Intergenerational Fairness in a CDC-Pension System

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About the speaker

- **Oskar Goecke**
- Deputy Director Institute for Insurance Studies, TH Köln
- Degree in Mathematics and Economics
- 9 year experience in a life insurance company
- primary research interest: Collective pension arrangements
- recently: Consultancy for governmental bodies

Technology
Arts Sciences
TH Köln

ivwKöln
Institut für Versicherungswesen

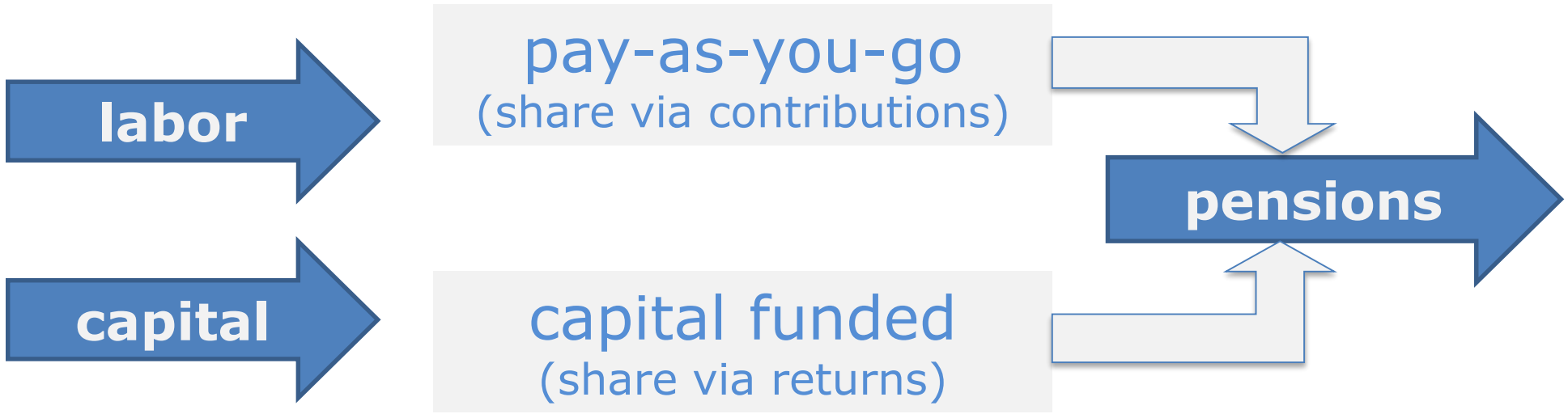
- **TH Köln:** 26,000 students; 420 professors and 600 academic staff members; 11 faculties with 48 institutes
- **ivwKöln:** BSc/ MSc degrees in business administration with focus on Risk & Insurance, 16 professors, 670 students

Overview

- Introduction: capital funded vs. pay-as-you-go
- **C**ollective **D**efined **C**ontribution schemes: properties and challenges
- ALM-rules to manage the intergenerational risk transfer
- Resilience of a CDC-system under capital market shock scenario
- Conclusion

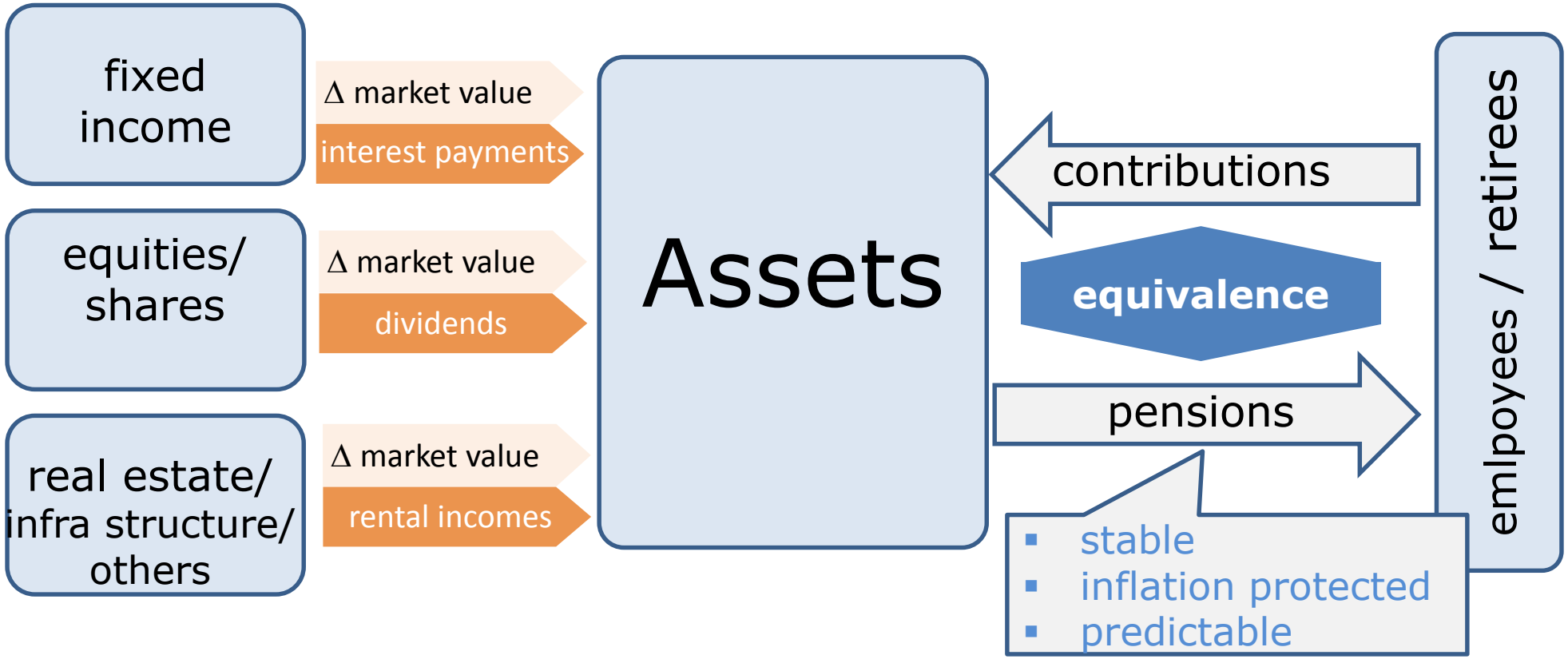
Old age pension: How does it work?

