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Examining pension plan risk from an Economic Capital Perspective

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SECTION COLLOQUIUM 2019

About the speaker

- Aniketh Pittea
- PhD student
- Mr Pittea is currently doing a research on the impact of population demographics on pension schemes in UK, US and Canada. Before starting his PhD, he was working as risk analyst in Mauritius. Mr Pittea holds a BSc(Hons) Actuarial Science from the University of Technology, Mauritius and an MSc in Applied Actuarial Science from the University of Kent. He has also completed the professional examinations of the Institute and Faculty of Actuaries (IFoA).

Motivation

- Typical pension plan valuation compares assets to liabilities
- This comparison looks at expected values (perhaps including some margin)
- One approach to pension plan risk assessment is Economic Capital [see Porteous, et al. (2012)]
  - Used for banking and insurance sectors under Basel 2, 3 and Solvency 2
  - Sufficient to cover 99.5th percentile outcome

Methodology

- Select a representative pension plan
  - Universities Superannuation Scheme (UK) 2014 Actuarial Valuation
  - Stylized US pension plan
- Select an Economic Scenario Generator
  - Graphical model (Oberoi et al. (2019))
- Select a mortality model
  - Model M7 (Cairns, et al. (2009))
- Quantify pension risk

USS Pension Scheme – Benefits

- 1.25% final salary benefit for service up to April 1, 2016
- 1.33% career revalued benefit for service from April 1, 2016
- Pension increases in line with the CPI

Sylized US Pension Plan – Benefits

- Benefits based on USS pension scheme, except for the following
- 1.50% final salary for all pension service
- No pension increases

USS Pension Scheme – Data

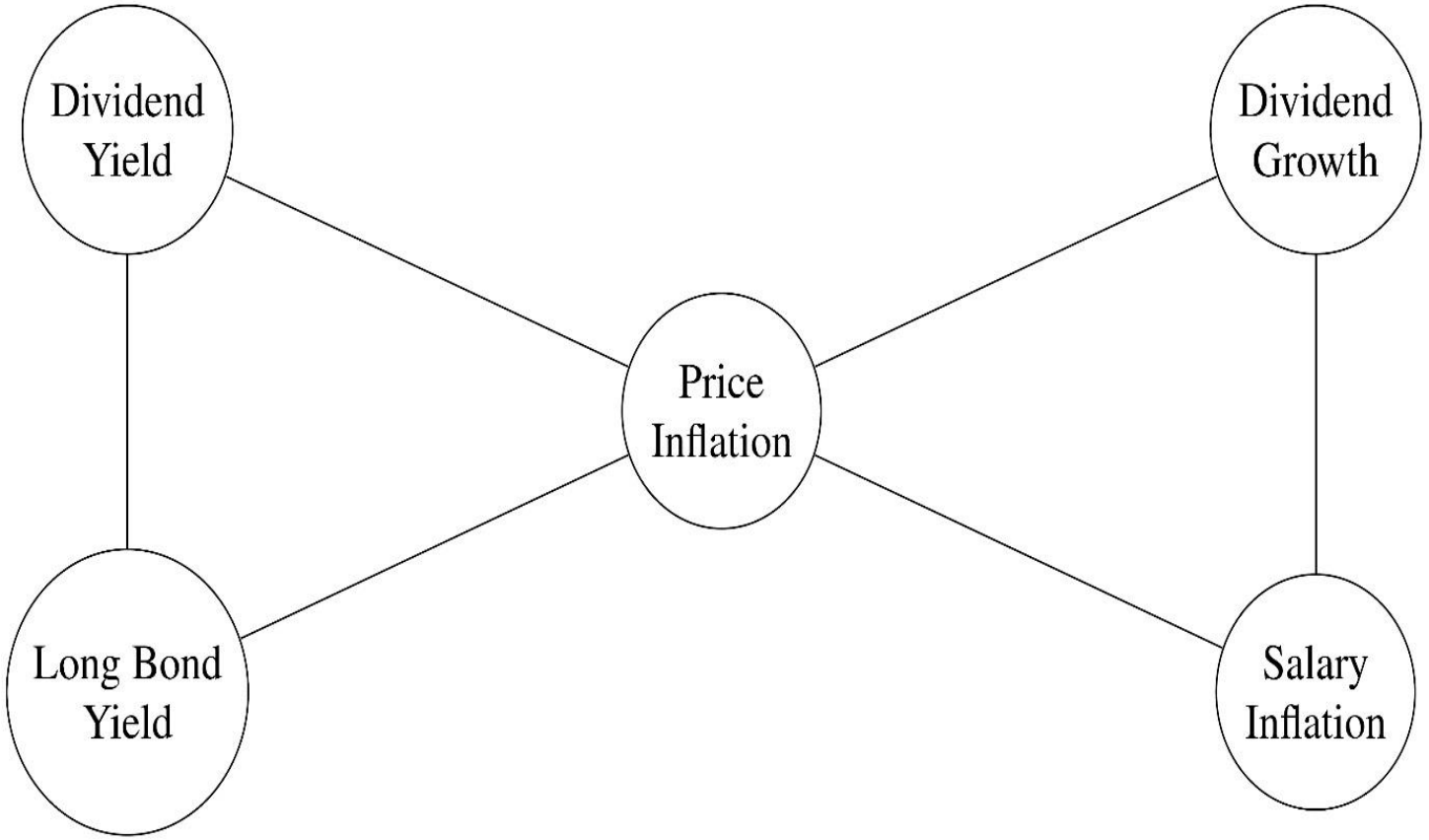
Active	Number	167,545
	Average pensionable salary	£42,729
	Average age	43.8
	Average past service	12.5
Deferred members	Number	110,430
	Average deferred pension	£2,373
	Average age	45.1
Pensioners (including dependents)	Number	70,380
	Average pension	£17,079
	Average age	71.1

