The Dynamics of Inequality

PRELIMINARY

XAVIER GABAIX
NYU Stern

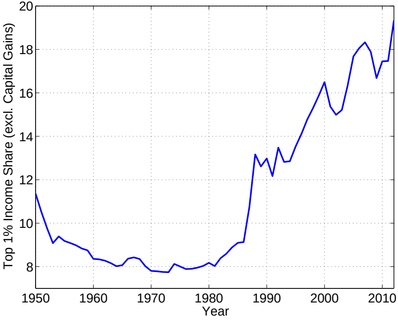
JEAN-MICHEL LASRY
Dauphine

PIERRE-LOUIS LIONS
Collège de France

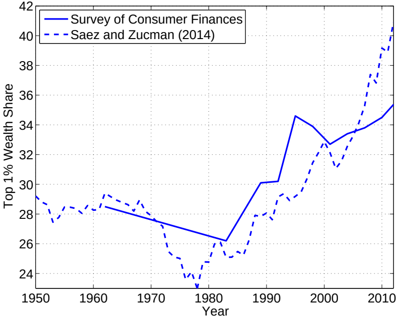
BENJAMIN MOLL
Princeton

JRCPPF Fourth Annual Conference
February 19, 2015

Question



(a) Top Income Inequality



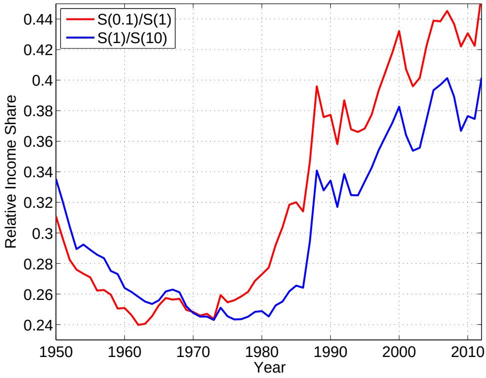
(b) Top Wealth Inequality

- In U.S. past 40 years have seen (Piketty, Saez, Zucman & coauthors)
  - rapid rise in top income inequality
  - rise in top wealth inequality (rapid? gradual?)
- **Why?**

Question

- **Main fact** about **top inequality** (since Pareto, 1896): upper tails of income and wealth distribution follow **power laws**
- Equivalently, top inequality is **fractal**
  1. ... top 0.01% are X times richer than top 0.1%,... are X times richer than top 1%,... are X times richer than top 10%,...
  2. ... top 0.01% share is fraction Y of 0.1% share,... is fraction Y of 1% share, ... is fraction Y of 10% share,...

Evolution of “Fractal Inequality”



- $\frac{S(p/10)}{S(p)}$ = fraction of top p% share going to top (p/10)%
  - e.g. $\frac{S(0.1)}{S(1)}$ = fraction of top 1% share going to top 0.1%
- Paper: same exercise for wealth

This Paper

- **Starting point:** existing theories that explain top inequality **at point in time**
  - differ in terms of underlying economics
  - but share basic mechanism for generating power laws: **random growth**
- **Our ultimate question:** which specific economic theories can also explain observed **dynamics** of top inequality?
  - income: e.g. falling income taxes? superstar effects?
  - wealth: e.g. falling capital taxes (rise in after-tax $r - g$)?
- **What we do:**
  - study **transition dynamics** of cross-sectional distribution of income/wealth in theories with random growth mechanism
  - contrast with data, **rule out** some theories, **rule in** others

Main Results

1. Transition dynamics of standard random growth models **too slow** relative to those observed in the data
   - analytic formula for speed of convergence
   - transitions particularly slow in **upper tail** of distribution

2. Fast transitions require specific departures from benchmark model
   - only certain economic stories generate such departures
   - $\Rightarrow$ eliminate the stories that cannot

3. Rise in top **income** inequality due to
   - ~~simple tax stories, stories about Var(permanent earnings)~~
   - **superstar effects, more complicated tax stories**