Capital funded vs. Pay-as-You-Go



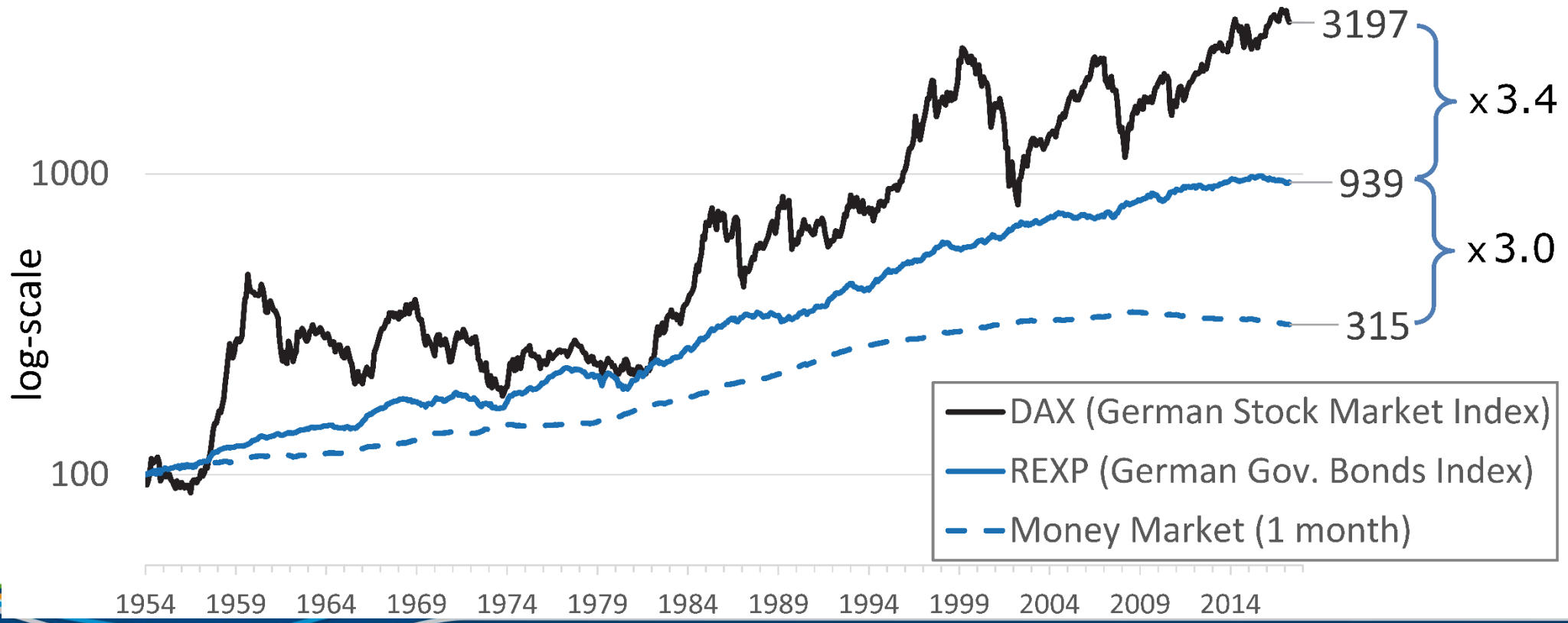
A good pension system guarantees a **fair participation** in the factor products of labor and capital!

Capital Funded Pension Schemes



Fair participation

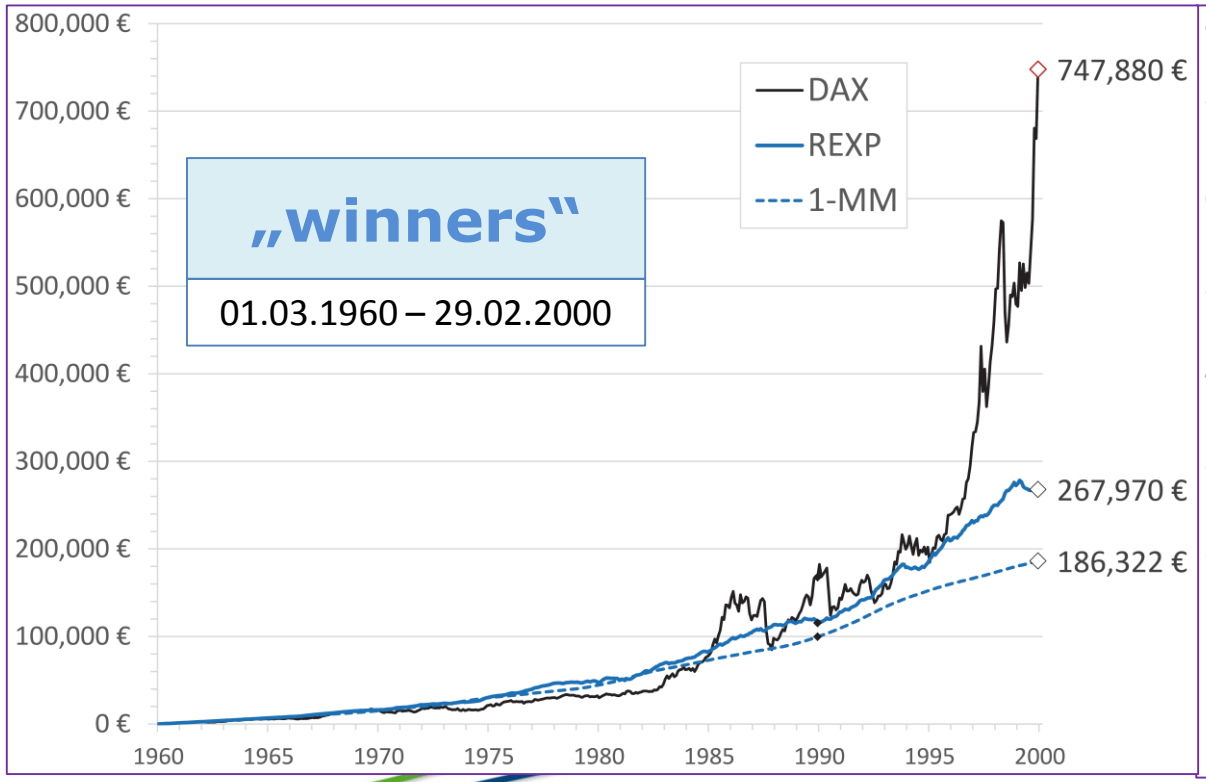
Performance Equities/ Gov. Bonds/ Money Market
(price-adjusted, Jan 1955 - April 2018)

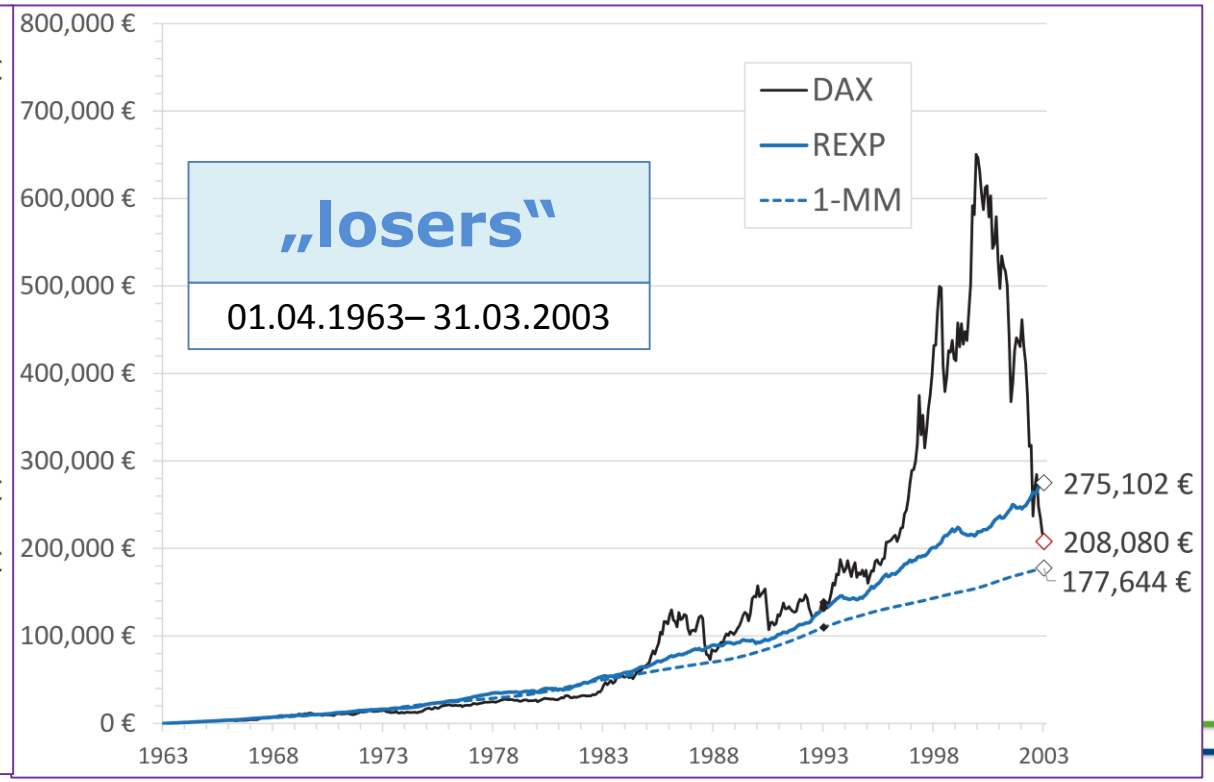


Intergenerational Fairness (1/2)