USS Pension Scheme – Assets

	Assets	Allocation (%)
Real	UK equities	16
	Overseas equities	31
	Alternative assets	19
	Property	7
	Total real	73%
Fixed	Fixed interest	27
	Cash	0
	Total fixed	27%

Note: Modelled as 70% Equities and 30% Bonds

Economic Scenario Generator



Mortality Model – M7 from Cairns, et al. (2009)

- logit $q(t,x) = k_t^{(1)} + k_t^{(2)}(x-\bar{x}) + k_t^{(3)}[(x-\bar{x})^2 - \sigma^2] + \gamma_{(t-x)}^{(4)}$

- Model assumes a functional relationship between ages (and hence smoothness).

- One of the better fit models to UK and US data (Cairns et al. (2009)).

D(t)

Calculation of pension risk

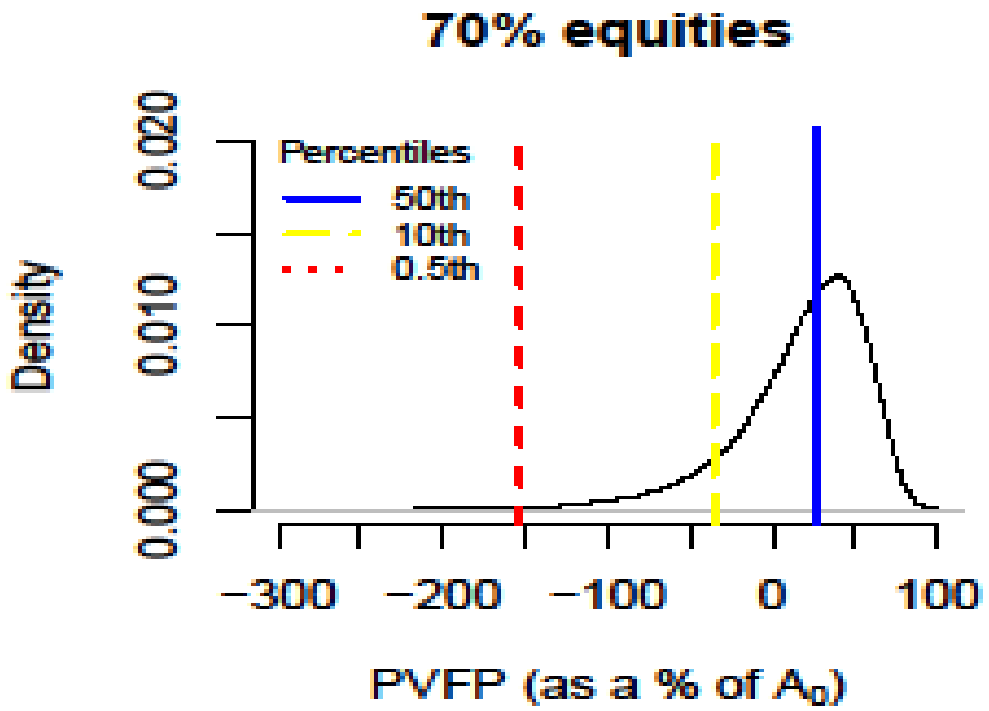
- Use asset yield at time t, discount future benefits/expenses to obtain best estimate asset requirement

