

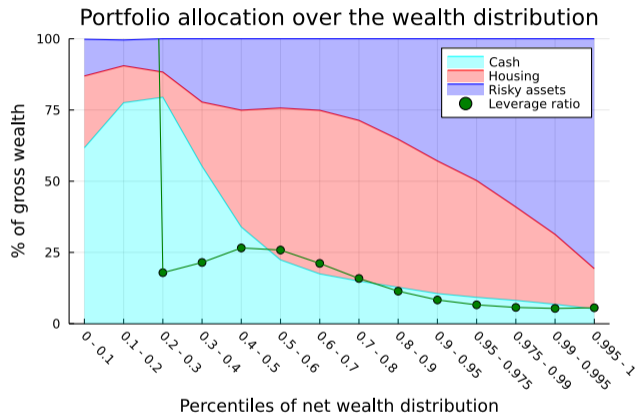
Housing and Portfolio Choice over the Wealth Distribution

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EEA Bordeaux, August 25, 2025

Asset choices of households vary significantly over the wealth distribution



- The poorest hold mostly cash
- Housing wealth is the dominant asset class for the middle class,
- ... largely financed by debt for the lower middle class
- For the richest other risky assets (stocks and private equity) are the most important

Figure: Composition of gross wealth in Sweden, 2000

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Need to study how portfolio choice depends on **wealth**, not only on **age** (in contrast to much of the household finance literature)!

This paper

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- Decreasing housing shares generate increasing stock shares in wealth via two mechanisms:
 - ⇒ Housing crowds out risky investments for poor homeowners.
 - ⇒ Poorer households are more leveraged. Assuming mortgage rates are higher than deposit rates, this implies lower risk-taking among the poor, due to endogenously lower risk premia.

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Contributions:

- ① Derive optimal housing share as a function of human capital in an analytically tractable model
- ② Show evidence that the predicted relation is consistent with data
- ③ Show in a rich lifecycle model this helps explain the increasing share of stock in wealth

Literature

- Optimal housing level increases in human capital, crowds out stocks: Yao and Zhang (2004), Cocco (2005) and Flavin and Yamashita (2011)
- Wedges between borrowing and lending rates affect risk premia and hence optimal portfolio choices: Davis et al. (2006), Willen and Kubler (2006).
- Housing helps explain the risky share pattern over wealth: Cioffi (2021).

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 - ▶ Formalize in an analytically tractable model how exactly this relationship works
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- Housing helps explain the risky share pattern over wealth: Cioffi (2021).
 - ▶ Show that this is true even with homothetic preferences

Optimal housing choice, no frictions

- Finite horizon, deterministic, no frictions
- Utility from non-durable consumption and housing
- No rental market
- Saving into bonds and housing

The household maximizes

$$\sum_{t=0}^T \beta^t U(c_t, h_t)$$

such that

$$b_t + h_t = Rb_{t-1} + R^h h_{t-1} + y_t - c_t \quad \forall t$$

Assumption: $R^h < R$, ignoring the services it provides, housing is a bad investment.

Optimal housing choice, no frictions

$$b_t + h_t - \frac{R - R^h}{R} h_t = Rb_{t-1} + R^h h_{t-1} + y_t - c_t - \frac{R - R^h}{R} h_t$$

$\frac{R - R^h}{R} h_t$ is the foregone capital income from consuming housing instead of saving in bonds.

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Define:

$$a_t = b_t + \frac{R^h}{R} h_t \quad (\text{bond-equivalent value of total saving})$$

$$x_t = c_t + \frac{R - R^h}{R} h_t \quad (\text{total expenditure})$$

Problem is equivalent to standard PIH model:

$$\begin{aligned} & \sum_{t=0}^T \beta^t u(x_t) \\ \text{s.t. } & a_t = Ra_{t-1} + y_t - x_t \quad \forall t \end{aligned}$$

with u being the indirect utility function.

Housing share increases in the share of human capital to wealth

Assume:

- $R\beta = 1$ and
- Cobb-Douglas preferences.

