



Dynamic Hedging of Variable Annuities – TwinStar: The AXA Way –

MathFinance Conference 2008

Frankfurt, March 17/18th

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Trends in the European Life Insurance Market

- Ability of insurers to generate attractive risk/reward profiles will predominantly determine success in the savings/retirement market
 - ➔ Importance of guarantees and other innovative, flexible product features
- At the same time: substantially increased importance of ALM techniques due to lower risk capital levels and changing supervisory regime
- Shift of focus from macro to micro ALM at least at the lower end of the learning curve
- Profitability also depending on the question which parts of the value creation chain can be dealt with internally
 - ➔ AXA's answer: variable annuities (Germany: TwinStar)



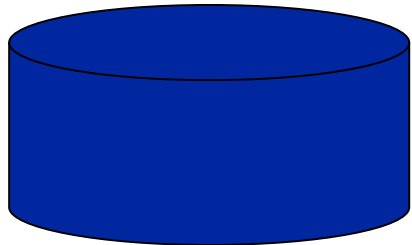
AXA TwinStar: Annuity with Financial Option (GMIB)

- Account value as underlying asset:
 - Depending on the account value, at the start of the annuity phase the client chooses to receive either his guaranteed annuity (option is exercised) or the fund based annuity (option expires).
- The option value is calculated using common economic principles; AXA protects itself against value changes through a sophisticated hedging program.
- The aim of hedging is to always have enough money to be able to finance the due annuities at the end of the deferred period by hedging the annual IFRS result.

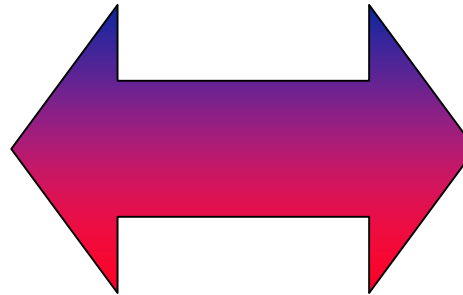
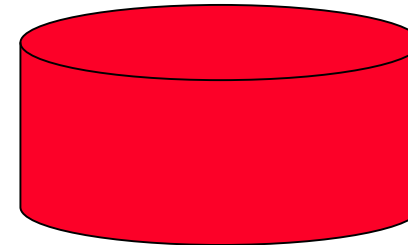


The USP of the Variable Annuities is Generated by Separating Guarantee and Asset management.

Asset Management



Guarantee Management



- The customer can choose asset manager at contract inception and can change within a selected choice of managers at any time during the lifetime of the contract.
- The customer can determine the share of his assets that is to be invested into equity and be assured that this share will not change unlike he wishes to do so.
- The customer can decide on the investment style and regional focus of his investments.

Top Return

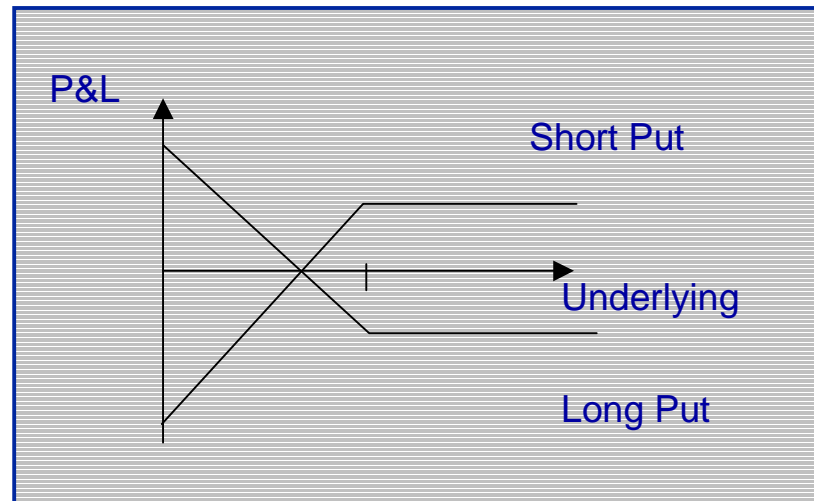
- The customer pays a fee for the guarantee that is priced. This is transparent and easy to understand.
- Guarantee can be tailored to the needs of the customer (guaranteed income, guaranteed withdrawals, guaranteed death benefit).
- Guarantee can be given on regular and single premiums and on any type of underlying assets.

