“Wealth Distribution and Monetary Policy”

Valerio Pieroni

IDEA, UAB and BSE

Introduction

How does wealth inequality shape the transmission of monetary policy to household consumption?

- Existing studies mostly emphasize the role of low-liquidity households.
- Most of these households are in the bottom 50% of the wealth distribution.
- In advanced economies wealth is highly concentrated at the top.
- Macroeconomic impact of top wealth groups?

Contribution

- Use the joint distribution of income and wealth to quantify the impact of different wealth groups on the aggregate consumption response to MP.

Methods:

- Quantitative HANK model.
- Calibrate and validate the model with US micro data (SCF and PSID).
- Leverage the model to analyze the impact of different wealth groups on:
  - Aggregate consumption response to monetary policy.
  - Transmission mechanism of monetary policy.

Findings

1. Heterogeneous income and consumption responses across wealth groups:
    - Households at the tails of the wealth distribution exhibit the largest responses.
2. Top wealth groups substantially shape aggregate consumption response.
    - Top 10 explains more than one-third of the aggregate response.
    - Wealthy households show large responses to monetary policy shocks.
    - Have sizable consumption shares.
3. Top wealth groups matter for the propagation of monetary policy:
    - Interest income channel and persistence of labor income channel.

Literature

- Quantitative work on monetary policy and household heterogeneity: Kaplan, Moll, and Violante (2018), Gornemann, Kuester, and Nakajima (2021), Auclert, Rognlie, and Straub (2020).
- Interactions between inequality and monetary policy: Luetticke (2021), Bilbiie, Kanzig, and Surico (2019), Auclert (2019).
- Literature on wealth inequality: Castañeda, Díaz-Giménez, and Ríos-Rull (2003), Poschke, Kaymak, and Leung (2021).
- Heterogeneous agent economies: Alves, Kaplan, Moll, and Violante (2020), Debortoli and Galì (2022), Bilbiie (2021).
- Empirical work on effects of monetary policy across wealth distribution: Holm, Paul, and Tischbirek (2020), Slacaleky, Tristani, and Violante (2020).

Model

Households

- Markets are incomplete, given states $x = (a, e, \rho)$ households solve

$$\max_{(c_t, n_t)} \ \mathbb{E}_0 \int_0^\infty e^{-\rho t} u(c_t, n_t) dt, \tag{H.1}$$

$$\text{s.t. } da_t = (w_t e_t n_t + r_t a_t + d_t - c_t) dt,$$

$$a_t \geq -\phi.$$

- Let ψ_t be the cross-sectional distribution over the state space X.
- Total firms' profits D_t are distributed across households according to

$$d_t = \left(e_t / \int_X e_t d\psi_t \right) D_t.$$

- High-income households receive a larger share of profits.

Firms

- The representative firm solve

$$\max_{Y_{it}} \; p_t Y_t - \int_0^1 p_{it} Y_{it} di, \;\; \text{s.t.} \;\; Y_t = \left(\int_0^1 Y_{it}^{\frac{\varepsilon-1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon-1}}. \tag{F.1}$$

- Input producers solve

$$\min_{K_{it}, N_{it}} \; w_t N_{it} + r_t^k K_{it}, \;\; \text{s.t.} \;\; Y_{it} = F(K_{it}, N_{it}), \tag{F.2}$$

$$\max_{\dot{p}_{it}} \; \int_0^\infty \left[\exp\left(- \int_0^t i_s ds \right) \left((p_{it} - m_{it}) Y_{it} - \Phi_t \left(\frac{\dot{p}_{it}}{p_{it}} \right) \right) \right] dt \tag{F.3}$$

$$\text{s.t.} \;\; Y_{it} = \left(\frac{p_{it}}{p_t} \right)^{-\varepsilon} Y_t.$$

- $\mu = \varepsilon/(\varepsilon - 1)$ with $\varepsilon > 1$, m_{it}, i_t are nominal marginal costs and interest rate.

Financial sector and monetary policy

- The investment fund owns the economy capital stock K_t
- The fund rents capital to the input producers and invests in new capital.
- Let $\iota_t = I_t/K_t$, the investment problem is

$$V_0 := \max_{\iota_t} \int_0^\infty \left[\exp\left(-\int_0^t r_s ds\right)\left((r_t^k - \iota_t)K_t - \chi_t(\iota_t)\right)\right] dt \qquad \text{(F.4)}$$
$$\text{s.t. } \dot{K}_t = (\iota_t - \delta)K_t.$$

- The market value of capital is given by $V_t = q_t K_t$.
- Taylor rule $i_t = r + \phi_\pi \pi_t + \upsilon_t$ with an interest rate policy $\upsilon_t = e^{-\eta t}\upsilon_0$.

Equilibrium

Definition 1. The equilibrium is (c_t, da_t, n_t), $(K_t, N_t, Y_t, I_t, C_t, R_t)$, $(r_t, r_t^k, q_t, w_t, \pi_t)$:

1. Households solve (H.1).
2. Firms solve (F.1), (F.2), (F.3), (F.4).
3. Markets clear

$$V_t = \int_X a_t d\psi_t,$$
$$N_t = \int_X e_t n_t d\psi_t.$$

4. Monetary policy follows a Taylor rule.
5. The sequence of distributions satisfies aggregate consistency conditions.

Recursive formulation using PDEs solved numerically with global methods.

Parametrization

Calibration strategy

- Two challenges:
  - Match wealth distribution including its Pareto tail.
  - Jointly match aggregate wealth holdings and average MPC.
- To match micro evidence combine:
  - Extraordinary earning states as in Castañeda, Díaz-Giménez, and Ríos-Rull (2003), Poschke, Kaymak, and Leung (2021).
  - Ex-ante heterogeneous discount rates ρ_1, ρ_2 with proportions p_1, p_2.
- Functional forms: CRRA utility function, Cobb-Douglas production function, quadratic (ivestment and price) adjustment costs.

Data

- Calibration is carried out at quarterly time frequency for the US economy.
- The main data source is the Survey of Consumer Finances (SCF) in 2004.[1]
- Earnings: wages and self-employment income.
- Wealth: net worth without home equity.

[1] In particular, the extract from the SCF 2004 in Kaplan, Moll, and Violante (2018).

Calibration

- Externally calibrated: Preferences, technology and New Keynesian block.
- Internally calibrated parameters: $\rho_1, \rho_2, p_1, e_1, e_2, \lambda_1, \lambda_2, \theta_1, \kappa$.
- Targeted moments:
  - Wealth-output ratio, aggregate return to wealth.
  - Gini coefficients of earnings, income, and wealth.
  - Top 0,1%,1% earning shares.
  - Overall fraction of low-liquidity households.
  - Peak of investment to output response about 2.

