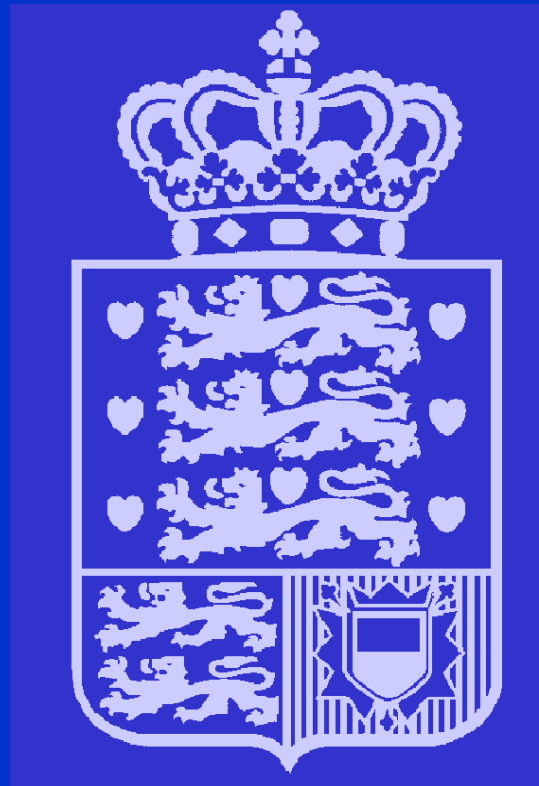


Cost-at-Risk



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Why Cost-at-Risk ?

- Demand from Ministry of Finance for supplement to duration and redemption profile that quantifies risk
- Considerable domestic debt
 - Approximately 55 pct. of GDP
 - 650 Billion DKK
- Focus is on nominal value of debt and annual costs - VaR not considered relevant !



Outline of the presentation

- Cost-at-Risk basics
- Interest-rate scenarios
- Results
- Future work



CaR basics (I)

Main idea

- Main idea: Evaluation of future costs based on simulation of plausible future interest scenarios for given portfolio management strategy.
- Focus on nominal costs (VaR has focus on market value).
- CaR: Maximum increase in costs in a given year with a given probability - typically 95 pct.
- Supplement to duration and redemption profile an “intuitive” risk-measure.



CaR basics (II)

