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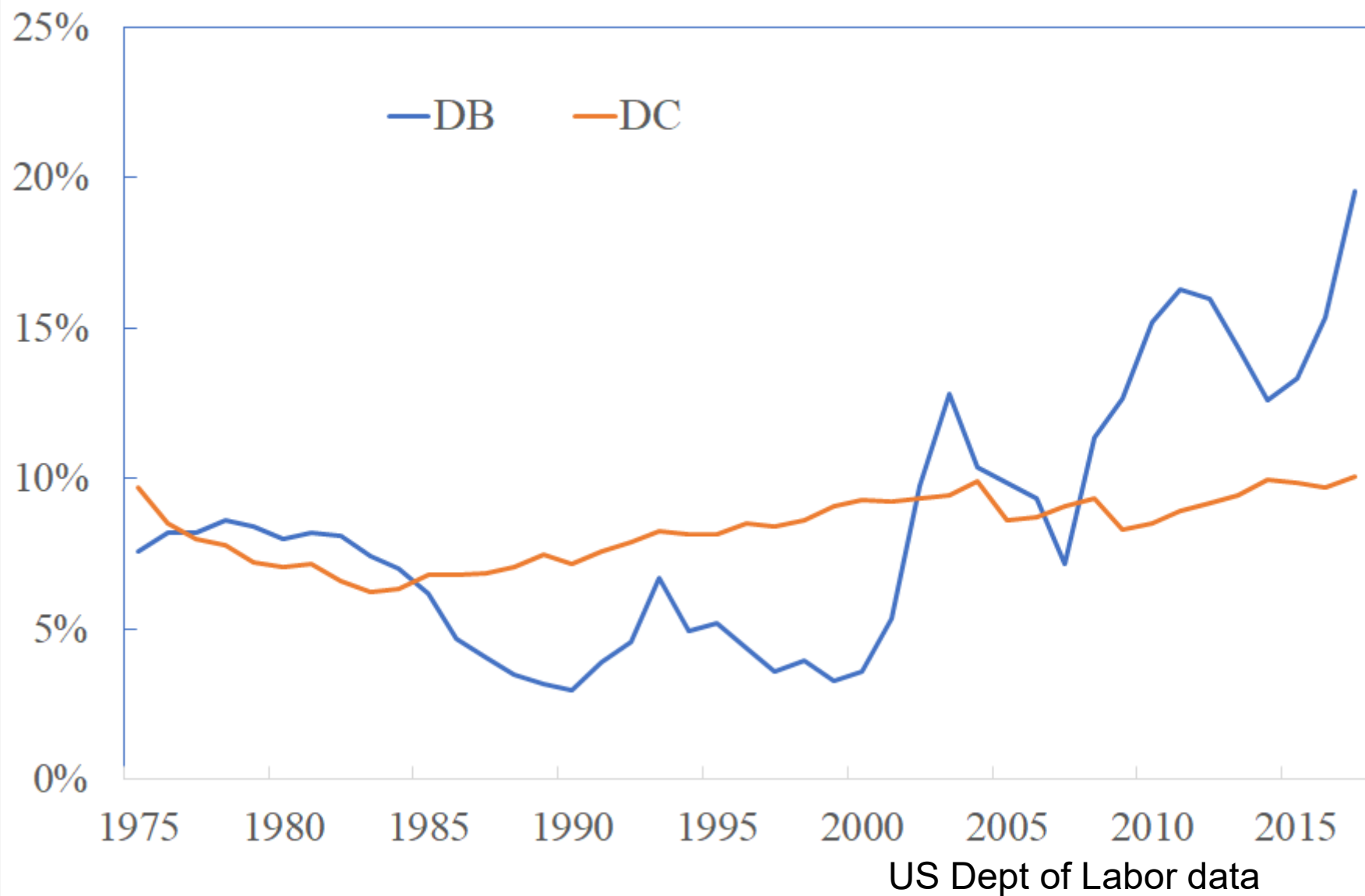
Objectives

- Briefly review the state of the world
- What we learned from stylized IRS models
- Compare performance of real world DB and IRS models
- Next steps

Why not DB?

- Volatile employer contributions
- Excessive cost to employer
- Unwieldy
- Fails to meet employer needs
- Fails to meet employee needs

Average contribution per \$1 median Income



Why not DC?

- *Decumulation options lack clarity and in many cases are not fit for purpose. (OECD)*
- *Defined contribution pensions are not fit for 21st century lives. (Altman: Pensions-time for change)*
- *Require people "to be able to cope with risks that they do not really understand".*
- *72% of people would be more likely to save into a pension if it guaranteed a level of retirement income.*

ILLUSTRATIVE DC REPLACEMENT RATES



Benefit design criteria

- **Affordable**
- **Sustainable**
- **Efficient**
- **Adequate**
- **Fair**

INTERGENERATIONAL RISK SHARING (IRS) PLANS

[Back to basics](#)

Stylized IRS models

- Stationary population of workers and retirees
- All contributions paid from salary
- Transparent risk sharing
- Stochastic asset process
- Dynamic control problem...
- Objective function:
 - aggregate square difference between target and actual income
 - or aggregate utility

Key results from theoretical analysis

- Optimal Risk sharing is linear:

$$c_t = c - \alpha \frac{(A_t - \psi L)}{N_w}$$

$$b_t = b + \beta \frac{(A_t - \psi L)}{N_r}$$

Key results from theoretical analysis

- Surplus above $A_t - \psi L$ is partially shared between workers and retirees
 - $(\alpha + \beta)(A_t - \psi L)$ is the total distributed at t
- Deficit exceeding $\psi L - A_t$ similarly.
- Deficit / surplus elimination period of $\frac{1}{\alpha + \beta}$
- Optimal α and β satisfy $\frac{\alpha}{\beta} \approx \frac{N_w}{N_r}$

FROM ABSTRACT TO REAL WORLD (ISH)

Back to reality...

