Capital in a Segregated Economy

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Wealth Inequality in the US

Figure 10.5. Wealth inequality in the U.S., 1810-2010

The top 10% wealth holders own about 80% of total wealth in 1910, and 75% today.
Sources and series: see piketty.pse.ens.fr/capital21c.
Inequality and Policy

• Existing research on inequality has mostly focused on how to generate such high levels of wealth inequality endogenously in a DSGE.
  – This turns out to be really, really hard.
  – A few people have more wealth than can be accumulated in one generation.
  – Death without altruism limits patience in long run.
  – Basic policy questions yield nonrobust results.

• I am proposing a model with exogenous heterogeneity where policy analysis is simple.
Literature on Bequests

• Barro (1974): pure altruism $\implies$ infinite horizon.

• Kotlikoff and Summers (1981): a large fraction of the capital stock is inherited.
  – $K/Y$ implies parents put little value on kids.

• De Nardi (2004), De Nardi and Yang (2014): impure altruism $\implies$ more plausible preferences.

• Feigenbaum and Li (2018): intrafamily bargaining leads to distinctly different bequest behavior between 99.9% and 0.1%.
A Segregated Economy

• A segregated economy model is a hybrid of an infinite-horizon model and an overlapping-generations (OLG) model.

• Laborers have a finite horizon since they do not earn enough wealth to pass onto next generation.
  – They live for two periods here.

• Capitalists, on the other hand, are characterized as an infinite-lived dynasty.
Preexisting Literature

• Others such as Mankiw and Pestieau have studied similar hybrid models.

• The idea, nevertheless, remains fairly obscure in the literature.

• The lessons of such hybrid models are particularly apropos in the current political climate.
Segregated Economy vs Microfoundations

• We can easily calibrate segregated economy to match holdings of, say, the 0.1%.
  – We cannot explain how the 0.1% wound up on top or why capitalist/laborer threshold is near 0.1%.

• Straightforward to study first-order interactions between wealth distribution and tax policy.

• We can also see how 0.1% could exploit their market power, which is beyond the scope of current micro-founded models.
Trickle-Down Economics

• The infinite-horizon result of no capital taxes still holds true in the baseline price-taking model.

• Almost all of welfare gains from eliminating capital tax go to capitalists.

• Early cohorts of workers will be hurt badly during the transition.
  – It takes several generations for after-tax wages to rise.

• A Pareto-improving path has to raise taxes on capitalists first.
The Warren Wealth Tax

- Capitalists will disappear if they are not more patient than the workers.

- A wealth tax on capitalists would effectively increase their discount rate by the tax rate.

- For the baseline calibration, the difference in annual discount rates is roughly 3 percentage points, which is also her proposed tax rate for billionaires.
A Trend of Diminishing Competition?

• While New Keynesian models incorporate imperfect competition, neoclassical models still routinely assume perfect competition.

• Nevertheless, consolidation of firms is a popular explanation for wage stagnation.

• Piketty (2014) emphasizes market power of executives when setting salaries.
Smith on Labor and Capital

• “The increase of stock [capital], which raises wages, tends to lower profit.”

• Smith recognized that, ceteris paribus, workers and capitalists play a zero-sum game.
  – First identification of economic class conflict.
  – Since he was unaware of the marginal principle, he could focus his attention on the game.
  – Wages are high where workers have more bargaining power, so capitalists will conspire to reduce this bargaining power.
Smith Distortions

- When wealth becomes concentrated in the hands of a few people, it is not rational for them to ignore their pricing power.
  - For capitalists, the collusive strategy is always the same: consume more and save less.

- Laborers cannot coordinate in the same way because the optimal strategy for them changes.
  - Optimal irrational behavior is very counterfactual and also very complicated.

- Upshot is markets are no longer efficient.
A Simple Example

• Consider a representative agent model with Cobb-Douglas production, log utility, fixed labor, and full depreciation.

• The Bellman equation is

$$v(K) = \max_{C,K'} \ln(C) + \beta v(K')$$

subject to

$$C + K' = Y = AK^\alpha N^{1-\alpha}$$
A Simple Solution

• We can show by guess and verify that

\[ v(K) = \frac{\alpha}{1 - \alpha \beta} \ln(K) + \text{constant} \]

• The policy function is

\[ C(K) = (1 - \alpha \beta) AK^\alpha N^{1-\alpha} \]
A Simple Steady State

• Next period’s capital is

\[ K'(K) = \alpha \beta AK^\alpha N^{1-\alpha} = \alpha \beta Y \]

• In the steady state, where \( K' = K \),

\[ \frac{K}{Y} = \alpha \beta. \]
Simple Solution with a Capitalist

- Suppose now that all the capital is owned by one capitalist and labor is supplied separately.