Then

$$h_t = A_t \left(w_t + \sum_{s=1}^{T-t} \frac{y_{t+s}}{R^s} \right)$$

\Downarrow

$$\frac{h_t}{w_t} = A_t \frac{w_t + HC_t}{w_t}$$

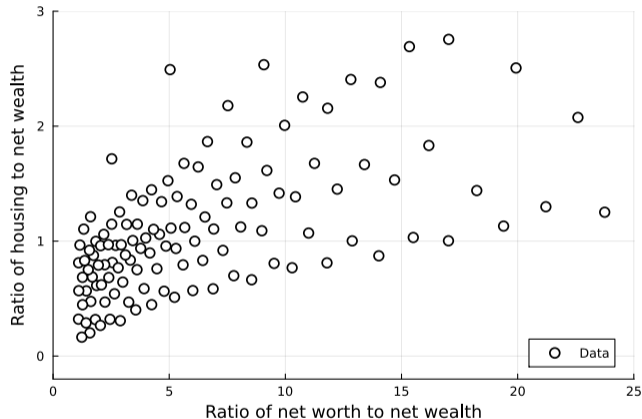


Figure: Sweden, 2000; One dot corresponds to a cluster of 1000 households

Why are stock holdings affected? (1): Human capital & Housing choice

Higher ratio of human capital to financial wealth \Rightarrow Higher optimal share of housing to wealth

The aim of saving is smooth out net worth (wealth + human capital) to be consumed evenly over time.

- More wealth \Rightarrow housing consumption \uparrow , and savings \uparrow
- More human capital \Rightarrow housing consumption \uparrow , but savings \downarrow

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On average, poor households have a higher optimal share of housing to wealth

- Wealth is more unequally distributed than human capital
- Across individuals, wealth is negatively correlated with the ratio of human capital to wealth.

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Among wealth-poor homeowners, housing can **crowd out** other assets due to **optimal consumption decisions**.

Why are stock holdings affected? (2): Wedges between interest rates

Depressed risky share for the poor due to lower risk premia from debt

- Households with relatively more human capital are optimally more leveraged in average.
- Their alternative to liquid risky assets is less debt, not more deposit
- Higher interest rate on debt relative to deposits \Rightarrow lower effective risk premium

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Climbing out of debt \Rightarrow Invest in risky assets

- Due to interest rate wedges, many homeowners are at corner solutions regarding risk-free assets (e.g. max out mortgages, or no risk-free asset holdings).
- All their extra money goes into stocks
- \Rightarrow High marginal propensity to invest in stocks for homeowners without debt

Model

Starting point is a standard lifecycle model

Demographics

Income process

Bellman equation

Key to generate results:

- Housing choice
- A menu of different risk-free assets
- Calibration: target average holdings of different asset types over the life-cycle
- Accurate solution method: FOC-based, EGM + discrete choices

Solution method

Housing

- Utility from non-durable consumption (c) and housing services (h):

$$U(c, h) = h^\omega c^{1-\omega}$$

Housing services come either from renting or owning

- Owned house (H) provides services equal to its size ($h = H$ if $H > 0$)
- H has market value $P_t^h H$

$$P_t^h = G_h^t \exp(\tilde{p}_t^h)$$

$$\tilde{p}_t^h = \rho^h \tilde{p}_{t-1}^h + \varepsilon_t^h$$

- Costs for owners: maintenance and transaction costs (both when selling or buying)
- Rental cost is $\tau P_t^h h$, no frictions

Liquid assets

Bonds (B) offer a risk-free gross rate R_f ; stocks (ξ) with risky gross rate R . Participating ($\xi > 0$) involves yearly participation cost F . Debt in the form of mortgage (M) and consumption loan (L) with constant rates R_m and R_l :

$$s_{it} = B_{it} + \xi_{it} + F\mathbb{1}_{\xi_{it}>0} + M_{it} + L_{it} \quad R_f < R_m < R_l$$

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No short positions and borrowing limits (LTV and LTI):

$$0 \leq B_{it}$$

$$0 \leq \xi_{it}$$

$$0 \leq M_{it} \leq \min \left\{ \eta_m HC(z_{it}, j), \delta P_t^h H_{it} \right\}$$

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- Costless, but obligatory renegotiation in every period \Rightarrow no extra state variable

