

Macro Longevity Risk

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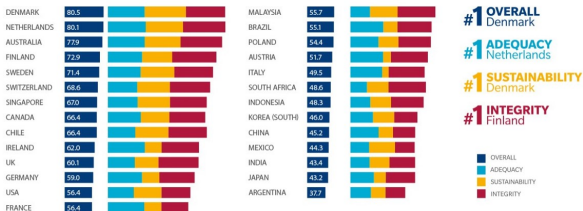
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Introduction

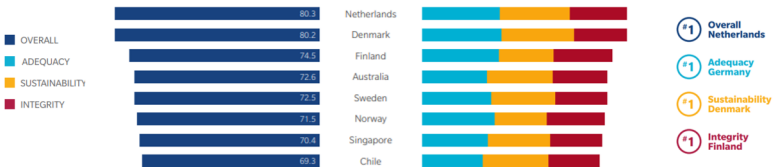
- Pension systems around the world are **challenged** by:
 - Historical **low interest** levels
 - **Increases in life expectancy**
 - Fulfillment of Solvency II **capital requirements**
- Furthermore, a global transition is observed
 - As pension schemes move from **defined-benefit schemes** (DB)
 - To **defined-contribution schemes** (DC)

Motivation

- The Dutch and the Danish pension systems are referred to as “the best in the world”
 - How can they maintain this position in the future?
 - Mercer 2017



- Mercer 2018



Motivation

- Measured in relation to GDP, private pension savings in The Netherlands and Denmark are the largest in the world.
 - Despite large pension savings, both the Danish and the Dutch pension systems face challenges to honour promised (or guaranteed) pensions
- Focus on the shift from “safe” to “risky” pension products in Denmark.
 - Moving from fixed annuities (guaranteed) to variable (unguaranteed) pension products.
 - Extension of variable annuity model by including longevity.

Denmark - From

- The majority of products in Denmark have **historically** included a guaranteed annual return based on a minimum **guaranteed interest rate**.
 - i.e. the contributions were guaranteed to increase by a certain minimum return.
 - Interest guarantees between 0% and 4.5%.
 - When interest rates are low, pension guarantees force pension companies to **invest mainly in safe assets**, in order to fulfill guarantees in DC schemes.
- **Fixed mortality rates agreed upon at contract initiation**, usually according to a mortality table.
 - **No longevity risk** for the individual.

Denmark - To

- Within the last decade, the majority of the pension funds in Denmark have moved form from guaranteed fixed annuities to **unguaranteed variable annuities**. Variable life annuity products include:
 - No minimum guaranteed return.
 - Variable mortality rates, if the initial agreed mortality rates changes throughout the contract period.
 - **Longevity risk** for the individual

Denmark - Switch

- Some pension funds made a collective decision to transfer all policyholders to zero interest guarantees.
- Other funds (Danica, PFA and JØP) offered the policyholders the option
- Financial compensation.
- In *Balter, Kallestrup-Lamb and Rangvid (2021). Macro longevity risk and the choice between annuity products: Evidence from Denmark, Insurance: Mathematics and Economics.*
- Analysed which person specific characteristics would make it more likely to relinquish the guarantee.
 - If you are **male, living in the city**, or have **moderate pension wealth** it will increase the probability of giving up the interest rate guarantee.
 - Individuals with **higher levels of guarantees, above the age of 50** or **retired**, significantly decreases the probability of relinquishing the guarantee.
 - We find no effect on the decision from **marital status**.

The Netherlands - From

- DB, DC, CDC?
- Contribution rate age-independent and **fixed**
- Uniform accrual pension rights age-independent
- Pension payments can be increased or decreased depending on **funding ratio**
- Until 2008, inflation-based indexation of pension benefits was **deemed almost certain** by participants in DB schemes
- (Indexed) entitlements are **no guarantees**

The Netherlands - To

- New Pension Contract
- Individual pension pots, capital converted into pension at retirement.
- Allocation rule to share collective risks/to allocate fund returns among participants
 - Life cycle
- Collective solidarity reserve
- Lower solvency requirements
- Transition: by default, all entitlements accrued in the past will be converted into the new contract. This involves an operation at a nation-wide scale that is unprecedented in pension reforms in the world.

