Inequality in Landownership, the Emergence of Human Capital Promoting Institutions and the Great Divergence

Oded Galor, Omer Moav and Deitrcih Vollrath
Inequality and Sources of Under-Investment in Human Capital Formation

The rise in the demand for human capital in the process of development has generated a growth promoting role for human capital formation. Inequality has adversely affected human capital formation and economic growth:

Income inequality \( \Rightarrow \) Limits the financial ability of segments of society to optimally invest in education

Inequality in Landownership \( \Rightarrow \) Delays the implementation of human capital promoting institution (e.g., public education)
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The rise in the demand for human capital in the process of development has generated a growth promoting role for human capital formation. Inequality has adversely affected human capital formation and economic growth:

- Income inequality (in the presence of CMI) \( \implies \) Limits the financial ability of segments of society to optimally invest in education
- Inequality in Landownership \( \implies \) Delays the implementation of human capital promoting institution (e.g., public education)
Main Hypothesis

Human capital accumulation has not benefited equally all sectors of the economy. Complementarity between [human capital & land] is less than complementarity between [human & physical capital].

Capitalists, who were striving for an educated labor force, supported policies that promoted the education of the masses (Galor and Moav (RES, 2006)).

Landowners, whose interests lay in the reduction of the mobility of the rural labor force, favored policies that deprived the masses from education (Galor, Moav and Vollrath (RES, 2009)).
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Introduction

Main Hypothesis

The transition from an agricultural to an industrial economy changed the nature of the main economic conflict in society:

Agrarian economy: Conflict of interest between the landed aristocracy and the masses

Industrialization: Conflict between the entrenched landed elite and the emerging capitalist elite
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Main Hypothesis

Concentration of landownership

\[ \text{Delayed the implementation of human capital promoting institutions} \]

\[ \text{Generated a sub-optimal level of investment in human capital} \]

\[ \text{Lowered the skill intensity of the industrial sector} \]

\[ \text{Slowed pace of economic development} \]

Galor-Moav-Vollrath
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The Model

Overlapping-generations economy

One good produced in two sectors:

Aggregate output:

\[ y_t = y_A + y_M \]

Agricultural production

inputs: land & raw labor

Industrial production

inputs: physical capital & human capital
The Model

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- Agricultural production \( y_t^A \)
  - inputs: land & raw labor

- Industrial production \( y_t^M \)
  - inputs: physical capital & human capital
Agricultural Sector

\[\text{Production} = F(\text{Land}, \text{Number of Workers})\]

\[\text{Demand for labor and land} = F_{\text{Land}}(\text{Land}, \text{Number of Workers})\]

\[\rho_t = F_{\text{Land}}(\text{Land}, \text{Number of Workers})\]

\[w_t = \text{ wage per worker}\]

\[\rho_t = \text{ rental rate on land}\]
Agricultural Sector

\[ y_t^A = F(X, L_t) \]

- \( X \) - land
- \( L_t \) - number of workers
Agricultural Sector

\[ y_t^A = F(X, L_t) \]

- \( X \) - land
- \( L_t \) - number of workers

Demand for labor and land

\[ w_t^A = F_L(X_t, L_t) \]
\[ \rho_t = F_X(X_t, L_t) \]

- \( w_t^A \) - wage per worker
- \( \rho_t \) - rental rate on land
Industrial Sector

\[ M_t = K_t \alpha_t H_t^{1+\alpha} \]

- \( K_t \) - physical capital
- \( H_t \) - efficiency units of labor

Demand for physical and human capital:

\[ R_t = \alpha_t k_t \alpha_t \]

\[ w_M \]

\[ \frac{K_t}{H_t} \]

- \( R_t \) - return to physical capital
- \( w_M \) - wage per unit of human capital

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Inequality and Growth
Industrial Sector

\[ y_t^M = K_t^\alpha H_t^{1-\alpha} \quad \alpha \in (0, 1) \]

- \( K_t \) - physical capital
- \( H_t \) - Efficiency units of labor
Industrial Sector

\[ y^M_t = K_t^\alpha H_t^{1-\alpha} \quad \alpha \in (0, 1) \]

