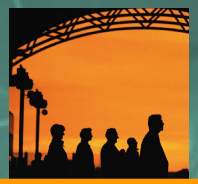
Realistic balance sheet



The realistic balance sheet

- Realistic projection with separation of future liability cashflows.
- Simple deterministic methods do not capture the optionality (time value).
- Complex approaches (probably) require interaction between assets and liabilities.
- Still not fully realistic
  - value of assets not always market value.
  - value of liabilities may contain margins.
- Stress test applied for regulatory capital purposes.

Draft rules & guidance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Realistic assets

PRU 7.4.29

	Regulatory value of assets (7.4.22)
+	Excess admissible assets (7.4.30)
+	Non-profit embedded value (7.4.31)

Realistic liabilities

PRU 7.4.32

	With-profits benefits reserve (7.4.98 – 7.4.114)
+	Future policy related liabilities (7.4.115 – 7.4.164)
+	Realistic current liabilities (7.4.165)

PRU 7.4.89-7.4.97

General rules and guidance on valuation approach

With-profits benefits reserve

PRU 7.4.98

Two possible approaches

- retrospective calculation of asset shares (7.4.100 – 7.4.103)
- prospective valuation of cashflows (7.4.108 – 7.4.110).

Different methods allowed for different types of business.

Future policy related liabilities

PRU 7.4.116

- Past misc profits/losses (7.4.117)
- Planned enhancements to WPBR (7.4.119)
- Planned deductions from WPBR (7.4.122, 7.4.124)
- Future guarantee costs (7.4.126 – 7.4.127)
- Future non-contractual commitment costs (7.4.131)
- Future option costs (7.4.133)
- Future smoothing costs (7.4.135 – 7.4.137)
- Financing costs (7.4.139)
- Anything else (7.4.142)

Valuation of guarantees

- Three possible approaches

  - stochastic approach using a market consistent asset model (7.4.145).
  - market costs of hedging.
  - series of deterministic projections with attributed probabilities.

Management and policyholder action

PRU 7.4.160

Valuation of guarantee costs *may* reflect expected management action.

Valuation of guarantee costs *must* reflect expected policyholder action.

Disclosure

- Annual public disclosure
  - Form 19 (also new Form 18).
  - Abstract of realistic valuation report (Appendix 9.4A).
  - Directors' certificate.
  - Independent external audit required.
- Half yearly private disclosure
  - Forms 9, 18 and 19.
  - Abstract of realistic valuation report (Appendix 9.4A).

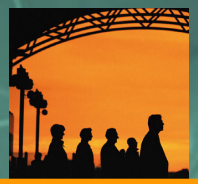
Abstract of realistic valuation report

- Assumptions
  - value of non-profit business.
  - prospective WPBR.
  - management action and policyholder behaviour.
- Details of guarantee valuation approach.
- Results
  - broken down by product group and WPBR approach.
  - separately for WPBR, FPRL and guarantee costs.
  - analysis of movement in working capital.
- Other
  - data groupings, expense analysis, payout ratios, etc.

CP195 issues

- New business?
- Tax
- Shareholders transfers
- Non-profit business
- Increased stability?
- What risk-adjusted yield?

Possible valuation approaches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Deterministic

- Present value of projected cash flows.
- Guarantee cost emerging in the single scenario
  - no allowance for optionality.
- Implicit allowance via prudent margins.
- Currently common (EV approach).
- Not market consistent.

Deterministic II

- Series of deterministic projections.
- Guarantee cost is expected value averaged across each scenario
  - based on attributed probabilities.
- Scenarios should be
  - appropriate
  - numerous
  - subject to overall reasonableness check.
- Not market consistent.

Closed form approximation

- Analytical approach to identify a replicating portfolio of options.
- Difficulties
  - regular premiums
  - multiple asset classes
  - dynamic nature of bonuses
  - dynamic asset allocation
  - recharging of costs to asset shares
  - dynamic policyholder behaviour.
- Market consistent.

Replicating portfolio

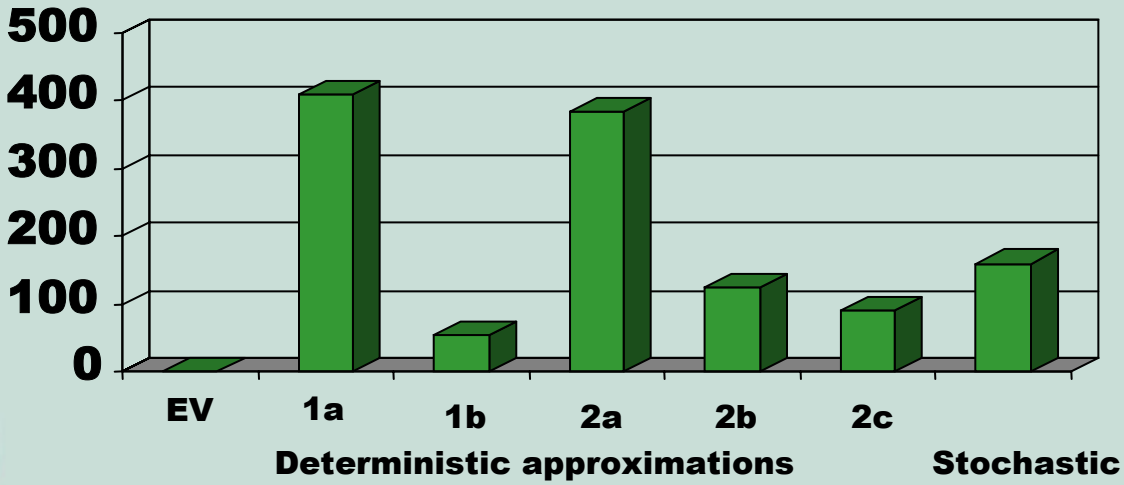
- Empirical derivation of a replicating portfolio of options.
- Based on a series of deterministic projections.
- Difficulties
  - path dependency
  - multiple asset classes.
- Market consistent.

Stochastic valuation

- Stochastic projection of guarantee / smoothing costs.
- Based on economic scenarios generated using a stochastic asset model
  - econometric (traditional, real world)
  - market consistent (risk neutral, deflator).
- (Weighted) mean result = (market consistent) cost.
- Difficulties
  - model development
  - run times.
- Market consistent if market consistent asset model used.

Comparison of results

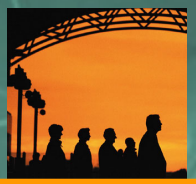
With Profits Bond - Guarantee cost



EV Traditional (not enhanced) EV
1a 'Best estimate' scenario–fixed future RB
1b. No future RB
2a. Range equity fall scenarios – fall at end
2b. Range equity fall scenarios – fall in middle
2c. Range equity fall scenarios – fall at start
Full stochastic using dynamic RB and EBR rules

- Fund 10,000 , 5 ytm
- AS/fund = 1.1
- RB rule
  - targets TB cushion 10%
  - subj. to max change 2%
  - last declared rate 5%
- Starting EBR 75%
  - dynamic rule
  - max switch 20%
- Policy level calculation
  - no recharging
  - no solvency considerations

Management action & policyholder behaviour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Why model management action and policyholder behaviour?

