Institut für Finanz- und Aktuarwissenschaften

Intertemporal Smoothing and Intergenerational Risk Sharing: The Impact on Objective Utility and Subjective Attractiveness of Retirement Savings Products

- Ulm Actuarial Day
- March 2025

- Timon Kramer
- Joint work with Alexander Kling, Jochen Ruß, and Stefan Schelling

Agenda

Introduction

Motivation and Objective of this Paper

- **Starting point:**
  - In traditional life insurance, policyholders participate in the same pool of assets.
  - Enables the implementation of various **return smoothing mechanisms**
    - Goal: Reduction of the volatility of the policyholders' return.
  - Concrete type of smoothing mechanism can have a significant effect on **risk-return-characteristics** cf. Kling et al. (2024).
    - Intertemporal smoothing reduces pathwise volatility.
    - Intergenerational risk sharing reduces uncertainty of terminal value.

- **This raises the question which type of smoothing mechanism results in a**
  - high **objective utility** according to standard economic models of rational decision making.
  - high **subjective attractiveness** for policyholders according to decision models of behavioral economics.

- Can we identify so-called "**compromise products**" which perform well in both dimensions?

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Capital Market and Products

The Capital Market Model and the Book Of Business (Kling et al. 2024)

Capital Market Model:

- On a finite time horizon $\mathbb{T} = [-T, T]$, our model consists of
  - a **risky asset** $(S_t)_{t\in\mathbb{T}}$ following a geometric Brownian motion

$$dS_t = S_t(\mu dt + \sigma dW_t)$$

    with constant drift μ and volatility σ.
  - a **risk-free asset** given by

$$\beta_t = e^{r(t-(-T))}$$

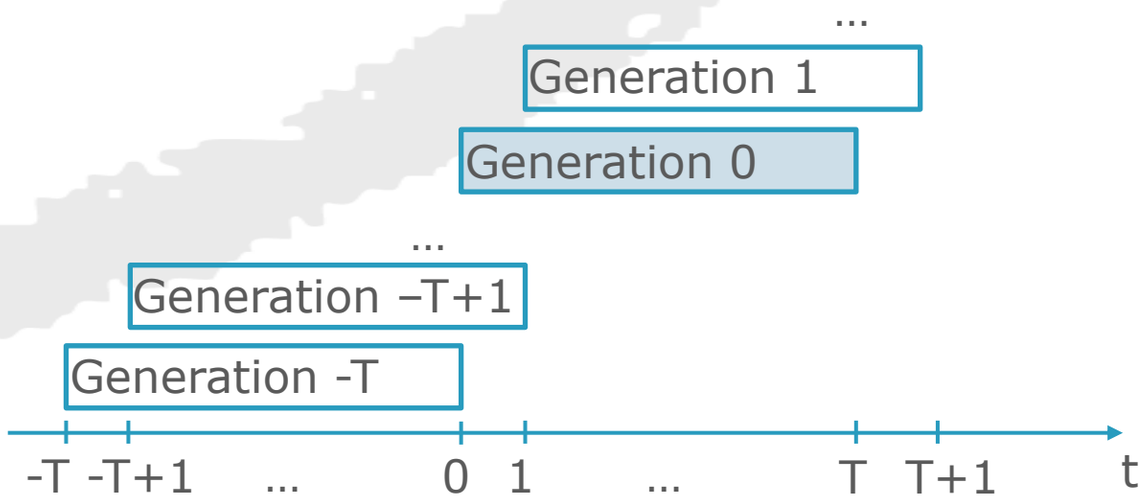
- From these we derive a fund process F^{δ}

$$dF_t^{\delta} = F_t^{\delta}(\delta\frac{dS_t}{S_t} + (1-\delta)\frac{d\beta_t}{\beta_t})$$

  with $\delta \in [0,1]$.

Book Of Business:

- Policyholder pays a single premium at the start of the contract.
- After T years policyholder's account is paid out.
- Based on different generations buying the same contract at different points in time.
- The set of all generations is $\mathcal{H} = \{-T, \dots, T\}$.
- Analysis focuses on the generation entering at time $t = 0$ while the company is in a going-concern state.



