Political Economy, Institutions and Development. Lecture 2: Politics, Social Mobility and Labor Coercion

Daron Acemoglu

MIT & Northwestern

May 13, 2014.

Introduction

- We now turn to an more detailed analysis of economic distortions that arise within a given political system because those with political power try to influence economic activities in a way that is advantageous for them.
- We will focus on a dynamic model social mobility and also models and issues in the study of labor coercion.

Simple Model of Elite Control

- Infinite horizon economy populated by a continuum 1 of risk neutral agents, with discount factor equal to $\beta < 1$.
- Unique non-storable final good denoted by y.
- The expected utility of agent j at time 0 is given by:

$$U_0^j = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t c_t^j, \tag{1}$$

  where $c_t^j \in \mathbb{R}$ denotes the consumption of agent j at time t and $\mathbb{E}_t$ is the expectations operator conditional on information available at time t.
- Suppose that each individual dies with a small probability ε in every period, and a mass ε of new individuals are born (with the convention that after death there is zero utility and β is the discount factor inclusive of the probability of death).
- We will consider the limit of this economy with $\varepsilon \to 0$.

Occupations

- production workers versus capitalists/entrepreneurs.
- All agents have the same productivity as workers, their productivity in entrepreneurship differs.
- Agent j at time t has entrepreneurial talent/skills $a_t^j \in \{A^L, A^H\}$ with $A^L < A^H$.
- To become an entrepreneur, an agent needs to set up a firm, if he does not have an active firm already.
- Setting up a new firm may be costly because of entry barriers created by existing entrepreneurs.

States

- Each agent therefore starts period t with two state variables:
  - skill level $a_t^j \in \{A^H, A^L\}$
  - $s_t^j \in \{0, 1\}$ denoting whether the individual has an active firm.
- We refer to an agent with $s_t^j = 1$ as a member of the "elite," since he will have an advantage in becoming an entrepreneur (when there are entry barriers), and in an oligarchic society, he may be politically more influential than non-elite agents.

Decisions

- Within each period, each agent makes the following decisions:
  - an occupation choice $e_t^j \in \{0, 1\}$, and in addition if $e_t^j = 1$, i.e., if he becomes an entrepreneur,
  - investment, employment, and hiding decisions, k_t^j, l_t^j and h_t^j, where h_t^j denotes whether he decides to hide his output in order to avoid taxation (since the final good is not storable, the consumption decision is simply given by the budget constraint).
- Agents also make the policy choices in this society.
- Three policy choices:
  - a tax rate $\tau_t \in [0, 1]$ on output,
  - lump-sum transfers to all agents denoted by $T_t \in [0, \infty)$,
  - cost $B_t \in [0, \infty)$ to set up a new firm.

Production

- An entrepreneur with skill level a_t^j can produce

$$y_t^j = \frac{1}{1-\alpha}(a_t^j)^\alpha (k_t^j)^{1-\alpha} (l_t^j)^\alpha \tag{2}$$

- Suppose that all firms have to operate at the same size, λ, so

$$l_t^j = \lambda.$$

- Suppose also that the entrepreneur himself can work in his firm as one of the workers, which implies that the opportunity cost of becoming an entrepreneur is 0.

Profits

- Given a tax rate τ_t and a wage rate $w_t \geq 0$ and using the fact that $l_t^j = \lambda$, the net profits of an entrepreneur with talent a_t^j at time t are:

$$\pi\left(k_t^j \mid a_t^j, w_t, \tau_t\right) = \frac{1-\tau_t}{1-\alpha}(a_t^j)^\alpha (k_t^j)^{1-\alpha}\lambda^\alpha - w_t\lambda - k_t^j. \tag{3}$$

- If taxes are too high, he can choose to hide his output, $h_t^j = 1$. In this case, he avoids the tax, but loses a fraction $\delta < 1$ of his revenues, so his profits are:

$$\tilde{\pi}\left(k_t^j \mid a_t^j, w_t, \tau_t\right) = \frac{1-\delta}{1-\alpha}(a_t^j)^\alpha (k_t^j)^{1-\alpha}\lambda^\alpha - w_t\lambda - k_t^j.$$

- This implies that taxes are always constrained to be:

$$0 \leq \tau_t \leq \delta.$$

Profit Maximization

- The (instantaneous) gain from entrepreneurship for an agent of talent $z \in \{L, H\}$ as a function of the tax rate τ_t, and the wage rate, w_t, is:

$$\Pi^z(\tau_t, w_t) = \max_{k_t^j} \pi\left(k_t^j \mid a_t^j = A^z, w_t, \tau_t\right). \tag{4}$$

- Note that this is the *net gain* to entrepreneurship since the agent receives the wage rate w_t irrespective (either working for another entrepreneur when he is a worker, or working for himself—thus having to hire one less worker—when he is an entrepreneur).
- The gain to becoming an entrepreneur for an agent with $s_t^j = 0$ and ability $a_t^j = A^z$ is

$$\Pi^z(\tau_t, w_t) - B_t = \Pi^z(\tau_t, w_t) - \lambda b_t,$$

where $b_t \equiv B_t/\lambda$ is the cost imposed by the entry barriers.

Market Clearing

- Market clearing condition:

$$\int_0^1 e_t^j l_t^j dj = \int_{j \in \mathbf{S}_t^E} \lambda dj \leq 1, \tag{5}$$

where $\mathbf{S}_t^E$ is the set of entrepreneurs at time t.

Evolution of State Variables

- Law of motion of the vector $\left(s_t^j, a_t^j\right)$ given by

$$s_{t+1}^j = e_t^j, \tag{6}$$

with $s_0^j = 0$ for all j, and also $s_t^j = 0$ if an individual j is born at time t.

- And

$$a_{t+1}^j = \begin{cases} A^H & \text{with probability} & \sigma^H & \text{if } a_t^j = A^H \\ A^H & \text{with probability} & \sigma^L & \text{if } a_t^j = A^L \\ A^L & \text{with probability} & 1-\sigma^H & \text{if } a_t^j = A^H \\ A^L & \text{with probability} & 1-\sigma^L & \text{if } a_t^j = A^L \end{cases}, \tag{7}$$

where σ^H, $\sigma^L \in (0,1)$.

- Suppose that $\sigma^H \geq \sigma^L > 0$, so that skills are persistent and low skill is not an absorbing state.

Evolution of State Variables (continued)

- Fraction of high skill agents in the stationary distribution is

$$M \equiv \frac{\sigma^L}{1 - \sigma^H + \sigma^L} \in (0, 1) .$$

- Suppose that

$$M\lambda > 1,$$

  so that, without entry barriers, high-skill entrepreneurs generate more than sufficient demand to employ the entire labor supply.

Timing of Events

- Entrepreneurial talents/skills, $\left[a_t^j\right]$, are realized.
- The entry barrier for new entrepreneurs b_t is set.
- Agents make occupational choices, $\left[e_t^j\right]$, and entrepreneurs make investment decisions, $\left[k_t^j\right]$.
- The labor market clearing wage rate, w_t, is determined.
- The tax rate on entrepreneurs, τ_t, is set.
- Entrepreneurs make hiding decisions, $\left[h_t^j\right]$.

Policy Choices

- Entry barriers and taxes will be set by different agents in different political regimes.
- Taxes are set after the investment decisions, which can be motivated by potential commitment problems whereby entrepreneurs can be "held up" after they make their investments decision.
- Once these investments are sunk, it is in the interest of the workers to tax and redistribute entrepreneurial income.

Equilibrium Concept

- Focus on the Markov Perfect Equilibrium (MPE), where strategies are only a function of the payoff relevant states.
- For individual j the payoff relevant state at time t includes his own state $\left(s_t^j, a_t^j\right)$, and potentially the fraction of entrepreneurs that are high skill, denoted by μ_t, and defined as

$$\mu_t = \Pr\left(a_t^j = A^H \mid e_t^j = 1\right) = \Pr\left(a_t^j = A^H \mid j \in \mathbf{S}_t^E\right).$$

- $x_t^j = \left(e_t^j, k_t^j, , h_t^j\right)$: the vector of choices of agent j at time t,
- $x_t = \left[x_t^j\right]_{j\in[0,1]}$: the choices for all agents,
- $p_t = (b_t, \tau_t)$: vector of policies at time t.
- $\mathbf{p}^t = \{p_n\}_{n=t}^{\infty}$: the infinite sequence of policies from time t onwards,
- $\mathbf{w}^t$ and $\mathbf{x}^t$: sequences of wages and choices from t onwards.

