Mandatory Pension Savings and Wealth Inequality: Theory and Evidence

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Motivation

- Many countries are currently reforming their pension system, adding a funded occupational scheme to existing public plans
- Households are now mandated to accumulate assets during working age, to be consumed in retirement
- Effects on the level as well as the distribution of household wealth – the latter has not been studied
- This paper studies the **effect of pension reform on wealth inequality**:
  - in a theoretical framework
  - in a case study on Denmark

Linking pension system and wealth distribution

- In a PAYG scheme, the state transfers assets from the current working-age population to the current retirees

  $\leftrightarrow$ in a FF scheme, there are explicit asset positions

- When mandatory pension savings increase, all households respond by reducing voluntary pension savings
  Gale (1998), Attanasio et al. (2003, 2007), Engelhardt and Kumar (2011)

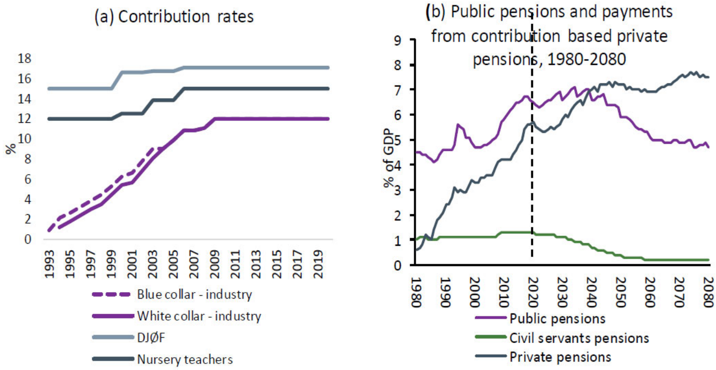
- but at varying degrees across the wealth distribution: the rich offset more than the poor Chetty et al. (2014)

- As a result, wealth inequality decreases definition

A case study on Denmark

- Denmark offers an ideal test case:
    - Pension reform in 1993: textbook transition from PAYG-based to a multi-pillar system with a key role for FF pillar.

Pension reform in Denmark

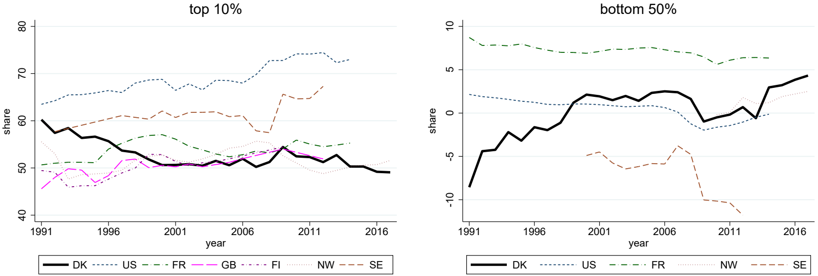


Source: Finansministeriet (2017)

A case study on Denmark

- Denmark offers an ideal test case:
    - Pension reform in 1993: textbook transition from PAYG-based to multi-pillar system.
    - At the same time, decline in wealth inequality: Gini coefficent drops from 0.86 to 0.70 between 1993 and 2017. In contrast, increasing wealth inequality elsewhere.

Wealth concentration - international comparison



Source: World Inequality Database, Roine and Waldenström (2009), Lundberg and Waldenström (2018), own calculations for DK.

A case study on Denmark

- Denmark offers an ideal test case:
  - Pension reform in 1993: textbook transition from PAYG-based to multi-pillar system.
  - At the same time, decline in wealth inequality: Gini coefficent drops from from 0.86 to 0.70 between 1993 and 2017. In contrast, increasing wealth inequality elsewhere.
  - New registry data allows to study the distribution of pension wealth in detail.
- Many aging economies are currently discussing similar pension reforms. Being a front-runner, the Danish case offers important insights.

This paper

Three contributions:

1. Two-period overlapping generations model explaining the mechanism
2. New stylized facts on wealth inequality in Denmark 1986-2017
3. Structural life-cycle model with pension reform calibrated to Denmark

Finding: The model explains most of the decline in wealth inequality in Denmark. So the design of the pension system plays a key role for the wealth distribution in the economy.

