

# 2023 INTERNATIONAL CONGRESS OF ACTUARIES



# BRIDGE TO TOMORROW

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# Financial Forecast of Income Contingent Student Loan ~ from Actuarial Perspective

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# Outline

1. What is ICL?
2. Existing model
3. Portfolio model
4. Simple example
5. Forecasting Result
6. Future challenges
7. Actuarial new fields



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# 1. WHAT IS ICL?



# What is ICL?

- A kind of **student loan** whose **repayments** are related to graduate's **income or earnings**
- Expanding with the needs from
  - Start of tuition fee collection
  - National budget restriction
  - Extension of opportunities of education

Australia  
UK  
South Africa



# Typical ICL system

- Payment is generally fixed
- Loan may have interest (generally variable)
- **Repayment is a certain portion of the income**
- **If income is under threshold, repayment is postponed**
- Sometimes repayment is collected using tax collection system



# Typical ICL system(Cont'd)

- Repayment ends when
  - Borrower **repay all** the principal and interests
  - Borrower's **death or disability**
  - Borrower become to **certain retirement age**  
(sometimes)
- Loans not returned is compensated by tax or other public fund



# ICL as a Reverse Pension

	ICL System	Pension Fund (DB)
Collection	Certain portion of income	
Interest	Variable on collection period	
Retirement Age	Sometime exist	Exist
Benefit time	In advance	After retirement
Benefit period	Fixed	Generally lifetime
Benefit amount	Fixed in advance	Related to salary or collected amount



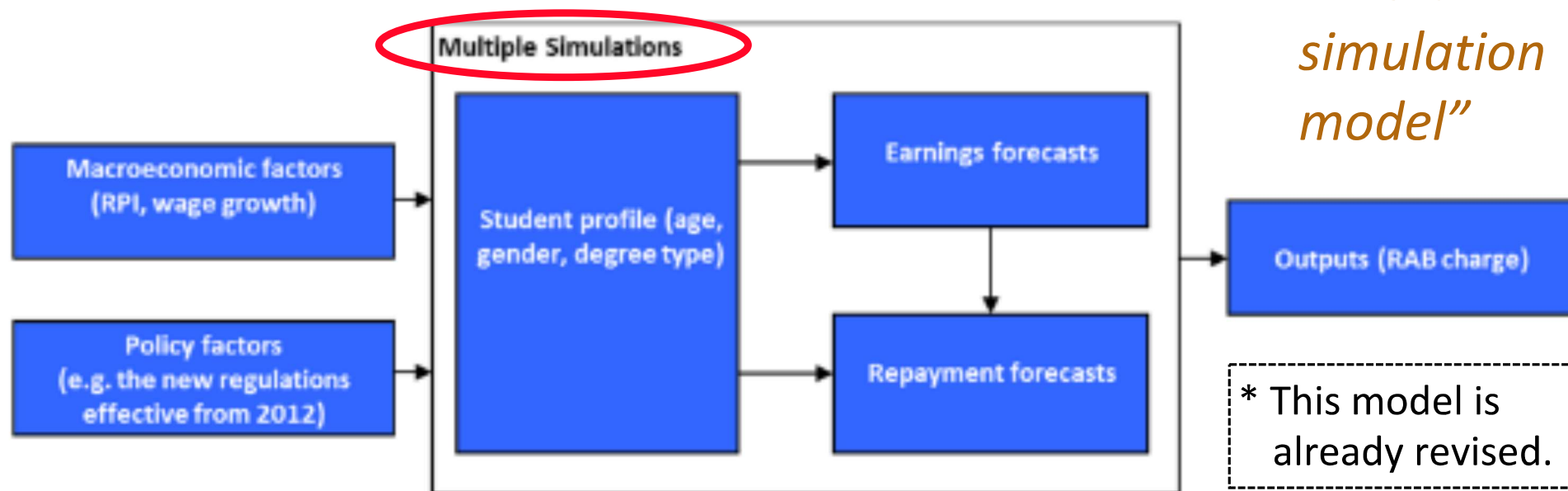
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## **2. EXISTING MODEL**



