

# “Wealth Distribution and Monetary Policy”

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# Introduction

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

- In advanced economies wealth is highly concentrated at the top.
- Existing literature focuses on the role of low-liquidity households.
- Macroeconomic impact of top wealth groups?
- Evidence on the responses to monetary policy from Denmark and Norway.
- Implications for the response of aggregate consumption to monetary policy.

# Contribution

To quantify the macroeconomic impact of different wealth groups I combine:

- The joint distribution of consumption, income, and wealth in the US.
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- Validate the model with US micro data (SCF and PSID).
  - Income composition and consumption shares.

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- Validate the model with US micro data (SCF and PSID).
  - Income composition and consumption shares.
- Leverage the model to analyze the impact of different wealth groups on
  - Transmission mechanism of monetary policy to aggregate consumption.

# Main findings

1. Heterogeneous income and consumption responses across wealth groups:
  - Households at the tails of the wealth distribution show 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 benefit from higher equity prices and capital gains.
  - Have low MPCs but sizable consumption shares.
3. Wealth distribution matter in the propagation of monetary policy (MP):
  - In HANK framework changes in the wealth distribution amplify MP effects.

# Literature

- Quantitative work on monetary policy and household heterogeneity: Kaplan, Moll, and Violante (2018), Gornemann, Kuester, and Nakajima (2021), Lee (2021), Wolf (2021).
- Literature on wealth inequality: Castañeda, Díaz-Giménez, and Ríos-Rull (2003), Poschke, Kaymak, and Leung (2021).
- Empirical evidence on heterogeneous effects of monetary policy: Amberg, Jansson, Klein, and Rogantini Picco (2022), Andersen, Johannesen, Jorgensen, and Peydró (2021), Chang and Schorfheide (2022), Slacaleky, Tristani, and Violante (2020), Holm, Paul, and Tischbirek (2021)).



# Literature

- Interactions between inequality and monetary policy: Bilbiie, Kanzig, and Surico (2019), Auclert (2019), Melcangi and Sterk (2020), Luetticke (2021), Kekre and Lenel (2022), Bayer, Luetticke, Pham-Dao, and Tjaden (2019).
- Heterogeneous Agents and the macroeconomy: Alves, Kaplan, Moll, and Violante (2020), Debortoli and Galì (2022), Bilbiie (2021).

Model

# Households

- Let  $\psi_t$  be the cross-sectional distribution over the state space  $X$ .
- Markets are incomplete, given states  $x = (a, e)$  households solve

$$\begin{aligned} \max_{(c_t)} \quad & \mathbb{E}_0 \int_0^\infty e^{-\rho t} u(c_t, n_t) dt, \\ \text{s.t.} \quad & da_t = (w_t e_t n_t + r_t a_t + d_t - c_t) dt, \\ & a_t \geq -\phi. \end{aligned}$$

- Households trade bonds and accumulate capital.
- Firms' profits  $D_t$  are distributed according to  $d_t = (e_t / \int_X e_t d\psi_t) D_t$ .
- High-income households receive a larger share of profits.

## Wage and price rigidities

- Households supply a continuum of labor services (imperfect substitutes).
- Unions set nominal wages by maximizing the average welfare.

$$\pi_{w,t} \left( r_t - \frac{\dot{N}_t}{N_t} \right) = \dot{\pi}_{w,t} + \frac{\epsilon_w}{\Psi_w} \left( \frac{v'(N_t)}{u'(C_t)} - w_t \mu_w^{-1} \right).$$

- Intermediate input producers operate under monopolistic competition.
- Intermediate producers set prices to maximize profits.

$$\pi_t \left( r_t - \frac{\dot{Y}_t}{Y_t} \right) = \dot{\pi}_t + \frac{\epsilon_p}{\Psi_p} (mc_t - \mu_p^{-1}).$$

## 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

$$V_0 := \max_{\iota_t} \int_0^\infty \left[ \exp\left(-\int_0^t r_s ds\right) \left( (r_t^k - \iota_t)K_t - \chi_t(\iota_t) \right) \right] dt$$

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  $i_t = r + \phi_\pi \pi_t + v_t$  with an interest rate policy  $\{v_t\}$ .

# Equilibrium

**Definition 1.** The equilibrium is  $(c_t, n_t), (K_t, N_t, Y_t, I_t, C_t, D_t), (r_t, q_t, w_t, \pi_t, \pi_{w,t}) :$

1. Households and unions maximize utility.
2. Firms maximize profits and minimize costs.
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.

Nonlinear system of PDEs solved numerically with global methods.

# Parametrization

# Calibration

- Two challenges:
  - Match wealth distribution including its Pareto tail.
  - Jointly match aggregate wealth holdings and average MPC.
- To relax this trade-off:
  - Extraordinary earning states as in [Castañeda, Díaz-Giménez, and Ríos-Rull \(2003\)](#), [Poschke, Kaymak, and Leung \(2021\)](#).
  - Calibrate to financial wealth. Alternatives: heterogeneous discount rates, heterogeneous asset returns, two-assets.
- Functional forms: CRRA utility function, Cobb-Douglas production function, quadratic investment, price, and wage adjustment costs.



# Calibration

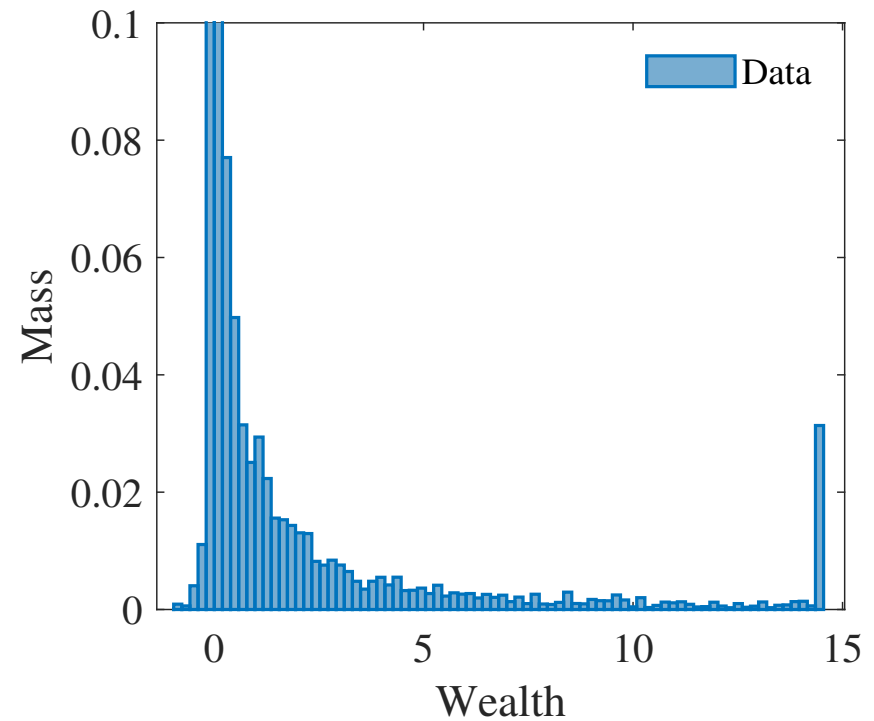
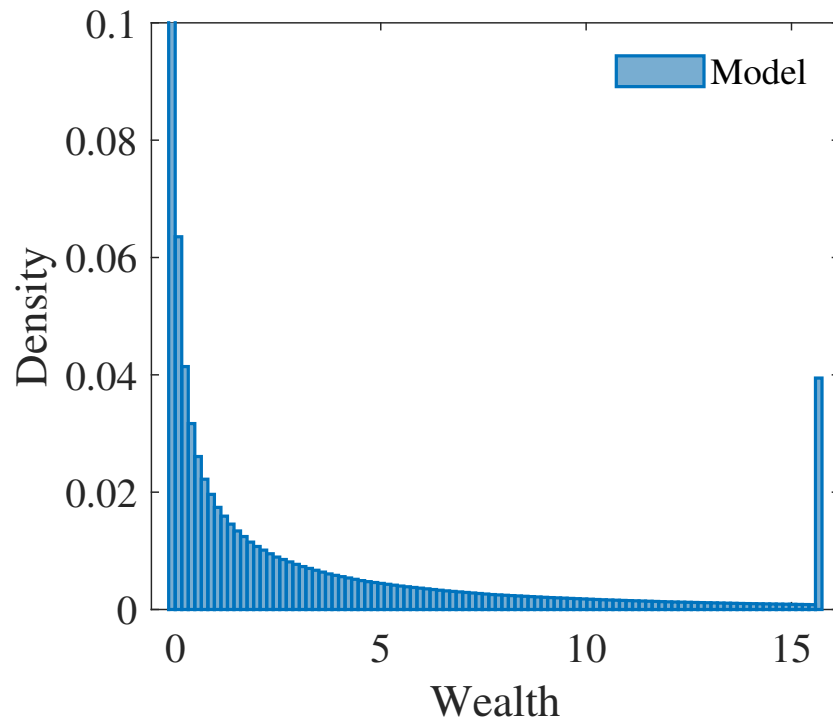
- Externally calibrated: Preferences, production and New Keynesian block.
- Internally calibrated parameters:  $\rho, e_1, e_2, \lambda_1, \lambda_2, \theta_1, \kappa$ .
- Targeted moments:
  - Wealth-output ratio, aggregate return to wealth.
  - Gini coefficients of earnings and wealth.
  - Top 0,1%,1% earning shares.
  - Overall fraction of low-liquidity households.
  - Peak of real interest rate response.