Two-period model

Set-up

- Overlapping generations of two-period lived agents
  - earn income w when young
  - save into a safe asset with return R; no borrowing
- Rational agents maximize lifetime utility

$$\Omega^i = u(c^i_y) + \beta^i u(c^i_o)$$

- Optimization results in the standard Euler equation

$$\frac{\partial u}{\partial c^i_y} = R\beta^i \frac{\partial u}{\partial c^i_o}$$

Savings increase in β^i; dispersion in β^i creates dispersion in wealth
Epper et al. (2020)

- How does the pension system affect the wealth distribution?

PAYG pension system

- Young agents pay taxes τ, old agents receive b. Assume $b = \tau$ for simplicity.
- Budget constraints:

$$c_y^i = w - s^i - \tau \qquad c_o^i = Rs^i + \tau$$

- Agents offset an increase in τ by a decrease in s^i.
- For τ sufficiently large, agents are driven into zero savings corner. There exists a threshold value β^P below which agents don't save:

$$\frac{\partial u(w-\tau)}{\partial c_y} = R\beta^P \frac{\partial u(\tau)}{\partial c_o} \Leftrightarrow \beta^P = \frac{\partial u(w-\tau)}{\partial c_y} / R \frac{\partial u(\tau)}{\partial c_o}$$

- As τ is not a wealth position, these agents hold zero wealth.

FF pension system

- Young agents pay contributions τ, when old receive $R\tau$. This is an income as well as wealth position.
- Voluntary and mandatory savings are perfect substitutes, so that agents offset an increase in τ one-by-one. For τ sufficiently large, agents are driven into zero voluntary savings corner. The threshold value β^F is

$$\beta^F = \frac{\partial u(w-\tau)}{\partial c_y} / R \frac{\partial u(R\tau)}{\partial c_o}$$

- This value is higher than β^P because of the higher return $R > 1$ on FF savings

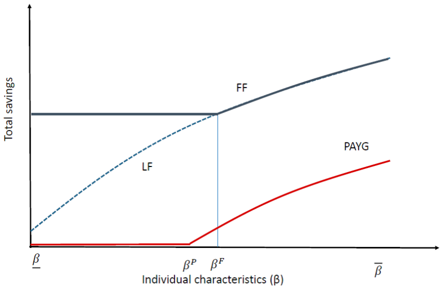
Wealth distribution under FF vs. PAYG

(1) Low-β types have some (mandatory) wealth under FF, but none under PAYG

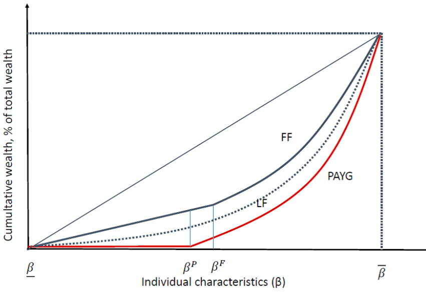
(2) More agents with voluntary savings under PAYG ($\beta^F > \beta^P$)

For τ not too high, (1) is stronger and the wealth distribution under FF is more equal.

