Heterogeneous Returns and the Distribution of Wealth

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Why do macroeconomists care about inequality?

Empirical evidence shows that macroeconomic policies, as well as aggregate shocks, may have differential effects across households.

- Macro matters for inequality

Representative agent models have a difficult time matching empirical estimates of macroeconomic variables (MPC and the wealth distribution).

- Inequality matters for macro

Macro with heterogeneous agents

- Uninsurable, idiosyncratic risk to income and movements in aggregate productivity (Krusell and Smith 1998)
- Ex-ante heterogeneity in the time preference of households (Carroll et al. 2017)
- Classifying models with ex-ante and ex-post heterogeneity (Kaplan and Violante 2022)
- Further surveys regarding heterogeneous agent macroeconomics (Guvenen 2011) and (Krueger, Mitman, and Perri 2016)

Empirical estimates of returns

1. Comprehensive, administrative tax data in Norway from 2004 to 2015 (Fagereng et al. 2020)
2. Asset holdings and income for Swedish residents from 1999 to 2007 (Bach, Calvet, and Sodini 2018)
3. Wealth held in equity accounts in India from 2002 to 2011 (Campbell, Ramadorai, and Ranish 2019)
4. DNB 2005 survey of dutch households regarding savings accounts and financial literacy (Deuflhard, Georgarakos, and Inderst 2018)

Related literature

- Stochastic process for returns which best fits the empirical distribution of wealth.
  (Benhabib, Bisin, and Luo 2019)
- Endogenize heterogeneous returns through access to high return investment technology.
  (Guler, Kuruscu, and Robinson 2022)
- Documents heterogeneous returns in PSID and structural estimation of a model with skill endowments.
  (Daminato and Pistaferri 2024)

Outline

1. Empirical evidence of heterogeneous returns
2. Model of saving with heterogeneous returns
3. Structural estimation of model to match wealth data

A closer look at Fagereng et al. 2020

Following optimal portfolio choice theory from Merton (1969) and Samuelson (1969)

- Optimal share in the risky asset is given by

$$\alpha_{it}^{m} = \frac{\mathbb{E}(r_t^m - r_t^s)}{\gamma_i \sigma_t^2}.$$

- Individual *realized* return to financial assets can be written as

$$r_{it}^{f} = r_t^s + \alpha_{it}^{m}(r_t^m - r_t^s).$$

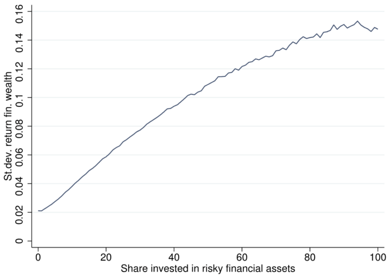


Figure: Heterogeneity in returns to financial wealth by share of risky assets from Fagereng et al. 2020.

- Step 1: *linear panel data regression model* for the return to net worth

$$r^n_{it} = X'_{it}\beta + u_{it}.$$

- Step 2: Add fixed effects

$$u_{it} = f_i + e_{it}.$$

$\implies R^2$ goes from .33 to .5.

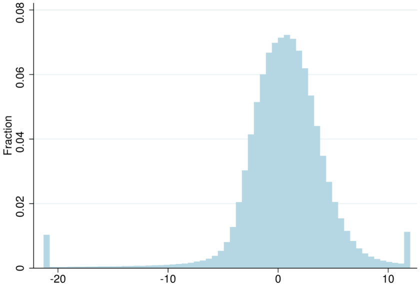


Figure: Distribution of fixed effects in the return to net worth from Fagereng et al. 2020.

Labor income process

- Household income:

$$y_t = p_t \xi_t W_t$$

- Permanent component:

$$p_t = p_{t-1} \psi_t$$

- Transitory component:

$$\xi_t = \begin{cases} \mu & \text{with probability } \mho \\ (1-\tau_t)\ell\theta_t & \text{with probability } 1-\mho \end{cases}$$

(Normalized) Optimization problem

Choose profiles $\{c_{t_n}\}_{n=0}^{\infty}$ that satisfy

$$\begin{aligned}
v(m_t) &= \max_{c_t} u(c_t(m_t)) + \beta \not{D} \mathbb{E}_t[\psi_{t+1}^{1-\rho} v(m_{t+1})] \\
&\text{s.t.} \\
a_t &= m_t - c_t(m_t), \\
k_{t+1} &= \frac{a_t}{\not{D}\psi_{t+1}}, \\
m_{t+1} &= (\daleth + r_t)k_{t+1} + \xi_{t+1}, \\
a_t &\geq 0.
\end{aligned}$$

Production function

$$Y = ZK^{\alpha}(\ell L)^{1-\alpha}$$

Calibration

Standard calibration scheme used to simulate the model.