DB vs IRS

- 1.8% accrual rate; 3-year FAS plan.
- Single life annuity from age 65.
- COLA up to 3%, funded; lost on wind-up.
- PUC (partial) funding; TUC solvency
- All contributions from workers' pay*
- Invested 60% stocks, 40% long bonds
- Starting A/L = 1 (going concern)
- Normal Contribution rate \approx 18.5%

DB Plan

- Funding A/L > 1.2 → contributions reduced
- Solvency A/L < 1.0 → contributions increased,
- 30% cap on total contribution rates (TCR)
- Wind-up triggered if solvency A/L < 0.5
 - Accrued benefits reduced pro-rata
 - COLA suspended
 - Bulk-buy-out → no further risk

IRS Plan

- Target benefits, valuations, assets, as for DB
- Same wind-up threshold (Solvency A/L < 0.5)
- No TCR cap
- Funding A/L > 1.2 → surplus distributed
 - Based on 5-year recovery period
- Solvency A/L < 1.0 → deficit recouped
 - Based on 10-year recovery period

IRS Surplus Sharing

$$TCR = NCR - \alpha_h \frac{(A_t - \psi_h L_f)}{S(t)}$$

$$BAF = 1 + \beta_h \frac{(A_t - \psi_h L_f)}{B(t)}$$

IRS Deficit Sharing

$$TCR = NCR + \alpha_l \frac{(\psi_l L_s - A_t)}{S(t)}$$

$$BAF = 1 - \beta_l \frac{(\psi_l L_s - A_t)}{B(t)}$$

IRS Parameters

Total proportion of surplus /deficit distributed each year

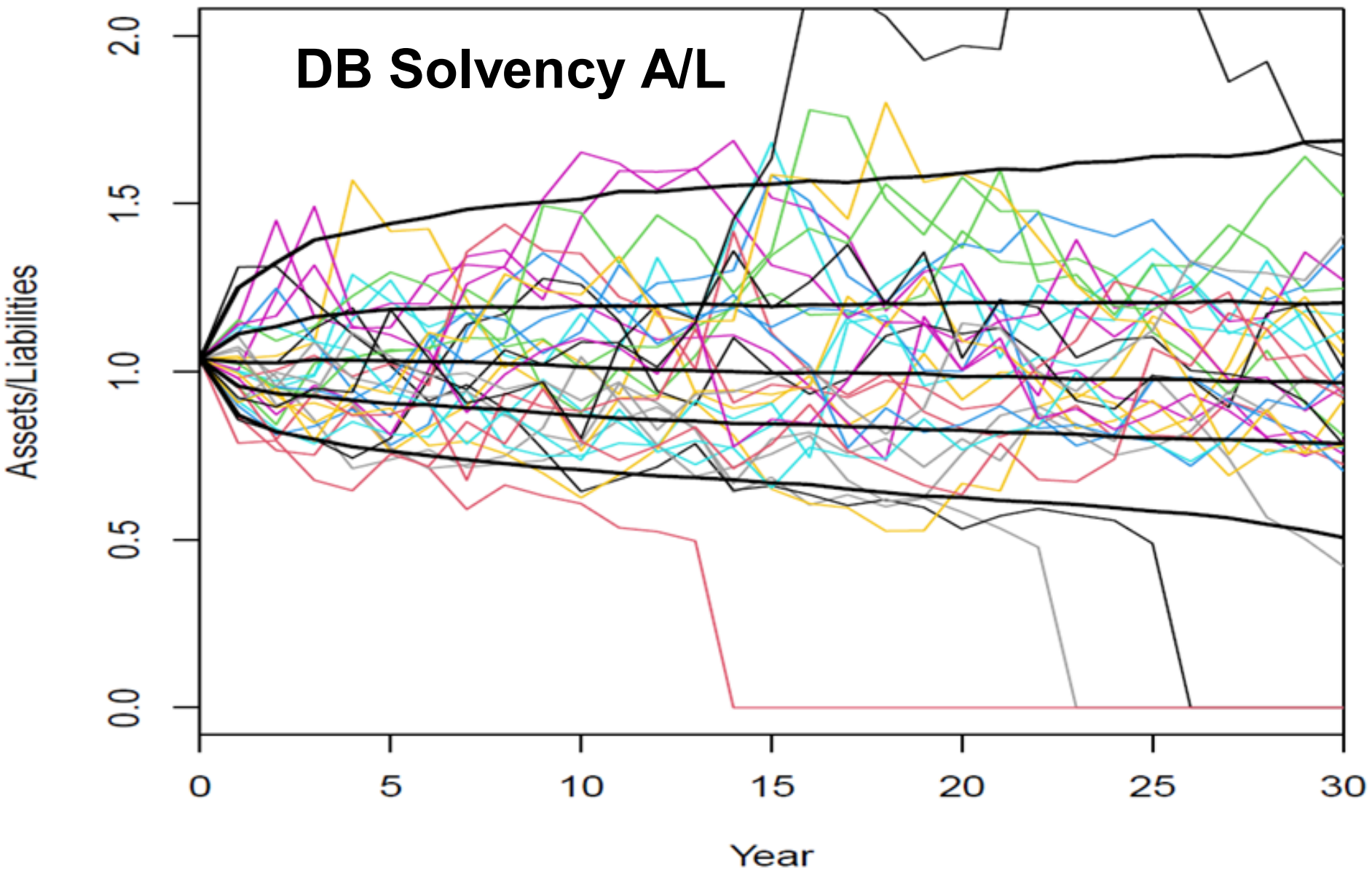
$$= \alpha_j + \beta_j, \quad j = h \text{ (high) }, l \text{ (low)}$$

$$\text{Five year spread of surplus} \Rightarrow \alpha_h + \beta_h = \frac{1}{5}$$

$$\text{Ten year spread of deficit} \Rightarrow \alpha_l + \beta_l = \frac{1}{10}$$

