Sources of U.S. Wealth Inequality in the Past, Present, and Future and Past, Present, and Future Marginal Propensities to Consume

Joachim Hubmer, Per Krusell, Tony Smith
UPenn, IIES, Yale

Graduate Center@CUNY, February 2021

Extremely brief history of modern macro

- frustration with keynesian economics on methodological grounds:
  - lucas critique
  - seemingly unstable relationships
  - hard to conduct welfare analysis
- lucas, sargent, wallace, etc. proposed to build new macroeconomic models based on *microeconomic foundations*
- for decades, models remained very simple and stylized
  - toy models, i.e., not quantitatively serious
  - no econometric evaluation
  - markets (mostly) work
  - representative agent
- representative-agent assumption most challenging to drop
- conceptual, theoretical, and computational advances since mid 1990s have now born fruit: *heterogeneous-agent macro*

Heterogeneous-agent macro

- now seems ubiquitous
  - business cycles
  - monetary economics
- ...and less and less difficult to study (numerically)
- it has delivered
  - a framework with higher propensities to consume
  - a framework for analyzing equilibrium inequality (in consumption, wealth, etc.)
- in this piece we evaluate the benchmark model's quantitative implications of these over time
  - what is/has been the evolution of mpcs?
  - what is/has been the evolution of wealth inequality?

MPCs

simplest possible consumption-saving model, in macroeconomic steady state:

$$\max_{\{c_t, a_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

s.t.

$$c_t + k_{t+1} = k_t(1 + r - \delta) + w \quad \text{for all } t$$

in a steady state, $\beta(1 + r - \delta) = 1$, so we obtain, for all t,

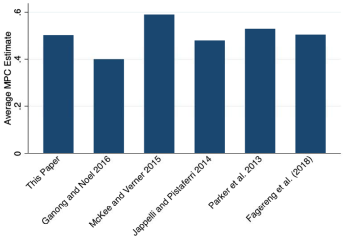
$$k_t = k_0 \quad \text{and} \quad c_t = k_0(r - \delta) + w$$

hence MPC out of wealth is $r - \delta$: super-small!

this is a robust result—so what does the data say?

Average MPCs

Figure A7: Estimates of the Average Marginal Propensity to Consume in the Literature

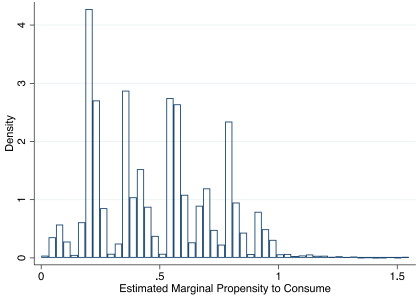


Notes: The estimates for this paper, labeled "baseline," are those plotted Figure 2. Ganong and Noel (2017) estimate the MPC at the onset of unemployment using balance sheet data from JPMorgan Chase & Co.. See Appendix Table 5 in their paper. Jappelli and Pistaferri (2014) use survey data in Italy to illicit MPCs out of transitory income shocks. Parker et al. (2013) identify the consumption response to the 2008 tax rebates. See Table 2 in their paper. McKee and Verner (2015) use Nielsen panel data to estimate the MPC out of unemployment insurance benefits.

cut/paste from Patterson (2019)

Dispersion

Figure 3: The Distribution of Estimated Marginal Propensities to Consume



Notes: See Appendix Table A7 for the coefficients that underlie this imputation. Negative imputed MPCs are set to 0. Consumption is measured using total consumption, imputed using the method in Blundell et al. (2008). Income is measured using individual labor income. The instrument for income changes is unemployment. The sample includes the set of workers who were employed two years before the current year. The sample in the PSID excludes observations with more than a 400 percent change in food consumption or income over a given two-year period. Lagged income is measured as the average labor marker earnings of the individual in $t-2$ and $t-3$. Regression includes year-by-state fixed effects and observations from 1992 to 2013.

more cut/paste from Patterson (2019)

Heterogeneous-agent models

the standard model (huggett-aiyagari)

- has idiosyncratic, partially uninsurable shocks
- non-trivial wealth distribution
- and mpc heterogeneity

high mpcs for “people in need”, i.e., those with

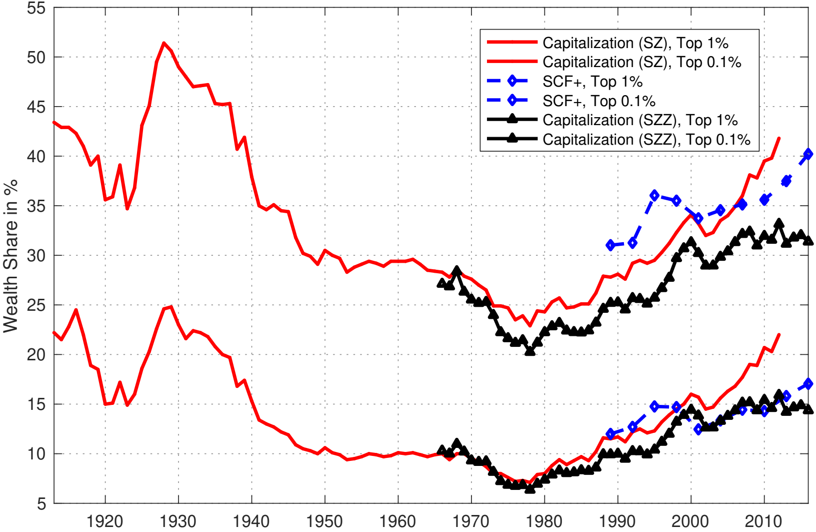
- low income realizations
- low liquid wealth
- so with low wealth (esp. close to borrowing constraint)

in this paper: for a quantitative model of this kind, i.e., one that

- matches wealth distribution on average
- and over time

ask whether the mpc distribution looks like in the data, how it has evolved, and how it will evolve

Evolution of top wealth inequality in the U.S.



Data: Kopczuk 2015, Saez & Zucman 2016, Smith, Zidar, and Zwick (2019).

Goals, more specifically

1. evaluate basic model against the wealth data
   - examine a quantitative macro model with sharp implications for the distribution of wealth: can it match the data?
     - its average shape
     - its evolution over time
   - in particular, study the role of a number of wealth-inequality determinants: marginal tax rates, preferences, earnings, and portfolio returns—all varying across households and over time
   - we tie all of the parameters to micro data; does the benchmark framework do an adequate job?
2. examine (the evolution of the) implied mpc distribution

Overview: findings

1. wealth distribution evaluation
    - average shape:
        - yes
        - due to portfolio heterogeneity, very small (or no) role for preference heterogeneity
    - dynamic evolution:
        - yes, except for very, very top
        - lower tax progressivity plays key role for cumulative
        - portfolio heterogeneity and asset prices key for swings
        - earnings variance plays little role
    - predictions for future: slow but significant further widening of inequality
2. mpc distribution
    - MUCH higher on average than in RA model, but perhaps too low, significant heterogeneity