4. Rise in top **wealth** inequality due to
   - ~~increase in $r - g$ due to falling capital taxes~~
   - **rise in saving rates/RoRs of super wealthy**

Literature: Inequality and Random Growth

- **Income distribution**
  - Champernowne (1953), Simon (1955), Mandelbrot (1961), Nirei (2009), Toda (2012), Kim (2013), Jones and Kim (2013), Aoki and Nirei (2014),...
- **Wealth distribution**
  - Wold and Whittle (1957), Stiglitz (1969), Cowell (1998), Nirei and Souma (2007), Benhabib, Bisin, Zhu (2012, 2014), Piketty and Zucman (2014), Piketty and Saez (2014), **Piketty (2015)**
- **Dynamics** of income and wealth distribution
  - Blinder (1973), but no Pareto tail
  - Aoki and Nirei (2014)
- **Power laws are everywhere** ⇒ results useful there as well
  - firm size distribution (e.g. Luttmer, 2007)
  - city size distribution (e.g. Gabaix, 1999)
  - ...

Plan

- **Theory**
  - a simple theory of top income inequality
  - stationary distribution
  - **transition dynamics** (this is the new stuff)
- **Which economic theories can explain observed dynamics of top inequality?**
- **Today's presentation:** focus on top income inequality
- **Paper:** analogous results for top wealth inequality

A Random Growth Theory of Income Dynamics

- Continuous time
- Continuum of workers, heterogeneous in human capital h_{it}
- die/retire at rate δ, replaced by young worker with h_{i0}
- Wage is $w_{it} = \omega h_{it}$
- Human capital accumulation involves
  - investment
  - luck
- "Right" assumptions $\Rightarrow$ wages evolve as

$$\frac{dw_{it}/dt}{w_{it}} = \gamma_{it}, \quad \gamma_{it} dt = \bar{\gamma} dt + \sigma dZ_{it}$$

  - **growth rate** of wage w_{it} is **stochastic**
  - $\bar{\gamma}, \sigma$ depend on model parameters
  - Z_{it} = Brownian motion, i.e. $dZ_{it} \equiv \lim_{\Delta t \to 0} \varepsilon_{it} \sqrt{\Delta t}, \varepsilon_{it} \sim \mathcal{N}(0,1)$
- A number of alternative theories lead to same reduced form

Stationary Income Distribution

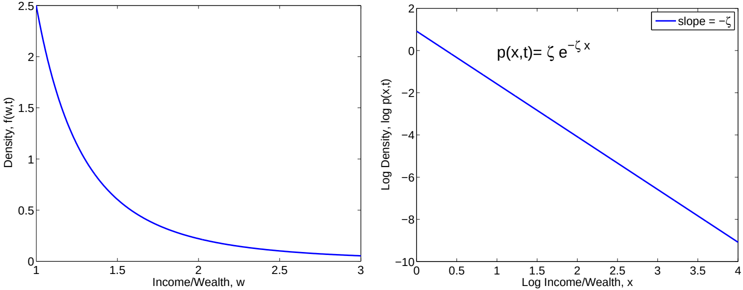
- **Result:** The stationary income distribution has a Pareto tail

$$\Pr(\tilde{w} > w) \sim C w^{-\zeta}$$

with tail inequality

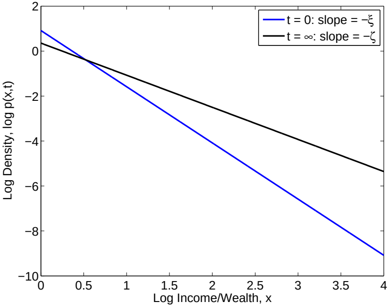
$$\eta = \frac{1}{\zeta} = \text{solution to quadratic equation}(\bar{\gamma}, \sigma, \delta)$$

- Inequality η increasing in $\bar{\gamma}, \sigma$, decreasing in δ
- Useful momentarily: w is Pareto $\Leftrightarrow$ $x = \log w$ is exponential



Transitions: The Thought Experiment

- $\sigma \uparrow$ leads to increase in stationary tail inequality
- But what about dynamics? Thought experiment:
    - suppose economy is in Pareto steady state
    - at $t = 0$, $\sigma \uparrow$. Know: in long-run $\rightarrow$ higher top inequality



- What can we say about the speed at which this happens?
    1. average speed of convergence?
    2. transition in upper tail?

