

Modelling Longevity Risk using Health Simulation Models

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Context

- Defined-benefit pension plans face financial difficulties
- Life expectancy is increasing (large medical progress)
 - Even more so than actuaries predicted
 - Important challenge for pension plans
- A disease-based projection model may allow to understand the structure of risk using scenarios on medical progress at the disease level.

What we do?

- Effects of trends in health status (mortality and diseases) on a DB pension plan's solvency between 2010 and 2050
- How?
 - Microsimulation model: COMPAS
 - Simple pension plan model
 - Isolates the longevity risk
 - Different scenarios

COMPAS

- Microsimulation model using data from Statistics Canada
- Health status of individuals aged 30 to 110 between 2010 and 2050 (Quebec)
- Find size of the population by age group, which is the input of the retirement model
- 3 steps to the simulation
 1. Initialization module creates the initial population of the model
 - Social and demographic characteristics, diseases, risk factors and incapacity (CCHS)
 2. Transition module
 - Population ages 1 year (NHPS)
 - Transitions between health states
 3. Renewal module
 - New cohorts
- Repeat steps 2 and 3 until 2050

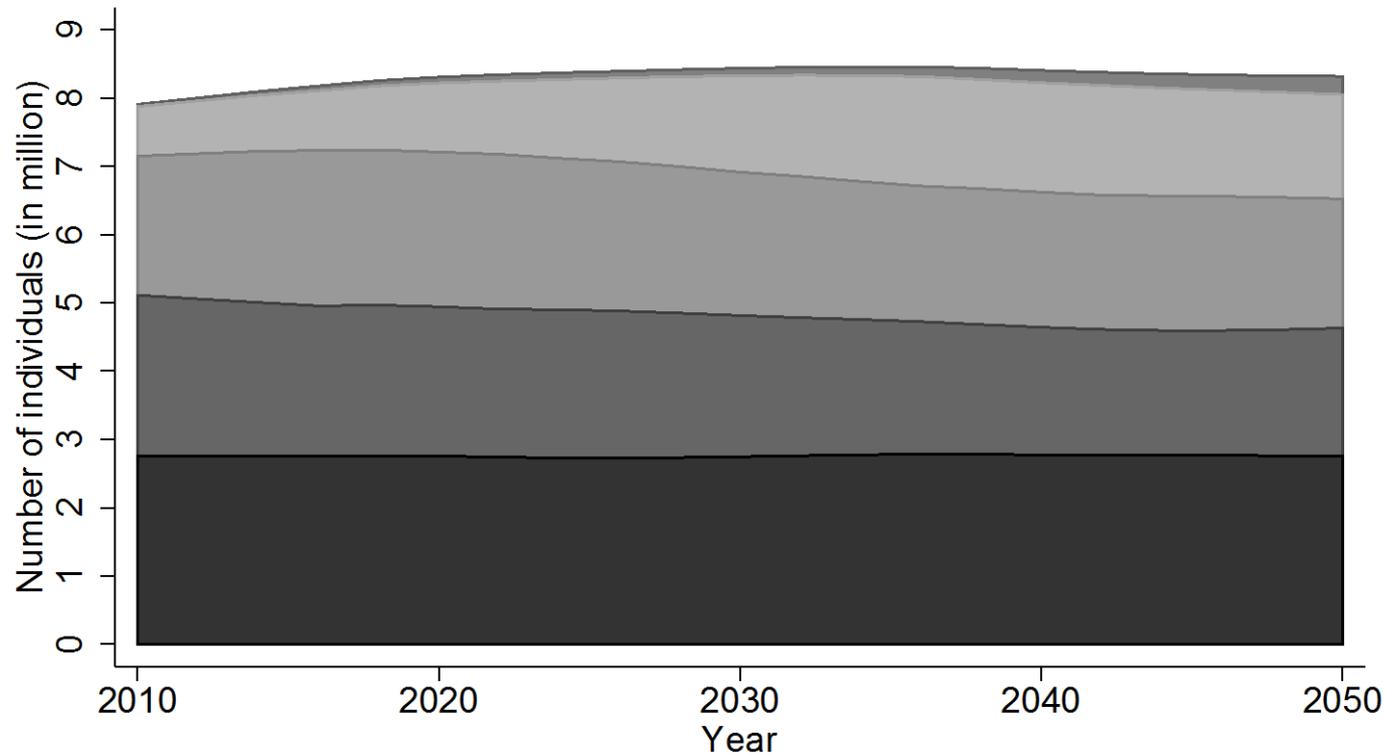
Pension Plan

- Dynamic of a pension plan is very complex
- We seek to isolate the longevity risk
 - Set
 - Retirement at age 65
 - Eliminate
 - Rate of return risk
 - Productivity risk
 - Wages are constant and normalized to 1
 - Wages are identical for all individuals
- Standard DB pension plan (factor * years worked * salary), prefunded in 2010.
- Discounting rate = 3%

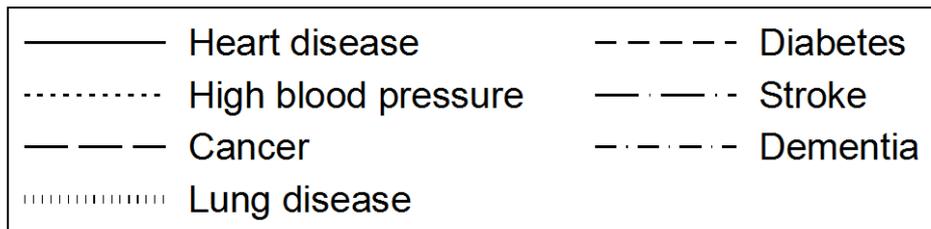
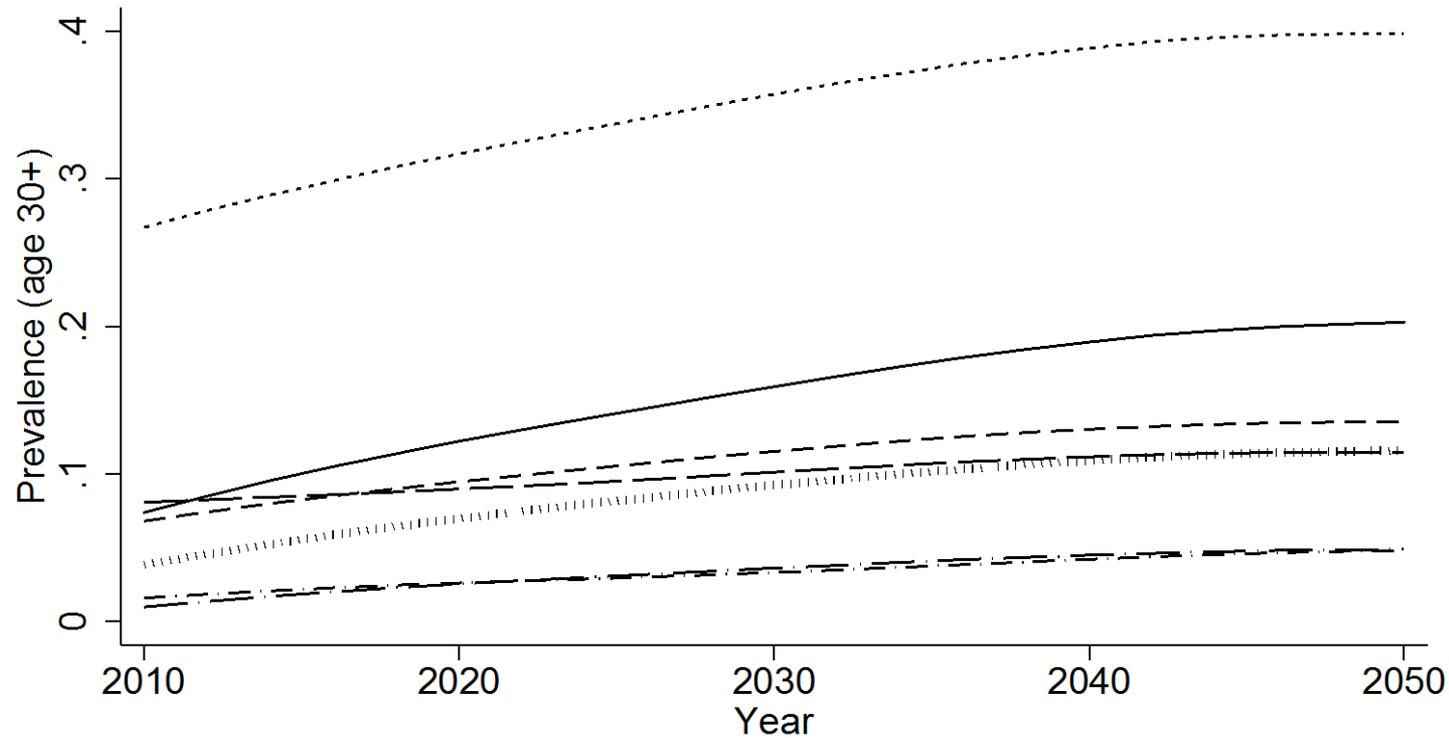
Baseline assumptions