Quantitative model

- extended Aiyagari 1994 framework:
  - log labor income as sum of persistent and transitory component; adjusted at the top to match the observed Pareto tail in labor income
  - transitory component incorporates zero earnings state
  - heterogeneous returns: reduced-form portfolio choice, returns increasing in wealth and have i.i.d. idiosyncratic component
  - stochastic discount factor follows AR(1) process (Krusell-Smith 1998 extended)
  - progressive taxation: use data on federal effective tax rates for 11 income brackets (Piketty & Saez 2007)
  - parsimonious modeling of social safety net: 60% of tax revenues rebated as lump-sum transfers
- time-varying tax system, labor income process, and excess returns
- finding: saving rates (key consumer choice) very robust and unresponsive to all drivers

Return heterogeneity

- total return given asset holdings a_t is

$$\underline{r}_t + r_t^X(a_t) + \sigma^X(a_t)\eta_t$$

- $\underline{r}_t$ is endogenous
- $r_t^X(\cdot)$ and $\sigma^X(\cdot)$ are exogenous excess return schedules (mean and st.dev.), taken from the data
- η_t is an i.i.d. standard normal shock
- rationalize as reduced form of portfolio choice model

The consumer's problem

$$V_t(x_t, p_t, \beta_t) = \max_{a_{t+1} \geq \underline{a}} \{u(x_t - a_{t+1}) + \beta_t \mathbb{E}\left[V_{t+1}(x_{t+1}, p_{t+1}, \beta_{t+1}) | p_t, \beta_t\right]\}$$

$$\text{subject to: } x_{t+1} = a_{t+1} + y^{ord}_{t+1} - \tau^{ord}_{t+1}(y^{ord}_{t+1}) + (1 - \tau^{cg}_{t+1}) y^{cg}_{t+1} + T_{t+1}$$

$$y^{ord}_{t+1} = (\underline{r}_{t+1} + r^X_{t+1}(a_{t+1})) a_{t+1} + w_{t+1} l_{t+1}(p_{t+1}, \nu_{t+1})$$

$$y^{cg}_{t+1} = \sigma^X(a_{t+1}) \eta_{t+1} a_{t+1}$$

x_t cash on hand
p_t persistent component of earnings process
$l_{t+1}(\cdot, \cdot)$ efficiency units of labor, moves over time
ν_{t+1} transitory earnings shock
$\tau^{ord}_t(\cdot)$ progressive tax on ordinary income, moves over time
τ^{cg}_t flat capital gains tax
T_t lump-sum transfer

Whence wealth inequality?

- a dynasty model with complete markets, identical (standard) preferences and returns: generates no long-run wealth inequality beyond initial conditions $=>$ inadequate model of wealth inequality
- incomplete markets added: has predictions, i.e., generates unique distribution in steady state
- Aiyagari (1994) delivers far too little wealth inequality: Gini of wealth becomes that of earnings (in data: $>>$)
- the literature has struggled with this (no clear consensus)
  - finite lives/OG?
  - preference heterogeneity
  - returns increase with wealth, entrepreneurs
  - different earnings processes
- here:
  - no "tricks": just feed in micro observations, works well
  - portfolio heterogeneity important but next step is to explain it!

Nontrivial mechanisms at top of the distribution

- in the data, both earnings and wealth distribution have Pareto shapes at the top
  - again, wealth has a fatter tail (lower Pareto coefficient)
- we calibrate earnings as in Aiyagari but add Pareto distribution at the top—calibrated to data
  - this generates Pareto in wealth but with same coefficient $=>$ too thin a tail
- however: stochastic returns or βs generate a Pareto tail in the wealth distribution endogenously!
  - follows from random growth theory (Kesten 1973, see also Gabaix 2009)
  - mechanism has been employed by Benhabib, Bisin and Zhu 2015, Nirei & Aoki 2015, Piketty & Zucman 2015

Calibration strategy

1. calibrate earnings process, tax rates, return process, social safety net to observables
2. choose randomness in discount factor residually so as to replicate the wealth distribution in the initial steady state (1967)

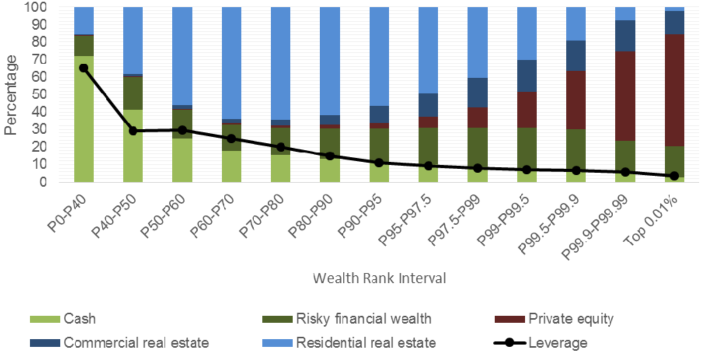
note: focus on tail coefficient alone misleading—even if, say, the richest 10% can be described exactly by a Pareto distribution, the shape parameter only tells us how wealth is distributed *within* these 10%, not how much wealth the top 10% control as a fraction of total wealth

Calibration: return process

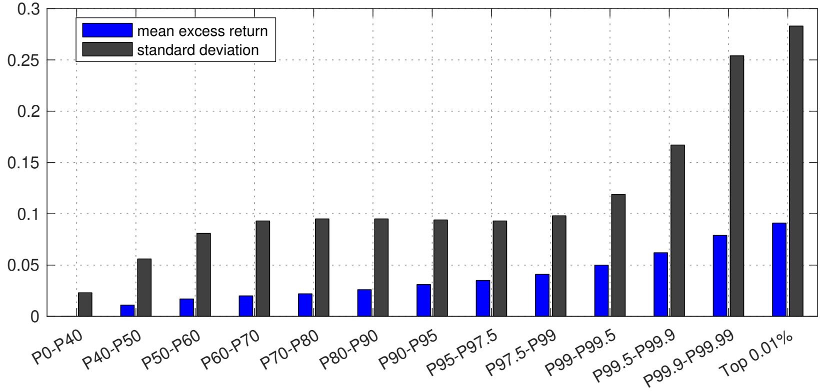
$$r_t^X(a_t) = \sum_{c \in C} w_c(a_t)\left(\bar{r}_{c,t} + \tilde{r}_c^X(a_t)\right)$$
$$\left(\sigma^X(a_t)\right)^2 = \sum_{c \in C}\left(w_c(a_t)\tilde{\sigma}_c^X(a_t)\right)^2$$

- asset classes C: risk-free, public equity, private equity, housing
- $\bar{r}_{c,t}$: aggregate return on asset class c (U.S. data), time-varying
- fixed over time, based on Swedish administrative data from Bach, Calvet, Sodini (2016):
  - $w_c(\cdot)$: portfolio weights
  - $\tilde{r}_c^X(\cdot)$: within asset class return heterogeneity
  - $\tilde{\sigma}_c^X(\cdot)$: asset c idiosyncratic return standard deviation

Portfolio holdings



Schedule of excess returns



Data sources: Bach, Calvet, Sodini (2019); Kartashova (2014); Jorda, Knoll, Kuvshinov, Schularick, Taylor (2019); Case-Shiller.

