Inequality and Asset Prices

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Question

How does wealth and income inequality affect asset prices?

Recent Developments

- "The 1%": A small group of investors holds ever larger share of asset market.
- Some groups have ceased to participate in asset markets, e.g. have become liquidity-constrained.
- Income inequality has increased.

⇒ What does this mean for asset prices?

⇒ Interesting: Debate about re-distributive tax policy, which will affect inequality.

Potential Channels

How could changes in inequality affect asset prices?

In this paper:

- The rich's income is highly correlated with asset returns
  $\Rightarrow$ Value payoffs from assets different from representative agent
- Changes in market participation: poor are driven out of market
  $\Rightarrow$ Changes in aggregate asset demand and supply

Not in this paper:

- The rich have different information
- Preferences:
  - Rich are more patient. . . : e.g. Krusell & Smith (1997)
  - . . . or less risk averse: e.g. Dumas (1989)
  - Concave absolute risk tolerance: e.g. Gollier (2001)
  - Keeping-up-with-the-Joneses preferences: e.g. Johnson (2011)

Literature

1. Bewley-Krusell-Smith-type models:
   - Idiosyncratic shocks wash out.
   - Wealth distribution does not affect asset prices.

   ⇒ Need **correlated risk** to generate effects.

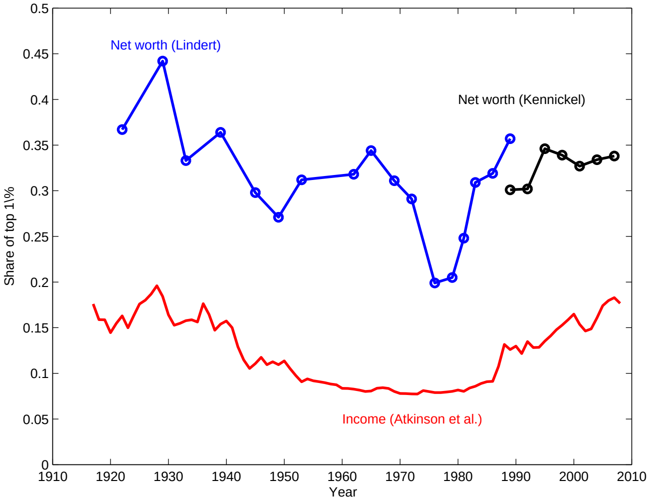
2. Incomplete-markets with few types of agents: DenHaan (1996), Heaton & Lucas (1996), Stepanchuk & Tsyrennikov (2011) etc.

   ⇒ Highly computational, focus on long-run time-series outcomes.

3. Closest to our model: Scheinkman & Weiss (1986), **but**:
   - Agents never cease to participate in asset market (Inada condition).
   - Linear preferences for leisure ⇒ Rich agents have constant consumption.

   ⇒ We obtain different results for asset prices in a more standard environment.

Data: Inequality



Issues with Inequality Data

- Good data only since 1970s (especially for "99%")
- Wealth-inequality series poorly measured.
- Slow-moving ⇒ Essentially very few observations.
- Other factors that affect asset markets co-move with inequality: business cycle, policy,...
  ⇒ Hard to identify contribution of inequality.
- Exploit cross-country variation? Not convincing: asset markets correlate.

⇒ **We opt for modeling approach.** asset data

Model

Setting

Endowment economy with two types of agents 1, 2 (of equal measure) in continuous time:

- Exogenous endowment stream:
  - Agent 1's income $y \in \{y_l, y_h\}$ follows Poisson process with switching rate η.
  - Whenever agent 1 has low income y_l, agent 2 has high income y_h and vice versa.
- One asset: Lucas tree in unit supply
  - Initial endowments: a_0^1, a_0^2.
  - Constant dividend stream $d > 0$.
  - No short-selling: $a_t^i \geq \underline{a} = 0$.
  - Traded at price P_t (in terms of consumption good).