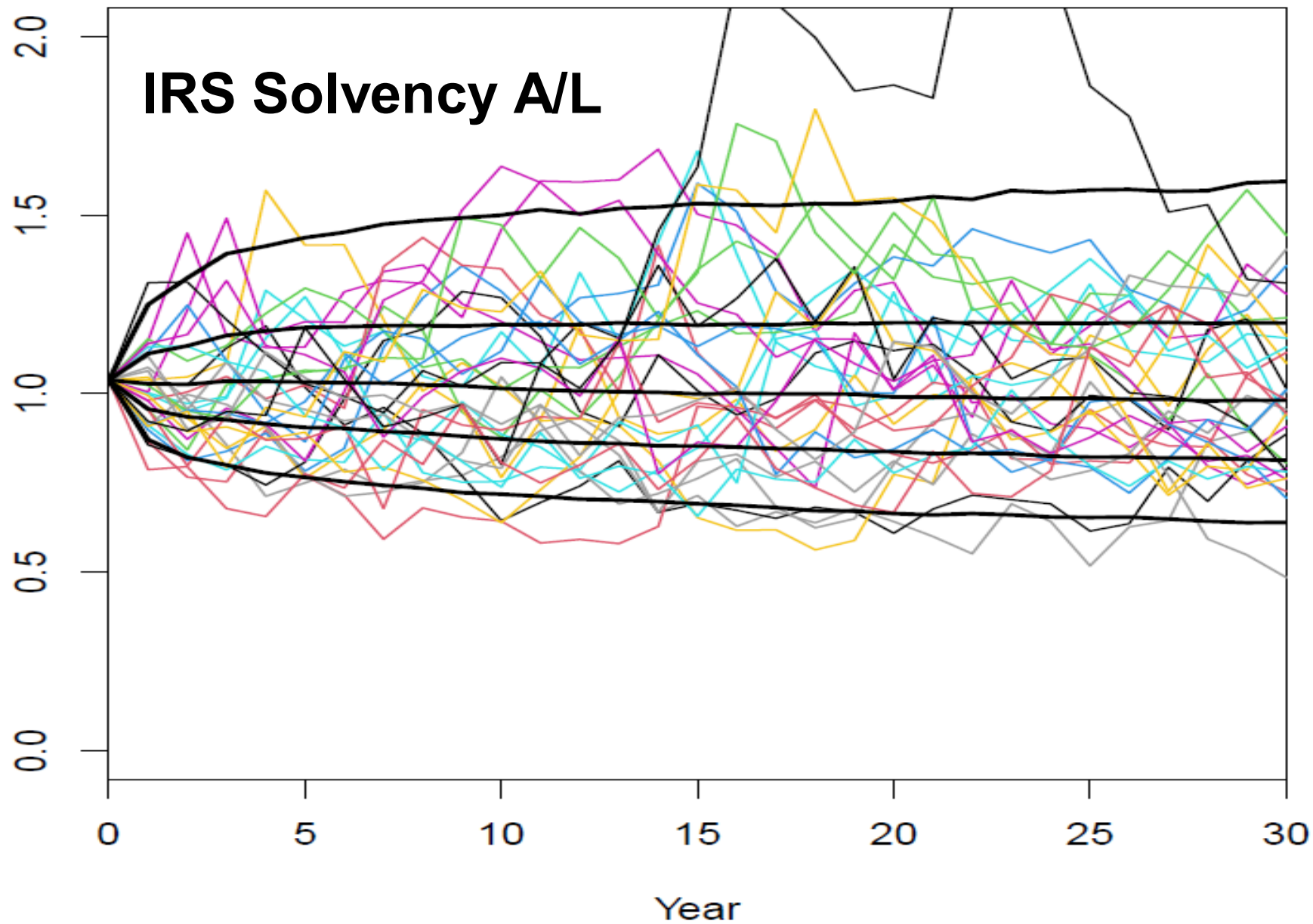
Also

$$\frac{\alpha_h}{\beta_h} = \frac{\alpha_l}{\beta_l} = \frac{S(t)}{B(t)}$$

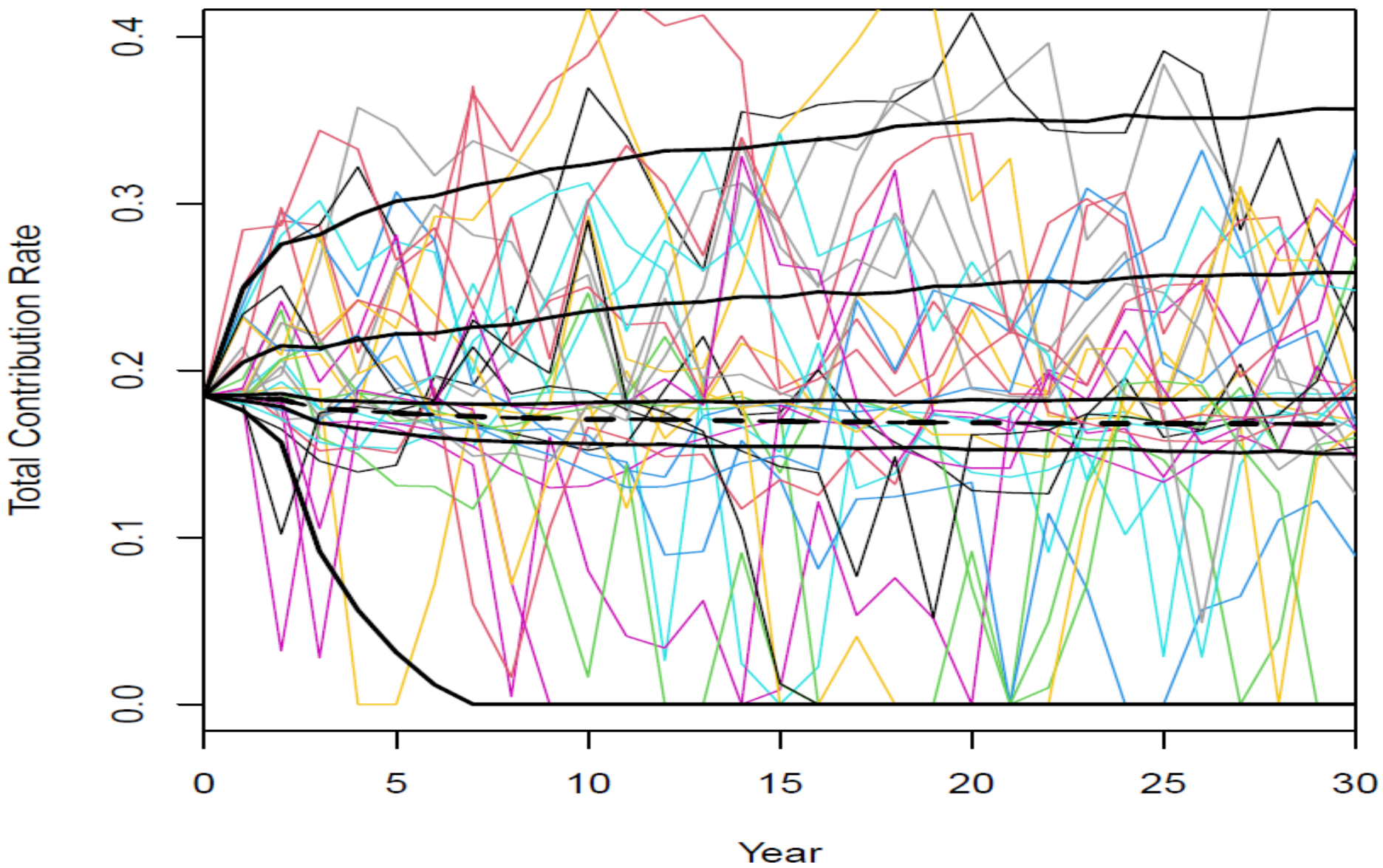