# UK “HERO” model

A simplified description of the HERO model



Source :National Audit Office (UK) "Student Loan Repayment", HC818 Session 2013-14



# From the Report of UK NAO

- consistently **over-forecast repayments** (by the HERO model)
- using **old data** (before recession, 2001-2009) for graduate income distribution and apply it unchanged for the future
- assume **earnings growth is uniform** through income classes
- overestimates the earnings of older cohorts because the model **does not exclude high earners who have finished repaying**
- do not consider **institute groups** and **subjects studied**
- adding **lagged year of earnings** as an explanatory variable clearly improve the predictive fit

• The report is for the old model.



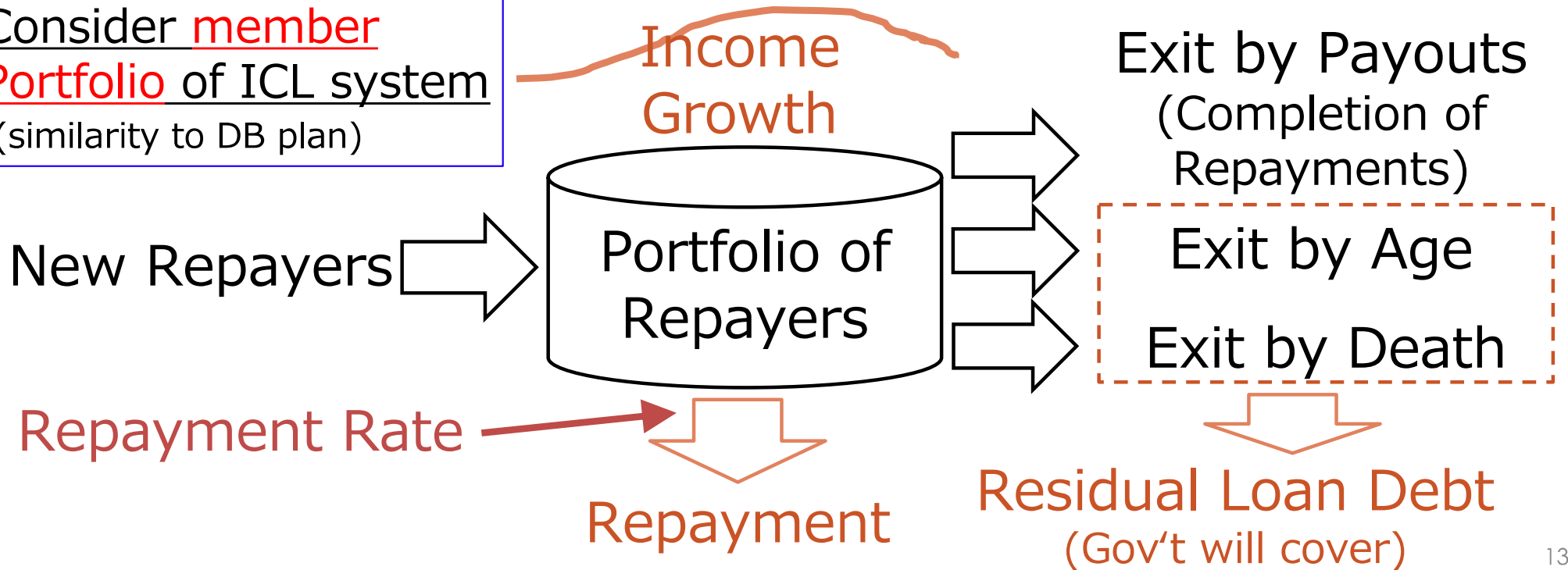
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## **3. PORTFOLIO MODEL**