Total savings



Lorenz curve



Wealth distribution in Denmark

Dataset construction

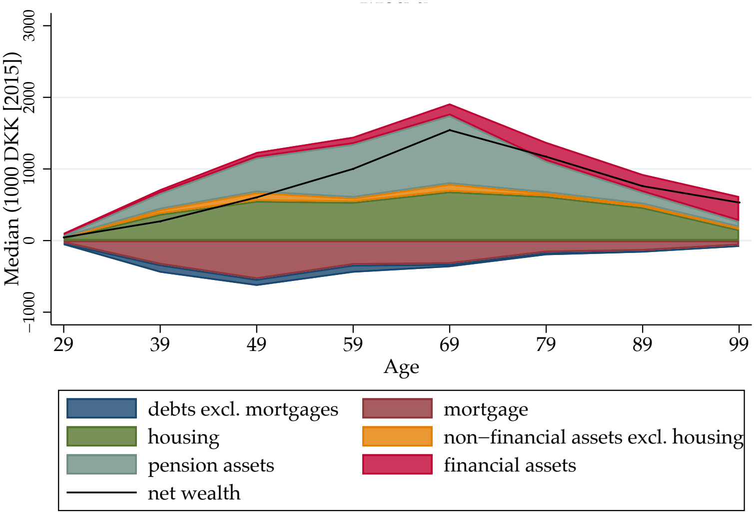
Definitions

- Wealth = net wealth excl. durables
- This means we only include marketable wealth, not implicit social security "wealth" (see OECD, 2013) definition
- Equal-split household measure (individual equivalents)
- Exclude entrepreneurs as these do not pay into mandatory pension scheme

Dataset

- Detailed wealth data available since 2014
- For earlier years, we need to impute pension wealth. more
- Can link wealth information with individual socioeconomic characteristics.

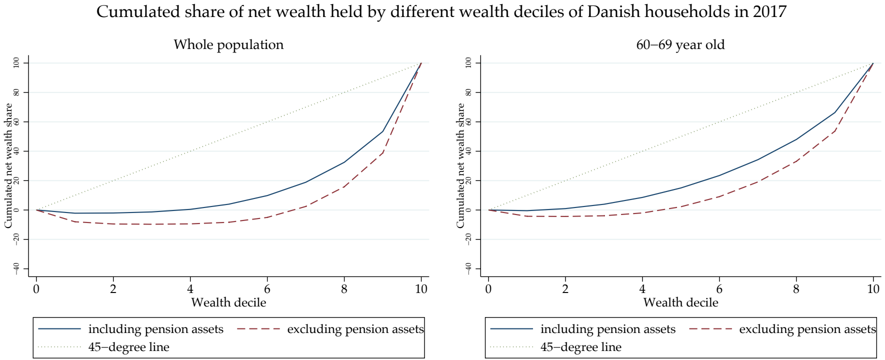
Cross-sectional wealth distribution, 2017



Note: Median household (100 obs.).

mean 1992

Wealth inequality in Denmark, 2017



Structural life-cycle model

Overview

- Multi-period OLG: Agents live through a working and a retirement period and save optimally over their life cycle. Survival is stochastic.
- Agents differ by
  - time preferences
  - shocks to labor income (permanent and transitory)

  $\rightarrow$ different life-cycle savings generating wealth inequality
- Pension system with two pillars: (tax-financed) PAYG and FF (gradually introduced)
- Other model elements:
  - Borrowing constraint
  - One savings vehicle: safe asset with exogenous return (small open economy)
  - Bequest motive (extension)

details

Calibration and Simulation

- Two steady states, pre-reform (1970) and post-reform (2100). Pension reform takes place between 1993 and 2009.
- Calibrate the model to 1992 and compare the wealth distribution in 1992 and 2017.

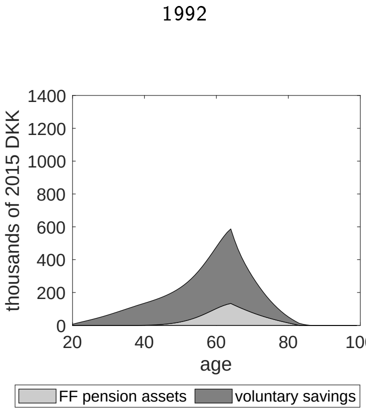
more

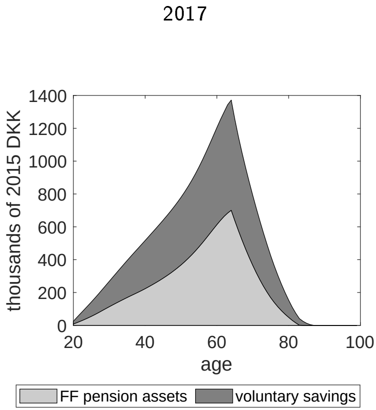
- Pre-reform inequality is generated using
  - Differences in labor income shocks: estimated following Cocco et al. (2005)
  - Differences in time preferences: grid with equal probability mass (Carroll et al. 2017)

$$[b-3d \quad b-2d \quad b-d \quad b \quad b+d \quad b+2d \quad b+3d]$$

- Calibrate b and d jointly to match peak non-pension assets in 1992 and Gini coefficient in 1992.
- Resulting values $b = 0.952$, $d = 0.0125 \rightarrow$ $\beta_i \in [0.9145, 0.9895]$.