- Affects liability values, and hence regulatory capital.
- Take credit for management action to mitigate risks, eg
  - bonus policy
  - investment strategy
  - asset share methodology / recharging.
- Recognise possible anti-selective policyholder behaviour, eg
  - surrender rates
  - option take-up rates
  - new premiums.

Regular bonus

- Affects the build up of guarantees.
- Likely to depend on
  - economic conditions
  - previously declared rates
  - smoothing considerations
  - long term supportable rate
  - statutory affordability.
- Practical complications
  - multiple bonus series
  - nested (stochastic) projections.

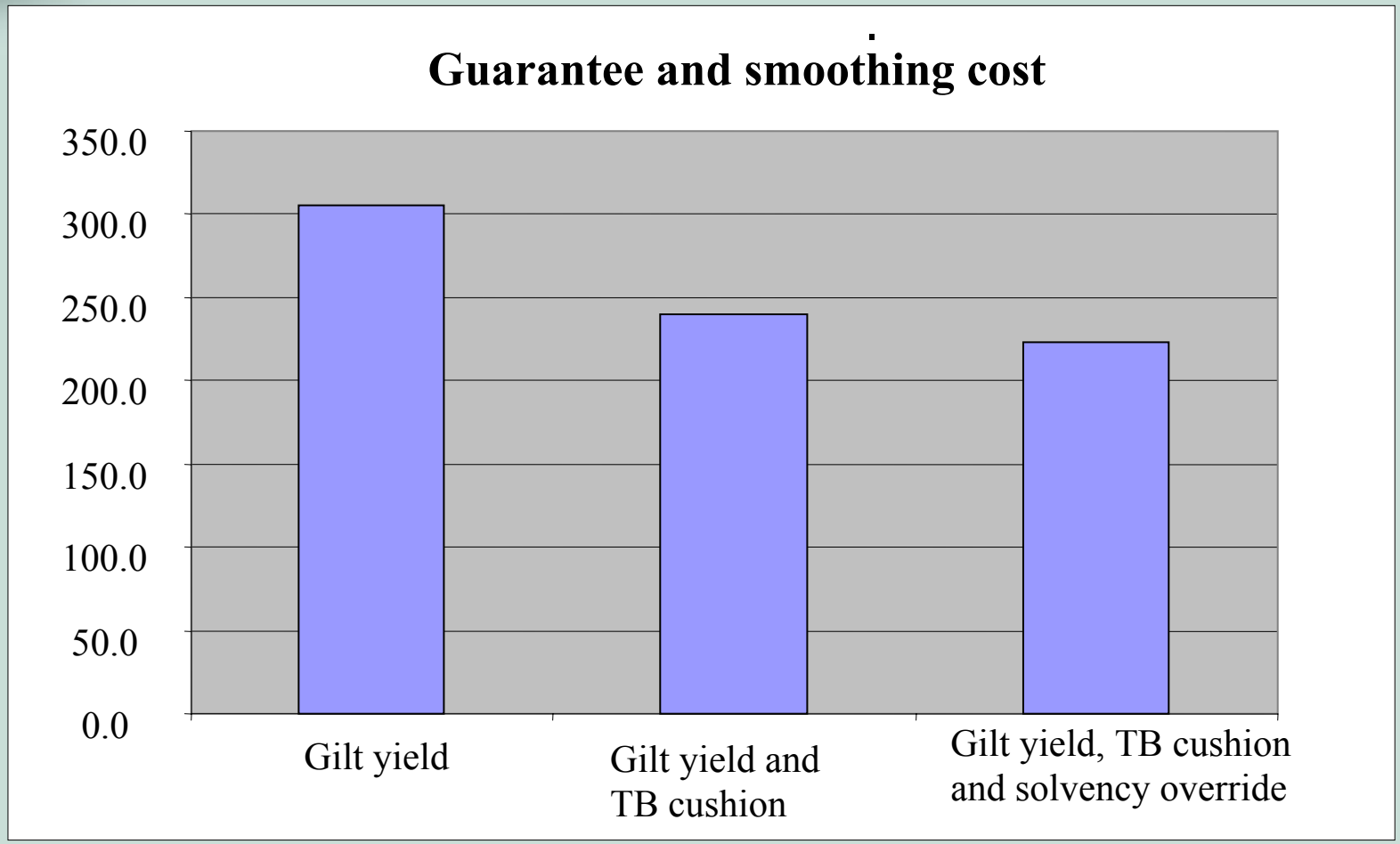
Regular bonus

Example decision rules

- 80% of long term bond rate, with maximum of 1% year-on-year change.
- target a TB cushion within a specified range, subject to a maximum of 80% of long term bond rate and a maximum of 1% year-on-year change.
- as above but with 0% bonus if fund is insolvent.

Many other possibilities exist.

Regular bonus



Terminal bonus (and MVR)

- Affects ultimate payouts.
- Likely to depend on
  - asset shares
  - smoothing policy / mechanism.
- Practical complications
  - smoothing
  - short term glidepath
  - approach when asset share is not useful, eg whole life business.

Investment strategy

- Affects degree of mismatch risk taken.
- Decision rules possible in a number of areas
  - asset allocation
  - duration matching of bonds
  - derivative strategies, eg capital protection.
- Likely to depend on
  - financial strength
  - investment guidelines / limits.
- Practical complications
  - demands on asset model
  - manager performance / bias.

Other management actions

- Surrender value bases
  - could incorporate “once every x years” review of bases
  - easier to always pay desired % of asset shares.
- Asset share methodology
  - vary guarantee recharging in response to solvency level and emerging costs
  - underlying methodology and smoothing policy might also be dependent on fund solvency level in long term.
- Contingent financing.
- Expense control.

Policyholder behaviour

- Affects emergence of guarantee costs.
- Likely to depend on
  - intrinsic value of options.
- Practical complications
  - policyholders' sophistication, involvement of advice in sales process
  - asymmetry of knowledge between firm and policyholder (and possible changes to disclosure requirements)
  - other external factors, e.g. lifestyle changes, economic cycle.

