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The Bright Future of Life Insurance

4. Weiterbildungstag der DGVFM
Hannover, 1. Juni 2017
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AGENDA

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1. The Demand for Life Insurance
2. New Capital Efficient Annuity Products
3. Valuation of Long-Term Guarantees

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1 The Demand for Life Insurance

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Essential human needs

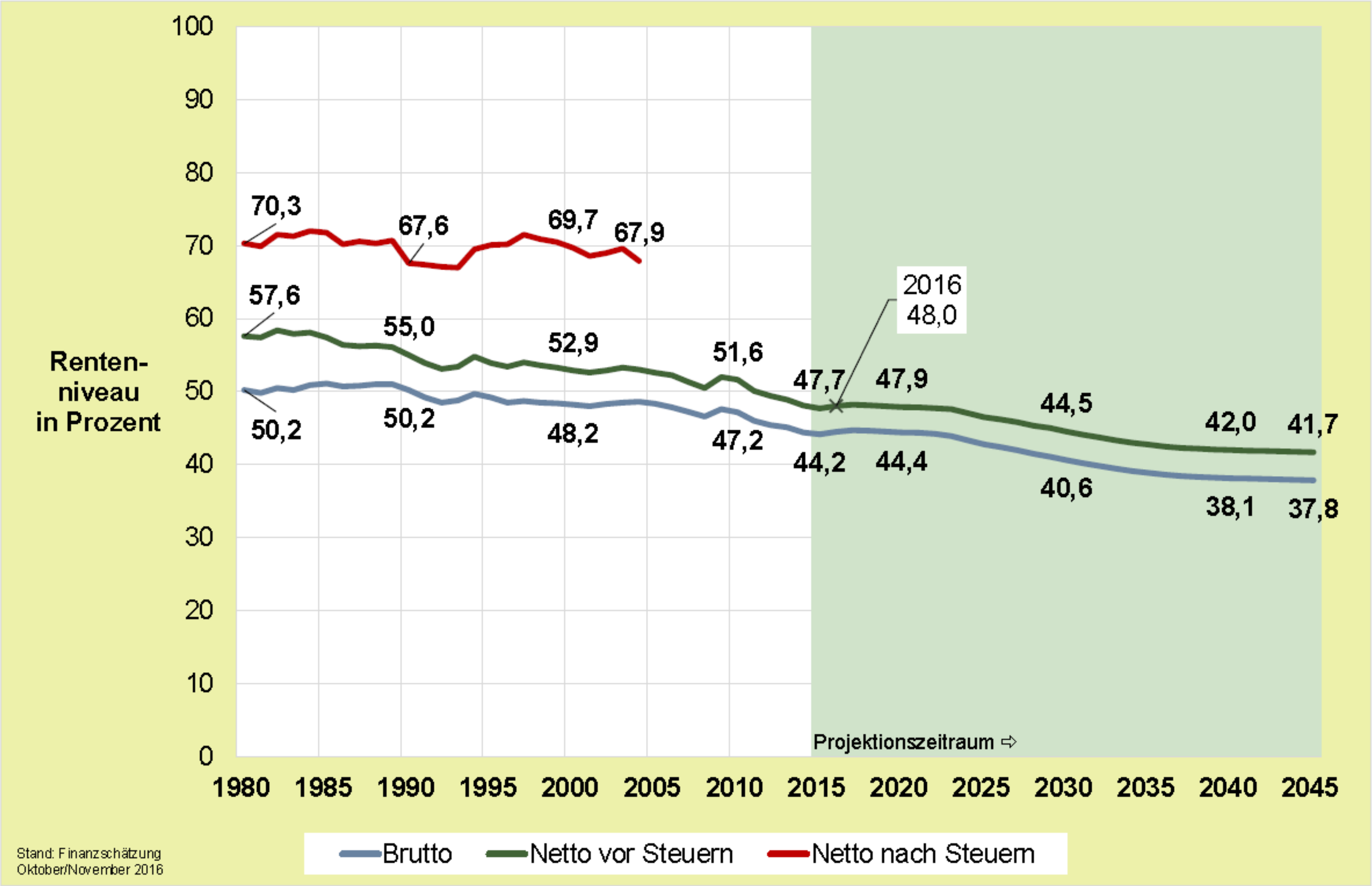
- Protection of income / financial aid in the case of disability
- Protecting one‘s family in case of death
- Lifelong income
- Saving for the future / building wealth

Statutory pensions / social security systems often insufficient

→ Demand for life insurance offered by insurance companies

1. The Demand for Life Insurance

Example: Development of German Statutory Pensions (1980 – 2045)



Source: Deutsche Rentenversicherung Bund 2016

1. The Demand for Life Insurance

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Life Insurance and Risk Selection / Price Differentiation

Example: Pricing a disability product

- Today: i(x) = i(x, m, nm)
  - x: parameter for age and sex
  - m: parameter for medical risks
  - nm: parameter for non-medical risks, e.g. occupation

  Statistical models rather simple and easy to explain

- Tomorrow (?): i(x) = i(x, m, nm, aod)
  - x, m, nm as above
  - aod: any other data
  - Use of "big data / analytics"

  More complicated models. Outcomes may be difficult to explain. Acceptance?