  $\Rightarrow$ GDP is constant (normalize: $d + y_l + y_h = 1$).
- Standard preferences:

$$U_i = E_0 \int_0^\infty e^{-\rho t} u(c_t^i) dt.$$

Incomplete Markets: Agent's Constraints

- The budget constraint at t, given the inherited asset position $a_{t-\Delta t}$, is:

$$c_t \Delta t + P_t(\underbrace{a_t - a_{t-\Delta t}}_{\text{net demand for tree at } t}) = \underbrace{y_t \Delta t + a_{t-\Delta t} d \Delta t}_{\text{total income}}.$$

- Divide by Δt and take limits as $\Delta t \to 0$ to find budget constraint:

$$c_t + P_t \dot{a}_t = y_t + d a_t,$$

where $\dot{a}_t = \lim_{\Delta t \to 0} \frac{a_t - a_{t-\Delta t}}{\Delta t}$ is the agent's **net demand** for the asset at t.

- No short-selling:

$$a_t \geq 0.$$

State: big-A, little-a

- Aggregate state: (y_t, A_t)
- Individual state: $(y_t, A_t; a_t)$
- A_t: Fraction of tree that **all** agents of type 1 hold (together).

  $\Rightarrow$ Must have $A_t \in [0, 1]$.
- **Perceived law of motion** $\dot{A}_t$ implied by:
  1. $C(y_t, A_t)$: Consumption of typical agent 1 and
  2. $P(y_t, A_t)$: Pricing function.
- The typical agent 2 consumes $1 - C(y_t, A_t)$.

Equilibrium

A *competitive equilibrium* consists of functions $c^1(y, A)$, $c^2(y, A)$, $C(y, A)$ and $P(y, A)$ such that

- The stochastic process $c^i(y_t, A_t)$ solves agent i's problem given the perceived law of motion implied by $C(y, A)$ and $P(y, A)$.
- Rational expectations/consistency:

$$c^1(y, A) = C(y, A),$$
$$c^2(y, A) = 1 - C(y, A).$$

- Market clearing for consumption good (already implied):

$$c^1(y, A) + c^2(y, A) = d + y_l + y_h = 1.$$

Note: Asset-market clearing is implied by Walras' Law.

Solving for Equilibrium

Strategy: Find functions $C(y, A)$ and $P(y, A)$ such that

1. Stochastic process $c_t^1 = C(y_t, A_t)$ fulfills agent 1's Euler equation.
2. Stochastic process $c_t^2 = 1 - C(y_t, A_t)$ fulfills agent 2's Euler equation.

$\Rightarrow$ 4 first-order differential equations for

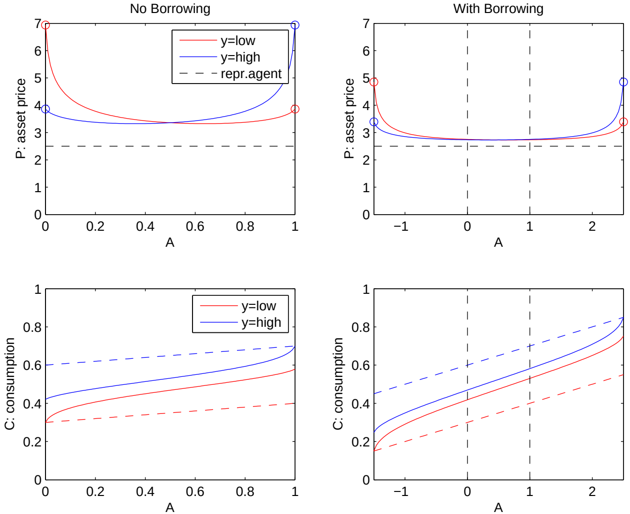
$$\{C(\cdot, y_l), C(\cdot, y_h), P(\cdot, y_l), P(\cdot, y_h)\}$$

with 4 boundary conditions (Euler equations at constraints).