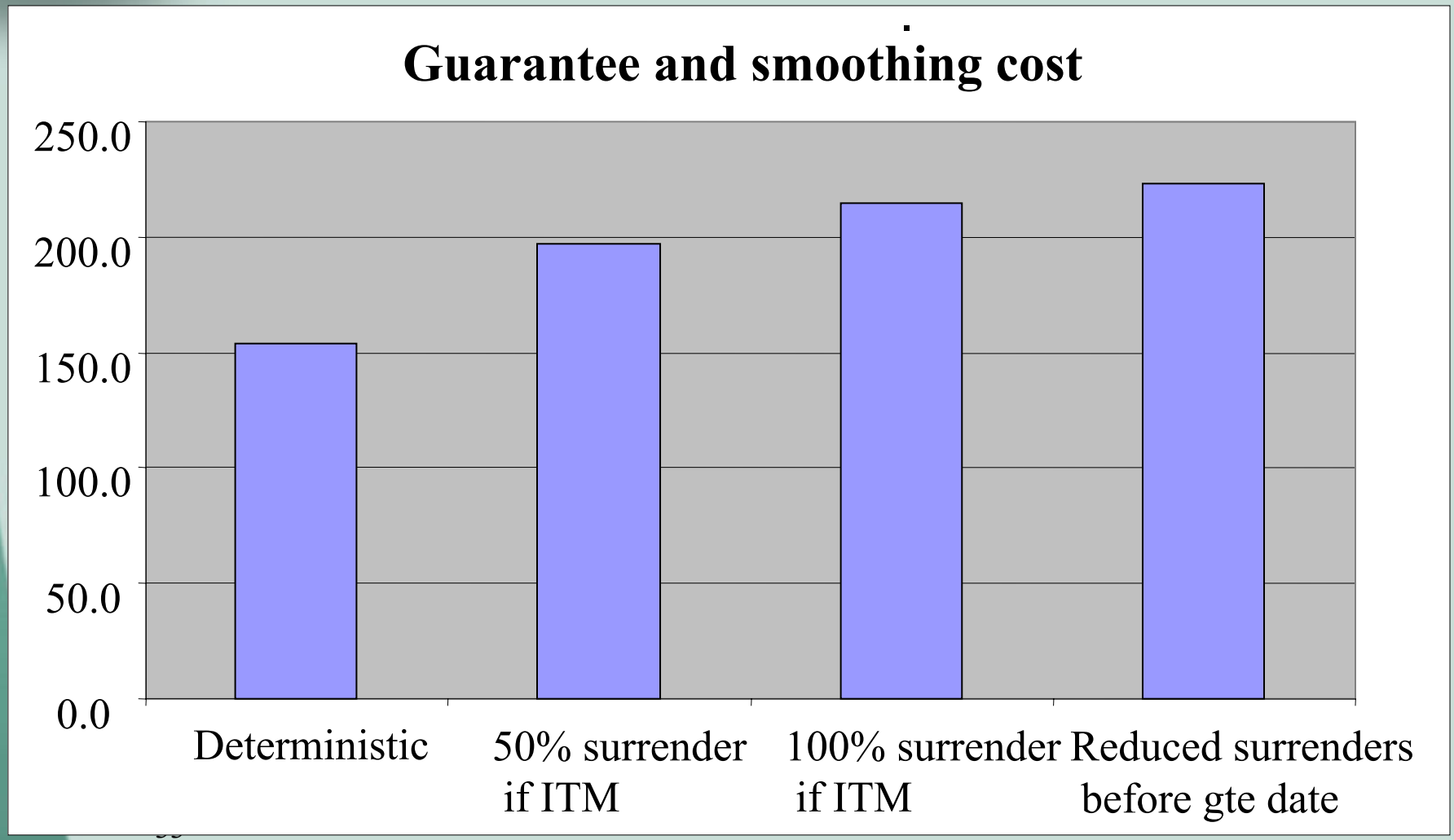
Policyholder behaviour

No-MVR guarantee on UWP bond example.

Example decision rules

- surrender rates set deterministically
- surrender rates set deterministically with additional surrender rate on guarantee date (sliding scale up to 50%)
- as above with sliding scale up to 100%
- as above with surrender rates reduced before the guarantee date if guarantee is in-the-money.

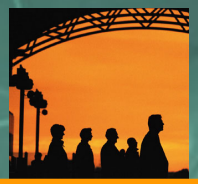
Policyholder behaviour



Other issues

- Maintenance of records, quantification of impacts.
- Consistency with PPFM.
- Robustness / documentation / resilience of management policy.
- Timing
  - asset switches
  - terminal bonus / MVR changes
  - asset share recharges.

Reasonableness checking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Model testing

- Asset model
  - empirical tests on scenario files
- Data grouping
  - comparisons with policy-by-policy results
- Liability code
  - reconciliation with existing liability model
- Decision rules / stochastic
  - detailed checks for individual scenarios
  - preservation of value test