2 New Capital Efficient Annuity Products

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2. New Capital Efficient Annuity Products

Characteristics of Traditional Annuity Products in the German Life Insurance Market

- Structur of guarantees creates significant risks (interest rate risk, longevity risk)
  → required risk capital rather large
- Cost of capital not adequately reflected in prices
- Only partial hedging of risks possible (and expensive)
- Main risk-drivers:
  - Bonuses increase guarantees (guaranteed sum, guaranteed annuity)
  - Guaranteed rate has to be earned year by year
  - Policyholder options can be very expensive, especially if exercised rationally

2. New Capital Efficient Annuity Products

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Properties of Traditional Annuity Products

- Collective smoothing
- Smoothing over time
- Long-term guarantees
- biometric guarantees (longevity!)
- Prudent pricing and reserving
- Discretionary bonuses
- Fair allocation of surplus

Goal: Create capital efficient annuity products while retaining the unique properties of traditional annuity products

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2. New Capital Efficient Annuity Products

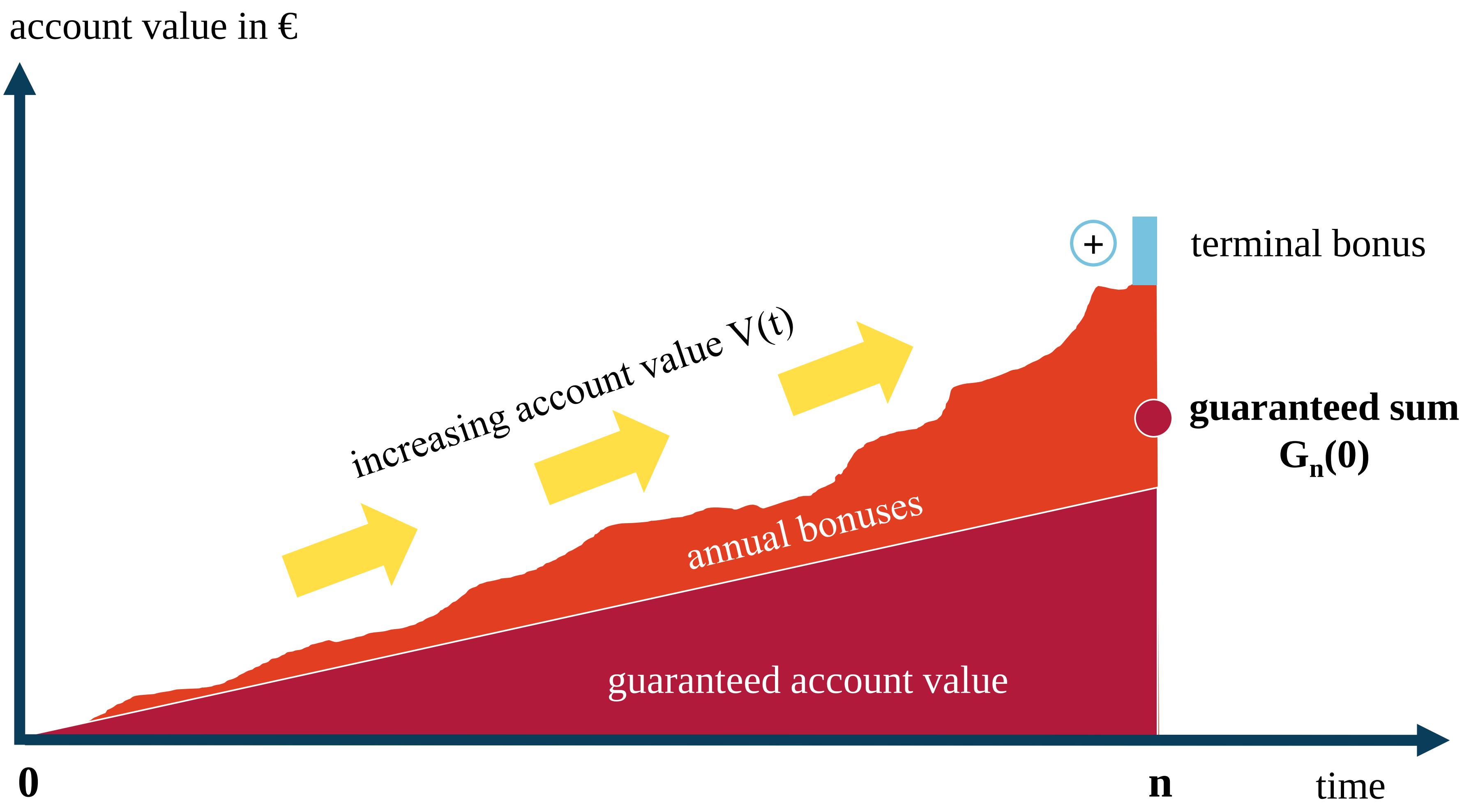
Characteristics of new, capital efficient annuity products