- Based on the demographic hypotheses of the Régie des rentes du Québec (RRQ)
 - Includes exogenous mortality improvement
- Trends in health status based on trends observed since 1994 for the composition of new cohorts
- No immigration

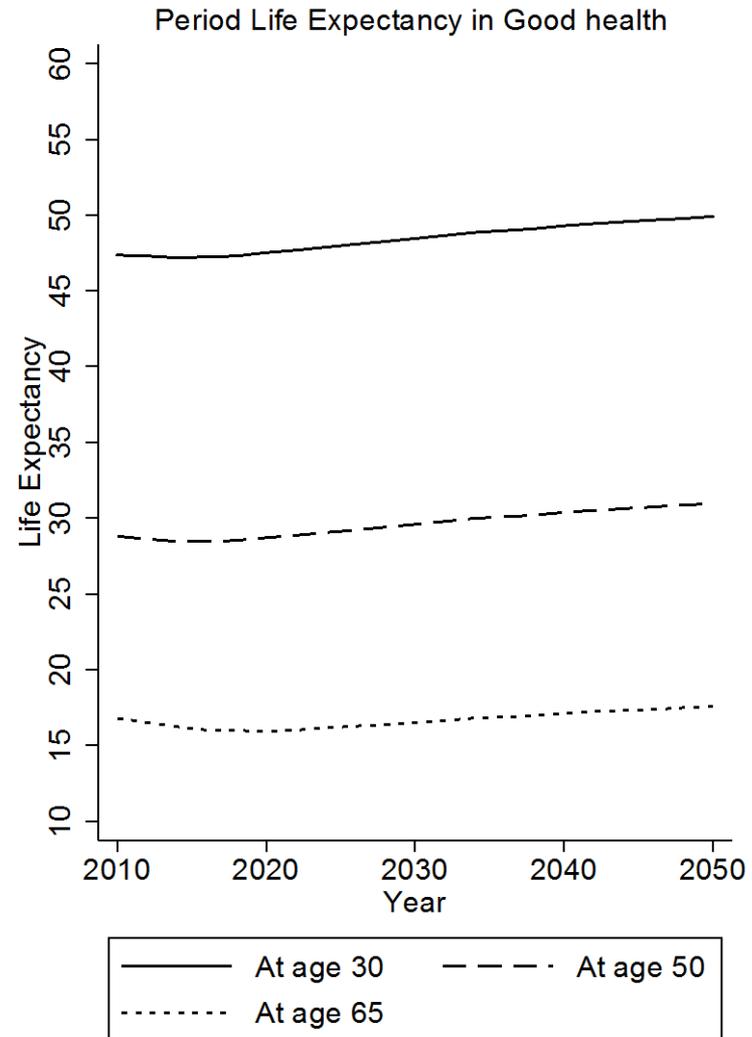
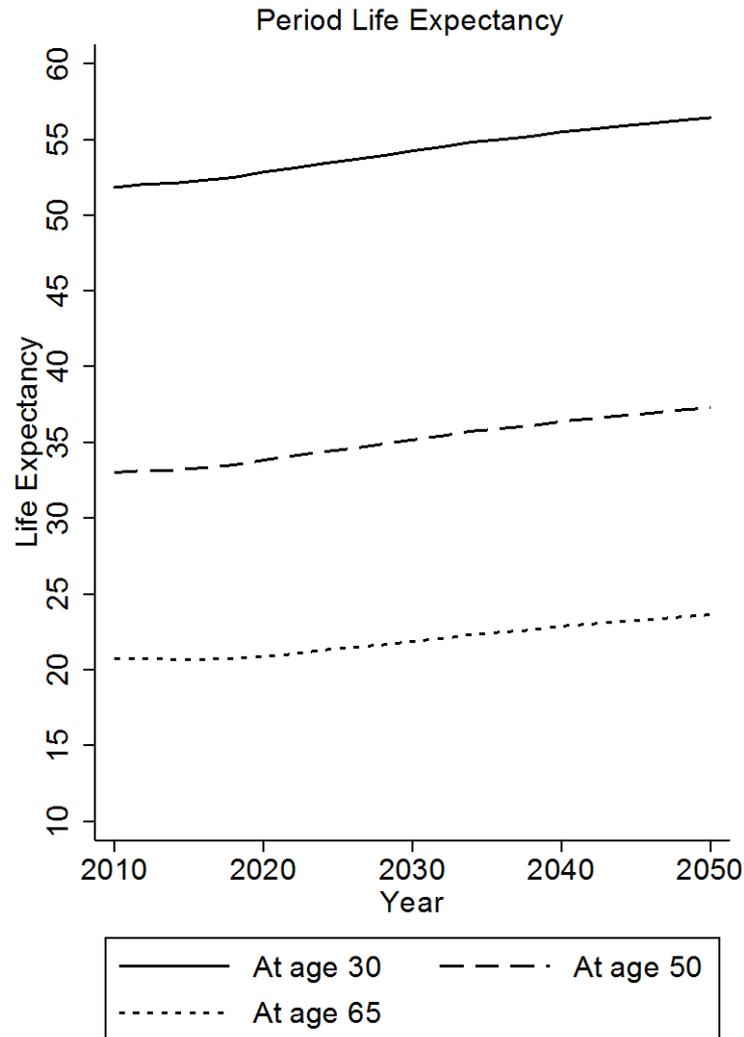
We are aging...