Economic Equilibrium

- $s_0^j = 0$ for all j, and suppose $b_0 = 0$, so that in the initial period there are no entry barriers (since $s_0^j = 0$ for all j, any positive entry barrier would create waste, but would not affect who enters entrepreneurship).
- Since $l_t^j = \lambda$ for all $j \in \mathbf{S}_t^E$, profit-maximizing investments are given by:

$$k_t^j = (1 - \tau_t)^{1/\alpha} a_t^j \lambda. \tag{8}$$

- Investment increasing in the skill level of the entrepreneur, a_t^j, and decreasing in the tax rate, τ_t.
- Net current gain to entrepreneurship, as a function of entry barriers, taxes, equilibrium wages, for an agent of type $z \in \{L, H\}$ is then

$$\Pi^z(\tau_t, w_t) = \frac{\alpha}{1-\alpha}(1 - \tau_t)^{1/\alpha} A^z \lambda - w_t \lambda. \tag{9}$$

Value Functions

- Let us denote the value of an entrepreneur with skill level $z \in \{L, H\}$ as a function of the sequence of future policies and equilibrium wages, $(\mathbf{p}^t, \mathbf{w}^t)$, by $V^z(\mathbf{p}^t, \mathbf{w}^t)$, and the value of a worker of type z in the same situation by $W^z(\mathbf{p}^t, \mathbf{w}^t)$.
- Then,

$$W^z\left(\mathbf{p}^t, \mathbf{w}^t\right) = w_t + T_t + \beta CW^z\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right), \tag{10}$$

where

$$\begin{aligned} & CW^z\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right) = \\ & \sigma^z \max\left\{W^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right), V^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right) - \lambda b_{t+1}\right\} \\ & + (1-\sigma^z) \max\left\{W^L\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right), V^L\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right) - \lambda b_{t+1}\right\}. \end{aligned} \tag{11}$$

- Intuition: a worker of type z receives a wage income of w_t (independent of his skill), a transfer of T_t, and the continuation value $CW^z\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right)$.

Value Functions (continued)

- To understand this continuation value, note that the worker stays high skill with probability σ^z, and in this case, he can either choose to remain a worker, receiving value $W^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right)$, or decide to become an entrepreneur by incurring the entry cost λb_{t+1}, receiving the value of a high-skill entrepreneur, $V^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right)$.
- The max operator makes sure that he chooses whichever option gives higher value.
- With probability $1 - \sigma^z$, he transitions from high skill to low skill, and receives the corresponding values.

Value Functions (continued)

- For entrepreneurs:

$$V^z\left(\mathbf{p}^t,\mathbf{w}^t\right) = w_t + T_t + \Pi^z\left(\tau_t, w_t\right) + \beta C V^z\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right), \qquad (12)$$

where Π^z is given by (9) and

$$\begin{aligned} CV^z\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right) &= \sigma^z \max\left\{W^H\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right), V^H\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right)\right\} \qquad (13) \\ &\quad + \left(1-\sigma^z\right)\max\left\{W^L\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right), V^L\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right)\right\} \end{aligned}$$

Value Functions (continued)

- Finally, let us define the *net value* of entrepreneurship as a function of an individual's skill a and ownership status, s,

$$
\begin{aligned}
& NV\left(\mathbf{p}^t, \mathbf{w}^t \mid a_t^j = A^z, s_t^j = s\right) \\
& = V^z\left(\mathbf{p}^t,\mathbf{w}^t\right) - W^z\left(\mathbf{p}^t,\mathbf{w}^t\right) \qquad - (1-s)\,\lambda b_t,
\end{aligned}
$$

  where the last term is the entry cost incurred by agents with $s = 0$.
- The max operators in (11) and (13) imply that if $NV > 0$ for an agent, then he prefers to become an entrepreneur.

Entrepreneurship Choices

- Straightforward to see that

$$NV\left(\mathbf{p}^t,\mathbf{w}^t \mid a_t^j = A^H, s_t^j = 0\right) \geq NV \left(\mathbf{p}^t,\mathbf{w}^t \mid a_t^j, s_t^j = s\right) \geq NV\left(\mathbf{p}^t,\mathbf{w}^t \mid a_t^j = A^L, s_t^j = 1\right)$$

- In other words, the net value of entrepreneurship is highest for high-skill existing entrepreneurs, and lowest for low-skill workers. However, it is unclear ex ante whether

$$NV\left(\mathbf{p}^t,\mathbf{w}^t \mid a_t^j = A^H, s_t^j = 0\right) > NV\left(\mathbf{p}^t,\mathbf{w}^t \mid a_t^j = A^L, s_t^j = 0\right)$$

or the other way round.

Entrepreneurship Choices (continued)

- Two different types of equilibria:
  1. *Entry equilibrium* where all entrepreneurs have $a_t^j = A^H$.
  2. *Sclerotic equilibrium* where agents with $s_t^j = 1$ become entrepreneurs irrespective of their productivity.
- An entry equilibrium requires the net value of entrepreneurship to be greater for a non-elite high skill agent than for a low-skill elite, i.e.,

$$NV\left(\mathbf{p}^t, \mathbf{w}^t \mid a_t^j = A^H, s_t^j = 0\right) \geq NV\left(\mathbf{p}^t, \mathbf{w}^t \mid a_t^j = A^L, s_t^j = 1\right).$$

- Define w_t^H such that at this wage rate, $NV\left(\mathbf{p}^t, \left[w_t^H, \mathbf{w}^{t+1}\right] \mid a_t^j = A^H, s_t^j = 0\right) = 0$, that is,

$$w_t^H \equiv \max\{\frac{\alpha}{1-\alpha}(1-\tau_t)^{1/\alpha}A^H - b_t + \frac{\beta\left(CV^H\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right) - CW^H\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right)\right)}{\lambda};0\}, \tag{14}$$

Entrepreneurship Choices (continued)

- Similarly, let w_t^L be such that $NV\left(\mathbf{p}^t, \left[w_t^L, \mathbf{w}^{t+1}\right] \mid a_t^j = A^L, s_t^j = 1\right) = 0$, that is,

$$w_t^L \equiv \max\{\frac{\alpha}{1-\alpha}(1-\tau_t)^{1/\alpha}A^L + \frac{\beta\left(CV^L\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right) - CW^L\left(\mathbf{p}^{t+1},\mathbf{w}^{t+1}\right)\right)}{\lambda}; 0\}. \tag{15}$$

Entry Equilibrium

- Given these definitions, the condition for an entry equilibrium to exist at time t can simply be written as

$$w_t^H \geq w_t^L. \tag{16}$$

- A sclerotic equilibrium emerges, on the other hand, only if the converse of (16) holds.

Equilibrium Wages

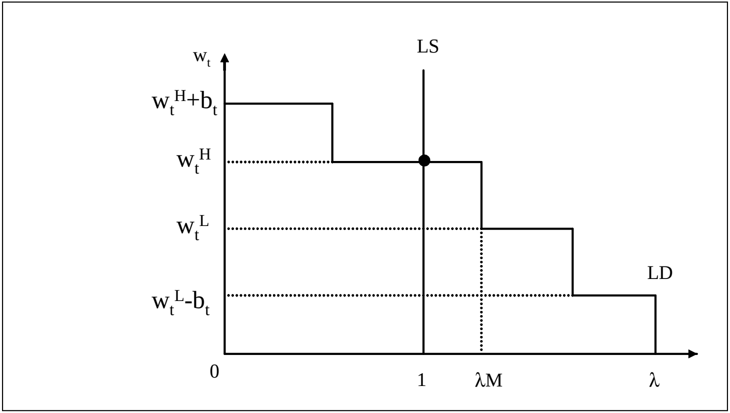
- In an entry equilibrium, i.e., when (16) holds, we must have that

$$NV\left(\mathbf{p}^t, \mathbf{w}^t \mid a_t^j = A^z, s_t^j = 0\right) = 0.$$

- Why?
- This implies that the equilibrium wage must be

$$w_t^e = w_t^H. \tag{17}$$

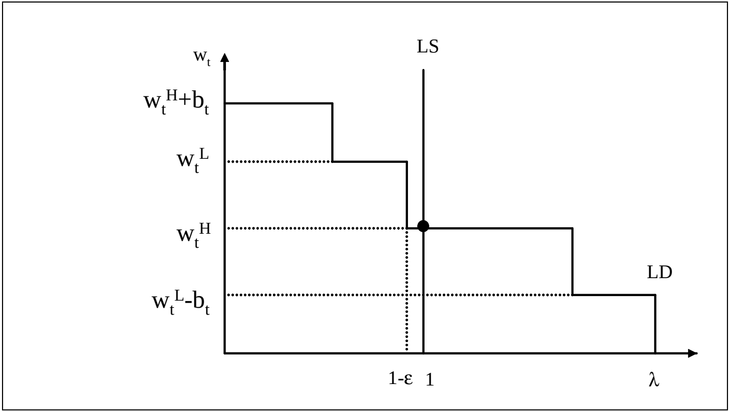
Entry Equilibrium (continued)



Labor supply and labor demand when (16) holds and there exists an entry equilibrium.