- Bankruptcy

Calibration

- Most parameters are exogenously set
- Rest (mostly preference parameters) are estimated through SMM

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Preference parameters

Return and income parameters

Housing parameters

Targeted moments:

- **Age profiles** of the means of net wealth, housing wealth, cash, risky assets, debt, participation rate, and homeownership rate.
- Shape of wealth distribution

Show targeted moments

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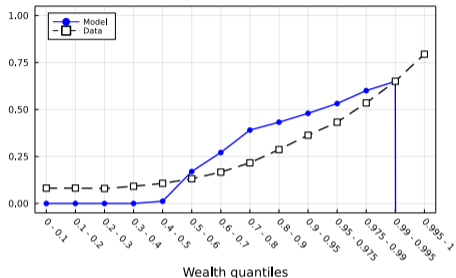
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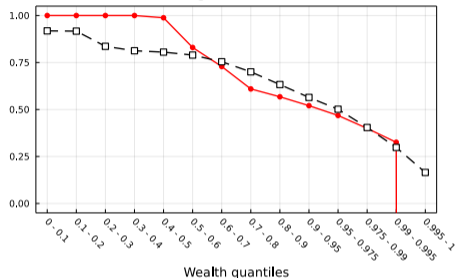
Validation: Portfolio allocation patterns **over the wealth distribution.**

Portfolio choice over the wealth distribution - homeowners

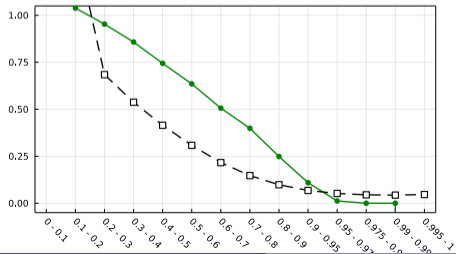
Risky share - owners



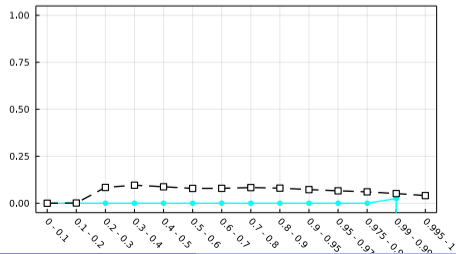
Housing share - owners



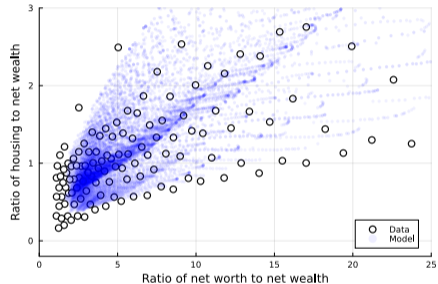
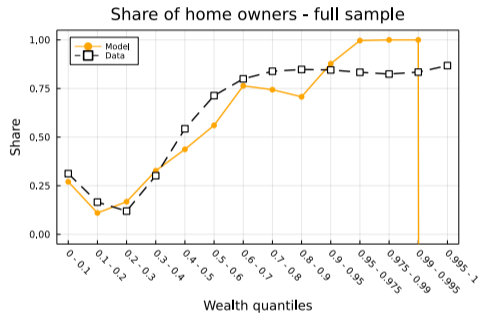
Leverage ratio - owners



Cash share - owners



Housing choices



Results for whole economy

Results for renters

Counterfactuals

I claim two channels are important:

- ① Optimal housing share varies over the wealth distribution, due to differences in human capital.
- ② Wedges in interest rates [More intuition](#)