with more diseases ...



but living longer...

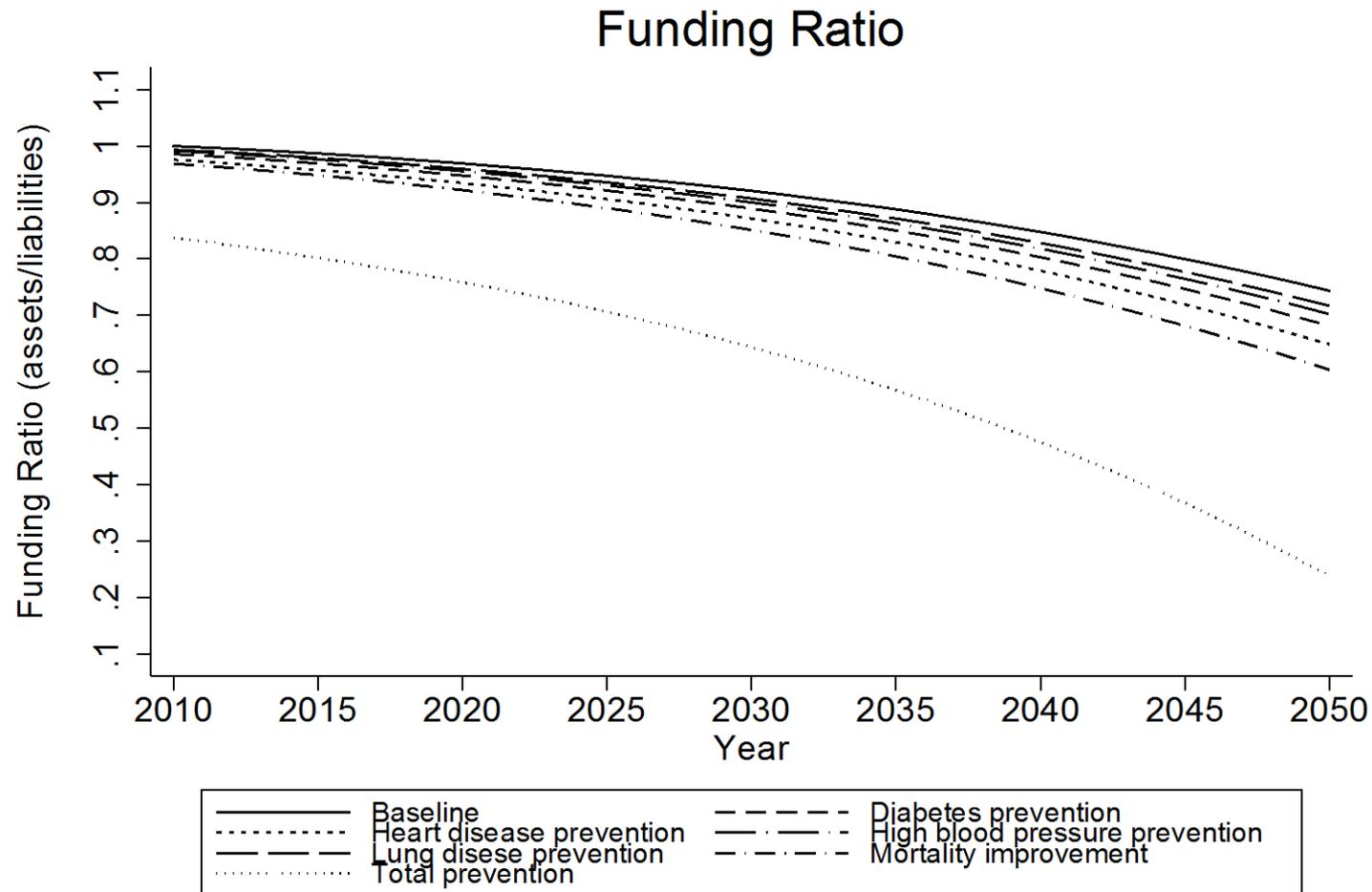




Exploring alternative scenarios

- Disease prevention
 - Diabetes
 - High blood pressure
 - Heart disease
 - Lung disease
- Total prevention
 - All diseases, obesity and smoking
- Mortality improvement
 - 50 % reduction in mortality rates