Results

Results: numerical example

$\gamma = 2$ (CRRA), $\rho = 0.04$, $\eta = 0.1$, $y_l = 0.3$, $y_h = 0.6$ and $d = 0.1$.



Results (I)

- **Asset prices are highest when constraint $A \in \{0, 1\}$ is reached.**
  Poor agent does not participate in asset market: drop in supply.
  $\Rightarrow$ Rich agent prices asset, wants insurance: surge in demand. Fears:

  1. Drop in labor income.
  2. Drop in asset price and thus wealth.

- **Expected returns** are **lowest** when **constraint** is reached.
  - Only rich agent demands asset, wants insurance.

- **Asset prices are increasing in wealth inequality**.
  High prices at constraint feed back into interior.
  $\Rightarrow$ Prices high whenever reaching constraint appears likely.

Results (II)

- Fixing wealth inequality (A), **asset prices are high** when asset-rich agent is also income-rich, i.e.
  - when **income inequality is high**, and
  - when **wealth inequality is on the rise**.
  - Intuition: higher probability of hitting constraint

- Asset-price **volatility is highest** when **wealth inequality is large**.
  $\Rightarrow$ Intuition: Large movements in asset demand since participation changes!

Pricing Equation

- Average marginal utility: $\Gamma_t \equiv \frac{1}{2}u'(c_t) + \frac{1}{2}u'(1-c_t)$
  $\Rightarrow$ Strictly increasing in consumption inequality if $u'(\cdot)$ convex
- Stochastic discount factor:

$$\Lambda_t = \Gamma_t \underbrace{\xi^{I_t^1}}_{>1} \underbrace{\zeta^{I_t^2}}_{>1},$$

  I_t^j: the number of times an income reversal occurred when agent j was constrained up.

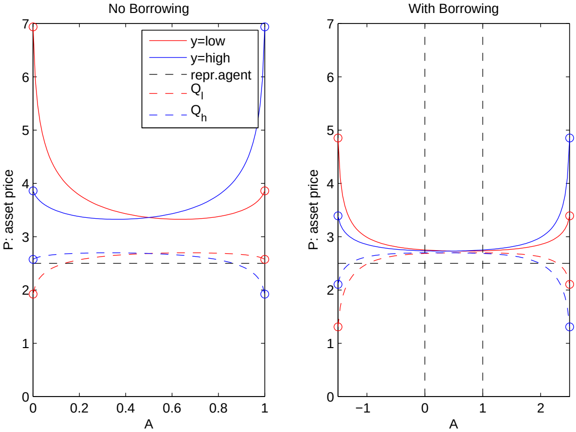
- The price of the asset satisfies

$$P_t \Lambda_t = E_t \left[\int_t^\infty \left(e^{-\rho(s-t)} \Lambda_{t+s} d \right) ds \right].$$

1. Constraint likely to bind in near future: $P_t \uparrow$
2. Relatively high current consumption inequality: $P_t \downarrow$

Disentangling the Pricing Equation

Construct hypothetical price: $Q_t \Gamma_t = E_t \int_0^\infty \left(e^{-\rho s} \Gamma_s d \right) ds$



⇒ High current consumption inequality lowers asset price, but effect from constraint dominates

Conclusions

Conclusions

- **Main results:** When **inequality is high**,
  1. asset **prices are high**.
  2. asset **returns are low**.
  3. **volatility is high**.
- Find similar results when replacing Lucas tree by:
  1. short-term bond
  2. capital in production economy
- Continuous time allows interesting **characterizations** at constraint.
- **To do: policy.** How does income redistribution affect asset markets?

Further lessons

- Stark counterexample to Krusell & Smith (1998):
  Wealth distribution **matters a lot** for predicting prices here.

- Cautionary note for computation in incomplete-markets international-finance models:
  Prices can do weird things when constraints start to bind.

