On the Mechanics of Top Wealth Inequality

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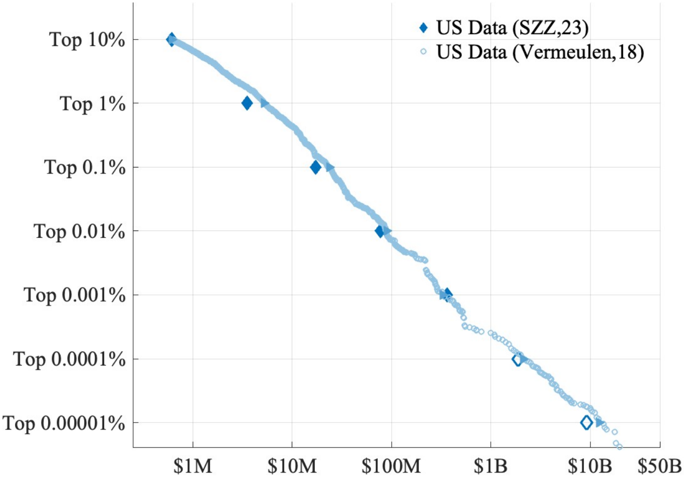
NBER SI - Inequality and Macroeconomics

July 15th, 2025

Wealth is Extremely Concentrated at the Top

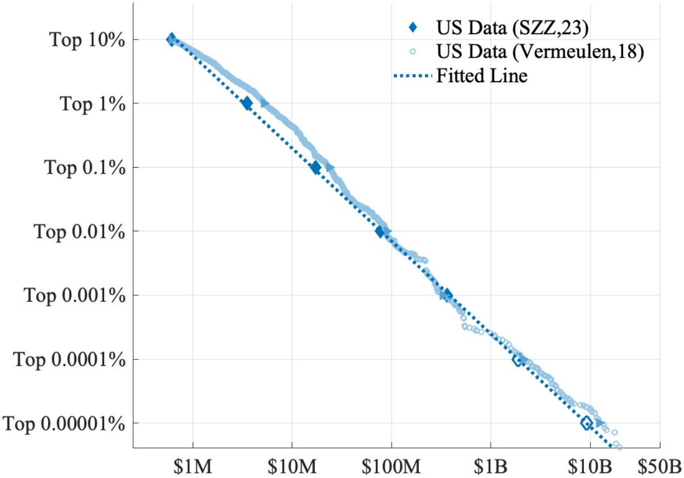
Wealth is Extremely Concentrated at the Top: US

Right Tail: Log Counter-CDF ($\Pr(w > x)$) vs Log Wealth



Wealth is Extremely Concentrated at the Top: US

Shape: A straight line implies a Pareto distribution: $P(w > x) \sim x^{-\alpha}$



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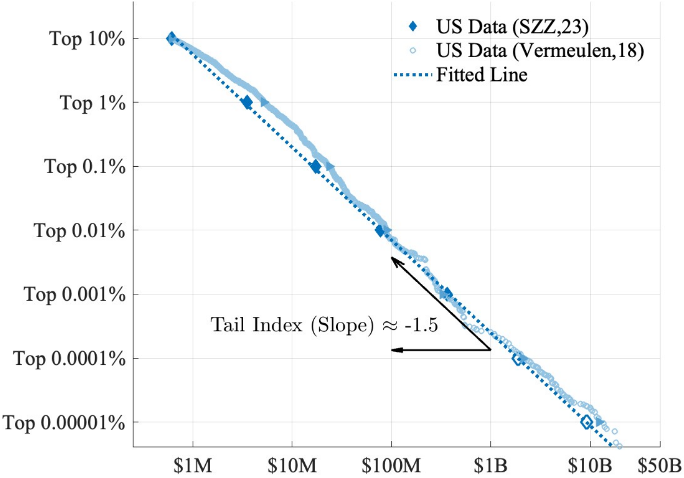
Thickness: Slope gives the tail index α



True in Most of the Developed Economies

	Pareto Tail Index for Wealth									
	Germany	Austria	Portugal	**US**	Italy	France	Spain	UK	Belgium	**Finland**
Tail Index	**1.39**	1.46	1.47	**~1.50**	1.58	1.62	1.69	1.74	1.87	**1.88**

Source: Vermuelen (RIW, 2018). Tail indices are estimated from country level surveys merged with Forbes' billionaires list.

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- **Thickness:** All countries with $\alpha < 2$. Very thick tail! (technically, Var (wealth) does not exist)
  - Matters in practice: Models with thick Pareto tail are harder to solve accurately.

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  - Many policy debates are (were!) about taxing 100-millionaires, billionaires, etc.

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- **Today:** Models that feature 1 through 5. How (well) do they generate wealth inequality?
- **Not Today:** Stochastic-beta, Heterogeneous risk aversion, Non-homothetic pref., etc.

  (Largely because we already have a good guess about their impact.)

Example

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   - Persistent return heterogeneity across households.
     (Fagereng, Guiso, Malacrino, Pistaferri, ECMA, 2020; Smith, Zidar, Zwick, QJE, 2023; etc)

   Two versions: *(i)* Entrepreneurship-based full-fledged macro model

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3. **Demographic structure** and wealth distribution: **Who holds the wealth?**

General Framework

I. Preferences and Demographics: 2 Versions

Version 1: CRRA Utility + Warm-Glow Bequests + **Perpetual-Youth** (cons. surv. ϕ)

$$U = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \Big(\underbrace{\phi}_{\text{Survival prob.}} \times u(c_t) \quad + \quad (1-\phi) \times \underbrace{v(b)}_{\text{Warm-glow bequest}} \Big)$$

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma} \qquad\qquad v(b) = \chi \frac{(b+b_0)^{1-\sigma}}{1-\sigma}$$

$\longrightarrow$ Used for Framework 1: **Awesome-State Model**

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Version 2: CRRA Utility + Warm-Glow Bequests + **Finite Horizon T** + **Stoch. Death** (ϕ_t from data)

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- Perpetual-youth will be critical ...as we will see

II. Household Consumption-Savings Problem

- Consumption-savings problem at the core of all 3 frameworks (ignoring bequests)

$$\mathcal{V}_t\left(a_t^i\,;\,\mathbf{Y_t^i}\right) = \max_{c_t^i, a_{t+1}^i} \left\{ U\left(c_t^i\right) + \beta\phi_{t+1}\mathbb{E}\left[\mathcal{V}_{t+1}\left(a_{t+1}^i\,;\,\mathbf{Y_{t+1}^i}\right) \mid \mathbf{Y_t^i}\right] \right\}$$

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  - No wealth Pareto (without thick tail inc shocks; Stachurski, Toda, 2019; Sargent, Wang, Yang, 2021)

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- **In Power-Law models** (Framework 3), risk comes from stochastic $\mathbf{R_t}$
  - Generate Pareto tail in wealth (thicker than income!)
  - But: How thick? How long does it take to emerge? $\longrightarrow$ Empirical questions