## Model fit

Table 1: Targeted statistics

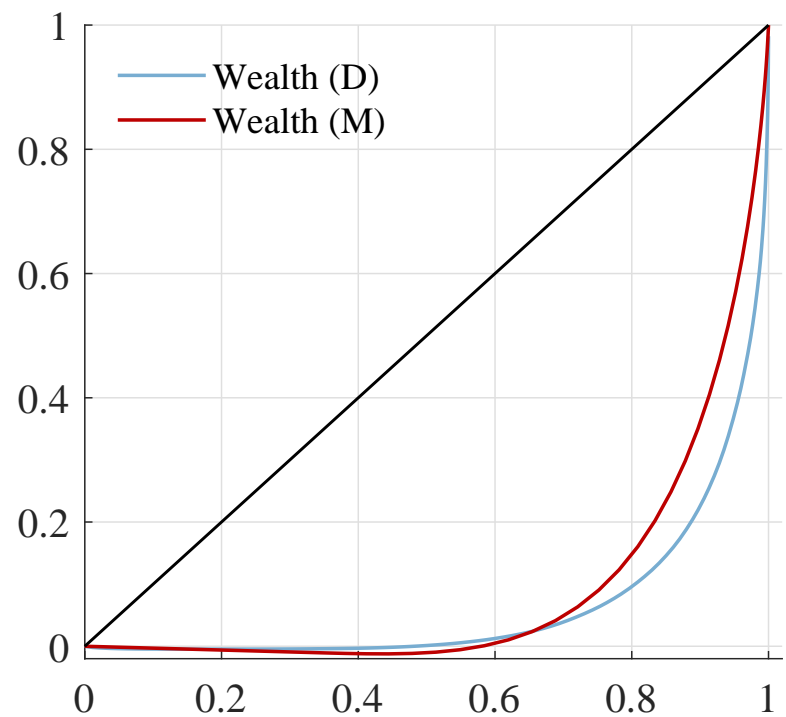
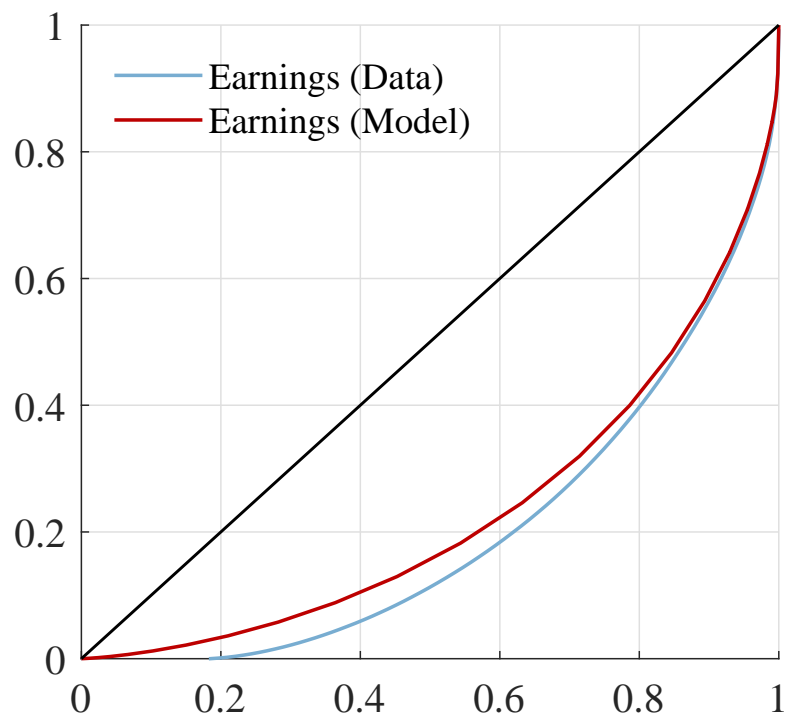
Targeted Statistics	Data	Model
Financial wealth-output ratio	1.42	1.6
Aggregate return on wealth	.065	0.74
Fraction with $a = \phi$	0.3	0.32
Gini wealth	0.87	0.81
Gini earnings	0.59	0.54
Top 0.1% earnings share	6	6
Top 1% earnings share	16	15.5