(table) (H2M)

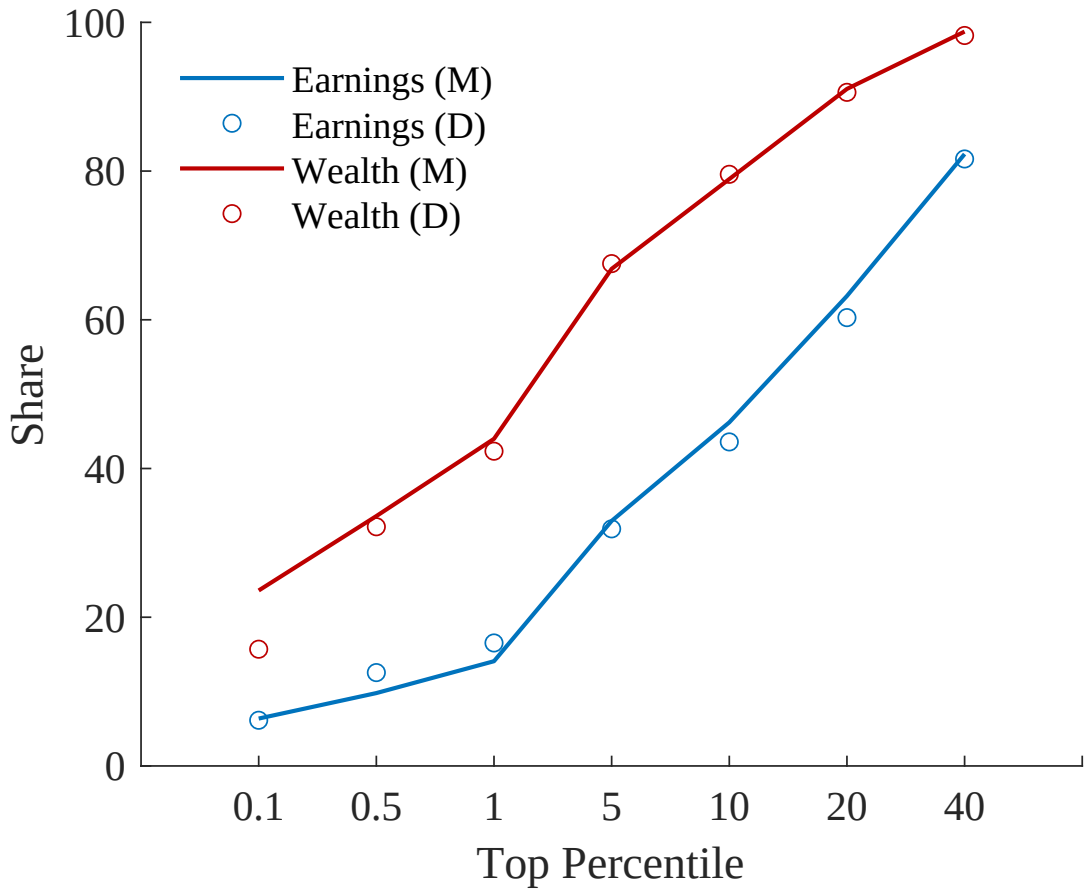
Model fit

Table 1: Targeted statistics

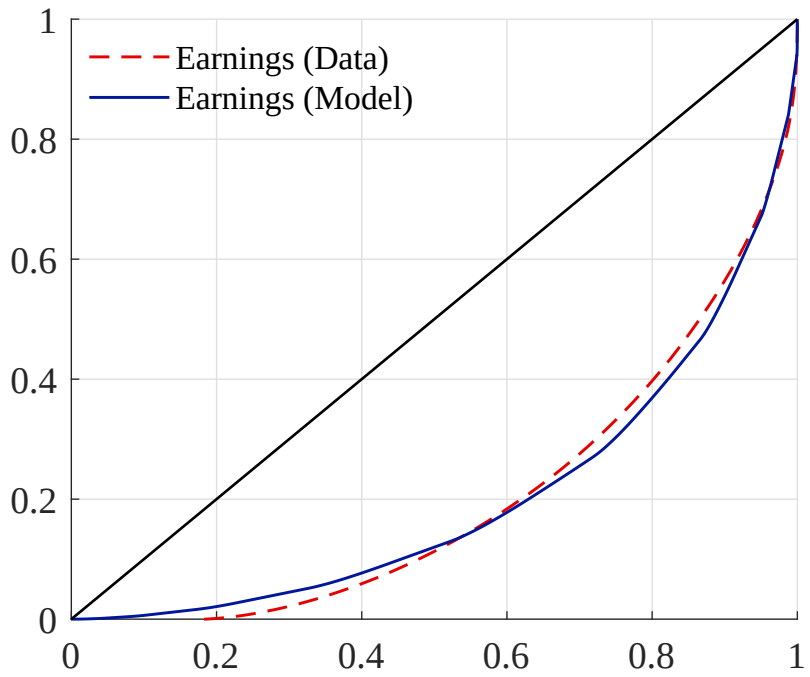
Targeted Statistics	Data	Model
Wealth-output ratio	2.55	2.8
Aggregate return on wealth	.065	.055
Fraction with $a = \phi$	0.3	0.27
Gini wealth	0.88	0.88
Gini earnings	0.59	0.59
Gini income	0.61	0.59
Top 0.1% earnings share	6	6
Top 1% earnings share	16	14

