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Return Smoothing and Risk Sharing Elements in Life Insurance from a Client Perspective

(based on joint work with Jochen Ruß)

Agenda

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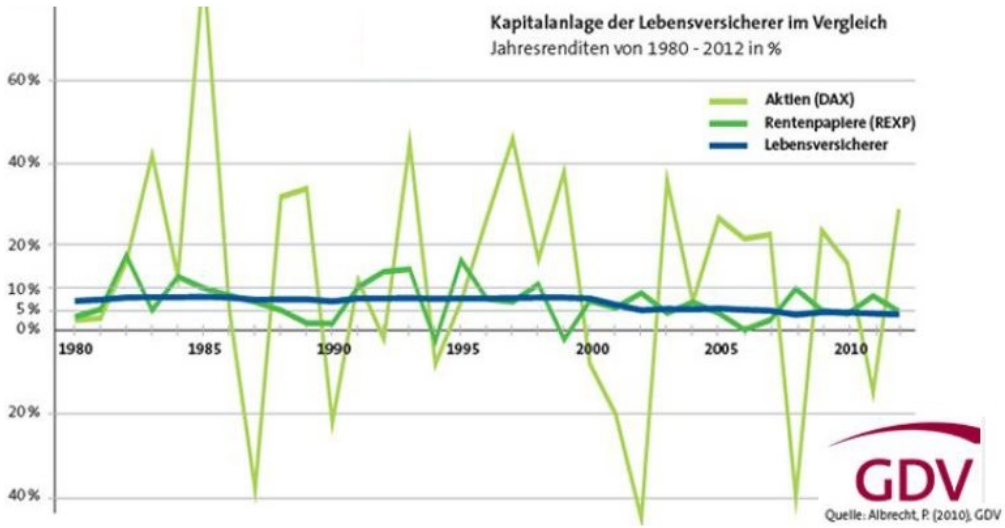
Motivation

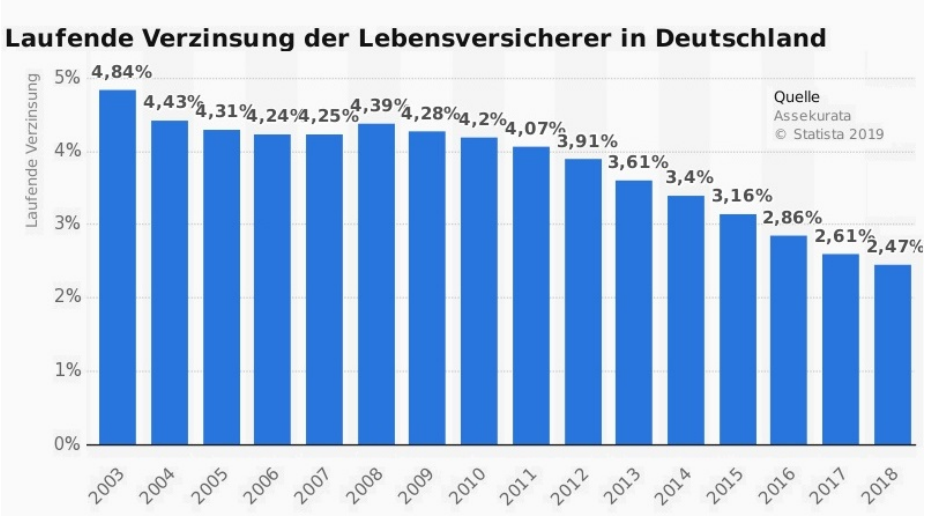
- **Traditional participating life insurance** (TPLI) contracts have been the core business of life insurers for many years.
  - typical components of TPLI contracts:
    - provide a year-to-year (cliquet) guarantee
    - receive additionally a surplus participation
  - main difference to individual retirement savings products:
    - life insurers pool assets and liabilities of a heterogeneous portfolio of TPLI contracts which allows for return smoothing and risk sharing.
      $\Rightarrow$ results in rather stable investment returns



Motivation

- (Current) challenges:
  - low interest rate environment
  - rather restrictive solvency requirements
    - allows only for low risk taking (due to rather high guarantees)

  $\Rightarrow$ total interest rate of TPLI contracts have decreased



- smoothing and risk sharing mechanisms can reduce volatility of returns, but cannot compensate long-term decline in the capital market returns

Motivation

- However, versions of TPLI contracts are still popular in the segment of retirement savings

Q: Why are TPLI contracts so popular?