# Wealth Distribution

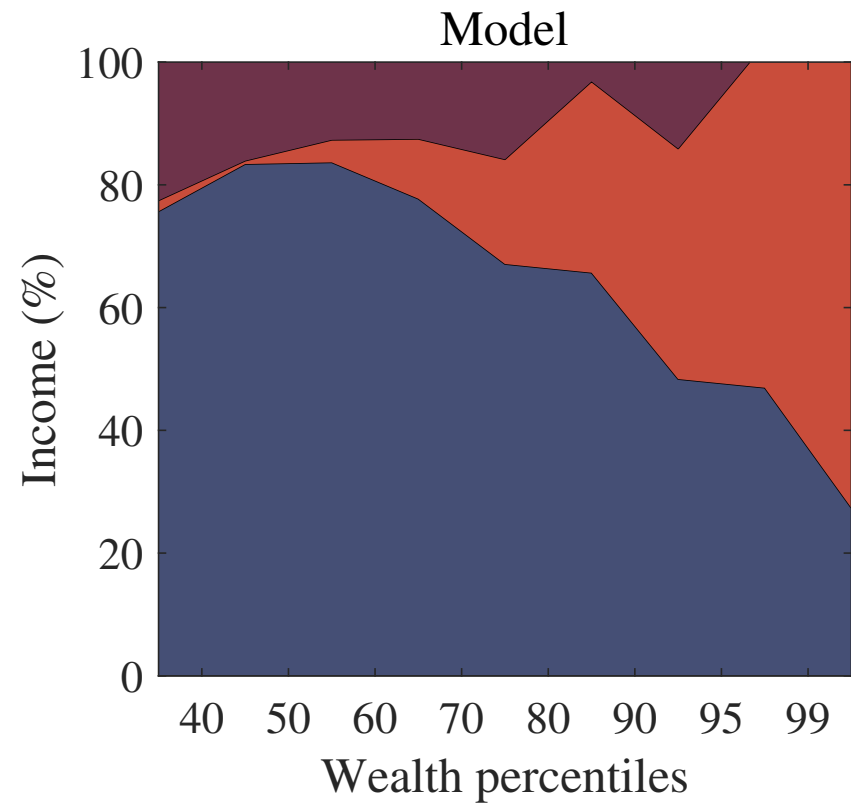
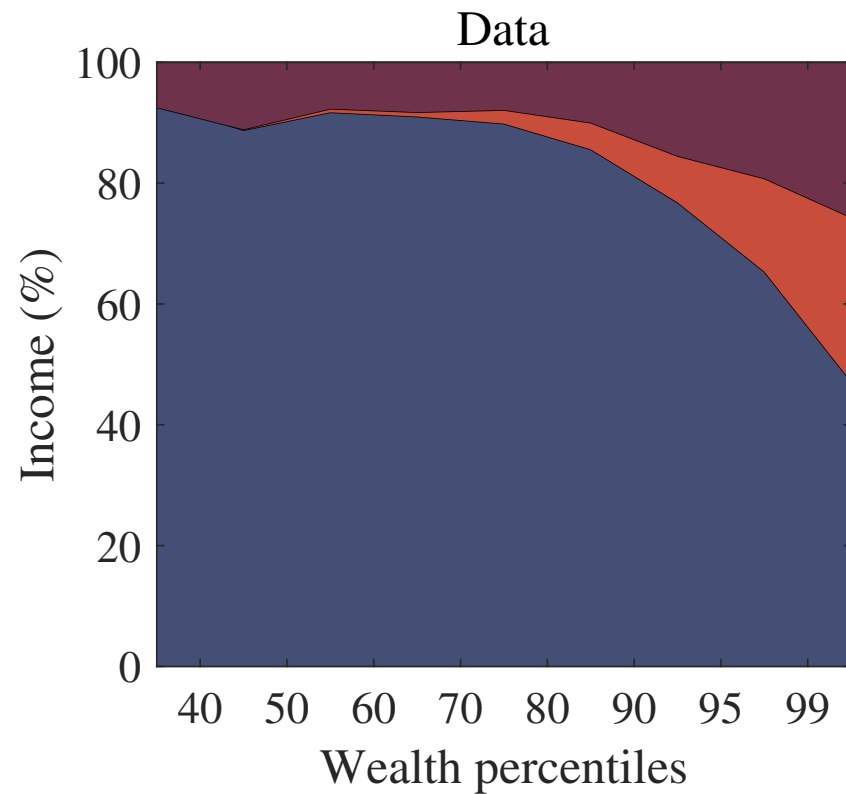


- Mean wealth 2.5 (data) and 2.7 (model), median wealth 0.17 and 0.12.
- 90th percentile 5 and 8, 95th pct 10 and 13, 99th pct 34 and 28.

# Marginal distributions

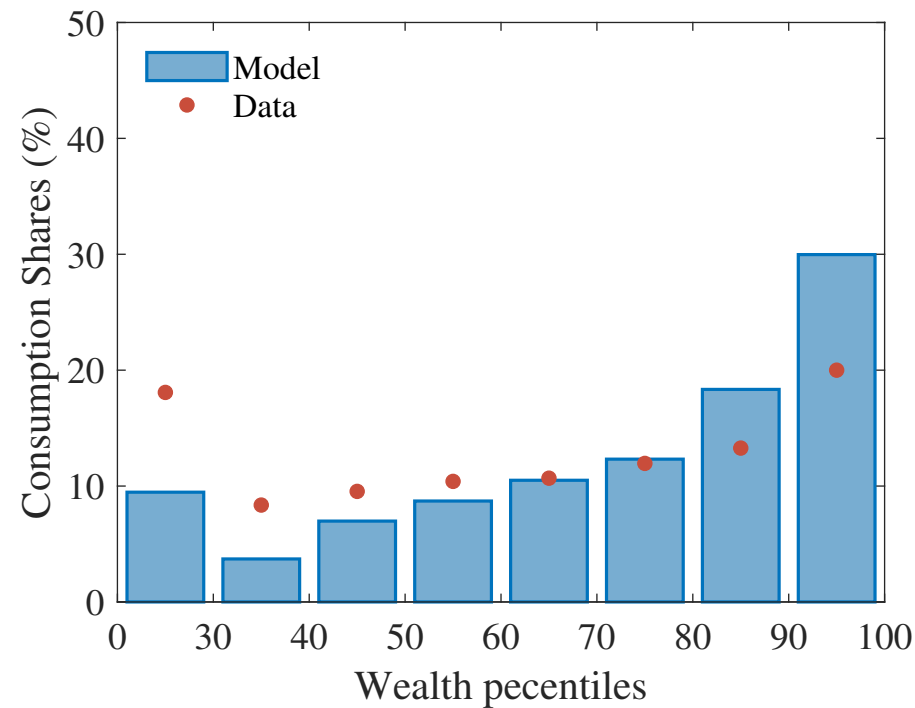


# Income composition



■ Labor Income ■ Financial Income ■ Business Income

# Consumption shares



- Nondurable consumption and financial wealth from PSID in 2004.
- The model generates increasing shares but overstate consumption at the top.

# Marginal propensities to consume

- Average fraction of a transfer consumed in a quarter or in a year
  - Empirical benchmark of 15-25% over one quarter out of a \$500 transfer.
  - In the model MPC of 20% over one quarter out of a \$500 transfer.
  - Quantitative HANK models at lower bound of empirical estimates.<sup>1</sup>
  - MPC at the top 10% of the wealth distribution is 3%.

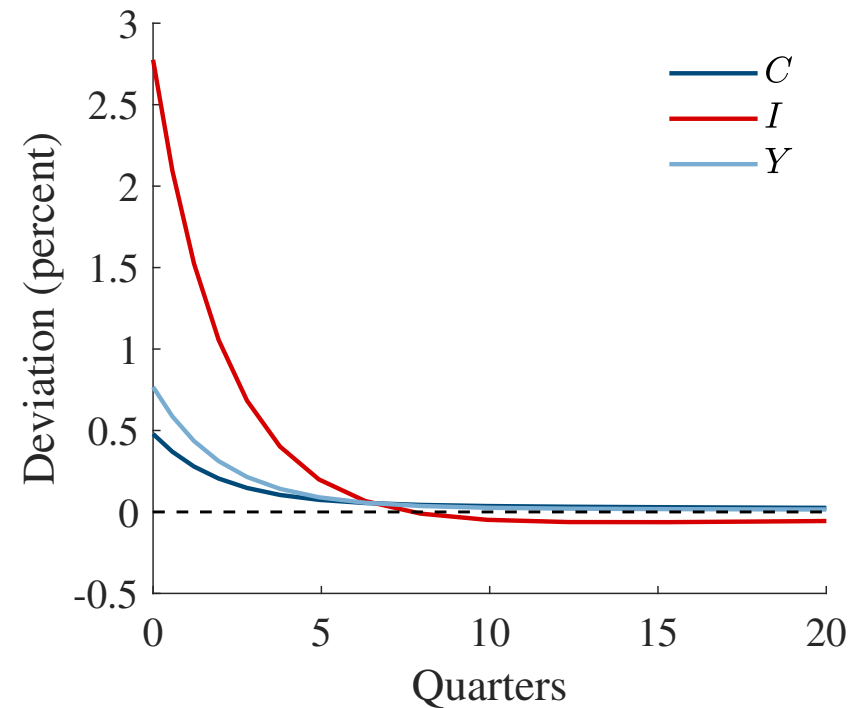
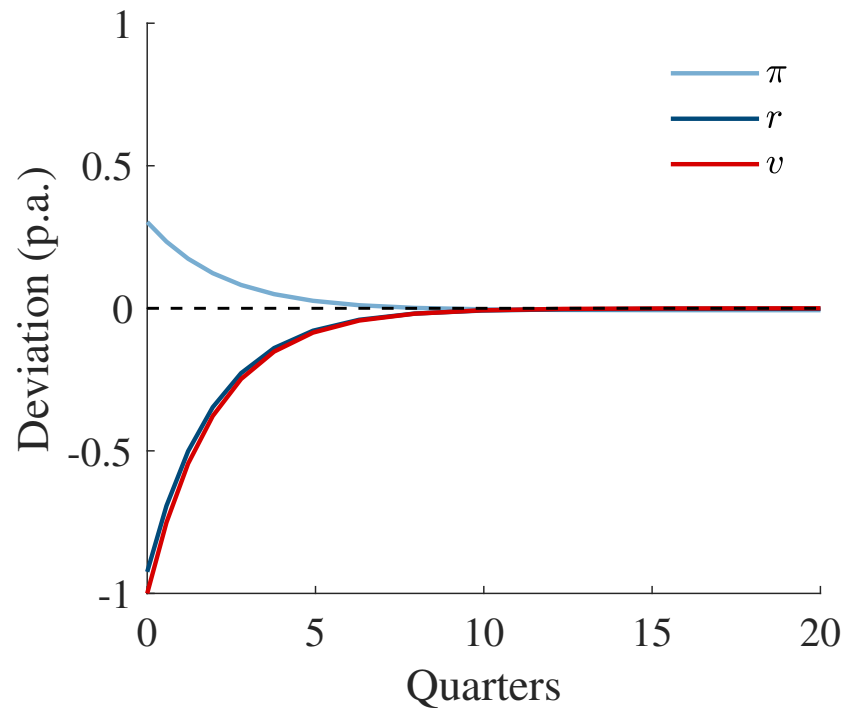
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<sup>1</sup>Respectively Gornemann, Kuester, and Nakajima (2021), Hagedorn, Manovskii, and Mitman (2019), Kaplan, Moll, and Violante (2018) find 15% (Q), 33% (Y), 12% (Q), 40% (Y), and 16% (Q) 33% (Y). These studies typically set a quarterly empirical 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