- If labor markets are competitive, the profit earned by the capitalist will be $\alpha K^\alpha N^{1-\alpha}$.
  - The capitalist’s problem is the same as before with $A = \alpha$ except $Y$ is now $K^\alpha N^{1-\alpha}$.

$$K' = \alpha \beta (\alpha K^\alpha N^{1-\alpha})$$
Macro with Capitalists

• In the steady state,

\[
\frac{K}{Y} = \alpha^2 \beta
\]

• If the capital-output ratio decreases by a factor of \( \alpha \), output and wages will decrease by a factor of \( \alpha^{1-\alpha} \).

• If \( \alpha = 1/3 \), this is \( \sqrt{\alpha} = 0.573 \).
  – Output and wages fall by 43%.
Price-Setting vs Price-Taking

• The key to this result is the assumption that the capitalist understands how his profit depends on his investment.

• If he assumes his income will be $RK$, where the gross return $R$ is beyond his influence, he will choose $K' = \beta RK$.

• In equilibrium $RK = \alpha Y$, so we then get back the representative-agent result, $K' = \alpha \beta Y$. 
A More Realistic Model

• As things stand, in the United States, the 0.1% own $\leq 30\%$ of the capital stock.

• If they own 20% of the capital stock, the effects of price-setting will be more modest.

• GDP is 7.5% lower and worker welfare decreases by equivalent of 6% of consumption.
  – Noise in measurements could mask price-setting.
  – If price-setting occurs, markets are not efficient.
Lessons about Price Setting

• Just as the solution to the Cass-Koopmans-Ramsey model behaves unintuitively, this is even more so for a price-setting capitalist.

• Optimal behavior for price-setting capitalists actually reduces their share of the capital stock.

• The standard Euler equation will not apply to capitalists, which may account for difficulty of pinning down preference parameters.
Philanthropy and Price Setting

• Increases in philanthropy after becoming wealthy are actually evidence of price-setting.
  – When a capitalist says that he is going to spend a good chunk of his wealth on stuff that will make him happy because his kids do not need so much to get by, that is in line with the price-setting model, not the price-taking model.

• Getting capitalists to decrease saving rate as they get wealthier requires exotic preferences.
The Model Structure

• In each period, a measure $\mu$ of laborers is born, and there is a measure $1 - \mu$ of capitalist dynasties.

• The laborers live for two periods with certainty while the dynasties live forever.

• The total population has measure $1 + \mu$. 
The Laborers

• The laborers work when young and are retired when old.

• They have utility

\[ U_t^l = u^l (c_{t,0}^l, l_t) + \beta^l u^l (c_{t+1,1}^l, 1) \]

• We will only consider the case

\[ u^l(c, l) = \eta \ln c + (1 - \eta) \ln l. \]
Laborer’s Behavior

With these preferences, the laborer chooses
\[ l = \frac{1 - \eta}{1 + \beta^l \eta}. \]

Let the wage at \( t \) be \( w_t \) and return on capital \( r_t \).
\[
\begin{align*}
c_{t,0}^l &= \frac{1}{1 + \beta^l} w_t (1 - l) \\
c_{t+1,1}^l &= \beta^l (1 + r_{t+1}) c_{t,0}^l
\end{align*}
\]
Laborers and Factor Markets

• Only the laborer’s work, so the labor supply is

\[ N = \mu(1 - l) = \frac{1 + \beta^l}{1 + \eta \beta^l} \mu \eta. \]

• The laborers’ saving contributes to capital:

\[ \mu k_{t+1}^l = \mu \frac{1 - l}{1 + \beta^l} w_t \]

• Let \( s = \frac{1-l}{1+\beta^l} \) be the saving rate out of the wage.
The Capitalists

• A capitalist dynasty maximizes

\[ U_t^c = \sum_{s=0}^{\infty} (\beta^c)^t u^c(c_t^c) \]

• Unlike the laborer, the dynasty will have previously accumulated capital.

• We consider both the cases where capitalists are price-takers and price-setters.
Output and Wages

- Let $K_t$ be the capital stock.
- There is a Cobb-Douglas production function
  \[ Y_t = K_t^\alpha N^{1-\alpha}. \]
- We assume the labor market is competitive, so the wage is the marginal product of labor.
  \[ w_t = w(K_t) = (1 - \alpha) \left( \frac{K_t}{N} \right)^\alpha. \]
Return on Capital

• The capital market is not competitive, but competitive wages mean the return on capital is

\[ r_t = r(K_t) = \alpha \left( \frac{K_t}{N} \right)^{\alpha-1} - \delta. \]

• The gross return is

\[ R_t = R_t(K) = 1 + r_t \]
Capital Accumulation

• Let $k_{t+1}$ denote the capitalist’s demand for capital at time $t + 1$.