Description	Parameter	Value	Source
Time discount factor	β	0.99	Den Haan, Judd, and Juillard 2010
CRRA	ρ	1	Den Haan, Judd, and Juillard 2010
Capital share	α	0.36	Den Haan, Judd, and Juillard 2010
Depreciation rate	δ	0.025	Den Haan, Judd, and Juillard 2010
Time worked per employee	ℓ	1/.09	Den Haan, Judd, and Juillard 2010
Capital/output ratio	$\frac{K}{Y}$	10.26	Den Haan, Judd, and Juillard 2010
Effective interest rate	$r - \delta$	0.01	Den Haan, Judd, and Juillard 2010
Wage rate	W	2.37	Den Haan, Judd, and Juillard 2010
Unempl. insurance payment	μ	0.15	Den Haan, Judd, and Juillard 2010
Probability of death	D	0.00625	Yields 40-year working life
Variance of $\log \theta_{t,i}$	σ_θ^2	0.010 x 4	Carroll 1992, Carroll, Slacalek, and Tokuoka 2015
Variance of $\log \psi_{t,i}$	σ_ψ^2	0.010 x 4/11	Carroll 1992, Debacker et al. 2013, Carroll, Slacalek, and Tokuoka 2015
Unemployment rate	$\mho$	0.07	Mean in Den Haan, Judd, and Juillard 2010

Table 1: Parameter values (quarterly frequency) for the perpetual youth model.

Estimation procedure

Simulated method of moments (SMM) estimation for R.

1. No ex-ante heterogeneity: *R-point* model
   R which matches the capital-to-output ($\frac{K}{Y}$) ratio of 10.26

2. Ex-ante heterogeneity: *R-dist* model
   Uniform distribution of R matching lorenz targets, given $\frac{K}{Y} = 10.26$

Estimation procedure with heterogeneity

Empirical lorenz targets using 2004 SCF data

Net worth percentile	Cumulative net worth
20th	-.18%
40th	.95%
60th	5.3%
80th	17.09%

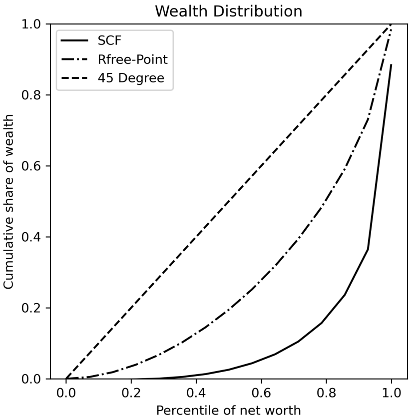
Optimization problem for the *R-dist* model

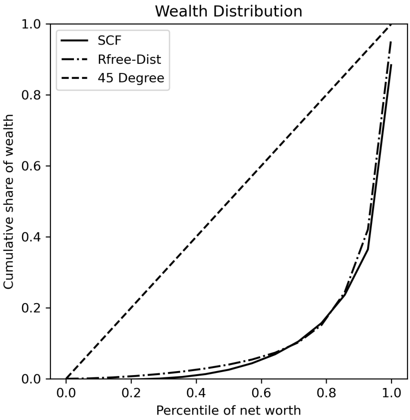
$$\{\grave{R}, \nabla\} = \arg\min_{R,\nabla} \left(\sum_{i=20,40,60,80} (w_i(R,\nabla) - \omega_i)^2 \right)^{\frac{1}{2}}$$

s.t.

$$\frac{K}{Y} = 10.26.$$

How good is the fit?