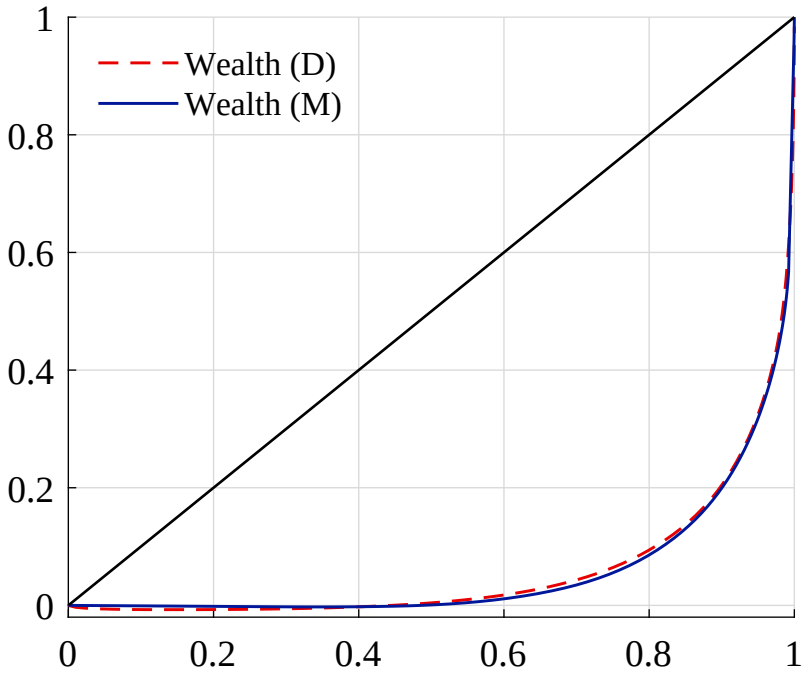
(model fit)

Top shares

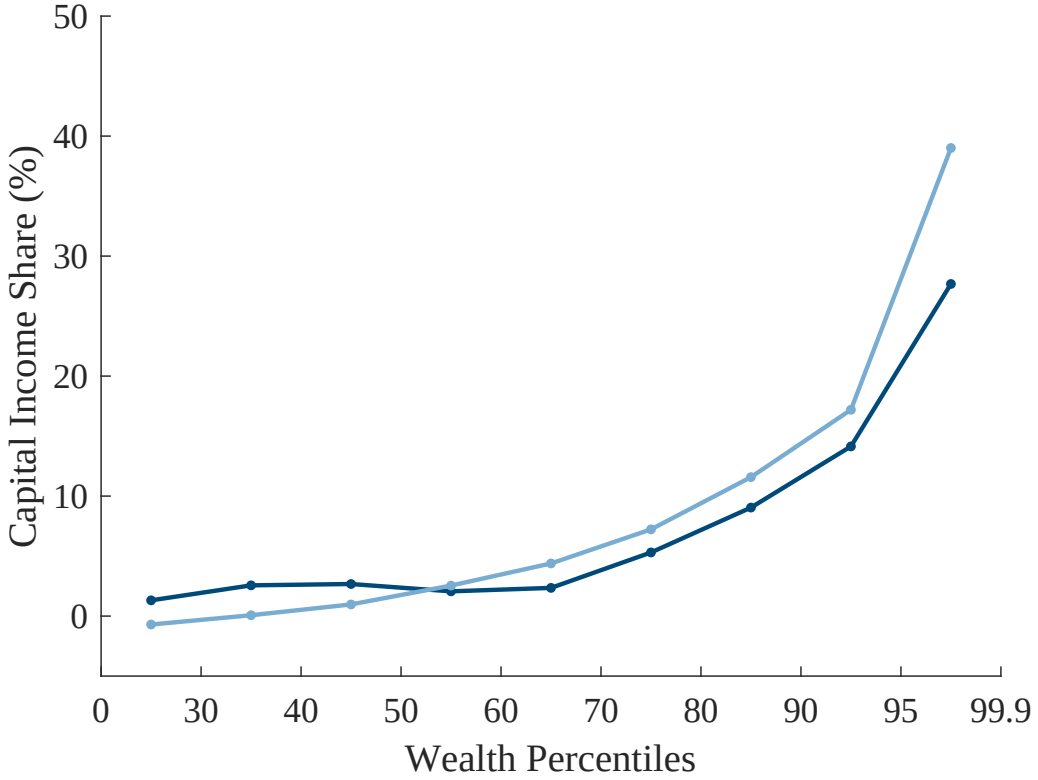

100
80
60
40
20
0
Share
Earnings (M)
Earnings (D)
Wealth (M)
Wealth (D)
0.1
0.5
1
5
10
20
40
Top Percentile

Marginal distributions





Capital income shares



- The model generates realistic capital income shares across wealth groups.
- Limitation: share of the top 1% in the model too high. (JointDist)