Cross-sectional asset holdings





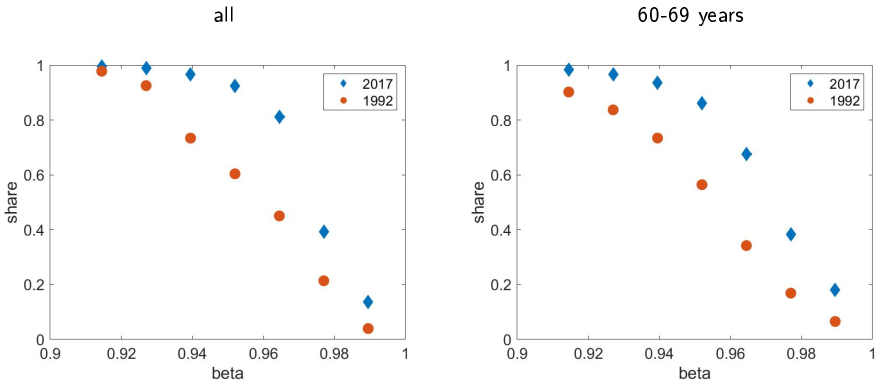
Wealth distribution 1992 vs. 2017

Gini coefficients

	1992		2017	
	60-69yrs	all	60-69yrs	all
model	0.626	0.773	0.534	0.642
data	0.626	0.750	0.511	0.691

- Wealth distribution becomes more equal
- The model almost fully explains the decline for the 60-69 year olds

Changing portfolio share of pension assets



- Biggest change for the medium-patience agents: pushed towards zero savings corner
- Constrained agents (pension share > 0.85) are 17% of working-aged population in 1992, 44% in 2017

Welfare implications

- Declining wealth inequality does not necessarily go along with welfare improvements
- Forcing low-β types to save more than they want may make them worse off if they are fully rational
- But we find that consumption inequality does not increase dramatically

Consumption Gini coefficients

	1992		**2017**	
	60-69yrs	all	60-69yrs	all
model	0.242	0.278	0.248	0.263

Conclusion

- Design of the pension system has large effects on wealth distribution
- Moving from PAYG towards a multi-pillar structure implies a more equal wealth distribution
- We document this effect for Denmark:
    - ranked one of the best pension systems in the world
    - pension reform serves as blueprint for other countries
    - excellent data on the whole population of Denmark
- Life-cycle model calibrated to Danish data can explain the observed decline in Gini coefficient well

Appendix

Definition of wealth

- In this paper, wealth = net worth, i.e. value of assets minus liabilities (following OECD, 2013)
- This definition includes assets that have economic value and are subject to ownership rights....
- ...but it excludes claims on social security (e.g. PAYG pensions), which cannot be used as collateral
- Claims on social security are also uncertain since the government can change the basis on which the entitlements are determined, e.g. in response to demographic aging

back

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Imputation of pension wealth before 2014

1. Use data on aggregate pension wealth for 1987-2013
2. Allocate the share of pension assets that belongs to pensioners vs. workers. We have data 1995-2013 and extrapolate the other years
   - For pensioners, allocate pension assets according to their share in a given year's pension income.
   - For workers, calculate the share of pension assets owned by each age group in the 2014-2017 data

     Within each age group, allocate pension wealth to individuals according to their share in incomes and pension contributions.
3. Group individuals into households and create equal-split measures.