Effects on the Pension Plan: All Scenarios



Discount rate = .03, contribution rate = .18, benefits points = .02

Contribution Rates

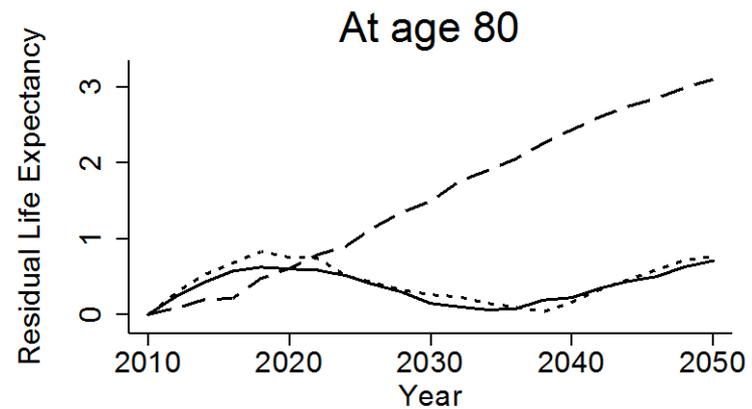
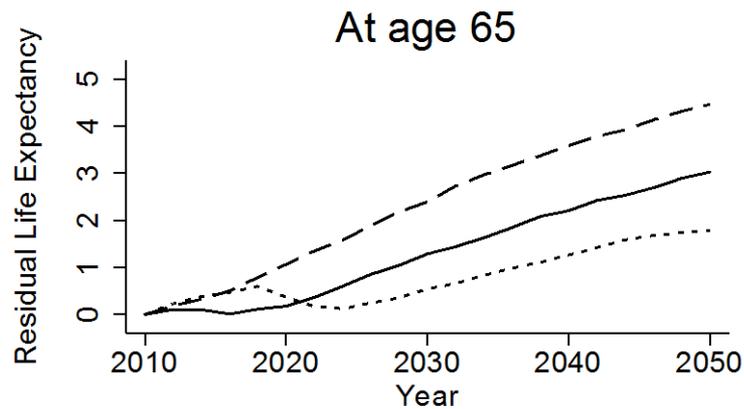
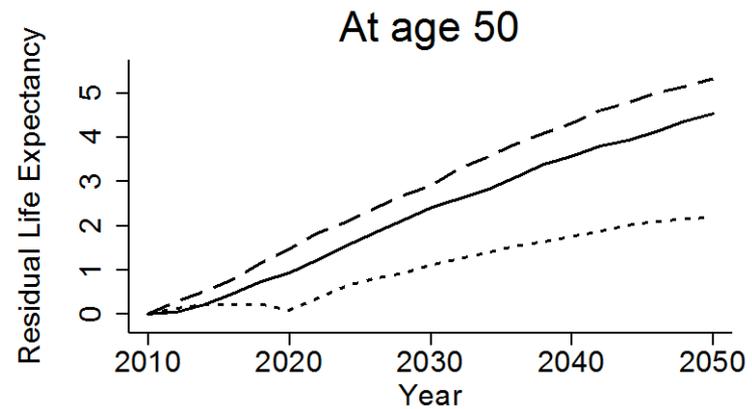
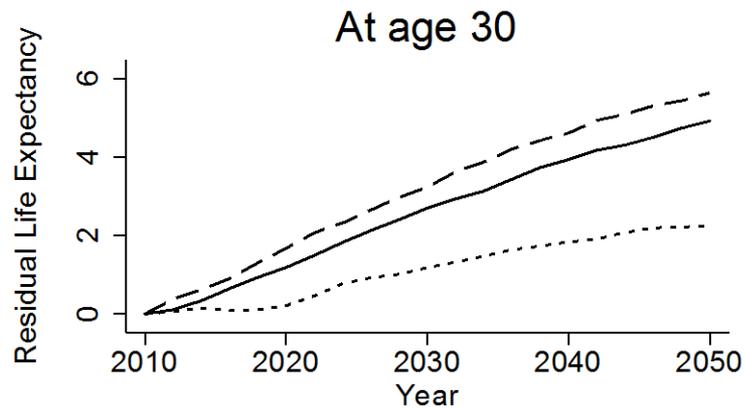
Scenarios	Contribution Rate	
	Baseline Funding Ratio (2050)	Equilibrium Funding Ratio (2050)
Baseline	18,00%	21,00%
Diabetes prevention	18,75%	21,90%
Heart disease prevention	19,18%	22,37%
High blood pressure prevention	18,49%	21,60%
Lung disease prevention	18,30%	21,37%
Mortality improvement	19,80%	23,10%
Total prevention	26,00%	30,10%



Improvements realistic?

- Baseline scenario with RRQ mortality improvement
- 2 alternative scenarios
 - Total prevention scenario (without RRQ mortality improvement)
 - Medical advances scenario (without RRQ mortality improvement)
 - Based on an expert panel in U.S. 2005
 - Probability of medical advances in 2020
 - Cancer vaccines: 100%
 - Telomerase inhibitors (cancer) : 15%
 - No heart disease incidence : 40%
 - Decreased diabetes incidence in obese population : 65%

Life Expectancy



— Baseline (with RRQ) Medical advances (without RRQ)
- - - Total prevention (without RRQ)

Collaborators

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