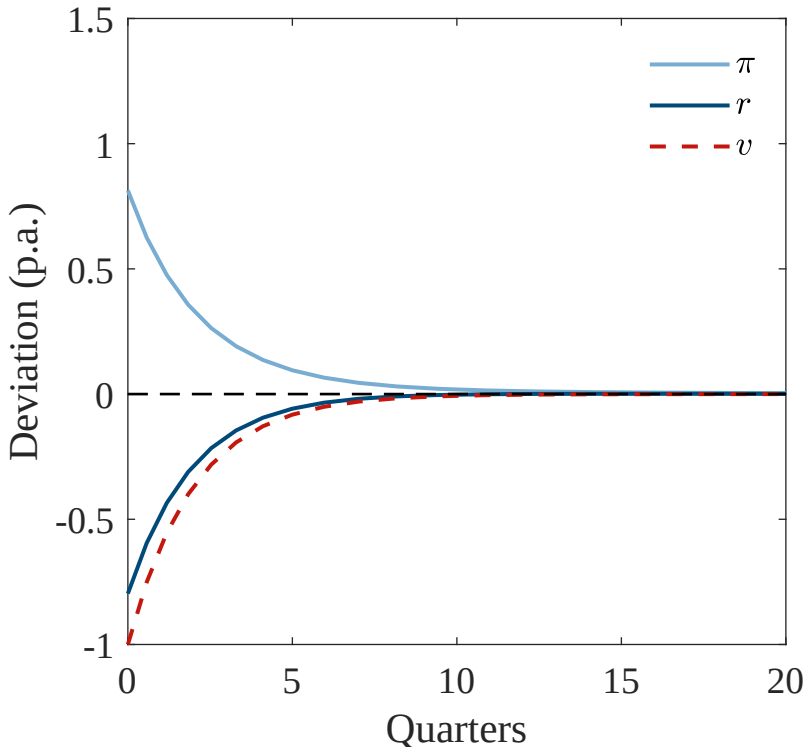
Marginal propensities to consume

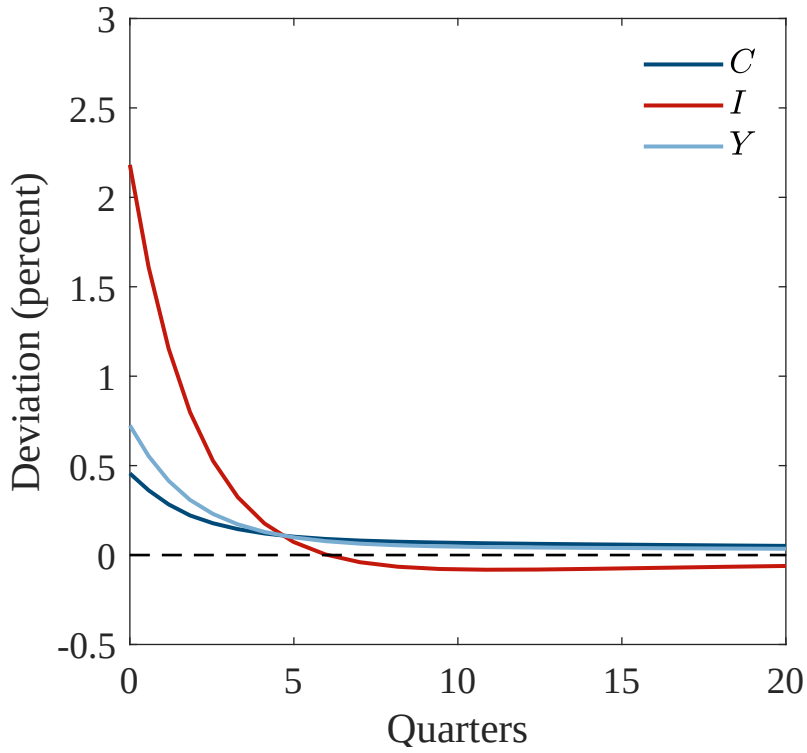
- Average fraction of a transfer consumed in a quarter or in a year
  - I find 13% over one quarter and 50% over a year out of a $500 transfer.
  - Quantitative HANK models at lower bound of empirical estimates.[2]

[2]Respectively Gornemann, Kuester, and Nakajima (2021), Hagedorn, Manovskii, and Mitman (2019), Kaplan, Moll, and Violante (2018) find 15% (Q), 33% (Y), 12% (Q), 40% (Y), and 16% (Q) 33% (Y). These studies typically set a quarterly empirical benchmark 15%-25% out of transfers between $500 and $1000 (Parker, Souleles, Johnson, and McClelland (2013), Broda and Parker (2014), Fagereng, Holm, and Natvik (2021)).