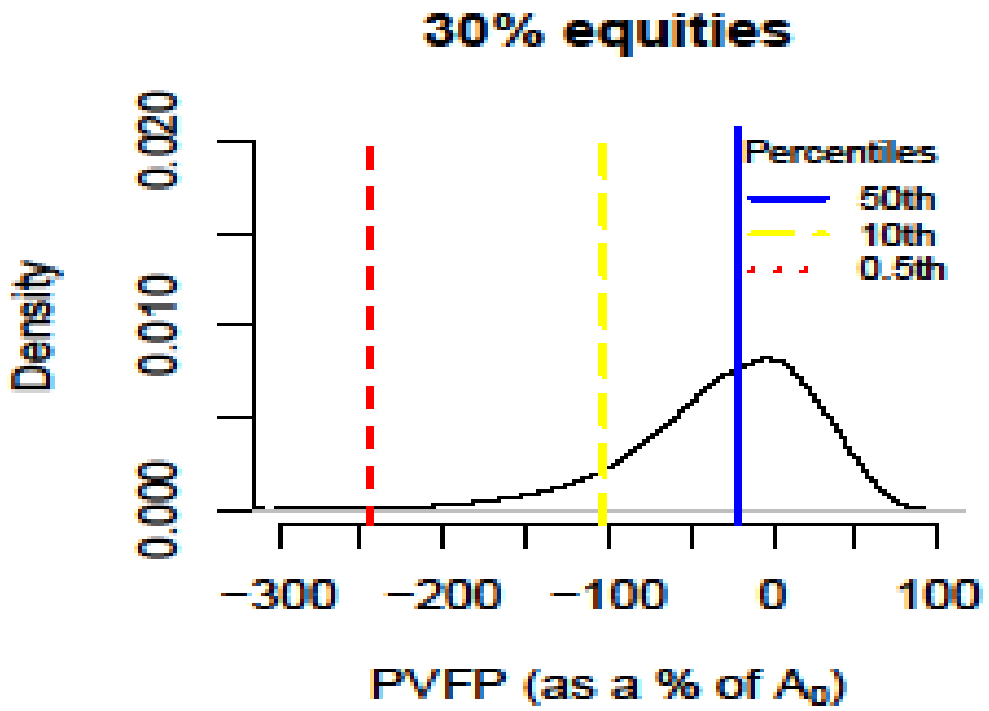
- Present value of future profits given by:

$$V_0 = A_0 - \sum_{t=0}^{T} X_t \,.\, D_{(0,t)}$$

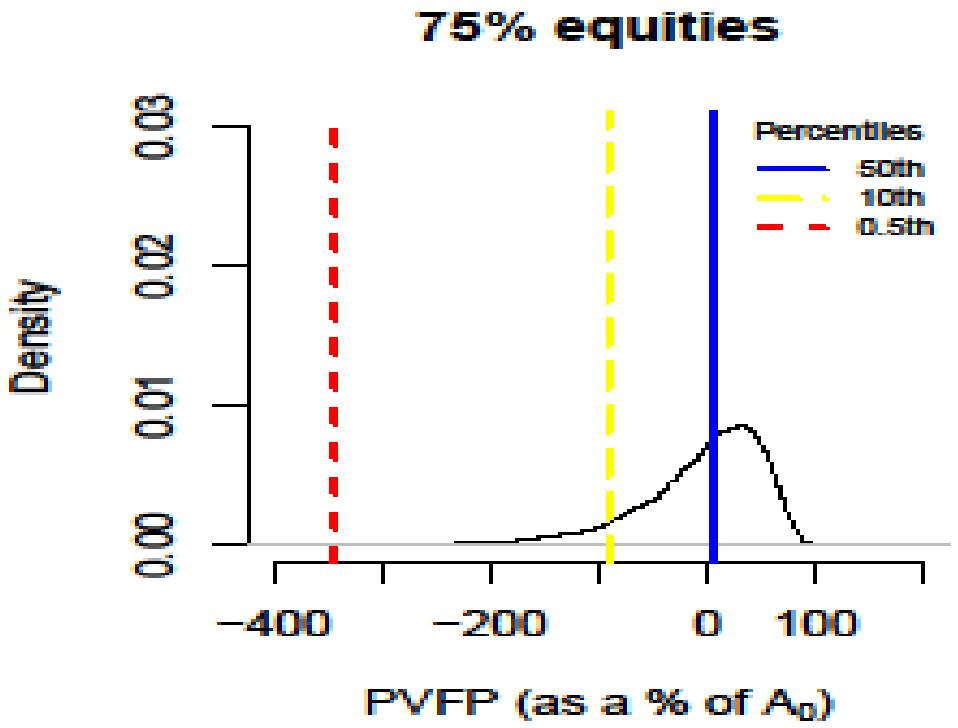
- Repeat 10,000 times to obtain a distribution of V_0 .