Longevity risk

- Idiosyncratic (micro) longevity risk
 - Risk that an individual might live longer (or shorter) than forecasted
 - Vanishes for large pools
- Systematic (macro) longevity risk
 - Risk that the life expectancy of the population as a whole increases (or decreases) unexpectedly
 - Updated mortality tables
 - Cannot be shared

Literature

- Piggott, Valdez and Detzel (2005) investigate **group self-annuitization (GSA)** in which the annuitants bear their systematic risk, but the pool shares idiosyncratic risk. CEA_t is the **changed expectation adjustment factor** measuring the change in mortality expectations.
- Boon, Brière and Werker (2020) finds that individuals **prefer to bear the risk under a collective arrangement** than to insure it with a life insurers' annuity contract subject to insolvency risk.

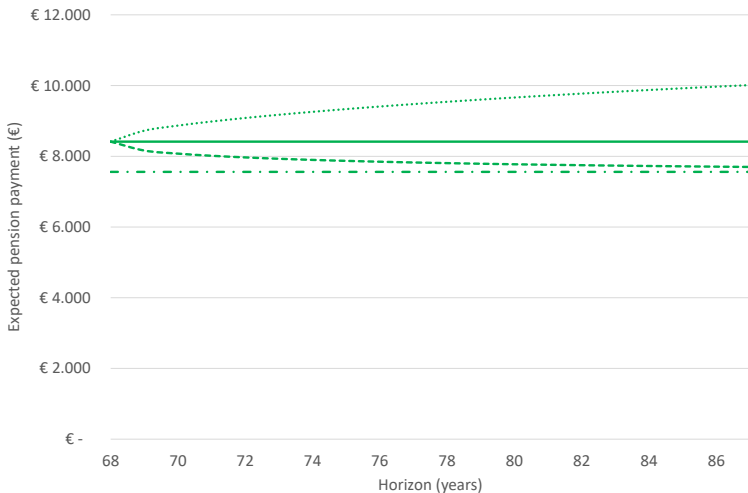
Literature

- Richards, Currie and Ritchie (2014) disentangle many types of **risk** (model risk, basis risk, trend risk, volatility, idiosyncratic risk, mis-estimation risk) and model the one-year ahead risk
- Dees, de Jong and Nijman (2021) looks at quantiles within LC and argues the risk is **negligible** compared to financial risk.
- De Waegenaere, Melenberg and Markwat (2017) **re-estimate** best estimates based on one-year forecasts of LC and show that the **impact on value of pension annuities is age dependent**.
- Broeders, Mehlkopf and van Ool (2021) combine stochastic variation, parameter risk (re-estimation) and model risk and focus on intergenerational risk-sharing.

Choice

- Between which two products did the pension holders actually have to choose?
 - Guaranteed pension product
 - No longevity risk
 - No complete freedom on investment strategy
 - Variable pension product
 - Longevity risk for pension holder
 - Complete freedom on investment strategy

Figure: Guarantee



$r_f = 2\%$, $r_g = 1\%$, $\mu - r_f = \lambda = 4\%$, $\sigma = 20\%$, $W_t = 100,000$, $w_U = 35\%$, $w_G = 100\%$