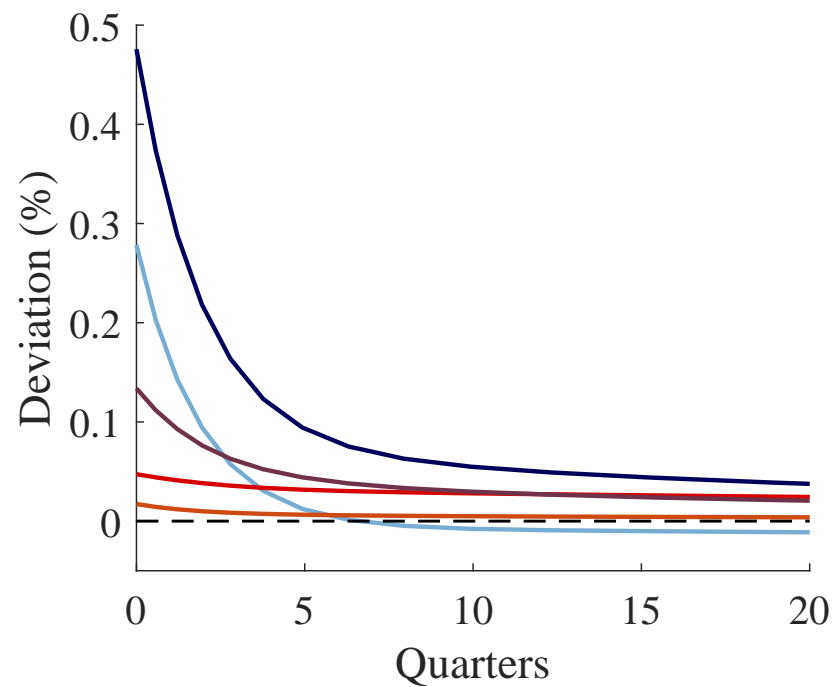
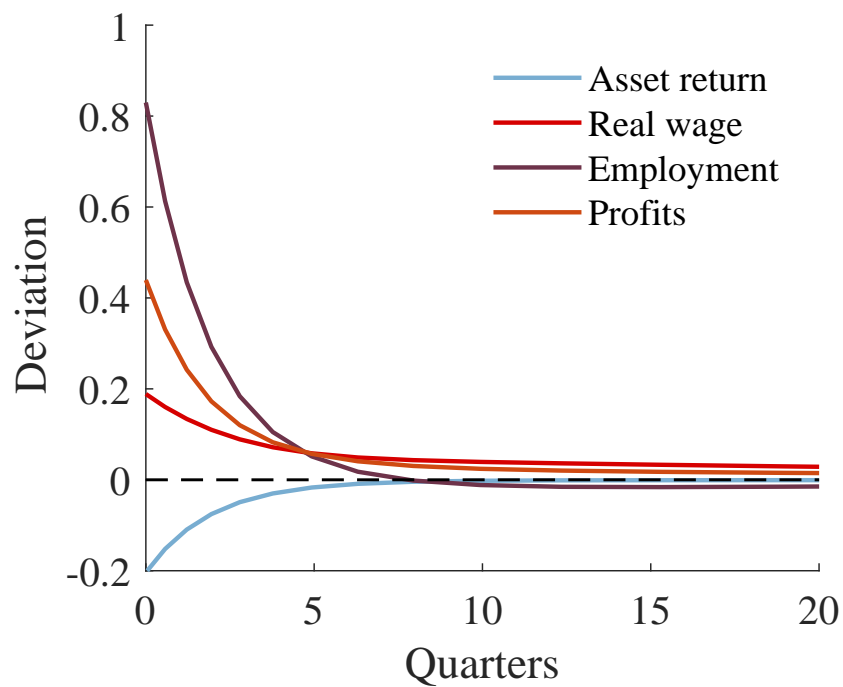


# Macro responses to monetary policy



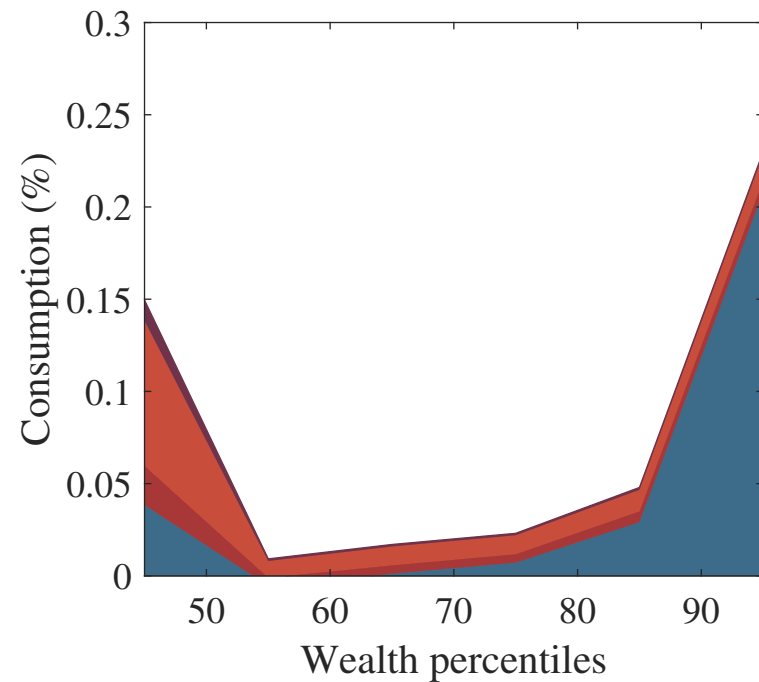
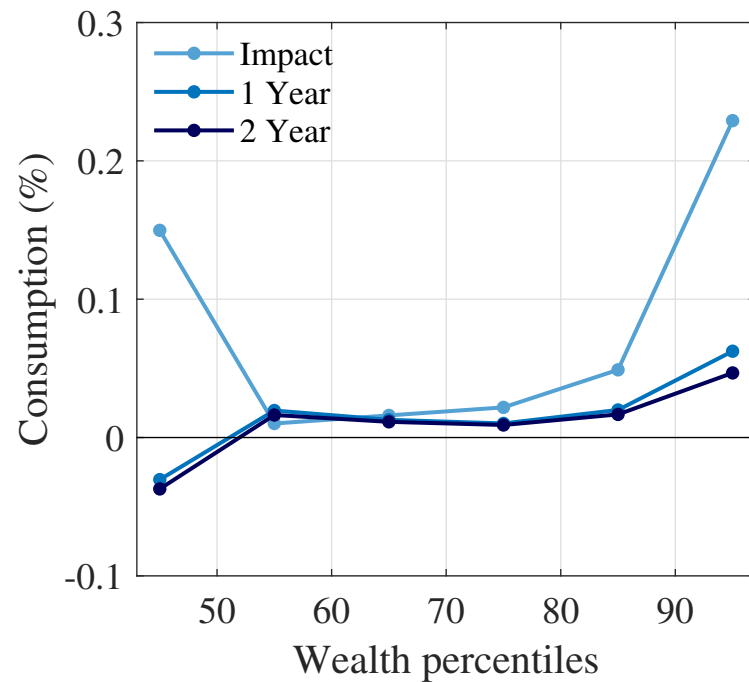
- IRFs to a 25 basis point or 1% annualized interest rate cut.
- Match volatility but overstate magnitudes.