Accrued Capital

(40year saving plan with saving rate of 100€ per month)

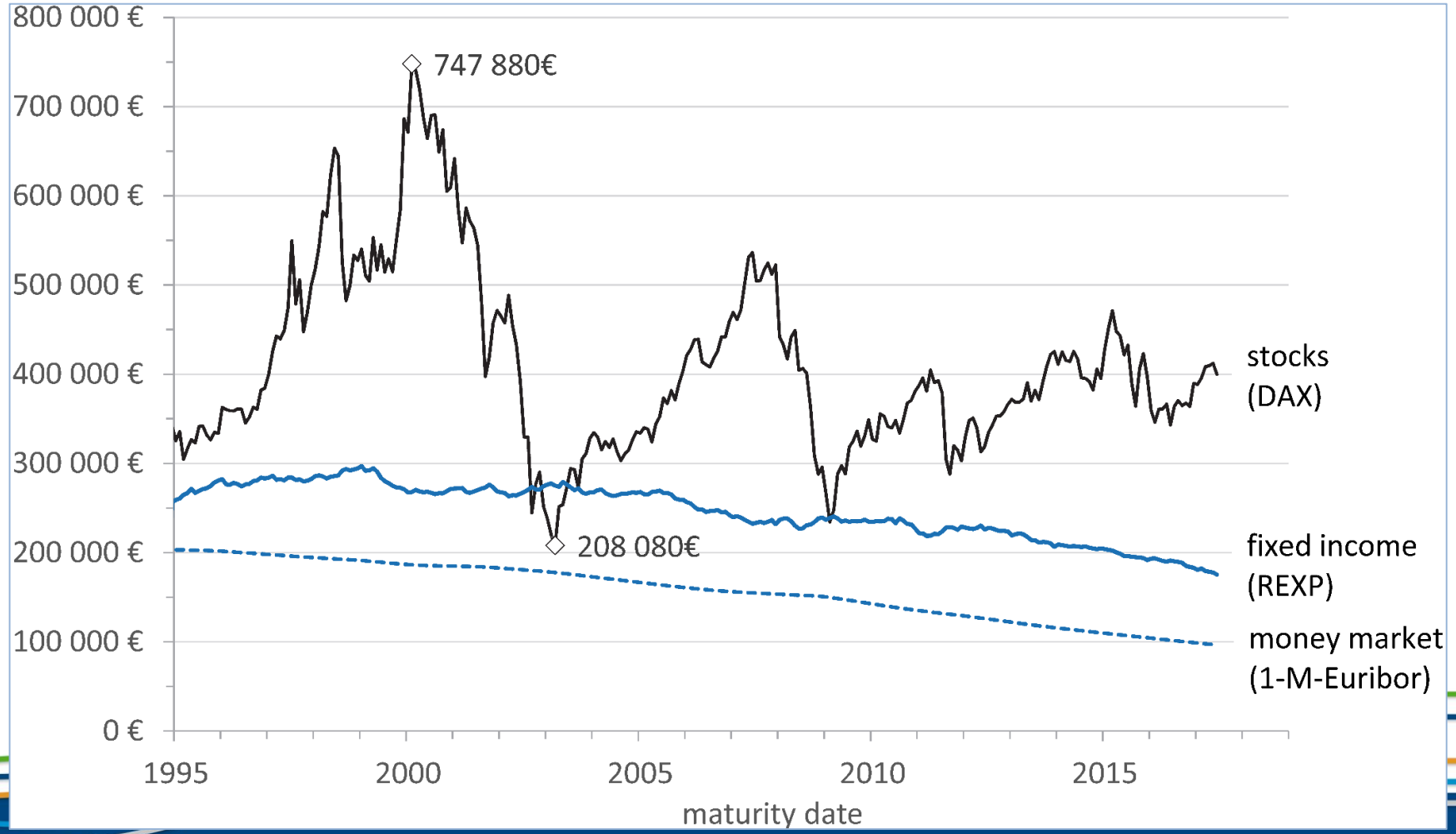




Intergenerational Fairness (2/2)

Accrued Capital

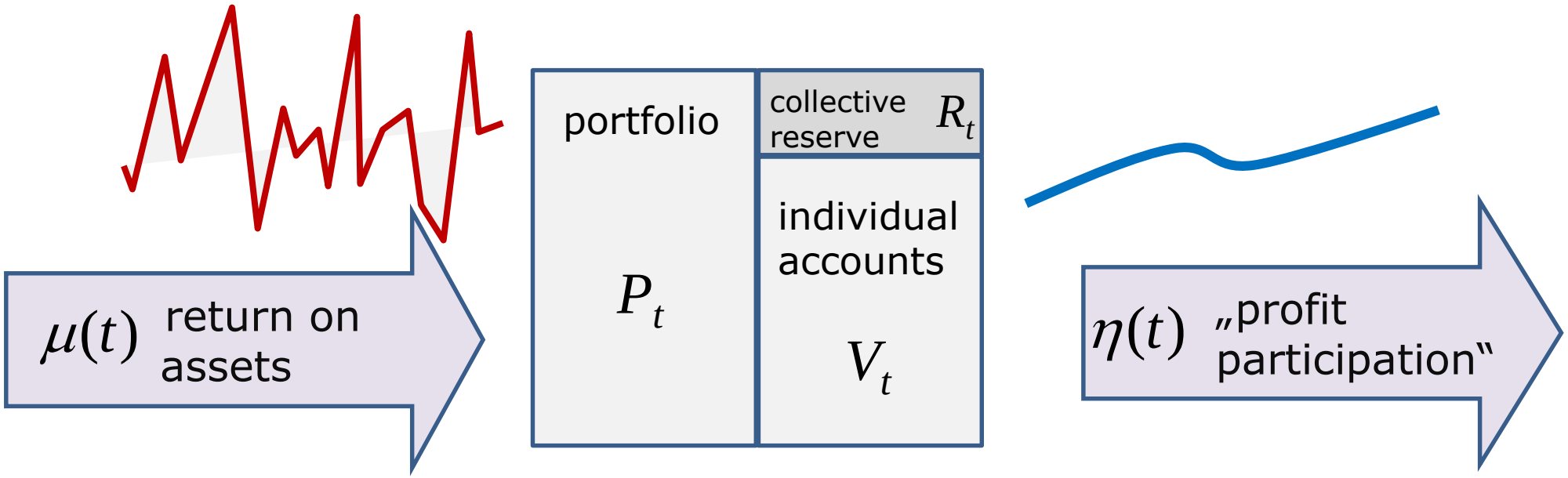
(Revolving 40years saving plans)