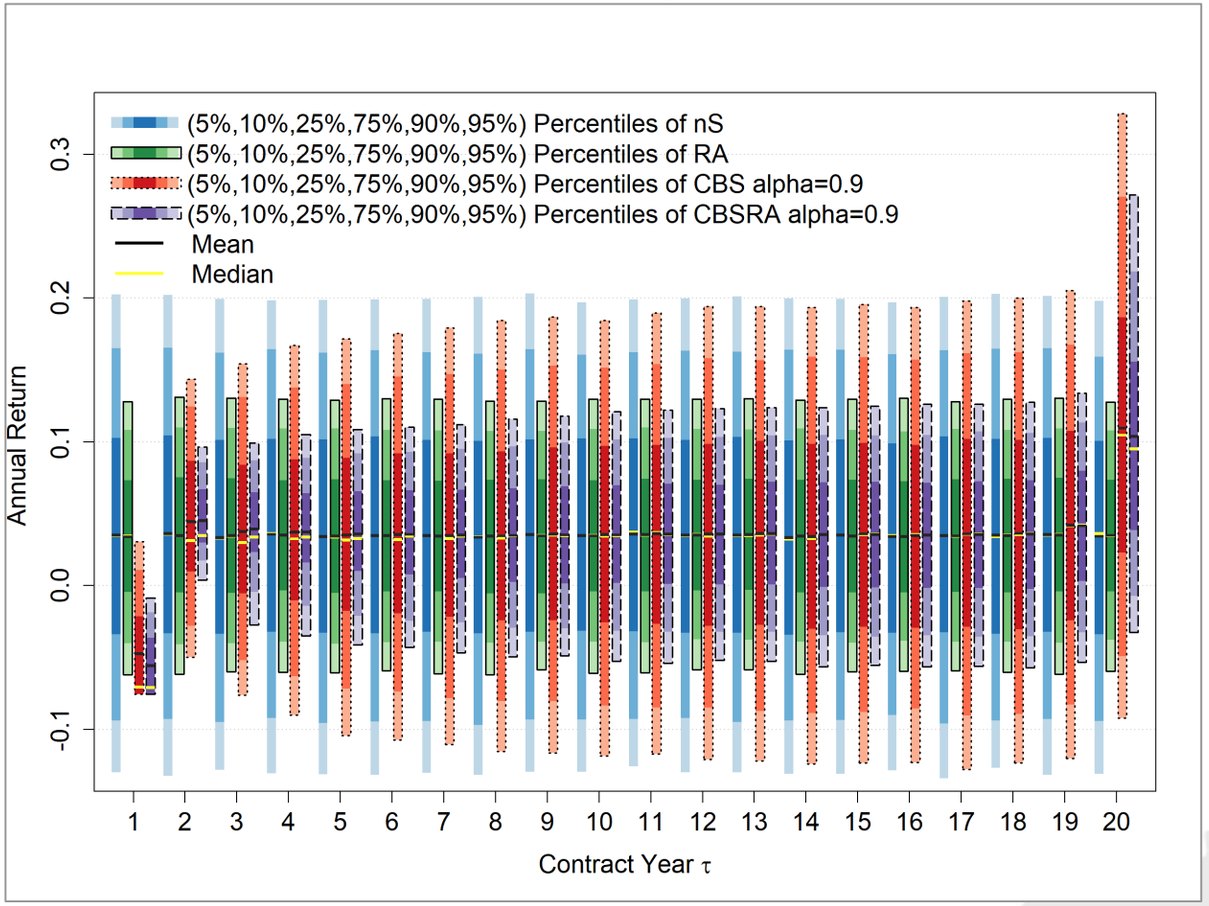
Capital Market and Products

Smoothing Mechanisms (Kling et al. 2024)

- Intertemporal Smoothing: **Return Averaging (RA) - 16** products
  - Return = average return of the past 3 years
- Intergenerational Risk Sharing: **Collective Buffer Smoothing (CBS) - 64** products
  - Policyholders pay a share $(1-\alpha)$ of their premium into a buffer account.
  - The buffer account is used to keep the annualized return of the policyholders' account within some target range.
  - Payment of a terminal bonus.
- Combination of the approaches: **Collective Buffer Smoothing and Return Averaging (CBS RA) - 64** products
- Additionally: **Product with no smoothing (nS) - 16** products
- For the model we use the following parameters: $T = 20$, $P = 10{,}000$, $r = 2\%$, $\mu = 6\%$, and $\sigma = 20\%$.
- For the fund process, we consider different levels of $\delta \in \{0.25, 0.3, \dots, 0.95, 1.0\}$.
- For collective buffer smoothing, we consider four different degrees of intergenerational risk sharing $\alpha \in \{0.9, 0.95, 0.98, 1.0\}$.

