SCOR
Modelling GMDB Portfolio

SCOR Global Life

Agenda

1	Product, Treaty & Portfolio
2	Modelling Approach
3	Biometric Assumptions and Experience
4	Fund Mapping
5	Economic Scenarios
6	Results and sensitivities

Introduction

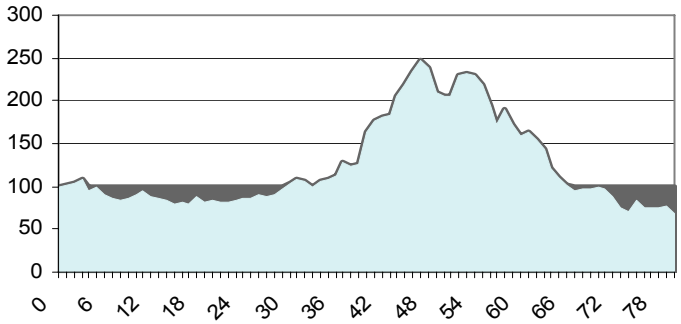
- Variable Annuities
  - (large) choice of investment funds
  - family of guarantees – GMDB, GMWB, GMAB ….

- SCOR reinsures fixed %age of GMDB rider only
  - receive M% of charges for GMDB rider
  - pays N% of guaranteed death benefits in excess of VA funds
  - i.e. pay N% x Max((GMDB – Account Value), 0)

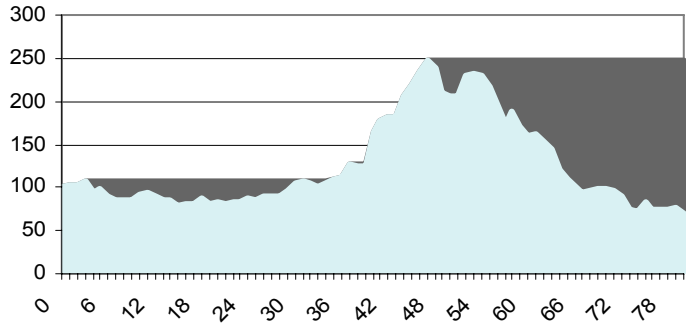
- Portfolio written by Converium 1999 – 2001
  - now in run-off

Product - Types of Guarantees

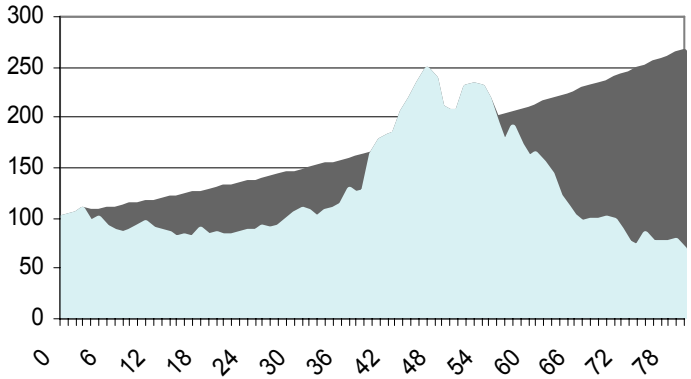
- Return of premium: <1%*)



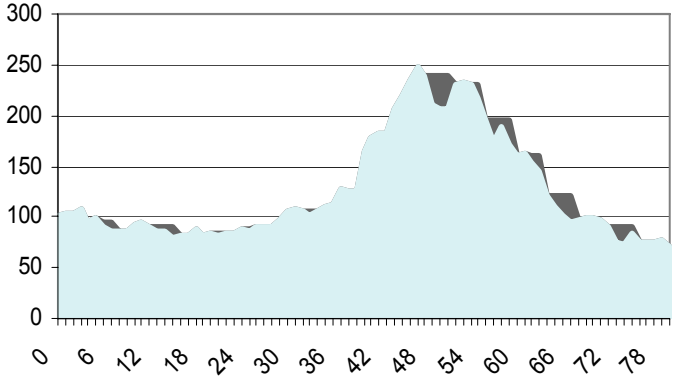
- Ratchet: 55%*)