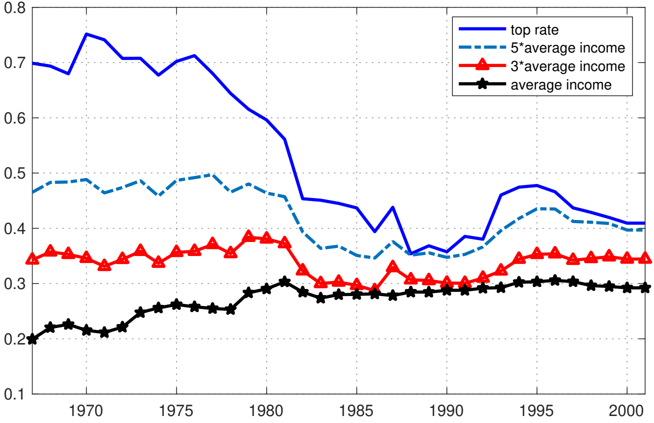
Results, I: steady state (1967)

	Top 10%	Top 1%	Top 0.1%	Top 0.01%
Data	70.8%	27.8%	9.4%	3.1%
Model	66.6%	23.7%	11.2%	7.2%
	Bottom 50%	Fraction $a < 0$		
Data	4.0%	8.0%		
Model	3.5%	7.3%		

- model matches wealth distribution well on its entire domain
  - return heterogeneity is key ingredient
  - wealth concentration is mitigated by progressive taxation and labor income risk

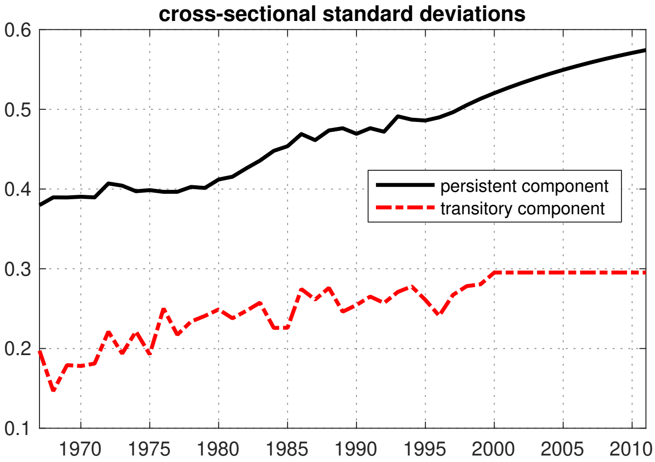
Observed change 1: decrease in tax progressivity

- federal effective tax rates (Piketty & Saez 2007): income, payroll, corporate and estate taxes



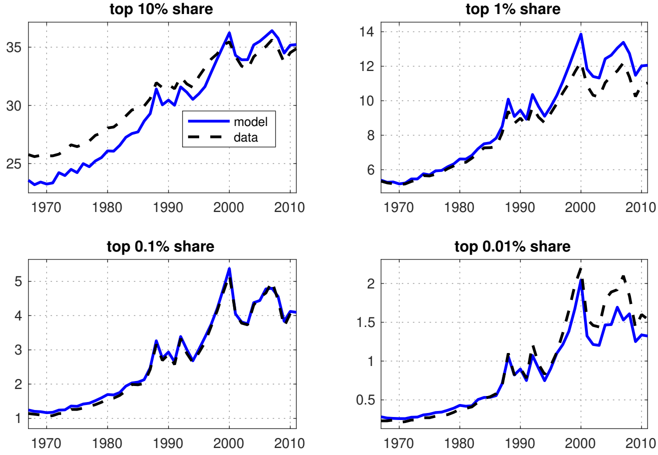
Observed change 2: increase in labor income risk

- estimates for variance of persistent and temporary components 1967-2000 (Heathcote, Storesletten & Violante 2010)



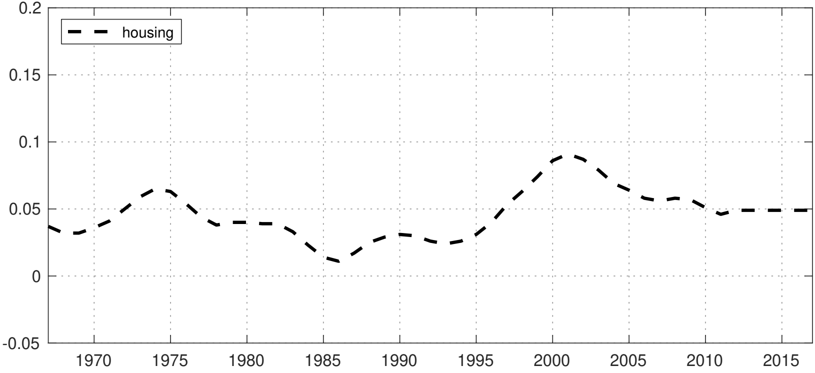
Observed change 3: increase in top labor income shares

- adjust standard AR(1) in idiosyncratic productivity by imposing a Pareto tail for the top 10% earners: calibrated tail coefficient decreases from 2.8 to 1.9 (updated Piketty & Saez 2003 series)



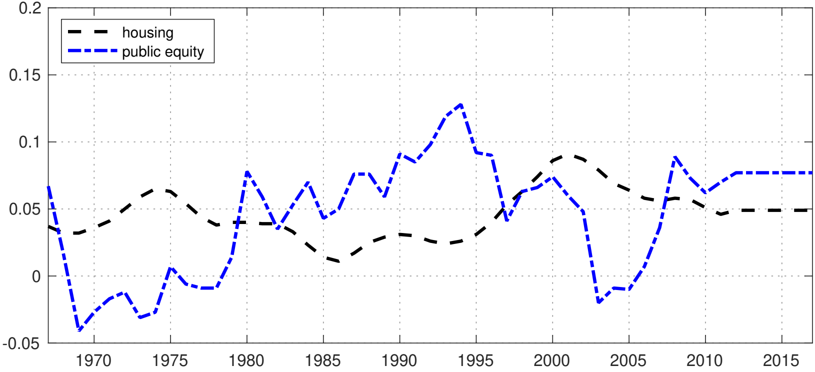
Observed change 4: return premia

- feed in (smoothed) time series of aggregate U.S. asset premia (Kartashova 2014, Case-Shiller index)



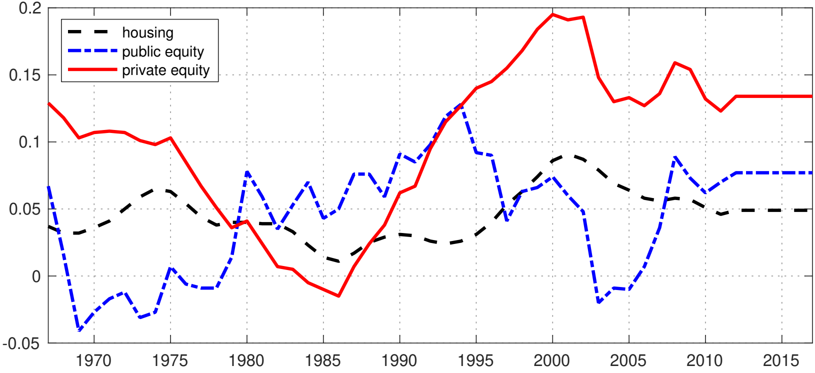
Observed change 4: return premia

- feed in (smoothed) time series of aggregate U.S. asset premia (Kartashova 2014, Case-Shiller index)