- How do clients perceive and evaluate TPLI contracts?
- Which features make TPLI contracts attractive?
  - role of smoothing and risk sharing elements
  - role of guarantees

- Approach:
  - we model these elements in detail by means of a stylized insurance company within a stochastic model framework
  - apply a descriptive model to analyze the impact of these elements from a client perspective
  - compare results for TPLI products with results for unit-linked products

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Decision Making of Long-term Investors

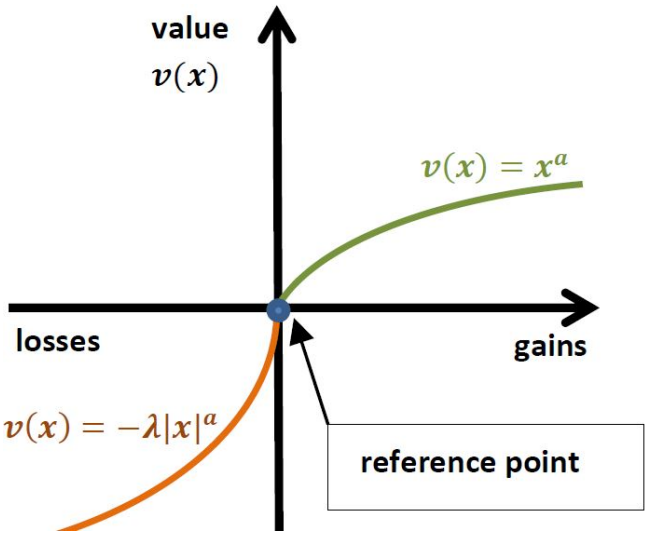
How do clients perceive and evaluate TPLI contracts?

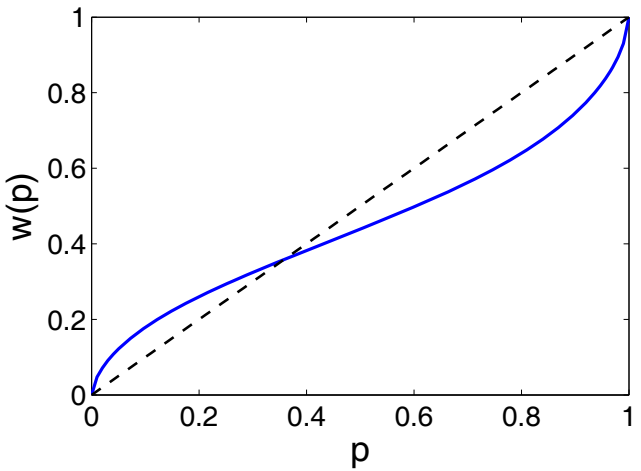
- Decision making of humans (often) depends on heuristics which can lead to cognitive biases and systematic deviations from rational decisions.
- A popular descriptive model of decision making is **Cumulative Prospect Theory** (CPT):
  - introduced by Tversky and Kahneman (1992)
  - descriptive model that tries to give a more accurate description of actual decision making
  - models several cognitive biases
  - consideration of gains and losses with respect to a reference point instead of the total wealth

Decision Making of Long-term Investors

Main components of CPT:

- S-shaped value function (v)
- different treatment of gains (concave) and losses (convex) (α)
- loss aversion w.r.t. a reference point (λ)
- probability distortion function (w)
- tail events with small prob. are overweighted (γ)





Decision Making of Long-term Investors

Common approach in this context:

- Consideration of the distribution of the total change in wealth, i.e.,

$$X := P_T - P_0$$

  with P_t denoting the level of wealth at time t.