- Bonuses only increase account value but not guaranteed annuity
- "Reset" of guaranteed annuity at the time of annuitization
- Reduction of (annual) guaranteed rates
- "Repricing" of policyholder options

→ Significant reduction of risks within the "class" of traditional annuities

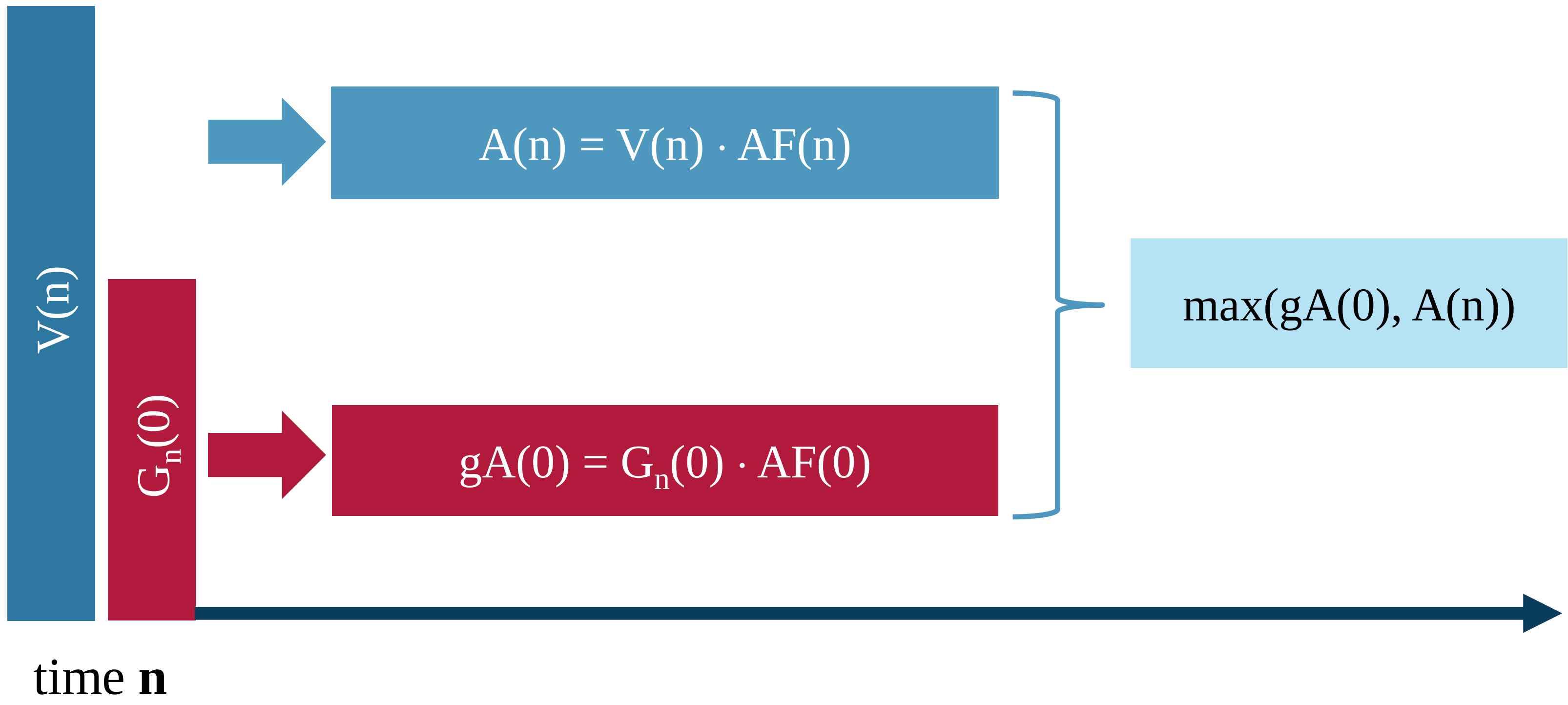
2. New Capital Efficient Annuity Products

Development in time



2. New Capital Efficient Annuity Products

Annuitization



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Example: Traditional vs. Capital Efficient Annuities

	traditional	**capital efficient**
Guaranteed rate at maturity	1.25 %	1.25 %
Guaranteed annual rate	1.25 %	**0.25 %**
Annual rate used for bonus amount	1.25 %	**0.25 %**
Guaranteed annuity at **t = 0**	Guaranteed Sum x AF(**0**)	Guaranteed Sum x AF(**0**)
Guaranteed annuity at **t = n**	Account Value(n) x AF(**0**)	Account Value(n) x AF(**n**)
Guaranteed rate for additional premiums	1.25%	**current statutory rate** (HRZ)

2. New Capital Efficient Annuity Products

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Illustration: Traditional Product vs. Capital Efficient Product (1/3)