Sclerotic Equilibrium

- In this case, wages are still given by $w_t^e = w_t^H$ because of $\varepsilon > 0$.



Labor supply and labor demand when (16) does not hold and there exists a sclerotic equilibrium.

Composition of Entrepreneurs

- Law of motion of the fraction of entrepreneurs with high skills is

$$\mu_t = \begin{cases} \sigma^H \mu_{t-1} + \sigma^L (1 - \mu_{t-1}) & \text{if (16) does not hold} \\ 1 & \text{if (16) holds} \end{cases}. \tag{18}$$

starting with $\mu_0 = 1$.

Democratic Equilibrium

- In democracy, policies made by majoritarian voting.
- In MPE, after investments are made, the median voter, a worker, wishes through distribute as much as possible, thus

$$\tau_t = \delta.$$

- Moreover, entry barriers reduce wages (from (14)), thus

$$b_t = 0.$$

- Than in equilibrium:

$$V^H = W^H = W^L = W = \frac{w^D + T^D}{1-\beta}, \tag{19}$$

where w^D is the equilibrium wage in democracy, and T^D is the level of transfers, given by δY^D.

Democratic Equilibrium (continued)

Proposition: A democratic equilibrium always features $\tau_t = \delta$ and $b_t = 0$. Moreover, we have $e_t^j = 1$ if and only if $a_t^j = A^H$, so $\mu_t = 1$. The equilibrium wage rate is given by

$$w_t^D = w^D \equiv \frac{\alpha}{1-\alpha}(1-\delta)^{1/\alpha} A^H, \tag{20}$$

and the aggregate output is

$$Y_t^D = Y^D \equiv \frac{1}{1-\alpha}(1-\delta)^{\frac{1-\alpha}{\alpha}} A^H. \tag{21}$$

- Aggregate output is constant over time
- Also perfect equality because the excess supply of high-skill entrepreneurs ensures that they receive no rents.

Oligarchy Equilibrium

- Policies are determined by majoritarian voting among the elite.
- At the time of voting over the entry barriers, b_t, the elite are those with $s_t = 1$, and at the time of voting over the taxes, τ_t, the elite are those with $e_t = 1$.
- Let us start with the taxation decision among those with $e_t = 1$.
- It can be proved that as long as

$$\lambda \geq \frac{1}{2}\frac{A^H}{A^L} + \frac{1}{2}, \tag{22}$$

then both high-skill and low-skill entrepreneurs prefer zero taxes, i.e., $\tau_t = 0$.
- Condition (22) requires the productivity gap between low and high-skill elites not to be so large that low-skill elites wish to tax profits in order to indirectly transfer resources from high-skill entrepreneurs to themselves.
- When condition (22) holds, the oligarchy will always choose $\tau_t = 0$.

Oligarchy Equilibrium (continued)

- Then anticipating this tax choice, at the stage of deciding the entry barriers, high-skill entrepreneurs would like to maximize $V^H\left(\left[b_t, 0, \mathbf{p}^{t+1}\right], \left[w_t, \mathbf{w}^{t+1}\right]\right)$, while low-skill entrepreneurs would like to maximize $V^L\left(\left[b_t, 0, \mathbf{p}^{t+1}\right], \left[w_t, \mathbf{w}^{t+1}\right]\right)$.
- Both of these are maximized by setting a level of the entry barrier that ensures the minimum level of equilibrium wages.
- Equilibrium wage, given in (17), will be minimized at $w_t^H = 0$, by choosing any

$$b_t \geq b_t^E \equiv \frac{\alpha}{1-\alpha} A^H + \beta \left(\frac{CV^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right) - CW^H\left(\mathbf{p}^{t+1}, \mathbf{w}^{t+1}\right)}{\lambda} \right). \tag{23}$$

- Without loss of any generality, set $b_t = b_t^E$.

Oligarchy Equilibrium (continued)

- Aggregate output in equilibrium is:

$$Y_t^E = \mu_t \frac{1}{1-\alpha} A^H + (1-\mu_t) \frac{1}{1-\alpha} A^L, \tag{24}$$

where $\mu_t = \sigma^H \mu_{t-1} + \sigma^L (1-\mu_{t-1})$ as given by (18), with $\mu_0 = 1$.

- Since μ_t is a decreasing sequence converging to M, aggregate output Y_t^E is also decreasing over time with:

$$\lim_{t \to \infty} Y_t^E = Y_\infty^E \equiv \frac{1}{1-\alpha} \left(A^L + M(A^H - A^L) \right). \tag{25}$$

- The reason for this is that as time goes by, the comparative advantage of the members of the elite in entrepreneurship gradually disappears because of the imperfect correlation between ability over time.

Oligarchy Equilibrium (continued)

- Also high degree of (earnings) inequality.
  - Wages are equal to 0, while entrepreneurs earn positive profits

Proposition: Suppose that condition (22) holds. Then an oligarchic equilibrium features $\tau_t = 0$ and $b_t = b^E$, and the equilibrium is sclerotic, with equilibrium wages $w_t^e = 0$, and fraction of high-skill entrepreneurs $\mu_t = \sigma^H \mu_{t-1} + \sigma^L (1 - \mu_{t-1})$ starting with $\mu_0 = 1$. Aggregate output is given by (**??**) and decreases over time starting at $Y_0^E = \frac{1}{1-\alpha} A^H$ with $\lim_{t \to \infty} Y_t^E = Y_\infty^E$ as given by (25).

Comparison between Democracy and Oligarchy

- First, as long as $\delta > 0$, then

$$Y^D = \frac{1}{1-\alpha}(1-\delta)^{\frac{1-\alpha}{\alpha}} A^H < Y_0^E = \frac{1}{1-\alpha} A^H.$$

- Therefore, for all $\delta > 0$, oligarchy initially generates greater output than democracy, because it is protecting the property rights of entrepreneurs.
- However, the analysis also shows that Y_t^E declines over time, while Y^D is constant, the oligarchic economy may subsequently fall behind the democratic society.
- Whether it does so or not depends on whether Y^D is greater than Y_∞^E as given by (25).

Comparison between Democracy and Oligarchy (continued)

- This will be the case if $(1-\delta)^{\frac{1-\alpha}{\alpha}} A^H / (1-\alpha) > \left(A^L + M(A^H - A^L)\right) / (1-\alpha)$, or if

$$(1-\delta)^{\frac{1-\alpha}{\alpha}} > \frac{A^L}{A^H} + M\left(1 - \frac{A^L}{A^H}\right). \tag{26}$$

- If condition (26) holds, then at some point the democratic society will overtake ("leapfrog") the oligarchic society.

Comparison between Democracy and Oligarchy (continued)

Proposition: Suppose that condition (22) holds. Then at $t = 0$, aggregate output is higher in an oligarchic society than in a democratic society, i.e., $Y_0^E > Y^D$. If (26) does not hold, then aggregate output in oligarchy is always higher than in democracy, i.e., $Y_t^E > Y^D$ for all t. If (26) holds, then there exists $t' \in N$ such that for $t \leq t'$, $Y_t^E \geq Y^D$ and for $t > t'$, $Y_t^E < Y^D$, so that the democratic society leapfrogs the oligarchic society. Leapfrogging is more likely when δ, A^L/A^H and M are low.

- Oligarchies are more likely to be relatively inefficient in the long run:
  - when δ is low, meaning that democracy is unable to pursue highly populist policies
  - when A^H is high relative to A^L, so that high-skill comparative advantage is important
  - M is low, so that a random selection of agents contains a small fraction of high-skill agents, making oligarchic sclerosis highly distortionary.