III. Return Process: Two Options

1. **Fully-fledged model:** Entrepreneurial returns (Guvenen, Kambourov, Kuruscu, Ocampo, Chen, QJE, 2023)
   - Individuals differ in *entrepreneurial ability* z_t^i (permanent + transitory components)
   - Returns from entrepreneurial profits

$$\pi_t^i = \max_{k_t^i \leq \vartheta\left(\bar{z}^i\right) \times a_t^i} \mathcal{P} \times \left(z_t^i k_t^i\right)^{\mu} - (R + \delta)\, k_t^i$$

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2. **Simple benchmark: Markovian returns** consistent with wealth inequality facts

$$R_t^i = R \times \exp\left(z_t^i\right) \qquad \text{where } z_t^i \text{ follows a Markov Chain}$$

   - Later allow for permanent types

Calibration of Models

	Frameworks		
	Awesome-State	PEER Model	Return Heterogeneity
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3.	Wealth-to-Income Ratio		4	
4.	Average HH. Earnings		$60,462	

- Earnings correspond to total wages and salaries per household in 2016 (BLS; Census)
- Wealth level determined by average returns to wealth

details

Road Map

1. **Income Dynamics:**
   1. Income Processes
   2. Models vs Data
2. Wealth Inequality: Models vs Data
3. Demographics and Wealth: Models vs Data

Income Processes: 1. Awesome-State Model

	Stationary Distribution of Income, Y			
	s_1	s_2	s_3	s_4
Y	**1.00**	3.15	9.78	1,061
π	**61.1%**	22.4%	16.5%	0.0389%

Source: *Castañeda, Díaz–Giménez, Ríos–Rull (JPE, 2003)*

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Today: I will focus on Castañeda, Díaz–Giménez, Ríos–Rull (2003) version

We have also studied Kaymak and Poschke (2016); Grinwald, Leombroni, Lustig, Van Nieuwerburgh (2021); Kindermann and Krueger (2022); Boar and Midrigan (2022); etc.

Income Process: 2. PEER Model

Very rich income process with **21 parameters** *(Guvenen, Karahan, Ozkan, Song, ECMA, 2021)* details

Normal mixture persistent + transitory shocks; Non-employment shocks with scarring effects;

Shocks are age-income dependent; More!

- Matches 2000+ moments of **nonlinear and non-Gaussian** income dynamics

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PEER-Top: Alternative model with higher income inequality at the top *(more on this later!)*

Income Process: 3. Return Heterogeneity Model

- **Deliberately very standard:** Canonical persistent-plus-transitory income process:

$$\log y_t^i = \alpha^i + g(t) + \eta_t^i ;$$

$$\eta_t^i = \rho \eta_{t-1}^i + \varepsilon_t^i .$$

- All random objects are Gaussian (κ^i, ν_t^i)

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   - What type of risk people face (Upward? Downward?): Skewness

Other features skipped for today:

Heterogeneous income growth over the life cycle; Income persistence of top earners; Distribution of income changes over longer horizons; Asymmetric Impulse response functions.

I. Income Inequality

Ratio of Top Percentile Threshold to Median Earnings

	Percentile Threshold		
	99%	99.9%	99.99%
US Data			
Awesome-State			
PEER Model			
Gaussian-AR			

I. Income Inequality

Ratio of Top Percentile Threshold to Median Earnings

	Percentile Threshold		
	99%	99.9%	99.99%
US Data	**8.5**		
Awesome-State	9.8		
PEER Model	14.8		
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I. Income Inequality

Ratio of Top Percentile Threshold to Median Earnings

	Percentile Threshold		
	99%	99.9%	99.99%
US Data	8.5	**30.4**	
Awesome-State	9.8	9.8	
PEER Model	14.8	33.6	
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US Data	8.5	30.4	**135.8**
Awesome-State	9.8	9.8	1061.0
PEER Model	14.8	33.6	65.0
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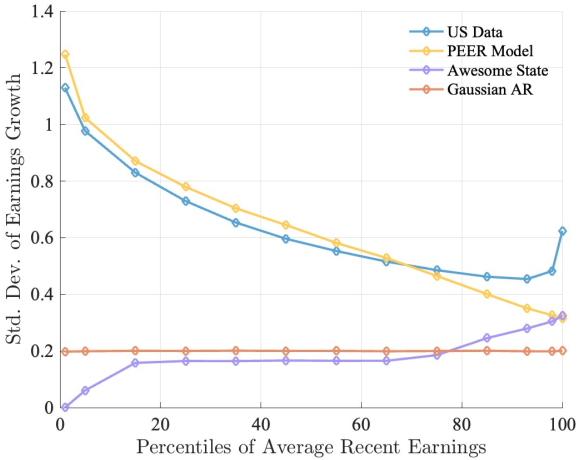
- **PEER-TOP:** modified for higher income inequality $\longrightarrow \frac{y^{99.9}}{y^{50}} = 72\,;\ \frac{y^{99.99}}{y^{50}} = 334$
  - Thick *income* Pareto tail but *wealth* results qualitatively unchanged

Income Pareto

II. Income Risk: Standard Deviation of Income Growth

▸ Densities



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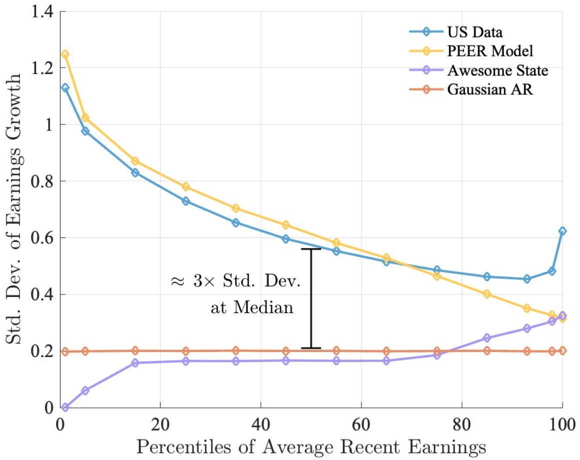

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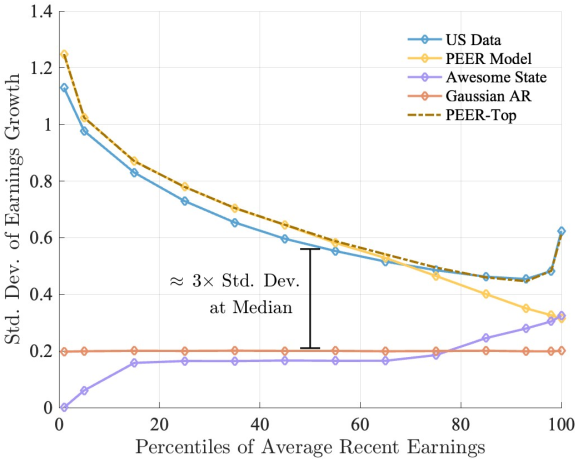
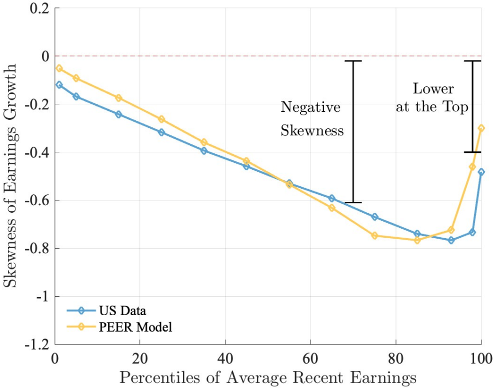