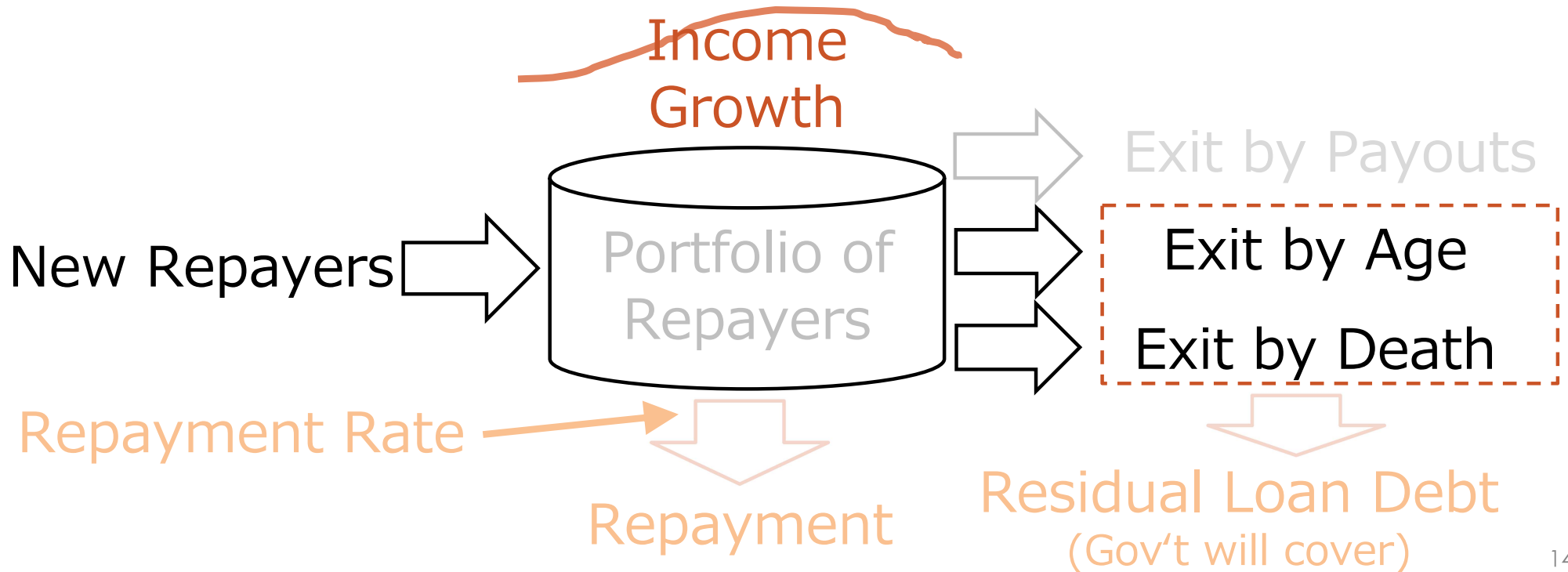
# Consider the Portfolio

Consider member  
Portfolio of ICL system  
(similarity to DB plan)