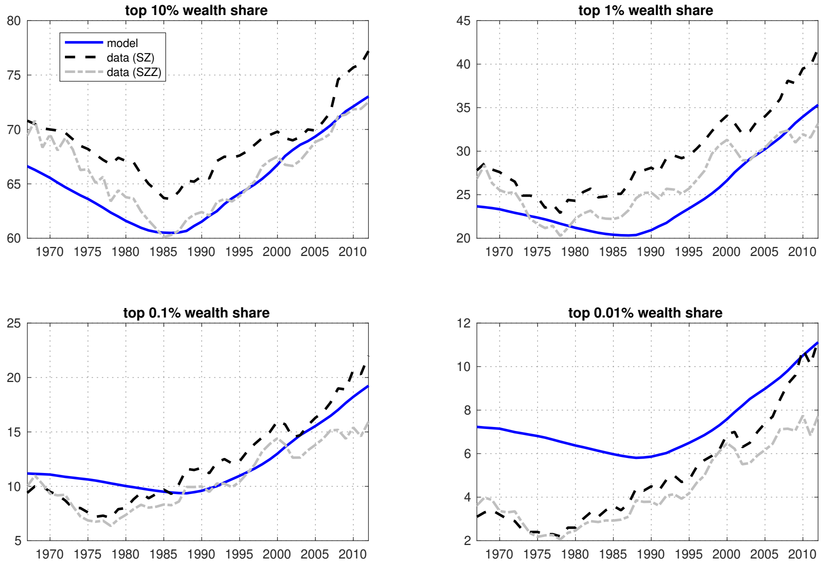


Observed change 4: return premia

- feed in (smoothed) time series of aggregate U.S. asset premia (Kartashova 2014, Case-Shiller index)



Results, II: historical evolution



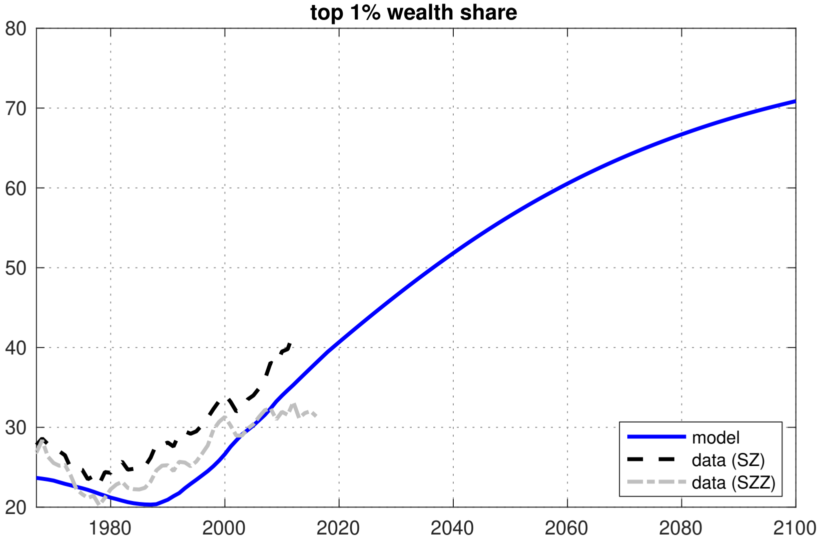
Summary of transitional dynamics

- model captures the salient features of the evolution of the U.S. wealth distribution
- these results are robust
  - perfect foresight not critical (details)
  - robust to CES production function with elasticity > 1 and more generally falling labor share (details)
- shortcomings:
  - explosion of wealth concentration at the extreme top (0.01%) not fully captured quantitatively

Decomposition of transitional dynamics

- overall increase in wealth inequality (more than) fully explained by declining tax progressivity
  - primarily due to direct effect on resource distribution and not due to changing savings behavior details
- time-varying return premia account for U-shape in wealth inequality
- subtle role of increasing earnings dispersion
  - thickening Pareto tail in labor income contributes slightly positively to wealth inequality
  - increase in overall earnings risk decreases wealth inequality

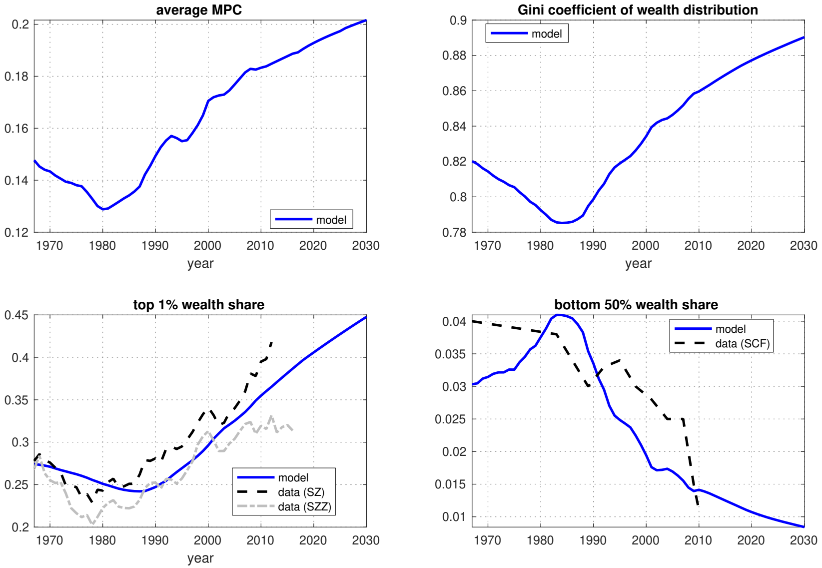
Capital in the 21st century?



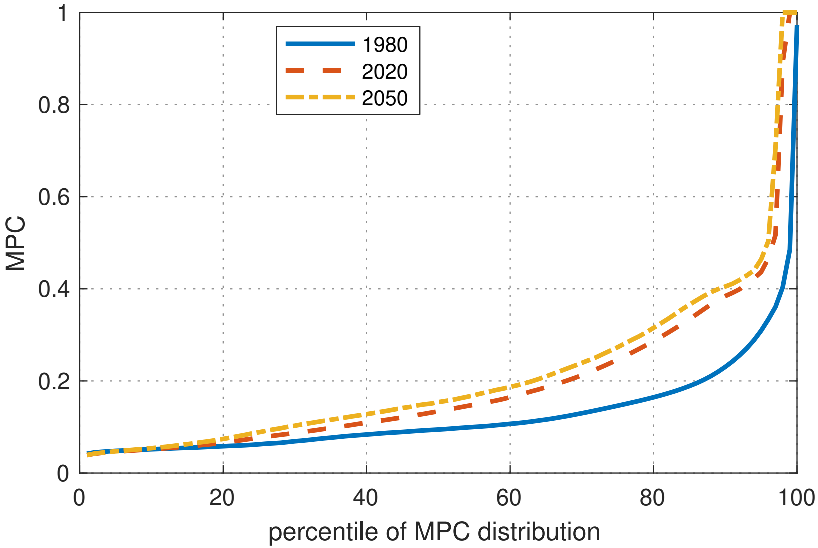
MPC distributions

- experiment: spending out of a surprise, one-time transfer of $100
- people respond based on their individual state (a_t, p_t, β_t):
  - heterogeneity also from β_t
  - cash-on-hand a_t now has a return component in it
  - consumption choice made in advance of knowing return shock, however (and it's iid)
- we first report the average in the population—evaluated at the relevant distribution at time $t \dots$
- and then show some details of the distribution