- \( K_t \) - physical capital
- \( H_t \) - Efficiency units of labor

Demand for physical and human capital:

\[ R_t = \alpha k_t^{\alpha-1} \equiv R(k_t) \]
\[ w^M_t = (1 - \alpha) k_t^\alpha \equiv w^M(k_t) \quad k_t \equiv K_t / H_t \]

- \( R_t \) - return to physical capital
- \( w^M_t \) - wage per unit of human capital
Wages

Labor is mobile across sectors:

\[ W_{t+1} = h_{t+1} + w_M t + \frac{w_t}{w_{M_t}} \]

- Wage per efficiency unit of labor in \( M \)
- Wage per worker in \( A \)
- Equilibrium wage per worker in the economy
Labor is mobile across sectors:

\[ w_{t+1}^A = h_{t+1} w_{t+1}^M \equiv w_{t+1} \]

- \( w_{t+1}^M \) - wage per efficiency unit of labor in \( M \)
- \( w_{t+1}^A \) - wage per worker in \( A \)
- \( w_{t+1} \) - equilibrium wage per worker in the economy
Individuals

Overlapping Generations (each of size 1)

Each individual has a single parent and a single child

Identical in:
Preferences & Innate abilities

Different in:
Endowments of: land & capital
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Individuals live for two periods:

1st period:
- Receive a transfer from parent
- Acquire human capital

2nd period:
- Join the labor force
- Allocate income between: Consumption & Transfers to offspring
- Transfer land to offspring
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Individual i in period t: Income

\[
I_{i,t+1} = \omega_{t+1} + \left( 1 - \tau_t \right) b_{i,t} R_{t+1} + x_{i,\rho_{t+1}}
\]

- \( I_{i,t+1} \): \( i \)th individual's income in period \( t+1 \)
- \( \omega_{t+1} \): wage income
- \( x_{i,\rho_{t+1}} \): income from land holding
- \( \left( 1 - \tau_t \right) b_{i,t} R_{t+1} \): income from capital holding
- \( \tau_t \): tax rate on initial capital inheritance
- \( b_{i,t} \): capital stock held by individual \( i \) in period \( t \)
- \( R_{t+1} \): return on capital
Individual $i$ in period $t$: Income

$$l_{t+1}^i = w_{t+1} + [(1 - \tau_t) b_t] R_{t+1} + x^i \rho_{t+1}$$

- $w_{t+1} \equiv$ wage income
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- \( \tau_t \equiv \) tax rate on initial capital inheritance
Individual $i$ in period $t$: Optimization

Preferences:

$$u_{it} = (1 - \beta) \log c_{it} + 1 + \beta \log b_{it} + 1$$

Budget constraint

$$c_{it} + 1 + b_{it} + 1 \leq I_{it} + 1$$

Second period consumption

$$b_{it} + 1 = \beta I_{it} + 1$$

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Inequality and Growth
Individual i in period t: Optimization

- Preferences:
  \[ u_t^i = (1 - \beta) \log c_{t+1}^i + \beta \log b_{t+1}^i \]
Individual i in period t: Optimization

- Preferences:
  \[ u^i_t = (1 - \beta) \log c^i_{t+1} + \beta \log b^i_{t+1} \]

- Budget constraint
  \[ c^i_{t+1} + b^i_{t+1} \leq I^i_{t+1} \]
  \( c^i_{t+1} \equiv \) second period consumption
  \( b^i_{t+1} \equiv \) transfer to the offspring
Individual i in period t: Optimization

- Preferences:
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- Budget constraint
  \[ c_{t+1}^i + b_{t+1}^i \leq l_{t+1}^i \]
  \( c_{t+1}^i \equiv \) second period consumption
  \( b_{t+1}^i \equiv \) transfer to the offspring

- Optimization: Intergenerational transfers
  \[ b_{t+1}^i = \beta l_{t+1}^i \]
Physical Capital Accumulation
Physical Capital Accumulation