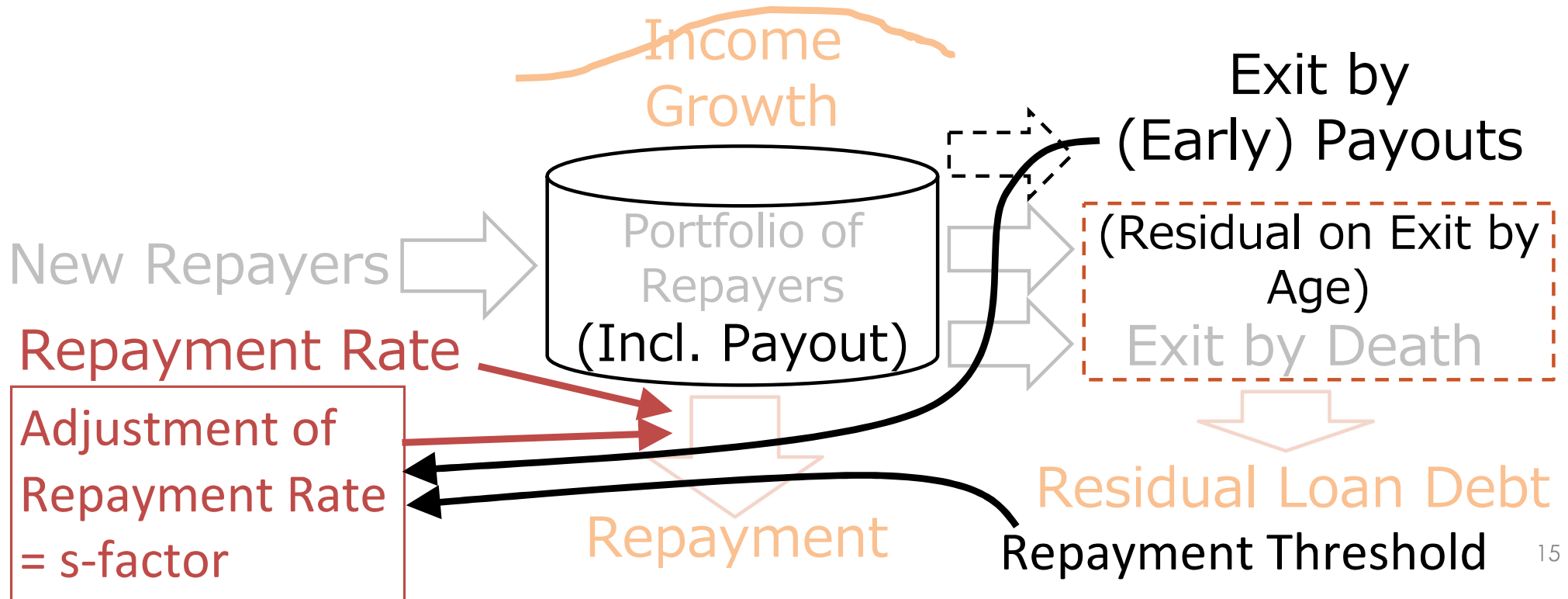


# Observable data





# Need of simulation (early stage)





# Why not “pure repayers” PF?

- the **income pass-dependency** of the repayments
  - the time one completes repayment of all his/her loan **depends on the history (path)** of his/her **incomes**.
  - **no pass information** in **portfolio simulation model**  
=> difficulty in forecasting “pure repayers” portfolio
- the assumption of the **income curves**
  - the **early completion** of repayment tend to occur **more for high-income persons**



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## **4. SIMPLE EXAMPLE**



# Model ICL system

- From Year 0, 10,000 borrowers graduate at age 22 every year.
- Each repayer owes 50,000 CU amount of loan at graduate.
- Repayers repay 7% of his/her income above 20,000
- If repayer's income is under 20,000, the repayment is not done and loan balance is kept still.
- If repayer is died, is disabled or become 60 years old, then the residual loan debt is cancelled.



# Model external environment

- The loan interest rate is set to zero.
- Distributions of income (set based on current info. by age) are assumed to be the same in the future.
- Mortality and disability rate by age is assumed unchanged by time and by income ranks.
- The transition matrix of income ranks (divided by decile points) is set fixed regardless of age, but linearly change in coming 20 years.