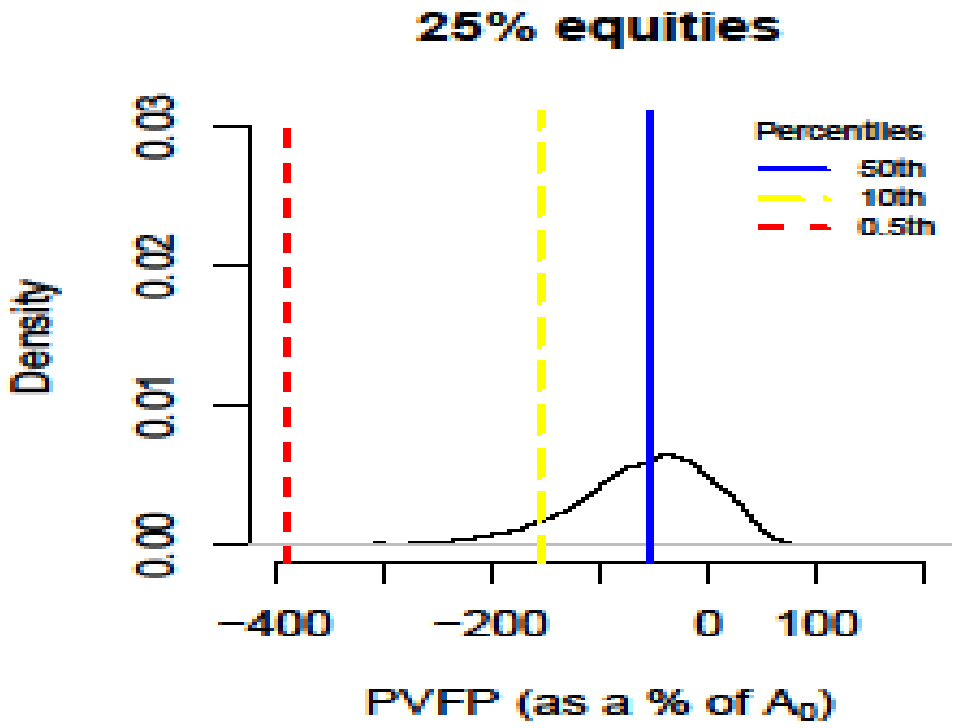
Pension risk – USS





Pension risk – Sylized US Pension Plan





D(t)

Summary

- In the USS, a significant bond weighting worsens the risk position
  - Greater mismatch with inflation-linked liabilities
  - Lower expected return
- In the US-style plan, a significant bond weighting improves the risk position
  - Improved matching with (mostly) nominal liabilities
- Economic capital requirement is significantly lower with the US-style plan
  - Much smaller inflation exposure

References

- Cairns, Andrew JG, David Blake, Kevin Dowd, Guy D. Coughlan, David Epstein, Alen Ong, and Igor Balevich. A quantitative comparison of stochastic mortality models using data from England and Wales and the United States. North American Actuarial Journal 13, no. 1: 1-35, 2009
- Oberoi, Jaideep, Aniketh Pittea and Pradip Tapadar. 2018. “A Graphical Model Approach to Simulating Economic Variables Over Long Horizons.” Working paper.
- Porteous, Bruce, Pradip Tapadar and Wei Yang. 2012. “Economic Capital for Defined Benefit Pension Schemes: An Application to the U.K. Universities Superannuation Scheme.” *Journal of Pension Economics and Finance* 11 (4): 471–99.