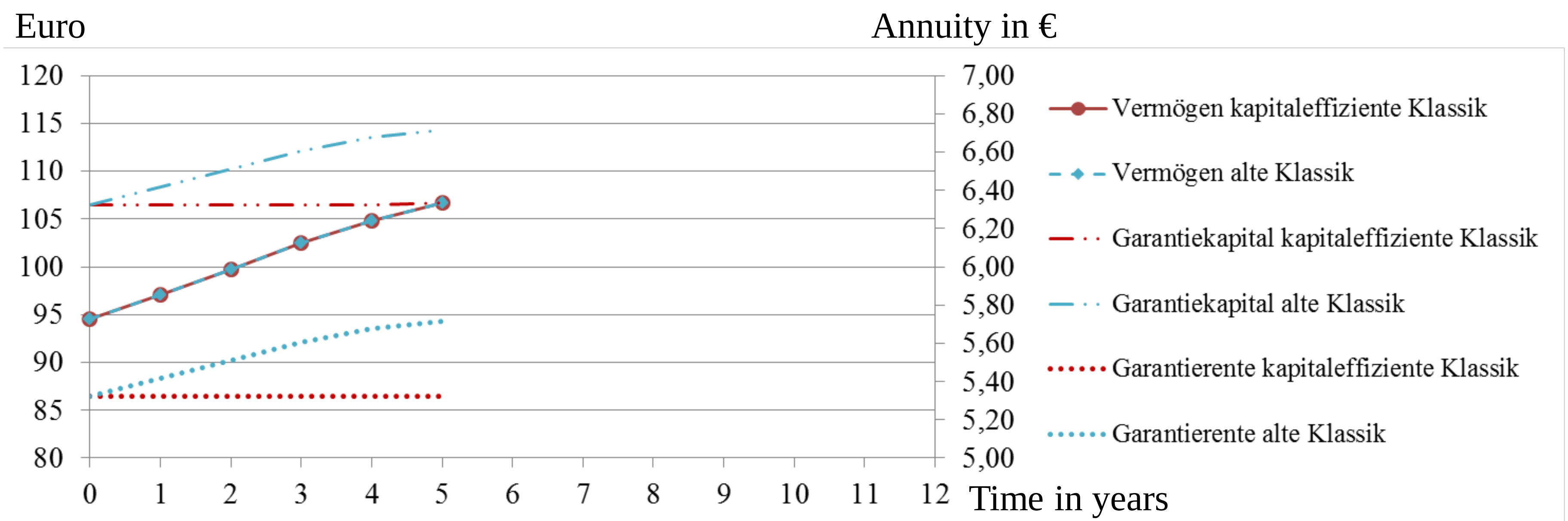
- Assumptions
  - Single Premium 100 Euro
  - Initial cost loading 5.50 Euro
  - 0.25% annual fee on AUM
  - Guaranteed rate at maturity = 1.25%
  - Annual guaranteed rate 1.25% and 0.25%, respectively
  - Time to maturity 12 years
  - Total credited rate decreasing over time from 3.0% to 0.5%

- Development of account value
  - Traditional product: **$V(j+1) = V(j) \cdot (1 + 1.25\% + bonus(j))$**
  - Capital efficient product: **$V(j+1) = V(j) \cdot (1 + 0.25\% + bonus^*(j))$**

- Development of guaranteed sum G_n
  - Traditional product: **$G_n(j+1) = G_n(j) \cdot (1 + 1.25\% + bonus(j)) / (1 + 1.25\%)$**
  - Capital efficient product: **$G_n(j+1) = G_n(j)$**

2. New Capital Efficient Annuity Products

Illustration: Traditional Product vs. Capital Efficient Product (2/3)



Observations

- At beginning identical guaranteed sum and guaranteed annuity
- Identical growth of account value as long as total rate ≥ 1.25%
- Traditional product: guaranteed sum and annuity grow with total rate
- Capital efficient product: account value ≥ guaranteed sum after 5 years