- Rollup: 40%*)



- Reset: 2%*)



Death benefit in excess of account value

Account value

*) of Net Amount at Risk 2010Q1

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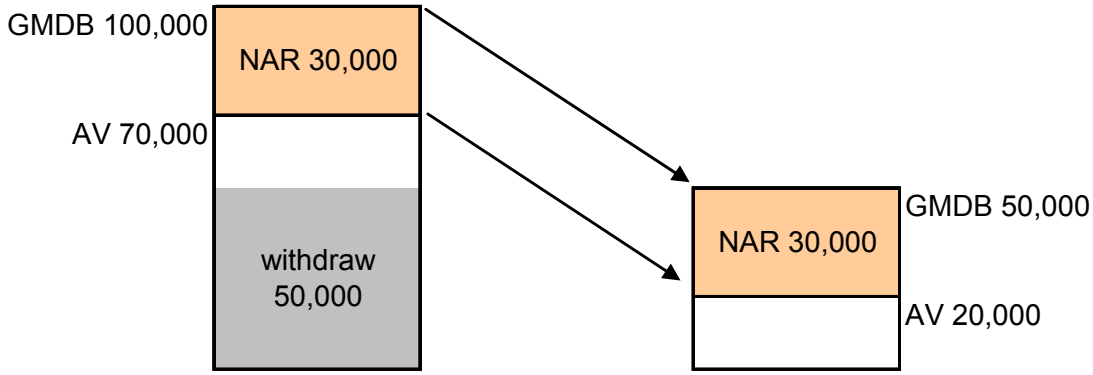
Product – policyholder options

- Partial Withdrawals
  - policyholder withdraws part of account value money
  - dollar for dollar (4) option (76% of NAR has this option):
    GMDB is decreased in the same $ amount as the funds withdrawn



  - Net amount at risk (NAR) = (GMDB – AV) remains unchanged
  - risk charges often proportional to AV

⇒ almost free life insurance

  - average age of policyholder > 70 years

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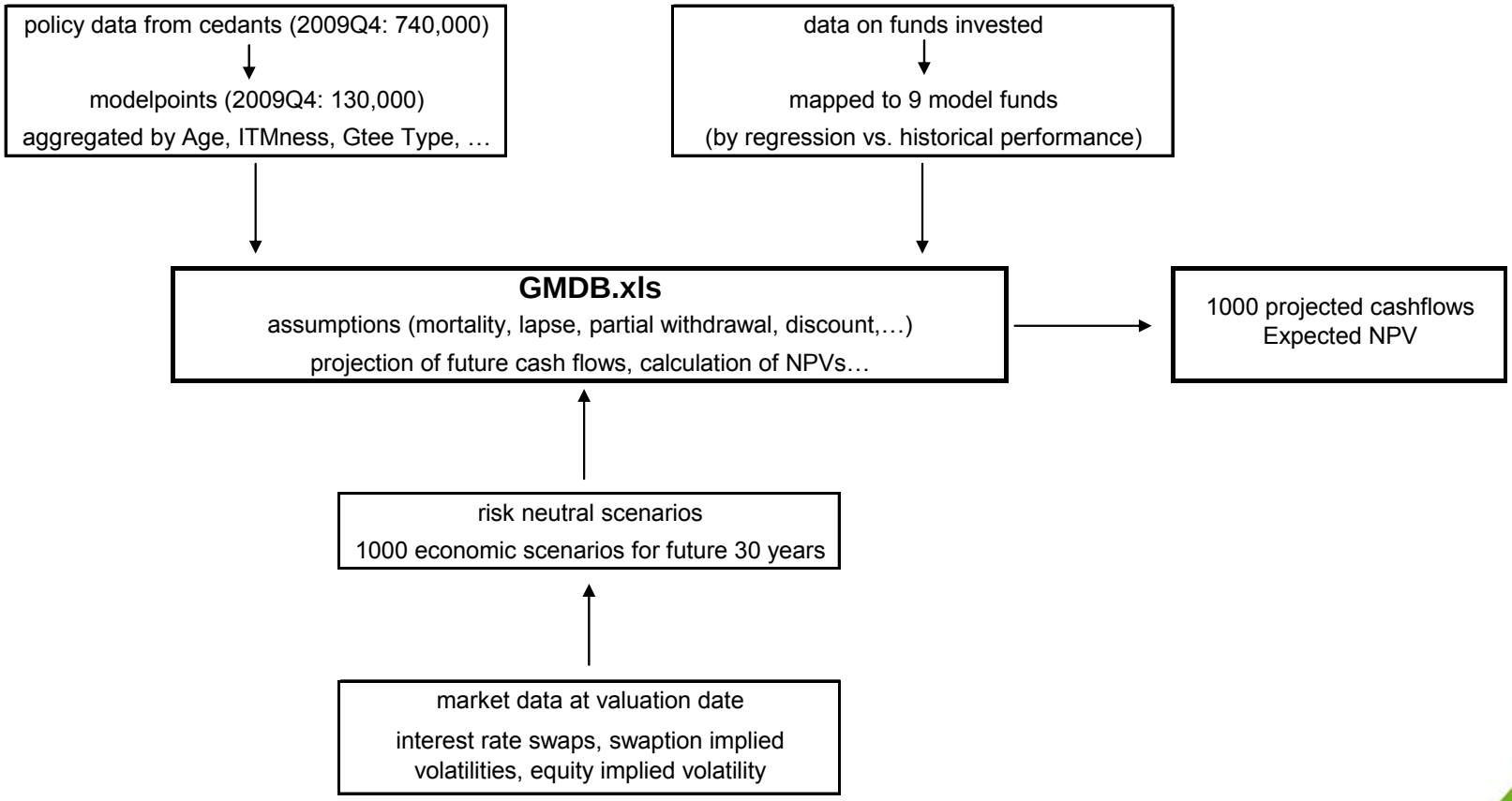
Modelling Approach