Lifecycle version of the model

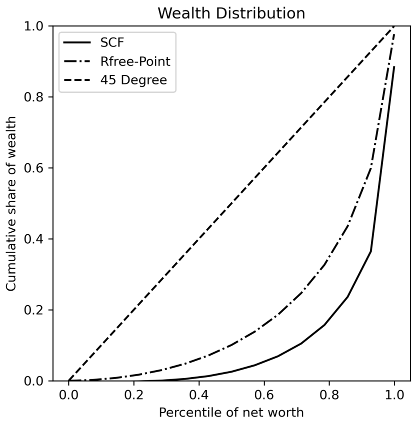
- Education cohort $e \in \{D, HS, C\}$
- Initial wealth-to-income k_0 and income p_0 levels
- Education-age dependent mortality rates (Brown, Liebman, and Pollet 2007)
- Modified labor income uncertainty $y_t = \xi_t \psi_t \overline{\psi}_{es} p_{t-1}$ (Cagetti 2003)
    - Education-age dependent shock variances (Sabelhaus and Song 2010)

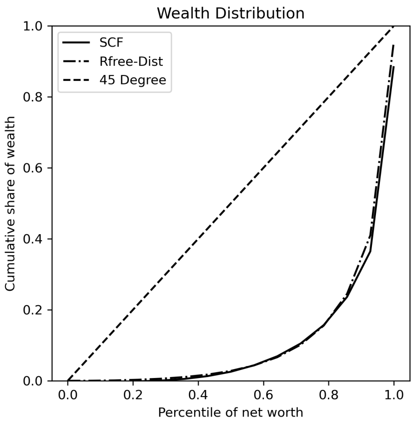
Calibration

Description	Parameter	Value
Population growth rate	N	0.0025
Technological growth rate	Γ	0.0037
Rate of high school dropouts	θ_D	0.11
Rate of high school graduates	θ_{HS}	0.55
Rate of college graduates	θ_C	0.34
Labor income tax rate	τ	0.0942

Table 1: Parameter values (quarterly frequency) for the lifecycle model.

How good is the fit?





Assessing the performance of the model

Empirical values from Fagereng et al. 2020

	Mean	St. Dev
Net worth (before tax)	0.0379	0.0859
Net worth (after tax)	0.0365	0.0781
Net worth (before tax, unweighted)	0.0004	0.2205
Net worth (after tax, unweighted)	0.0155	0.1546

Values from the structural estimation

	Center	Spread
PY-Point	1.015	0.0
PY-Dist	1.011	0.011
LC-Point	1.072	0.0
LC-Dist	1.05	0.074

Work to be done

1. Modify structural estimation to include bequest parameter
2. Incorporate choice of risky asset
3. Robustness checks
    - Wealth data from other waves of the SCF
    - Different measures of wealth (liquid and/or financial)

References I

Bach, Laurent, Laurent E. Calvet, and Paolo Sodini (2018). "Rich Pickings? Risk, Return, and Skill in Household Wealth". In: *American Economic Review* 110.9, pp. 2703–47. DOI: 10.1257/aer.20170666. URL: https://www.aeaweb.org/articles?id=10.1257/aer.20170666.

Benhabib, Jess, Alberto Bisin, and Mi Luo (May 2019). "Wealth Distribution and Social Mobility in the US: A Quantitative Approach". In: *Am. Econ. Rev.* 109.5, pp. 1623–1647. ISSN: 0002-8282. DOI: 10.1257/aer.20151684. URL: https://www.aeaweb.org/doi/10.1257/aer.20151684.

References II

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu (2011). "The Distribution of Wealth and Fiscal Policy in Economies With Finitely Lived Agents". In: *Econometrica* 79.1, pp. 123–157. DOI: https://doi.org/10.3982/ECTA8416. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA8416. URL: https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA8416.

— (2015). "The wealth distribution in Bewley economies with capital income risk". In: *J. Econ. Theory* 159, pp. 489–515. ISSN: 0022-0531.

References III

Benhabib, Jess, Alberto Bisin, and Shenghao Zhu (Mar. 2016). "THE DISTRIBUTION OF WEALTH IN THE BLANCHARD–YAARI MODEL". In: *Macroecon. Dyn.* 20.2, pp. 466–481. ISSN: 1365-1005, 1469-8056. DOI: 10.1017/S1365100514000066. URL: https://www.cambridge.org/core/journals/macroeconomic-dynamics/article/distribution-of-wealth-in-the-blanchardyaari-model/02522D3ADFD9A1A99C2650DFABDB220E.