Comparison between Democracy and Oligarchy (continued)

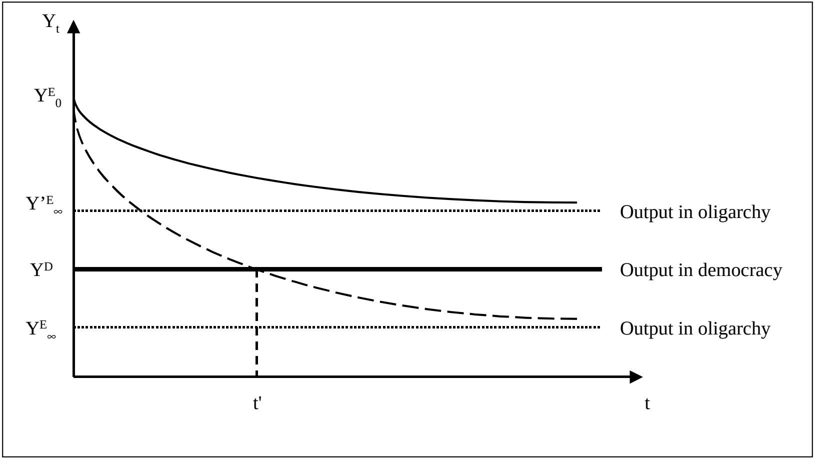


Figure 3: Comparison of aggregate output in democracy and oligarchy. The dashed curve depicts output in oligarchy when (26) holds, and the solid line when it does not.

Other Systems?

- Can other political systems do better?
- Yes, for example, delegate taxes to entrepreneurs and entry barriers to workers
- But, generally not feasible.
- Political power "indivisible": if the system is democratic, the party in power can also decides taxes.

New Technologies and Institutional Flexibility

- Democracies also more flexible.
- Suppose that at some date $t' > 0$, there is an unanticipated and exogenous arrival of a new technology, enabling entrepreneur j to produce:

$$y_t^j = \frac{1}{1-\alpha}(\psi \hat{a}_t^j)^{\alpha}(k_t^j)^{1-\alpha}(l_t^j)^{\alpha},$$

  where $\psi > 1$ and $\hat{a}_t^j$ is the talent of this entrepreneur with the new technology.
- Suppose $l_t^j = \lambda$ for the new technology as well, entrepreneur j's output can be written as

$$\max\left\{\frac{1}{1-\alpha}(\psi \hat{a}_t^j)^{\alpha}(k_t^j)^{1-\alpha}\lambda^{\alpha}, \frac{1}{1-\alpha}(a_t^j)^{\alpha}(k_t^j)^{1-\alpha}\lambda^{\alpha}\right\}.$$

New Technologies and Institutional Flexibility (continued)

- Also to simplify the discussion, assume that the law of motion of $\hat{a}_t^j$ is similar to that of a_t^j, given by

$$\hat{a}_{t+1}^j = \begin{cases} A^H & \text{with probability } \sigma^H & \text{if } \hat{a}_t^j = A^H \\ A^H & \text{with probability } \sigma^L & \text{if } \hat{a}_t^j = A^L \\ A^L & \text{with probability } 1 - \sigma^H & \text{if } \hat{a}_t^j = A^H \\ A^L & \text{with probability } 1 - \sigma^L & \text{if } \hat{a}_t^j = A^L \end{cases} \quad (27)$$

- Comparative advantage shifts to a new set of entrepreneurs.

New Technologies and Institutional Flexibility (continued)

- Democracy will immediately switched to the new technology, thus

$$\hat{Y}^D \equiv \frac{\psi}{1-\alpha}(1-\delta)^{\frac{1-\alpha}{\alpha}} A^H.$$

- In contrast, switch to new technology will be delayed in oligarchy in oligarchy.

Conclusion

- We have seen in this lecture how different types of economic institutions emerge when political power is largely uncontested in the hands of a single group with broadly homogeneous interests but competing with others in the economy.
- In the next lecture, we will investigate in greater theoretical and empirical detail the economics and politics of a specific and very common economic institutions that emerges under elite control—labor coercion.

Introduction

- One very common form of economic institutions under elite dominance is forced labor or labor coercion (including slavery, corvée labor, encomienda-type arrangements and feudal labor relations).
- "In the context of universal history, free labor, wage labor, is the peculiar institution"—M.I. Finley
- Forced labor (**slavery, serfdom**) basis of ancient Greece, Egypt and Rome; several Islamic and Asian empires; most pre-Colombian civilizations; plantation economies in Latin America and the U.S. South; European agriculture until the 19th century (feudalism).
- The ILO estimates that there are still between 8 and 12 million forced laborers worldwide, not counting forced sex workers.

Key Questions

- In what dimensions is labor coercion inefficient (or is it?), and when does it arise?
- Does labor coercion have persistent effects on technology, institutions, politics, inequality...?
- Is coercion to complement or to substitute to effort? I.e., should we expect more labor coercion when employers wish to induce greater effort from their workers?
  - Either could be rationalized on a priori grounds.
- Also, in this context some of the major reforms turn on the relationship between labor scarcity and coercion.

Labor Scarcity and Coercion

- **Central question:** Does labor scarcity lead to more or less coercion?
- "I would... expect to find a positive statistical correlation between free land and serfdom (or slavery)"—Evsey Domar (1970)
- "Rising population, rising prices, rising agricultural profits, low real incomes for the mass of the population, unfavorable terms of trade for industry" ... leading to the collapse of feudalism. H.J. Habakkuk, M.M. Postan, North and Thomas.
- Acemoglu, Johnson and Robinson (2012): "High population density, by providing a supply of labor that could be forced to work in agriculture or mining, made extractive institutions more profitable for the Europeans".

How to Model Labor Coercion?

- One natural approach is developed by Michael Chwe (1990): think of it as a principal-agent relationship and coercion corresponds to punishments conditional on the realization of output.
  - This, however, does not capture the essential feature of coercion: it is not a free relationship, but a forced relationship from the beginning.
- Alternative: Acemoglu and Wolitzky (2011): labor coercion arises if employers use force or threat of force to make agents accept contracts that they would not otherwise accept.
  - Still a form of principal-agent relationship, but different from the standard ones.
  - New technical and conceptual problems.
  - This will shed light on the relationship between labor scarcity and coercion.
- Then we will turn to how this perspective informs empirical work.

Model

- Mass 1 of *producers*, mass $L < 1$ of *agents*. All risk-neutral and identical
- Each producer has a project that yields x units of a consumption good if successful, 0 if unsuccessful.
- $x \sim F(x)$, density $f(x)$, on $[\underline{x}, \bar{x}]$, $\underline{x} > 0$.
- Market price P.
- Producers and agents matched at random.
- Once matched, producer chooses “guns” $g \geq 0$ at cost $\eta\chi(g)$, and offers a contract (w^y, p^y). $\chi(g)$ convex.
- w =wage, p =punishment.
- $w^y \geq 0$, $p^y \geq 0$ for $y \in \{0, x\}$ (“y^l, y^h”) — thus limited liability.
- **Important**: g is “coercion”, not p — coercion is about forcing people accepting contracts that they would not otherwise accept.

Model (continued)

- Agent accepts or rejects contract. If rejects, gets

$$\bar{u} - g.$$

  This is where coercion enters— reducing the "outside option" of the worker if she rejects the employer's offer.
- If accepts, chooses $a \in [0, 1]$, "effort", at cost $c(a)$.
- $a =$probability that project succeeds. $c(a)$ convex.
- Given contract (w^y, p^y), effort a, guns g, and output y, producer gets

$$Py - w^y - \eta\chi(g),$$

  and agent gets

$$w^y - p^y - c(a).$$

- Given price P, outside option $\bar{u}$, and productivity x, what level of guns/what is the profit maximizing contract for a (matched) producer?

Model (continued)

- Similar to a standard principal-agent problem:

$$\max_{(a,g,w^h,w^l,p^h,p^l)} a\left(Px - w^h\right) + (1-a)\left(-w^l\right) - \eta\chi(g)$$

subject to

$$a\left(w^h - p^h\right) + (1-a)\left(w^l - p^l\right) - c(a) \geq \bar{u} - g, \qquad \text{(IR)}$$

and

$$a \in \arg\max_{\tilde{a}\in[0,1]} \tilde{a}\left(w^h - p^h\right) + (1-\tilde{a})\left(w^l - p^l\right) - c(\tilde{a}). \qquad \text{(IC)}$$

- Call solutions to this **equilibrium contracts**.

Characterization of Equilibrium Contracts

- First, Partial Equilibrium (later, endogenize P and $\bar{u}$ and look at GE).

