Market Value of Insurance Contracts with Profit Sharing

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Outline

- Introduction
- Fixed Cash Flows
- Profit sharing
- Example
- Conclusion

Introduction

- Basic idea
  - There are no direct liquid markets for existing policies
  - Construct a replicating portfolio (matching cash flows)
  - Fair Value of policy = value of replicating assets
- Concentrate on simple life policy
  - Define guaranteed pay outs
  - Define profit sharing rule
  - Disregard mortality
  - Disregard expenses, taxes,…
  - Disregard other policyholders options: lapses, PUPing,…

Fixed Cash Flows

- Fixed Cash Flows with regard to other economic variables (especially interest)
  - Use term structure of interest
  - Equivalent to buying a replicating portfolio of default free bonds

Profit Sharing

- Understand fully your profit sharing
- Profit sharing has properties of interest rates derivatives (think of asymmetric behavior)
- Example (simplified Dutch experience)
  - “Each premium plus cash flow payment is supposed to be invested in a bullet bond, maturing at expiration of the contract. The excess of interest over 4% is paid out in cash to the policyholder”
  - Based on external interest rates (not results of the office)
  - Not fixed cash flow (very interest dependent)

Profit Sharing

- This particular profit sharing is
  - Equivalent to having the right to buy at par a bullet bond with minimal coupon c in the future
  - Both have annual payments for a given tranche of MAX(c;Market rate)
  - Value of this option is value of profit sharing

Profit Sharing

- Pay out desired option (buy bullet at par with minimal coupon c) at expiration date if market rate<c:
  - $-1 + c\,(D_1 + \ldots + D_n) + D_n$
- Payout swaption at expiration date if market rate<c:
  - Value variable interest rates: $1 - D_n$
  - Value fixed interest rates: $c(D_1 + \ldots + D_n)$
  - Receiver fixed part = - Payer variable part =>
  - Value contract = $-1 + c\,(D_1 + \ldots + D_n) + D_n$
- Calculate value swaption using an analytical formula (Black-Scholes type of formula)

Example

- Premium 10.000 annually
- Guarantee 4%
- Profit sharing: premiums and guaranteed interest supposed to be invested in bullet loan with expiration at maturity
- Payment of guaranteed capital after 10 years