Capital Market and Products

Effects of Return Smoothing on Annual Returns



Return Averaging:

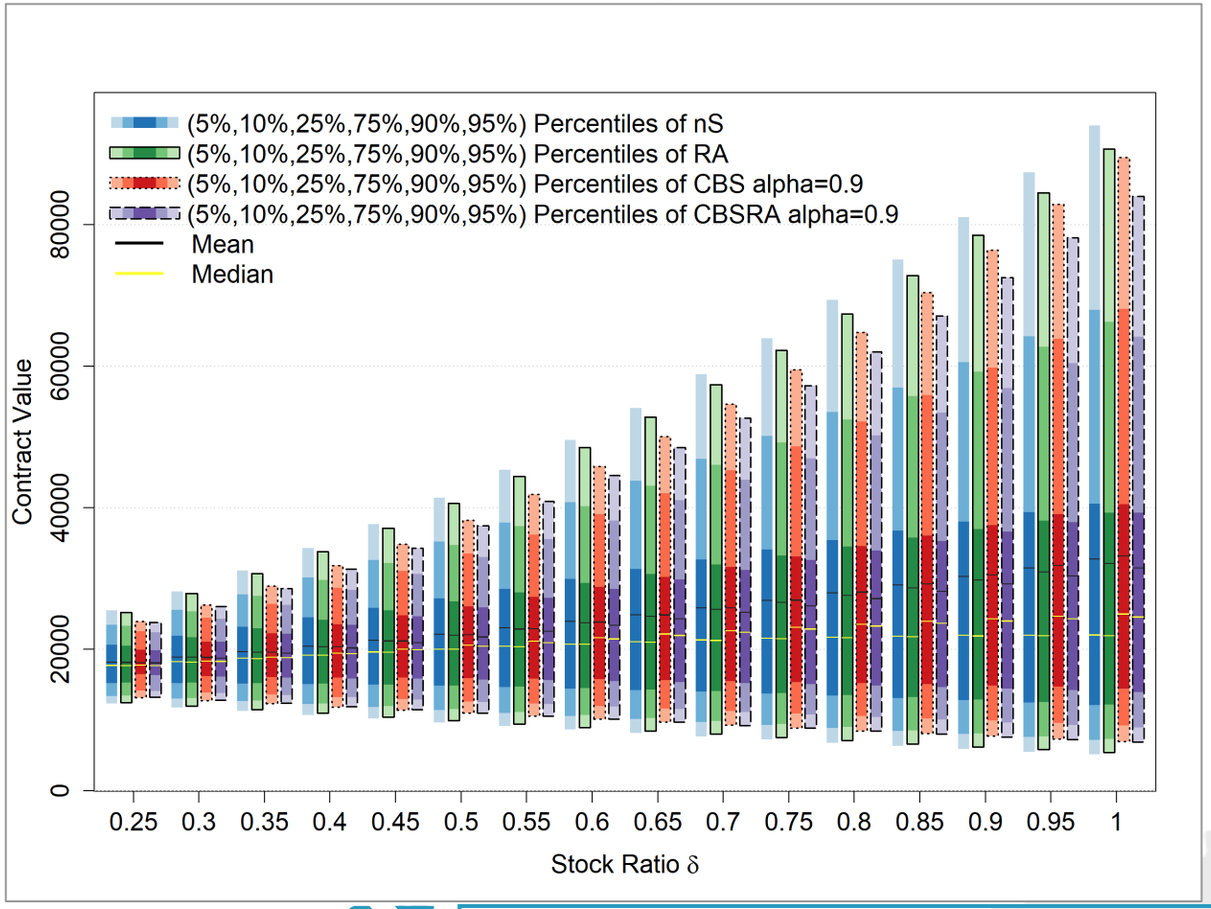
- Strong reduction of standard deviation of annual returns.
- Pathwise volatility is reduced.
- Expected return does not change.
- Effective in reducing risk of annual returns.