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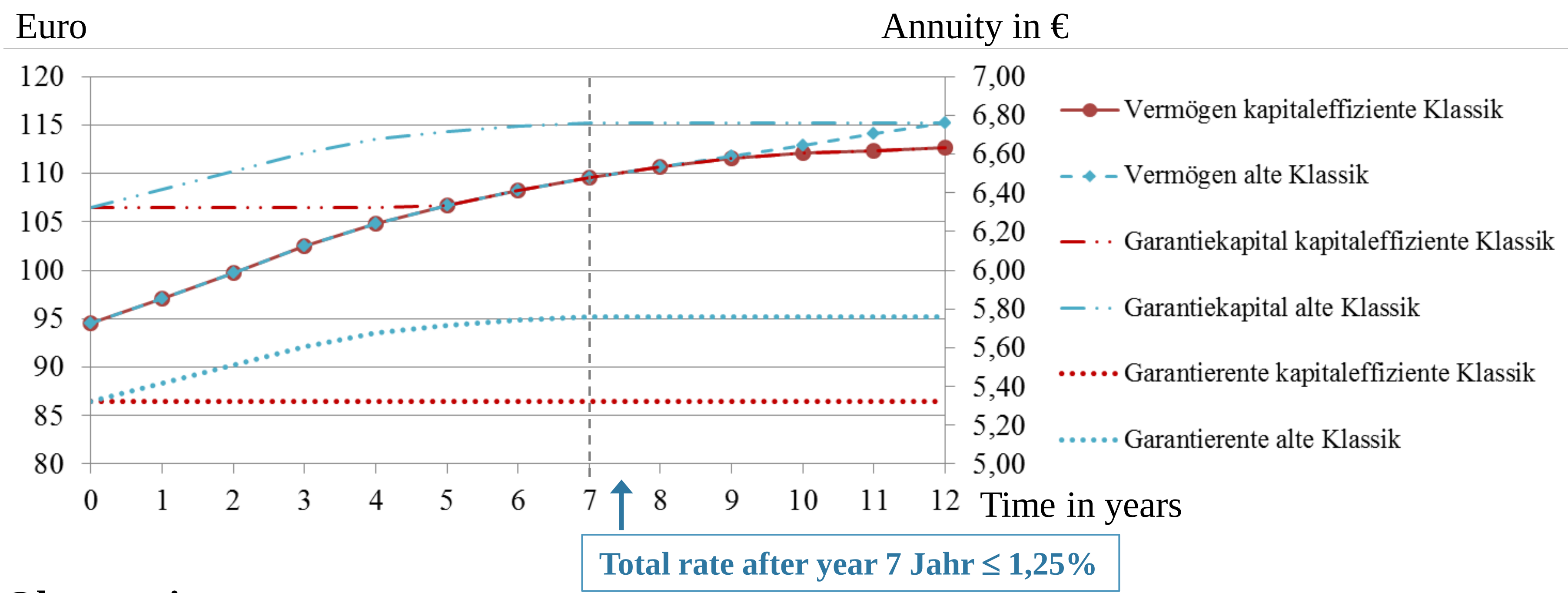
Illustration: Traditional Product vs. Capital Efficient Product (3/3)



Observations

- Trad. product: guarantees do not increase after year 7, but account value still growing at 1.25%
- Account value of capital efficient product increasing at total rate

→ Capital efficient product saves capital in low interest rate environment

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Value of Options & Guarantees

Approach 1 ("value of shortfall")

$$O\,\&\,G_1 = \mathbf{E}\left[\delta_{0,T}\cdot \max\left(Garantie\left(T\right) - Wert\ Assets\left(T\right),0\right)\right]$$

Approach 2 ("reduction in shareholder value")

$$O\,\&\,G_2 = \mathsf{E}[SH_{\text{det}} - SH]$$

where SH denotes shareholder profits

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Value of Options & Guarantees

Analysis of different capital efficient annuities vs. traditional annuity (accumulation phase)

tradional annuity with guaranteed rate 0.9%

a) total guaranteed rate 0.0%, annual guaranteed rate 0.0%

b) total guaranteed rate 0.9%, annual guaranteed rate 0.0%

c) total guaranteed rate 0.9%, annual guaranteed rate –100%

- credited rate based on 5-year average of 10Y rates and equity returns
- single premium, time to annuitization 30 years
- value of O&G relative to single premium

Product	O&G1	O&G2
traditional	2.57%	1.34%
new a)	0.76%	-0.49%
new b)	1.47%	0.21%
new c)	1.35%	0.10%

2. New Capital Efficient Annuity Products

Annuitization

- Traditional product

$$\mathbf{gA^{trad}(n) = V(n)\,AF(0) = G_n(0)\,AF(0) + (V(n) - G_n(0)) \cdot AF(0)}$$

- Capital efficient product

$$\mathbf{gA^{ce}(n) = \max(V(n)\,AF(n),\, G_n(0)\,AF(0))}$$

$$\mathbf{= G_n(0)\,AF(0) + (V(n)\,AF(n) - G_n(0)\,AF(0))^+}$$

- **Example**
  - $G_n(0) = 1.000$, $AF(0) = 5\%$ → $gA(0) = 50$
  - $V(n) = 1.500$, $AF(n) = 4\%$
  - $gA^{trad}(n) = V(n)\,AF(0) = 75$
  - $gA^{ce}(n) = \max(V(n)\,AF(n), gA(0)) = \max(60, 50) = 60$

→ C.e. product: bonuses from accumulation phase act as risk buffer at the time of annuitiziation