Assets/Liabilities

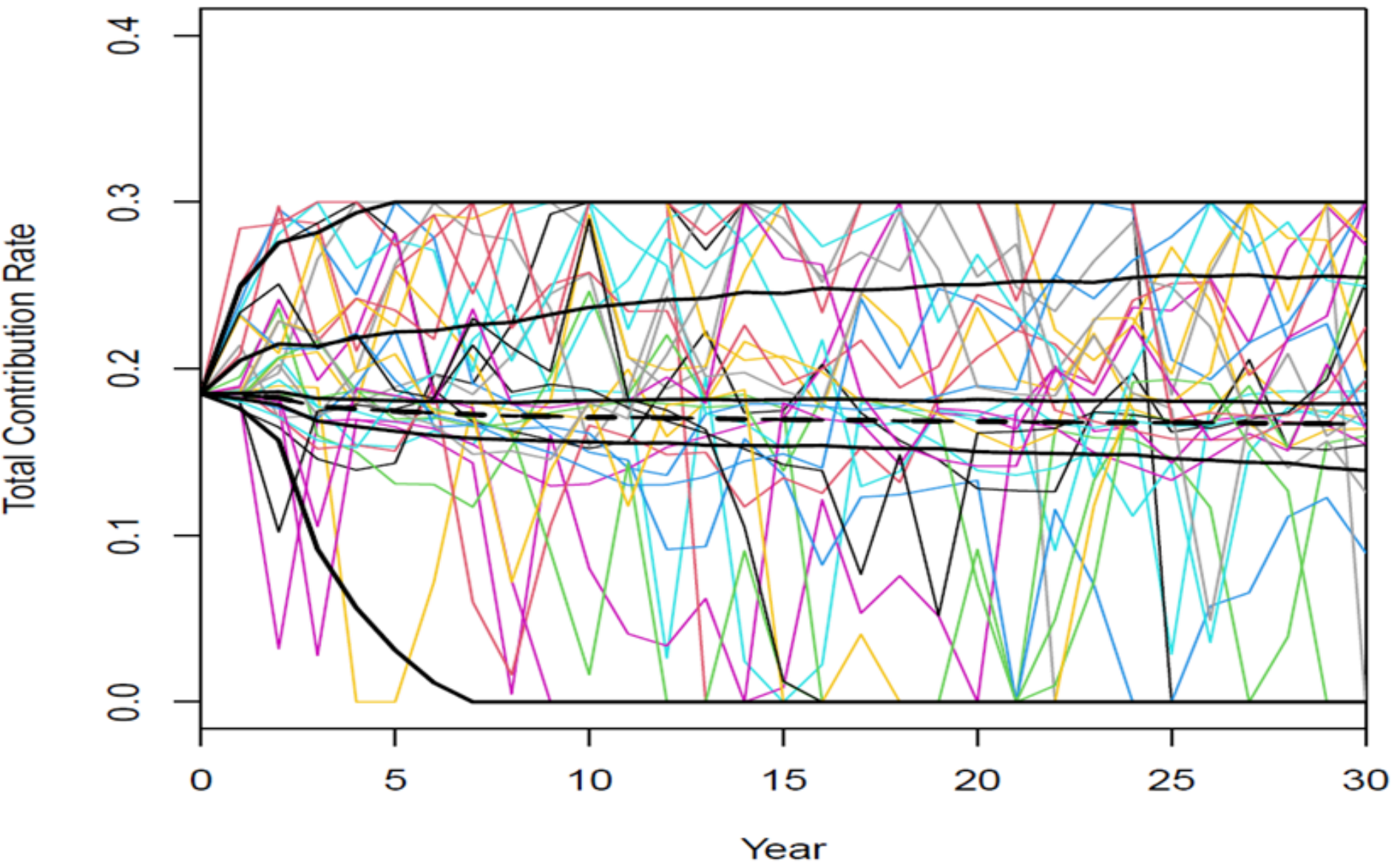
IRS Solvency A/L



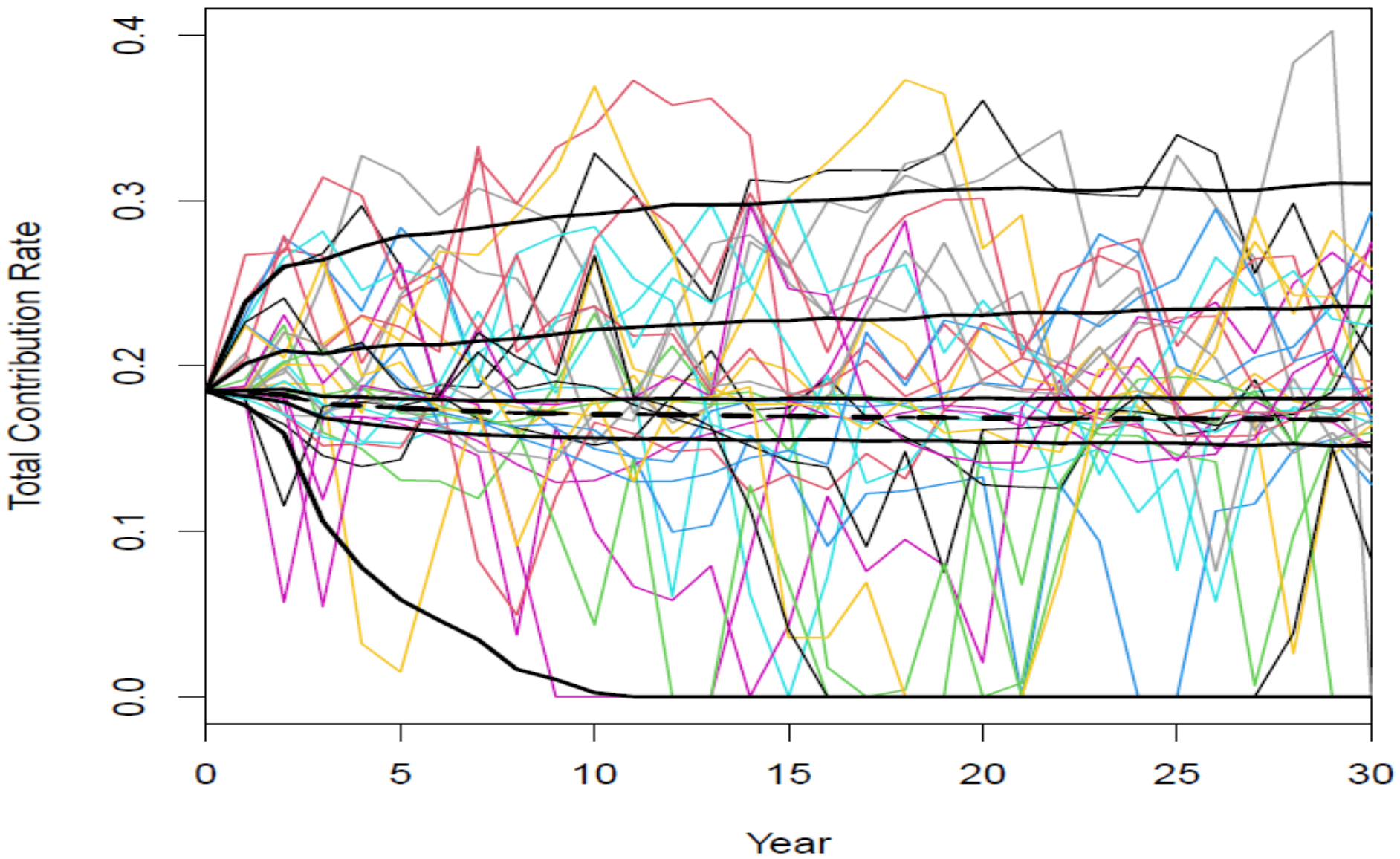
TCR, DB, NO Cap



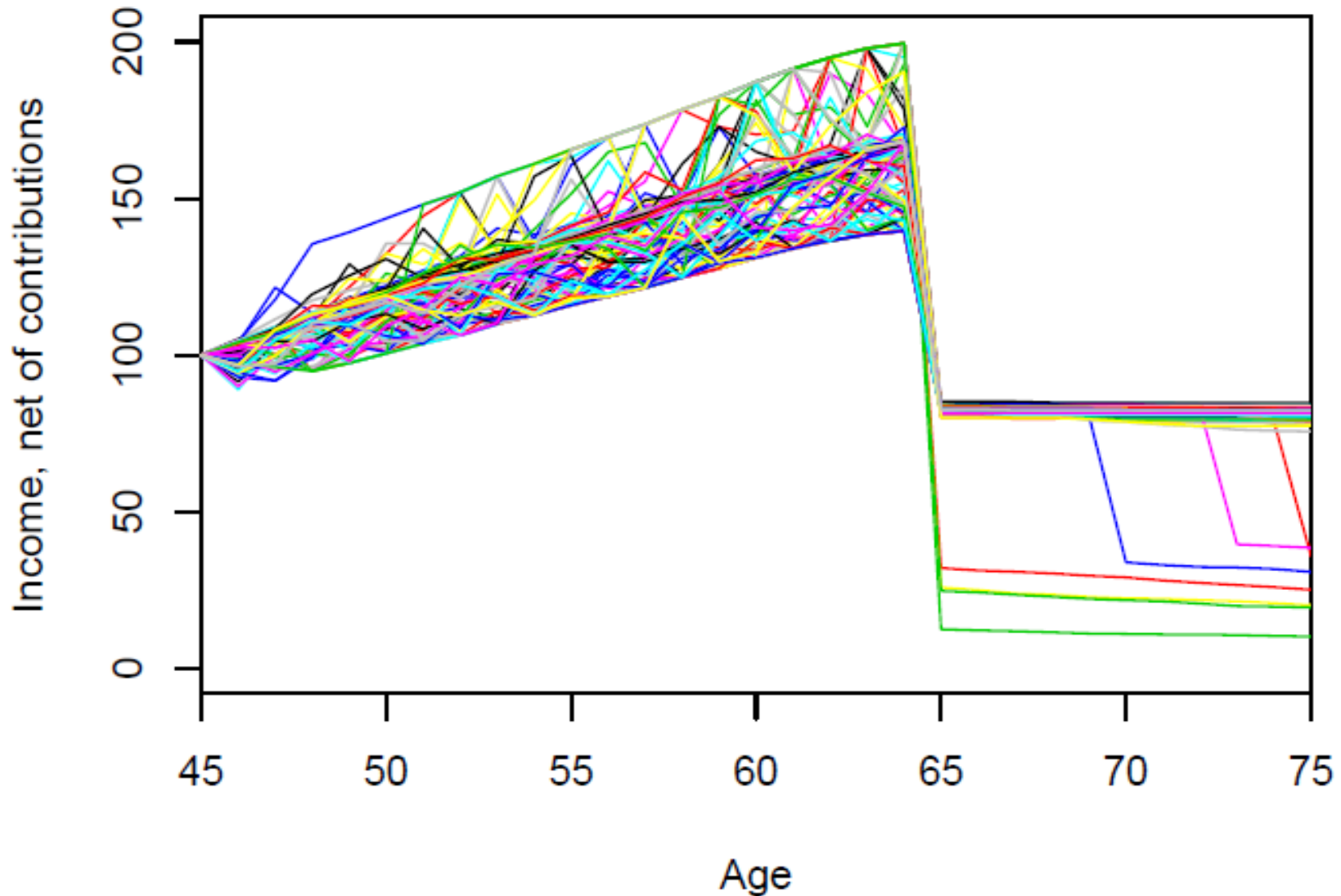