Quantitative Analysis

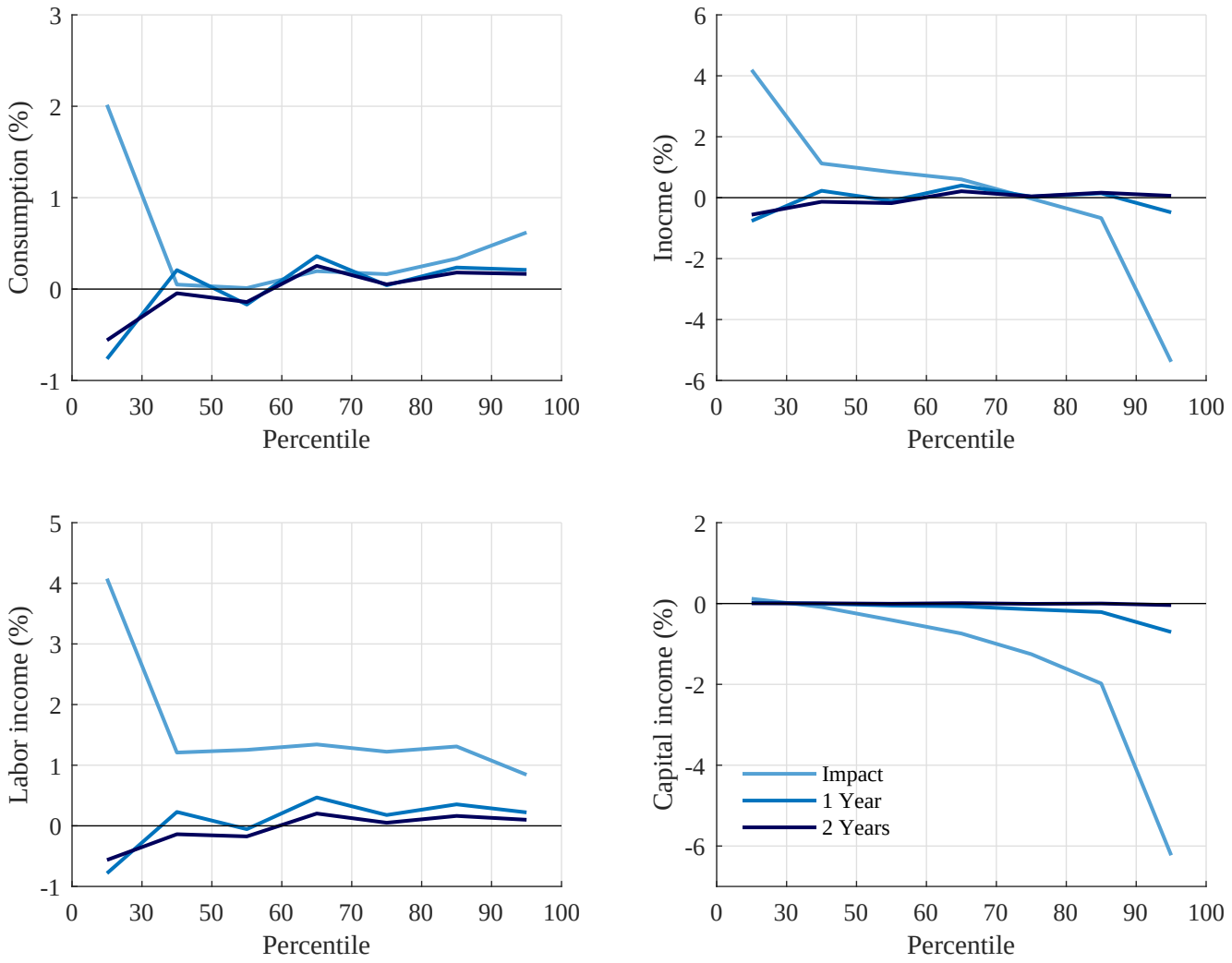
Macro responses to monetary policy



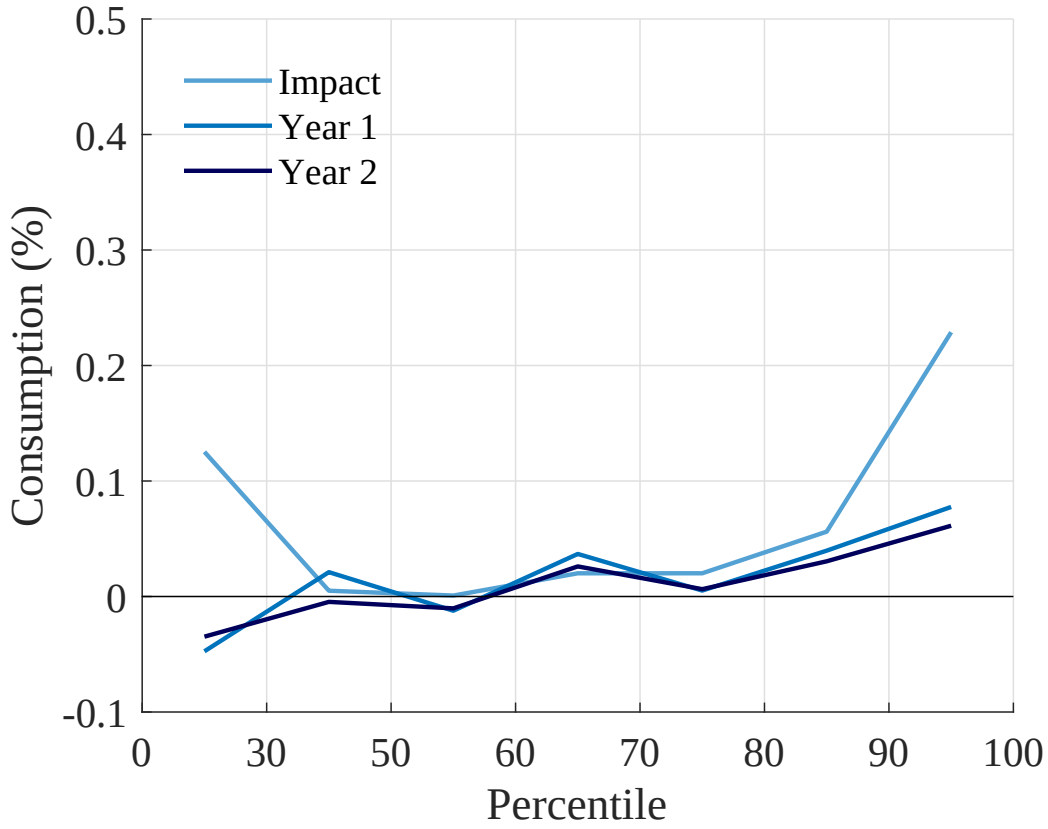


- 25 basis point or 1% annualized interest rate cut, $v_0 = -.0025$.

Heterogeneous responses to monetary policy

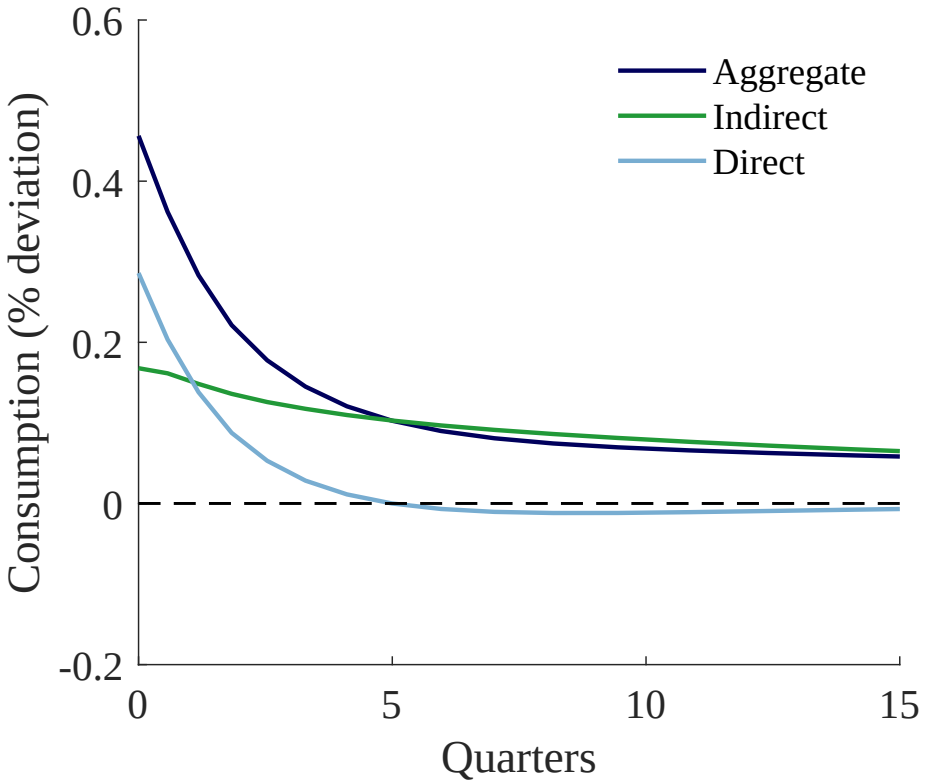


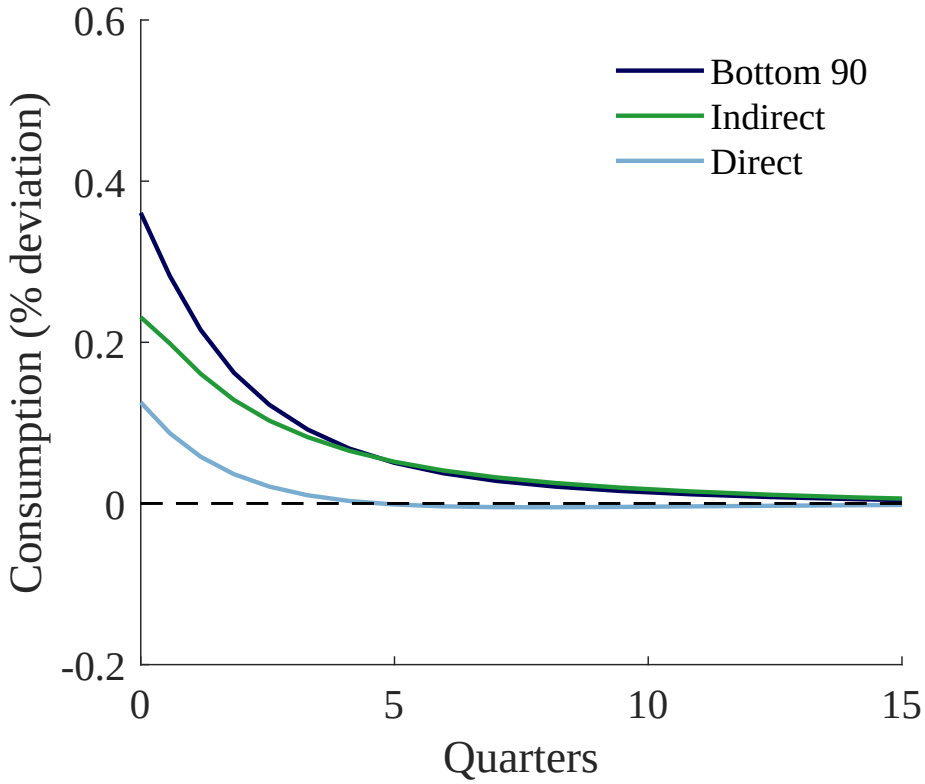
Aggregate consumption



- Households at the top have a large impact on the aggregate response.
- The response at the top is 0.16% without the top 1%.