The capital stock in period $t+1$

$$K_{t+1} = (1 - \tau_t) \beta y_t$$

$\beta y_t \equiv \text{Aggregate intergenerational transfers}$
Human Capital Accumulation

\[ h_{t+1} = h(e_t) \]

- Expenditure on public education:
  \[ h(0) = 1 \]
  - Basic skills, \( h(0)(e_t) > 0 \)
  - \( h(00)(e_t) < 0 \)

- Education expenditure in period \( t \):
  \[ e_t = \tau_t \beta y_t \]
Human Capital Accumulation

- The production of human capital

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\[ e_t \equiv \text{expenditure on public education} \]
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Human Capital Accumulation

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- \( \tau^*_t \) equates the marginal return to physical capital and human capital
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Efficient Level of Investment in Human Capital

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- \( \tau^*_t = \arg\max y^M_{t+1} \)
- \( \tau^*_t = \arg\max (1 - \tau_t) R_{t+1} \)
Efficient Level of Investment in Human Capital

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- \( \tau^*_t = \arg \max w_{t+1} \)
- \( \tau^*_t = \arg \min \rho_{t+1} \)
There exists a sufficiently low level of land holding by individual \(i\), \(\hat{x}_i\), such that the desirable level of taxation from the viewpoint of individual \(i\) is the level of taxation that maximizes output per capita, \(\tau\).

The level of expenditure on public schooling (and hence the level of taxation) that maximizes aggregate output is optimal from the viewpoint of all individuals except for landowners who own a large fraction of the land in the economy.
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Political Mechanism

- Changes in the existing educational policy require the consent of all 3 segments of society
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\[ \tau_0 = 0 \]
Landowners
Landowners

- $\lambda \in (0, 1)$ - fraction of Landlords in society
Landowners

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- Distribution of land and capital ownership:
  - Identical among landowners in period 0
Landowners

- $\lambda \in (0, 1)$ - fraction of Landlords in society
- Distribution of land and capital ownership:
  - Identical among landowners in period 0
  - $\rightarrow$ Identical in every period $t$
Landowners

Endowments in 1st period of life:

\[ \text{Land} = \frac{X}{\lambda} \]

\[ \text{Capital} = (1 - \tau^t) b_{t} \]

Second period income

\[ I_{t+1} = w_t + 1 + (1 - \tau^t) b_{t+1} + \left( \frac{X}{\lambda} \right) \rho_{t+1} + 1 \]

Optimal capital transfer to offspring

\[ b_{t+1} = \beta I_{t+1} + \left( y_t, b_{t}, \tau^t; \frac{X}{\lambda} \right) \]
Landowners

- Endowments in 1st period of life:
  - Land $- \frac{X}{\lambda}$
Landowners

- Endowments in 1st period of life:
  - Land: $\frac{X}{\lambda}$
  - Capital: $(1 - \tau_t) b^L_t$
Landowners

- Endowments in 1st period of life:
  - Land: \( X / \lambda \)
  - Capital: \( (1 - \tau_t) b_t^L \)

- Second period income

\[
I_{t+1}^L = w_{t+1} + [(1 - \tau_t) b_t^L] R_{t+1} + \left[ \frac{X}{\lambda} \right] \rho_{t+1}
\]
Landowners

- Endowments in 1st period of life:
  - Land: \( X / \lambda \)
  - Capital: \( (1 - \tau_t) b^L_t \)

- Second period income

\[
l^L_{t+1} = w_{t+1} + [(1 - \tau_t) b^L_t] R_{t+1} + [X / \lambda] \rho_{t+1}
\]

- Optimal capital transfer to offspring

\[
b^L_{t+1} = \beta l^L_{t+1} \equiv b^L(y_t, b^L_t, \tau_t; X / \lambda)
\]
The Emergence of Public Education

Lemma

(i) There exists a critical level of the aggregate capital holdings of all young landowner, $B^{*}$, above which their income under the efficient tax policy $\tau_t$ is higher than under $\tau_t = 0$, and the economy switches to $\tau_t^{*}(y_t; X, \lambda)$.