Idea of Collective DC

- enable a fair share in the production factor capital
- avoid „irrational exuberances“
- make the pension system resilient: buffer shocks and adapt to systematic changes
- … under strict observance of the equivalence principle

Idea of Collective DC (1/2)

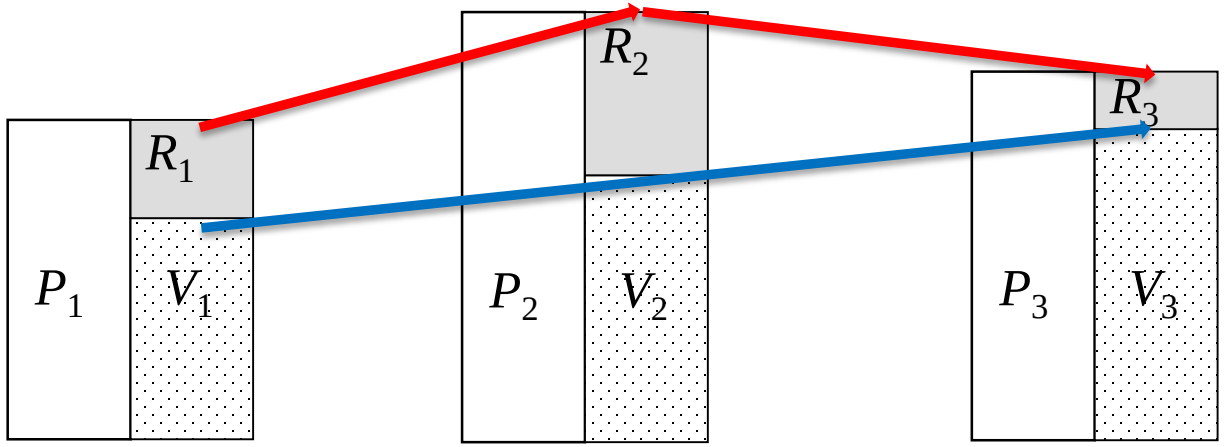


$$\rho(t) := \ln\left(\frac{P_t}{V_t}\right)$$ „reserve ratio“ = *log*(funding ratio)

Idea of Collective DC (2/2)

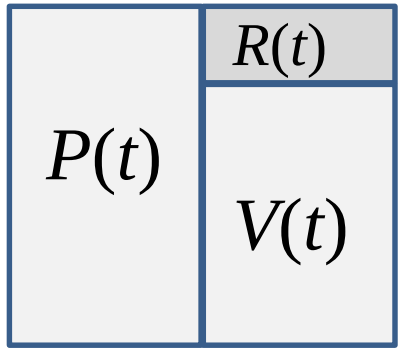
„bull markets“

„bear markets“



Volatile market values are buffered by the collective reserve.

Time Continuous ALM-Model *)



Assets: $\frac{dP(t)}{P(t)} = \left(\bar{\mu} + r_M\,\sigma(t)\right)dt + \sigma(t)dW_t$

Liabilities $\frac{dV(t)}{V(t)} = \eta(t)\,dt$

reserve gap: $\hat{\rho}(t) := \rho(t) - \rho_{\text{target}}$

ALM:

$$\sigma(t) = \hat{\sigma} + a\,\hat{\rho}(t)$$

$$\eta(t) = \left(\bar{\mu} + r_M\sigma(t) - \tfrac{1}{2}\sigma^2(t)\right) + \theta\,\hat{\rho}(t)$$

expected return on assets

*) Goecke: Insurance: Mathematics and Economics 2013, 678-689.

Solution *)

$$\sigma(t) = \hat{\sigma} + a\,\hat{\rho}(t)$$
$$\eta(t) = \left(\bar{\mu} + r_M \sigma(t) - \tfrac{1}{2}\sigma^2(t)\right) + \theta\,\hat{\rho}(t)$$

$$P(t) = P_0 \exp\left(\int_0^t \bar{\mu} + r_M\,\sigma(s) - \tfrac{1}{2}\sigma^2(s)\,ds + \int_0^t \sigma(s)\,dW_s \right)$$

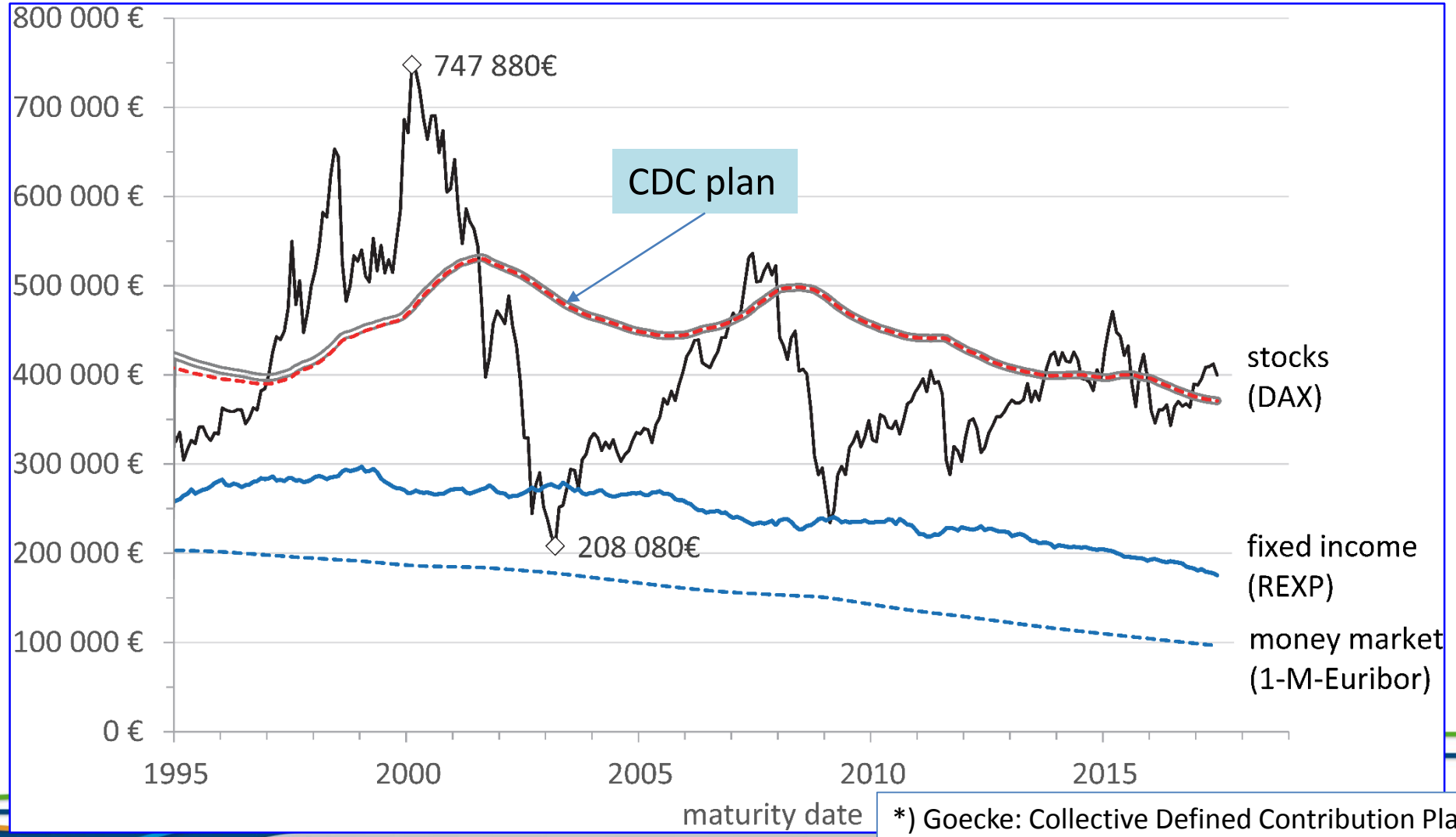
$$V(t) = V_0 \exp\left(\int_0^t \eta(s)ds \right) = V_0 \exp\left(\int_0^t \left(\bar{\mu} + r_M \sigma(t) - \tfrac{1}{2}\sigma^2(t)\right) + \theta\,\hat{\rho}(t)ds \right)$$