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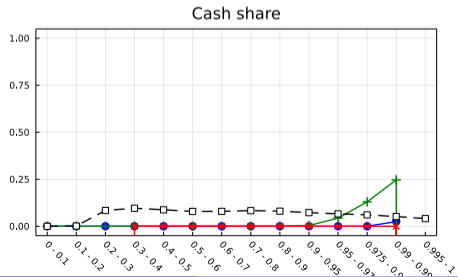
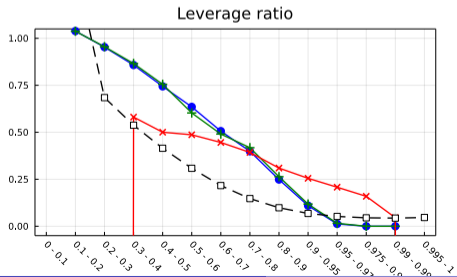
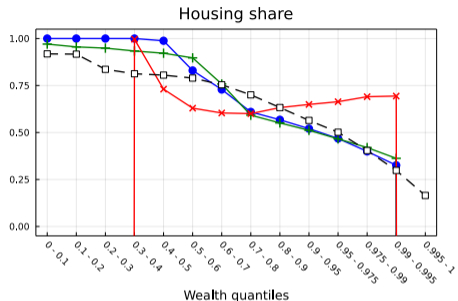
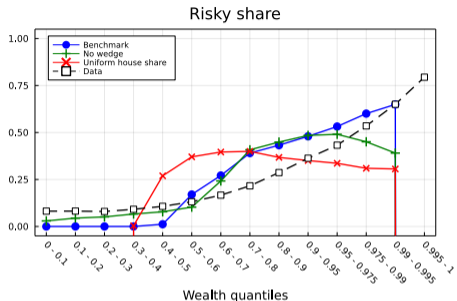
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We want to see if these mechanisms indeed play a key role in generating the results.

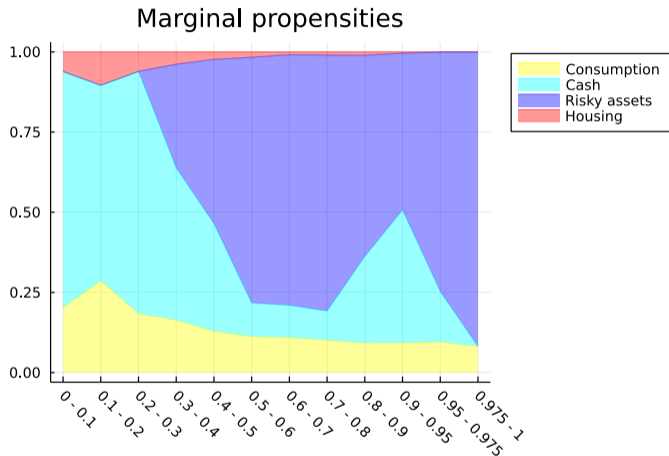
Two corresponding counterfactuals:

- ① All homeowners are forced to have the same (the average) ratio of housing to net wealth
- ② Replace the three risk-free assets with one (with interest rate R^m)

Counterfactuals - homeowners



An Implication: What do people do with an extra cent?



Optimal policies

Figure: Marginal propensities of different means of saving and expenditure.

Conclusion

- Homeowners with high human capital to financial wealth ratios optimally hold a portfolio dominated by real estate. This is financed via debt.
- Implies an increasing relationship between wealth and the share of stocks via two channels:
 - ① Housing wealth crowds out risky investments for households with low wealth-to-income ratios
 - ② Wedge between borrowing and lending rates imply lower risk premium for the leveraged \Rightarrow lower risky share for the poor
- These effects survive in a standard life-cycle model calibrated to age profiles of saving decisions and can explain the increasing risky share in household wealth among homeowners.
- In this model, helicopter money for the rich ends up in the stock market.

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Demographics

- Partial equilibrium overlapping generation economy
- Each period a measure one of 25 years old households are born
- Survival is stochastic, ...
- until certain death at age 100
- Bequests:
 - ▶ a fixed fraction of wealth is given to a random newborn
 - ▶ the rest is distributed evenly

Back

Income process

Log labor income is composed of a deterministic secular growth term (gt), a deterministic age term (f), a permanent (z) part following an AR(1) process and a transitory (ν) stochastic part.

$$y_{ij} = gt + f_j + z_{ij} + \nu_{ij}$$
$$z_{ij} = \rho z_{ij-1} + \varepsilon_{ij}$$

iid shocks

$$\varepsilon_{ij} \sim N(0, \sigma_\varepsilon^2)$$
$$\nu_{ij} \sim N(0, \sigma_\nu^2)$$

for ages $j > 65$ we have

$$y_{ij} = f_j + z_{i,65} + \nu_{ij}^r$$
$$\nu_{ij}^r \sim N(0, \sigma_{\nu^r}^2)$$