(ii) $B^{*}$ increases with the degree of land inequality in the economy, i.e., $\frac{\partial B^{*}(y_t; X, \lambda)}{\partial \lambda} < 0$.
The Emergence of Public Education

Lemma

(i) There exists a critical level of the aggregate capital holdings of all young landowner, \( \hat{B}_t^L \), above which their income under the efficient tax policy \( \tau_t^* \) is higher than under \( \tau_t = 0 \), and the economy switches to \( \tau_t^* \)

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\hat{B}_t^L \equiv \hat{B}^L(y_t; X, \lambda).
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Lemma

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(ii) $\hat{B}_t^L$ increases with the degree of land inequality in the economy, i.e.,

$$\partial \hat{B}^L(y_t; X, \lambda) / \partial \lambda < 0;$$
The Process of Development

The evolution of output per capita is given by:

\[ y_{t+1} = \psi_0(y_t) \]

for \( t < \hat{t} \),

\[ \psi(y_t) \]

for \( t \geq \hat{t} \),

where \( \hat{t} \) is the time the switch to the efficient tax rate regime occurs.
The Process of Development

The evolution of output per capita

\[ y_{t+1} = \begin{cases} 
\psi^0(y_t) & \text{for } t < \hat{t} \\
\psi^*(y_t) & \text{for } t \geq \hat{t}
\end{cases} \]
The Process of Development

The evolution of output per capita

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\end{cases} \]

\( \hat{t} \equiv \text{time the switch to the efficient tax rate regime occurs:} \)

\[ t \geq \hat{t} \iff B_t^L \geq \hat{B}_t \]
The Process of Development: Overtaking

\[ \psi^*(y_t) \]

\[ \psi^0(y_t) \]

\[ 45^0 \]

\[ y_t \]

\[ \hat{y} \]

\[ \bar{y}^0 \]

\[ \bar{y}^* \]
Inequality in Landownership vs. Wealth Inequality

Conﬂict of interest among the economic elites (industrialists vs. landowners) brought about the delay in the implementation of growth enhancing educational policies (GMV, GM).

Conﬂict of interest between the elite and the masses delayed reforms (ES, AJR).

Unequal distribution of land ownership adversely aﬀected the timing of educational reforms (GMV).

Unequal distribution of wealth induced the elite to block reforms that may lead to redistribution (ES).
Inequality in Landownership vs. Wealth Inequality

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Conflict of interest *among* the economic elites (industrialists vs. landowners) brought about the delay in the implementation of growth enhancing educational policies (GMV, GM)

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Inequality in Landownership vs. Wealth Inequality

Growth promoting institutions emerged in the development process as the landed aristocracy increases their stake in the industrial sector and the efficiency of the industrial sector dominates the decisions of the Elite (GMV, GM). Persistent desirability of extractive institutions (ES, AJR). Even if the political structure remains unchanged, economic development ultimately triggers the implementation of growth promoting institutions (GMV, GM). Growth promoting policies are implemented only if the distribution of political power changes (ES, AJR), inequality significantly diminishes reforms diminish instability and the risk of revolution (Marx) (extension of the franchise is a commitment device to ensure future redistribution from the elite to the masses (Acemoglu and Robinson (2000)).
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- Galor-Moav-Vollrath
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  - Persistent desirability of extractive institutions (ES, AJR)

- Even if the political structure remains unchanged, economic development ultimately triggers the implementation of growth promoting institutions (GMV, GM)

  - Growth promoting policies are implemented only if
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  - Growth promoting policies are implemented only if
    - distribution of political power changes (ES, AJR)
    - inequality significantly diminishes
    - reforms diminish instability and the risk of revolution (Marx) (extension of the franchise is a commitment device to ensure future redistribution from the elite to the masses (Acemoglu and Robinson (2000)))
Voting Rights and School Enrolment: England 1820-1925

Workers gain majority in the ballots only in 1883 and hence, unlike AR (2000), education reforms cannot be viewed as an outcome of the extension of the franchise that permits workers to redistribute resources to themselves.