- The CPT (subjective) utility is then defined as

$$CPT(X) := \int_{-\infty}^{0} v(x) d\left(w\left(F(x)\right)\right) + \int_{0}^{\infty} v(x) d\left(-w\left(1 - F(x)\right)\right)$$

  with $F(s) = \mathbb{P}(X \leq s) = \int_{-\infty}^{s} d\mu_X$.

- However, several studies (e.g., Benartzi and Thaler, 1995) indicate that long-term investors tend to take into account future annual value changes already when making the investment decision.

Decision Making of Long-term Investors

- Ruß and Schelling (2018) propose a model (MCPT) that considers a long-term investor whose investment decision is based on the distributions of all future annual value changes rather than solely on the distribution of the terminal outcome.
- Studies (Ruß and Schelling, 2018; Graf et al., 2018) indicate that MCPT describes long-term decision making more accurately.

The MCPT value at $t_0 = 0$ of investment A with maturity T and annual value changes $\{X_t\}_{t=1}^{T}$ with $F_t(x) = \mathbb{P}(X_t \leq x)$ is defined by

$$MCPT(A) := \sum_{t=1}^{T} CPT(X_t),$$

where $CPT(X_t) = \int_{-\infty}^{0} v(x)\,\mathrm{d}\big(w\left(F_t(x)\right)\big) + \int_{0}^{\infty} v(x)\,\mathrm{d}\big(-w\left(1-F_t(x)\right)\big)$.

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Model Framework[1]

- We consider the following TPLI contract:
  - policyholder with initial age of $x = 40$ years
  - term to maturity $T = 20$ years
  - annual premium P derived by principle of equivalence
  - annual charges c_t^p
  - total interest rate is based on
    - annual guaranteed interest rate $i^g = 1.25\%$ (cliquet style)
    - additional surplus participation

      $\Rightarrow$ depends on smoothing and risk sharing elements

      $\Rightarrow$ based on a stylized insurance company

[1] For more information see preprint Ruß and Schelling (2018b).

Model Framework

- Main aspects of the **stylized insurance company**
  - heterogeneous insurance portfolio
    - at the beginning of each year a new cohort of contracts joins
    - contracts differ w.r.t. guaranteed rate and contract inception
    - initial portfolio has been built up over the previous T years based on a historic deterministic scenario
  - collective assets
    - portfolio of coupon bonds and stocks
    - strategic annual rebalancing of the asset allocation (stock ratio $\approx 10\%$)
    - differences in market and book values of the assets may result in unrealized gains and losses
  - investment surplus is the only source of surplus [2]
    - $\geq 90\%$ of the investment return are distributed to the policyholder ($\rightarrow$ collective RfB)
  - (collective) reserves for premium refunds (collective RfB)
    - can be used as buffer to smooth returns for clients

[2] first and second-order mortality rates and charges coincide, no lapses, tax payments etc.

Model Framework

- **Surplus distribution**:
  - total investment return of the insurance company i_t^* is mainly based on
    - coupon payments
    - building up and dissolving unrealized gains and losses
  - Insurer stipulates in advance the total interest rate ${}_k i_t$ of the policyholder at the beginning of each year (for each cohort k)
    - subject to further smoothing and risk sharing elements
    - credited at the end of each year (collective RfB $\rightarrow$ account value)
  - total interest rate ${}_k i_t$:
    1. based on average total investment returns of the last 3 years ($\overline{i_t^*}$)
    2. insurer reduces (increases) ${}_k i_t$ in case of rather low (high) reserves ($\Delta reserve$)
    3. at least guaranteed interest rate (i_{t-k}^g)
    4. expiring contracts receive addional terminal bonus rate (i_t^{term})

$$i_t = 0.9 \cdot \overline{i_t^*} + \pi \cdot \Delta reserve \quad (\pi \text{ adjustment factor})$$

$$\Rightarrow {}_k i_t = i_{t-k}^g + \max\left\{i_t - i_{t-k}^g, 0\right\}$$

$${}_k i_t = \max\left(i_t + i_t^{term}, i_{t-k}^g\right) \quad \text{(at maturity)}$$