TCR, DB, 30% Cap



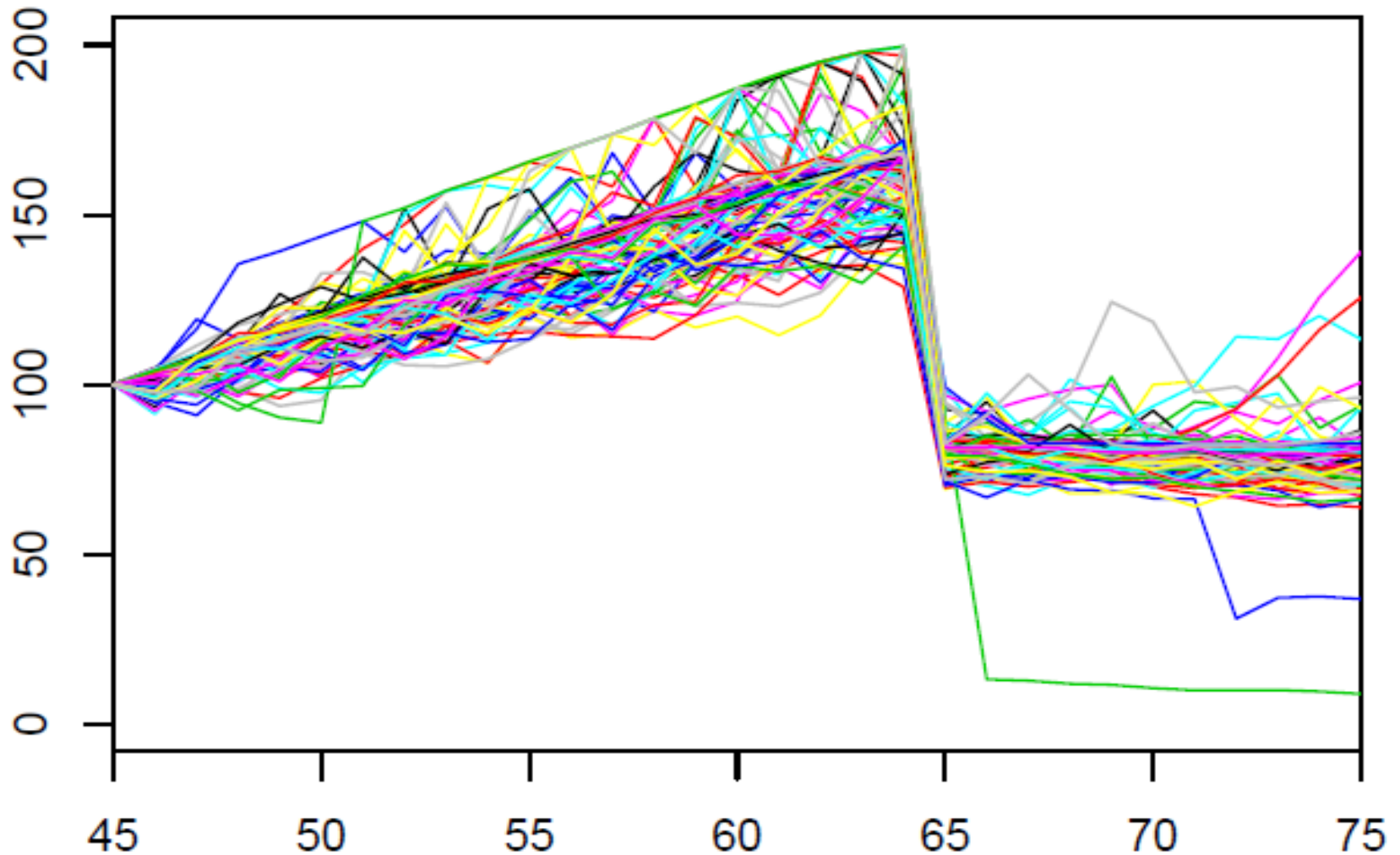
TCR, IRS



Real Income Paths; age 45; DB



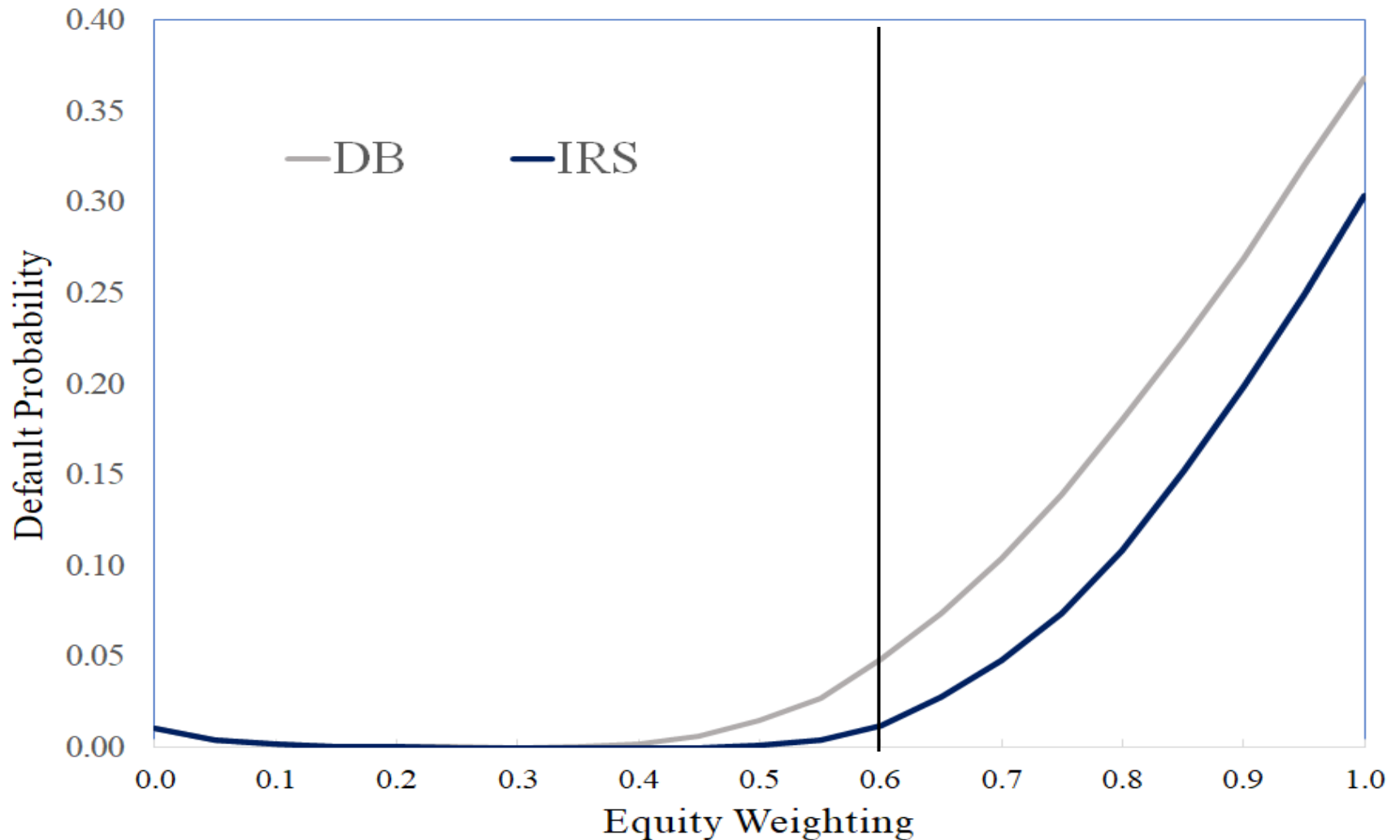