Brown, Jeffrey R, Jeffrey B Liebman, and Joshua Pollet (Nov. 2007). "Appendix: Estimating Life Tables That Reflect Socioeconomic Differences in Mortality". en. In: *The Distributional Aspects of Social Security and Social Security Reform*. University of Chicago Press, pp. 447–458. ISBN: 9780226241890. URL: https://www.degruyter.com/document/doi/10.7208/9780226241890-013/html?lang=en.

References IV

Cagetti, Marco (2003). "Wealth Accumulation over the Life Cycle and Precautionary Savings". In: *J. Bus. Econ. Stat.* 21.3, pp. 339–353. ISSN: 0735-0015. URL: http://www.jstor.org/stable/1392584.

Campbell, John Y, Tarun Ramadorai, and Benjamin Ranish (Sept. 2019). "Do the Rich Get Richer in the Stock Market? Evidence from India". In: *American Economic Review: Insights* 1.2, pp. 225–240. DOI: 10.1257/aeri.20180158. URL: https://www.aeaweb.org/articles?id=10.1257/aeri.20180158.

Carroll, Christopher et al. (2017). "The distribution of wealth and the marginal propensity to consume". In: *Quantitative Economics* 8.3, pp. 977–1020. DOI: https://doi.org/10.3982/QE694. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/QE694. URL: https://onlinelibrary.wiley.com/doi/abs/10.3982/QE694.

References V

Daminato, Claudio and Luigi Pistaferri (May 2024). "Returns Heterogeneity and Consumption Inequality Over the Life Cycle". DOI: 10.3386/w32490. URL: http://www.nber.org/papers/w32490.

Deuflhard, Florian, Dimitris Georgarakos, and Roman Inderst (Apr. 2018). "Financial Literacy and Savings Account Returns". en. In: *J. Eur. Econ. Assoc.* 17.1, pp. 131–164. ISSN: 1542-4766. DOI: 10.1093/jeea/jvy003. URL: https://academic.oup.com/jeea/article-abstract/17/1/131/4981453.

References VI

Fagereng, Andreas et al. (2020). "Heterogeneity and Persistence in Returns to Wealth". In: *Econometrica* 88.1, pp. 115–170. DOI: https://doi.org/10.3982/ECTA14835. eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA14835. URL: https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA14835.

Guler, Bulent, Burhan Kuruscu, and Baxter Robinson (2022). *The composition and distribution of wealth and aggregate consumption dynamics*. https://events.bse.eu/live/files/4096-gkrdraftv31submitpdf. Accessed: 2023-9-6. URL: https://events.bse.eu/live/files/4096-gkrdraftv31submitpdf.

References VII

Guvenen, Fatih (Nov. 2011). *Macroeconomics With Heterogeneity: A Practical Guide*. NBER Working Papers 17622. National Bureau of Economic Research, Inc. URL: https://ideas.repec.org/p/nbr/nberwo/17622.html.

Kaplan, Greg and Giovanni L Violante (2022). *The Marginal Propensity to Consume in Heterogeneous Agent Models*. Working Paper 30013. National Bureau of Economic Research. DOI: 10.3386/w30013. URL: http://www.nber.org/papers/w30013.

Krueger, Dirk, Kurt Mitman, and Fabrizio Perri (June 2016). "Macroeconomics and Household Heterogeneity". URL: http://www.nber.org/papers/w22319.

References VIII

Krusell, Per and Anthony Smith (1998). "Income and Wealth Heterogeneity in the Macroeconomy". In: *Journal of Political Economy* 106.5, pp. 867–896. DOI: 10.1086/250034. URL: https://ideas.repec.org/a/ucp/jpolec/v106y1998i5p867-896.html.

Sabelhaus, John and Jae Song (May 2010). "The great moderation in micro labor earnings". In: *J. Monet. Econ.* 57.4, pp. 391–403. ISSN: 0304-3932. DOI: 10.1016/j.jmoneco.2010.04.003. URL: https://www.sciencedirect.com/science/article/pii/S0304393210000358.