$$\hat{\rho}(t) = \rho(t) - \rho_{\text{target}} = \hat{\rho}_0 - \theta \int_0^t \hat{\rho}(s)ds + \int_0^t \left(\hat{\sigma} + a\,\hat{\rho}(s)\right) dW_s$$

$$\Rightarrow \quad d\,\hat{\rho}(t) = -\theta\;\hat{\rho}(t)\;dt + \left(\hat{\sigma} + a\,\hat{\rho}(t)\right) dW_t$$

*) Goecke: Insurance: Mathematics and Economics 2013, 678-689.

CDC and Intergenerational Equity



*) Goecke: Collective Defined Contribution Plans – Backtesting based on German capital market data 1955 – 2015, Forschung am IVW Köln, Band 5/2016 (Preprint)

Resilience of a CDC-system

What happens to a CDC-pension system in case of a

- **capital market shock**
- capital market shift
- mortality shift

?

We asses this by determining the

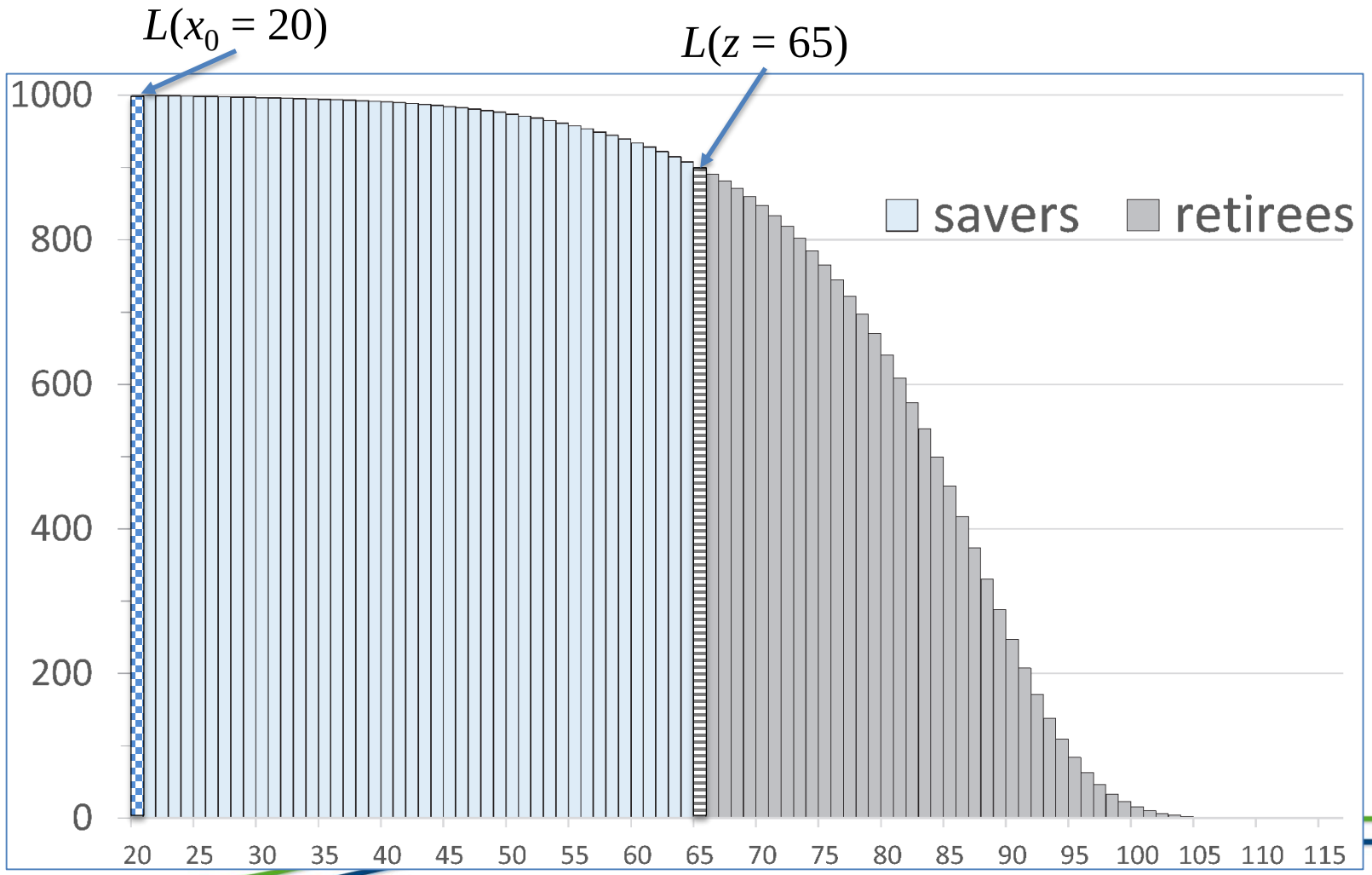
intergenerational wealth transfer.

Starting from a Steady State

- stationary population {L(x): 20≤x≤115, L(20)=1000}
- contribution of 1 from age x= 20 to 64
- old age pension from age x=65, actuarial interest rate μ_a = 1%
- constant capital market return μ = 2.5%
- constant pension adjustment $\varepsilon = \mu - \mu_a$ = 1.5%
- assets = liabilities ($P = V$, $\rho = \rho_{target}$=0)

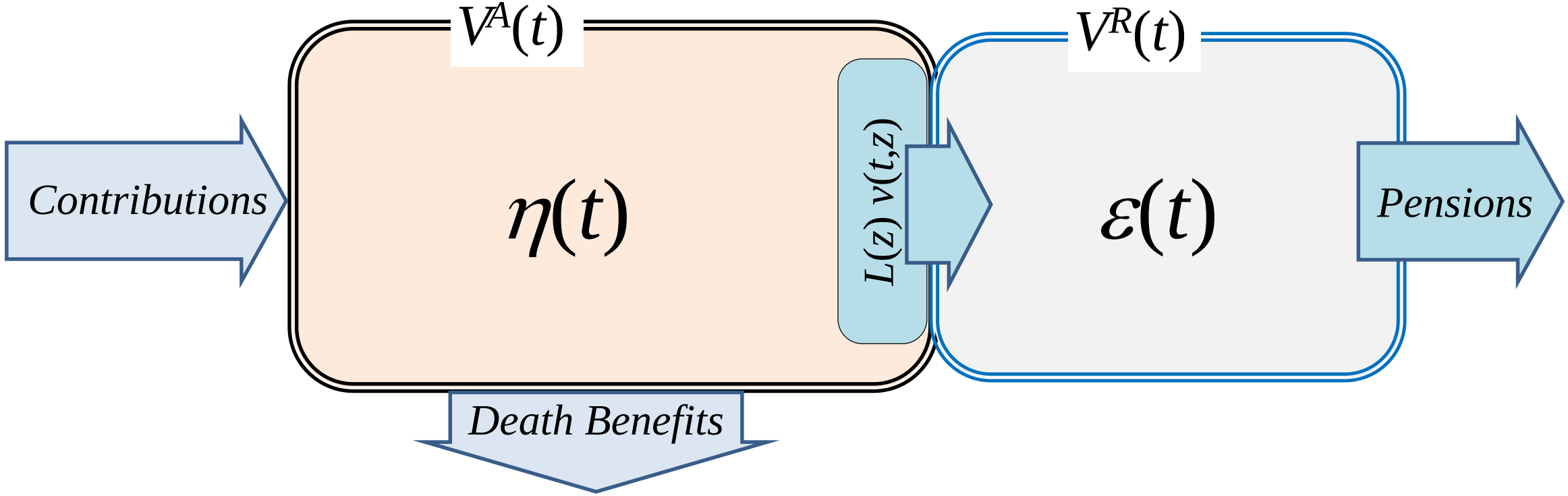
We use exponential interest rates: $\exp(\mu) = 1 + i$