Real Income Paths; age 45; IRS



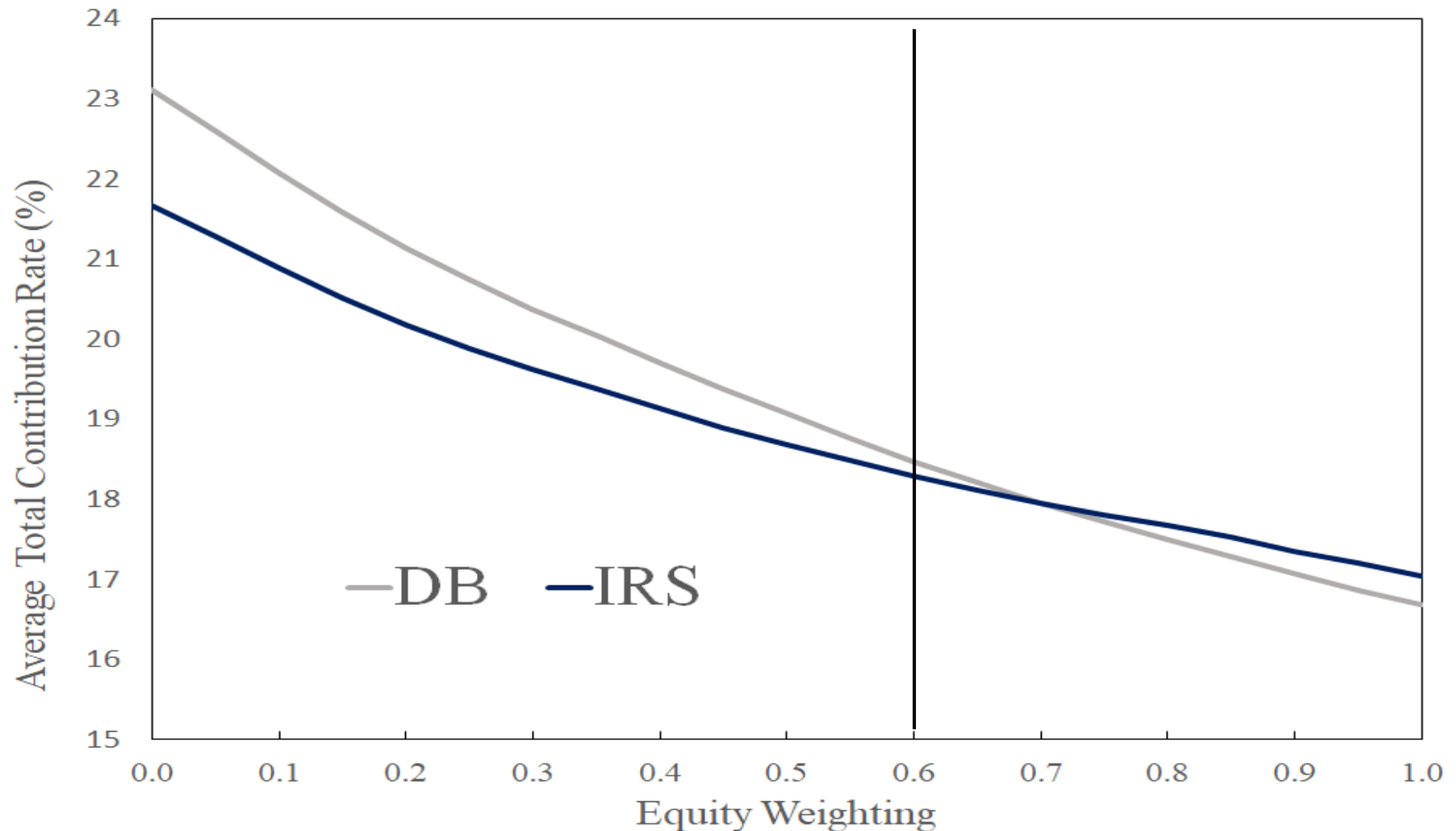
Comparison metrics

- Probability of wind-up
 - Sustainability, adequacy, efficiency, fairness
- Average total contribution rate
 - Affordability
- Income stability – compares actual and target income
 - Adequacy, fairness, efficiency
- Plotted across a range of equity weighting