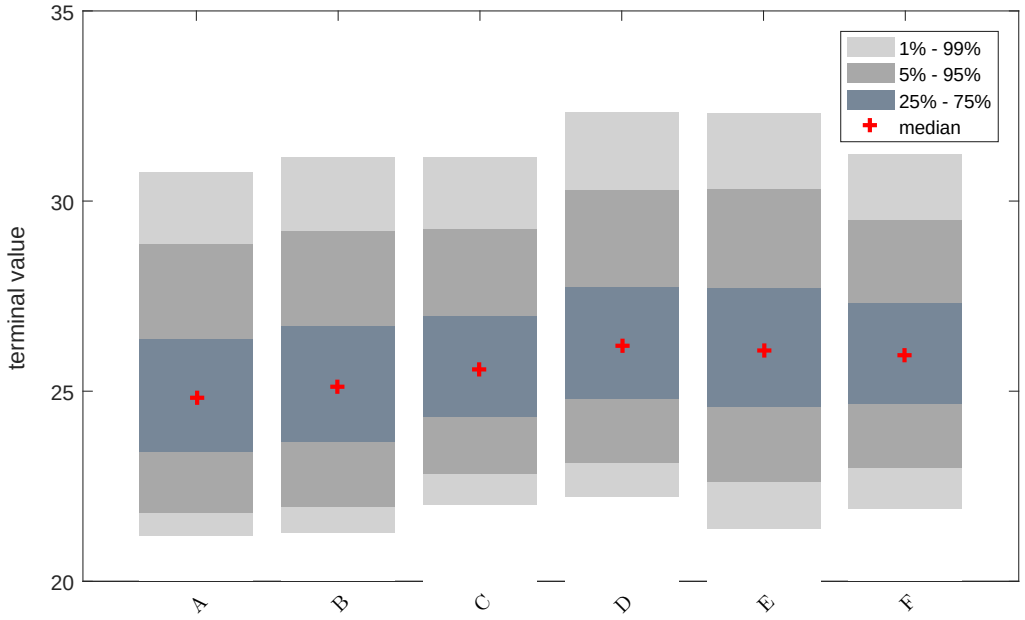
Model Framework

- Impact of **systematic intergenerational effects**:
  - E.g. new contracts possibly ...
    - subsidize old contracts (with much higher guaranteed rates)
    - benefit from assets that have been bought in the past.
  - impacts of different aspects are not intuitively clear
  - Eckert et al. (2018) propose a measure for the ex ante "collective bonus"
    - contract receives an ex ante "collective bonus" if on average it will earn more than an investment in a reference portfolio that replicates the market values of the assets of the insurance company
    - we consider the ex ante collective bonus in relation to the fair value of the investment in the reference portfolio ($CB^{\%}$)
  - Some contract settings:
    - Contract A (base case): $CB^{\%} = -6.12\%$.
    - Contract B ($+\ \Delta reserve = 0$ at inception): $CB^{\%} = -5.08\%$
    - Contract C ($+$ all contracts have the same guaranteed rate): $CB^{\%} = -2.31\%$
    - Contract D ($+$ increase surplus participation to $\approx 97\%$): $CB^{\%} = 0\%$

Agenda

Selected Results

Percentiles of the terminal value:



E: unsmoothed investment in the reference portfolio replicating the market value of the assets of the insurance company ($CB^{\%} = 0\%$).