Monetary policy transmission





$$dC_t = \int_0^\infty \frac{\partial C_t}{\partial r_s} dr_s ds + \int_0^\infty \frac{\partial C_t}{\partial w_s} dw_s ds.$$

Conclusions

Main messages:

- Wealth concentration at the top matters for aggregate dynamics:
- Wealthy households substantial impact on aggregate consumption response.
- Top wealth groups shape transmission channels of monetary policy.

Extensions:

- Additional channels relevant at the top, e.g. dividends and capital gains.

Thank you!

References

Aguiar, Mark, Mark Bils, and Corina Boar (2021). "Who Are the Hand-to-Mouth?" Working Papers.

Alves, Felipe, Greg Kaplan, Benjamin Moll, and Gianluca Violante (2020). "A Further Look at the Propagation of Monetary Policy Shocks in HANK".

Auclert, Adrien (2019). "Monetary Policy and the Redistribution Channel". In: *American Economic Review* 109 (6), pp. 2333–2367.

Auclert, Adrien, Matthew Rognlie, and Ludwig Straub (2020). "Micro Jumps, Macro Humps: Monetary Policy and Business Cycles in an Estimated HANK Model". Working Papers.

Bilbiie, Florin (2021). "Monetary Policy and Heterogeneity: An Analytical Framework". Working Papers.

Bilbiie, Florin, Diego Kanzig, and Paolo Surico (2019). “Capital, Income Inequality, and Consumption: the Missing Link”. Working Papers.

Broda, Christian and Jonathan Parker (2014). “The Economic Stimulus Payments of 2008 and the Aggregate Demand for Consumption.” In: *Journal of Monetary Economics* 68 (S), S20–S36.

Castañeda, Ana, Javier Díaz-Giménez, and José-Vícotr Ríos-Rull (2003). “Accounting for the U.S. Earnings and Wealth Inequality”. In: *Journal of Political Economy* 111 (4), pp. 818–857.

Debortoli, Davide and Jordi Galì (2022). “Idiosyncratic Income Risk and Aggregate Fluctuations”. Working paper.

Fagereng, Andreas, Martin Holm, and Gisle J. Natvik (2021). “MPC Heterogeneity and Household Balance Sheets.” Working Papers.

Gornemann, Nils, Keith Kuester, and Makoto Nakajima (2021). "Doves for the Rich, Hawks for the Poor? Distributional Consequences of Systematic Monetary Policy". Working Papers.

Hagedorn, Marcus, Iourii Manovskii, and Kurt Mitman (2019). "The Fiscal Multiplier". Working Papers.

Holm, Martin, Pascal Paul, and Andreas Tischbirek (2020). "The Transmission of Monetary Policy under the Microscope". Working Papers.

Kaplan, Greg, Benjamin Moll, and Gianluca Violante (2018). "Monetary Policy According to HANK". In: *American Economic Review* 108 (5), pp. 697–743.

Luetticke, Ralph (2021). "Transmission of Monetary Policy with Heterogeneity in Household Portfolios". In: *American Economic Journal: Macroeconomics* 13 (2), pp. 1–25.

Parker, Jonathan, Nicholas Souleles, David Johnson, and Robert McClelland (2013). "Consumer Spending and the Economic Stimulus Payments of 2008." In: *American Economic Review* 103 (6), pp. 2530–53.

Poschke, Markus, Barış Kaymak, and David Leung (2021). "Accounting for wealth concentration in the US". Working Papers.

Slacaleky, Jiri, Oreste Tristani, and Gianluca Violante (2020). "Household Balance Sheet Channels of Monetary Policy: A Back of the Envelope Calculation for the Euro Area". In: *Journal of Economic Dynamics and Control* 115.

Weidner, Justin, Greg Kaplan, and Gianluca Violante (2014). "The Wealthy-Hand-to-Mouth". In: *Brookings Papers on Economic Activity* 45 (1), pp. 77–153.

Appendices

Table 2: Model parameters

Parameter	Description	Value	Source
Households			
γ	CRRA/Inverse IES	1	External
ν	Frisch elasticity of labor supply	1	External
ρ_1, ρ_2	Individual discount rates (p.a.)	8%, 14%	Internally calibrated
ϕ	Borrowing limit	0.5	External
λ_e	Arrival rate normal states	1	External
ν_e	Mean reversion coeff.	0.0263	External
σ_e	S. d. of innovations	0.2	External
θ_1	Transition probability to e_1	0.6	Internally calibrated
λ_1	Arrival rate top states	0.00045	Internally calibrated
λ_2	Arrival rate leave top states	0.8	Internally calibrated
e_1, e_2	Top earnings states	50, 350	Internally calibrated
p_1	Fraction of patient types	0.1	Internally calibrated

Table 3: Model parameters

Parameter	Description	Value	Source
Firms and policy			
θ	Capital elasticity	0.33	External
δ	Depreciation rate (p.a.)	5%	External
Ψ	Price adjustment cost	100	PC slope of 0.1
ε	Intermediate goods elasticity	10	Profit share of 0.1
κ	Investment adjustment cost	16	Internally calibrated
ϕ_π	Taylor coeff.	1.25	External

(back)

Variables definition

- Assets: durables net of real estate, deposits, bonds, public and private equity.
- Liabilities: overdraft debt and consumer credit.
- Earnings: wages and business income.
- Income: sum of earnings, interest and dividend income, and capital gains.
- Consumption: food at home and away from home, trips, recreation activities, education, child care, health, clothing, insurance, and utilities.