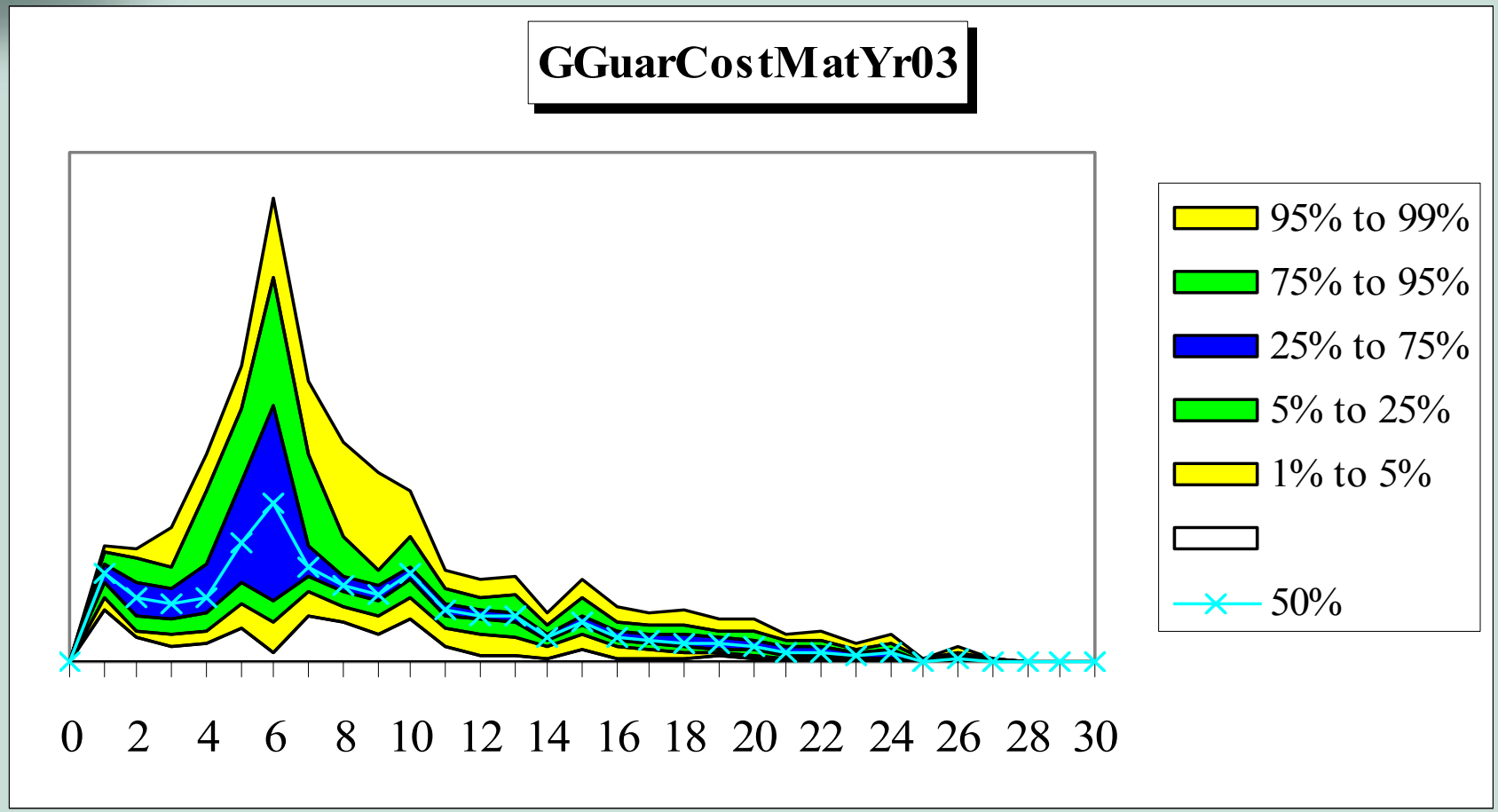
Output – aggregate analysis

Guarantee cost

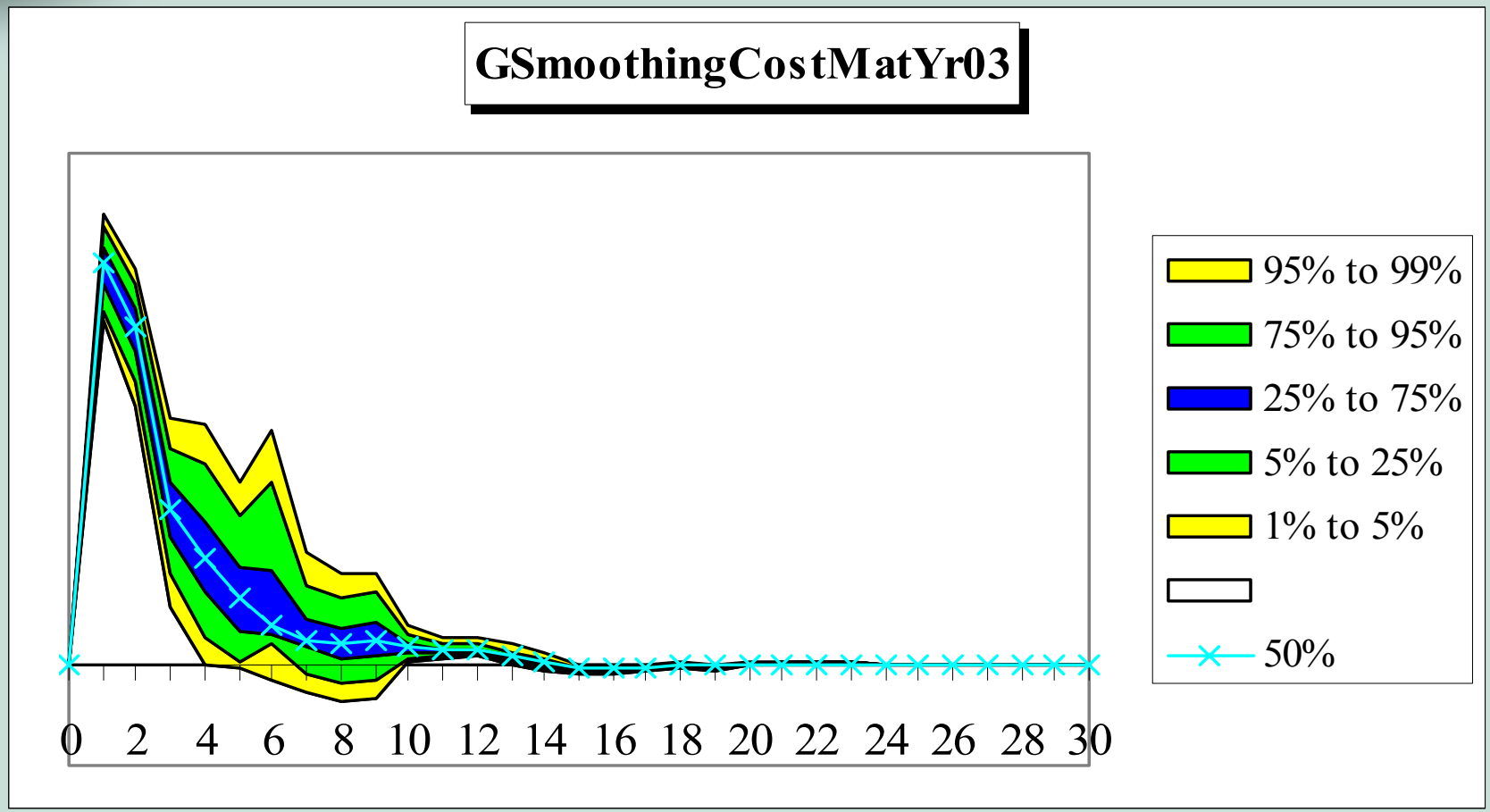
	Deferred Annuity	UWP Pensions	UWP Bond	TOTAL
On surrender	x	x	x	x
On maturity	x	x	x	x
On death	x	x	x	x
Asset share recharge	(x)	(x)	(x)	(x)
Capital support	(x)	(x)	(x)	(x)
TOTAL	x	x	x	x