- SCOR's model produces a market consistent best estimate value of its GMDB liabilities



Modelling Approach

- Policy data received with delay of 6-8 weeks
  We need to "Age" the previous portfolio data to the valuation date:
  - Apply mortality and lapse for one quarter to derive #lives
  - Use assumed portfolio decomposition (asset split) and actual movement of financial markets to derive AV & GMDB
- We receive aggregate data on fund mapping,
  - Map 200+ actual funds to 9 model indices (S&P 500, Russell 2000, Treasury Bills, Investment grade bonds, …)
  - Map these 9 funds to 4 asset classes
    - S&P 500
    - 3 year treasuries
    - 6 year treasuries
    - cash
- We simulate 1000 market consistent economic scenarios using Hull-White model for these asset classes.

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Biometric parameters

- Key parameters
  - Mortality
  - Lapses
  - Partial withdrawals
- No movement data
  - deduce from change in policy data
  - some information from clients
  - comparison with peers
- Identify decrements by comparing successive policy lists, but cannot distinguish lapses from deaths.
- No study yet on partial withdrawals

Portfolio Experience - Mortality

- Compare reported aggregate death claims with expected death claims to see if our mortality assumptions are correct.

- Assumed mortality
  105% US Annuity 2000 table
  Nil mortality improvement (population improvement vs antiselection?)

		2005	2006	2007	2008	2009
Total Portfolio	Actual claims					
	Expected claims					
	AvsE	96%	109%	104%	110%	92%

- No trend observable.
  - very crude result
  - detailed movements needed for credible result

Portfolio Experience - Lapse

- Penalties on surrender in early years
  → initially low lapses
  followed by peak lapses at end of lapse period

	SCOR assumptions
Year 5	5.8%
Year 6	6.5%
Year 7	15.0%
Year 8	10.0%
Year 9+	8.0%

- 2009 lapse study:
  comparing successive policy lists (each quarter)
  → total decrement rate each quarter
  Subtract assumed mortality rate
  → approximate lapse rate

- Results analysed by
  - duration
  - “in-the-moneyness (ITMness)” = GMDB / AV

Portfolio Experience - Lapse

- Key results
  - peak lapses at end of surrender charge period, as expected
  - lapse rates fell sharply during 2008 & 2009