[Graph showing changes in voting rights and school enrolment over time in England.]
Voting Rights and School Enrolment: France 1820-1925

- Enfranchised as a percentage of the legal age population
- Percentage of children age 5-14 in public primary schools
Anecdotal Evidence

Land reforms diminish the economic incentives of landowners to block education reforms in: Korea, Taiwan, Japan, Russia.

The feasibility of land reforms is indicative of the political weakness of the landed aristocracy that prevents them from blocking growth enhancing education reforms.
Land reforms followed by education reforms in:
- Korea, Taiwan, Japan, Russia
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Land reforms diminish the economic incentives of landowners to block education reforms
Anecdotal Evidence

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Anecdotal Evidence

The concentration of land ownership across countries and regions are inversely related to education expenditure and attainment:

- North and South America
- North vs. South Mexico (After the Revolution of 1910)
- Argentina, Chile & Uruguay vs. rest of South American
- Costa Rica vs. Honduras & El Salvador (small vs. large plantations)
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Korea

Land Reforms: 1948-1950
- % tenants among farming households: 70% (1945), 0% (1950)

Education Reforms: 1949 –
- Education as % of GNP: 8% (1948), 15% (1960)
- Years of Schooling: 3 (1948), 6 (1960)

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Inequality and Growth
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  - Years of Schooling: 3 (1948), 6 (1960)
  - GDP/GDP_{US}: 8% (1948), 12% (1960)
Taiwan

Land Reforms: 1949-1953
- % tenants among farming households: 43% (1948), 19% (1959)

Education Reforms: 1950 –
- Education as % of GNP: 1.78% (1948), 4.12% (1970)
Taiwan

- **Land Reforms: 1949-1953**
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Japan: the Meiji Restoration

The Meiji Restoration 1868 - Downfall of the traditional feudal structure

Land Reforms: 1871-1883

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Education Reforms: 1872, 1879, 1886

% of 6-14 in schools: 28% (1873), 51% (1883), 94% (1903)
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Russia

Anecdotal Evidence

Land Reforms: 1906
Large landowners: 40% (1860), 17% (1917)

Education Reforms: 1908-1912
% government’s budget devoted to education: 1.4% (1906) 4.9% (1915)
% of the population in schools: 1.7% (1897) 5.7% (1915)

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Inequality and Growth
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Evidence: The High School Movement

A major transformation of the US high school system from an insignificant secondary education to a universal secondary education that is geared towards industrial needs.

Graduation rates:

<table>
<thead>
<tr>
<th>Region</th>
<th>1910</th>
<th>1950</th>
</tr>
</thead>
<tbody>
<tr>
<td>South</td>
<td>3%</td>
<td>49%</td>
</tr>
<tr>
<td>Midwest</td>
<td>11%</td>
<td>58%</td>
</tr>
<tr>
<td>Northeast</td>
<td>10%</td>
<td>56%</td>
</tr>
<tr>
<td>West</td>
<td>11%</td>
<td>61%</td>
</tr>
<tr>
<td>US</td>
<td>5%</td>
<td>57%</td>
</tr>
</tbody>
</table>
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<table>
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<tr>
<th>Year</th>
<th>South</th>
<th>Midwest</th>
<th>Northeast</th>
<th>West</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>1910</td>
<td>3%</td>
<td>11%</td>
<td>10%</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>1950</td>
<td>39%</td>
<td>58%</td>
<td>56%</td>
<td>61%</td>
<td>57%</td>
</tr>
</tbody>
</table>
Evidence: The High School Movement
Evidence: The High School Movement

- Changes in the concentration of land ownership

<table>
<thead>
<tr>
<th>Year</th>
<th>South</th>
<th>Midwest</th>
<th>Northeast</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
</tr>
<tr>
<td>1900</td>
<td>12%</td>
<td>16%</td>
<td>22%</td>
<td>9%</td>
</tr>
<tr>
<td>1920</td>
<td>8%</td>
<td>13%</td>
<td>24%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Hypothesis and Identification Strategy

Central Hypothesis

Inequality in distribution of land ownership adversely affected human capital formation.

Empirical Task

Estimating the effect of land inequality on education expenditure.