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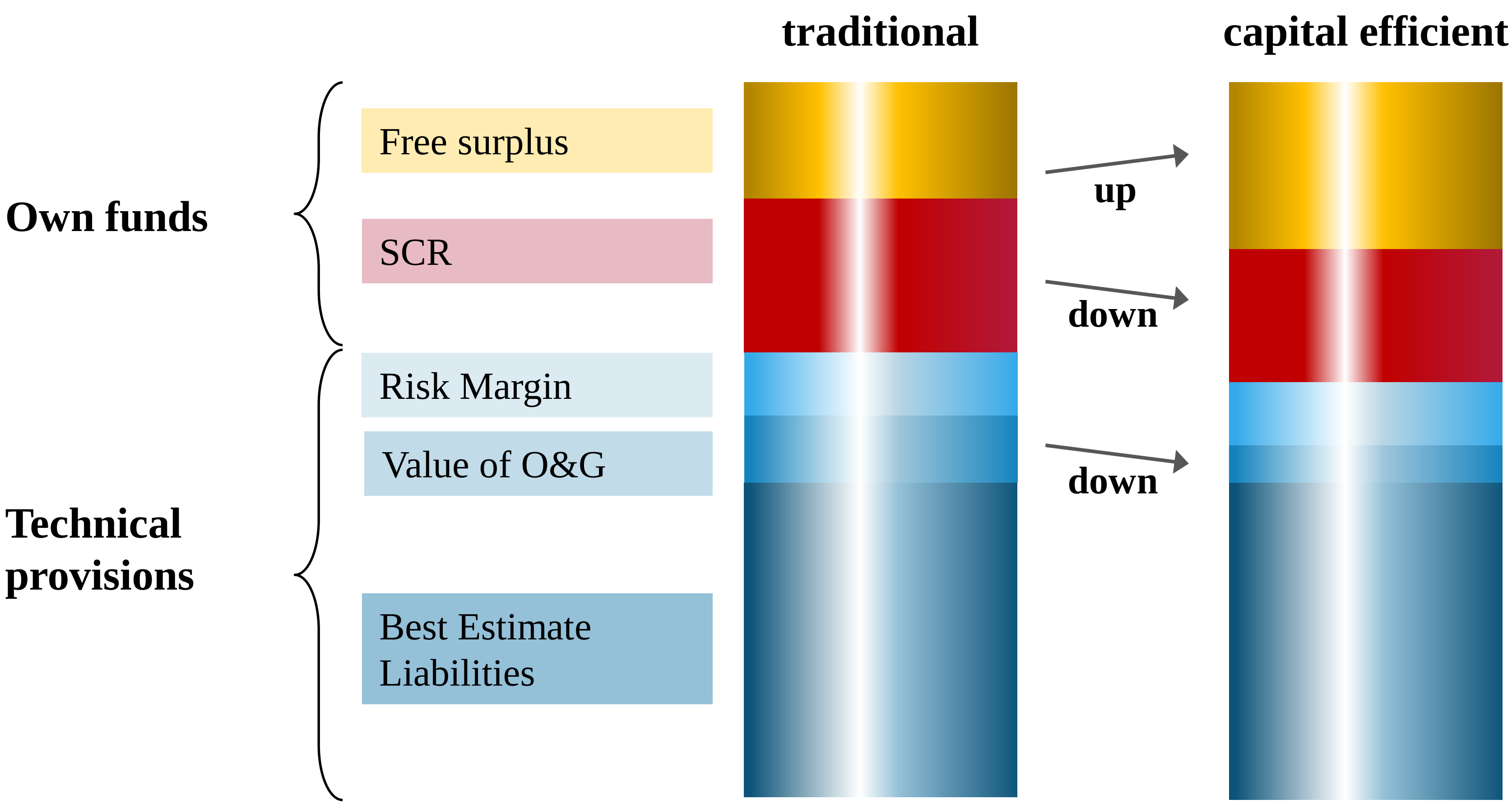
Effects on Solvency II Balance Sheet



→ Capital efficient products c.p. increase free surplus in SII balance sheet

3 Valuation of Long-Term Guarantees

3. Valuation of Long-Term Guarantees

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General remarks

- Valuation approach should be aligned with the scope of the valuation, e.g.
  - → Valuation of a exchange-traded option vs. valuation of a insurance product without market price
  - → Analysis of profitability vs. determination of statutory solvency
- "No Arbitrage" is generally useful but often not applicable in insurance.
- "Market consistency" provides a guideline for valuation but is useless if there are no market prices.
- "Numerical" market consistency and "market consistent techniques" (e.g. martingale pricing) should be distiguished.
- Life insurance products with long-term guarantees are typically not traded on markets and have embedded biometric risks …

3. Valuation of Long-Term Guarantees

Active Market Segments

A market segment is **active** if the following conditions hold

[Transparency]

All relevant market data are available.

[Liquidity]

Transactions of any size are possible at all times and have no influence on prices.

[Depth]

The number of counterparties and tradable instruments is sufficiently large.

Solvency II (e.g.) based on assumption that all relevant market segments are active