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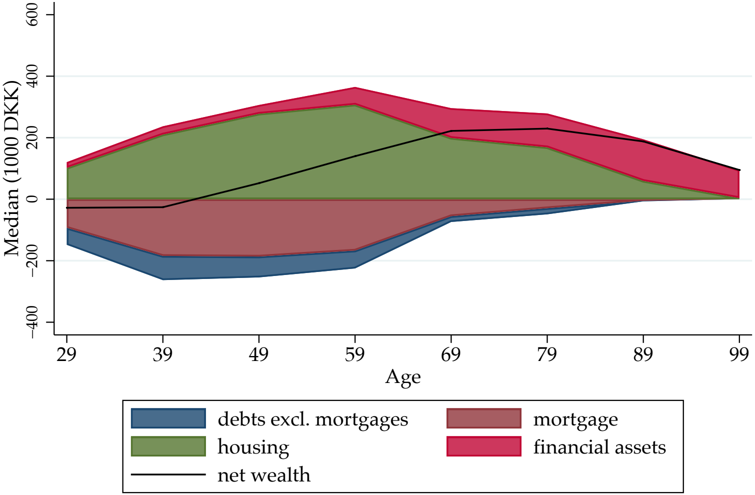
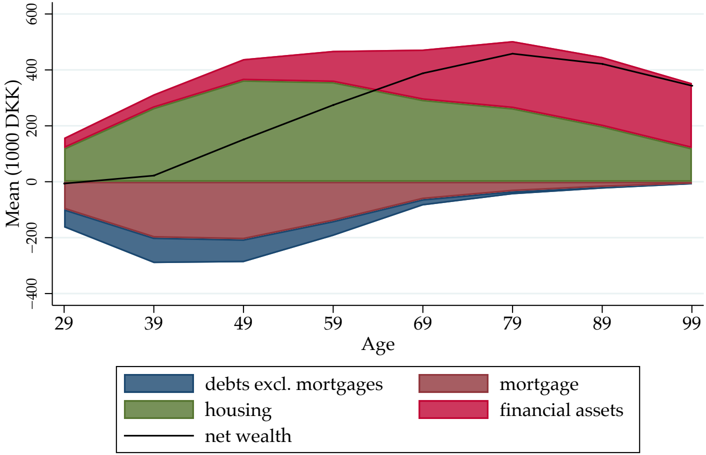
Life-cycle wealth distribution, 1992



Note: Median household (100 obs.).

mean back

Life-cycle wealth distribution, 1992



Note: Mean household.

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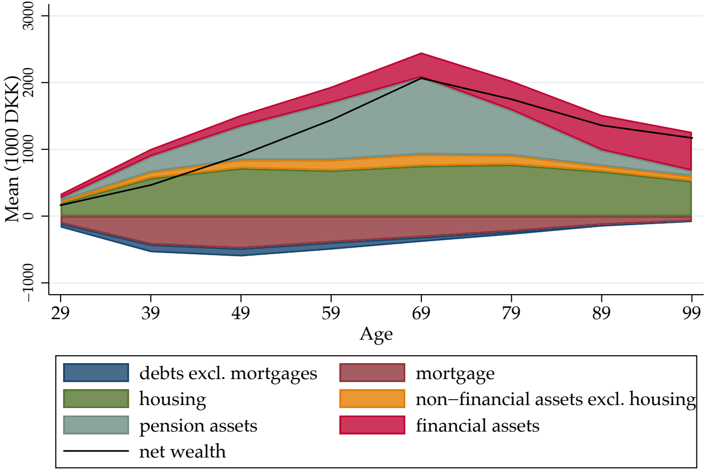
Life-cycle wealth distribution, 2014-2017



Note: Mean household.

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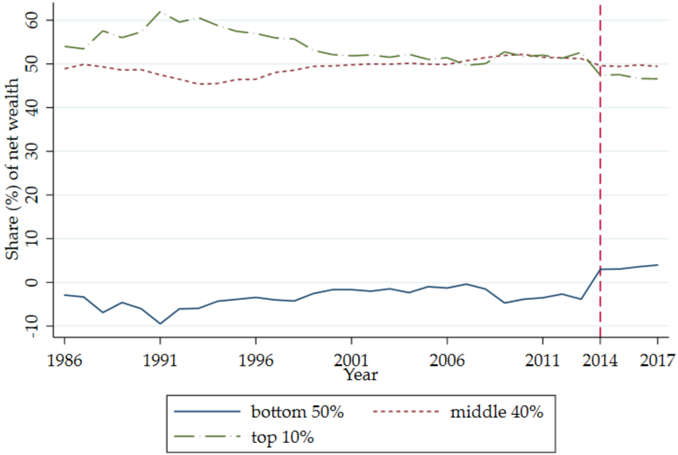
Wealth shares in Denmark



top shares

Demographics

- Agents born at age N^b start working immediately
- They life to a maximum age of N^d and survival until this point is stochastic. $\tilde{\delta}_n$ is the cumulative survival probability between periods N^b and n
- Fixed retirement age N^r.