Solution method

Combining EGM Carroll (2006) with discrete choices as in Fella (2014) and Iskhakov et al. (2017)

- All risky share and consumption decisions are based on first order conditions - higher precision than VFI
- Difficulties arise as the value function is only piecewise concave
 - ▶ global optimization is needed to solve for ξ
 - ▶ piecewise integration
 - ▶ developed a substitution method to ensure accuracy even close to bankruptcy
 - ▶ optimal saving policy is still increasing but can have jumps -> check several candidates and find jumping points
- Comparing values is used only for discrete decisions (participation and housing)

Back

Bankruptcy

- Due to bad income draws or
- tightening borrowing constraints,

bankruptcy can occur.

- House is lost;
- asset level is set to borrowing limit;
- expenditure is set to a consumption floor ζ .

ζ determines how hard households try to avoid being close to their borrowing limit [Back](#)

Bellman-equation

$$\begin{aligned} V_j(P_t^h, a_{it}, z_{it}, H_{it-1}) = & \max_{\{c, B, L, M, \xi, H, h\}} \left\{ (1 - \beta) U(c_{it}, h_{it})^{1-\psi} + \right. \\ & + \beta \left(q_{j+1} \mathbb{E}_t \left[V(P_{t+1}^H, a_{it+1}, z_{it+1}, H_{it})^{1-\gamma} \right] + \right. \\ & \left. \left. + (1 - q_{j+1}) \mathbb{E}_t \left[B(P_{t+1}^H, a_{it+1}, H_{it})^{1-\gamma} \right] \right)^{\frac{1-\psi}{1-\gamma}} \right\}^{\frac{1}{1-\psi}} \end{aligned}$$

subject to the budget constraints

$$a_{it} = c_{it} + s_{it} + \tau h_{it} P_t^h \mathbb{1}_{h_{it}=0} + D(H_{it-1}, H_{it}, P_t^h)$$

$$a_{it} = \hat{s}_{it} + \exp(y_{it})$$

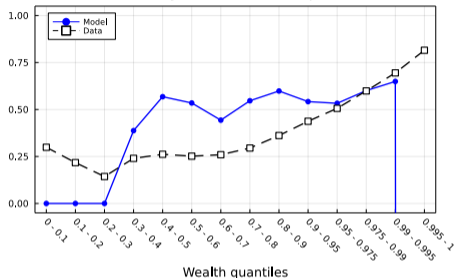
$$\hat{s}_{it} = \xi_{i,t-1} R_t + R^f B_{i,t-1} + R^m M_{i,t-1} + R^l L_{i,t-1}$$