(back)

Low-liquidity households

- Let b be liquid asset holdings, y monthly income, $\phi = y$.
- A low liquidity household has either

$$b \geq 0 \quad \text{and} \quad b \leq y/2,$$

$$b < 0 \quad \text{and} \quad b \leq y/2 - \phi = -y/2.$$

- Capture kinks in budget set around zero and ϕ.
- $1/2$ is due to the assumption that resources are consumed at constant rate.
- Overstate low-liwquidity households if use before tax income.
- Understate low-liquidity households if start period with positive savings.

(back)

Low-liquidity households across the wealth distribution

	Bottom 30	Bottom 50	Next 40	Top 10
Between shares	47	71	25	4
Within shares	70	50	20	13

- I find that in the SCF 36% of the households are liquidity constrained.[3]
- Shares of low-liquidity households between and within each wealth decile.
- These numbers do not substantially change if I include home equity.

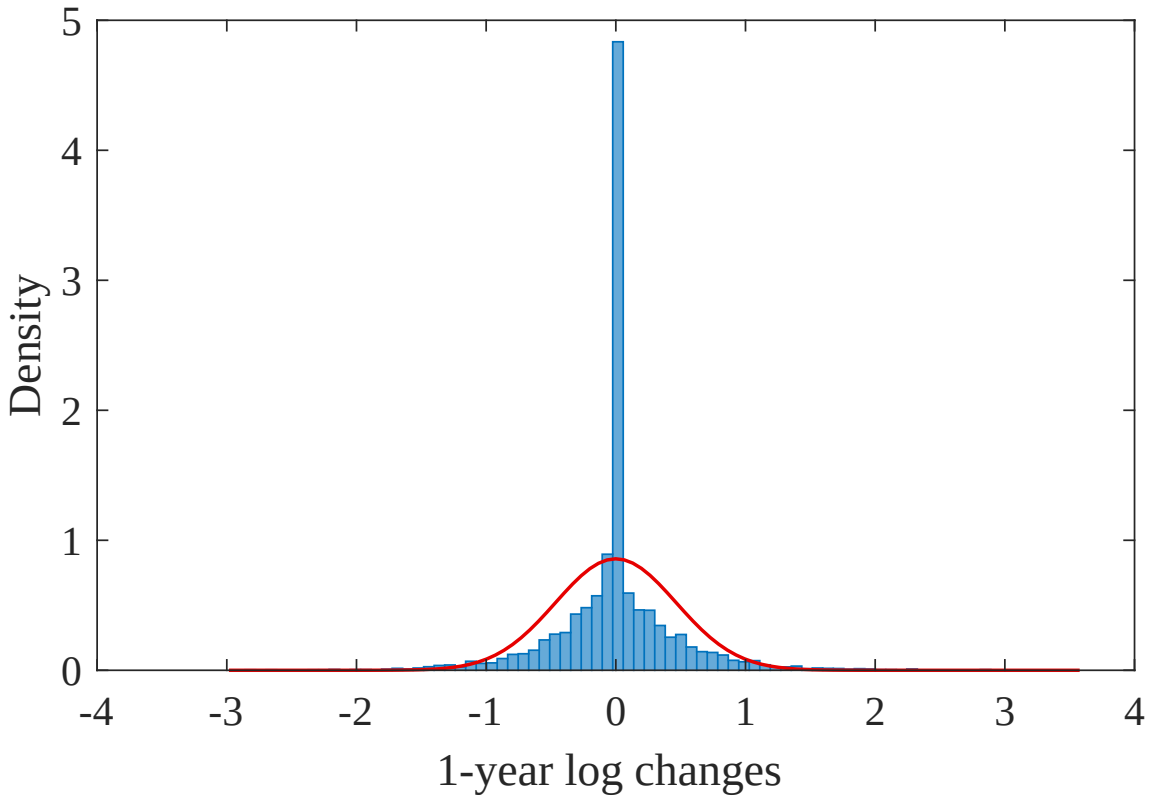
[3] Aguiar, Bils, and Boar (2021) using PSID find 40%, Weidner, Kaplan, and Violante (2014) find 30%.

Labor income process

Labor income risk e_t follows a Poisson process:

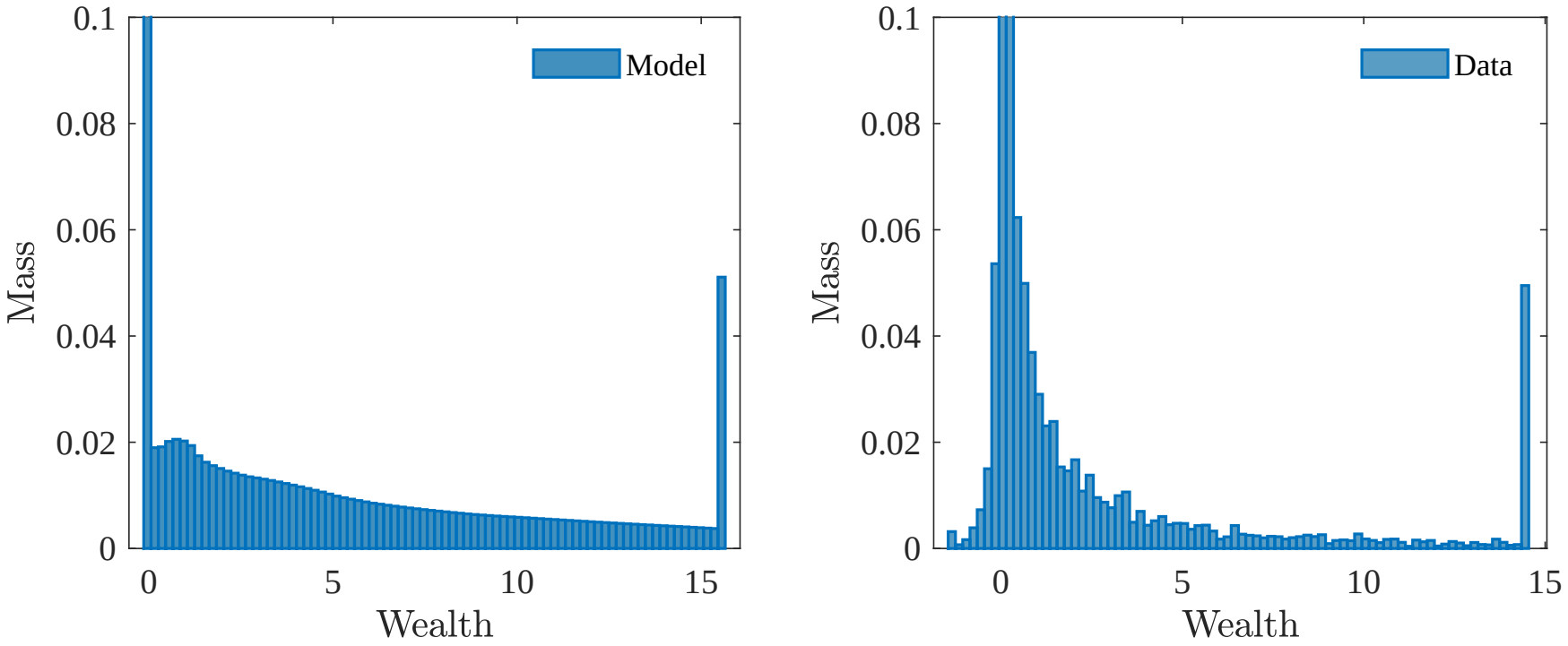
- Households switch between normal states
  - Arrival rate λ_e, conditional distribution F_e, stationary distribution ϕ_e.
  - F_e is characterized by a stochastic transition matrix.
  - This matrix follows from an AR(1) process with parameters $1 - \nu_e, \sigma_e$.
- Jumps from normal states to extraordinary states e_1, e_2
  - Arrival rate λ_1 and transition probabilities θ_1, θ_2.
  - Switch back to normal at rate λ_2 and draw a new state from ϕ_e.