Portfolio Experience - Lapse

- Key results
  - lapses depend strongly on ITMness
    $\Rightarrow$ lapses fell as a result of 2008-2009 financial crisis
  - hard to see any further effect of crisis
  - policies with very high ITMness show very low lapse rates

    very high ITMness due to 4 withdrawals

    $\Rightarrow$ rational policyholder behaviour
    perhaps with further antiselection (higher mortality)
- Model should make dynamic lapse assumption
- Rise in ITMness in 2008 & 2009 explains most of fall in lapses by duration

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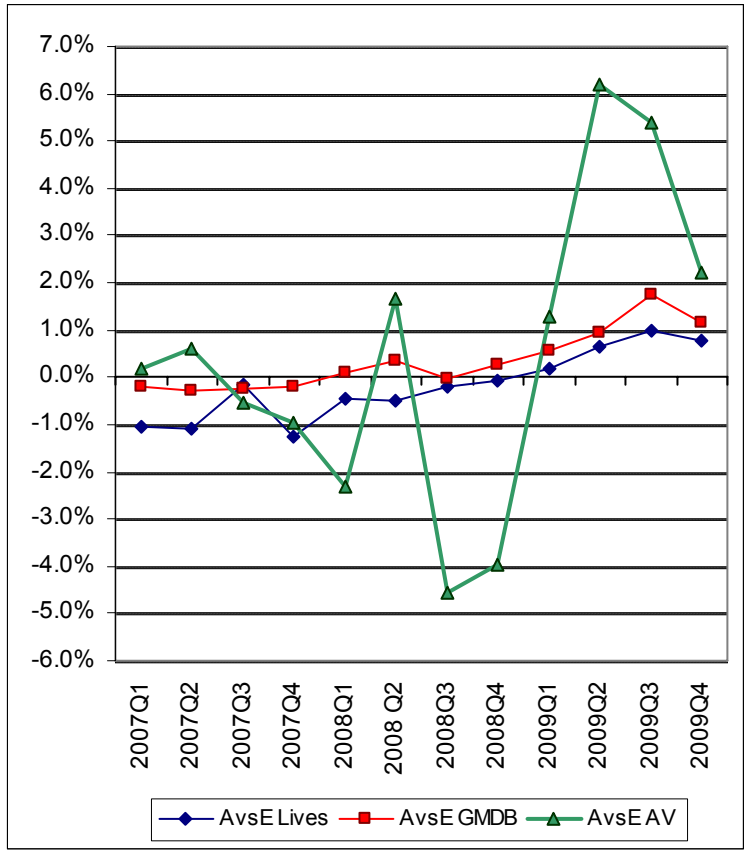
Fund Mapping

- Cedants provide aggregate data on fund mapping
  - 200+ actual funds to 9 model indices,
  - Linear regression based on 60 months historical returns
  - SCOR map these 9 funds to 4 asset classes
- Portfolio “aging” routine allows high level check of fund mapping (and other model assumptions)
  - E.g. Policy data 30/9/2008 “aged” to 31/12/2008
    - Assumed lapses, mortality, partial withdrawal
    - Actual returns on mapped indices
  - Compare
    Actual account value at 31/12/2008 with
    Expected account value at 31/12/2008 projected from 30/9/2008

Fund Mapping

- Result
  - 2008 Q3 & 2008 Q4
    actual fund returns were well below actual returns on assumed indices
  - 2009 Q2 & 2009 Q3
    actual fund returns were well above actual returns on assumed indices
  - Due to
    - credit spread losses & gains
    - higher volatility on actual equities than in S&P 500 index
    - rebalancing by policyholders?
    - …..