# Transmission mechanism



$$dC_t = \int_0^\infty \frac{\partial C_t}{\partial r_s} dr_s ds + \int_0^\infty \left( \frac{\partial C_t}{\partial w_s} dw_s + \frac{\partial C_t}{\partial n_s} dn_s + \frac{\partial C_t}{\partial d_s} dd_s \right) ds.$$

# Consumption responses



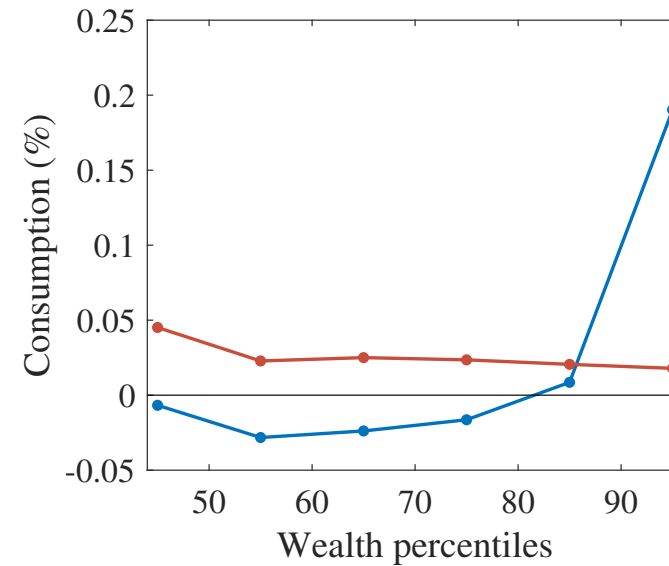
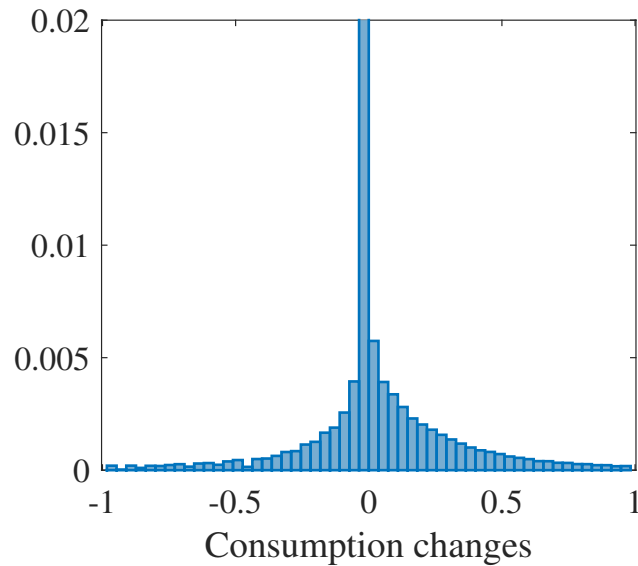
- Households at the top have a strong impact on aggregate consumption.
- The response at the top is 0.16% without the top 1%.

## Wealth dynamics

- Consider the consumption response to asset returns  $\{r_t\}$ .
- On impact higher equity prices leads to capital gains  $\uparrow a_t := q_t k_t$ .
- Shift the wealth distribution  $\Rightarrow$  income and wealth gains.

Consumption response	Total	No capital gains	Amplification
Aggregate consumption	0.27	0.15	0.12
Top 10% consumption	0.21	0.02	0.19

# Wealth dynamics




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# Inflationary shocks

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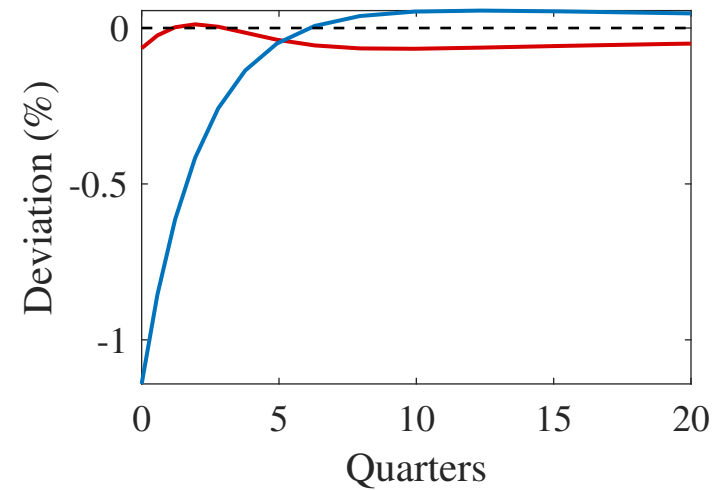
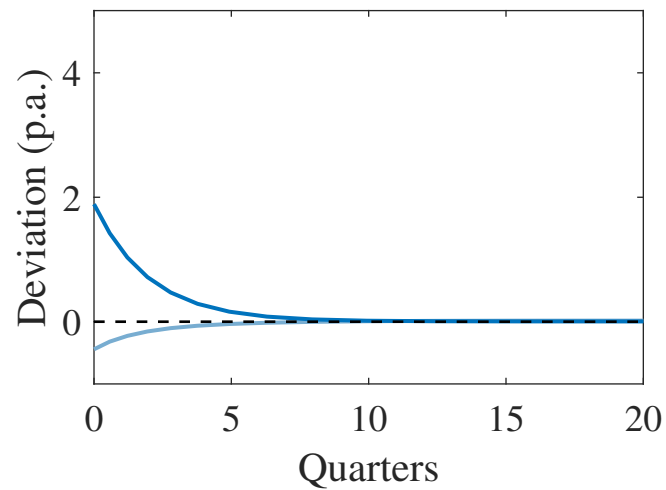
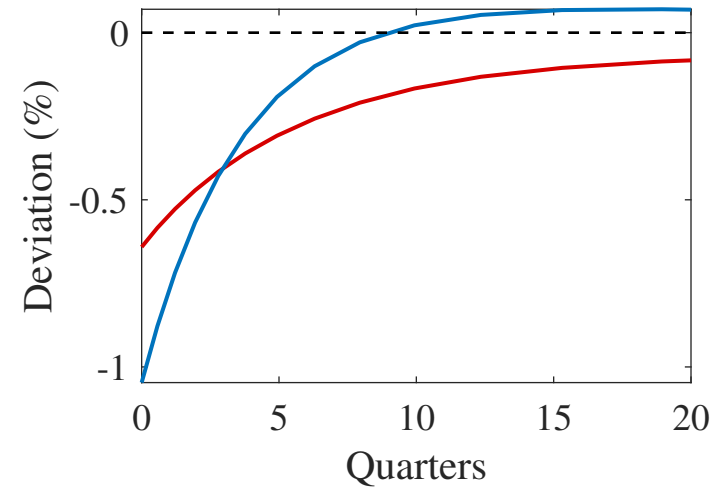
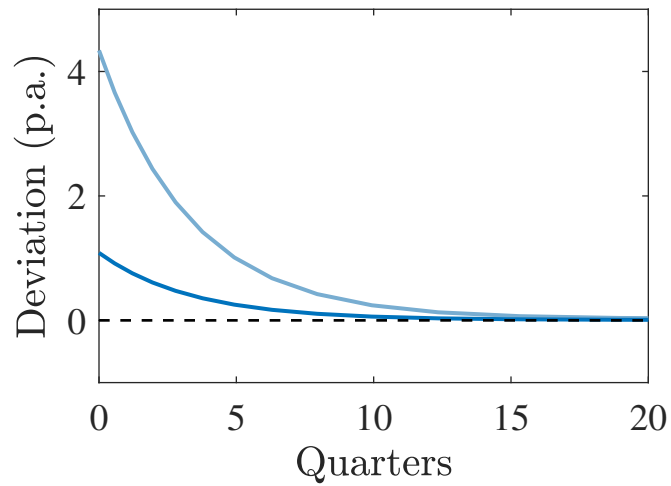
At least part of the return of inflation is attributed to supply shocks

- Supply chain bottlenecks and global trade crisis.
- Shortages of labor, materials, and energy.
- [Amiti, Heise, Karahan, and Şahin \(2022\)](#).