3. Valuation of Long-Term Guarantees

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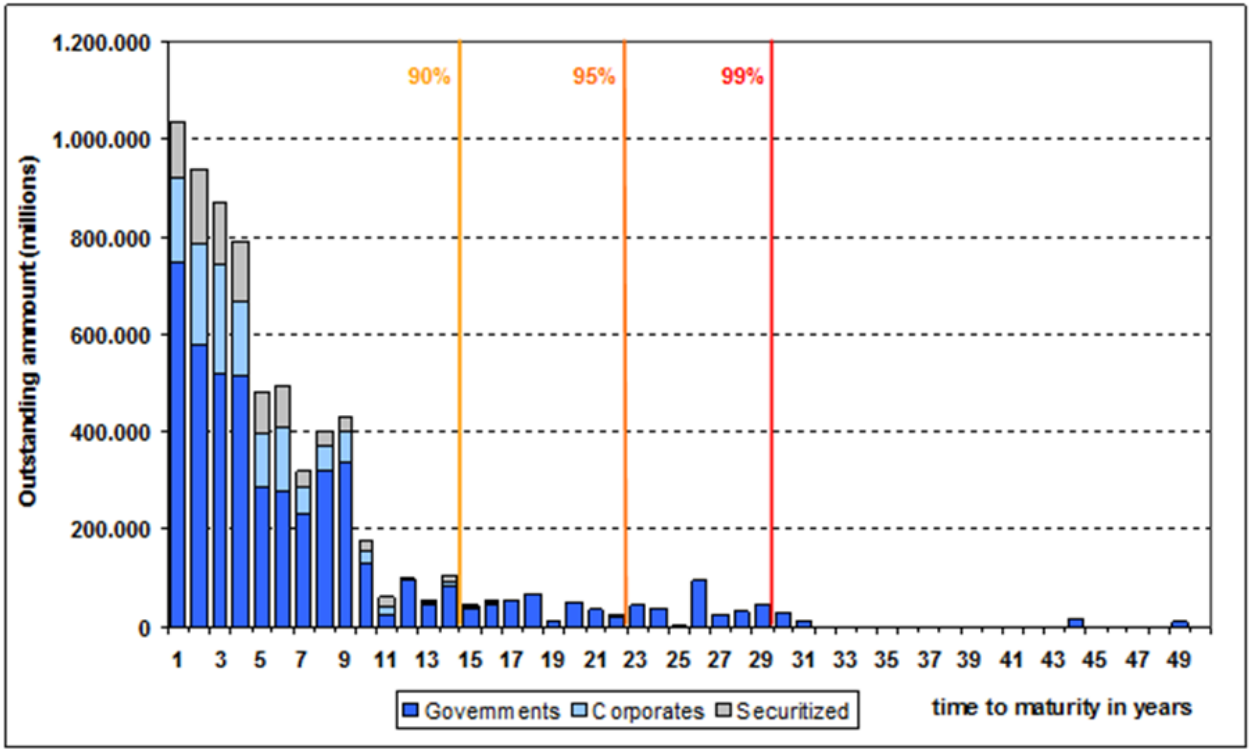
Reality Check

- Bond market is only active for durations of less then 20 years. → ECB has exacerbated the problem



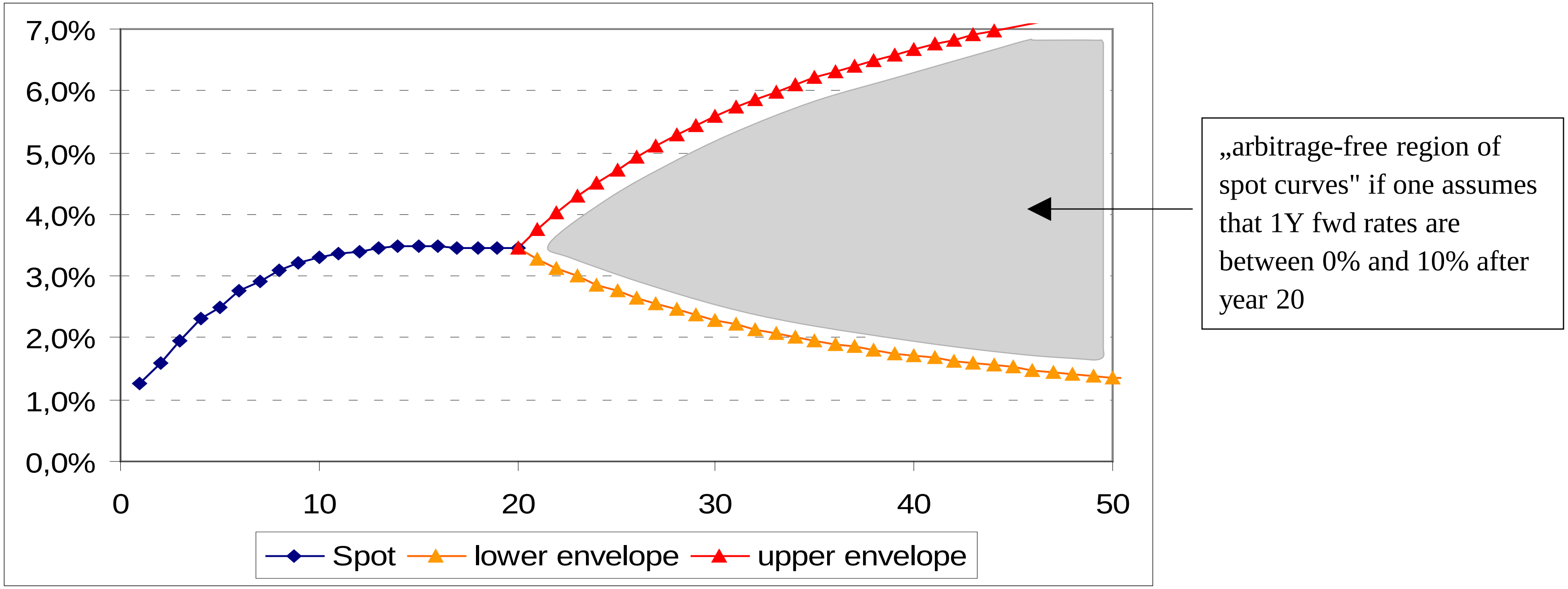
Quelle: Barclays Euro Aggregate Q1 2011

- Other valuation parameters like implied volatilities are also not reliable for long durations.

