UNIVERSITÄT LIECHTENSTEIN

Decision Methods and Tools in the Context of Pension Finance

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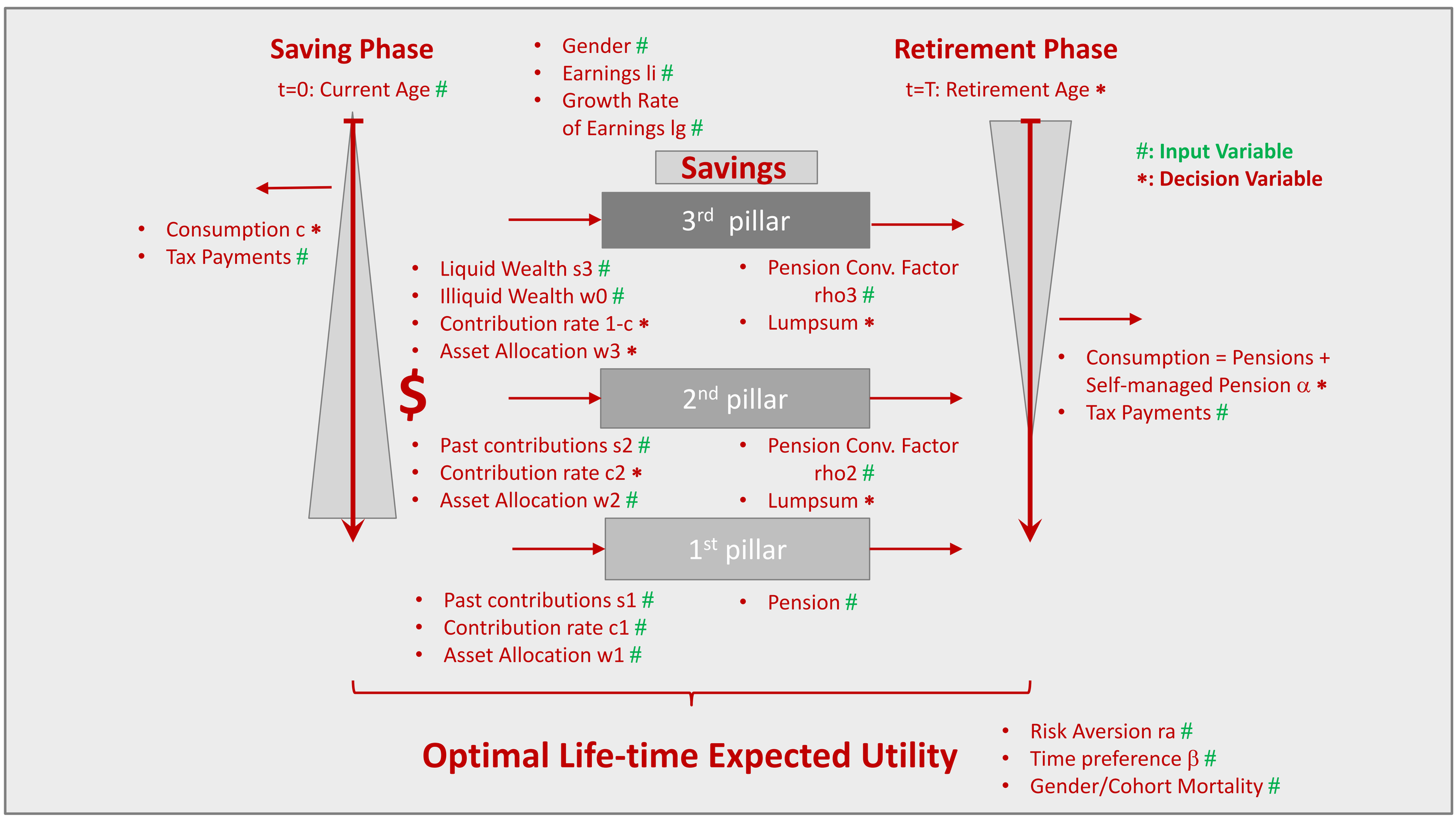


Initial Situation:

- fin_15_2 prepared code to **optimize pension decision** in the Liechtenstein pension system
- Problem:
  - Computationally quite demanding
  - Not easily accessible for everyone

Overall Project Goals:

1. Make model available to everyone
2. Better understanding of model and implications

Step 1:

1. Improve Code
   a. Avoid infeasible in- & outputs* ✓
   b. Speed up optimization ✓
   c. Make code publicly available ✓
   d. Document code/law/tax scheme ✓

R-package on github: *install_github("sstoeckl/pensionfinanceLi")*
Detailed documentation: *vignette("model")*
*Moral Hazard: Borrow pension from the bank without intention of payback

Step 2:

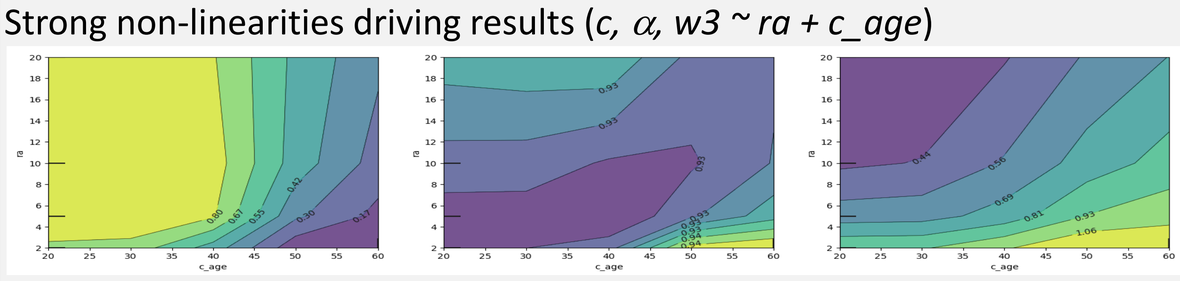
2. Determine grid of feasible input parameters (3'110'400) ✓
3. Run optimization for every parameter combination
   a. Massive parallelization necessary ✓
   b. To avoid data loss in case of crash & provide easy access data save to high-performance database (Amazon RDS) ✓
   c. Rent clusters & run code (Amazon AWS) ✓

To better understand the model and its drivers | Computationally demanding (approx. 10 minutes per optimization) | Currently at 800'000 | Expected to finish in Dec 2021 (necessary cost reduction)

Step 3:

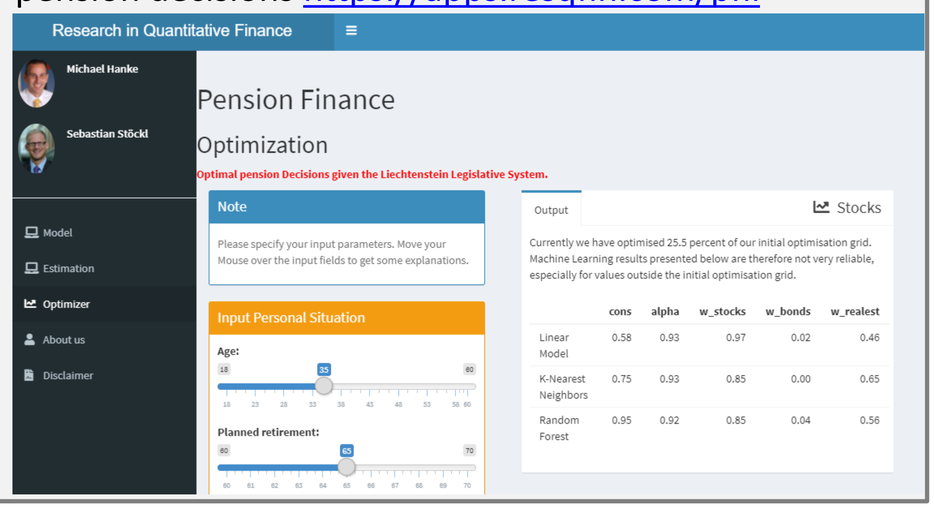
4. Develop heuristic model to predict (near-optimal) pension decisions in real-time through Machine Learning
   a. Linear & nonlinear models (k-nearest neighbor, random forest) using *scikit-learn* ✓
   b. Random Forest shows considerable forecasting power ✓
5. Use models to gain better understanding of relation between in- and output variables (preliminary) ✓

Strong non-linearities driving results (*c, α, w3 ~ ra + c_age*)



Step 4:

6. Make results available to the public through online app
   a. Use *plumber/swagger* to create api that weekly updates Machine Learning models ✓
   b. Create *Shiny App* that connects to api and allows for real-time near-optimal pension decisions https://apps.resqfin.com/pfli ✓



Forschungsförderungsfonds

FFF Project No: FIN_19_2