Quantification of guarantee costs and their funding

Output – product analysis



Output – product analysis

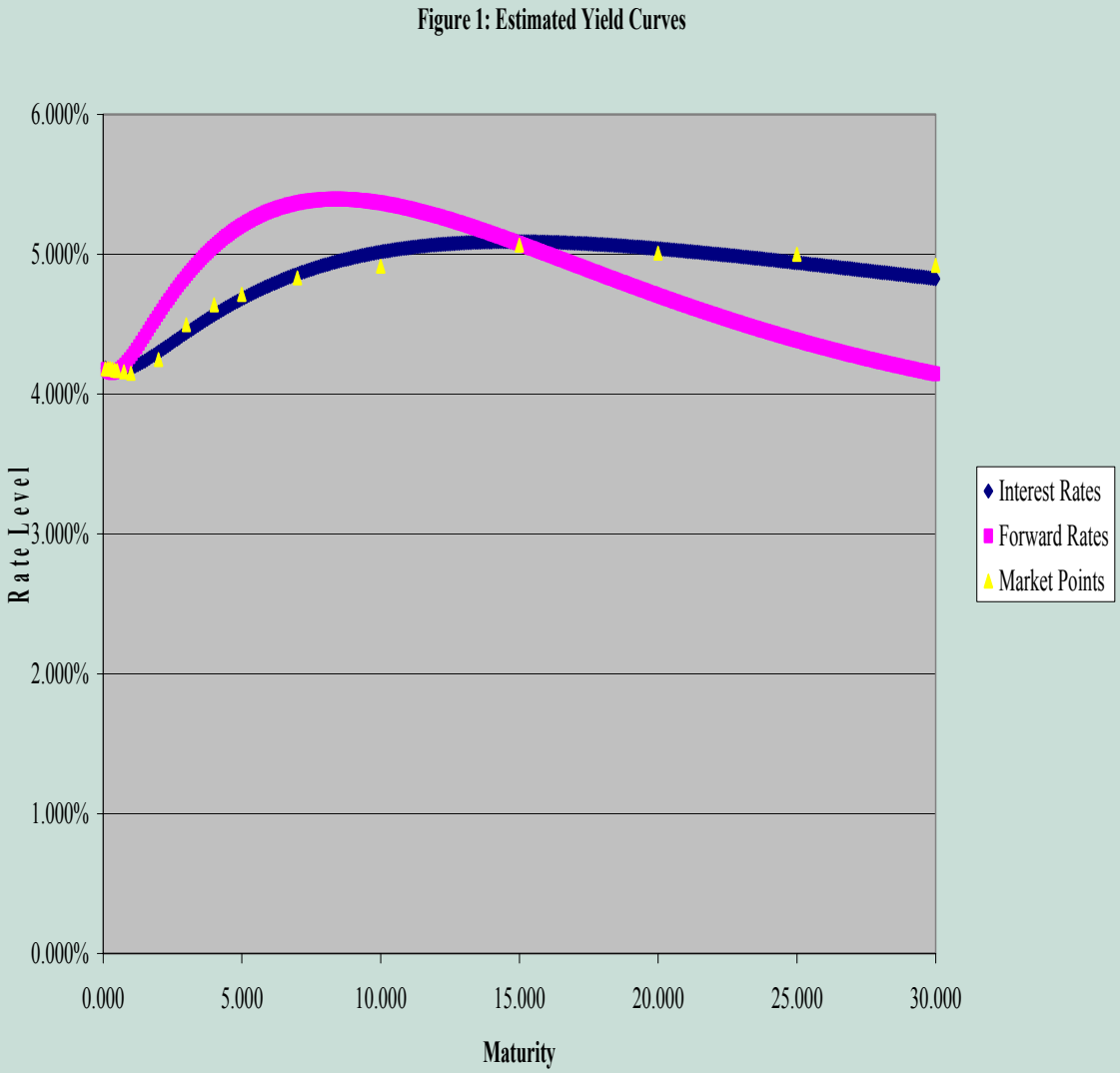


Asset models – empirical tests

- Verify that calibrated assets
  - are relevant to the product you are pricing
  - have prices replicated from the output
- Distinguish
  - calibration error (complexity or richness of model)
  - simulation error (efficiency of model)
- Check statistical features
- Perform sensitivity analysis
  - e.g. non-market parameters

Asset models – curve calibration

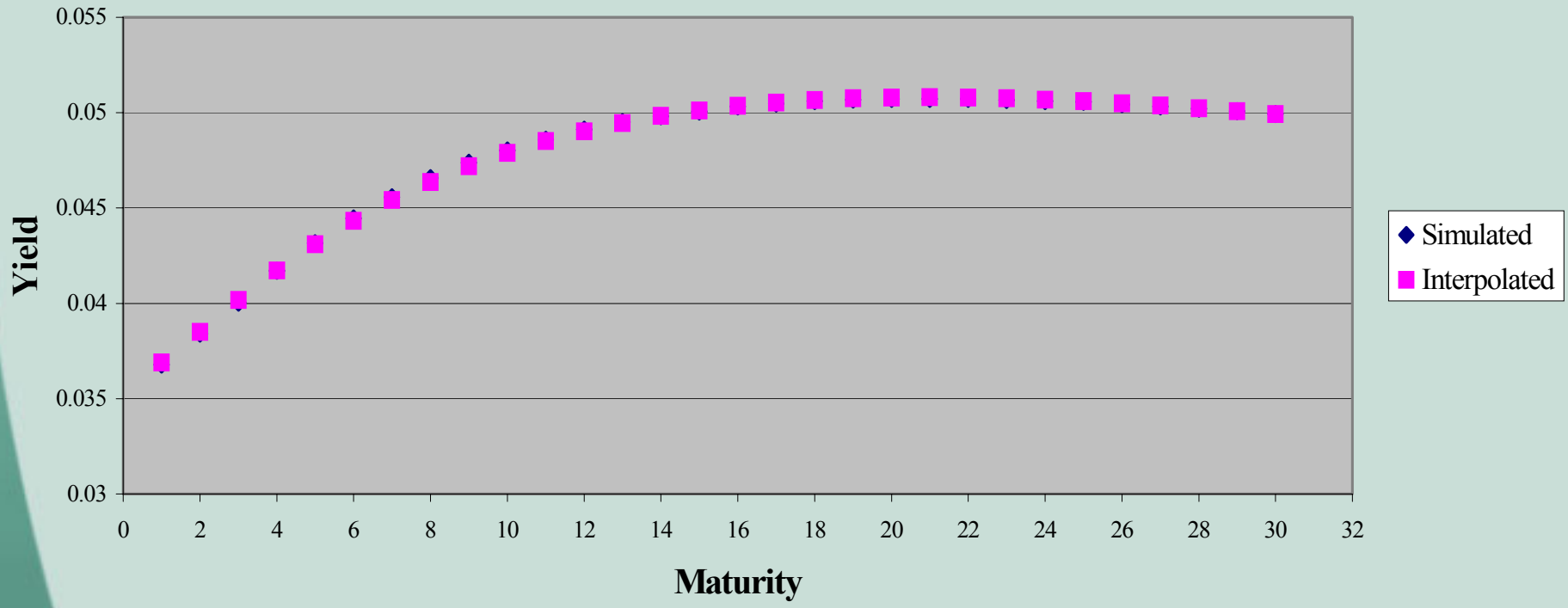
- Benchmark choice for risk free rate
- Fitting error
  - Interpolation
  - Extrapolation



Zero coupon bonds

- Simulation error

Figure 2: Zero Coupon Bond Test - Simulated Vs Interpolated (Market)



Primary asset prices

- Discounting total return indices should replicate starting price
- Both for deflator and risk neutral models