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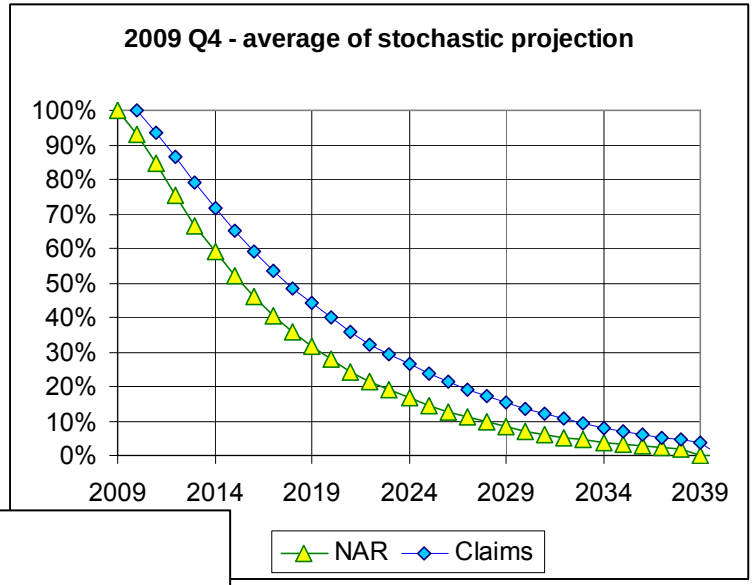
Economic scenarios

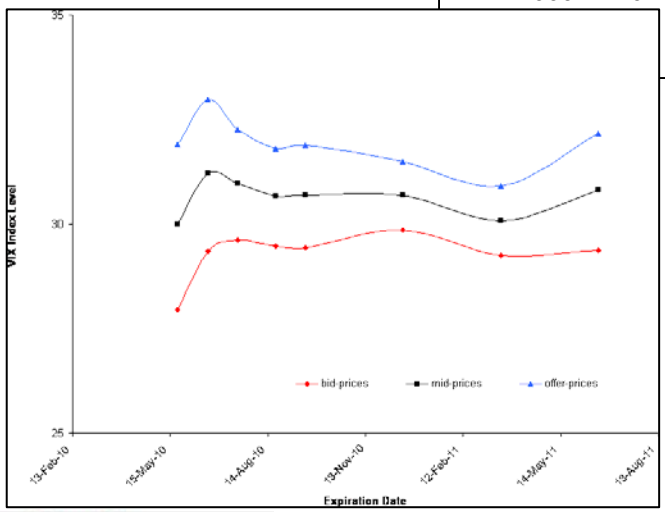
- Risk neutral (Hull-White interest rate model)
- 1000 scenarios only, but results converge satisfactorily
- Variance reduction by antithetic sampling
- Market calibrated to
  - USD interest rate swaps
  - USD Swaptions
  - Implied volatility on S&P 500 options
    one implied volatility value only

Economic scenarios

- Problems – one equity implied volatility value

- need long term implied volatility curve – to allow for term of GMDB options





- Implied volatility curve, (usually) upward sloping

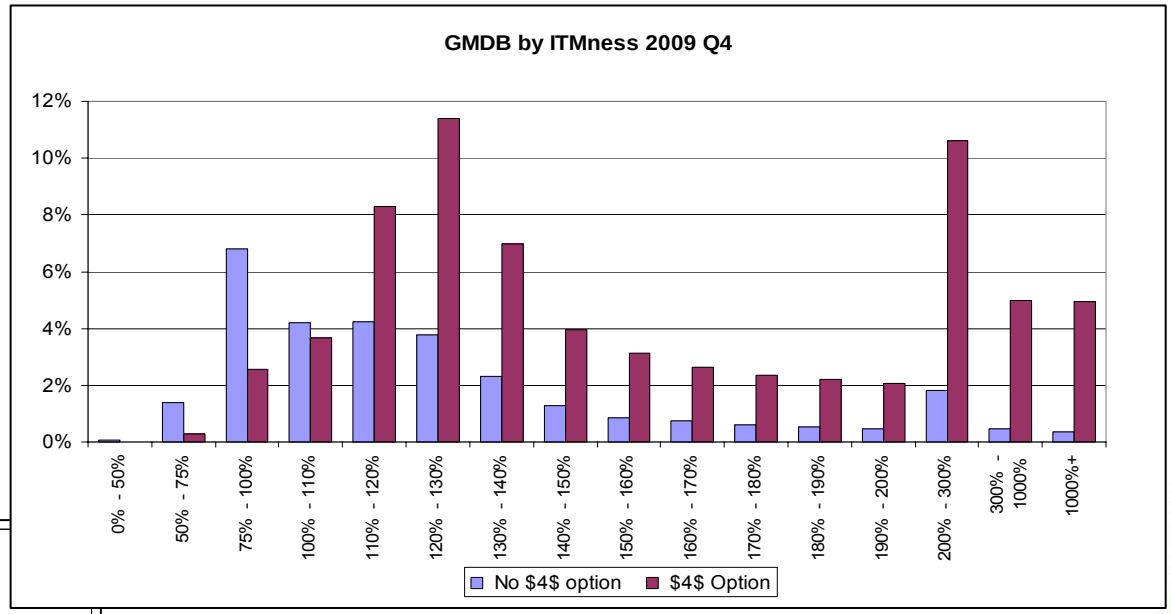
  http://www.cboe.com/micro/vix/vixtermstructure.aspx