Structure

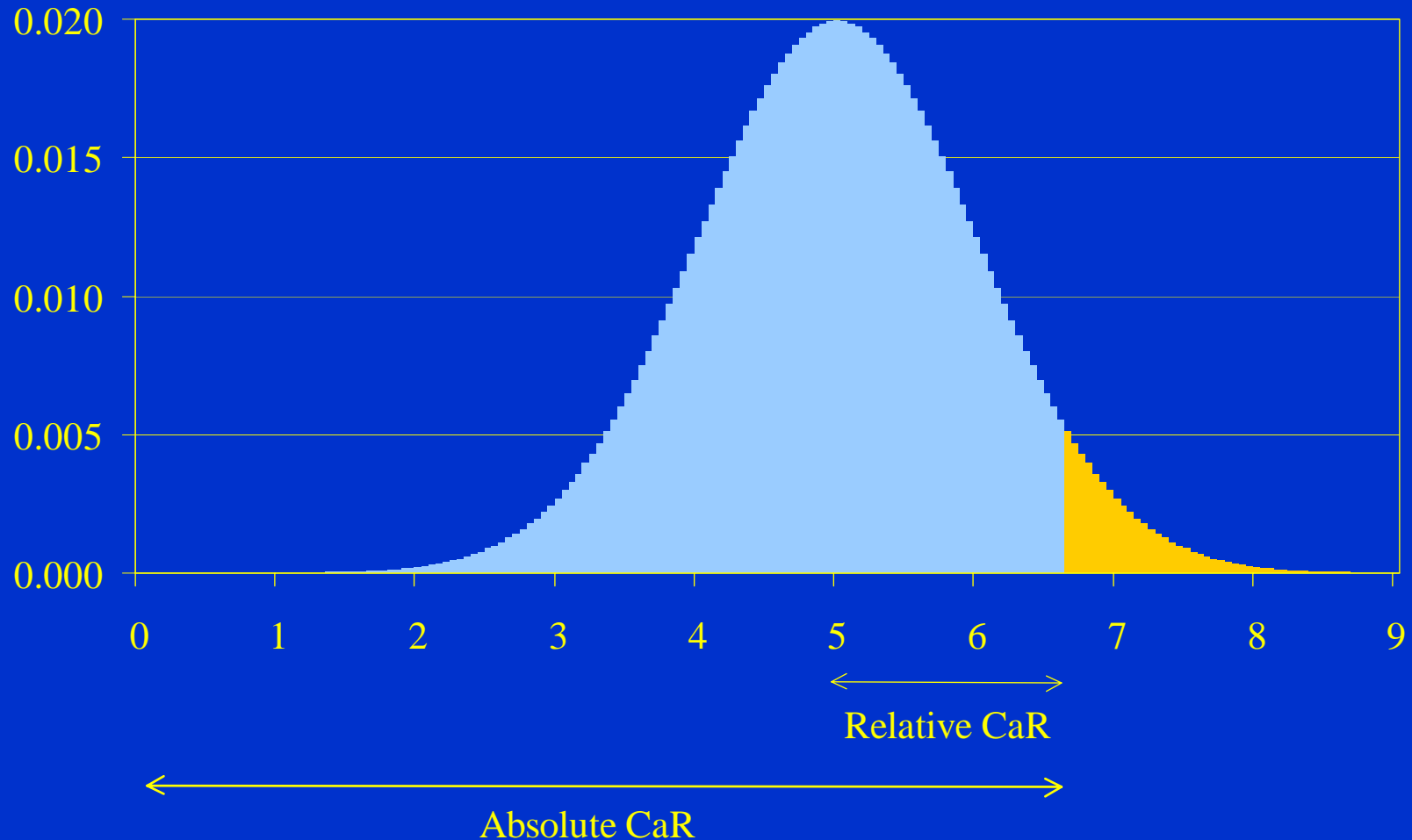
- Input
 - Complete description of future “cost-flows” for existing debt
 - Scenarios for future primary budget deficits and borrowing
 - Scenarios for future interest rates
- Output
 - Distribution of future costs on an annual basis



CaR basics (III)

Terminology

Example: Normally distributed costs, billion DKK



Interest-rate scenarios (I)

Simulation methods

- Numerical simulation
 - Example: Postulate conditional distributions for 0, 2, 10 and 30 year rates and estimate zero-coupon curve
- Sampling from historical yield-curves
- Theoretical term-structure model
 - Our choice so far: Cox, Ingersoll & Ross (1985)
 - Parameters estimated on data from 1987-1999



Interest-rate scenarios (II)

Numerical simulation

- Advantages
 - Flexibility and full control over input
 - Makes stress-testing easy
- Critique
 - Not arbitrage free yield-curve
 - “Too easy” to manipulate
 - No theoretical foundation



Interest-rate scenarios (III)

Historical sampling

- Advantages
 - Well known method and easy to generate
 - Yields curves have actually been seen
- Critique
 - May generate highly plausible future interest rate scenarios



Interest-rate scenarios (IV)

Theoretical term structure model

- Advantages
 - Well known and easy to generate
 - Theoretically consistent, i.e. the yields curves are arbitrage-free
- Critique
 - “Too simple”



Results (I)