Identification Strategy

Exploit variations in distribution of land ownership and in education expenditures across and within states during the high school movement in the US, controlling for state fixed effects.
Hypothesis and Identification Strategy

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- **Empirical Task**
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The Statistical Model

\[ \ln e_{it} = \beta_0 + \beta_1 S_{it} + \beta_2 \ln y_{it} + \beta_3 U_{it} + \beta_4 B_{it} + v_{it} \]

- Expenditure per child in state \( i \) in period \( t \)
- Share of land held by large landowners
- Percentage of the urban population
- Percentage of the black population
- Error term of state \( i \) in period \( t \)

Hypothesis: \( \beta_1 < 0 \)
The Statistical Model

\[ \ln e_{it} = \beta_0 + \beta_1 S_{i,t-1} + \beta_2 \ln y_{i,t-1} + \beta_3 U_{i,t-1} + \beta_4 B_{i,t-1} + \nu_{it} \]
The Statistical Model

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Hypothesis: \( \beta_1 < 0 \)
The Statistical Model: Unobserved Heterogeneity

\[ v_{it} = \eta_i + \delta_t + \theta_{it} + \epsilon_{it} \]

The specification allows for unobserved heterogeneity between states:

(a) Time invariant unobserved heterogeneity across states in the level of log expenditure per child \( \eta_i \)
(b) Linear unobserved heterogeneity across states in the time trend of log expenditure per child \( \theta_{it} \)
(c) Common time trend \( \delta_t \)

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The Statistical Model: Unobserved Heterogeneity

\[ \nu_{it} = \eta_i + \delta_t + \theta_i t + \varepsilon_{it} \]
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- (c) Common time trend \( \delta_t \)
Estimating Strategy

\[ \Delta \ln e_{it} = \beta_1 \Delta S_{i,t} + \beta_2 \Delta \ln y_{i,t} + \beta_3 \Delta U_{i,t} + \beta_4 \Delta B_{i,t} + \Delta \delta_t + \theta_i + \Delta \epsilon_{it} \]

\[ \Delta \ln e_{it} = \ln e_{it} (1920 \text{ vs. } 1900 \text{ & } 1940 \text{ vs. } 1920) \]

\[ S_{i,t} = S_{i,t} (1900 \text{ vs. } 1880 \text{ & } 1920 \text{ vs. } 1900) \]
Estimating Strategy

- Heterogeneity across states in the level of log expenditure per child: Accounted for by estimating the difference equation

\[
\Delta \ln e_{it} = \beta_1 \Delta S_{i,t-1} + \beta_2 \Delta \ln y_{i,t-1} + \beta_3 \Delta U_{i,t-1} + \beta_4 \Delta B_{i,t-1} \\
+ \Delta \delta_{t-1} + \theta_i + \Delta \varepsilon_{it}
\]
Estimating Strategy

- Heterogeneity across state in the level of log expenditure per child:
  Accounted for by estimating the difference equation

\[
\Delta \ln e_{it} = \beta_1 \Delta S_{i,t-1} + \beta_2 \Delta \ln y_{i,t-1} + \beta_3 \Delta U_{i,t-1} + \beta_4 \Delta B_{i,t-1} \\
+ \Delta \delta_{t-1} + \theta_i + \Delta \varepsilon_{it}
\]

- \(\Delta \ln e_{it} \equiv \ln e_{it+1} - \ln e_{it}\) (1920 vs. 1900 & 1940 vs. 1920)
- \(\Delta S_{i,t-1} \equiv S_{i,t} - S_{i,t-1}\) (1900 vs. 1880 & 1920 vs. 1900)
Data

Anecdotal Evidence

Evidence from the High School Movement

Galor-Moav-Vollrath

Inequality and Growth

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Data

- Observations in the years: 1880, 1900, 1920, 1940
  - $\{(t - 1, t)\} = \{(1880, 1900), (1900, 1920), (1920, 1940)\}$
Data

- Observations in the years: 1880, 1900, 1920, 1940
  - \( \{(t - 1, t)\} = \{(1880, 1900), (1900, 1920), (1920, 1940)\} \)