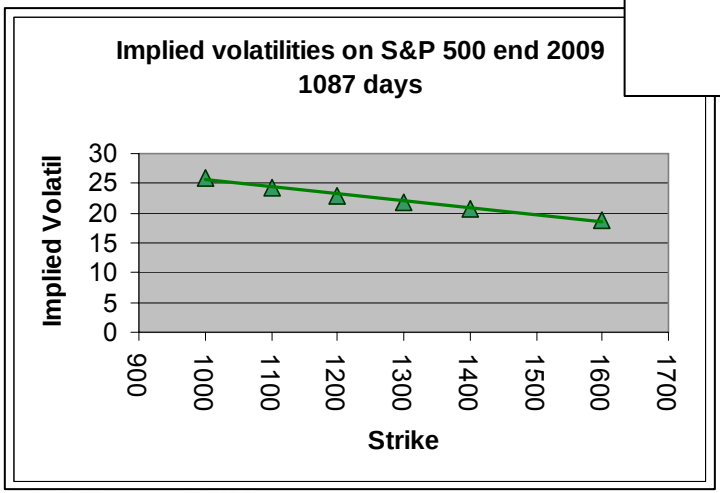
Economic scenarios

- Problems – one equity implied volatility value

- policies have different ITMness

  i.e. different strikes relative to asset value





- Implied volatility of options on equities depends on strike (Volatility smile)

⇒ need implied volatility surface (by term and ITMness) to calibrate to options market

- not compatible with monte-carlo simulation

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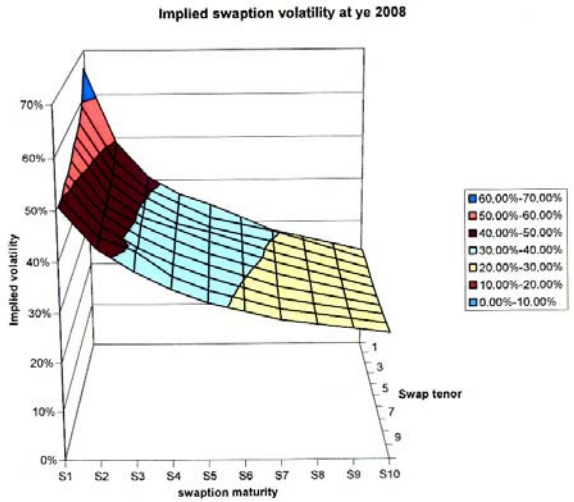
Economic scenarios

Problems

2-parameter Hull-White model cannot capture properties of interest rate volatility surface at year-end 2008



Deviations from theoretical impl vol
Receiver swaptions

Maturity\Ten	5	7	10
5	5%	-1%	-5%
7	2%	-1%	-6%
10	5%	0%	-4%
15	1%	-2%	-4%
20	2%	1%	0%
25	8%	6%	3%

- Extraordinary volatility of interest rates at year-end 2008
  - Highly skewed surface
  - Extremely high volas for short-term contracts
  - Stable but still high volas for long-term contracts
- => In practice, inability to reflect the complete volatility surface within a 2-parameter Hull-White model
- Possible solution
  - Calibration to specified durations / tenors

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