Wind-up Risk by equity weighting

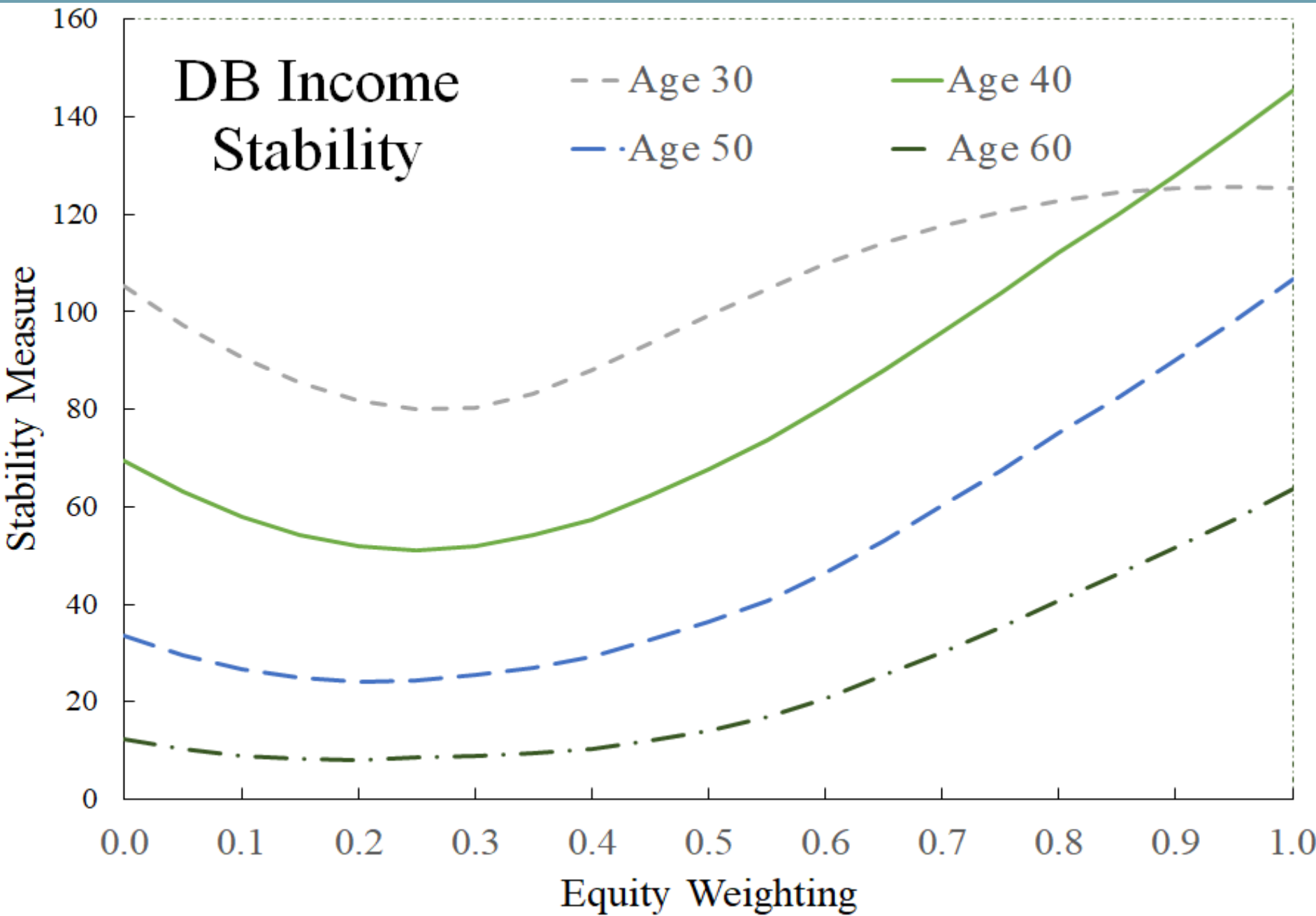


Average TCR by equity weighting

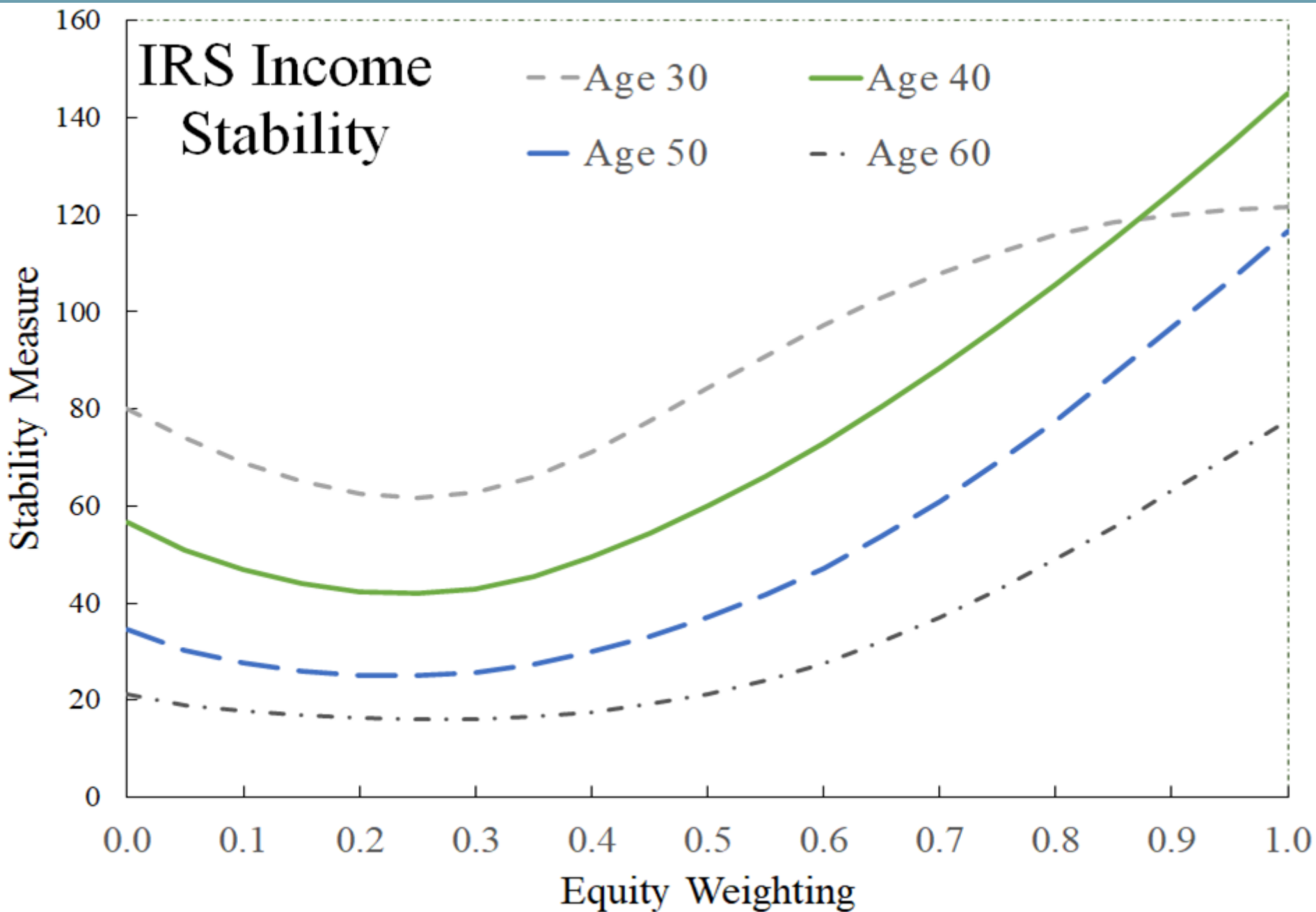


Notes on income stability (IS)

- IS^2 is the average squared disparity of actual and target income.
- Low values are better
- Positive and negative disparities are penalised equally
- Calculated by cohort
- Similar to the objective function used in theory papers



IRS Income Stability



FAIRNESS?

Heterogeneity in active member classes

Salaried vs Non-Salaried Employees

- Identical demographics
- Flat salary scale from age 30

	Default Rate	Average TCR
DB Salaried	4.9%	18.5%
DB Non-salaried	0.2%	14.4%

	Default Rate	Average TCR
IRS Salaried	1.2%	18.3%
IRS Non-salaried	0.04%	14.7%

CONCLUSIONS

Back to the future

Conclusions (1): usefulness of theory

- Theoretical results pointed to:
 - appropriate risk sharing mechanism
 - parameter constraints and relationships
 - the income stability metric
 - fair transition process

Conclusions (2): IRS plan advantages

- IRS with a linear risk sharing mechanism is
 - Transparent,
 - Relatively robust
 - Surprisingly effective
- IRS dominates DB on affordability, sustainability, efficiency (based on strong modelling assumptions)
- With default risk, IRS may dominate DB on adequacy
- IRS improves fairness between generations

Conclusions (3): More work required

- IRS does not much mitigate blue-collar/white collar inequity
- But IRS + CARE helps.
- To be further investigated
 - Fairness of discretionary COLA
 - Fairness between stayers and leavers
 - Separating worker/sponsor objectives

Selected References

- Hardy MR, Saunders D, Zhu XM. (2020). Risk Sharing Pension Plans: Sustainability, Affordability, Adequacy, and Fairness. National Pension Hub Publication.
- Zhu XM, Hardy MR, and Saunders D (2020a). Structure of Intergenerational Risk-Sharing Plans: Optimality and Fairness. Scandinavian Actuarial Journal (forthcoming) .
- Zhu XM, Hardy MR, Saunders D (2020b). Fair transition from a defined benefit to a target benefit pension plan. SSRN (forthcoming).
- Cui J, De Jong F, Ponds E (2011). Intergenerational risk sharing within funded pension schemes. Journal of Pension Economics & Finance, 10(1).
- Gollier C (2008). Intergenerational risk-sharing and risk-taking of a pension fund." Journal of Public Economics, 92(5-6).
- Wang S, Lu Y, Sanders B (2018). Optimal investment strategies and intergenerational risk sharing for target benefit pension plans. Insurance: Mathematics and Economics, 80.