Labor income process

Agents work between ages N^b and N^r. Labor income net of taxes of agent i of age $n < N^r$ at time t is

$$Y_{i,n,t} = P_{i,n,t}\epsilon_{i,n,t} \qquad P_{i,n,t} = G_{n,t}P_{i,n-1,t-1}\eta_{i,n,t}$$

- $G_{n,t}$: age-specific component, with time trend.
- $\epsilon_{i,n,t}$: transitory shock, log-normally distributed
- $\eta_{i,n,t}$: permanent shock, log-normally distributed

$\Rightarrow$ save for precautionary reasons and for life-cycle consumption smoothing

Public pension (PAYG)

- Stylized representation of Danish system: Flat rate scheme plus two means-tested supplements:

$$\tilde{Y}^{PG}_{i,n,t} = \theta_0 + \underbrace{\max(0, \theta_1 - \max(\tau_1(\tilde{Y}^{FF}_{i,n,t}), 0))}_{\text{negative function of FF income}} + \underbrace{\max(0, \min(\theta_2, (1 - \tau_2(\tilde{Y}^{FF}_{i,n,t}))\theta_{2,t}))}_{\text{negative function of FF income}}$$

- System is tax-financed $\rightarrow$ abstract from contributions.

Labor market pension (FF)

- Fraction $\pi_{i,n,t}$ of labor income goes to FF pensions:

$$\pi_{i,n,t} = \bar{\pi}_t + \pi(Y_{i,n,t})$$

$\rightarrow$ positive trend and income-dependent element

- Accumulated pension assets just before retirement

$$LW_{i,N^r-1,t} = \sum_{n=N^b}^{N^r-1} (\pi_{i,n,t-N^r-n+1} Y_{i,n,t-N^r-n+1}) R_{t-N^r-n+1}^{N^r-n}$$

- Paid out as an annuity at each age $n > N^r$

$$\tilde{Y}_{i,n,t}^{FF} = \frac{LW_{i,N^r,t-N^r-n} \prod_{s=1}^{T} \mathbb{E}_t \left[R_{t+s}\right]}{\sum_{s=1}^{T} \mathbb{E}_t \left[R_{t+s}^{s-1}\right]}$$

with T expected remaining lifetime. Risk-sharing within each cohort.

Household optimization

Agents choose private assets $A_{i,n,t}$ to maximize

$$\Omega_{0,i} = \mathbb{E}\left[\sum_{n=N^b}^{N^d} \beta_i^{n-N^b} \tilde{\delta}_n \frac{C_{i,n,t}^{1-\vartheta}}{1-\vartheta}\right]$$

Discount factor is individual-specific and drawn from a uniform distribution $\beta_i \in \left[\underline{\beta}, \bar{\beta}\right]$ at the beginning of life.

Budget constraints:

- working age: $C_{i,n,t} + A_{i,n,t} \leq A_{i,n-1,t-1} R_t + (1 - \pi_{i,n,t}) Y_{i,n,t}$
- retired: $C_{i,n,t} + A_{i,n,t} \leq A_{i,n-1,t-1} R_t + \tilde{Y}_{i,n,t}^{PG} + \tilde{Y}_{i,n,t}^{FF}$

No-borrowing constraint: $A_{i,n,t} \geq 0$.