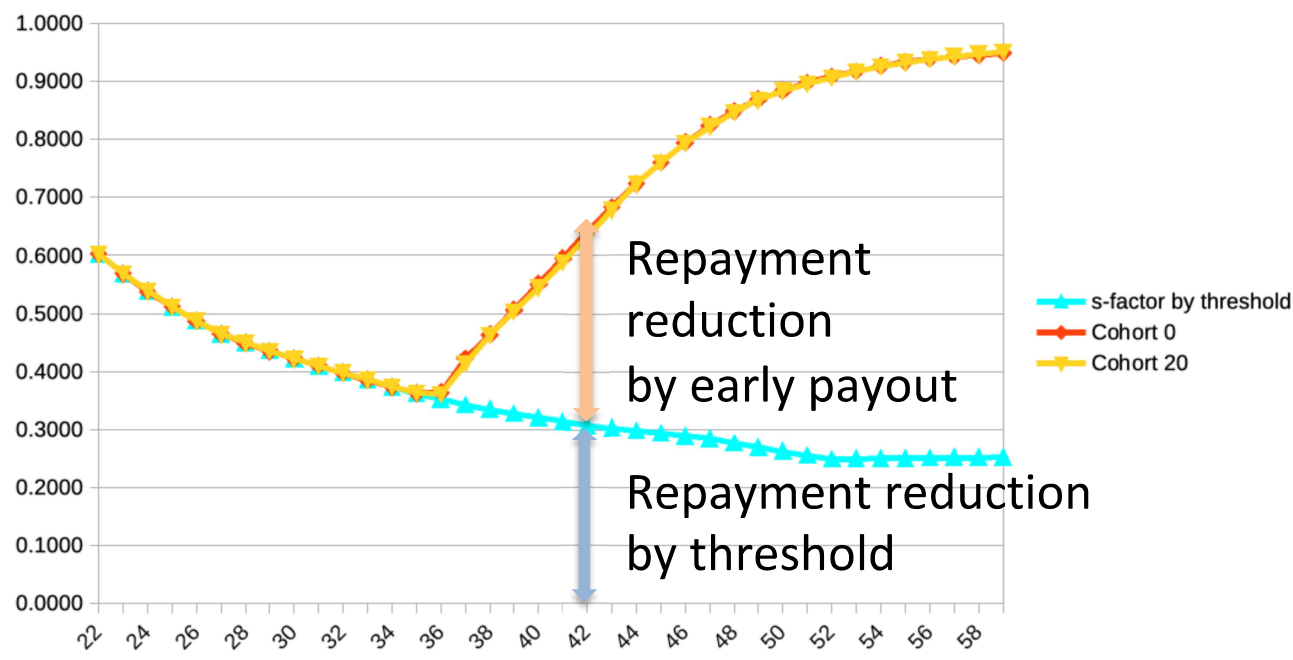
# Portfolio model

- First make stochastic simulation to get  $s$ -factor (adjustment factor of repayment rate to the income).
- Then make the future simulation using above parameters together with observable parameters (as set).  
Calculation is made cohort by cohort.