Stationary Population

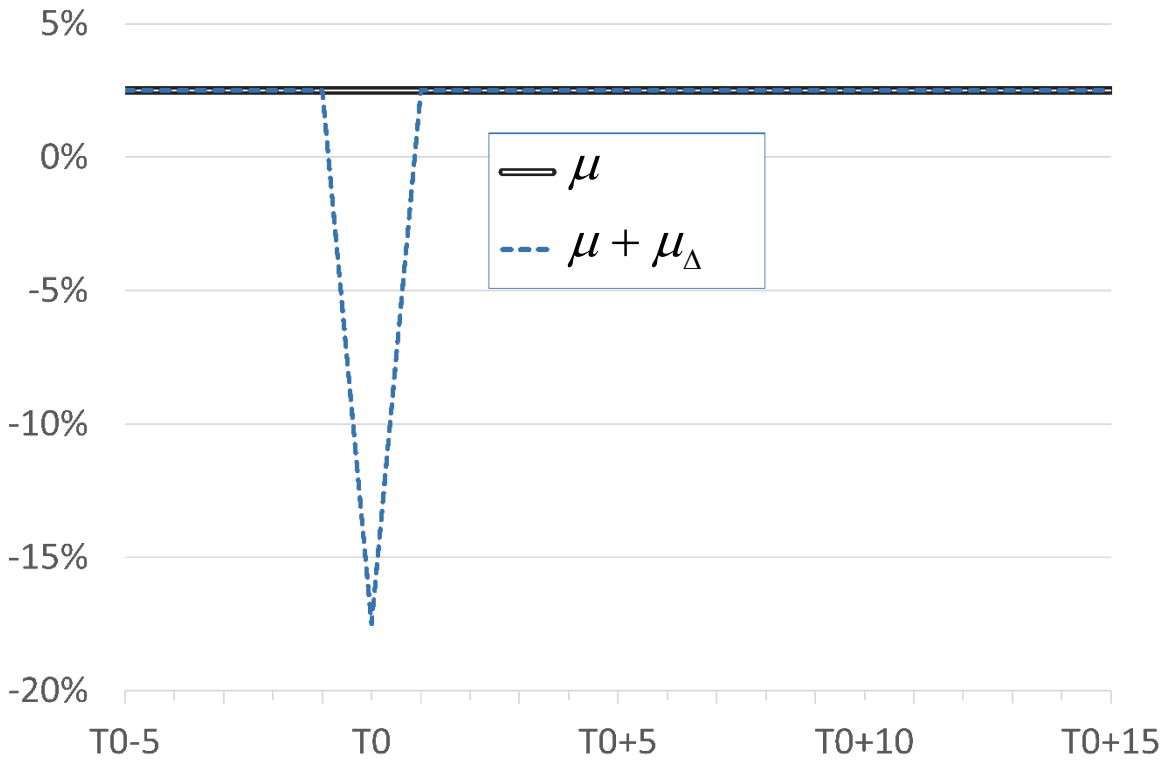


$P(t)$	$R(t)$
	$V(t) = V^A(t) + V^R(t)$

CDC-Model (Discrete Version)



Capital market shock (μ_Δ=-20%)



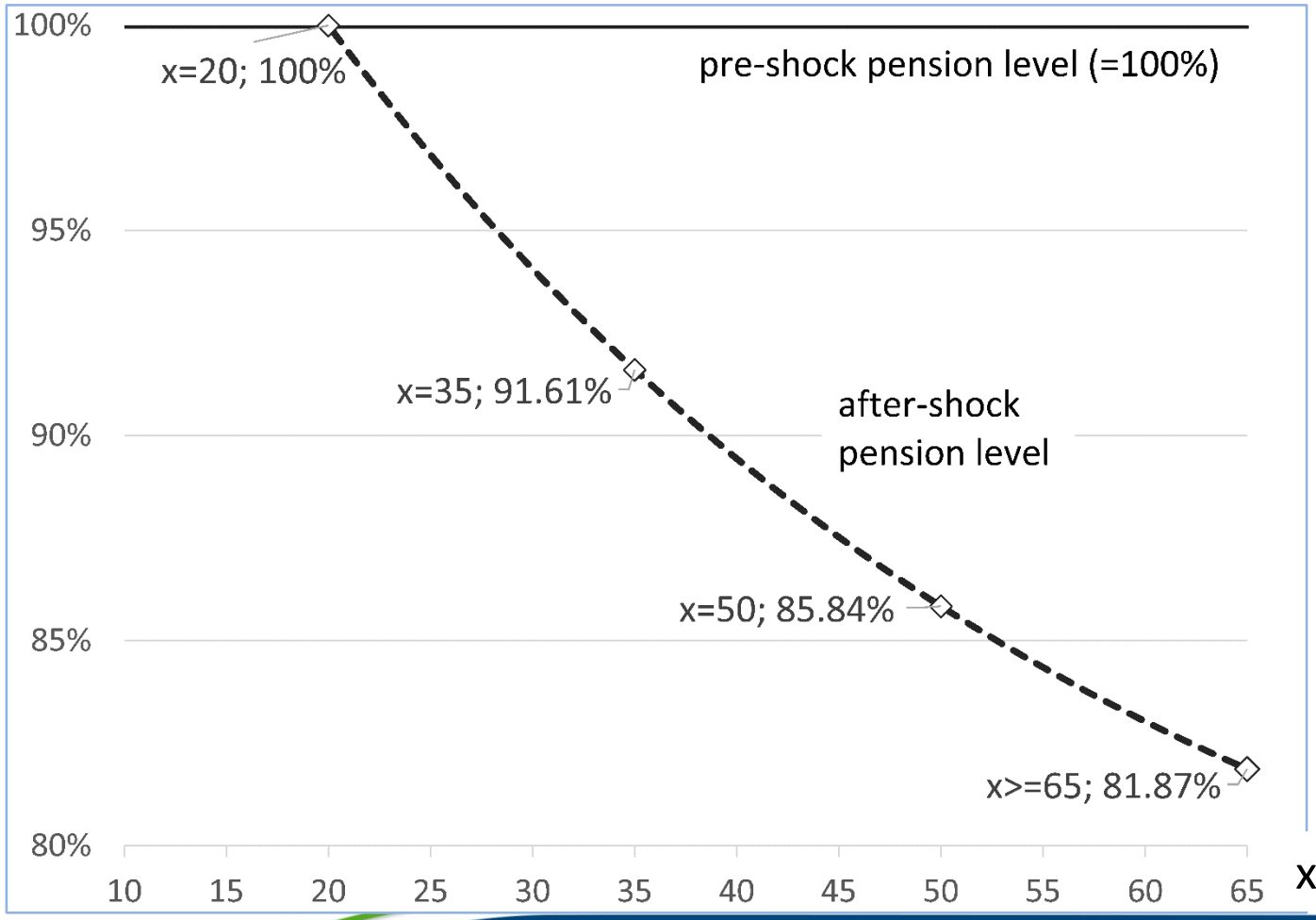
Capital market shock (IDC-case)