Collective Buffer Smoothing:

- Low annual return in the first year.
- High annual return in the last year.
- Reduction of variance in the first years. Effect diminishes over time.
- Much smaller and erratic effect on annual returns.

Capital Market and Products

Effects of Return Smoothing on Terminal Distribution



Return Averaging:

- Return averaging has almost no effect on risk and return profile of the whole contract.
- Slight effect on upper percentiles for higher stock ratios.
- Almost no effect on risk.

Collective Buffer Smoothing:

- Distribution of terminal wealth is narrower.
- Expected performance does not change.
- Effective in reducing uncertainty of terminal value.

- Intertemporal smoothing reduces pathwise volatility but has hardly any effect on the terminal value.
- Intergenerational risk sharing can significantly reduce the uncertainty of the terminal value.

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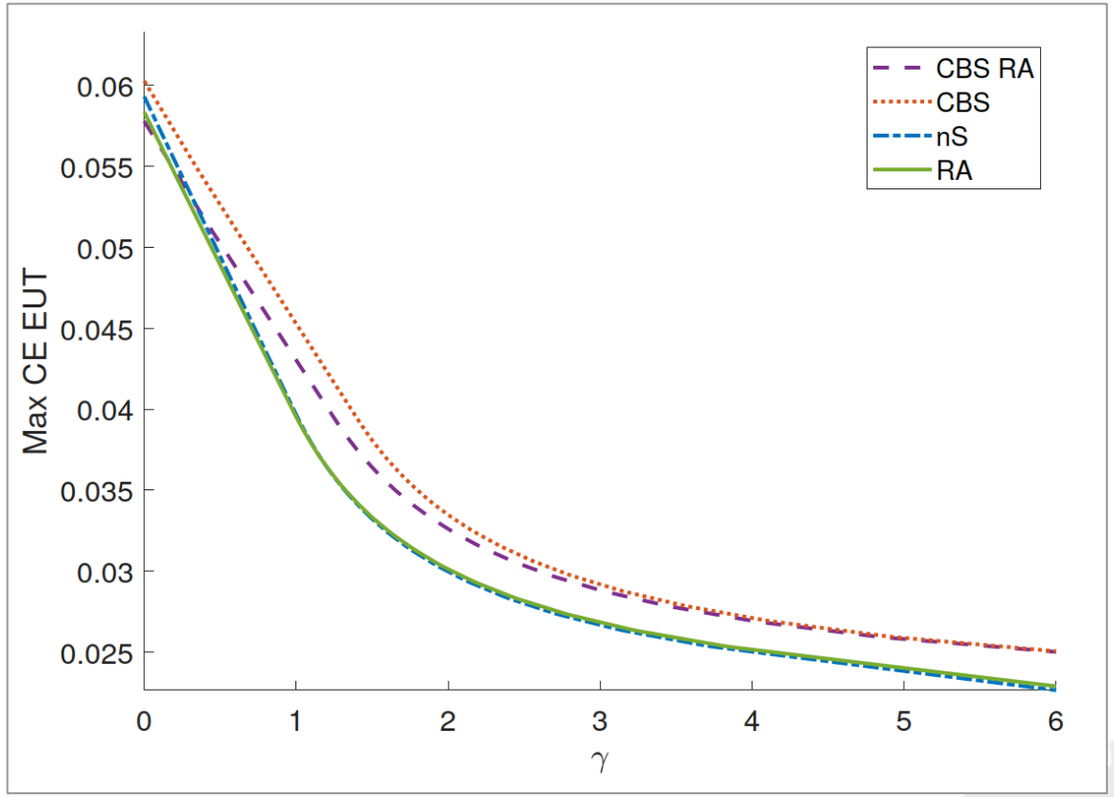
Analysis of Objective Utility and Subjective Attractiveness

Normative and Descriptive Models

- Normative models (Objective Utility)
  - Describe how individuals **should** make decisions.
  - E.g., Expected Utility Theory (EUT) with Power utility function $u(x) = \frac{x^{1-\gamma}}{1-\gamma}$
- Descriptive models (Subjective Attractiveness)
  - Describe how individuals **make** decisions.
  - E.g., Cumulative Prospect Theory (CPT) (cf. Tversky and Kahneman 1992)
  - For long-term investment decisions, CPT fails to explain typical behavior.
  - Ruß and Schelling (2018) propose the Partial Multi Cumulative Prospect Theory (PMCPT):
    - Apply CPT on annual gains and losses and the total value change of the product.
- Under both preference formulations we can derive unique certainty equivalent values (annual CE returns).