Proposition

Suppose $Px > \bar{u} + c'(0)$. Then any equilibrium contract involves $a > 0$ and $g > 0$, and an equilibrium contract for a producer of type x is given by $\left(a, g, w^h, w^l, p^h, p^l\right)$ such that

$$(a, g) \in \arg \max_{(\tilde{a}, \tilde{g}) \in \mathbb{R}^2_+} Px\tilde{a} - \tilde{a}\left[(1 - \tilde{a})\, c'(\tilde{a}) + c(\tilde{a}) + \bar{u} - \tilde{g}\right]_+ - \eta\chi(\tilde{g}), \tag{28}$$

with $w^l = p^h = 0$, $w^h = (1 - a)\, c'(a) + c(a) + \bar{u} - g > 0$, and $p^l = c'(a) - w^h \geq 0$.

- $Px > \bar{u} + c'(0)$: to ensure that $a > 0$. In the paper, assumption on primitives ensures this.

Key Formula

- **Key formula**:

$$\max_{(a,g)} Pxa - a(1-a)c'(a) - ac(a) - a\bar{u} + ag - \eta\chi(g).$$

- Importantly, this problem is **supermodular** in $(a, g, x, P, -\bar{u} - \eta)$.
- This problem directly leads to a range of partial equilibrium comparative statics.
  - In particular, the set of equilibrium contracts (a, g) is a lattice, and its largest and smallest elements are increasing in x and P and decreasing in $\bar{u}$ and η.
- Note for future use that given the choice of a, g is uniquely pinned down by:

$$g = \chi^{-1}\left(\frac{a}{\eta}\right).$$

- Multiplicity may arise because multiple choices of a could be optimal.

Derivation of the Key Formula

- Let $u^h \equiv w^h - p^h$, $u^l \equiv w^l - p^l$.
- If $a > 0$, (IC) becomes

$$u^h - u^l = c'(a)$$

and (IR) becomes

$$au^h + (1-a)\,u^l - c(a) \geq \bar{u} - g \qquad (\text{IR}_1)$$

- Plugging $u^l = u^h - c'(a)$ into (IR_1) gives

$$u^h - (1-a)\,c'(a) - c(a) \geq \bar{u} - g \qquad (\text{IR}_2)$$

- There is a $1:1$ tradeoff between u^h and g in (IR_2).
- If $u^h = w^h$, this means that raising g by one unit lets the producer pay the worker one unit less after high output.

Derivation of the Key Formula (continued)

- Plugging (IR_2) into the principal's objective, assuming that $u^h = w^h$ and $w^l = 0$, gives

$$\begin{aligned} & a(Px - ((1-a)\,c'(a) + c(a) + \bar{u} - g)) - (1-a)(0) - \eta\chi(g) \\ & \quad = aPx - a(1-a)\,c'(a) - ac(a) - a\bar{u} + ag - \eta\chi(g) \end{aligned}.$$

- High $a \implies$ success more likely $\implies$ reducing w^h more important.
    - Since raising g by one unit lets the producer reduce w^h by one unit,this means that the return to g is higher when a is higher.
- With multiple output levels, $1:1$ tradeoff between u^h and g may not hold, so complementarity between a and g may not hold. But does hold under reasonable conditions. For example, holds if $\Pr(y = \underline{y}|a) + \Pr(y = \bar{y}|a)$ doesn't depend on a. More generally, under MLRP and additional "mild" conditions.

Results

- Complementarity between a and g derived from principal-agent model.
- This is one of our main contributions and implies:

Proposition

1. *The set of equilibrium contracts for a producer of type x forms a lattice, with greatest and smallest equilibrium contracts $(a^{+}(x), g^{+}(x))$ and $(a^{-}(x), g^{-}(x))$. The extremal equilibrium contracts $(a^{+}(x), g^{+}(x))$ and $(a^{-}(x), g^{-}(x))$ are increasing in x and P and decreasing in $\bar{u}$ and η.*
2. *In addition, if $(1-a)c'''(a) \geq c''(a)$ for all a, then the equilibrium contract $(a(x), g(x))$ is unique and thus is everywhere increasing in x and P and decreasing in $\bar{u}$ and η.*

Results (continued)

- Immediate implications

Corollary

In equilibrium contracts:

1. *Agents with worse outside options (lower $\bar{u}$) are subject to more coercion.*
2. *Easier coercion (lower η) leads to higher effort.*
3. *Easier coercion reduces agent welfare.*
4. *Agents are better off when matched with less productive producers*

Interpretation

- Agents with worse outside options (lower $\bar{u}$) are subject to more coercion:
- Key formula is

$$\max_{(a,g)} Pxa - a(1-a)c'(a) - ac(a) - a\bar{u} + ag - \eta\chi(g).$$

- Recall that this is supermodular in $(a, g, -\bar{u})$. So lower $\bar{u}$ leads to higher a and g.
- Intuitively, it is cheaper to induce high effort when agents have bad outside options, so agents with worse outside options work harder. By supermodularity, this implies that agents with worse outside options are also subject to more coercion.
- This formalizes the **neo-Malthusian** idea that agents with low outside wages face more coercion.

Further Corollaries

Corollary

If coercion is sufficiently easy ($\eta < \eta^*$), effort is above first-best

Corollary

Banning coercion increases social welfare.

Coercion and Wages

Corollary

The correlation between expected wage payments and coercion is ambiguous (positive if $\partial w^h/\partial a > 0$, and negative if $\partial w^h/\partial a \geq 0$).

- Contrast to Fogel and Engerman:
  - Coercion increases effort, but generally this is not efficient. It also reduces "social welfare".
  - That the end of slavery did not increase wages is **not** a puzzle.
  - That gang labor did not arise after the end of slavery is **not** a puzzle.

Corollary

Greater demand (higher P) increases coercion and may or may not increase wages.

- Greater labor demand may not translate into higher wages because it also becomes optimal for employers to use more coercion.

Coercion and Social Welfare

- Banning coercion increases social welfare:

$$\begin{aligned} SW^C &= Px a - a(1-a)c'(a) - ac(a) - a\bar{u} \\ &\qquad + ag - \eta\chi(g) + \bar{u} - g \\ &< Px a - a(1-a)c'(a) - ac(a) - a\bar{u} + \bar{u} \\ &\leq \max_{\tilde{a}\in[0,1]} Px\tilde{a} - \tilde{a}(1-\tilde{a})c'(\tilde{a}) - \tilde{a}c(\tilde{a}) - \tilde{a}\bar{u} + \bar{u} \\ &= SW^N \end{aligned}$$

- Ignoring $\eta\chi(g)$, the benefit of coercion to the principal is ag and the cost of coercion to the agent is g.
- Coercion also distorts effort **away** from second-best.

General Equilibrium

- We next endogenize P and $\bar{u}$.
- Key questions:
  1. What is the effect of labor scarcity on coercion?
  2. What are the strategic interactions among producers?
  3. Can these overturn partial equilibrium comparative statics? Partial equilibrium welfare results?

Endogenizing Price

- **Endogenizing P:**
- Due to random matching, expected output per matched producer-agent pair is

$$Q \equiv \int_{\underline{x}}^{\bar{x}} a(x) x dF(x)$$

- QL is *aggregate output*.
- Assume that there is a downward sloping market demand curve so that *market price* is

$$P \equiv P(QL).$$

Endogenizing Outside Option

- **Endogenizing $\bar{u}$:**
- If an agent rejects a contract, let us assume that she is then matched with a random, previously unmatched coercive producer with probability γ, and is matched with a noncoercive ("city") producer with probability $1-\gamma$ and receives utility $\tilde{u}(L)$, where $\tilde{u}$ is decreasing in L (e.g., because when population is greater, wages in the noncoercive sector are also lower). So:

$$\bar{u} = \gamma \int_{\underline{x}}^{\bar{x}} (\bar{u} - g(x))\, dF(x) + (1-\gamma)\, \tilde{u}(L)$$

- Let G be the average number of guns used by a matched, coercive producer, or equivalently *aggregate coercion*. Then

$$G \equiv \int_{\underline{x}}^{\bar{x}} g(x)\, dF(x).$$

$$\bar{u} = \tilde{u}(L) - \frac{\gamma}{1-\gamma} G.$$

General Equilibrium Definition

Definition

A (pure-strategy) equilibrium is a pair of functions $(a^*(\cdot), g^*(\cdot))$ *such that, for each* $x \in [\underline{x}, \bar{x}]$, $(a^*(x), g^*(x))$ *is an equilibrium contract given market price* P *and outside option* $\bar{u}$, *and* P *and* $\bar{u}$ *are given by*

$$P = P(QL)$$

and

$$\bar{u} = \tilde{u}(L) - \frac{\gamma}{1-\gamma} G$$

evaluated at $(a^*(\cdot), g^*(\cdot))$.