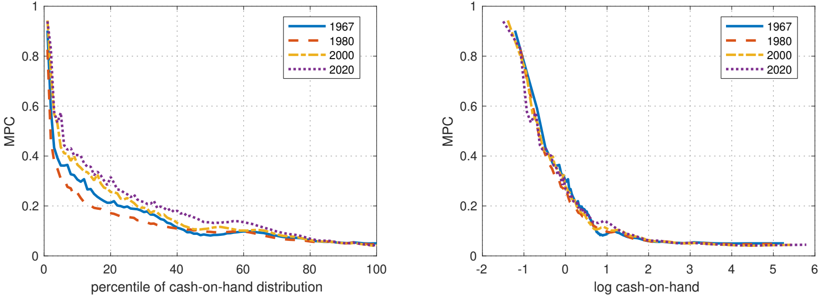
The averages



The heterogeneity



Time change driven by change in distribution of cash-on-hand



Concluding comments

- main findings:
  - account for most long-run inequality w/o β heterogeneity
  - account well for historical evolution due to taxes (trend) and asset-price movements (swings); exception: the very top
  - significantly higher average mpc and high dispersion accounted for but maybe not enough?
  - mpcs significantly higher now than in 1970
- remaining questions:
  - missing rise at top: increased idiosyncratic return volatility, shift toward private equity?
  - why are portfolios heterogeneous (both across and within wealth levels), what drives returns?
  - interactions with aggregate risk

thanks for your attention

wanna see the appendix?

Trends in wealth inequality: recent literature

- *data:* Saez and Zucman 2015, Kopczuk 2015, Bricker, Henriques, Krimmel, and Sabelhaus 2016.
- *models of Pareto tails:* Piketty and Zucman 2015, Benhabib, Bisin, and Luo 2015, Nirei and Aoki 2015.
- *models of transitions:* Kaymak and Poschke 2016, Gabaix, Lasry, Lions, and Moll 2016, Aoki and Nirei 2016.

Equilibrium: capital market clearing

need to find two equilibrium objects $(K_t, \underline{r}_t)$ for market clearing:

1. aggregate capital (as usual)

$$K_t = \int a_t d\Gamma(a_t)$$

2. aggregate capital income (redundant if $r_t^X(\cdot) = 0$)

$$(MPK(K_t) - \delta)K_t = \int \left(\underline{r}_t + r_t^X(a_t)\right) a_t d\Gamma(a_t)$$

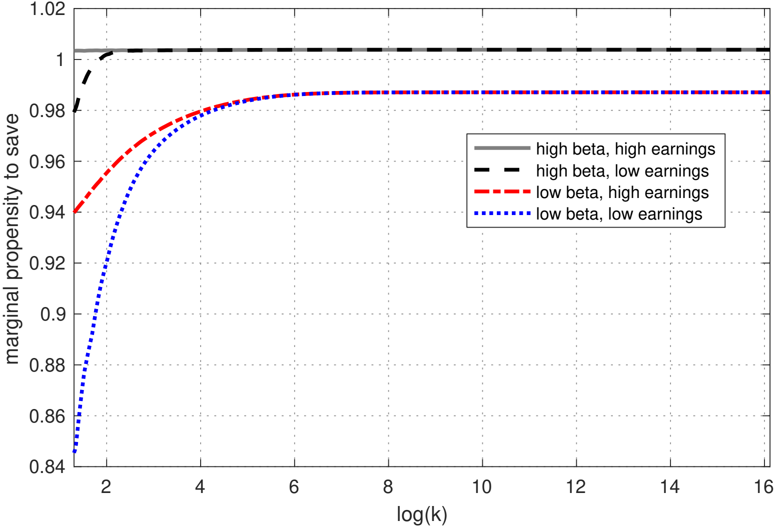
Multiplicative shocks and Pareto tails

- linear savings rules as wealth grows large (Bewley 1977; Carroll 2012; Benhabib et al. 2015): $\lim_{x \to \infty} s(x, \beta) = \bar{s}_\beta x$.
- asset accumulation for large x:

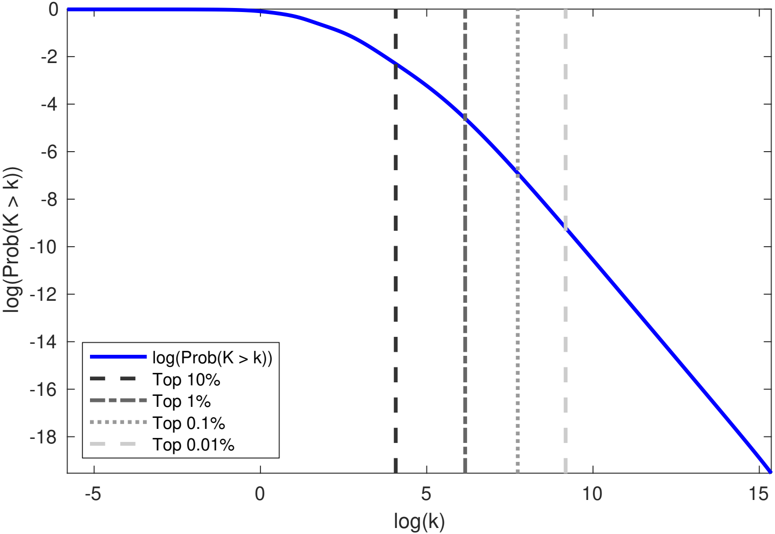
$$\begin{aligned} a_{t+1} &= s(x_t, \beta) \\ &= s(a_t + y_t - T(y_t), \beta) \\ &\approx \bar{s}_\beta a_t (1 + (1 - \tau_{\max}) r) + \bar{s}_\beta (1 - \tau_{\max}) e_t \\ &\equiv \hat{s} a_t + z_t, \end{aligned}$$

  where e_t is earnings.
- β and/or r random $\to \hat{s}$ is random.
- with reflecting barrier (borrowing constraint) and/or random earnings, the invariant distribution for wealth has a Pareto tail with coefficient ζ solving: $\mathbb{E}[\hat{s}^\zeta] = 1$.

Stochastic-β yields stochastic, linear savings decisions



Gives rise to a Pareto tail in the wealth distribution



Cumulative change in top wealth shares

		Top 10%	Top 1%	Top 0.1%	Top 0.01%
Data	1967	70.8	27.8	9.4	3.1
	2012	77.2	41.8	22.0	11.2
	Relative Δ	9.0%	50.4%	134.0%	261.3%
Model	1967	73.8	27.4	8.4	3.2
	2012	78.5	36.5	14.4	5.6
	Relative Δ	6.4%	33.2%	72.2%	75.4%
Fraction explained		70.8%	65.9%	53.8%	28.9%

Wealth shares in %.
Data (capitalization): Saez & Zucman 2016.