Tailored guarantee

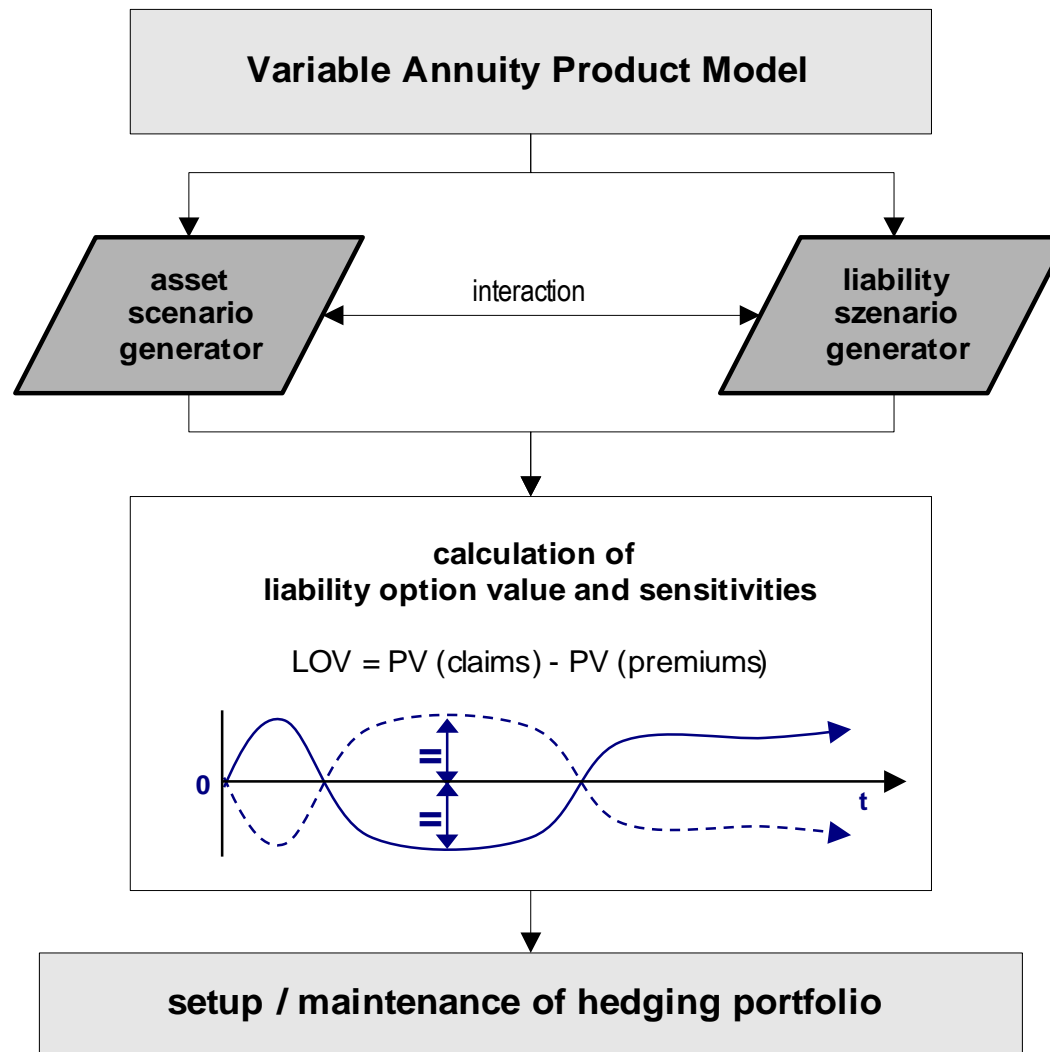


Put Option

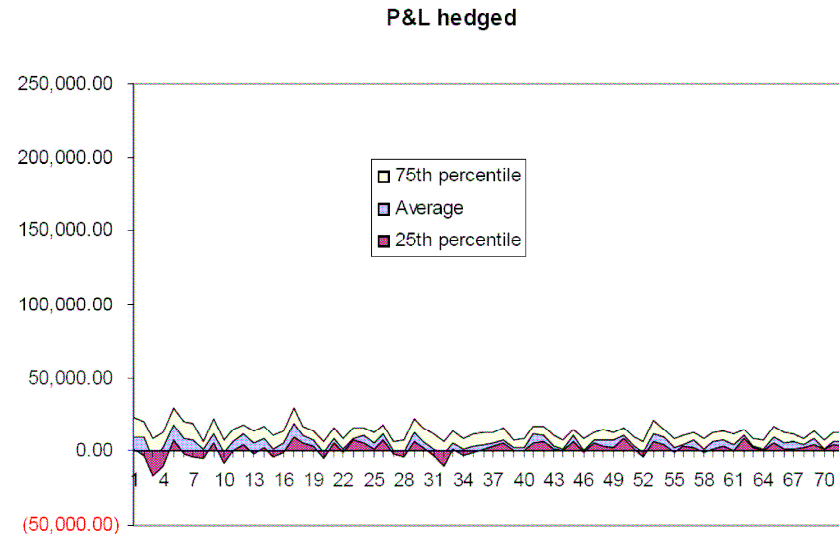
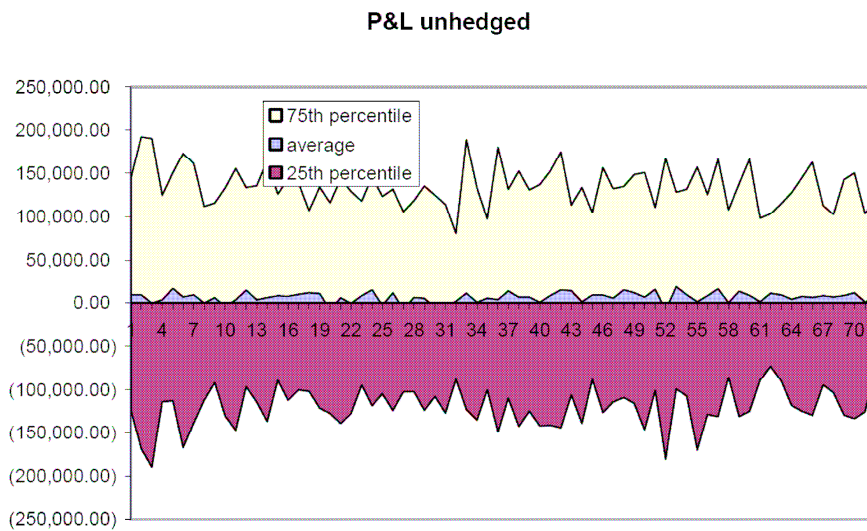
- The client has a long put position, thus executing his option depending on his individual account value at the start of the annuity phase.