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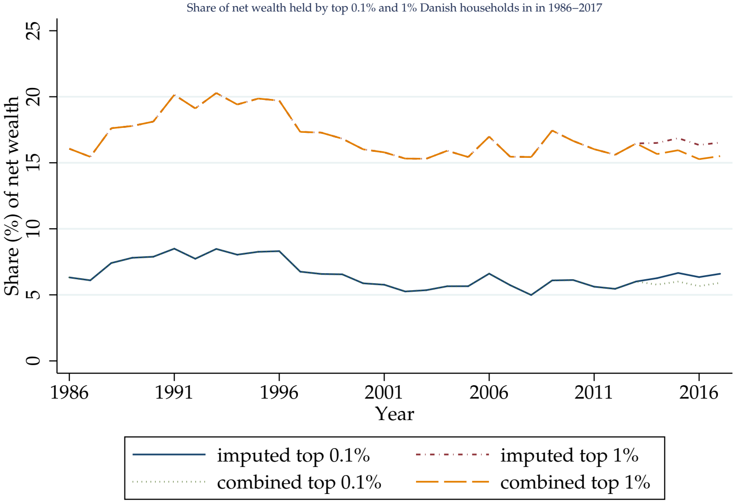
Top wealth shares in Denmark



Note: Net wealth does not include durables. Imputed pension assets are net of taxes.

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Other parameters determined outside the model

Parameter		Value	Source
Age at birth	N^b	20	
Maximum age	N^d	100	
Retirement age	N^r	65	official retirement age in Denmark 2004-18
CRRA parameter	ϑ	0.65	Andersen et al. (2014)
Survival probabilities	δ_n		UN Population Prospects data for 1992
Life expectancy at age N^r	T	18	UN Population Prospects data for 1992
Population size			no. of individuals in registry data
Return on asset	R	1.037	real return on retirement savings plans 2001-2019 (OECD, 2020)

Parameters calibrated internally (SMM)

- **FF contributions:**
  - Time trend $\bar{\pi}_t$ taken from registry data.
  - Income-dependent part calibrated to match peak FF pension assets in 1992.
  - We get
$$\pi(Y_{i,n,t}) = -0.1 + 0.00035 Y_{i,n,t}$$

- **Time preferences:** grid with equal probability mass
$$[b - 3d \quad b - 2d \quad b - d \quad b \quad b + d \quad b + 2d \quad b + 3d]$$
  - Calibrate b and d jointly to match peak non-pension assets in 1992 and Gini coefficient in 1992.
  - Resulting values $b = 0.952$, $d = 0.0125 \rightarrow \beta_i \in [0.9145, 0.9895]$.

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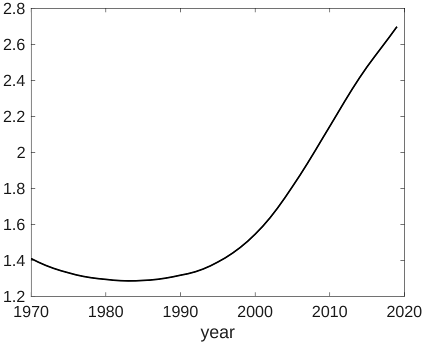
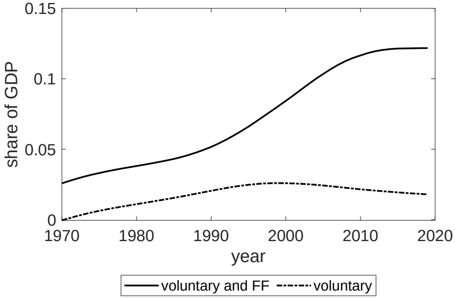
Aggregates