III. Income Risk: Skewness of Income Growth

More



III. Income Risk: Skewness of Income Growth

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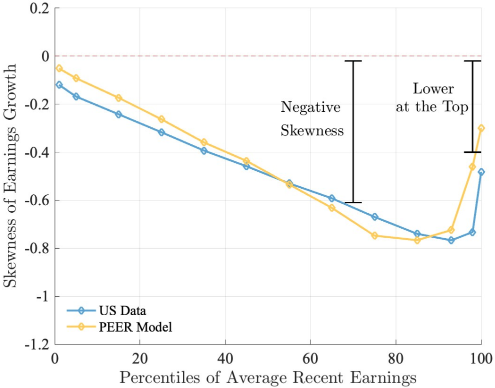

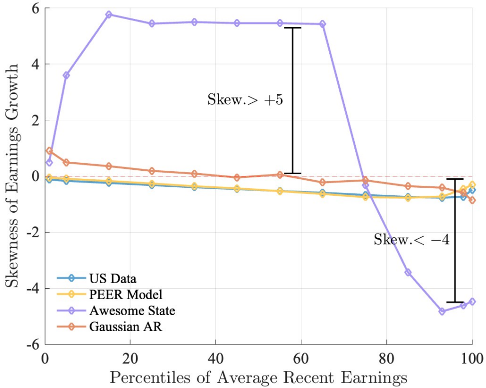

Road Map

1. Income Dynamics: Models vs Data
   1. Income Processes
   2. Models vs Data
2. **Wealth Inequality:**
   1. Return Heterogeneity
   2. Models vs Data
3. Demographics and Wealth: Models vs Data

Return Heterogeneity

	Cross-Section		Life-Time		
	Average	p90-p10	Std. Dev.	p99	p99.9
PEER Model & Awesome State	3.0	–	–	–	–
Markovian Returns	12.2				
Entrepreneurial Returns	8.3				
Norway	3.8 (Private equity: 10)				

Notes: All statistics are wealth-weighted. Norwegian statistics from Fagereng, Guiso, Malacrino, Pistaferri (ECMA, 2020).

Return Heterogeneity

	Cross-Section		Life-Time		
	Average	p90-p10	Std. Dev.	p99	p99.9
PEER Model & Awesome State	3.0	—	—	—	—
Markovian Returns	12.2	23.6	6.7		
Entrepreneurial Returns	8.3	17.3	3.8		
Norway	3.8 (Private equity: 10)	14.2	6.0		

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Return Heterogeneity and Entrepreneurship

	Cross-Section		Life-Time		
	Average	p90-p10	Std. Dev.	p99	p99.9
PEER Model & Awesome State	3.0	–	–	–	–
Markovian Returns	12.2	23.6	6.7	15.6	19.8
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Notes: All statistics are wealth-weighted. Norwegian statistics from Fagereng, Guiso, Malacrino, Pistaferri (ECMA, 2020).

For Entrepreneurial Returns model:

- Entrepreneurship: **10.6% vs 11.5% in US** (Model: Entrep. Inc.>50% of Inc.; Data: Cagetti, DeNardi, 2006)
- Entrepreneurs hold 80% of wealth among top 1% wealth holders

What Aspects of Wealth Inequality to Match?

1. Top end of the wealth distribution:

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3. **Life-cycle wealth dynamics** of super wealthy:
   - **55%** of US Forbes billionaires **are self-made** (see also Hubmer, Halvorsen, Salgado, Ozkan, 2024)

     → **10,000- to 20,000-fold increase in wealth** over 30-40 years.

Pareto Tail: Models vs US Data

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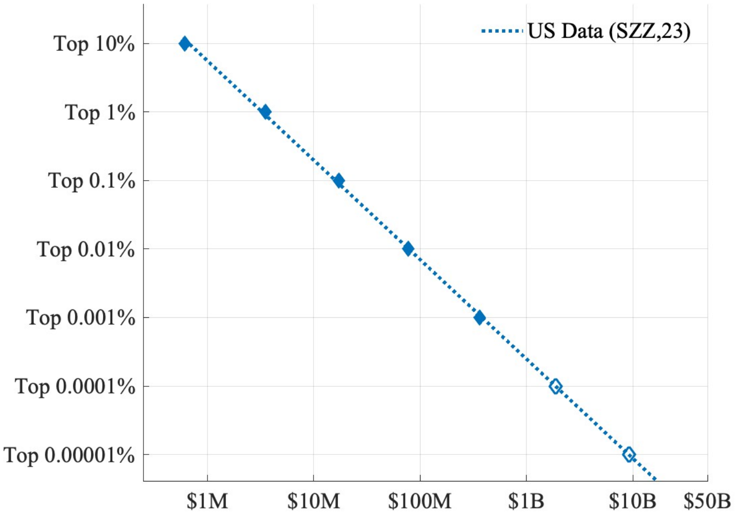

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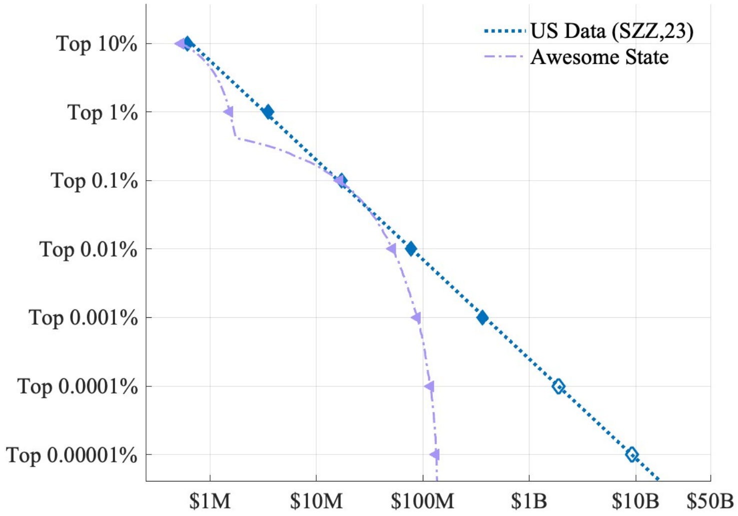