... when compared to SCF data

		Top 10%	Top 1%	Top 0.1%
Data	1989	67.1	30.1	10.8
	2013	75.3	35.8	13.5
	Relative Δ	12.2%	19.1%	25.4%
Model	1989	69.3	24.5	7.4
	2013	78.9	37.1	14.8
	Relative Δ	13.7%	51.5%	100.3%
Fraction Explained		112.5%	270.1%	394.5%

Wealth shares in %.
Data: SCF, as reported by Saez & Zucman 2016.

Other parts of the distribution

		Bottom 50%	$\frac{\text{personal wealth}}{Y}$	$\frac{\text{nat'l wealth}}{Y}$	$\frac{K}{Y}$
Data	1967	4.0%	3.6	4.1	
	2010	1.1%	4.1	4.6	
	Relative Δ	-73%	14%	14%	
Model	1967	3.0%			4.0
	2010	1.4%			4.4
	Relative Δ	-53%			10%
Fraction explained		74%			

Bottom 50% Data: SCF, as reported by Kennickell 2011.
Personal/national wealth data: Piketty & Zucman 2014.

Excess return schedule details

Aggregate Excess Returns in 1967 steady state (over risk-free rate):

- public equity 0.067
- private equity 0.129
- housing 0.037 (incl. imputed rent)

	P0-P40	P40-P50	P50-P60	P60-P70	P70-P80	P80-P90	P90-P95	P95-P97.5	P97.5-P99	P99-P99.5	P99.5-P99.9	P99.9-P99.99	Top 0.01%
fixed portfolio weights													
cash	0.722	0.412	0.248	0.182	0.156	0.134	0.115	0.102	0.090	0.079	0.071	0.051	0.029
housing	0.162	0.394	0.580	0.662	0.678	0.674	0.658	0.626	0.572	0.482	0.363	0.253	0.155
public equity	0.113	0.189	0.165	0.147	0.153	0.170	0.189	0.207	0.219	0.232	0.230	0.185	0.179
private equity	0.002	0.005	0.007	0.009	0.013	0.021	0.038	0.065	0.118	0.207	0.336	0.511	0.637
difference from aggregate return on asset class													
cash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
housing	0.000	0.000	0.002	0.004	0.005	0.007	0.009	0.010	0.010	0.011	0.010	0.010	0.011
public equity	0.000	0.000	0.001	0.002	0.003	0.005	0.008	0.012	0.014	0.015	0.016	0.016	0.016
private equity	0.000	0.000	-0.019	-0.030	-0.054	-0.055	-0.049	-0.066	-0.064	-0.063	-0.063	-0.059	-0.060
standard deviation of return on asset class													
cash	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
housing	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140	0.140
public equity	0.035	0.035	0.031	0.031	0.031	0.031	0.032	0.033	0.035	0.038	0.042	0.046	0.053
private equity	0.664	0.664	0.621	0.595	0.544	0.525	0.518	0.480	0.474	0.470	0.474	0.492	0.443
private equity (re-scaled)	0.345	0.345	0.323	0.309	0.283	0.273	0.269	0.249	0.246	0.245	0.246	0.256	0.230
excess return schedule in 1967													
mean excess return	0.000	0.011	0.017	0.020	0.022	0.026	0.031	0.035	0.041	0.050	0.062	0.079	0.091
standard deviation	0.023	0.056	0.081	0.093	0.095	0.095	0.094	0.093	0.098	0.119	0.167	0.254	0.283
st. dev. (priv.equ. re-scaled)	0.023	0.056	0.081	0.093	0.095	0.095	0.093	0.089	0.086	0.085	0.098	0.136	0.149

Housing details

- financial return on housing as sum of capital gains term and rental income
- we set capital gains term to zero in steady states (in long run 0-0.5% real price growth)
- over transition, use growth in aggregate house price index (Case-Shiller)
- rental income set to 5.33% (average for U.S. from Jorda, Knoll, Kuvshinov, Schularick, Tayler "Rate of Return on Everything")

Public and private equity

Public Equity

- U.S. stock market return

Private Equity

- Kartashova (AER, 2014) documents private equity premium over stock market
- aggregate time series for U.S. starting in 1960

Capital in the 21st century?

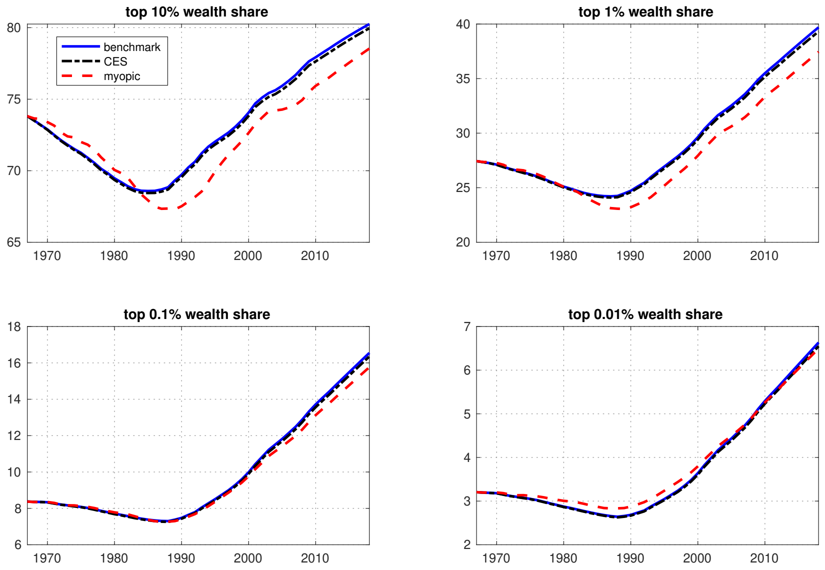
	Top 10%	Top 1%	Top 0.1%	Top 0.01%	Bottom 50%
1967	73.8	27.4	8.4	3.2	3.0
2017	80.0	39.2	16.2	6.5	1.2
2100	89.1	61.6	35.2	17.0	0.3

Model predictions for 21st century. Wealth shares in %.