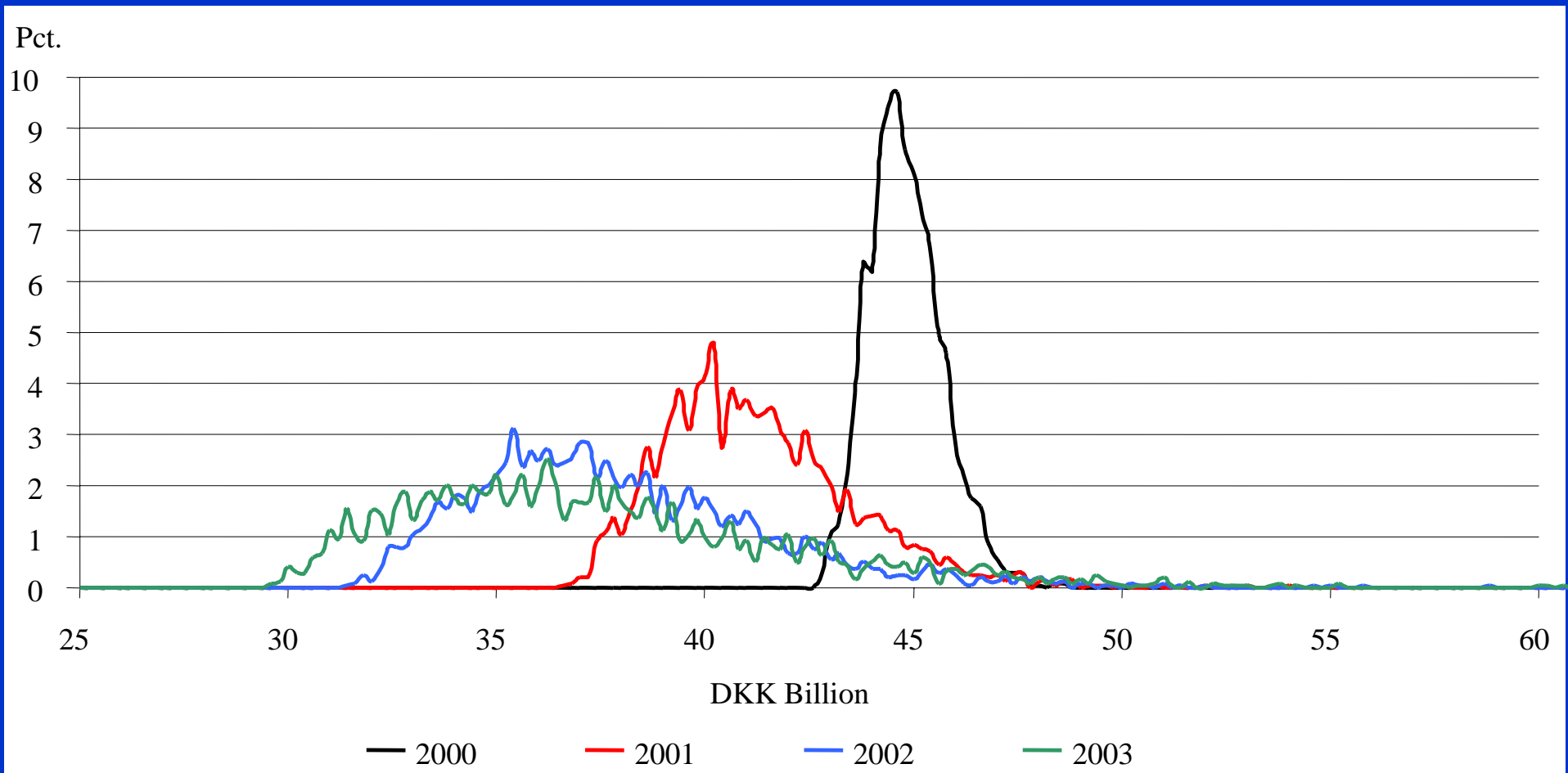
4th quarter 1999, DKK billion

99th percentile	47.2	47.2	47.7	48.3	51.1
95th percentile	47.2	46.5	45.4	44.4	46.3
Relative CaR	0.1	1.6	4.0	6.4	8.8
Average	47.1	44.9	41.3	38.0	37.5



Results (II)

Cost distributions 2000-2003



CaR until now...

- CaR for the Danish domestic government debt is low
- CaR is reported on a quarterly basis to the Ministry of Finance
- Currently no limits on CaR



Future work

- Make decision on CaR limits together with the Ministry of Finance
- Include foreign debt
- Consider more recent theoretical term structure models



Concluding remarks

- CaR is a useful and necessary supplement to duration and shape of redemption profile - not an objective measure
- “Too sophisticated”
- Requires more work than duration and redemption profile