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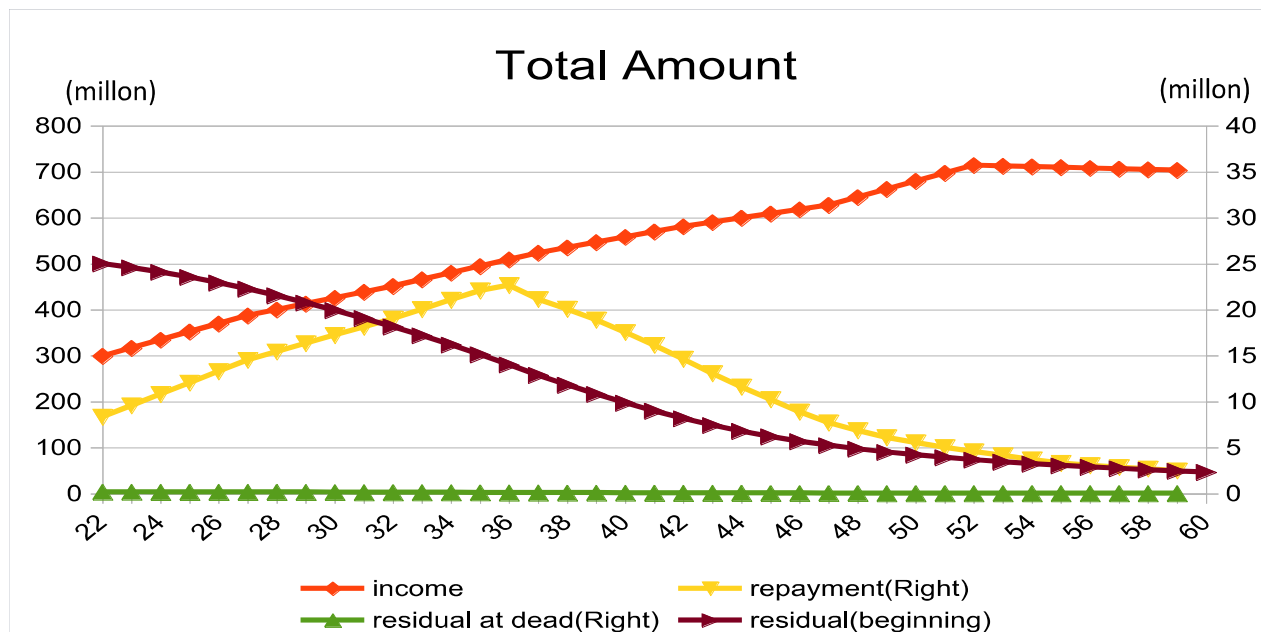
## **5. FORECASTING RESULT**



# Reduction parameter (s-factor)

By the threshold, s-factor decrease with income increase.

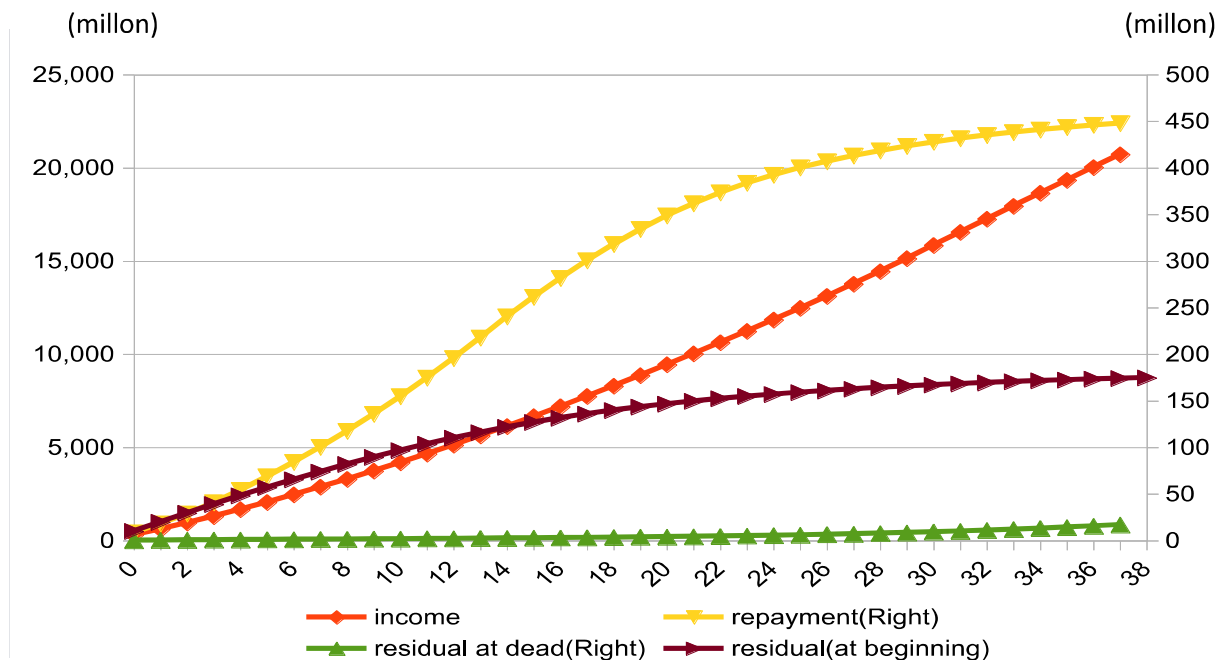
After Age 36, the effect of payout increases the s-factor.