Extra Slides

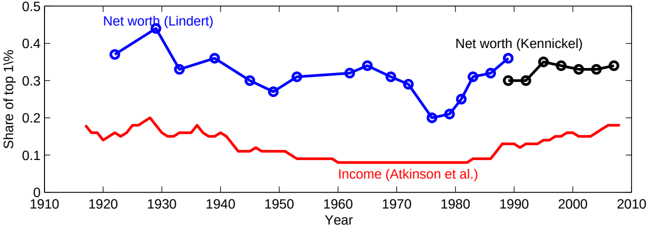
Data summary: inequality and asset returns

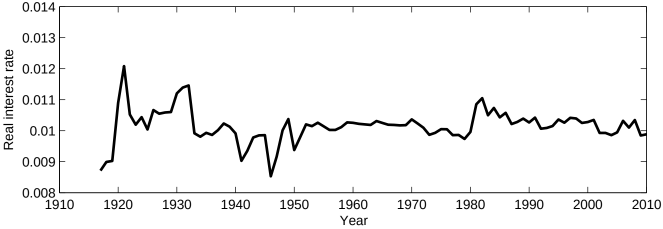
Returns data: Risk-free rate and S&P 500, 1917-2010.

- No visible correlation of inequality and asset-returns.
- Asset returns seem more volatile in times of high inequality.

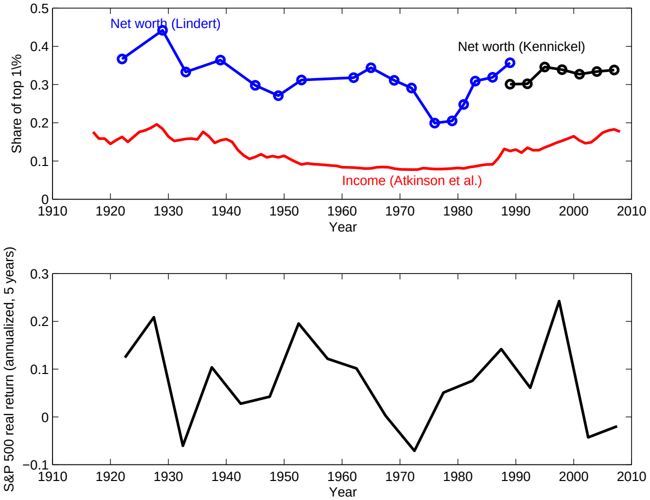
But: Don't want to take this evidence too seriously because of issues mentioned above.

Inequality and the risk-free rate

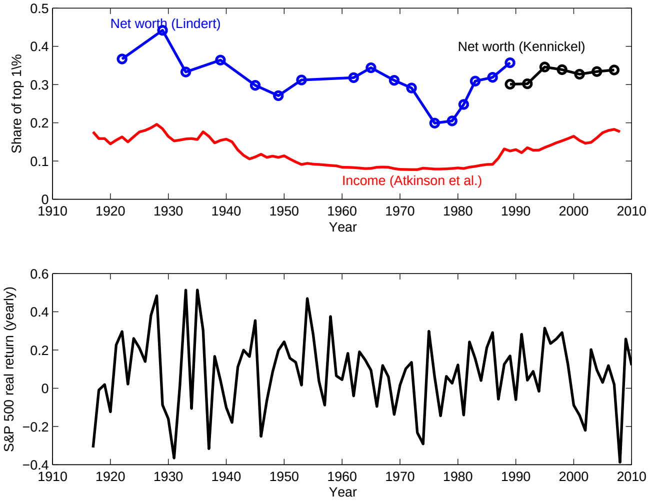




Inequality and 5-year stock returns



Inequality and stock-market volatility



Extra: Advantages of continuous time

1. Agent only constrained when $x = 0$ (discrete time: also for some $x > 0$)
2. Can study **jumps** in asset returns at $x = 0$ analytically.
3. Euler equations give us **differential equations** for policies and prices.
   - In discrete time, have to go through all cases: Go broke in 1,2,3,... periods.
   - Have N initial and M terminal conditions: Tells us how many equilibria to expect (generically).

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