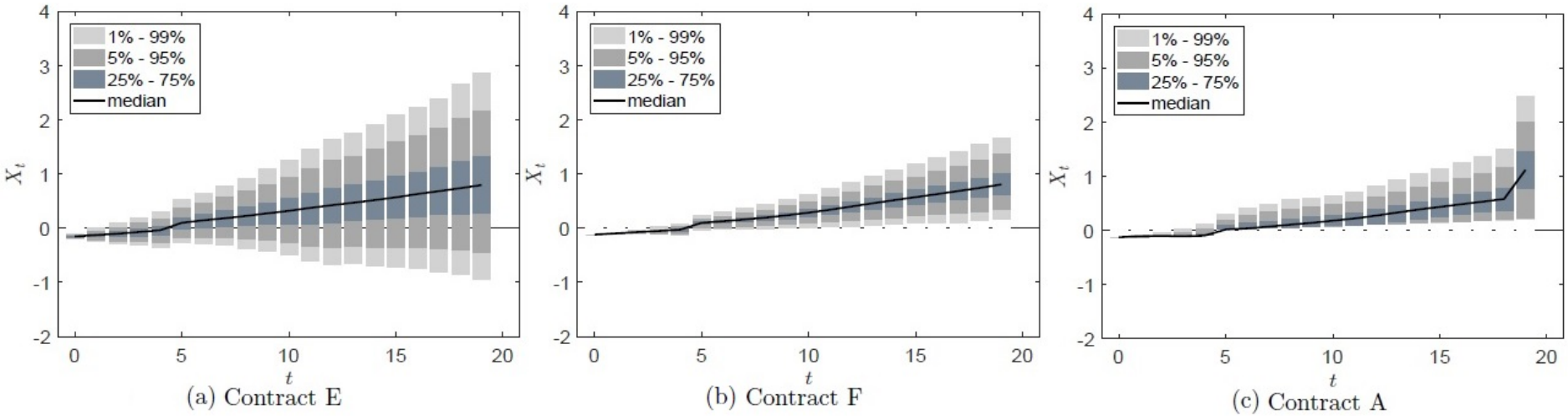
F: investment that earns the average investment return $\overline{i_t^*}$, that is, only asset smoothing but no further risk sharing ($CB^{\%} = -1.38\%$).

$\Rightarrow$ Rather similar risk-return characteristics of the terminal value

Selected Results

Percentiles of the annual changes:

- $X_t = A_t - \overline{A}_{(t-1)+}$ with $\overline{A}_{(t-1)+}$ denoting the account value at time $t-1$ plus the premium P paid at time $(t-1)+$



(a) Contract E (b) Contract F (c) Contract A

E: unsmoothed investment in the reference portfolio (a)

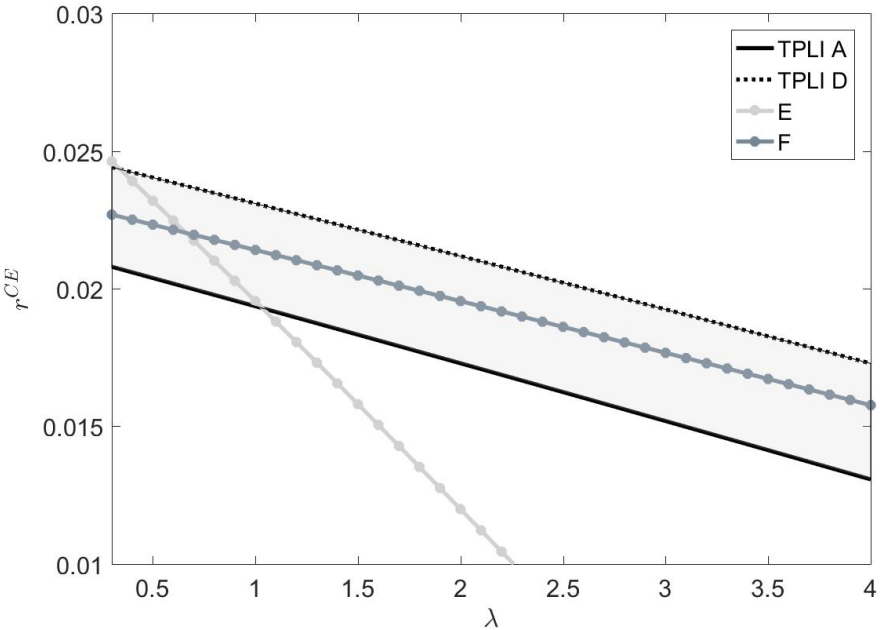
F: investment that earns the average investment return $\overline{i^*}_t$ (b)