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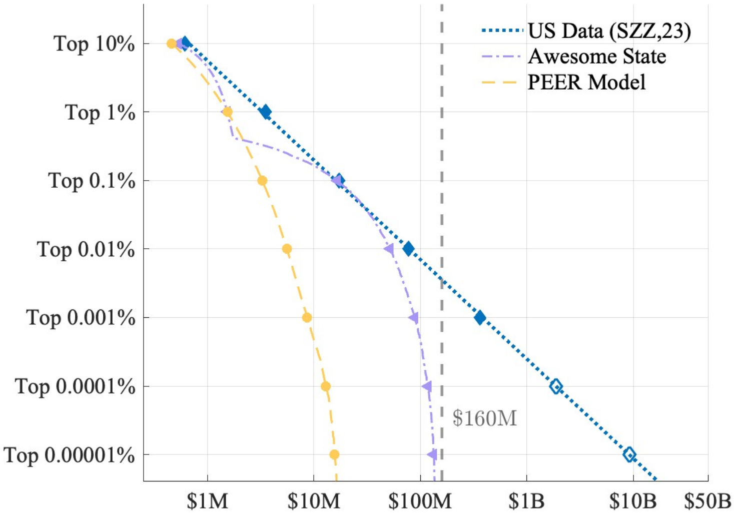
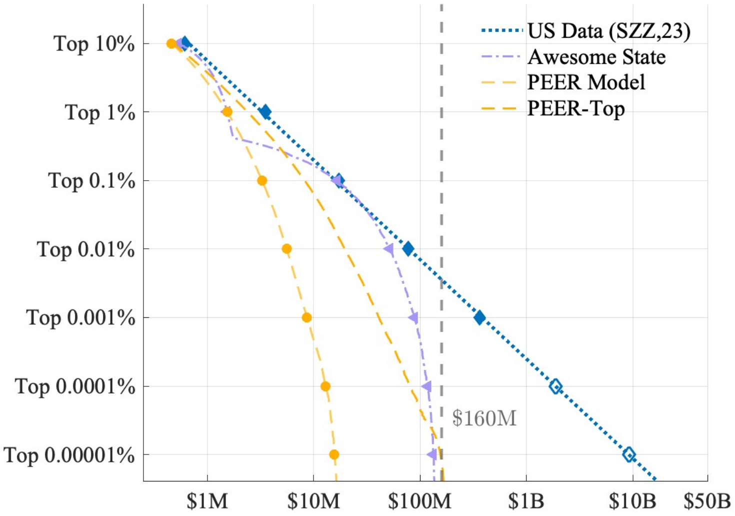


Pareto Tail: Models vs US Data

High R PEER



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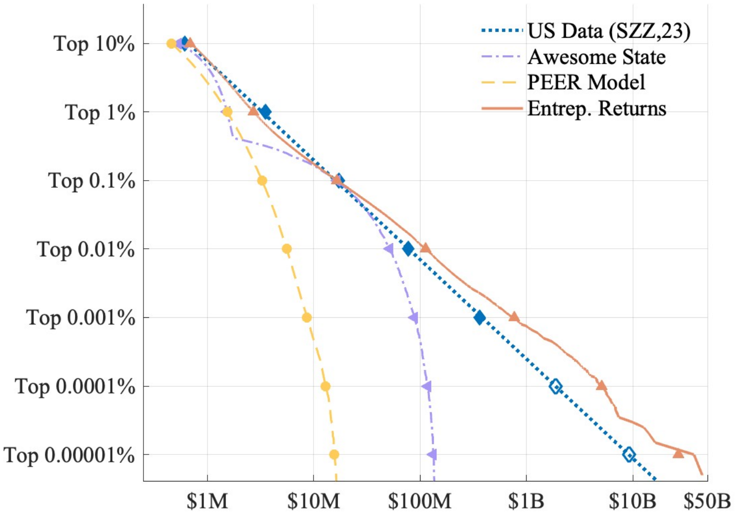
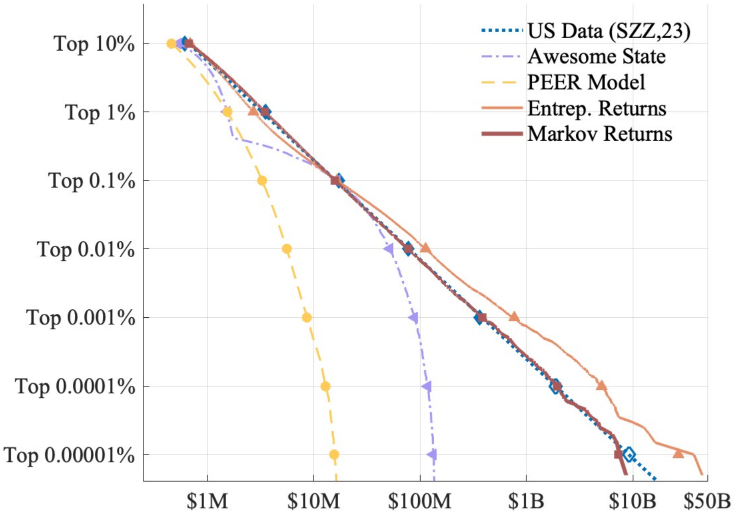


Pareto Tail: Models vs US Data

Top Cutoffs



Wealth Inequality: Gini

		Frameworks			
	US Data	Awesome State	PEER Model	Return Heterogeneity	
				Markov	Entrepreneurial
Gini	**0.85**	0.84	0.72	0.79	0.78
Top 10%	68.6	71.5	54.2	67.3	64.6
Top 1%	33.7	30.0	13.5	31.5	34.9
Top 0.1%	15.7	15.4	2.5	14.8	22.2
Top 0.01%	7.1	3.3	0.4	7.0	13.0
% Self-made	55	0.4	0.0	0.0	57.5

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023) complemented with Forbes data.

Wealth Inequality: Top Shares

				Frameworks	
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Wealth Inequality: Top-Top Shares

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* **Awesome-state model: only 0.002%** above **empirical 0.01% wealth threshold**. Millionaires

Wealth Inequality: Fraction Self-Made

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Top 0.01%	7.1	3.3	0.4	7.0	13.0	9.4
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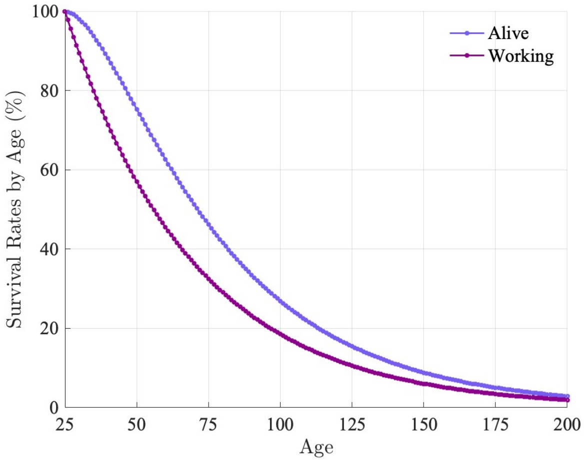
Age Distribution: Awesome-State Model



Notes: Perpetual-youth with constant probability of retiring of 1/45 and constant probability of dying after retirement of 1/15.