Average Speed of Convergence

- **Proposition:** $p(x,t)$ converges to stationary distrib. $p_\infty(x)$

$$||p(x,t) - p_\infty(x)|| \sim ke^{-\lambda t}$$

with rate of convergence

$$\lambda = \frac{1}{2}\frac{\mu^2}{\sigma^2}\mathbf{1}_{\{\mu<0\}} + \delta$$

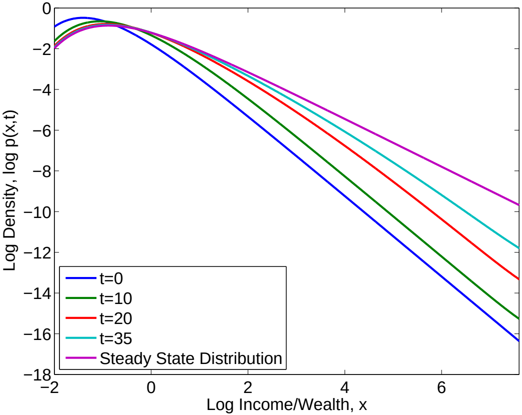
- For given amount of top inequality η, speed $\lambda(\eta, \sigma, \delta)$ satisfies

$$\frac{\partial\lambda}{\partial\eta} \leq 0, \quad \frac{\partial\lambda}{\partial\sigma} \geq 0, \quad \frac{\partial\lambda}{\partial\delta} > 0$$

- **Observations:**
  - **high inequality** goes hand in hand with **slow transitions**
  - half life is $t_{1/2} = \ln(2)/\lambda \Rightarrow$ precise quantitative predictions
- **Rough idea:** $\lambda =$ 2nd eigenvalue of "transition matrix" summarizing process

Transition in Upper Tail

- So far: **average** speed of convergence of whole distribution
- But care in particular about speed in **upper tail**
- Paper: full characterization of all moments of distribution $\Rightarrow$ transition can be much **slower** in upper tail



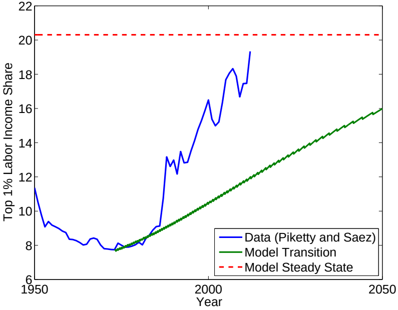
Dynamics of Income Inequality

- Recall process for log wages

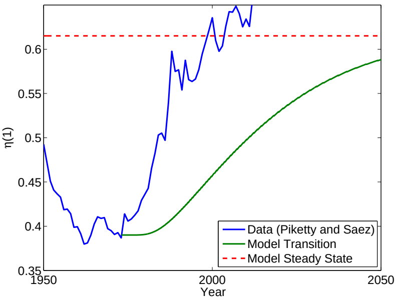
$$d \log w_{it} = \mu dt + \sigma dZ_{it} \qquad + \text{ death at rate } \delta$$

- Literature: σ has increased over last thirty years
  - documented by Kopczuk, Saez and Song (2010), DeBacker et al. (2013), Heathcote, Perri and Violante (2010) using PSID
  - but Guvenen, Ozkan and Song (2014): σ stable in SSA data
- **Can increase in σ explain increase in top income inequality?**