A: TPLI (base case) (c)

$\Rightarrow$ Collective investment can heavily stabilize annual changes without significantly changing the risk-return characteristics of the terminal value

Selected Results

Results for an MCPT-investor[3]:



contract setting	return smooth.	risk sharing	i^g	coll. bonus
TPLI A	✓	✓	1.25%	−6.12%
TPLI D	✓	✓	1.25%	0%
E	✗	✗	✗	0%
F	✓	(✗)	✗	−1.38%

r^{CE} describes the guaranteed annual return that an investor would regard equally desirable as the considered contract.

- Contract E without return smoothing is significantly less attractive than other products.
- Result for contract F shows that collective smoothing elements heavily increases attractiveness.

[3] $\gamma = 0.65$ (probability weighting), $\alpha = 0.88$ (sensitivity to marginal gains and losses)

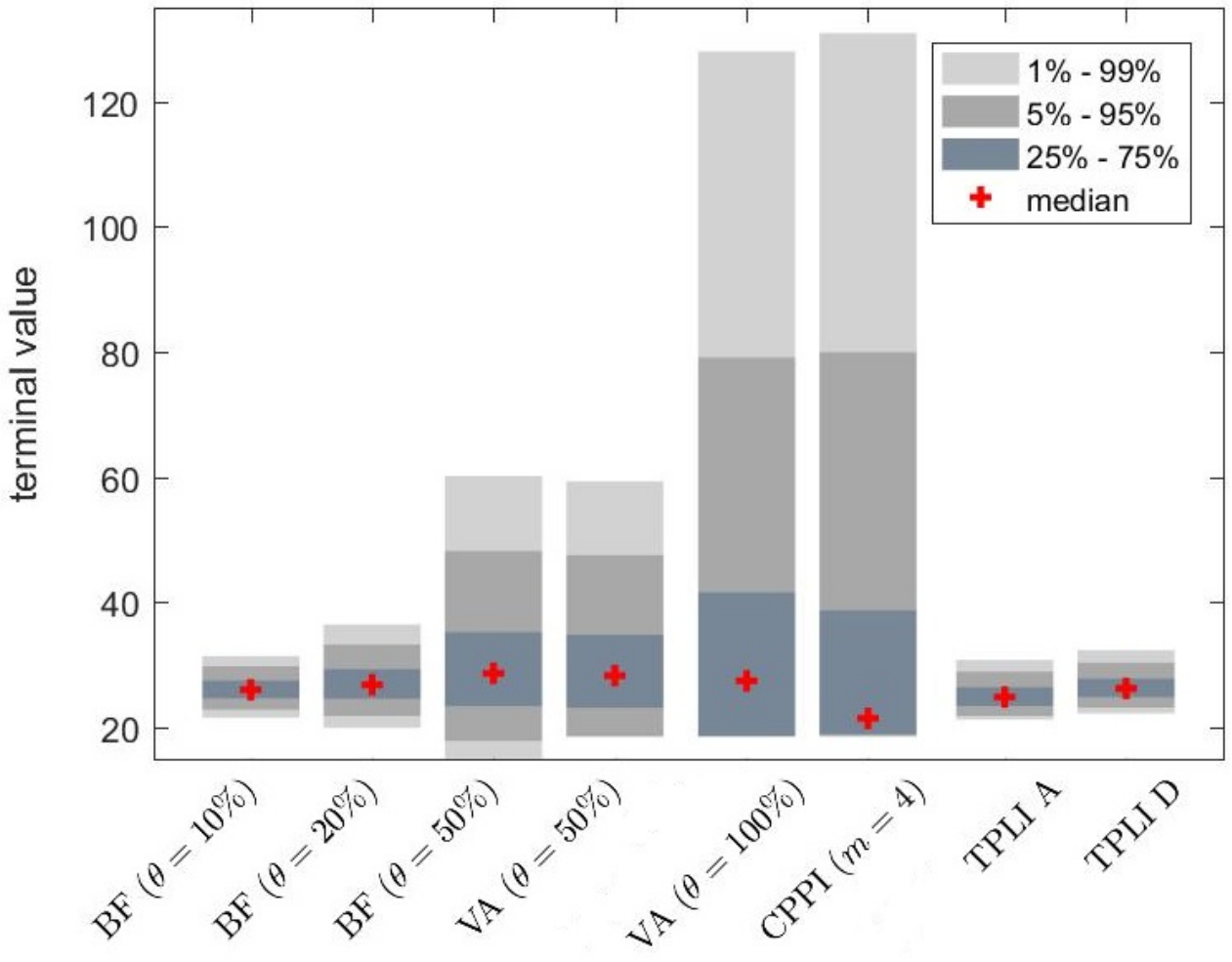
Selected Results

Comparison with common individualized **unit-linked products**:

- Products without guarantee
  - Balanced fund (BF) (invests $\theta \in [0,1]$ in risky and $(1-\theta)$ in a less risky asset)
- Products with guarantee
  1. Variable annuity (VA) products
     - ensure guarantee by a suitable hedging strategy (option-based)
  2. Constant proportion portfolio insurance (CPPI) products
     - achieve "guarantee" by dynamic investment strategy
  - considered guaranteed types for VA and CPPI products:
    (a) terminal guarantee only ("money-back")
    (b) additional annual cliquet-style guarantee
- additional charges for unit-linked products:
  - fund charges $\gamma^F = 1\%$
  - (fair) guarantee fees γ^g for VA products
  - charge for overnight risk $\gamma^{g,CPPI} \approx 0.1\% - 0.2\%$ for CPPI products

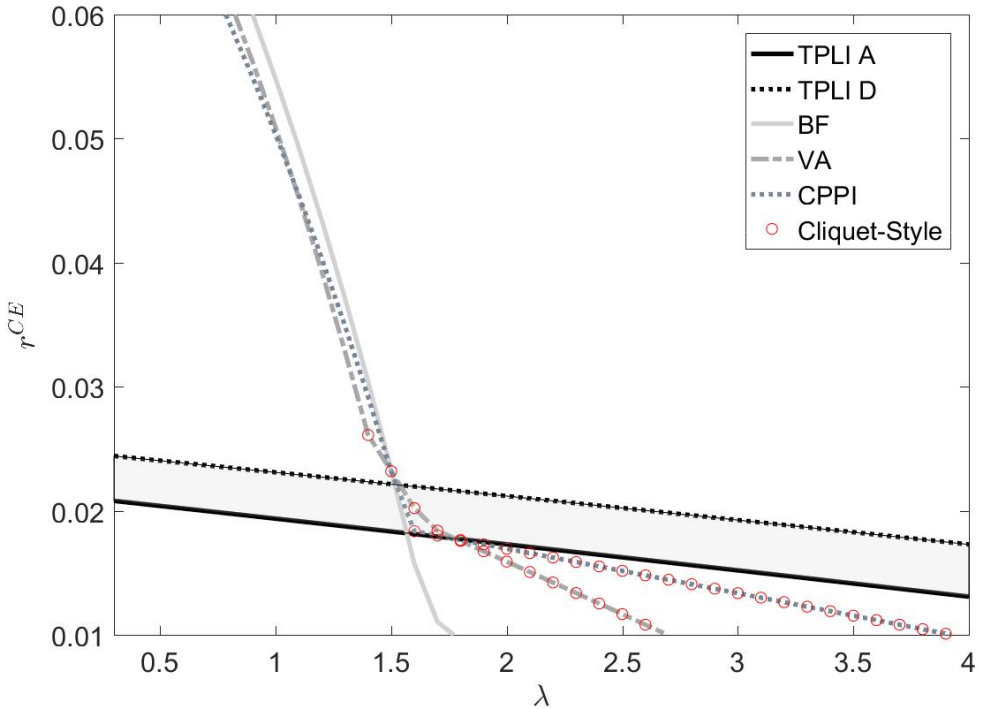
Selected Results

Exemplary percentiles of the terminal value:



Selected Results

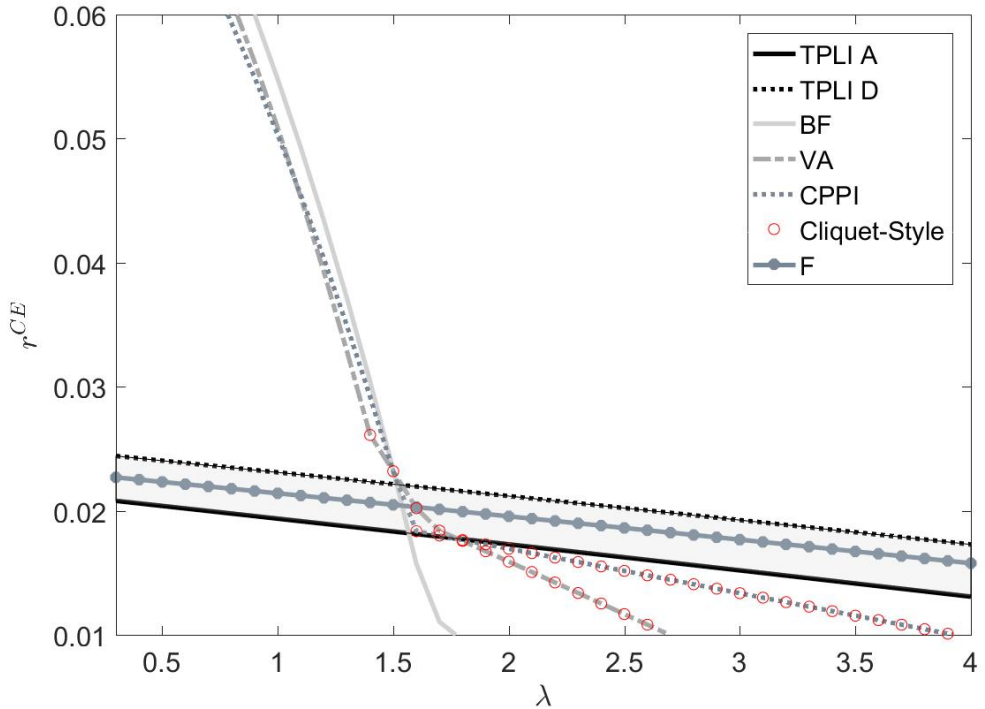
Results for an MCPT-investor:



- Unit-linked products (without guarantee) are significantly more attractive than TPLI contracts in case of low degrees of loss aversion ($\lambda \leq 1.5$)
- TPLI contracts are preferred over other products for typical degrees of loss aversion
  $\rightarrow$ note that this is even true for unit-linked products with annual guarantee feature!

Selected Results

Results for an MCPT-investor:



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Summary

- The **results show**:
  - collective investment can heavily stabilize annual returns without significantly changing the risk-return characteristics of terminal value
  - For an MCPT-investor:
    - Smoothing elements significantly increase the attractiveness (even in case without guarantee)
    - TPLI products are preferred over common unit-linked products

  $\Rightarrow$ MCPT provides an explanation for the popularity of traditional participating life insurance products

- Hence, the **results indicate** (w.r.t. product design) that participating products ...
  - which make use of smoothing and risk sharing elements of a collective investment and
  - with rather weak (or even without) guarantee features ...

  seem promising in ...
  - providing an objectively superior distribution of terminal value ...
  - while at the same subjectively being attractive for the customer.

Thank you for your attention!

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Selected References

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