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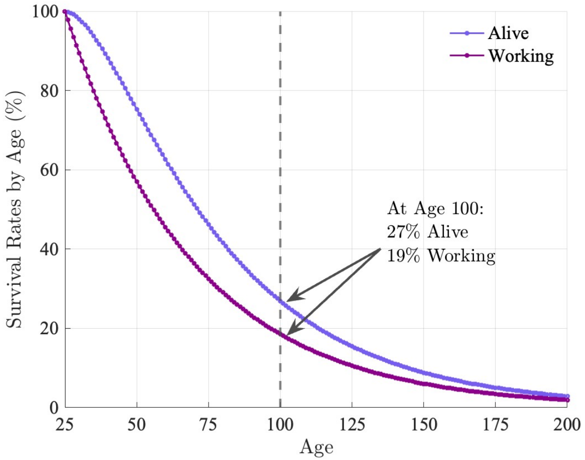
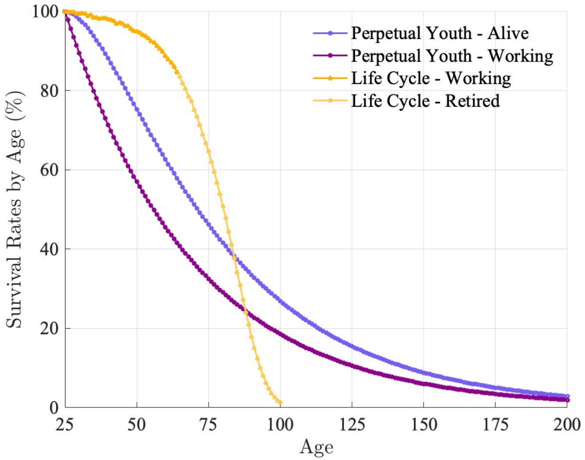


Notes: Perpetual-youth with constant probability of retiring of 1/45 and constant probability of dying after retirement of 1/15.

- US has 97,000 centenarians. **Or 0.029% of population**

US Data

Age Distribution: Awesome-State Model vs Life Cycle Models



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US Data

Who Holds the Wealth?

Wealth Age Profiles

Representation of the Very Old in **Top 1%**

	Awesome State		Markov Returns	
Age	Population Share	Wealth Share	Population Share	Wealth Share
65+	81.1	67.0	43.6	41.3
85+				
100+				
120+				

Notes: SCF overall wealth shares for 65+, 38%, and 85+, 4.8%. For Markov Returns 65+, 36.6%, and 85+, 2.7%. Among top 1%, 33.2% are 65+ and hold 36.1% of wealth; 5.4% are 85+ and hold 4.6% of wealth.

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100+	**61.2**	**39.1**	NA	NA
120+	**39.8**	**25.0**	NA	NA

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Recap: Comparison of Models' Performance

		Pareto Tail		**Overall Inequality**	**Lyfe Cycle Dynamics**
Model:		Shape	Thickness	Gini + Top Shares	Self-made
1.	PEER model	No	No	No	No
2.	Awesome-State model	No	No	**Yes**	No
3.	Return heterogeneity	**Yes**	**Yes**	**Yes**	**Yes**

Conclusions

- **"Awesome-State"** Model:
  - Perpetual youth creates highly questionable demographics.
    - Centenarians hold 2/5 of top 1% wealth
  - Income process contradicts a large number of facts that are now well established.
  - Model does not generate a Pareto tail, and nobody has more than 150 million in wealth.

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- **PEER** Model:
  - Realistic income + demographics go some way toward creating high wealth inequality
  - Minimal effect of top 1% wealth holdings and beyond.
- **“Rate of Return Heterogeneity”** Model:
  - Matches salient features of the wealth distribution with empirically reasonable returns.
  - Substantially different & interesting policy implications (than Aiyagari framework).

APPENDIX

Limited effect of saving rates with finite lives

back

Simple wealth accumulation process:

$$w_{h+1} = R \cdot w_h + s \cdot y_h \longrightarrow w_h = R^h w_0 + \sum_{t=0}^{h-1} R^{h-1-t} s y_t$$

- Set $w_0 = \$1M$, $R = 1.03$, and $s = 1$
- High and constant income: $y_h = y$ with $y \in \{ p90 , p99 , p99.9\}$

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- High and constant income: $y_h = y$ with $y \in \{p90, p99, p99.9\}$

Takes over 100 years to accumulate $1B (even for the earnings-rich!)

Years to	Income		
	p90 ($108K)	p90 ($309K)	p99.9 ($927K)
$100M	106	78	48
$1B	183	153	118
$10B	260	230	195

Limited effect of saving rates with finite lives II

back

$w_{h+1} = R \cdot w_h + s \cdot y_h$ Set $R = 1.03;\ s = 1;$ High+Constant Income

Limited effect of saving rates with finite lives II

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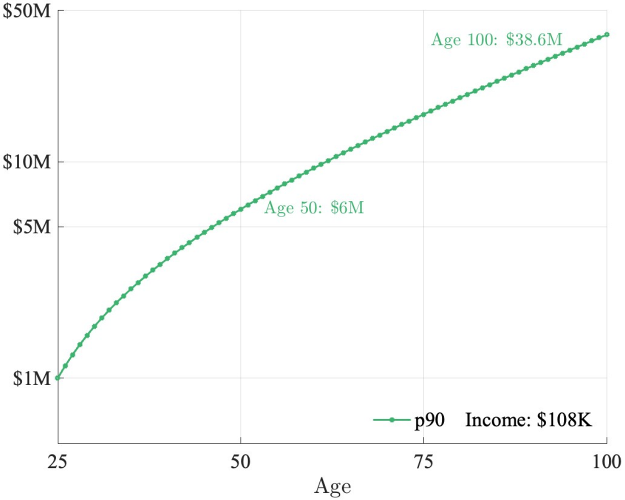

Limited effect of saving rates with finite lives II

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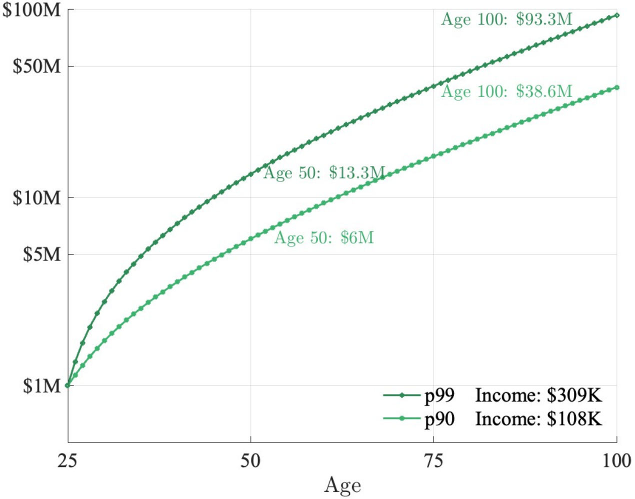

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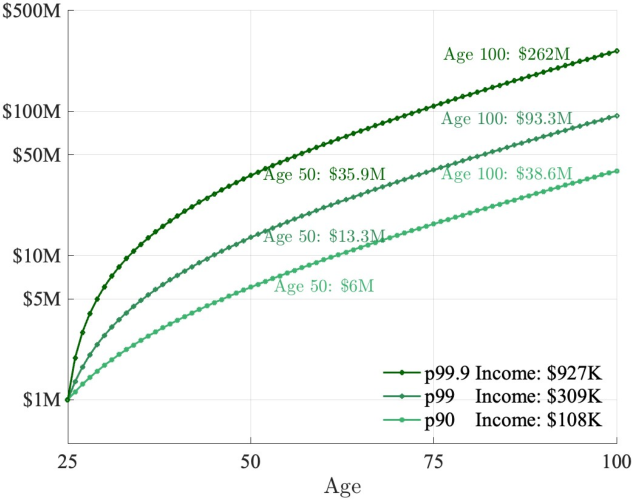

Labor Income, Returns, and Wealth Levels

back

- We fix average labor income (~\$60K) and the wealth to income ratio (4)

$$4 = \frac{W}{\text{Labor Income} + \text{Capital Income}}$$

  - Labor income = Working-Share $\times$ Avg. Labor Inc.