Estimation of Future CF Profile to Arrive at the Hedge Portfolio



Dynamic Hedging: P&L Implications



→ Hedging doesn't change the expected mean P&L, but reduces its distribution significantly!



Share Price Risk (Delta Hedging)

- necessary: information about the magnitude of change of the liability option value in case of share price changes
- operationalisation using liquid derivatives (futures) on broadly diversified equity indices:
 - EuroStoxx 50
 - FTSE 100
 - S&P 500
 - Nikkei 225
 - (...)
- wanted: change in liability option value if indices c.p. change by 1% (i.e. delta of the option)



Fund Mapping

- necessary: establishment of a link between individual funds and liability option value
 - Which linear combination of indices (resp. index derivatives) delivers a similar return like the funds?

Fund Name	DJEuroStoxx	UKX	NKY	SPX	FI
AXA Welt	17,69%	17,63%	19,23%	36,27%	9,18%
AXA DEFENSIV INVEST	5,35%	6,65%	4,03%	4,00%	79,97%
(...)					
AXA Rosenb. Eurobloc Equity Alpha	82,52%	8,13%	2,26%	7,09%	0,00%
AXA ROSENBERG GLOBAL EQTY-B=	8,70%	23,53%	19,00%	45,19%	3,58%
FIDELITY - EUROPEAN GROWTH A	70,11%	0,00%	8,57%	0,00%	21,32%
JPMF EUR Global Bond A - EUR	0,06%	0,34%	0,00%	0,00%	99,60%
Templeton Growth (Euro) Fund A	33,04%	4,64%	9,59%	26,09%	26,64%
PIONEER FUNDS-US PIONEER A=	7,95%	9,35%	4,28%	78,42%	0,00%
TOTAL EXPOSURE RELATIVE TO AV	20,72%	12,26%	9,70%	11,05%	46,26%