Analysis of Objective Utility and Subjective Attractiveness

Objective Utility - EUT

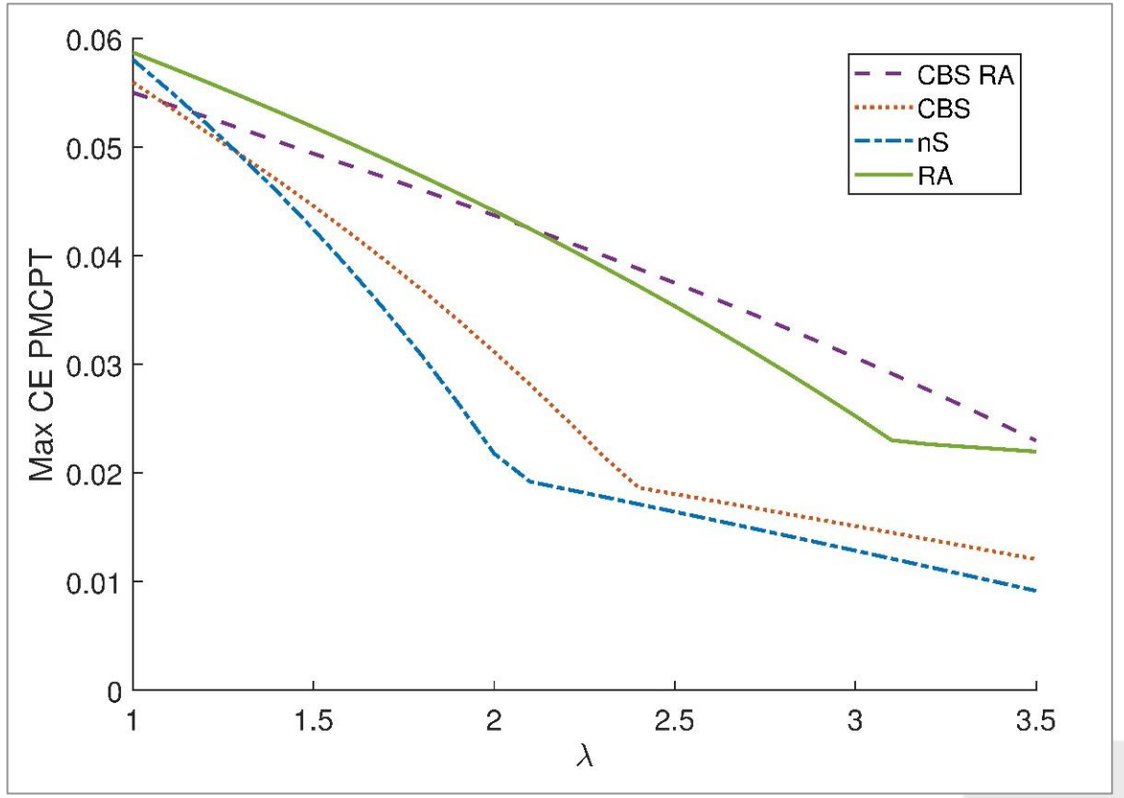


- CBS product dominates.
- For $\gamma > 1$, both products with collective buffer smoothing clearly dominate.
- For very low risk aversion, nS and RA have similar expected utility to that of CBS products.
- Optimal stock ratio decreases with increasing risk aversion γ (e.g. $\gamma = 1, \delta = 100\%$; $\gamma = 3, \delta = 45\%$).

→ Intergenerational risk sharing leads to higher objective utility.

Analysis of Objective Utility and Subjective Attractiveness

Subjective Attractiveness - PMCPT



- Products with return averaging dominate the other products.
- For $\lambda < 2.25$ product with RA is dominating.
- For $\lambda > 2.25$ product with CBSRA is dominating.
- The optimal stock ratio is $\delta = 100\%$.