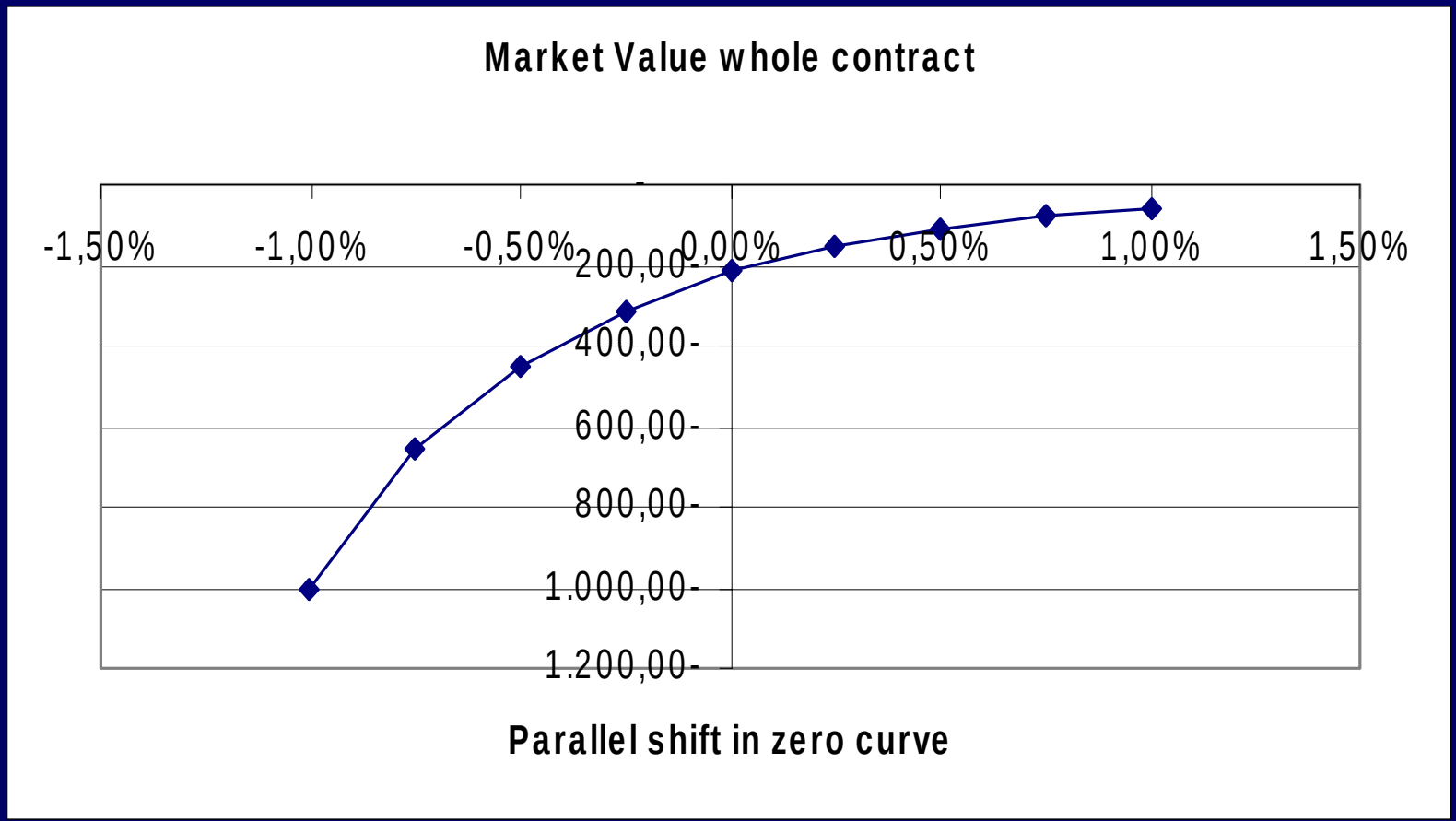
Example

T	ZeroRate	Cashflow	Notional	Forward	Swaption	Prognosis
0	4,00%	10.000	10.000,00	4,92%	-722,04	-722,04
1	4,10%	10.000	10.400,00	5,03%	-746,10	-740,93
8	4,80%	10.000	13.685,69	5,80%	-333,58	-311,57
9	4,90%	10.000	14.233,12	5,90%	-178,58	-166,40
10	5,00%	-124.864				
Value:		5.676,29			-5.893,30	

Example

- MV fixed cash flows **5.676,29**
- MV profit sharing **5.893,30-**
- MV contract **217,01-**
- Negative value because the company only can lose due to the 100% profit given away
- After signing the contract we need 217,01 in order to replicate all the cash flows

Example (sensitivity analysis)



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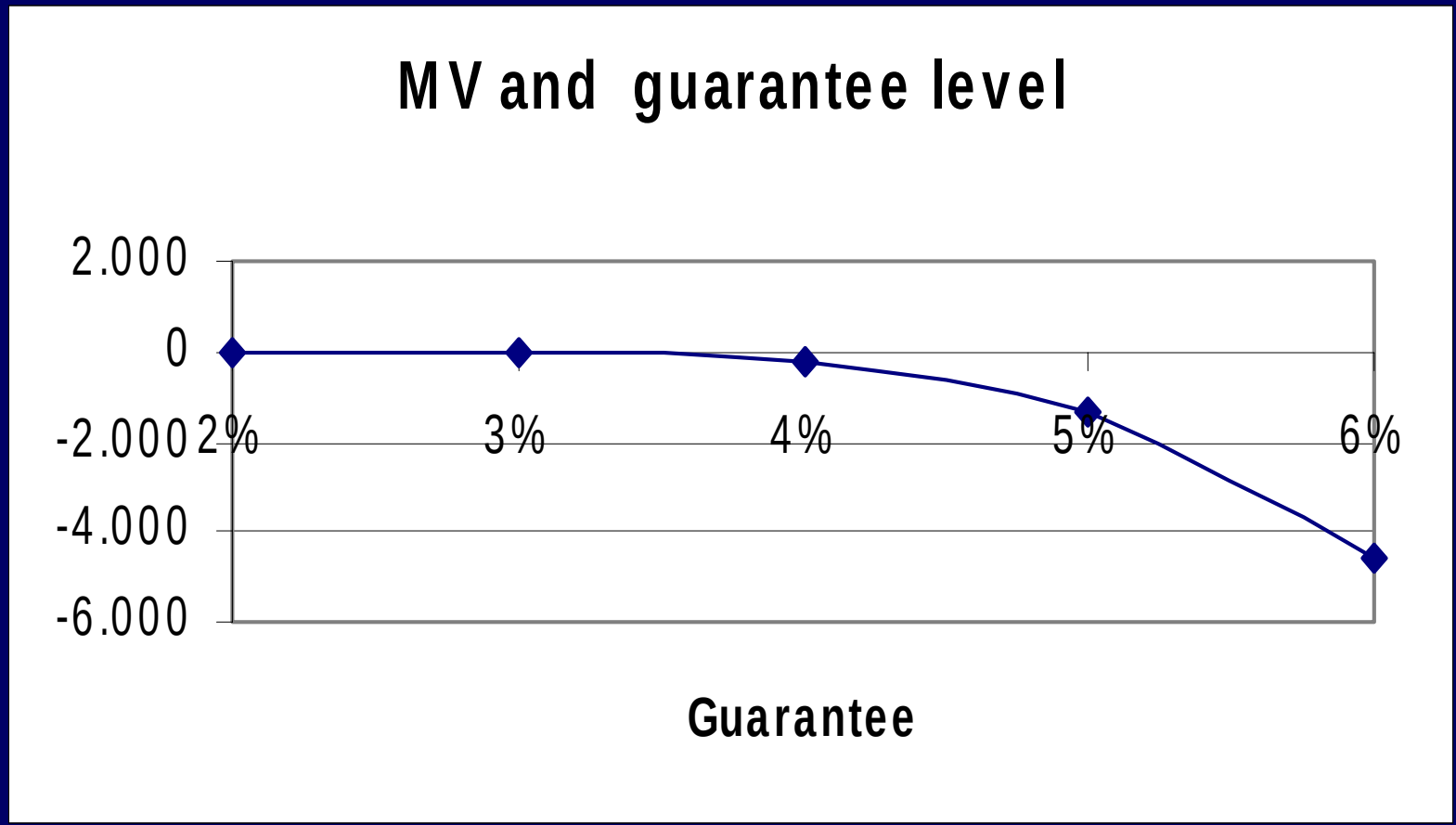