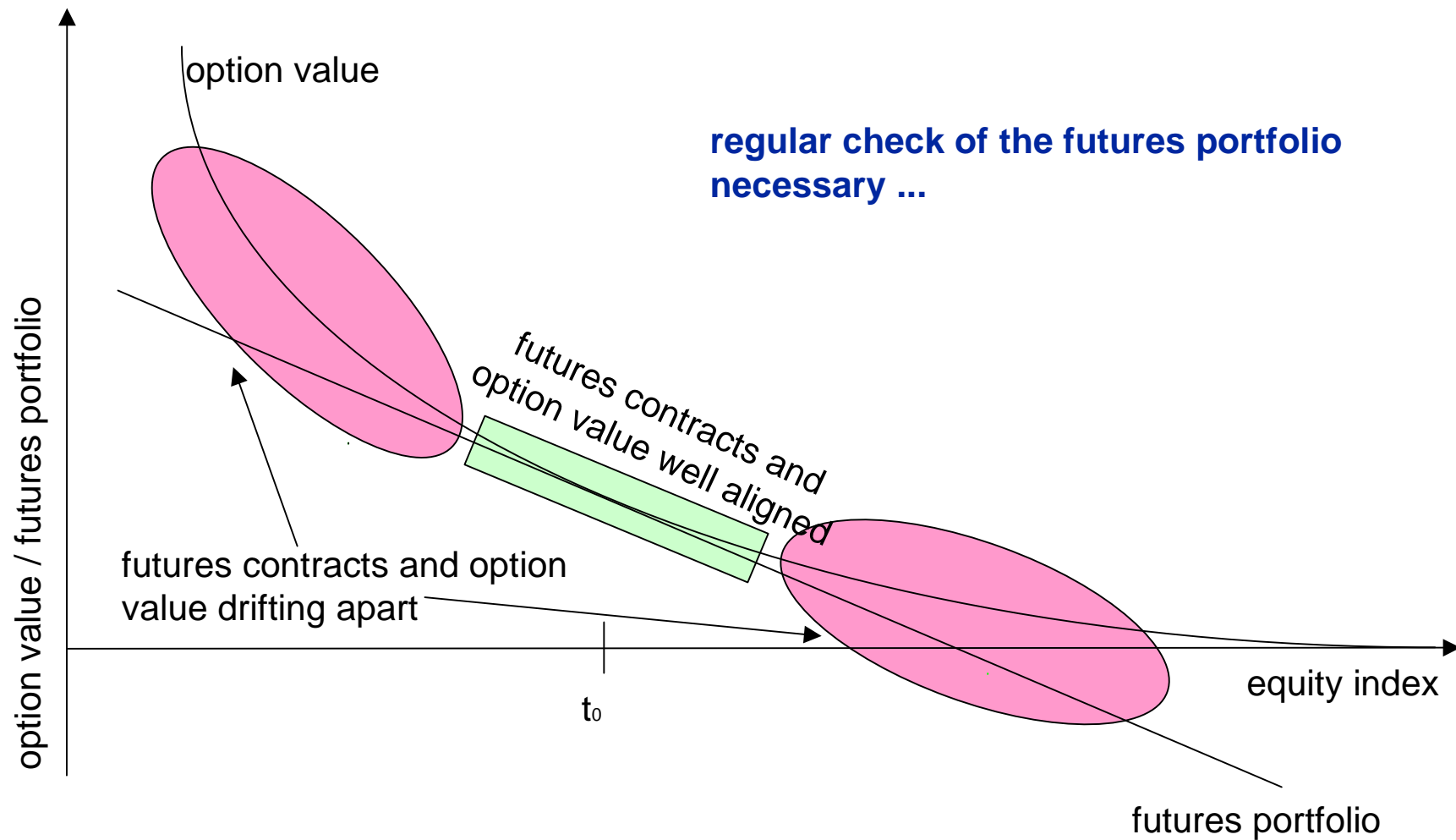
Hedging Recommendation

- The hedging recommendation is the result of the (daily) comparison of the option delta and the futures contracts already held:

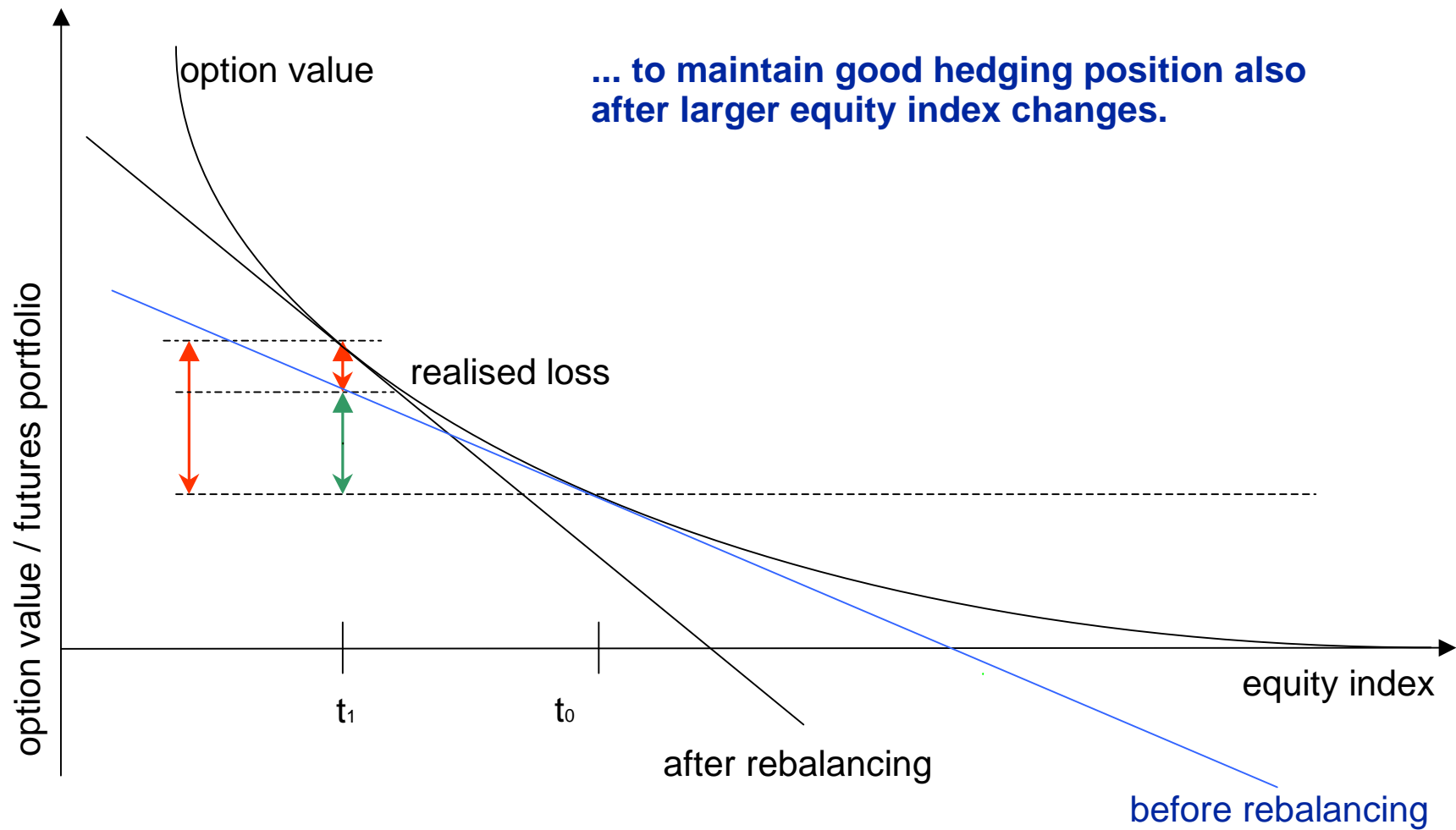
	Liability Position	Futures and Swaps		Total
		Position	Recom	
Euro Delta				
DJ EuroStoxx 50	€ 91.127	-€ 85.720	-€ 5.953	-€ 91.672
FTSE 100	€ 41.182	-€ 39.657	-€ 2.644	-€ 42.301
S&P 500	€ 57.912	-€ 55.216	-€ 3.155	-€ 58.371
Nikkei	€ 53.367	-€ 49.458	-€ 3.297	-€ 52.756
Total	€ 243.589	-€ 230.051	-€ 15.049	-€ 245.100