→ Intertemporal smoothing is subjectively very attractive.

- The objectively optimal product may differ considerably from the subjectively attractive ones.
- CBS RA products perform well in both dimensions. Their specifications may differ significantly.
- Can we find a **"suitable compromise"**?

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Finding Compromises

Motivation

- Compromises are important when the objectively best choice is perceived subjectively very unattractive and vice versa.
  - Often the case in the context of retirement savings due to complexity of long-term financial decision.
  - Problem: Strongly sub-optimal decisions can have significant negative consequences for the standard of living in retirement.
- Finding a compromise is highly relevant for
  - Policymakers: Can promote suitable product designs that are accepted by many consumers.
  - Financial advisors: Guide clients toward objective better choices while still accounting for their preference.
  - Individuals: Reduce postponement of decision and negative emotions (cf. Luce et al. 1999).
- We use a framework introduced by Ruß et al. (2023) to simultaneously assess objective utility and subjective attractiveness to identify compromise products that create a
  - High (albeit not the maximum possible) objective utility and
  - High (albeit not the maximum possible) subjective attractiveness.

Finding Compromises

Proposed simultaneous evaluation approach (Ruß et al. 2023)

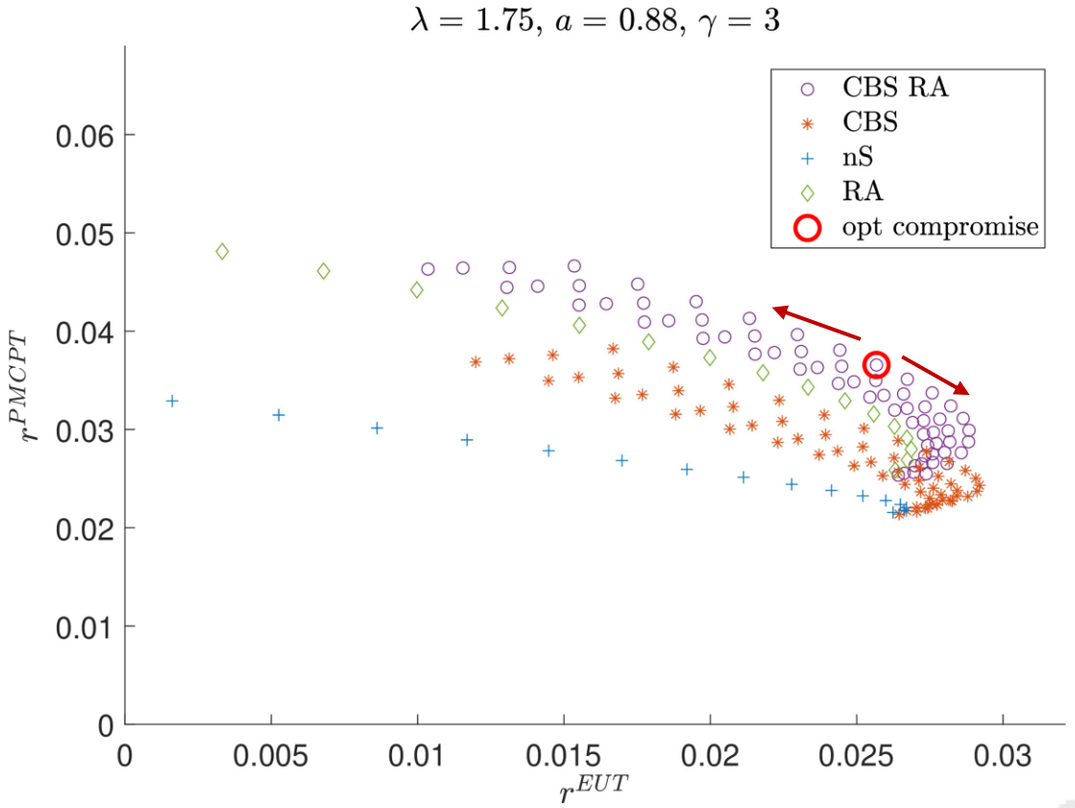
- Assessing objective utility and subjective attractiveness by preference formulations:
  - objective: $G_1 = EUT$
  - subjective: $G_2 = PMCPT$
- The combined preference function K for the simultaneous evaluation for a product $c_i \in C$ with CE returns $r_i^{G_1}$ and $r_i^{G_2}$ is