- Level of wealth depends on returns to wealth

$$4 = \frac{W}{\text{Labor Income} + R \times W} \longrightarrow W = \frac{4}{1 - 4 \times R} \times \text{Labor Income}$$

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	US Data	Awesome State $R = 3\%$	PEER $R = 3\%$	Markov Returns $R = 12\%$
Avg. Wealth	\$320K	\$200K	\$170K	\$330K

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- Wealth concentration results unchanged when matching average wealth

High R PEER

Empirical Benchmark Income Process (Guvenen et al, 2021, ECMA)

back

$$\text{Level of earnings:} \quad \tilde{Y}_t^i = (1-\nu_t^i)e^{\left(g(t)+\alpha^i+\theta^i t+z_t^i+\varepsilon_t^i\right)} \tag{1}$$

$$\text{Persistent component:} \quad z_t^i = \rho z_{t-1}^i + \eta_t^i, \tag{2}$$

$$\text{Innovations to AR(1):} \quad \eta_t^i \sim \begin{cases} \mathcal{N}(\mu_{\eta,1},\sigma_{\eta,1}) & \text{with prob. } p_z \\ \mathcal{N}(\mu_{\eta,2},\sigma_{\eta,2}) & \text{with prob. } 1-p_z \end{cases} \tag{3}$$

$$\text{Initial condition of } z_t^i\text{:} \quad z_0^i \sim \mathcal{N}(0,\sigma_{z_0}) \tag{4}$$

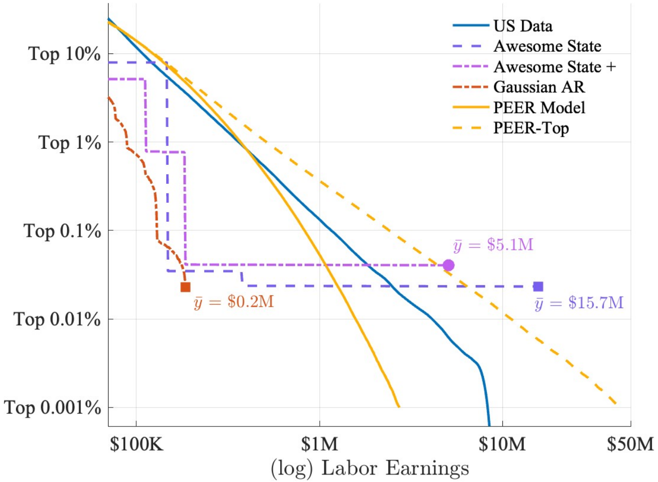
$$\text{Transitory shock:} \quad \varepsilon_t^i \sim \begin{cases} \mathcal{N}(\mu_{\varepsilon,1},\sigma_{\varepsilon,1}) & \text{with prob. } p_\varepsilon \\ \mathcal{N}(\mu_{\varepsilon,2},\sigma_{\varepsilon,2}) & \text{with prob. } 1-p_\varepsilon \end{cases} \tag{5}$$

$$\text{Nonemployment duration:} \quad \nu_t^i \sim \begin{cases} 0 & \text{with prob. } 1-p_\nu(t,z_t^i) \\ \min\left\{1, F_{\text{exp}}(\varphi)\right\} & \text{with prob. } p_\nu(t,z_t^i) \end{cases} \tag{6}$$

$$\text{Prob of Nonemp. shock:} \quad p_\nu^i(t,z_t) = \frac{e^{\xi_t^i}}{1+e^{\xi_t^i}}, \text{ where } \xi_t^i \equiv a + bt + cz_t^i + dz_t^i t. \tag{7}$$

I.A. Income Inequality: Top Tail of Income Distribution

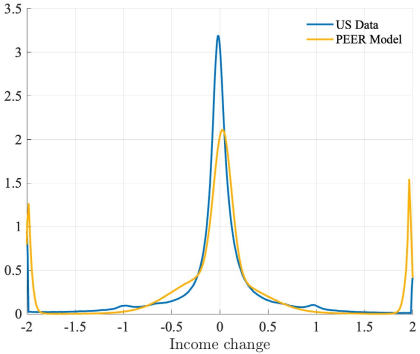
back



Income Risk: Density of Income Growth

back

Histogram of $\Delta \log Y$



Income Risk: Density of Income Growth

back

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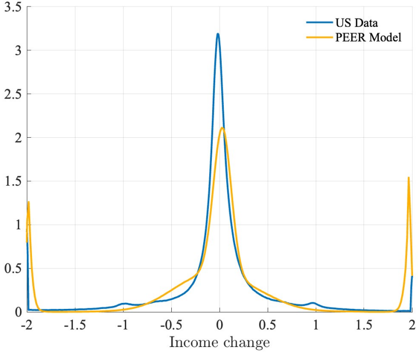

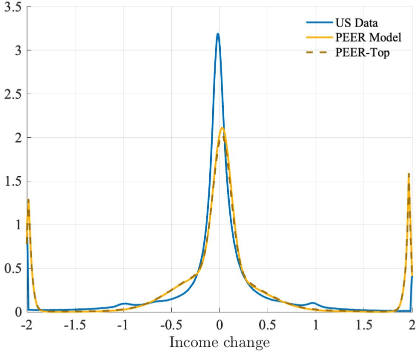

Income Risk: Density of Income Growth

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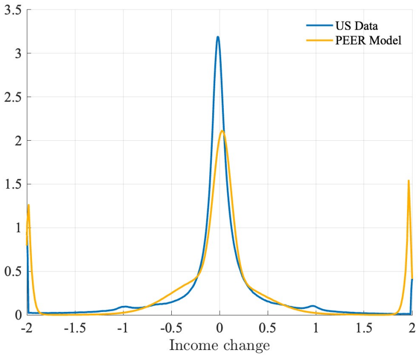