- Most important from the hedging perspective:
 - reproduction of the fund performance using stable combination of hedging assets
 - basis risk monitoring needed

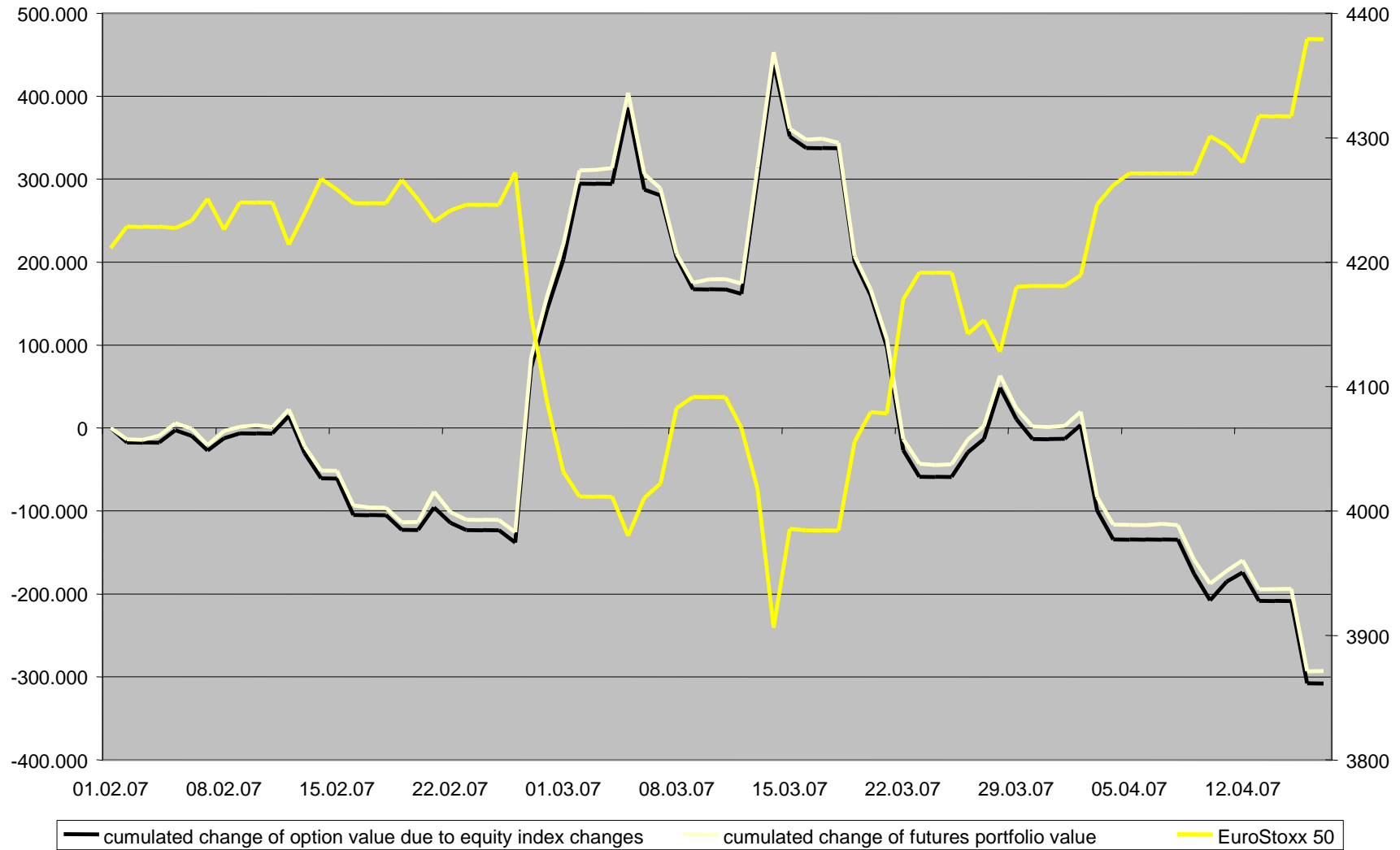
Over Time: Dynamic Hedging (1/2)