- long-run effects of decrease in tax progressivity

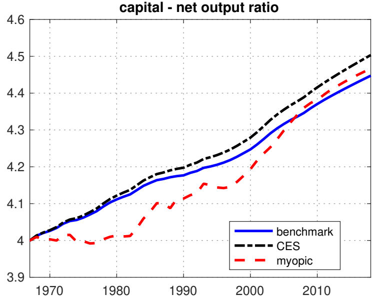
Perfect foresight vs. myopic transition; CES

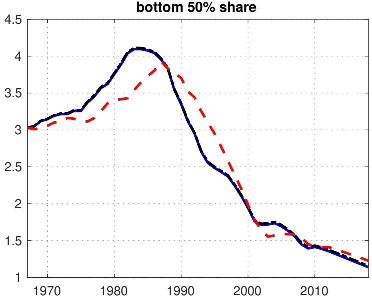
return



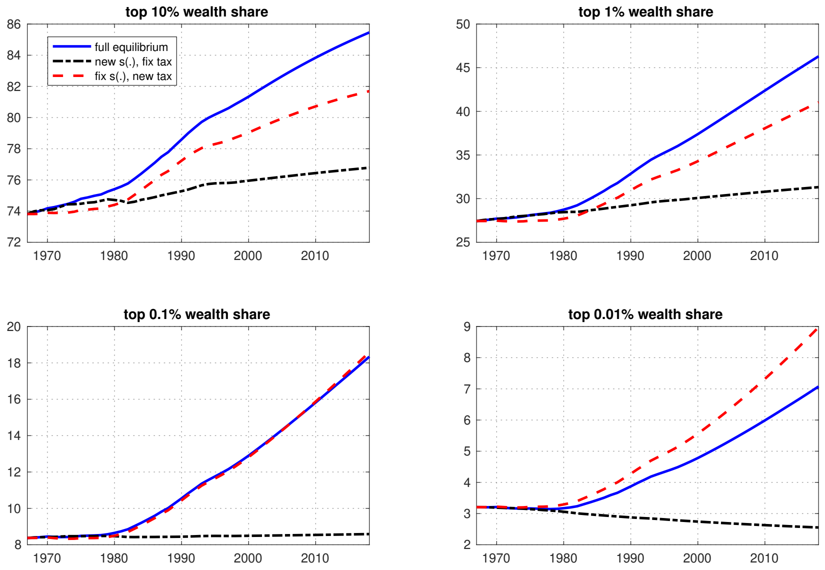
Perfect foresight vs. myopic transition; CES

▸ return

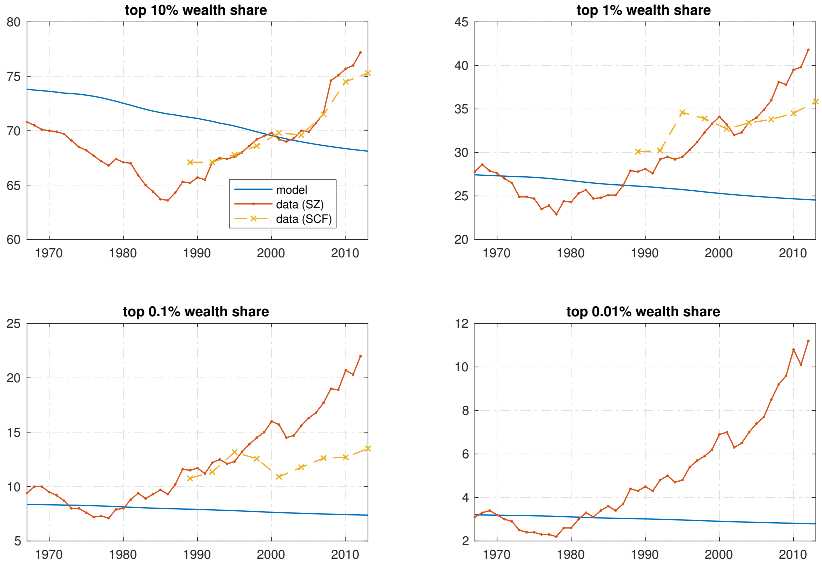




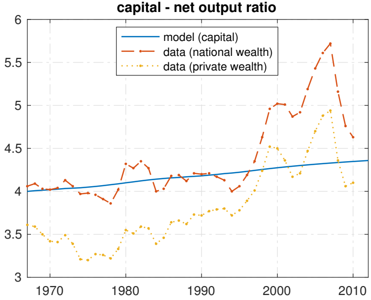
Tax changes: changes in savings behavior vs. resources

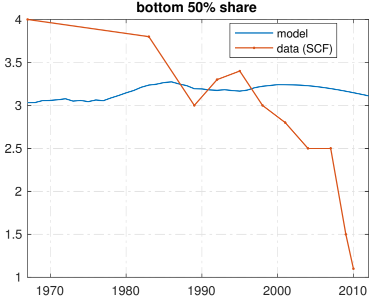


Only changes in earnings risk I ▸ return

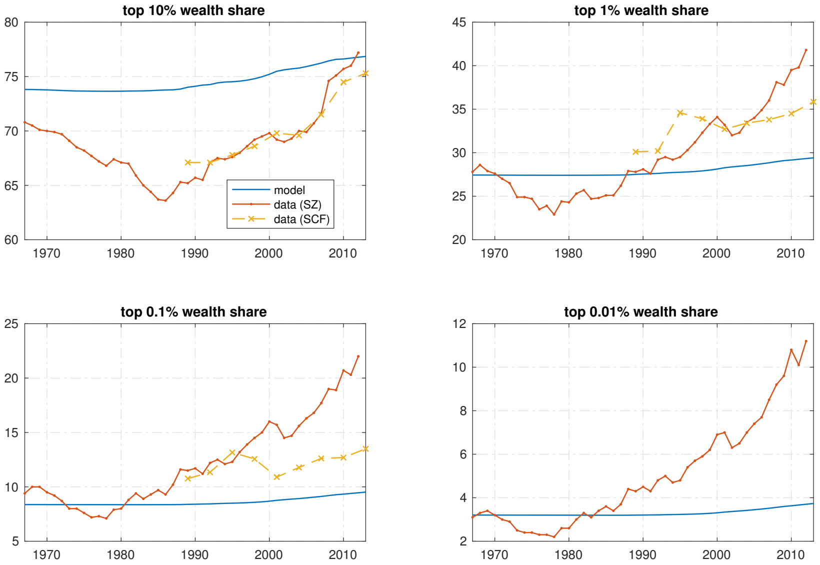


Only changes in earnings risk II ▸ return



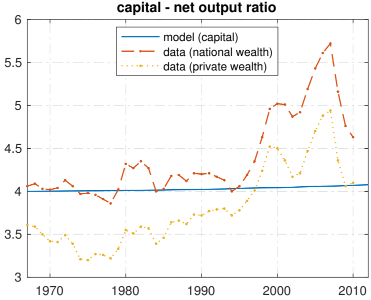


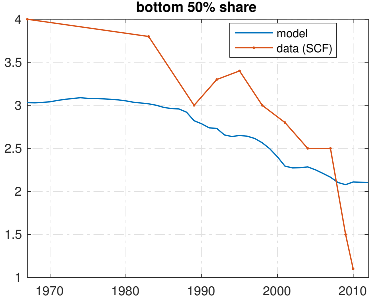
Only changes in top earnings shares I ▸ return