Deflated Total Returns (start price = 1)		
Equity	0.99724	1
Bond	1.00015	1

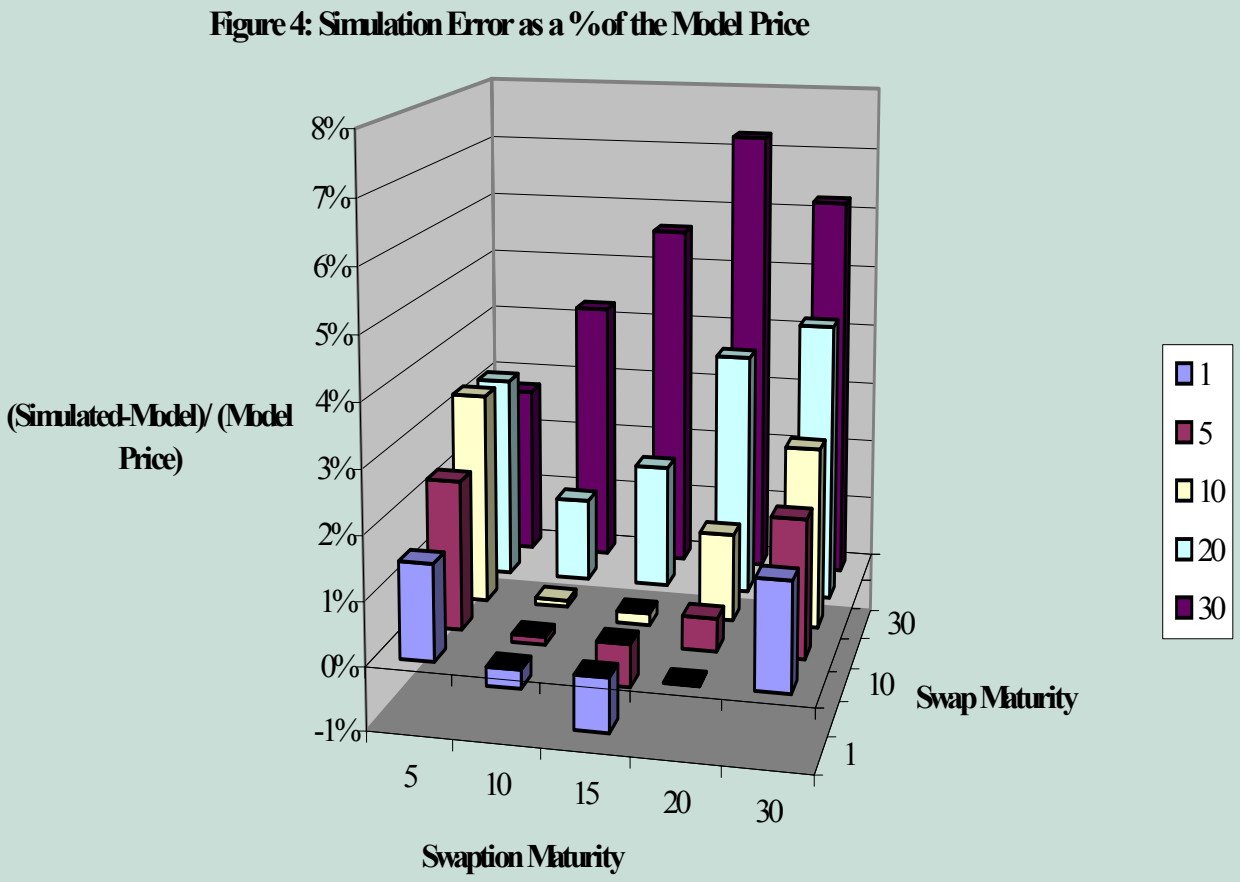
Derivative instruments

- Fitting error
  - volatility structure (‘smile’)
  - test out of sample goodness of fit