Over Time: Dynamic Hedging (2/2)

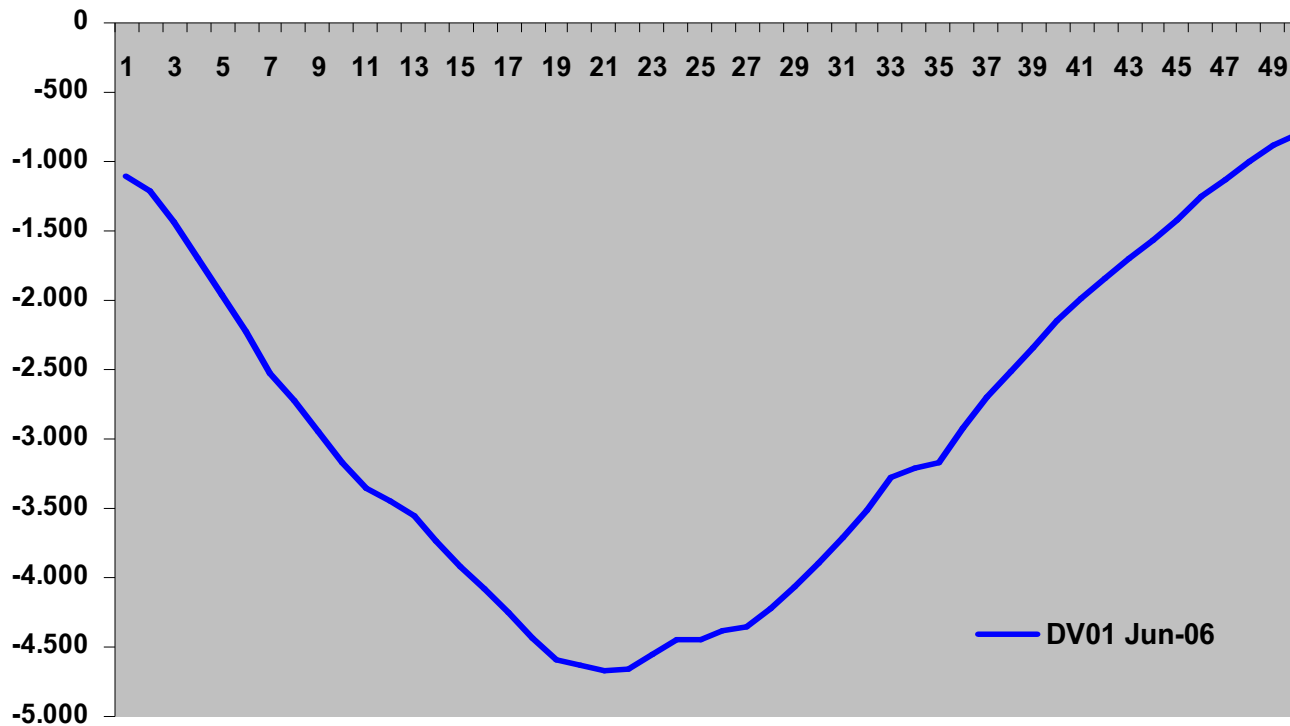


Observed Delta Hedging Efficiency



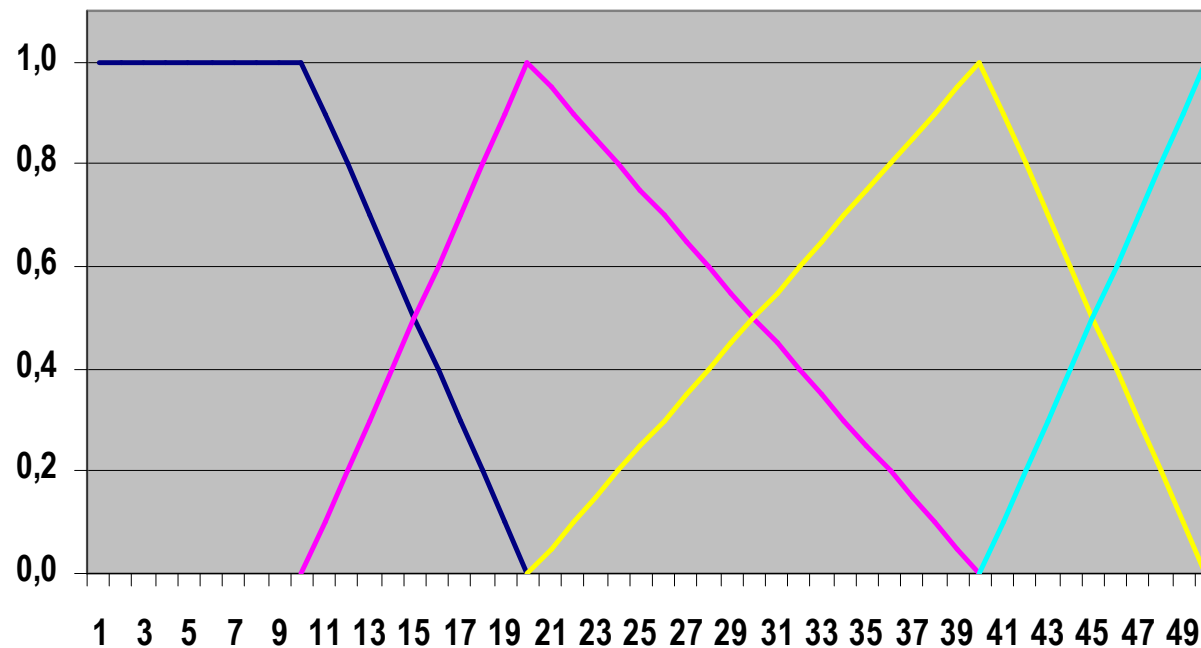
Interest Rate Risk (Rho Hedging)

- TwinStar means high interest rate risk for AXA in case of regular premium tariff.
- needed: information about the sensitivity of the option value to interest rate shocks along the curve (DV01)