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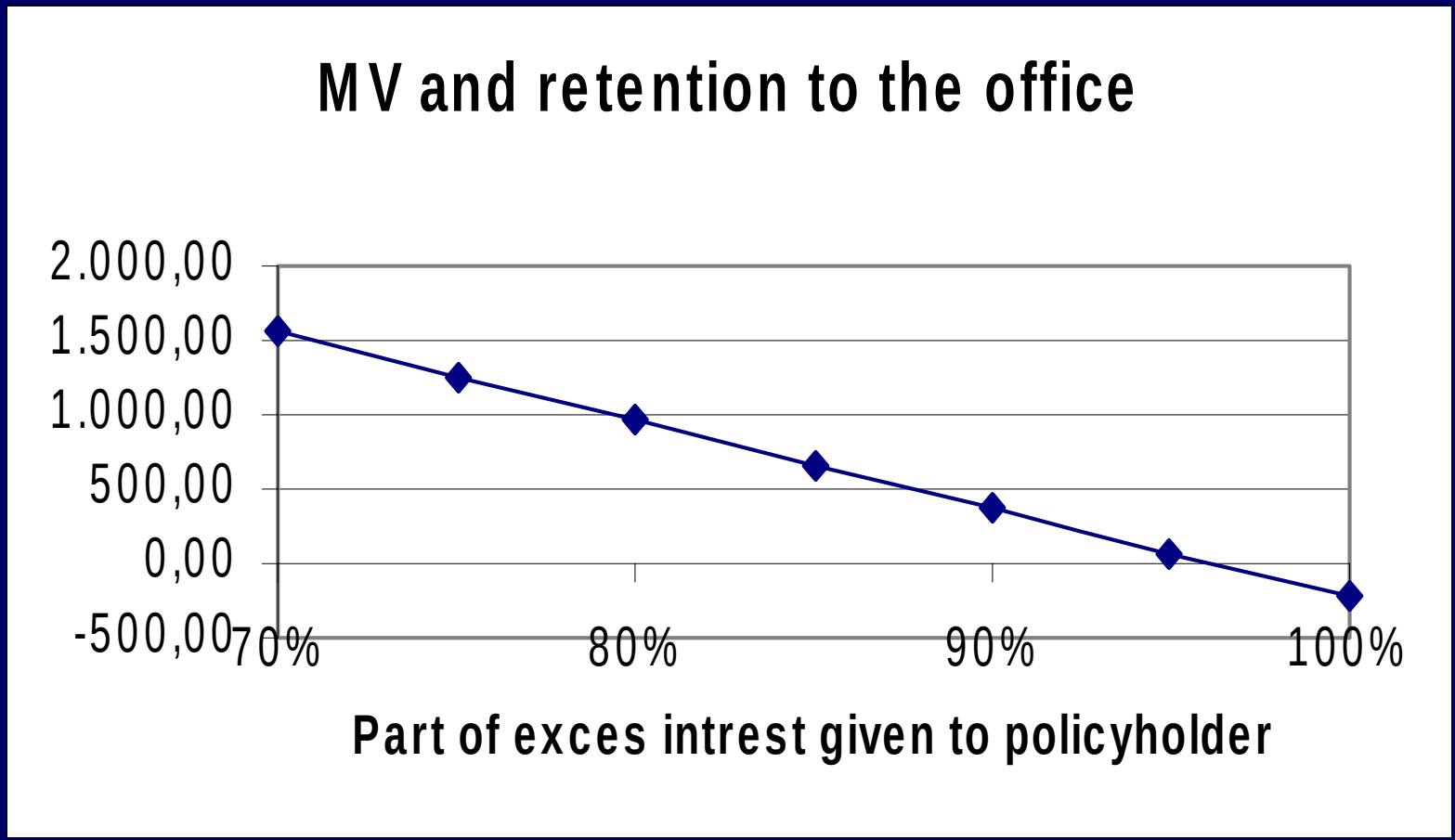

Conclusion

- Use replicating portfolio for valuation insurance contract
- Use option pricing for profit sharing rules
- You can measure simply and consistently changes in market prices