Figure 3: Fitting Error of the 20 year (GBP) Swaption as a % of the Market Price

Derivative instruments

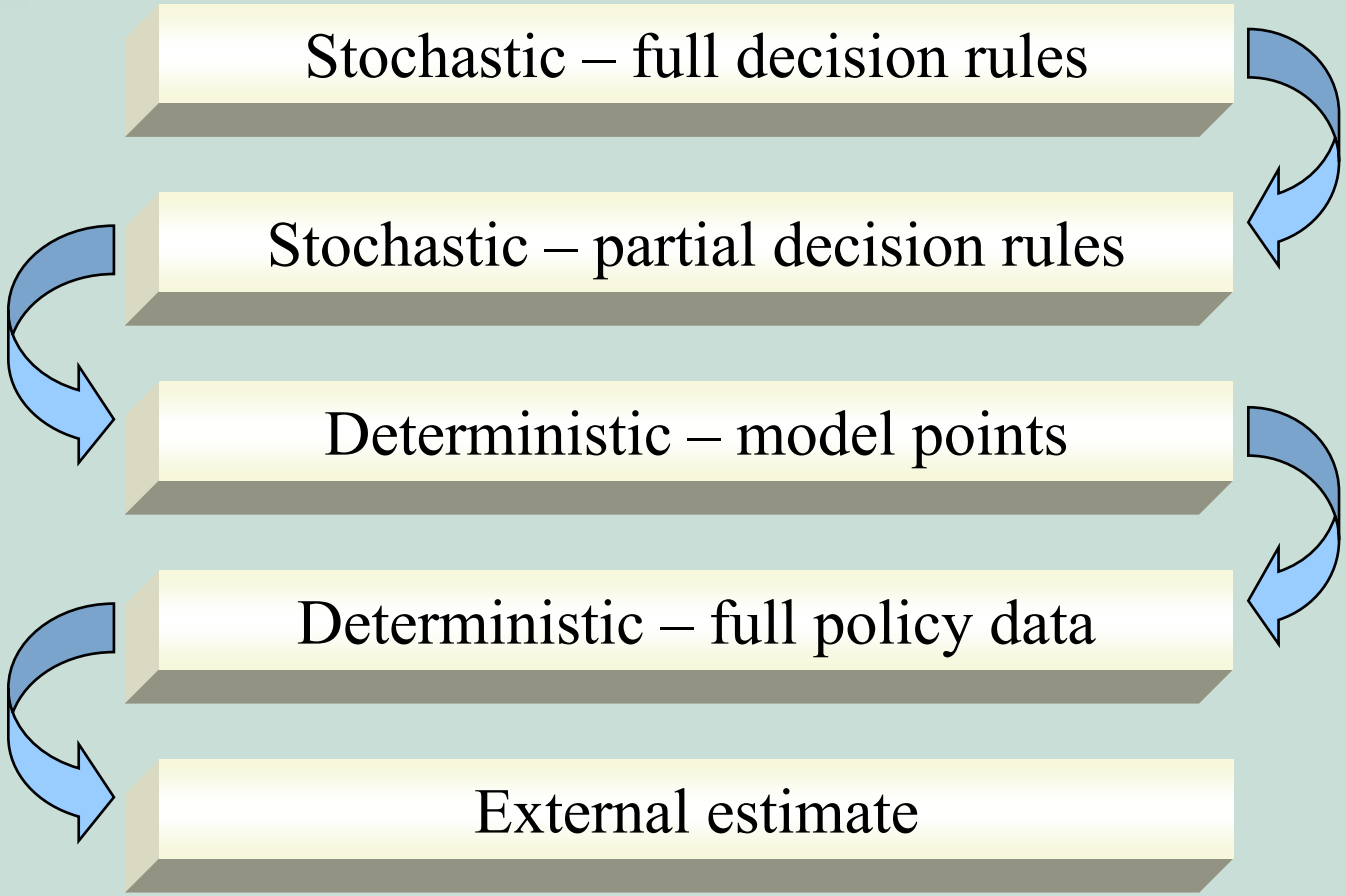
- Simulation error



Statistical Features

	Statistical Features of FTSE TR Index									
	1	2	3	4	5	6	7	8	9	10
min	-0.58737	-0.54641	-0.55298	-0.51144	-0.56181	-0.55137	-0.60526	-0.50618	-0.55372	-0.52528
max	1.419813	1.295017	1.343175	1.190496	1.247603	1.558885	1.45918	1.593356	1.592439	1.409066
stdev	0.219996	0.220905	0.226379	0.223048	0.224156	0.227264	0.227747	0.223087	0.228883	0.225764
skewness	0.659279	0.678668	0.672587	0.589684	0.649754	0.736	0.653971	0.649338	0.746721	0.605602
kurtosis	0.906098	0.90291	0.856025	0.551863	0.741937	1.218075	0.820688	0.760288	1.236817	0.625504
	11	12	13	14	15	16	17	18	19	20
min	-0.56175	-0.52635	-0.57476	-0.55808	-0.51791	-0.53336	-0.5528	-0.53136	-0.5115	-0.52231
max	1.2274	1.407061	1.37336	1.538156	1.252007	1.223937	1.238173	1.421338	1.175165	1.381571
stdev	0.22687	0.225807	0.225573	0.225971	0.228247	0.229028	0.226112	0.230926	0.229679	0.227109
skewness	0.654969	0.653459	0.61877	0.585453	0.658297	0.627725	0.663893	0.677146	0.658084	0.641097
kurtosis	0.66884	0.699801	0.657507	0.53966	0.699755	0.562677	0.804219	0.763481	0.695522	0.692034
	21	22	23	24	25	26	27	28	29	30
min	-0.515	-0.50574	-0.57938	-0.52639	-0.58954	-0.54244	-0.52452	-0.56057	-0.6136	-0.51049
max	1.216598	1.342824	1.311739	1.332021	1.270478	1.259898	1.298421	1.213131	1.576567	1.261184
stdev	0.228039	0.230148	0.233225	0.229425	0.229814	0.230391	0.232753	0.229799	0.2296	0.231487
skewness	0.670363	0.656928	0.74231	0.67838	0.635098	0.692187	0.61174	0.661904	0.705108	0.670343
kurtosis	0.647895	0.773656	1.005499	0.813898	0.714506	0.943345	0.575042	0.787619	1.103682	0.856188

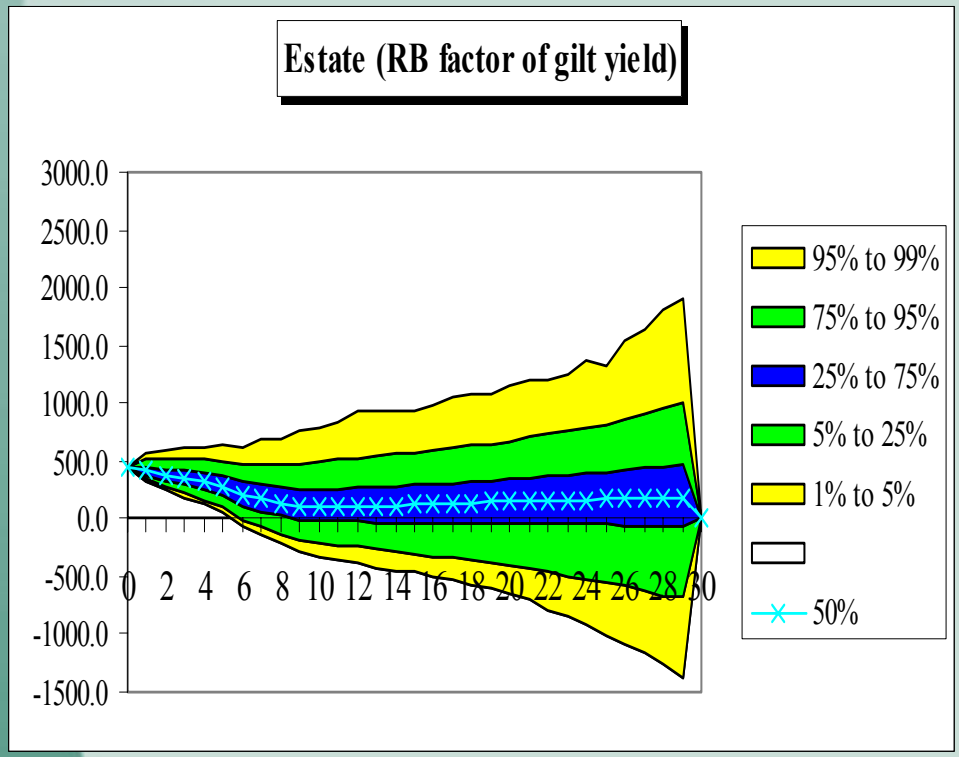
Breaking down the output

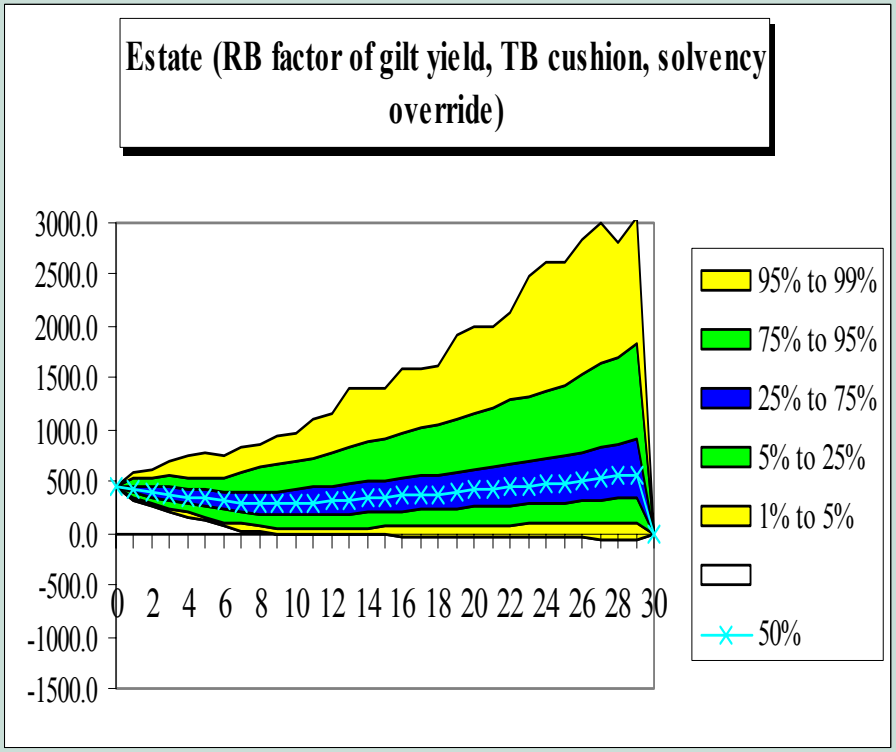


Testing decision rules

- Need some way of checking whether the modelled decision rules are reasonable and sufficiently robust
- Could consider:
  - effect on realistic liabilities of alternative rules
  - effect on future (statutory) solvency levels, e.g. frequency of insolvencies, size of deficit if insolvent
  - effect on projected policy values, eg mean and variance of payouts, relative values of different bonus series, projected TB cushions, etc.
  - range of different decisions actually generated by model, e.g. to ensure focus on relevance and avoid unnecessary rules
  - tracing through individual scenarios
- Potentially time consuming, complex and iterative process