- Could also define a similar [more involved] definition of equilibrium in mixed strategies.

Side Comments

- This is an *aggregative game*: a producer's problem is affected by other producers' actions only through Q and G.
- (a, g) is increasing in P and decreasing in $\bar{u}$.
- Therefore, (a, g) is decreasing in Q and increasing in G.
- Q and G are increasing in (a, g).
- The game has strategic substitutes in a and strategic complements in g.
- Therefore, the set of equilibria may not be a lattice.

General Equilibrium Comparative Statics

How to do comparative statics? Two approaches:

1. More Traditional Approach (less general; stronger results): Impose conditions that guarantee that equilibrium set is a lattice, and then study extremal (Q, G) pairs.
2. New Approach (general; weaker results): Study extremal equilibria in Q and G separately, accepting that equilibrium set may not be a lattice.

Comparative Statics: Main Results

Assumption

(concavity)

1. $c(\cdot)$ *is three times differentiable and satisfies*

$$(1-a)\,c'''(a) \geq c''(a) \text{ for all } a.$$

2. $x_j = x$ *for all producers.*

- This assumption ensures concavity of the employer's maximization problem (it was already used in the second part of the first proposition above).

Existence and Comparative Statics

Proposition

Suppose that Assumption (concavity) holds. Then:

1. *An equilibrium exists, the set of equilibria is a lattice, and the smallest and greatest equilibrium aggregates* (Q, G) *are increasing in* γ *and decreasing in* η.
2. *If* $\tilde{u}(L) = \tilde{u}_0$ *for all* L*, then the smallest and greatest equilibrium aggregates* (Q, G) *are decreasing in* L.
3. *If* $P(QL) = P_0$ *for all* QL*, then the smallest and greatest equilibrium aggregates* (Q, G) *are increasing in* L.

- If $\tilde{u}(L) = \tilde{u}_0$, then only the Domar effect.
- If $P(QL) = P_0$, then only the neo-Malthusian effect.

Comparing the Two Effects

- Let $\left(Q^{+}(L), G^{+}(L)\right)$ and $\left(Q^{-}(L), G^{-}(L)\right)$ denote the smallest and greatest equilibrium aggregates given labor L, and let us use $\left(Q^{\bullet}(L), G^{\bullet}(L)\right)$ to refer to either one of these two pairs.

Proposition

Suppose that $Q^{\bullet}(L_0) P'(Q^{\bullet}(L_0) L_0) > \tilde{u}'(L_0)$ (where $Q^{\bullet}(L_0)$ is either $Q^{+}(L)$ or $Q^{-}(L)$). Then there exists $\delta > 0$ such that $\left(Q^{\bullet}(L), G^{\bullet}(L)\right) > \left(Q^{\bullet}(L_0), G^{\bullet}(L_0)\right)$ for all $L \in (L_0, L_0 + \delta)$ (and $\left(Q^{\bullet}(L), G^{\bullet}(L)\right) < \left(Q^{\bullet}(L_0), G^{\bullet}(L_0)\right)$ for all $L \in (L_0 - \delta, L_0)$). Conversely, suppose that $Q^{\bullet}(L_0) P'(Q^{\bullet}(L_0) L_0) < \tilde{u}'(L_0)$. Then there exists $\delta > 0$ such that $\left(Q^{\bullet}(L), G^{\bullet}(L)\right) < Q^{\bullet}(L_0), G^{\bullet}(L_0)$ for all $L \in (L_0, L_0 + \delta)$ (and $\left(Q^{\bullet}(L), G^{\bullet}(L)\right) > Q^{\bullet}(L_0), G^{\bullet}(L_0)$ for all $L \in (L_0 - \delta, L_0)$).

Interpretation

- When both the Domar and the neo-Malthusian effects are present, local comparative statics are determined simply by which of these two effects are greater.
  1. If $Q(L_0) P'(Q(L_0) L_0) > \tilde{u}'(L_0)$, then the neo-Malthusian effect is greater, and a decline in population reduces coercion.
  2. If $Q(L_0) P'(Q(L_0) L_0) < \tilde{u}'(L_0)$, then the Domar effect is greater, and a decline in population increases coercion.
- Why different effects in the aftermath of the Black Death and during Second Serfdom?
  - Perhaps $Q(L_0) P'(Q(L_0) L_0) > \tilde{u}'(L_0)$ following the Black Death because cities are already important.
  - In contrast, $Q(L_0) P'(Q(L_0) L_0) < \tilde{u}'(L_0)$ in Eastern Europe, because demand for grain from the West increasing prices and cities are not as important, so $\tilde{u}'(L_0)$ small.

Economies of Scales in Coercion

- The "AJR idea": coercion worthwhile only in the colonies were there are large native populations to coerce.
- This can be captured by assuming that producers choose g before they learn whether they are matched with an agent.
- Suppose also that $P(\cdot) \equiv P_0$ and $\tilde{u}(\cdot) = \tilde{u}_0$.
- Because probability of matching for a producer is $1/L$, an equilibrium is a solution to:

$$\max_{(a,g)} L\left(aP_0x - a\left[(1-a)\,c'(a) + c(a) + \tilde{u}_0 - \frac{\gamma}{1-\gamma}G - g\right]_+ - (1-a)\left[-ac'(a) + c(a) + \tilde{u}_0 - \frac{\gamma}{1-\gamma}G - g\right]_+\right) - \eta\chi(g),$$

with the interpretation that a is the level of effort that will be chosen following a match with an agent.

Economies of Scales in Coercion (continued)

- Rewrite this as:

$$\max_{(a,g)} aP_0x - a\left[(1-a)\,c'(a) + c(a) + \tilde{u}_0 - \frac{\gamma}{1-\gamma}G - g\right]_+$$
$$-(1-a)\left[-ac'(a) + c(a) + \tilde{u}_0 - \frac{\gamma}{1-\gamma}G - g\right]_+ - \frac{\eta}{L}\chi(g).$$

- Same as before except that the cost of guns η is replaced by η/L. Thus:

Proposition

Consider the modified model presented with economies of scale in coercion. Then, an equilibrium exists and the set of equilibria is a lattice. Labor scarcity reduces coercion, that is, a decline in L reduces the smallest and greatest equilibrium aggregates (Q, G). Moreover, the smallest and greatest equilibrium aggregates (Q, G) are increasing in P_0, γ, and x, and decreasing in $\tilde{u}_0$ and η.

More General Comparative Statics

- **Nested fixed point approach.**
- Define a function ϕ that maps Q and parameters to those Q' that are equilibrium levels of output in modified model where price is fixed at $P(QL)$.
- Formally: Given $a(\cdot) : [\underline{x}, \bar{x}] \longrightarrow \mathbb{R}_+$, let

$$G(a(\cdot)) \equiv \int_{\underline{x}}^{\bar{x}} (\chi')^{-1} \left(\frac{a(x)}{\eta} \right) dF(x).$$

- Let

$$\phi(Q, \text{parameters}) \equiv$$

$$\left\{ \begin{array}{c} Q' : \exists\ a(\cdot) \text{ s.t. } a(x) \text{ is part of an equilibrium contract given} \\ \text{parameters and } (Q, G(a(\cdot))) \text{ and } Q' = \int_{\underline{x}}^{\bar{x}} a(x)\, x dF(x) \end{array} \right\}$$

Comparative Statics (continued)

- Equilibrium values of Q in the full model are fixed points of $\phi(Q, \text{parameters})$.
- Changing parameters shifts the smallest and largest elements of $\phi(Q, \text{parameters})$ in the same direction.
- $\phi(Q, \text{parameters})$ is monotone (decreasing) in Q, so changing parameters also shifts the smallest and largest fixed points of $\phi(Q, \text{parameters})$ in the same direction.
- The same idea applies to the smallest and largest equilibrium values of G, since best responses are also monotone in G, holding fixed Q and parameters.
- Therefore, the smallest and largest equilibrium values of both Q and G are increasing in $F(\cdot)$ [with the *first-order stochastic dominance* order] and γ and decreasing in L, $\tilde{u}$, and η.

Summarizing

Proposition

The smallest and greatest equilibrium values of Q are increasing in $F(\cdot)$ and γ, and decreasing in L, $\tilde{u}$, and η.