Dynamics of Income Inequality: Model vs. Data



(a) Top 1% Labor Income Share



(b) Pareto Exponent

- Experiment $\sigma^2 \uparrow$ from 0.01 in 1973 to 0.025 in 2014
- Note: PL exponent $\eta = 1 + \log_{10} \frac{S(0.1)}{S(1)}$ (from $\frac{S(0.1)}{S(1)} = 10^{\eta - 1}$)

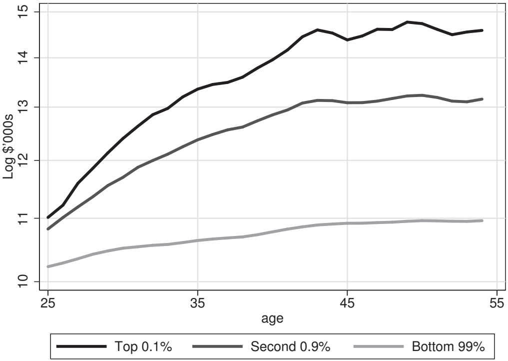
OK, so what drives top inequality then?

Two candidates:

1. our leading example: heterogeneity in mean growth rates
2. another candidate: non-proportional random growth, i.e. deviations from Gibrat's law

Heterogeneity in Mean Growth Rates

(A) Mean earnings by age



- Guvenen, Kaplan and Song (2014): between age 25 and 35
  - earnings of top 0.1% of lifetime inc. grow by ≈ 25% each year
  - and only ≈ 3% per year for bottom 99%

Heterogeneity in Mean Growth Rates

- Two regimes: H and L

$$dx_{it} = \mu_H dt + \sigma_H dZ_{it}$$
$$dx_{it} = \mu_L dt + \sigma_L dZ_{it}$$

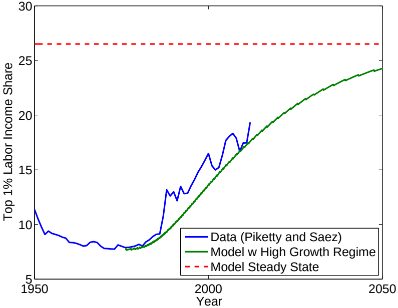
- Assumptions
  - $\mu_H > \mu_L$
  - fraction θ enter labor force in H-regime
  - switch from H to L at rate ϕ, $L =$ absorbing state
  - retire at rate δ

- **Proposition:** The dynamics of $\hat{p}(x,t) = \mathbb{E}[e^{-\xi x}]$ satisfy

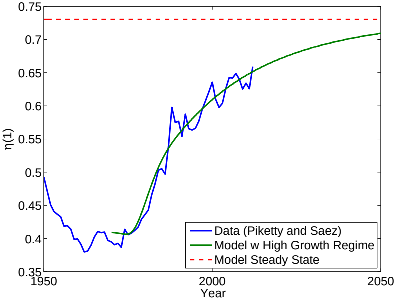
$$\hat{p}(\xi,t) - \hat{p}_\infty(\xi) = c_H(\xi)e^{-\lambda_H(\xi)t} + c_L(\xi)e^{-\lambda_L(\xi)t}$$

with $\lambda_H(\xi) > \lambda_L(\xi)$, and $c_L(\xi), c_H(\xi) =$ constants

Revisiting the Rise in Income Inequality



(a) Top 1% Labor Income Share



(b) Pareto Exponent

- Experiment: in 1975 growth rate of H-types $\uparrow$ by 14%
- Empirical evidence?