Individual DC **= no intergenerational risk transfer**

$P(x)$: Steady state pension capital of x-cohort (before shock)

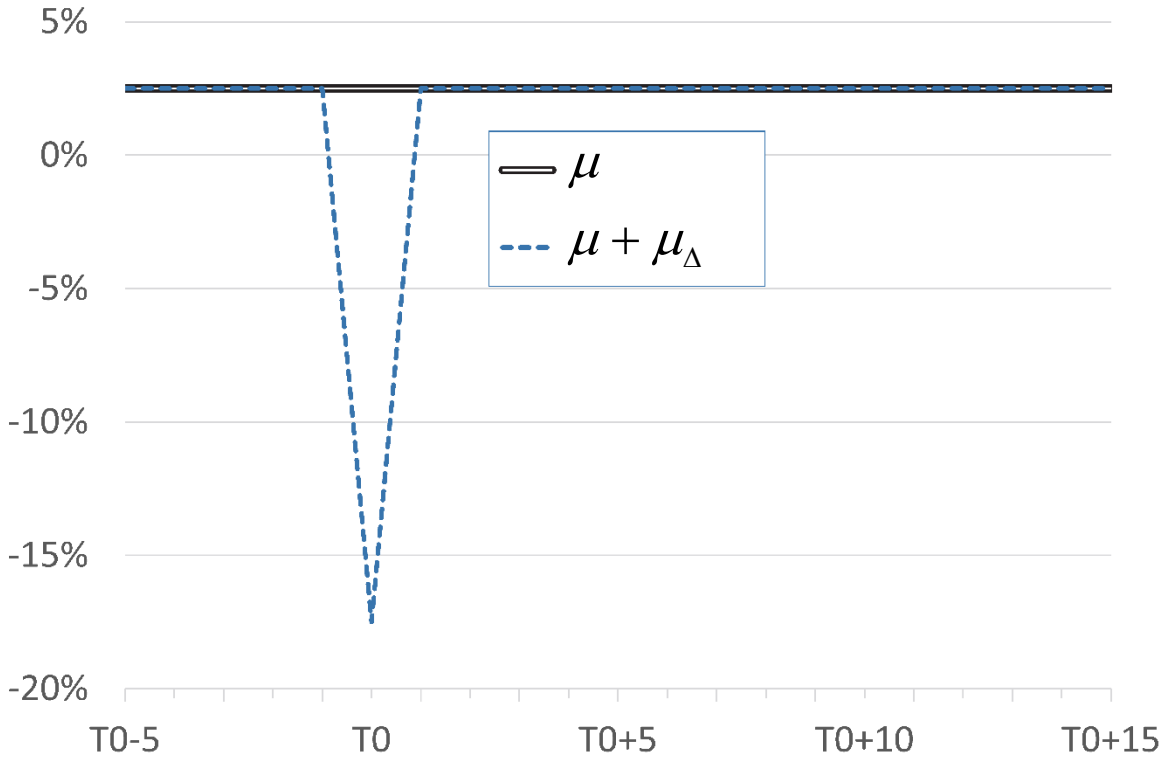
$\Rightarrow$ $exp(-0.2) \cdot P(x)$: pension capital (after shock)

Capital market shock (IDC-case)



x: age at T_0

Capital market shock (μ_Δ=-20%)