Two important consequences from the 2021 inflation I can study in the model:

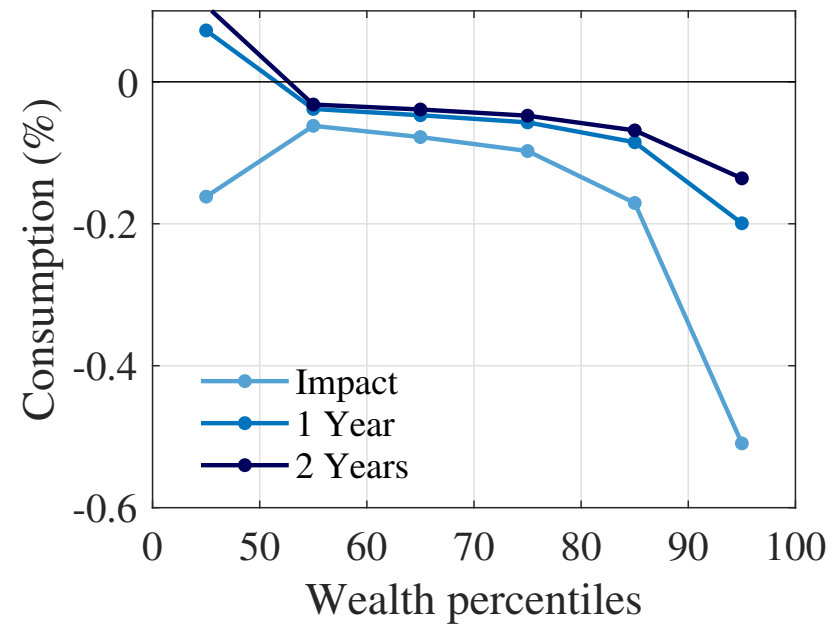
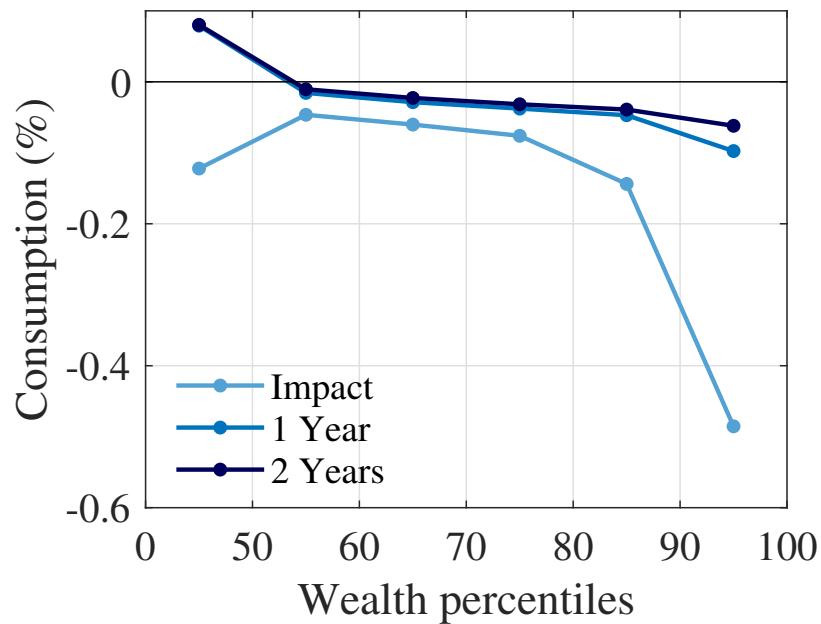
- Reduction in real wages in the presence of rigid nominal incomes.
- Reduction in equity prices.

# Inflationary shocks





# Inflationary shocks



- Macroeconomic shocks with an impact on labor and financial markets.

# Conclusion

Main messages:

- Wealth concentration at the top matter for aggregate dynamics:
- Top wealth groups have higher exposure and consumption shares.
- Wealth dynamics amplify the aggregate consumption response.

Extensions:

- Unequal incidence of capital gains.
- Heterogeneous asset returns.

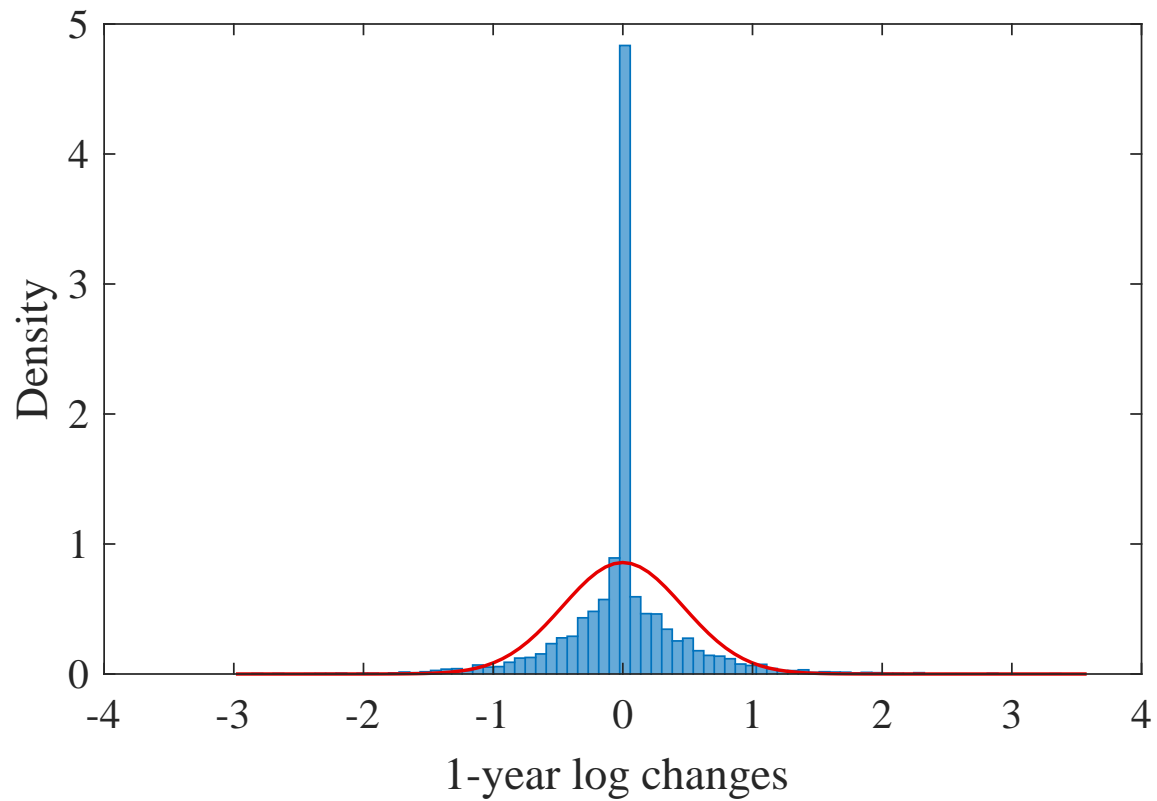
Thank you!