Capital-output ratio



Savings rate



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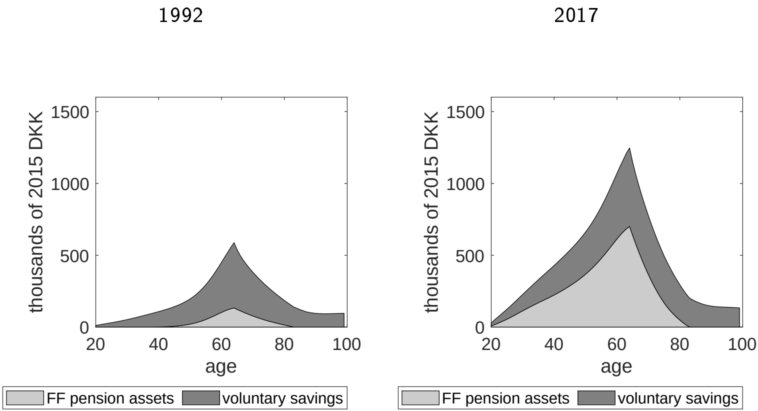
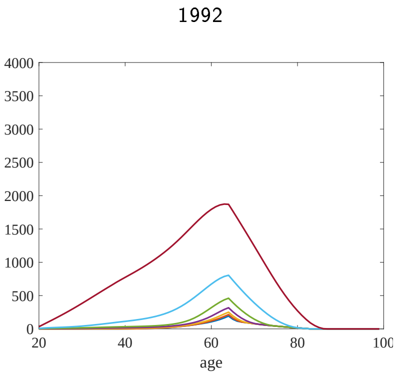
Bequest motive



Cross-sectional asset holdings, by β-type



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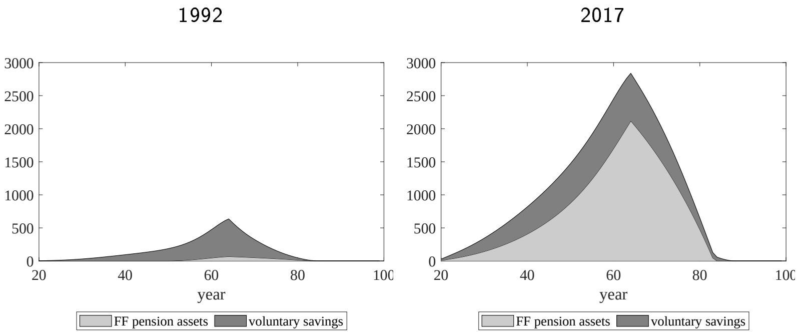
Steady state asset holdings



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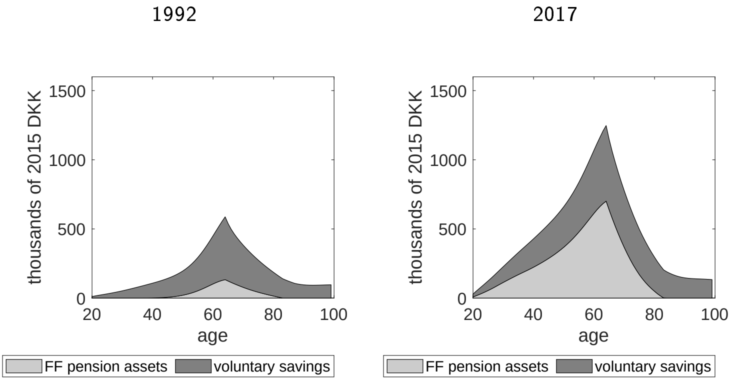
Bequest motive

With bequest, utility becomes

$$\Omega_{0,i} = \mathbb{E}\left[\sum_{n=N^b}^{N^d} \beta_i^{n-N^b}\tilde{\delta}_{n-1}\left(\delta_n \frac{C_{i,n,t}^{1-\vartheta}}{1-\vartheta} + (1-\delta_n)\mu^{\vartheta}\frac{X_{i,n,t}^{1-\vartheta}}{1-\vartheta}\right)\right]$$

We keep our calibration as it is, but calibrate μ to match end-of-life assets in the 1992 data
$\rightarrow \mu = 1.5$.

Bequest motive



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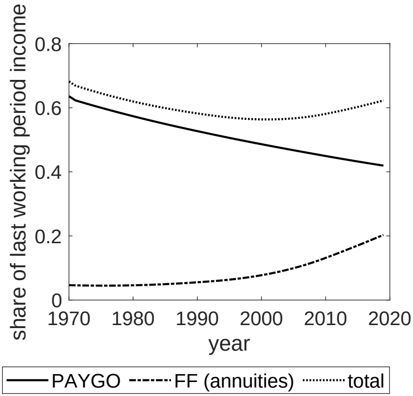
Replacement rates



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