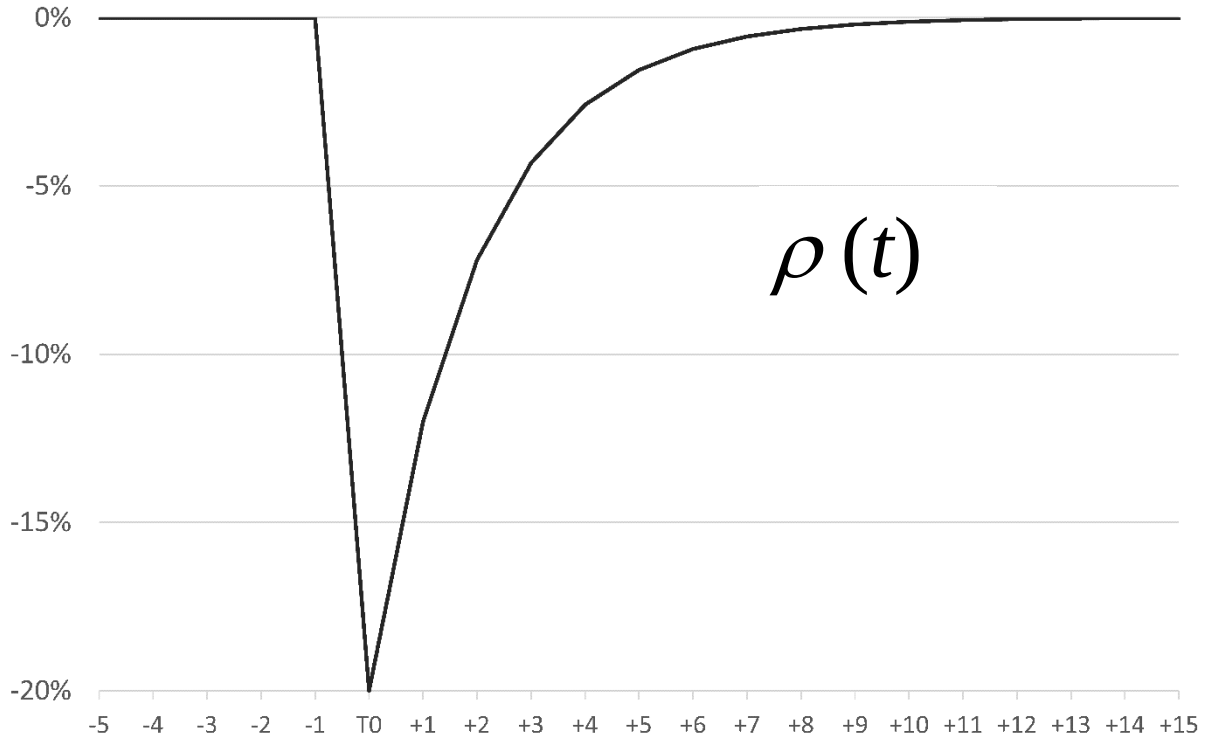


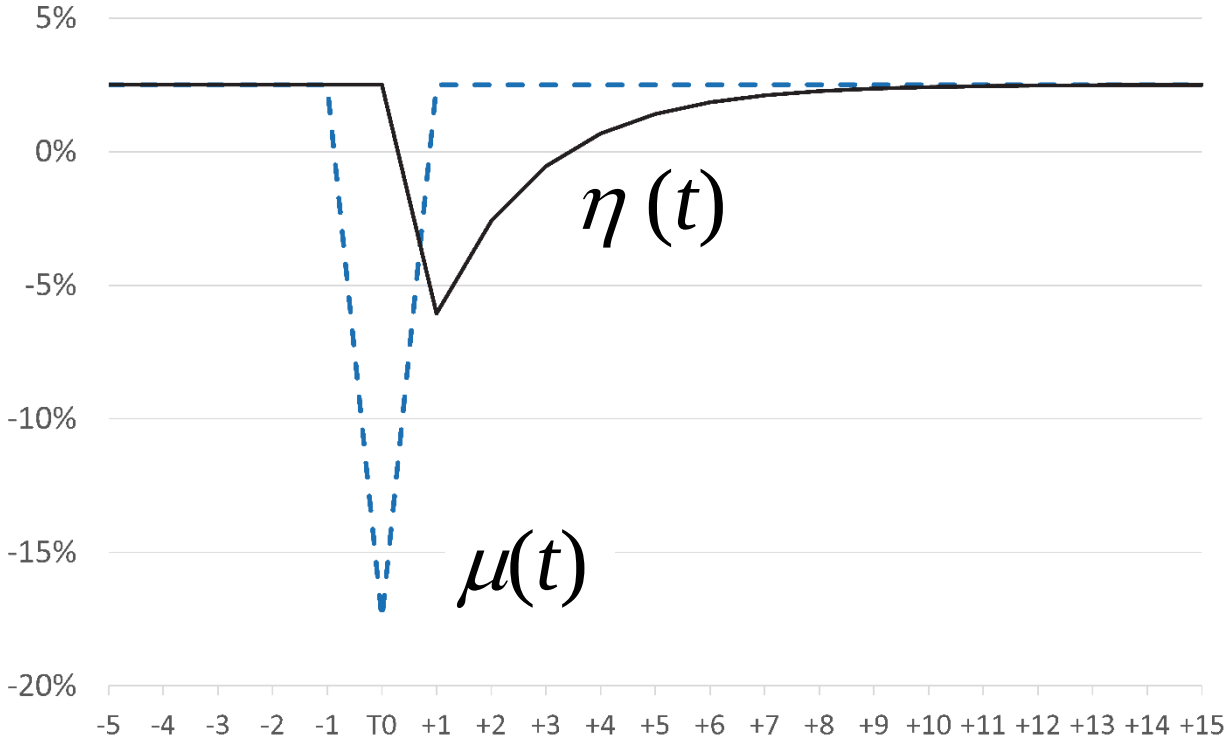
discrete ALM:

$$\eta(t+1) = \mu_{\text{expected}} + \theta\,\hat{\rho}(t)$$

$$\varepsilon(t+1) = \eta(t+1) - \mu_a$$

Capital market shock (CDC)





Intergenerational wealth transfer

- compare $V_{IDC}(T_0, x) = exp(-0.2) \cdot P(x)$ with

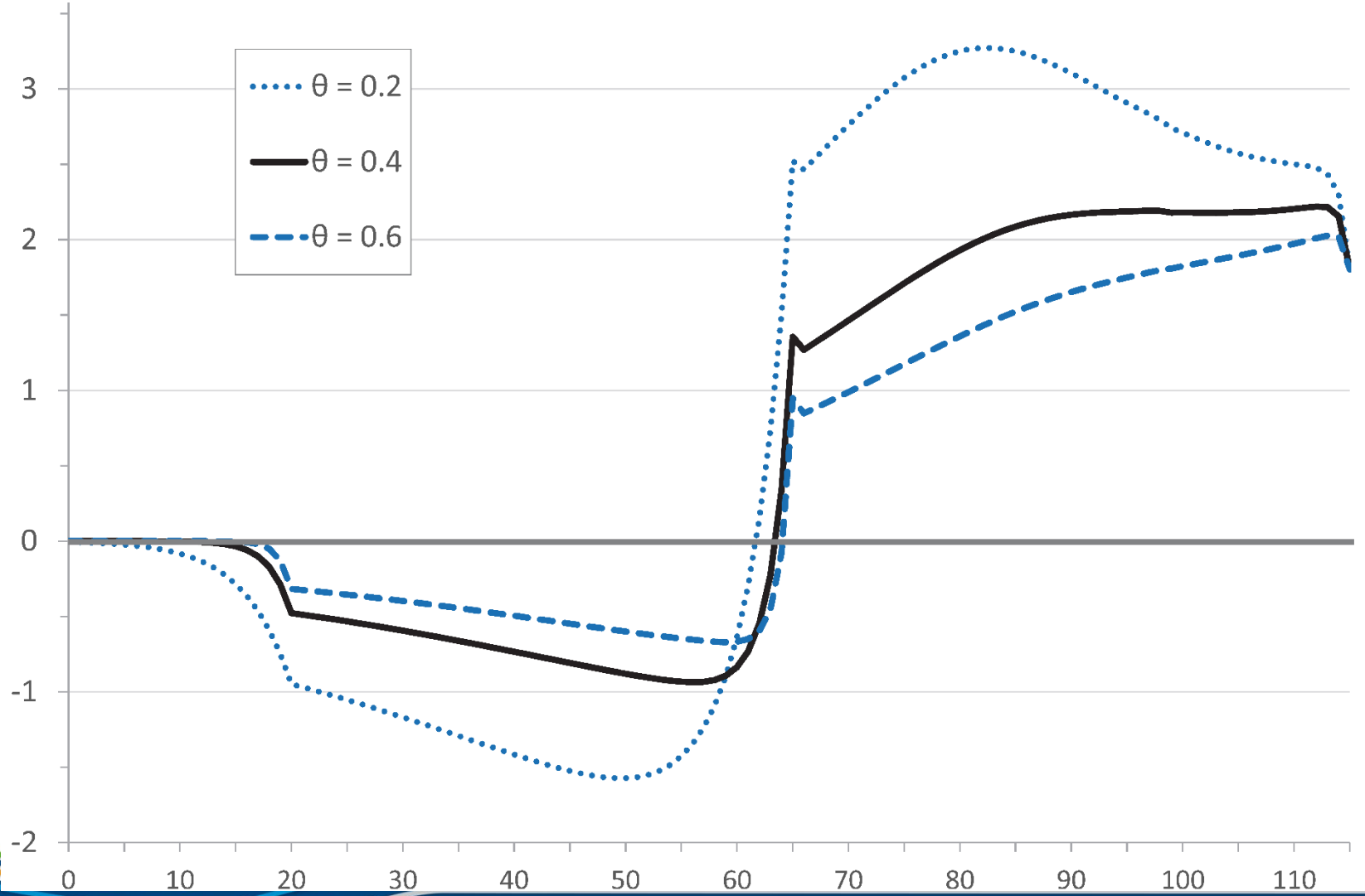
$$TV_{CDC}(T_0, x) := Time\ value\ at\ T_0\ of\ \ future\ cashflow\ \ for\ (T_0, x) - cohort$$

$$cashflow = death\ benefit + pensions - contributions$$

- wealth transfer: $\Delta TV(x) := TV_{CDC}(T_0, x) - exp(-0.2) \cdot P(x)$

Intergenerational transfer (per head)

multiple of the annual contribution



Conclusion

- A CDC-system can be understood as a “captive”– a self insurance of capital market and longevity risks
- A misuse of collective elements in a CDC-system can be prevented by strictly overserving the intergenerational fairness.
- We can use generational accounting principles to calculate intergenerational wealth transfer.

> “*As a general principle, IORPs shall, where relevant, have regard to the aim of having an* ***equitable spread of risks and benefits between generations*** *in their activities.*” (IORP II Directive, Article 7)

Thank you very much for your attention!

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