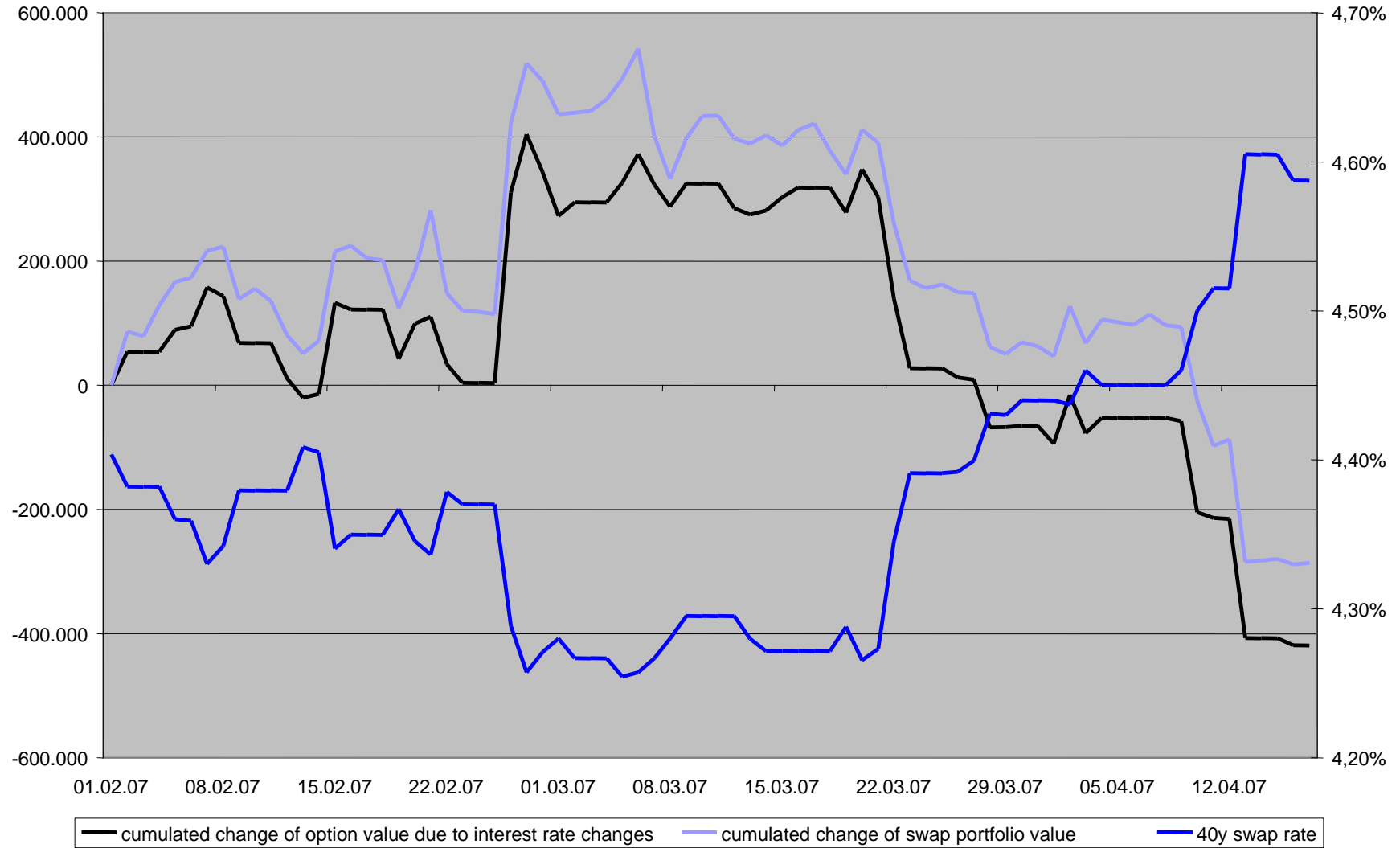


Interest Rate Hedge Calibration

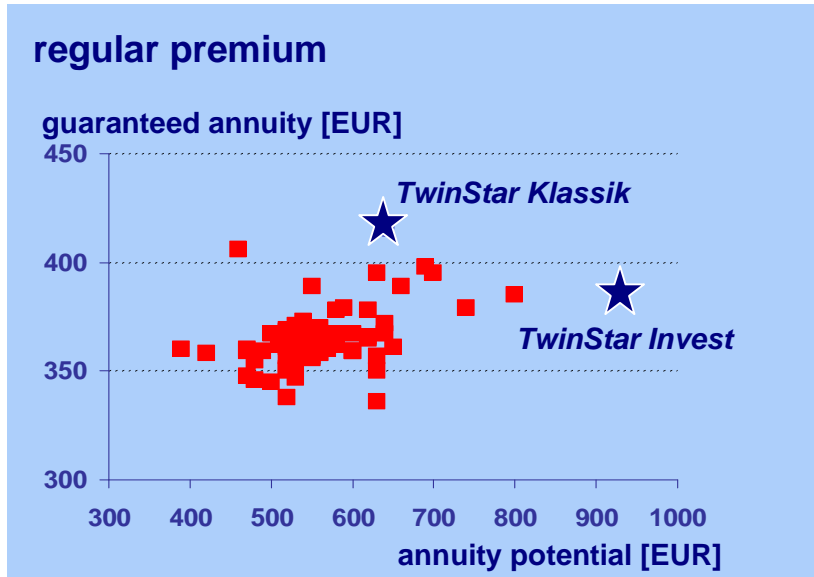
- calibration of interest rate derivatives (swaps) in order to compensate changes of the option value
- example: aggregation of DV01s and allocation to a series of buckets (10, 20, 40, 50y)



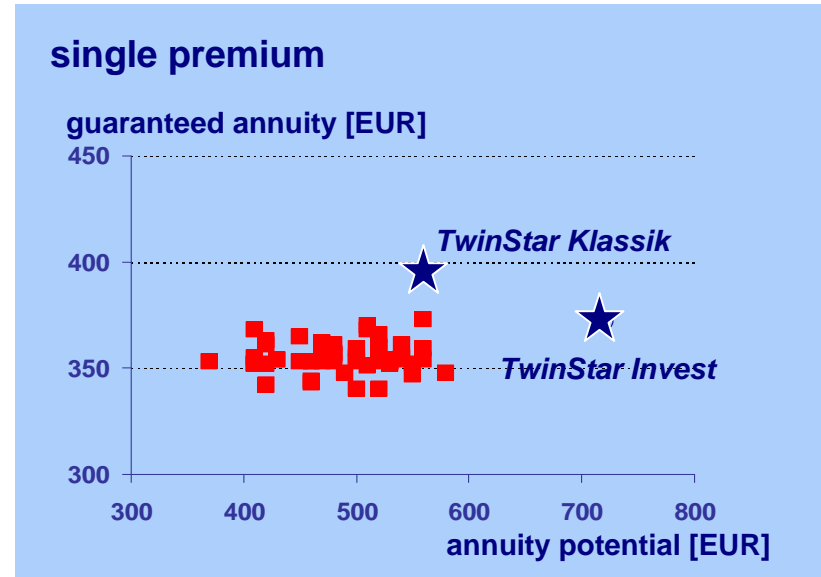
Observed Rho Hedging Efficiency



Market Situation at Product Launch in 2006



male, aged 30, EUR 150 monthly premium, retirement at 65



male, aged 45, EUR 50.000 single premium, retirement at 65



Market share 2006 (UL products Germany)

- single premium: 17%
- regular premium: 3%



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Multidisciplinary Team indispensable for Hedging

Manifold tasks ...

- projection of assets and liabilities to calculate option values
- sensitivity analyses of the option value („Greeks“)
- design and maintenance of derivatives portfolio
- complexity of necessary IT systems
- reserving (multiple accounting standards?)

... need comprehensive know how ...

- derivatives, mutual funds (...)
- thorough knowledge about liabilities
- ALM
- stochastic scenario generation
- equity/interest rate models (Hull/White, Heath/Jarrow/Morton being in use)

... plus robust operational processes and a powerful IT environment.

- interfaces (policy administration → option valuation → derivatives trading)
- greeks calculation takes approx. 15 secs per policy/CPU

Full value creation chain can only be retained by bigger market players!