# Appendix

Parameter	Description	Value	Source
<i>Households</i>			
$\gamma$	CRRA/Inverse IES	1	External
$\nu$	Inverse Frisch elasticity	1	External
$\phi$	Borrowing limit	0.5	External
$\lambda_e$	Arrival rate normal states	1	External
$\nu_e$	Mean reversion coeff.	0.0263	External
$\sigma_e$	S. d. of innovations	0.2	External
<i>Firms and policy</i>			
$\theta$	Capital elasticity	0.33	External
$\delta$	Depreciation rate (p.a.)	5%	External
$\Psi_p, \Psi_w$	Adjustment cost	100	External
$\epsilon_p, \epsilon_w$	Elasticities of substitution	10	External
$\phi_\pi$	Taylor coeff.	1.25	External

Parameter	Description	Value	Source
<i>Households</i>			
$\rho$	Individual discount rate (p.a.)	12%	Internally calibrated
$A_{illiq}$	Illiquid asset	7	Internally calibrated
$\lambda_d$	Profit disribution parameter	0.7	Internally calibrated
$\theta_1$	Transition probability to $e_1$	0.6	Internally calibrated
$\lambda_1$	Arrival rate top states	0.0028	Internally calibrated
$\lambda_2$	Arrival rate leave top states	0.8	Internally calibrated
$e_1, e_2$	Top earnings states	20, 70	Internally calibrated
<i>Firms and policy</i>			
$\kappa$	Investment adjustment cost	16	Internally calibrated

# Income dynamics



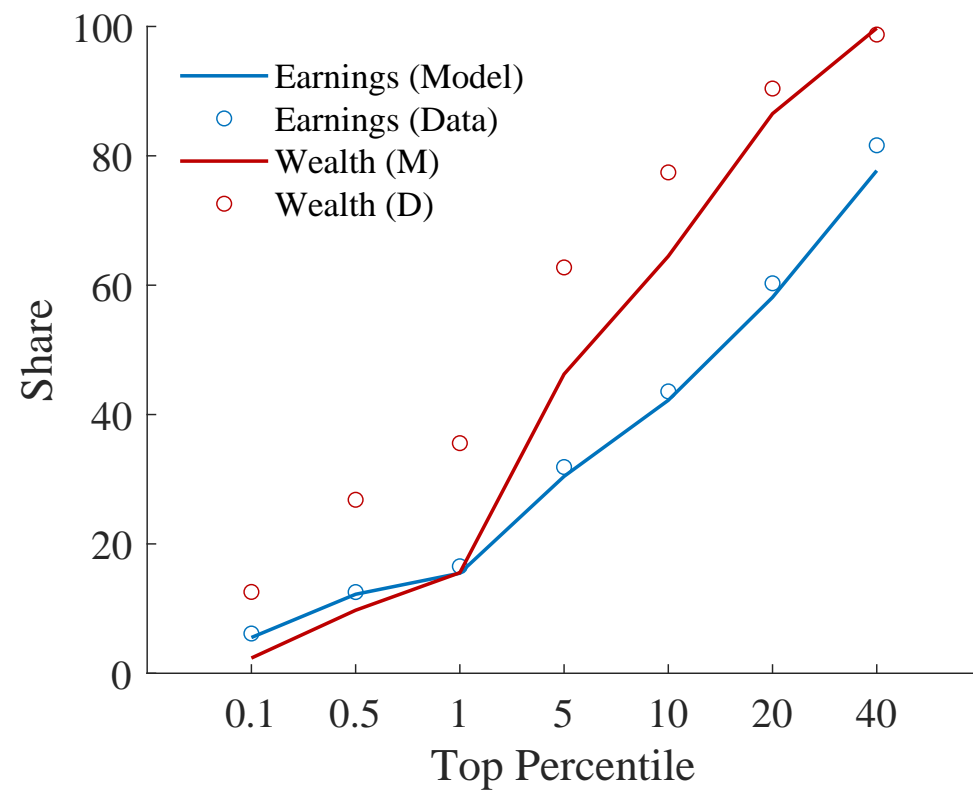
- The estimated kurtosis is around 9 in the model and 17.8 in the data.

## Wealth percentiles

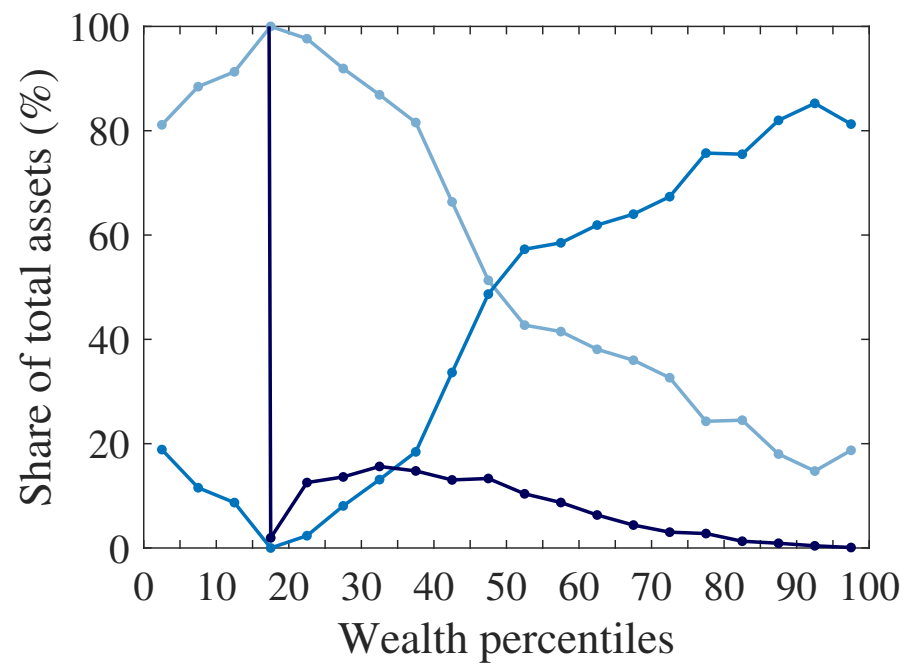
Wealth statistics	Data	Model	Wealth statistics	Data	Model
Mean wealth	2.5	2.7	90th percentile	5	8
Median wealth	0.17	0.12	95th percentile	10	13
75th percentile	1.3	2.3	99th percentile	34	28