$$h_{it} = H_{it} \quad \text{when } H_{it} > 0$$

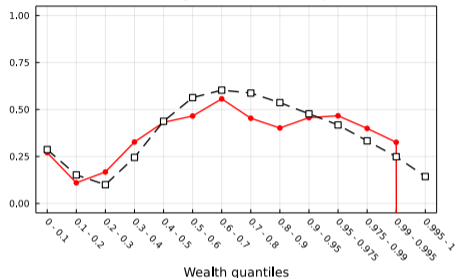
$$H_t \in \{0, H_1, \dots, H_l\}$$

Portfolio choice over wealth distribution - whole economy

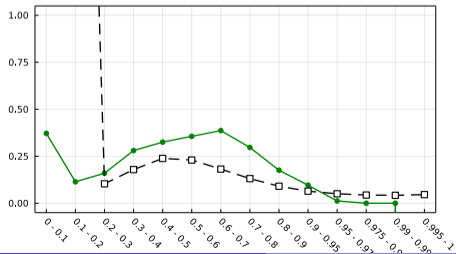
Risky share - full sample



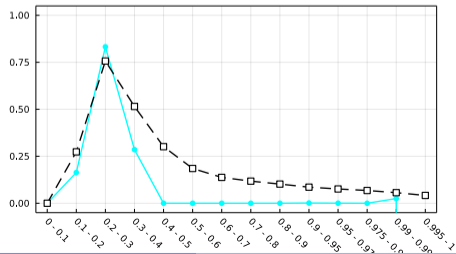
Housing share - full sample



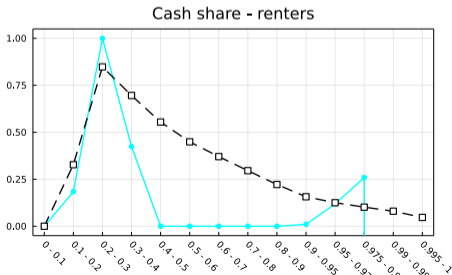
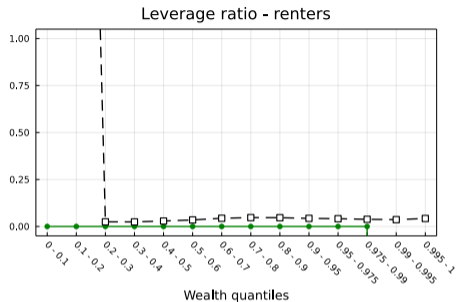
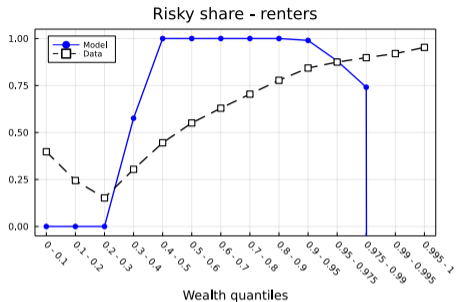
Leverage ratio - full sample



Cash share - full sample

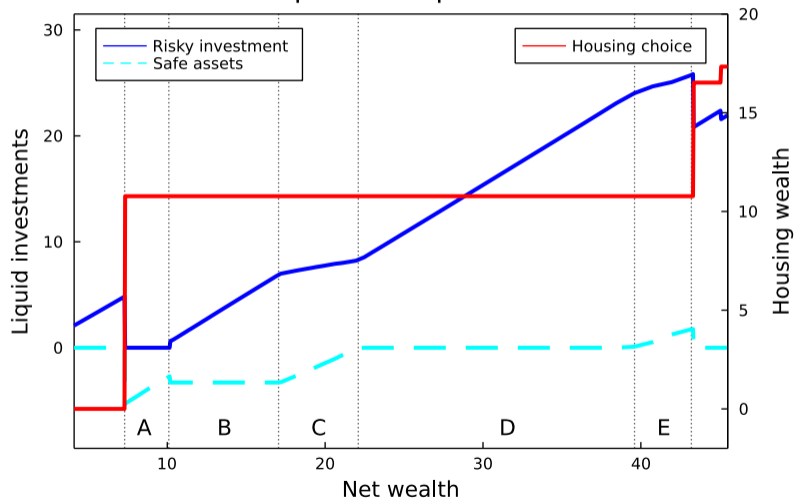


Portfolio choice over wealth distribution - renters



Why wedges between interest rates matter?

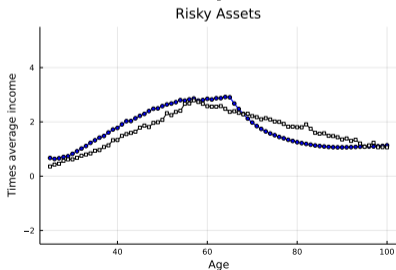
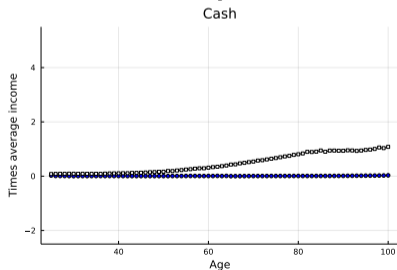
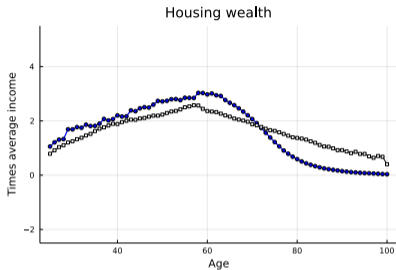
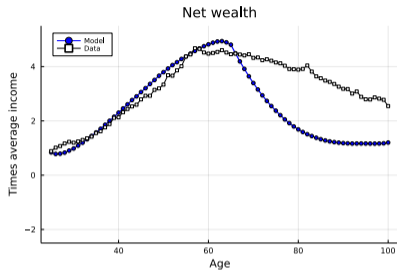
Liquid asset policies