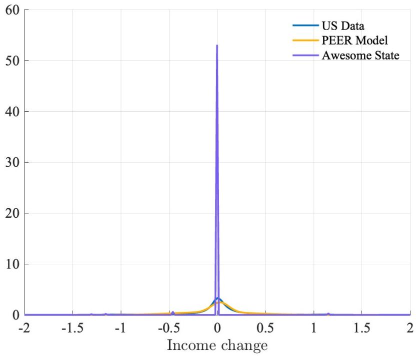

Income Risk: Density of Income Growth

back

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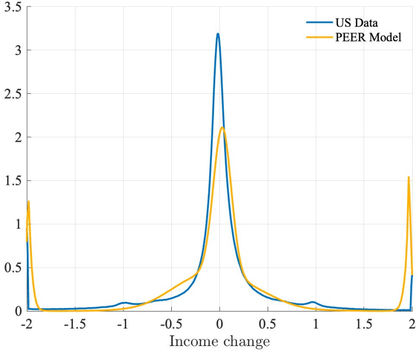
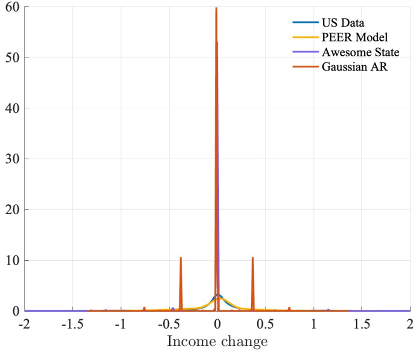
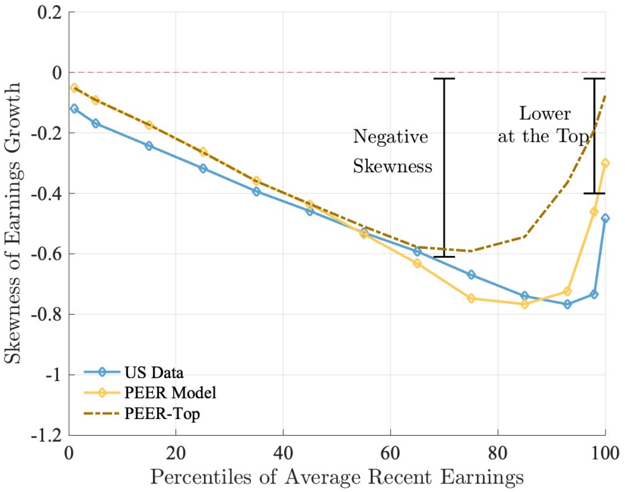




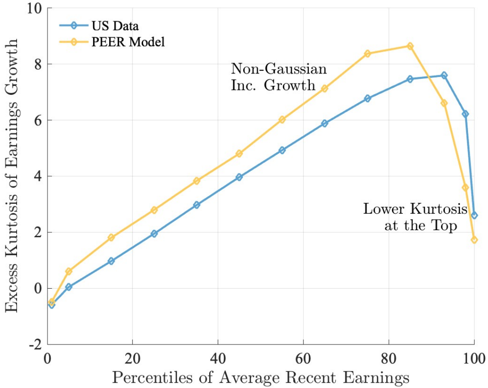
III.A Income Risk: Skewness of Income Growth

back



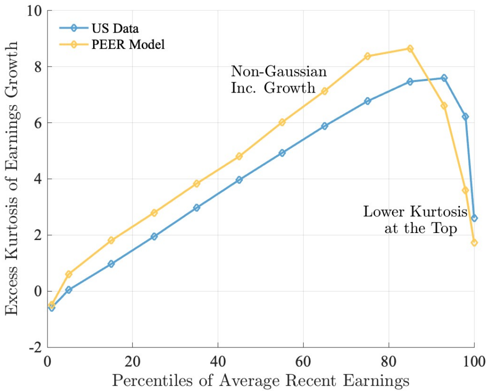
IV. Income Risk: Kurtosis of Income Growth

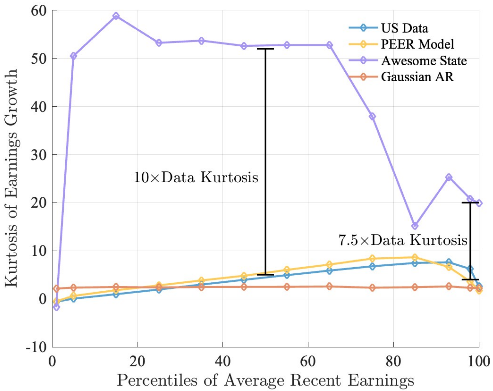
More back



IV. Income Risk: Kurtosis of Income Growth

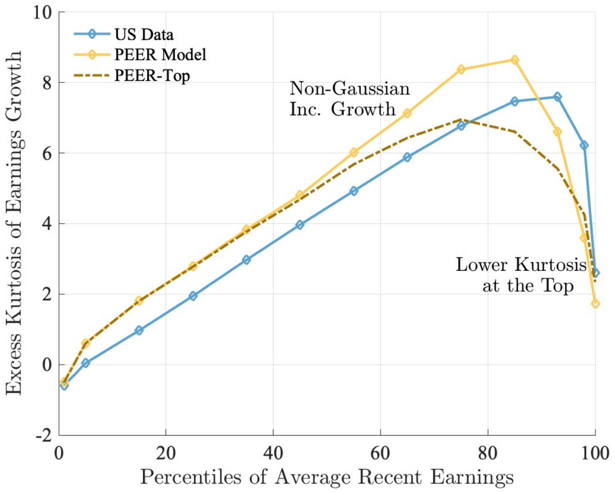
More back





IV.A Income Risk: Kurtosis of Income Growth

◂ back



Increasing R to Match Wealth Levels

more back 1 back 2

- Calibrate PEER model with $R = 11\%$ + Wealth-to-income ratio of 4

Increasing R to Match Wealth Levels

more back 1 back 2

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	US Data	PEER	PEER-Top	PEER-Top + $R = 11\%$	Markov Returns
Avg. Wealth	\$320K	\$170K	\$200K	\$314K	\$330K

Increasing R to Match Wealth Levels

more back 1 back 2

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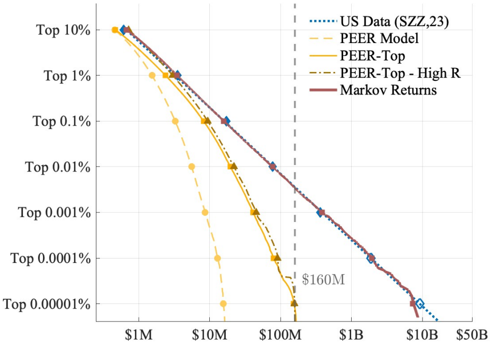

Wealth Inequality: PEER Model + PEER Top

back

	Gini + Top Shares			Top Wealth Thresholds		
	US Data	PEER Model	PEER Top	**US Data**	PEER Model	PEER Top
Gini	**0.85**	0.72	0.79			
Top 10%	**68.6**	54.2	65.2	0.6	0.5	0.5
Top 1%	**33.7**	13.5	24.1	3.5	1.5	2.4
Top 0.1%	**15.7**	2.5	6.6	**17.2**	3.3	8.2
Top 0.01%	**7.1**	0.4	1.4	**77.8**	5.6	19.6

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023) complemented with Forbes data.

Where is the Top? Top Percentile Thresholds

back

Cutoff Values in Millions of US Dollars

	US Data	Frameworks				
	Millions USD	Awesome State	PEER Model	Return Heterogeneity		
Threshold for top				Markov	Entrepreneurial	Markov +
1%	**3.5**	1.5	1.5	3.5	2.7	3.4
0.1%	**17.2**	16.5	3.2	15.9	16.5	13.4
0.01%	**77.8**	51.4	5.6	77.6	112.2	63.2

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023).

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Millionaires in the Model: Population Above Data Cutoffs

back

Cutoff (Millions USD)	US Data	Frameworks				
	Pop Share Above Cutoff	Awesome State	PEER Model	Return Heterogeneity		
				Markov	Entrepreneurial	Markov +
3.52	1.00	0.32	0.08	0.99	0.66	0.95

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023).