Heterogeneity in Mean Growth Rates

Some candidate economic explanations

- Different regimes = different occupations
  - high growth = finance, IT,...
- Increased returns to **superstars** in some occupations
  - larger returns to (perceived) talent
  - crucial parameter: "scale of operations", may be larger now (ICT etc)
  - Garicano and Rossi-Hansberg (2004, 2006, 2014), Gabaix and Landier (2008)
- Could decrease in labor income taxes have played a role?
  - yes, but simplest stories won't cut it
  - example of more sophisticated story: top income tax rates $\downarrow \Rightarrow$ more entry into high-growth, high-risk occupations ("I want to be a billionaire and now it's possible")

Wealth Inequality and Capital Taxes

- A simple model of top wealth inequality based on Piketty and Zucman (2015, HID), Piketty (2015, AERPP),...

$$dw_{it} = [y + (r - g - \theta)w_{it}]dt + \sigma w_{it} dZ_{it}$$
$$r = (1 - \tau)\tilde{r}, \quad \sigma = (1 - \tau)\tilde{\sigma}$$

  - y: labor income
  - $R_{it}dt = rdt + \sigma dZ_{it}$: after-tax return on wealth
  - τ: capital tax rate
  - g: economy-wide growth rate
  - θ: MPC out of wealth

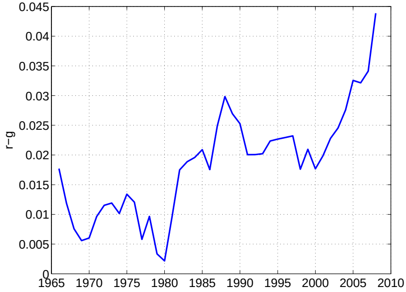
- Stationary top inequality

$$\eta = \frac{1}{\zeta} = \frac{\sigma^2/2}{\sigma^2/2 - (r - g - \theta)}$$

- **Can $r - g$ explain observed dynamics of wealth inequality?**

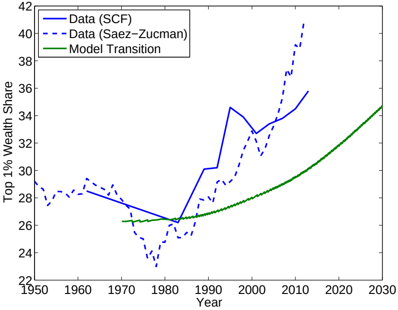
Wealth Inequality and Capital Taxes

- Compute $r_t - g_t = \tilde{r}_t(1 - \tau_t) - g_t$ with details
  - $\tilde{r}_t$ from Piketty and Zucman (2014)
  - τ_t = capital tax rates from Auerbach and Hassett (2015)
  - g_t = smoothed growth rate from PWT

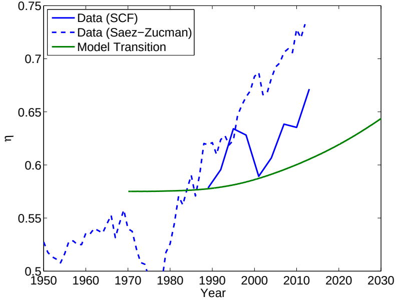


- $\sigma = 0.3$ = upper end of estimates from literature
- θ calibrated to match inequality in 1978

Dynamics of Wealth Inequality



(a) Top 1% Wealth Share



(b) Power Law Exponent

Note: PL exponent $\eta = 1 + \log_{10} \frac{S(0.1)}{S(1)}$ (from $\frac{S(0.1)}{S(1)} = 10^{\eta-1}$)

OK, so what drives top wealth inequality then?

- Rise in **rate of returns** of super wealthy relative to wealthy (top 0.01 vs. top 1%)
  - better investment advice?
  - better at taking advantage of "tax loopholes"?
- Rise in **saving rates** of super wealthy relative to wealthy
  - Saez and Zucman (2014) provide some evidence

Conclusion

- Transition dynamics of standard random growth models **too slow** relative to those observed in the data
- Rise in top **income** inequality due to
  - ~~simple tax stories, stories about Var(permanent earnings)~~
  - **superstar effects, more complicated tax stories**
- Rise in top **wealth** inequality due to
  - ~~increase in $r - g$ due to falling capital taxes~~
  - **rise in saving rates/RoRs of super wealthy**