$$K(c_i) := (1-\omega)\left(r_i^{G_1}\right)^{\xi} + \omega\left(r_i^{G_2}\right)^{\xi}$$

  with preference weight $\omega \in [0,1]$ and degree of well-balancedness $\xi \in (0,1)$.
- If there is a c_i s.t. $K(c_i) > K(c_j)\ \forall\, c_j \in C \backslash c_i$ then c_i is called the **favorable compromise product**.

Finding Compromises

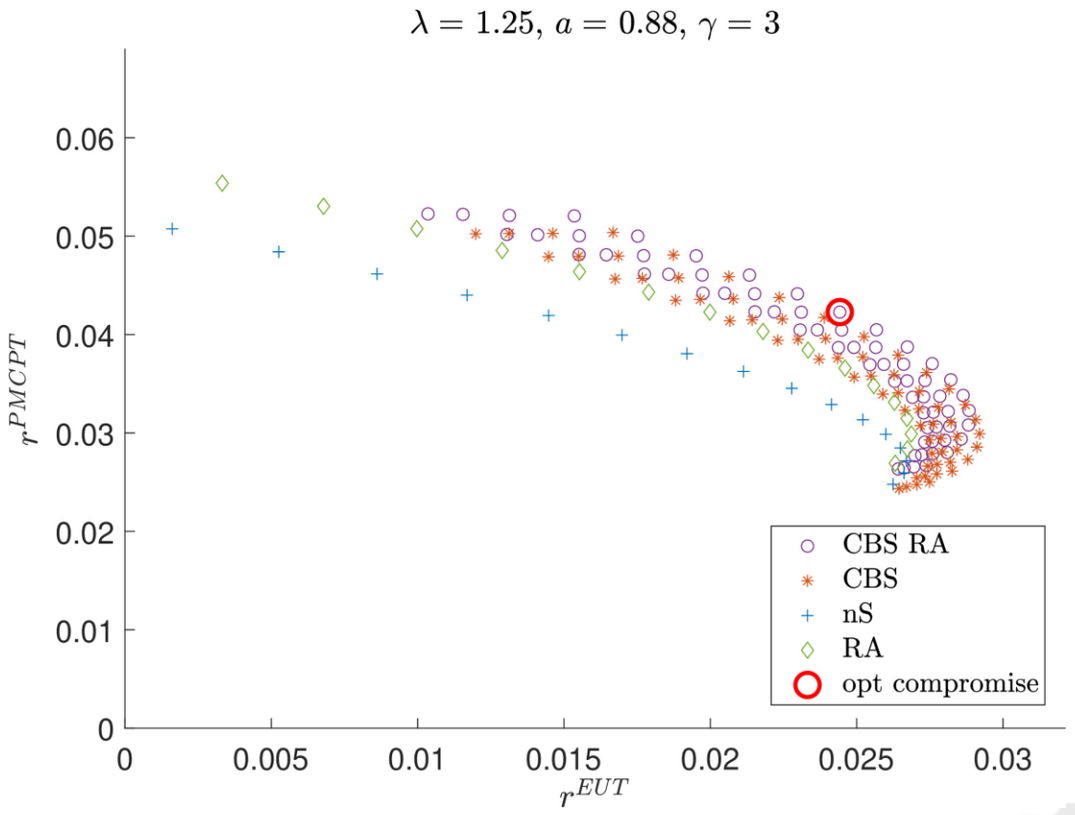
Numerical Findings

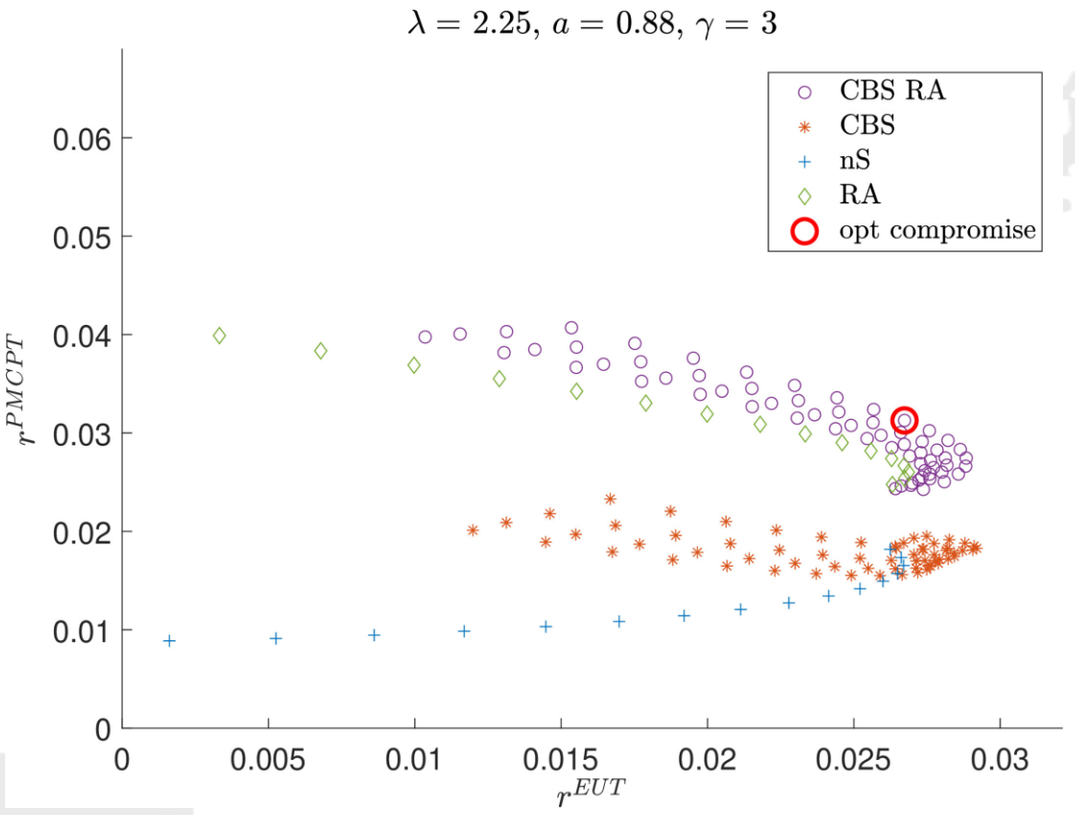


- Subjectively most attractive choice performs very poorly objectively and vice versa.
- CBS RA products are better suited than others to serve as a compromise.
- The favorable compromise is CBS RA with $\alpha = 0.9$ and $\delta = 70\%$.
- Compromise product performs well in both dimensions:
  - Objective price ~30bp, Subjective gain ~110bp
  - Subjective price ~120bp, Objective gain ~220bp
- The optimal compromise moves within the frontier for different preference weight ω.

Finding Compromises

Numerical Findings





- CBSRA is a very robust candidate for a favorable compromise.
- Specification (α and δ) of the favorable compromise is very similar in all settings.

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Our main results:

- Intergenerational risk sharing can significantly increase objective utility.
- Intertemporal smoothing can strongly increase subjective attractiveness.
- Smoothing elements can help to design a good compromise.

Consequences:

- Our results indicate that it could be beneficial to all stakeholders if a larger variety of different smoothed products were offered for long-term retirement savings.
  - Consumers would benefit from better trade-off between objective utility and subjective attractiveness.
  - Product providers could shift business from guaranteed products to smoothed products which are less risky and hence less capital intensive.

Obstacles:

- Increasing complexity and decreasing transparency which contradicts the targets of upcoming European regulation (e.g., “value for money” or IDD).
- Often lower surrender values in the first years (intergenerational risk sharing).
- Complexity of implementing different collective cover funds with different risk profiles (equity ratios) in practice.

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Parameter choice for the subjective attractiveness

- Preference parameters used in the base case are

γ	a	λ	β^+	β^-	α^+	α^-	ρ
$\in [0,6]$	0.88	$\in [1,3.5]$	1.052	0.934	0.767	0.863	1

- The range for γ is in line with the literature cf. Chiappori & Paiella (2011).
- The choice of the subjective parameters is based on l'Haridon & Vieider (2019).