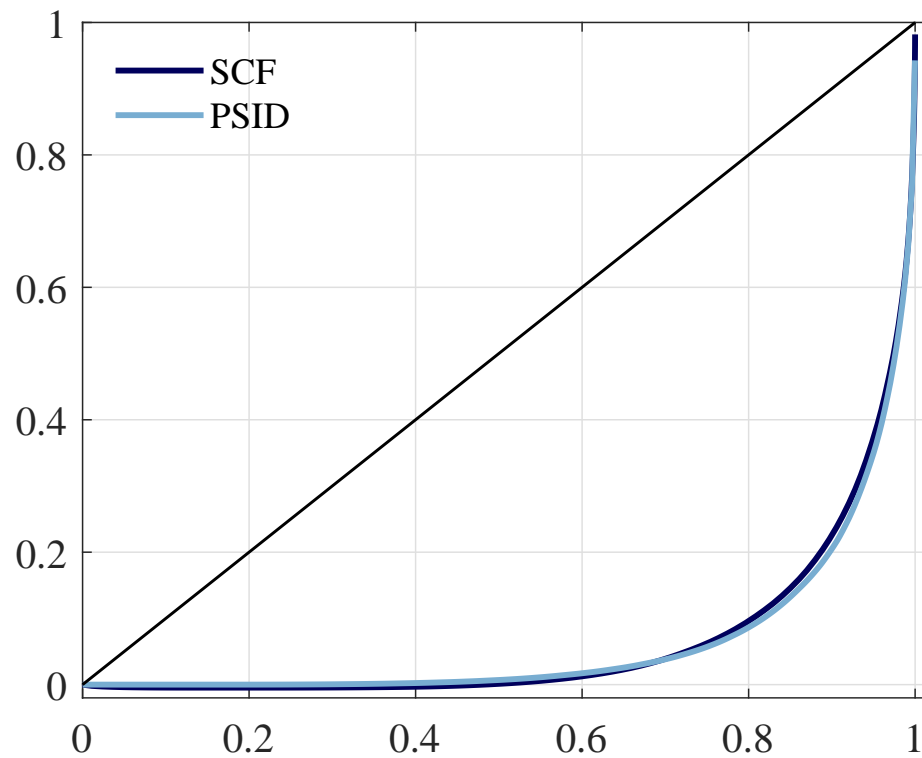
# Top shares

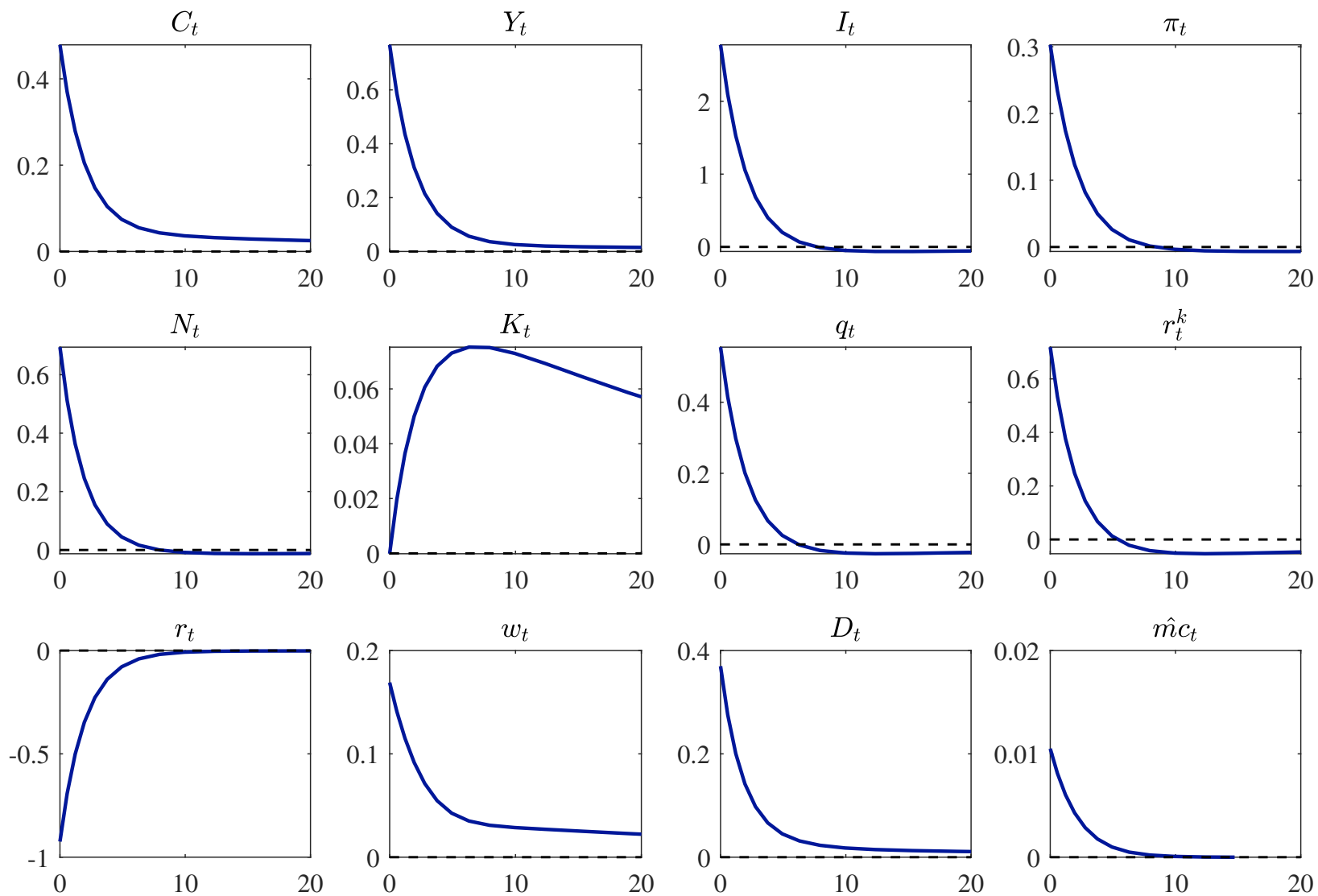


# Wealth composition



# Wealth in the SCF and PSID





# References

- Alves, Felipe, Greg Kaplan, Benjamin Moll, and Gianluca Violante (2020). “A Further Look at the Propagation of Monetary Policy Shocks in HANK”. Working Paper.
- Amberg, Niklas, Thomas Jansson, Mathias Klein, and Anna Rogantini Picco (2022). “Five Facts about the Distributional Income Effects of Monetary Policy”. In: *American Economic Review: Insights* 4, pp. 289–304.
- Amiti, Mary, Sebastian Heise, Fatih Karahan, and Ayşegül Şahin (2022). “Inflation Strikes Back: The Return of Wage to Price Pass-Through”. Working Paper.
- Andersen, Asger Lau, Niels Johannesen, Mia Jorgensen, and José-Luis Peydró (2021). “Monetary Policy and Inequality”. Working Paper.
- Auclert, Adrien (2019). “Monetary Policy and the Redistribution Channel”. In: *American Economic Review* 109 (6), pp. 2333–2367.

- Bayer, Christian, Ralph Luetticke, Lien Pham-Dao, and Volker Tjaden (2019). “Precautionary Savings, Illiquid Assets, and the Aggregate Consequences of Shocks to Household Income Risk”. In: *Econometrica* 87, pp. 255–290.
- Bilbiie, Florin (2021). “Monetary Policy and Heterogeneity: An Analytical Framework”. Working Paper.
- Bilbiie, Florin, Diego Kozicki, and Paolo Surico (2019). “Capital, Income Inequality, and Consumption: the Missing Link”. Working Paper.
- 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-Víctor Ríos-Rull (2003). “Accounting for the U.S. Earnings and Wealth Inequality”. In: *Journal of Political Economy* 111 (4), pp. 818–857.

Chang, Minsu and Frank Schorfheide (2022). “On the effects of monetary policy shocks on earnings and consumption heterogeneity”. CEPR Discussion Paper No. DP17049.

Debortoli, Davide and Jordi Galí (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 Paper.

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

Hagedorn, Marcus, Iourii Manovskii, and Kurt Mitman (2019). “The Fiscal Multiplier”. Working Paper.

Holm, Martin, Pascal Paul, and Andreas Tischbirek (2021). “The Transmission of Monetary Policy under the Microscope”. Working Paper.

- Kaplan, Greg, Benjamin Moll, and Gianluca Violante (2018). “Monetary Policy According to HANK”. In: *American Economic Review* 108 (5), pp. 697–743.
- Kekre, Rohan and Moritz Lenel (2022). “Monetary Policy, Redistribution, and Risk Premia”. Working Paper.
- Lee, Donggyu (2021). “The Effects of Monetary Policy on Consumption and Inequality”. Working paper.
- Luetticke, Ralph (2021). “Transmission of Monetary Policy with Heterogeneity in Household Portfolios”. In: *American Economic Journal: Macroeconomics* 13 (2), pp. 1–25.
- Melcangi, Davide and Vincent Sterk (2020). “Stock Market Participation, Inequality, and Monetary Policy”. Working Paper.
- 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 Paper.

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.

Wolf, Christian (2021). “Interest Rate Cuts vs. Stimulus Payments: An Equivalence Result”. Working Paper.