Figure: Variable product

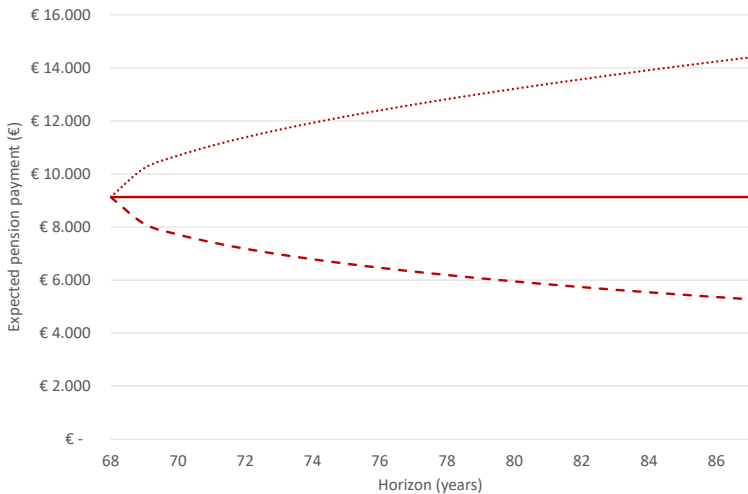
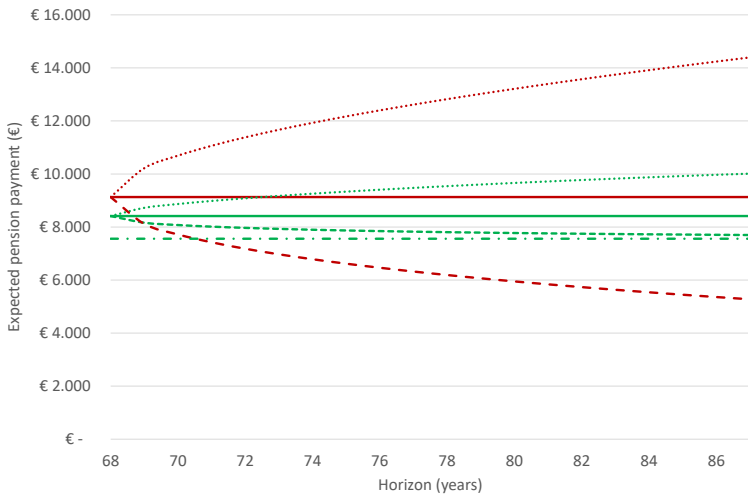


Figure: Variable and guaranteed product

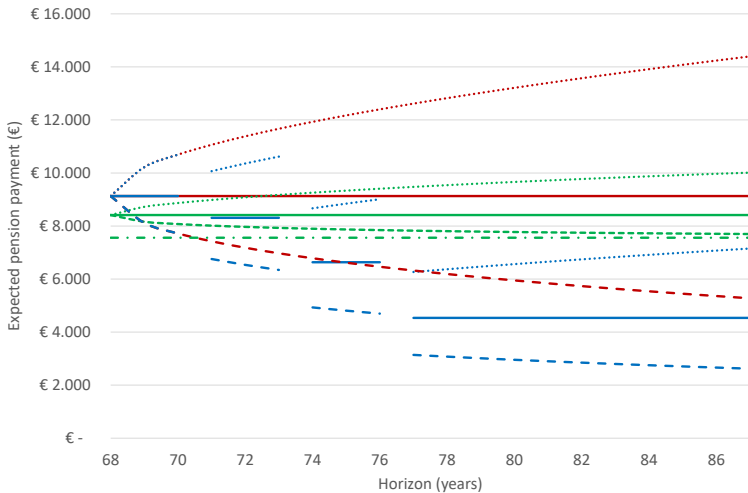


Unforeseen changes in life expectancies

Table: Unforeseen increases in life expectancy

data\conditional	2008	2011	2014	2017
2007	15y4m	12y5m	9y8m	7y3m
2010		13y8m	10y8m	8y2m
2013			12y3m	9y4m
2016				10y7m

Figure



Risk

- Previous figure shows macro longevity risk **ex post**
- What is the **ex ante** longevity risk?
- Drivers of longevity **risk**
 - **Parameter uncertainty**: stochastics within model - confidence interval forecasted mortality rates
 - **Model uncertainty**: arrival new data causes parameters to change - best estimates tables change

Conclusion and future research

- Ex post impact of macro longevity risk has shown to be large compared to financial risk.
- Future research: Quantification of the implied longevity hedge measured by the compensation.
- Importance increasing because of trend towards individual contracts in which longevity risk is explicitly borne by the individual - communication purposes.

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