Proposition

The smallest and greatest equilibrium values of G are increasing in $F(\cdot)$ and γ, and decreasing in L, $\tilde{u}$, and η.

- In addition:

Proposition

An equilibrium (in mixed strategies) exists.

Summary

- We have seen:
  1. **Price effect:** Labor scarcity increases (Q, G), because $P(QL)$ is decreasing in L and (Q, G) is increasing in P (*Domar channel*).
  2. **Outside option effect:** Let $\tilde{u}(L)$ be decreasing in L (e.g., more workers in the cities or having escaped to the cities). Then labor scarcity decreases (Q, G), because $\tilde{u}$ is decreasing in L and (Q, G) is decreasing in $\tilde{u}$ (*neo-Malthusian channel*).
  3. **Economies of scales in coercion:** Suppose that producers choose g **before** matching. Then labor scarcity decreases (Q, G), because (Q, G) is decreasing in η (*AJR channel*).
- Can we (empirically) say when one effect will be more important?

Welfare in General Equilibrium

Proposition

Social welfare in any equilibrium under coercion ($g > 0$) is strictly lower than social welfare in any equilibrium under no coercion.

- **Slave trade**:

Proposition

Introducing slave trade in the baseline model increases coercion (G) and reduces agent welfare. More formally, the smallest and the greatest equilibrium levels of coercion [average agent welfare] under slave trade are greater [smaller] than the smallest and the greatest equilibrium levels of coercion [average agent welfare] under no slave trade. In addition, social welfare may decline under slave trade.

Welfare in General Equilibrium

- New general equilibrium welfare result:

Proposition

If P is sufficiently steeply declining, banning coercion (ending slavery) is Pareto dominating (improves the welfare of both workers and producers).

- Intuition: price effect.

Ex Ante Investments and Coercion

- Investment i by agent costs $\zeta(i)$, chosen after matching and before gun purchases.
- Determines productivity $x(i)$, outside option $\bar{u}(i)$.
- No coercion:

$$\max_{i \geq 0} \bar{u}(i) - \zeta(i).$$

- Coercion:

$$\max_{i \geq 0} \bar{u}(i) - g(i) - \zeta(i).$$

- More investment under coercion if $g'(i) > 0$.
- By supermodularity,

$$sign\left(g'(i)\right) = sign\left(a'(i)\right).$$

Ex Ante Investments (continued)

- Key formula becomes:

$$\max_{(a,g)} Px(i)\,a - a(1-a)\,c'(a) - ac(a) - a\bar{u}(i) + ag - \eta\chi(g)$$

- So

$$sign\left(a'(i)\right) = sign\left(Px'(i) - \bar{u}'(i)\right)$$

- Therefore equilibrium investment by agent is higher under coercion if and only if

$$sign\left(Px'(i) - \bar{u}'(i)\right) \leq 0$$

- Coercion leads to increased investments in general human capital and to reduced investments in relationship-specific human capital.
- **Implication:** coercion more damaging (perhaps less likely to emerge) in "care-intensive" activities, which can be interpreted as those requiring greater relationship specific human capital.
    - Related to Fenoaltea (1984).

Ex Ante Investments by Producers

- Similarly, equilibrium investment I by producer is higher under coercion if and only if

$$sign\left(Px'(I) - \bar{u}'(hi)\right) \geq 0.$$

- **Implication:** coercion less damaging (perhaps more likely to emerge) in activities where producers can undertake large investments increasing productivity of workers without raising their outside options.

Persistent Effects of Coercion

- We saw in the first lecture from Melissa Dell's work that organized coercion, even at the village level, can have very persistent effects.
  - Empirical strategy is based on regression discontinuity design exploiting the fact that only villages within the catchment area were subject to forced labor under the mita system.
- The same pattern emerges in Acemoglu, Garcia-Jimeno and Robinson's (2012) work on slavery in Colombia, using a different strategy.
- Why would coercion have persistent effects lasting several hundreds of years?

Persistent Effects of the Mita

TABLE II

LIVING STANDARDS[a]

	Dependent Variable						
	Log Equiv. Household Consumption (2001)			Stunted Growth, Children 6–9 (2005)			
Sample Within:	<100 km of Bound. (1)	<75 km of Bound. (2)	<50 km of Bound. (3)	<100 km of Bound. (4)	<75 km of Bound. (5)	<50 km of Bound. (6)	Border District (7)
	Panel A. Cubic Polynomial in Latitude and Longitude						
Mita	−0.284	−0.216	−0.331	0.070	0.084*	0.087*	0.114**
	(0.198)	(0.207)	(0.219)	(0.043)	(0.046)	(0.048)	(0.049)
R^2	0.060	0.060	0.069	0.051	0.020	0.017	0.050
	Panel B. Cubic Polynomial in Distance to Potosí						
Mita	−0.337***	−0.307***	−0.329***	0.080***	0.078***	0.078***	0.063*
	(0.087)	(0.101)	(0.096)	(0.021)	(0.022)	(0.024)	(0.032)
R^2	0.046	0.036	0.047	0.049	0.017	0.013	0.047
	Panel C. Cubic Polynomial in Distance to *Mita* Boundary						
Mita	−0.277***	−0.230**	−0.224**	0.073***	0.061***	0.064***	0.055*
	(0.078)	(0.089)	(0.092)	(0.023)	(0.022)	(0.023)	(0.030)
R^2	0.044	0.042	0.040	0.040	0.015	0.013	0.043
Geo. controls	yes	yes	yes	yes	yes	yes	yes
Boundary F.E.s	yes	yes	yes	yes	yes	yes	yes
Clusters	71	60	52	289	239	185	63
Observations	1478	1161	1013	158,848	115,761	100,446	37,421

Persistent Effects of Colombian Slavery

- Different strategy in Acemoglu, Garcia-Jimeno and Robinson (2012).
- Slavery associated with gold-mining, and there is no longer gold-mining in Colombia.
- Thus use the presence of gold mines in the past as instrument for history of slavery.
- But gold-mining municipalities potentially different in terms of geography, area and other factors that non-gold-mining municipalities.
- Control strategy: compare gold-mining municipalities only to neighboring non-gold-mining municipalities (include neighborhood pair fixed effects).

Persistent Effects of Colombian Slavery (continued)

- Prosperity and public goods (part I)

LONG-RUN EFFECT OF SLAVERY ON DEVELOPMENT OUTCOMES: IV MODELS

	Poverty Rate 1993				Secondary Enrollment Rate Average 1992-2002			
	Neighbor-Pair Fixed Effects Models		Random Effects Models		Neighbor-Pair Fixed Effects Models		Random Effects Models	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Had Slaves in 1843	12.938	11.356	14.628	13.142	-0.114	-0.087	-0.127	-0.106
	(3.929)	(3.935)	(7.095)	(6.892)	(0.047)	(0.052)	(0.063)	(0.062)
σ_ε^2			13.374	9.031			0.000	0.000
σ_v^2			259.23	220.47			0.043	0.039
1st Stage F-statistic	2.190	2.217	3.181	2.345	2.318	2.430	3.069	2.462
p-value	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001
Geographic Controls	N	Y	N	Y	N	Y	N	Y
Observations	352	352	179	179	336	336	172	172

	Percent Children Vaccinated 2002				Land Gini 2002			
	Neighbor-Pair Fixed Effects Models		Random Effects Models		Neighbor-Pair Fixed Effects Models		Random Effects Models	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Had Slaves in 1843	-0.249	-0.251	-0.247	-0.254	0.087	0.045	0.048	0.040
	(0.066)	(0.074)	(0.097)	(0.107)	(0.017)	(0.015)	(0.024)	(0.021)
σ_ε^2			0.000	0.000			0.000	0.000
σ_v^2			0.041	0.040			0.007	0.005
1st Stage F-statistic	2.190	2.217	3.181	2.345	2.312	2.200	3.233	1.963
p-value	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.015
Geographic Controls	N	Y	N	Y	N	Y	N	Y
Observations	352	352	179	179	248	248	129	129

Persistent Effects of Colombian Slavery (continued)

- Early historical outcomes.