3. Valuation of Long-Term Guarantees

"No Arbitrage" is not sufficient for uniqueness of reserves

- Assume that the bond market is active for durations ≤ 20 years
- Assume that cash can be held at zero cost



3. Valuation of Long-Term Guarantees

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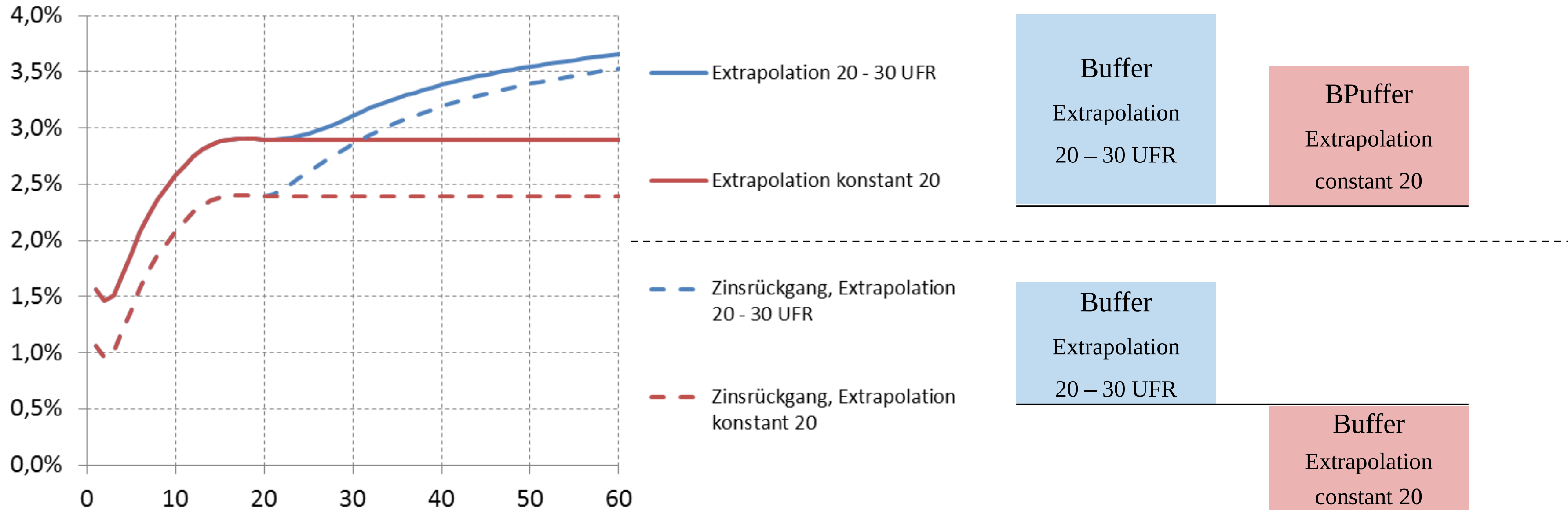
Example: Stability of a Solvency II Balance Sheet

- 40Y guarantee backed by 20Y zero bond
- Extrapolation of fwd rates from year 20 to 30 to UFR vs. extrapolation using 20Y rate
- Compare buffers before and after an increase in interest rates for durations ≤ 20 years



3. Valuation of Long-Term Guarantees

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A Principle-Based Valuation Approach (1/2)

I. Market Consistent Valuation for Active Market Segments (Mark-to-Market)

The capital market model replicates observable market data from active market segments.

II. Market Consistent Valuation Based on a Best Estimate for Inactive Market Segments (Mark-to-Model)

For market data from inactive market segments appropriate assumptions should be used to obtain a best estimate.
This affects both market data from permanently inactive market segments (for example long-term interest rate instruments or medium or long-term volatilities) and market data from temporarily inactive market segments (e.g., in the case of interruptions in trading ortemporary illiquidity).

III. No Arbitrage in the Combined Model in Accordance with Principles I and II

The capital market model in accordance with Principles I and II is based on no arbitrage. In particular, it does not contradict observable market data from active market segments.

A Principle-Based Valuation Approach (2/2)

IV. Consistency with Economic Conditions

When calibrating capital market models degrees of freedom arise. The resulting capital market model should not contradict existing conditions and common economic assumptions.

V. Asymptotic Behaviour in Times of Constant Capital Market Movements

In the event of temporary inactivity of a market segment the capital market model converges to a capital market model calibrated on a given reference date if the capital market is constantly moving sideways.

VI. Consistency of Valuation

When using mark-to-model valuation in accordance with Principles II and IV the assumptions used should be maintained provided there are no evident reasons to modify the valuation approaches.

VII. Transparency

The assumptions made for calibrating the capital market model should be explained in a transparent and comprehensible manner.

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