• Next period’s capital stock will be

$$K_{t+1} = \mu sw(K_t) + (1 - \mu)k_{t+1}.$$ 

• The state of the economy at $t$ will be $(k_t, K_t)$.
  – $k_t$ characterizes the capitalist’s wealth.
  – $K_t$ characterizes the aggregate economy and determines factor prices.
Bellman Equation

• The price-setting capitalist’s value function obeys

\[ \nu(k_t, K_t) = \max u^c(c_t^c) + \beta^c \nu(k_{t+1}, K_{t+1}) \]

subject to

\[ k_{t+1} = R(K_t)k_t - c_t^c \]

\[ K_{t+1} = \mu sw(K_t) + (1 - \mu) k_{t+1}. \]
Price-Taking Equilibrium

• For the rest of the talk, let $u^c(c) = \ln(c)$.

• Suppose the capitalist assumes $K_t$ follows some process that he has no influence over.

• The solution will then be

$$c_t^c(k_t, K_t) = (1 - \beta^c)R(K_t)k_t$$
$$k_{t+1}(k_t, K_t) = \beta^c R(K_t)k_t$$

• $R^*_pt = (\beta^c)^{-1}$ in the price-taking steady state.
Price-Setting FOC

• If, on the other hand, the capitalist knows the equation for $K_{t+1}$, the first-order condition is

$$\frac{1}{c_t^c} = \beta^c \left( \frac{R_{t+1}(K_{t+1})}{c_{t+1}^c} + (1 - \mu) \frac{\partial V}{\partial K}(k_{t+1}, K_{t+1}) \right)$$

• Ignoring the second term, we get back the usual Euler equation, which is a condition for efficiency:

$$c_{t+1}^c = \beta^c R_{t+1}(K_{t+1}) c_t^c.$$
Effect of Smith Distortion

• $V(k, K)$ decreases with $K$ since the rate of return decreases with $K$.

• Thus

$$c_t^c > \frac{c_{t+1}^c}{\beta^c R_{t+1}(K_{t+1})}.$$  

• A price-setting capitalist will consume more now and decrease his saving relative to a price-taking capitalist.
Understanding $\partial V/\partial K$

- The value function is largely determined by $R(K)k$ and its future iterations.

\[
\frac{d}{dk} R(K)k = R(K) + (1 - \mu)R'(K)k
\]

\[
= R(K) \left[ 1 + \frac{(1 - \mu)k}{K} \frac{KR'(K)}{R(K)} \right]
\]
Wealth Inequality

• Let us define

\[ \kappa = \frac{(1 - \mu)k}{K} \]

to be the share of capital owned by the capitalists.

• This also serves as our measure of wealth inequality.
Understanding $\partial V/\partial K$

- $\partial V/\partial K$ is proportional to $\kappa$:

$$
\frac{d}{dk} R(K)k = R(K) \left[ 1 + \kappa \frac{KR'(K)}{R(K)} \right]
$$

- The elasticity is a function of the curvature of the production function.
  - With full depreciation, it simplifies to $\alpha - 1$, i.e. minus the share of labor.
Calibration

• Share of capital: $\alpha = 1/3$

• 1 period = 30 years

• $K/Y = 3.0 \Rightarrow \beta^c = 0.965$ annual (0.343 period)

• $C/Y = 0.75 \Rightarrow \delta = 0.083$ per annum (0.926 1/per.)

• Labor hours: 40 per week $\Rightarrow \eta = 0.216$

• Price-setting capitalists are 0.1% $\Rightarrow \mu = 0.998$

• $\kappa = 0.20 \Rightarrow \beta^d = 0.935$ annual (0.133 period)
# Steady-State Observables

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<th>Variable</th>
<th>PT</th>
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How Much Do Capitalists Contribute to Welfare of Laborers?

- Welfare would decrease for laborers by the equivalent of 8.3% of consumption if we eliminated the price-setting capitalists.
  - Capitalists contribute 30% of the capital stock but only 10% of GDP.

- The drop would be 8.0% if we recalibrate the economy with price-taking capitalists.
Price-Taking to Price-Setting Transition – Capitalist Variables
Price-Taking to Price-Setting Transition – Laborer Variables
Price-Setting to Price-Taking Transition – Capitalist Variables
Price-Setting to Price-Taking Transition – Laborer CV
Price-Setting to Price-Taking Transition – $K/Y$ in years
Conclusions

1. If a large fraction of capital is owned by a small fraction of the population, they should rationally exploit their pricing power.

2. Divergence of Euler equation is proportional to fraction of capital owned by capitalists and curvature of production function.

3. Price-setting capitalists consume more in the short run.
More Conclusions

4. Future generations consume less, but higher return to capital reduces loss so there is an overall gain to dynastic utility.

5. Both the capitalist and initial generation of workers would be hurt by price-taking.

6. A Pareto-improving transition back to price-taking steady state requires slower initial increase in capital.
Future Research

1. Ideally, we should have both low-skilled and high-skilled labor.
   – Effect of skill-biased technological change.

2. Adding uncertainty?
   – Does price-setting lessen equity premium puzzle?

3. Endogenizing $\mu$