Only changes in top earnings shares II

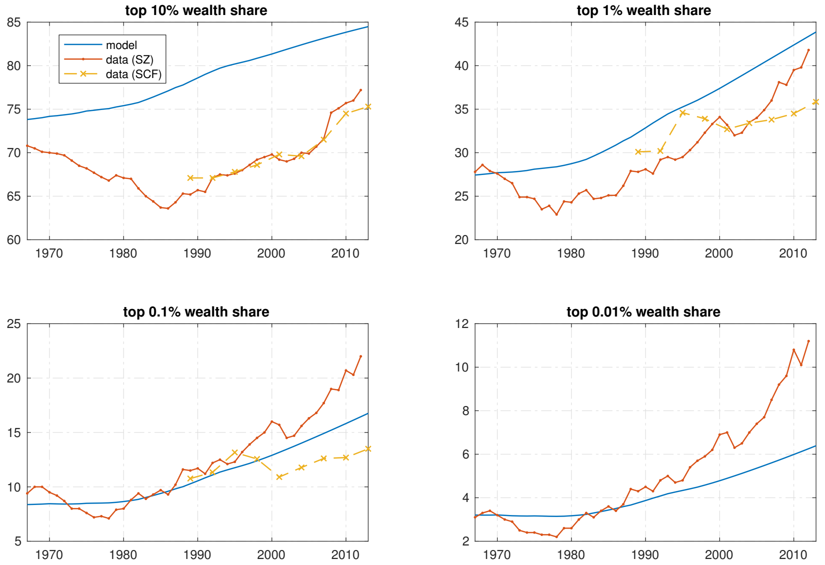
return



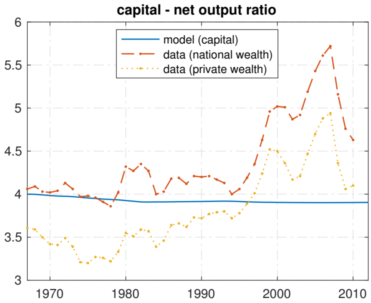


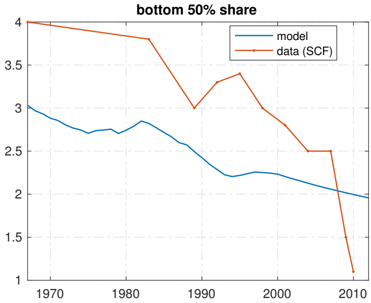
Only changes in taxes I

▸ return

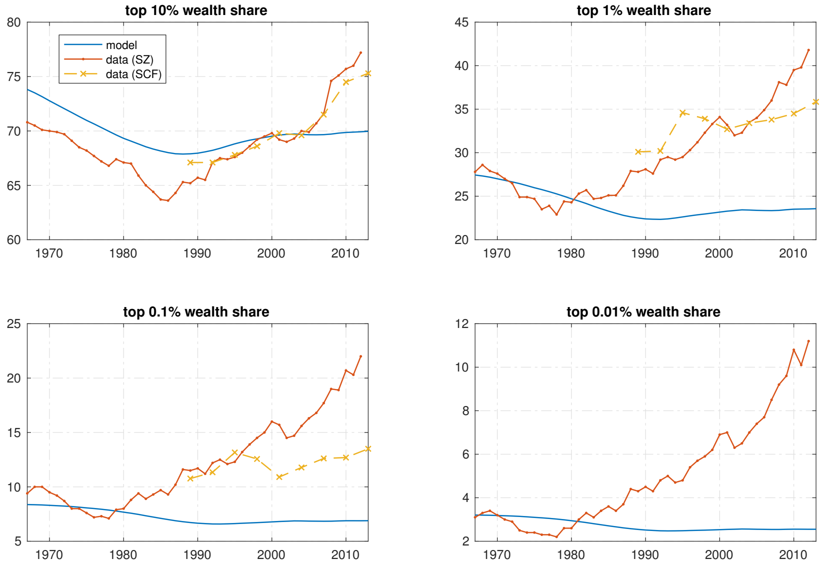


Only changes in taxes II ▸ return

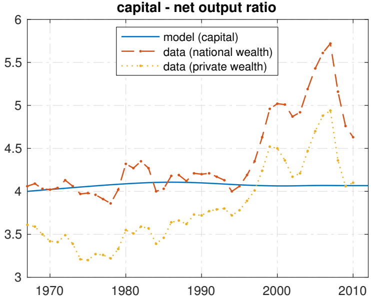


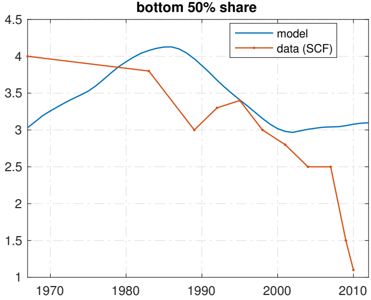


Only changes in return premia I ‣ return

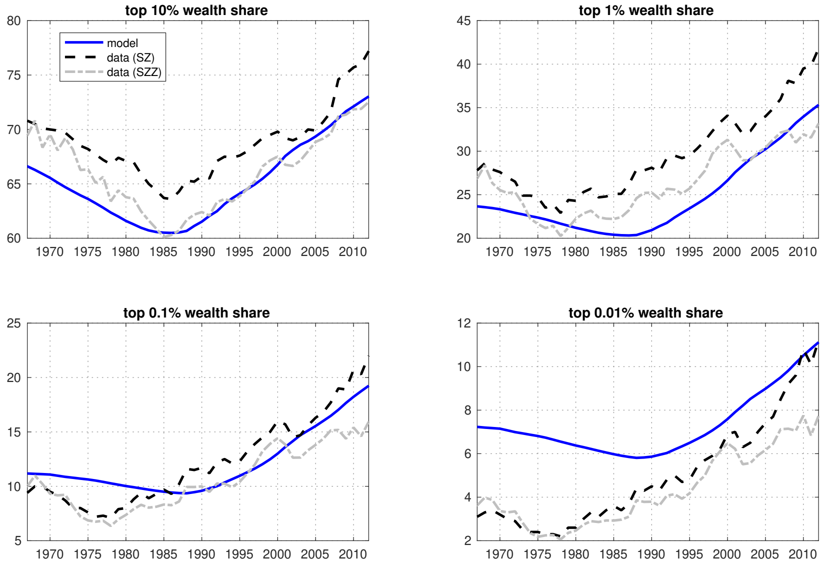


Only changes in return premia II ▸ return

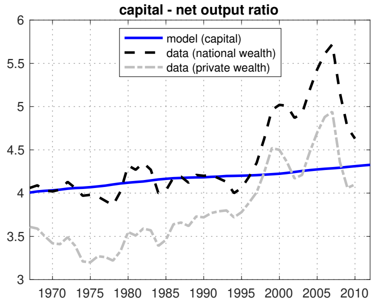


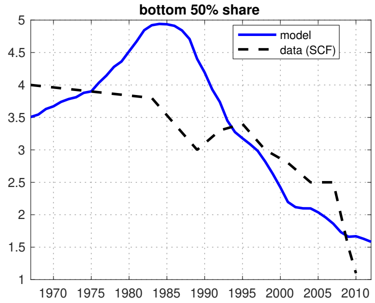


Dynamics in single-β model I



Dynamics in single-β model II





Inflation I


top 10% wealth share
benchmark
benchmark +inflation
85
80
75
70
65
60
1970
1980
1990
2000
2010
top 1% wealth share
40
35
30
25
20
15
1970
1980
1990
2000
2010
top 0.1% wealth share
18
16
14
12
10
8
6
4
1970
1980
1990
2000
2010
top 0.01% wealth share
7
6
5
4
3
2
1
1970
1980
1990
2000
2010

Inflation II