Income dynamics



- The estimated kurtosis is around 9 in the model and 17.8 in the data.

Wealth distribution



- Wealth relative to average earnings.
- Fraction households close to $a = 0$ approximately 26% in model and data.

Wealth distribution

Wealth statistics	Data	Model	Wealth statistics	Data	Model
Mean wealth	4.2	4.7	90th percentile	7.3	8
Median wealth	0.3	0.2	95th percentile	14.2	14.9
75th percentile	2	2.2	99th percentile	66.8	58.8

Model fit

The discount rates ρ_1, ρ_2 imply respectively

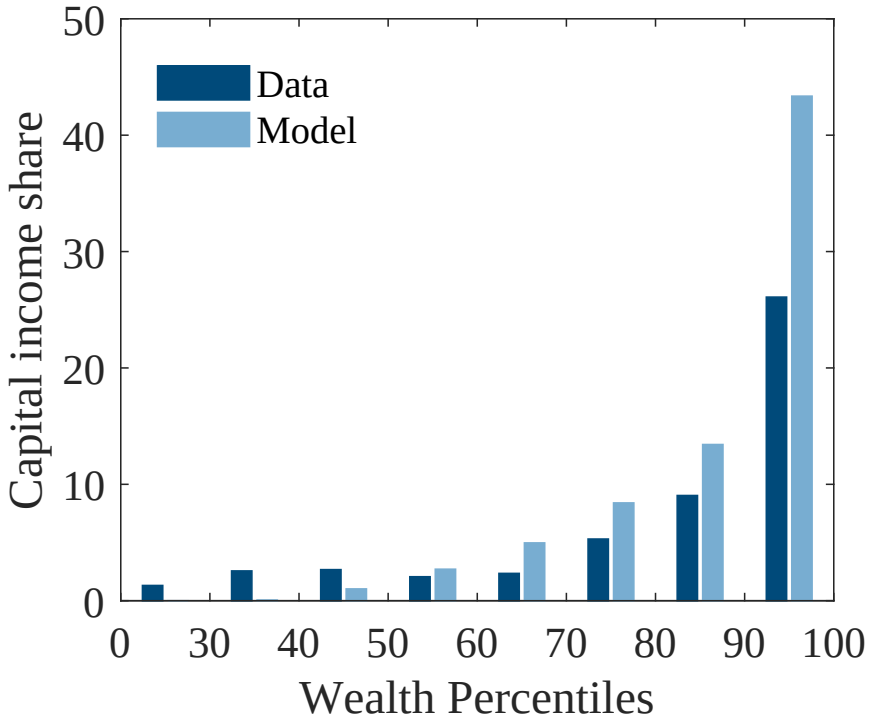
- Discount factors of 0.98, 0.96.
- Each preference type represent 10%, 90% of the population.

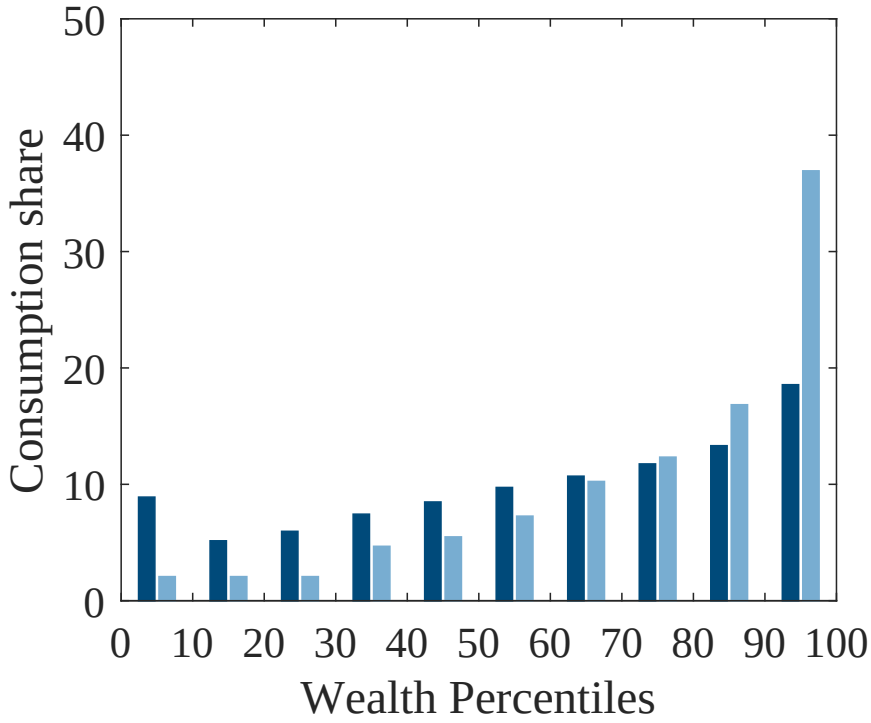
Labor income process:

- Top states e_1, e_2 are $27, 193$ times the average of the process.
- Only $0.03\%, 0.02\%$ of the households are in these states.

(back)

Joint distributions





- The model generates realistic joint distributions.
- Limitations: shares of the top 1% and consumption at the bottom.

(back)