Examples


Estate (RB factor of gilt yield)
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
-500.0
-1000.0
-1500.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
95% to 99%
75% to 95%
25% to 75%
5% to 25%
1% to 5%
50%


Estate (RB factor of gilt yield, TB cushion, solvency override)
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
-500.0
-1000.0
-1500.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
95% to 99%
75% to 95%
25% to 75%
5% to 25%
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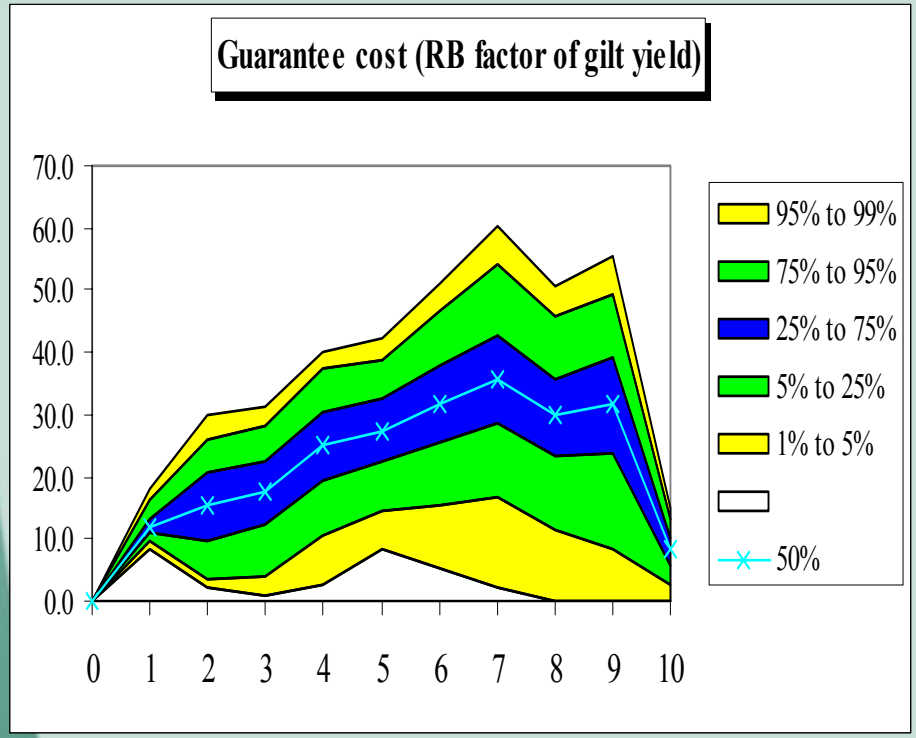
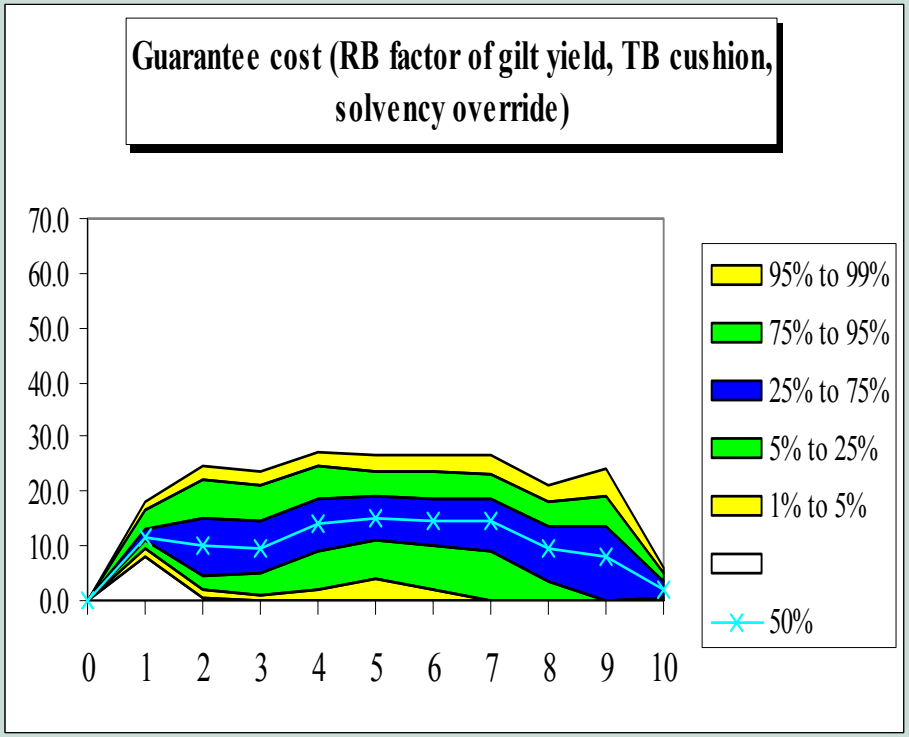
50%

Examples


Guarantee cost (RB factor of gilt yield)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0 1 2 3 4 5 6 7 8 9 10
95% to 99%
75% to 95%
25% to 75%
5% to 25%
1% to 5%
50%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10.0
0.0
0 1 2 3 4 5 6 7 8 9 10
95% to 99%
75% to 95%
25% to 75%
5% to 25%
1% to 5%
50%

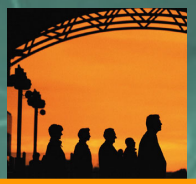
Model testing - conclusion

- Deeper understanding of

  - extent of guarantees (products, maturity profile)
  - nature of guarantees (optionality, sensitivity to interest rates / equity levels)
  - extent of cross-subsidies and impact of alternative asset share recharging triggers
  - value of any tax assets and capital support

- Effectiveness of responsive rules in managing risk / capital requirements

Practical pitfalls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Practical pitfalls

- Computer issues
  - network access / hardware limitations
  - spare PC's
- Contingency planning
  - multiple runs
  - trial runs
  - checking possible human error
- Model maintenance
  - model point grouping
  - avoiding unnecessary code
  - streamlining output files
  - avoiding need to manipulate output

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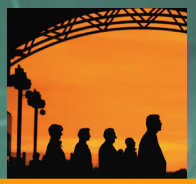


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