LONG-RUN EFFECT OF SLAVERY ON INTERMEDIATE DEVELOPMENT OUTCOMES: IV MODELS

	School Enrollment 1918				Vaccine Coverage 1918			
Panel A: Second Stage	Neighbor-Pair Fixed Effects Models		Random Effects Models		Neighbor-Pair Fixed Effects Models		Random Effects Models	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Had Slaves in 1843	-0.017	-0.017	-0.021	-0.022	-0.024	-0.018	-0.043	-0.037
	(0.009)	(0.010)	(0.016)	(0.019)	(0.039)	(0.039)	(0.076)	(0.076)
σ_ε^2			0.000	0.000			0.000	0.000
σ_v^2			0.001	0.001			0.023	0.020
1st Stage F-statistic	2.251	2.458	2.883	1.852	2.251	2.458	2.883	1.852
p-value	0.000	0.000	0.003	0.026	0.000	0.000	0.003	0.026
Geographic Controls	N	Y	N	Y	N	Y	N	Y
Observations	216	216	111	111	216	216	111	111

	Literacy Rate 1938				Aqueduct Coverage 1938			
Panel A: Second Stage	Neighbor-Pair Fixed Effects Models		Random Effects Models		Neighbor-Pair Fixed Effects Models		Random Effects Models	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Had Slaves in 1843	-0.080	-0.065	-0.069	-0.056	-0.029	-0.028	-0.024	-0.024
	(0.019)	(0.021)	(0.030)	(0.032)	(0.010)	(0.012)	(0.013)	(0.012)
σ_ε^2			0.001	0.001			0.000	0.000
σ_v^2			0.011	0.007			0.001	0.001
1st Stage F-statistic	1.949	2.286	2.061	1.492	1.949	2.286	2.061	1.492
p-value	0.000	0.000	0.029	0.097	0.000	0.000	0.029	0.097
Geographic Controls	N	Y	N	Y	N	Y	N	Y
Observations	242	242	123	123	242	242	123	123

Politics of Coercion

- Coercion and politics: most of the time, coercion is not just an individual-level activity undertaken by employers, but chosen and implemented by the state. The above model can be modified to allow for the possibility.
- But more importantly, state structures to implement coercion may be very different from others, and once coercion becomes endemic, this may lead to the development of a different state, and it is the state that persists.
- Alternatively, the presence of coercion can change the economic organization which can have very persistent effect.
- It could also affect within-community relations (e.g., less trust and more conflict).
- Dell's work suggests the possibility of labor coercion crowding out other types of labor demand (for example from haciendas), and perhaps this is a channel of persistence.
- Dell and Acemoglu, Garcia-Jimeno and Robinson also show that

Coercion and Technology

- More generally, coercion can have an impact on the choice of technology.
- Acemoglu (2010): when technologies "(strongly) labor-replacing" low wages discourage technology adoption and development.
  - Example: labor abundance may slow down mechanization of agriculture.

Coercion and Wages

- An interesting paper by Naidu and Yuchtman (2013) looks at the effects of the British Master Servant law, which was only repealed in 1875.
- This law gave employers the ability to criminally prosecute workers who quit and "breached their contract". Prosecutions were extremely common.
- The above ideas suggest that greater labor demand should translate into more prosecutions and the repeal of the law should lead to lower wages.
- This is what Naidu and Yuchtman find. They focus on textile, iron and coal prices as measures of the demand for labor in the three sectors respectively, and then interact with the shares of these industries in the county. They also look at wage changes at the county level as a function of the number of past persecutions after repeal.

Coercion and Labor Demand: Results

Table 2: Reduced Form Sectoral Shocks on Master and Servant Prosecutions

	OLS						*2SLS*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fraction Textiles 1851 X Log(Cotton Price Ratio)	210.9***			159.3***	145.5***	141.2***	147.2***	127.8*
	(42.39)			(42.02)	(46.24)	(39.05)	(45.04)	(64.94)
Iron County X Log(Iron Price)		76.03***		51.98**	64.58**	67.27**	90.64*	89.83*
		(22.90)		(19.48)	(27.84)	(33.18)	(46.71)	(49.25)
Coal County X Log(Coal Price)			68.32***	41.25***	35.63**	27.50***	25.22*	26.82**
			(15.90)	(10.11)	(14.31)	(8.428)	(14.92)	(12.05)
Log(Population)	145.5***	124.8***	73.26*	79.13**	41.84	54.69	83.75**	39.21
	(50.52)	(42.20)	(36.68)	(35.09)	(36.18)	(115.2)	(36.70)	(38.10)
F-statistic p-value on joint significance				0.000	0.000	0.000	0.000	0.000
District FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Time-Varying Controls	N	N	N	N	Y	Y	N	Y
County-Specific Trends	N	N	N	N	N	Y	N	N
N	3942	3942	3942	3942	3942	3942	3942	3942

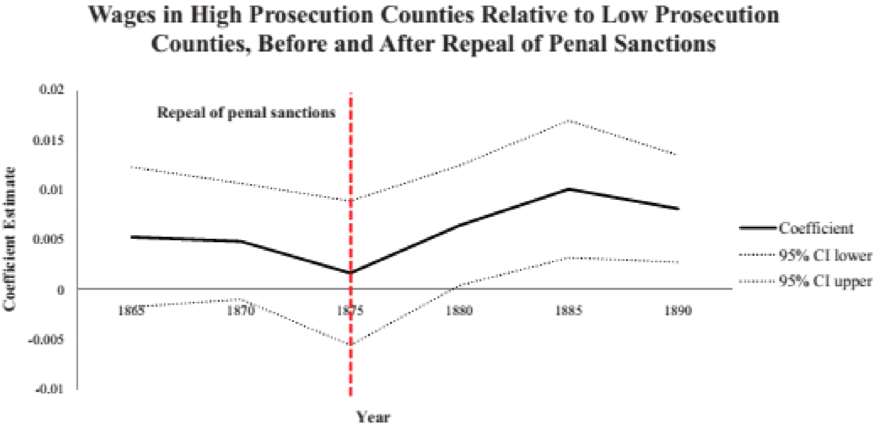
Dependent variable is absolute number of master and servant prosecutions. Standard errors, clustered on county, included in parentheses. Time varying controls are year specific effects of 1851 income, 1851 population density, 1851 proportion urban, and a Wales dummy. Columns (1) through (6) are estimated using OLS; columns (7) and (8) use 2SLS, where distance to Lancashire is used as an instrument for employment share in textiles and iron ore production is used as an instrument for pig iron production. First stage results from columns (7) and (8) are presented in the Appendix. * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Coercion and Wages: Results

Table 5: Effect of Repeal on Wage Levels, by Average Prosecutions

	OLS							*Arellano-Bond*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post-1875 X Log(Average Prosecutions)	0.0206**	0.0130*	0.0122*	0.0030**	0.0053***	0.0073***	0.0026**	0.0133**
	(0.0082)	(0.0072)	(0.0061)	(0.0013)	(0.0017)	(0.0024)	(0.0013)	(0.0053)
Population Density			-0.0570		-0.0105	-0.00453	-0.00722	-0.0455*
			(0.0583)		(0.00805)	(0.0124)	(0.00625)	(0.0274)
Proportion Urban			-0.0488		0.0009	0.0038	-0.0012	0.0010
			(0.0461)		(0.0022)	(0.0023)	(0.0018)	(0.0047)
Log(Income)			0.0291		0.0042	0.0034	0.0037	0.0194
			(0.0312)		(0.0035)	(0.0038)	(0.0030)	(0.0136)
Log(Population)	0.1050***	0.0559**	0.0944**	0.0113***	0.0177***	0.0158*	0.0123***	0.0511
	(0.0279)	(0.0219)	(0.0389)	(0.0038)	(0.0059)	(0.0090)	(0.0046)	(0.0343)
Union Membership		0.170	0.0881	0.0648**	0.0170	0.0234	0.0606**	0.0437
		(0.1080)	(0.0955)	(0.0282)	(0.0172)	(0.0235)	(0.0298)	(0.0500)
Lagged Log(Wage)				0.861***	0.849***	0.837***	0.836***	0.813***
				(0.0198)	(0.0125)	(0.0111)	(0.0110)	(0.0207)
Time-Varying Controls	N	Y	Y	N	Y	Y	Y	Y
Labor market controls	N	N	N	N	N	Y	N	N
Post-1875 X county controls	N	N	N	N	N	N	Y	N
County-specific recession effect	N	N	Y	N	Y	Y	Y	Y
N	2860	2860	2392	2808	2392	1685	2392	2392

Coercion and Wages: Results (continued)



Conclusion

- Labor coercion the "modal" form of transaction in labor markets throughout history.
- General theoretical issues showing when coercion emerges and how it is affected by
  1. price effect;
  2. outside option effect;
  3. economies of scale in coercion.
- Empirical results on persistent effect of coercion and how coercion response to labor demand.
- Much more to be done...