Millionaires in the Model: Population Above Data Cutoffs

back

Cutoff (Millions USD)	US Data	Frameworks				
	Pop Share Above Cutoff	Awesome State	PEER Model	Return Heterogeneity		
				Markov	Entrepreneurial	Markov +
3.52	1.00	0.32	0.08	0.99	0.66	0.95
17.2	0.10	0.09	0	0.09	0.10	0.07

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023).

Millionaires in the Model: Population Above Data Cutoffs

back

Cutoff (Millions USD)	US Data	Frameworks				
	Pop Share Above Cutoff	Awesome State	PEER Model	Return Heterogeneity		
				Markov	Entrepreneurial	Markov +
3.52	1.00	0.32	0.08	0.99	0.66	0.95
17.2	0.10	0.09	0	0.09	0.10	0.07
77.8	0.01	0.002	0	0.010	0.017	0.008

Source: US Data from *Smith, Zidar, Zwick* (QJE, 2023).

Wealth, Capital Income, and Consumption

▸ top zoom ◂ back

- How concentrated are capital income and consumption relative to wealth?

Wealth, Capital Income, and Consumption

top zoom back

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Lorenz: Consumption is less concentrated than wealth; Capital income is more

Wealth, Capital Income, and Consumption

top zoom back

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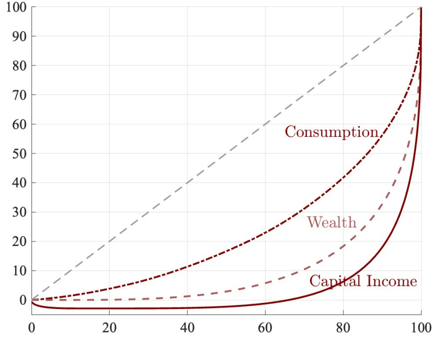
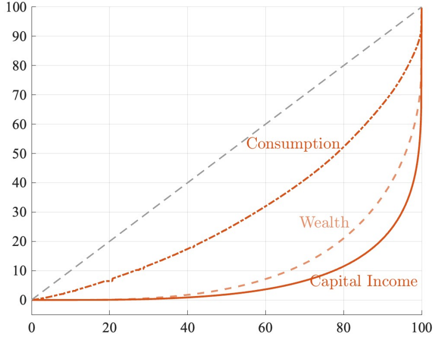
Markov Returns



Entrepreneurial Returns

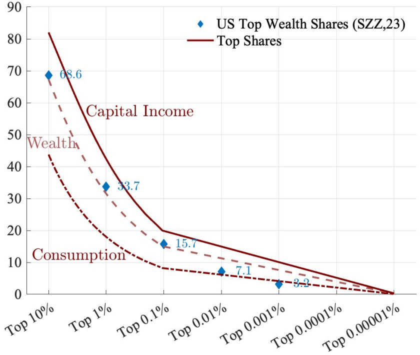


Wealth, Capital Income, and Consumption at the top

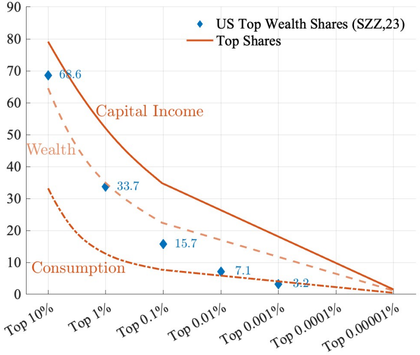
back

Top Shares: Consumption is less concentrated than wealth; Capital income is more

Markov Returns



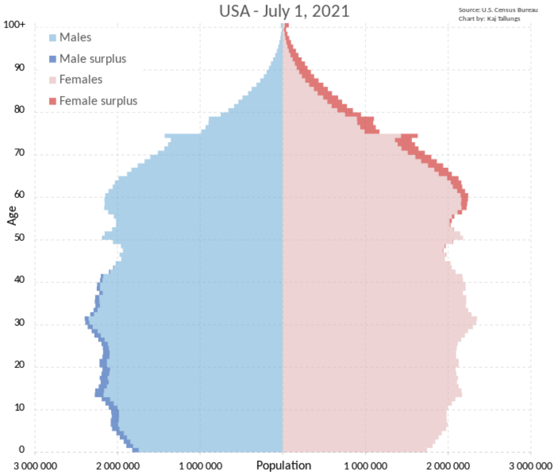
Entrepreneurial Returns



Age Distribution: US Data

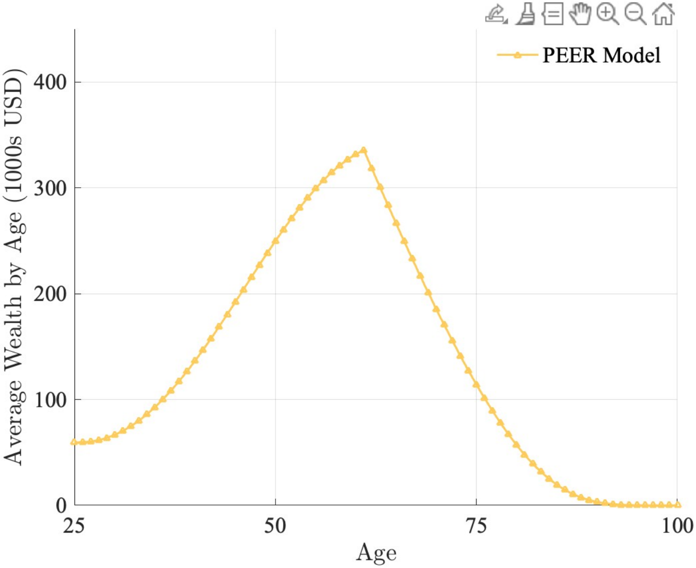
back

US has 97,000 centenarians. **Or 0.029% of population**



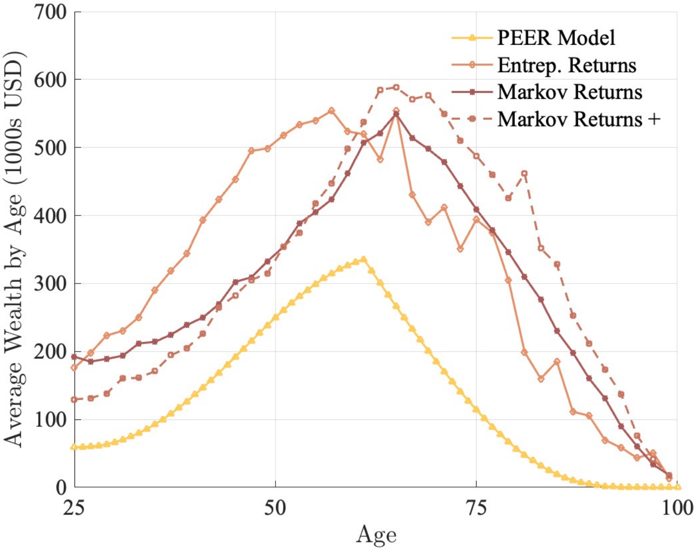
Average Lifecycle Wealth Profiles

back



Average Lifecycle Wealth Profiles

back



Average Lifecycle Wealth Profiles

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