# Cohort 0

Repayment once increases then decreases.

On the retirement age, still 10% of loan principal is not returned.



# Total portfolio

About 20 years after, the portfolio comes nearly steady-state.



# Pros and Cons

## Pros of portfolio model

- Less parameter
- Relation to the macro experience
- Easy to modify

## Cons of portfolio model

- Not consider individual circumstances
- Difficulty in granular analysis
- s-factor



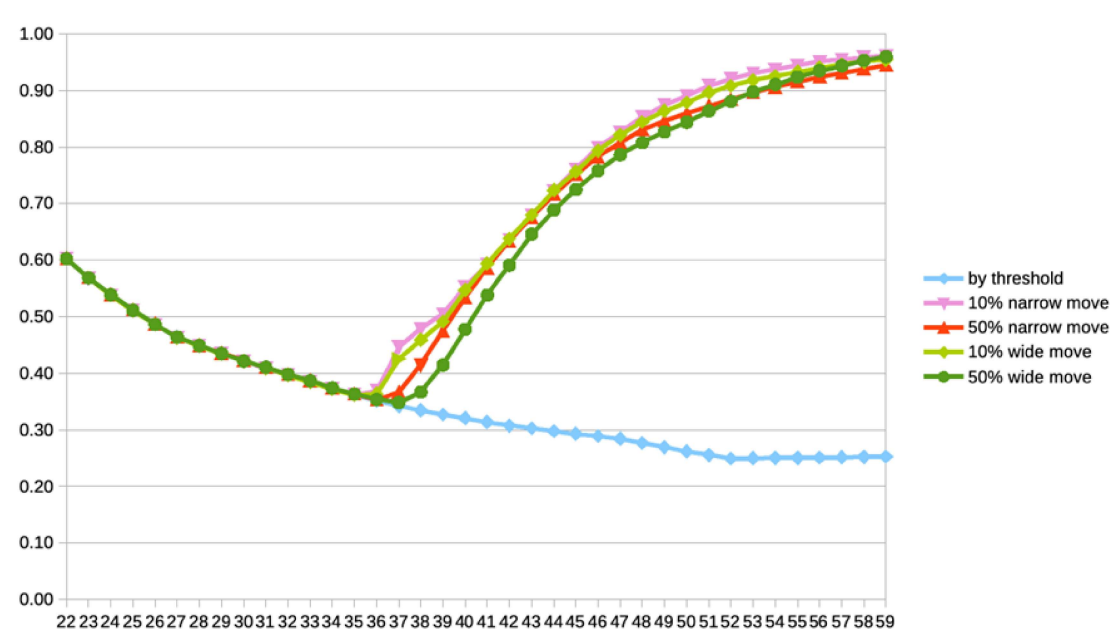
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## **6. FUTURE CHALLENGES**



# Future Challenges on Portfolio Model

- Reflection of future trends
- Interest rate and income/loan principal increase rate
- Assumption of s-factor
- Assumption of income class transition matrix



# (s-factor and income transition)

Broad income transition sometimes decreases the s-factors,  
but the effect is not simple.



# Future Challenges on PM (Cont'd)

- Reflection of personal differences
- Accumulation for future compensation
- Conservative margin and scenario testing
- Adjustment of model by real world data etc.
- Forecast analysis
- Communication



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## **7. ACTUARIAL NEW FIELDS**



# Features of traditional actuarial field

- **Portfolio** based
- Include **real world** parameter
- Treat **long term** cashflow
- **Proportional** principle (with professional decision)
  - ... might be a set of criteria of actuarial new field.

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**Thank you!**  
**Any Questions?**

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