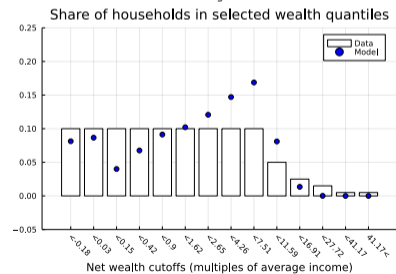
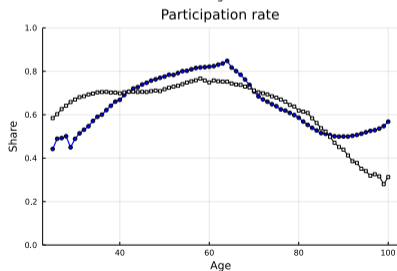
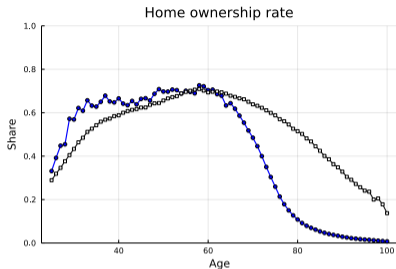
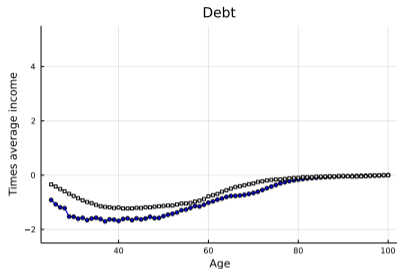
- A: consumption loan, non-participant
- B: maximal mortgage, participant
- C: trade-off between stocks and mortgage
- D: no risk-free assets
- E: trade-off between stocks and bonds

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Targeted moments



Targeted moments



Parameters

Preference parameters			
β	time preference rate	0.938	estimated
κ	Bequest strength	0.932	estimated
θ	Bequest share to offspring	0.473	estimated
γ	risk aversion	8.81	estimated
ψ	inverse EIS	0.761	estimated
ω	housing share	0.276	SCB - renters
ζ	consumption insurance	0.045%*	estimated

Table: Calibrated values for model parameters. Quantities marked with an asterisk * are expressed relative to average yearly income.

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Parameters

Returns and participation cost			
r^f	deposit rate	1.3%	SCB
μ_M	expected log stock market return	0.0646	SIXRX
σ_M	s.d. of log stock market return	0.14	SIXRX
r^m	interest rate - mortgage	4%	SCB
r^c	interest rate - consumption loan	7.5%	SCB
F	fixed participation cost	1.8%*	estimated
Income			
g	drift of aggregate wage growth	0.0213	data
ρ	auto-correlation of persistent component	0.924	data
σ_ε	s.d. of shocks to persistent income	0.171	data
σ_ν	s.d. of shocks to transitory income	0.356	data
$\sigma_{\nu pen}$	transitory pension	0.094	data

Table: Calibrated values for model parameters. Quantities marked with an asterisk * are expressed relative to average yearly income.

Parameters

Housing			
ρ_h	autocorrelation of housing prices	0.9334	data
σ_h	s.d. of housing price shocks	0.0836	data
\min_h	minimal housing size	1*	preset
Φ	buying costs	1.035	preset
α	selling costs	0.96	preset
τ	rental costs to price ratio	7.1%	estimated
η_m	PTI mortgage	0.18	preset
η_c	PTI consumption loan	0.2	FI
\bar{L}	maximal consumption loan	2*	FI
δ	mortgage max LTV	0.85	preset
χ	maintenance cost	0.04	Svensson (2023)

Table: Calibrated values for model parameters. Quantities marked with an asterisk * are expressed relative to average yearly income.