- Total observations: 79
  - 41 states (2 observations for 38 states & 1 observation for 3 states)
Land Inequality and Education Expenditure

![Graph showing the relationship between lagged change in land share of largest farms and change in log real expenditure per child. The graph includes a scatter plot with a trend line.]
Controls

- Income per capita
- Percentage of the urban population
- Percentage of the black population

Capturing urbanization's contrasting effects on education expenditure:

(i) Negative (economies of scale in education)
(ii) Positive (industrial (urban) demand for education)

Capturing the adverse effect of discrimination in the South (where land inequality is more pronounced) on educational expenditure.
Controls

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- Percentage of the black population
  - Capturing the adverse effect of the discrimination in the South (where land inequality is more pronounced) on educational expenditure
### Effect of Land Concentration on Educational Expenditure

<table>
<thead>
<tr>
<th></th>
<th>OLS (1)</th>
<th>OLS (2)</th>
<th>OLS (3)</th>
<th>OLS (4)</th>
<th>OLS (5)</th>
<th>OLS (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in log educational expend per child ($\Delta \ln e_{it}$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in land concentration ($\Delta S_{i,t-1}$)</td>
<td>-2.71***</td>
<td>-2.67***</td>
<td>-2.16***</td>
<td>-2.12***</td>
<td>-2.34***</td>
<td>-3.68*</td>
</tr>
<tr>
<td></td>
<td>(0.99)</td>
<td>(0.86)</td>
<td>(0.75)</td>
<td>(0.78)</td>
<td>(0.80)</td>
<td>(2.17)</td>
</tr>
<tr>
<td>Change in income per capita ($\Delta \ln y_{i,t-1}$)</td>
<td>0.84***</td>
<td>0.72***</td>
<td>0.72***</td>
<td>0.72***</td>
<td>0.71*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.13)</td>
<td>(0.13)</td>
<td>(0.17)</td>
<td>(0.41)</td>
<td></td>
</tr>
<tr>
<td>Change in % of the black pop. ($\Delta B_{i,t-1}$)</td>
<td>-3.74***</td>
<td>-3.78***</td>
<td>-2.90***</td>
<td>-2.90***</td>
<td>-5.13**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.59)</td>
<td>(0.73)</td>
<td>(0.96)</td>
<td>(0.96)</td>
<td>(2.17)</td>
<td></td>
</tr>
<tr>
<td>Change in % of the urban pop. ($\Delta U_{i,t-1}$)</td>
<td>-0.05</td>
<td>-0.66*</td>
<td>-0.12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(0.40)</td>
<td>(0.69)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National time fixed effects</td>
<td>No</td>
<td>No</td>
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<td>No</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>State fixed effects (linear time trend)</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
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<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.11</td>
<td>0.27</td>
<td>0.39</td>
<td>0.39</td>
<td>0.48</td>
<td>0.38</td>
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<tr>
<td>Hausman Statistic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.16</td>
<td></td>
</tr>
<tr>
<td>Hausman p-value</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.71</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1
A 10 percentage point decline in $S_{i,t-1}$ would have increased expenditure per child at the following period by 21–27%.
Interpretation

- A 10 percentage point decline in $S_{i,t-1}$ would have increased expenditure per child at the following period by 21–27%.
- In 1920 California $S_{1920} = 0.096$ (25th percentile of the distribution of $S$ across states in the U.S.) and in Vermont $S_{1920} = 0.215$ (75th percentile). Vermont’s expenditure per child in 1920 would have been 25% higher if it had a land share of large farms as small as California’s. That difference would have eliminated more than a $1/3$ of the actual gap in expenditure per child that existed between California ($68$ per child) and Vermont ($41$ per child) in 1940.
Anecdotal Evidence

Regressions

Instrumental Variable

The price of a pound of cotton relative to a bushel of corn declined monotonically over the period 1880-1940. In regions that were climatically more receptive to cotton production, the concentration of land ownership held by the largest farms declined. In 29 states that produced no cotton in 1860, the average change in land concentration was just -0.2% over the period 1880-1940. Among states that produced some cotton in 1860, the average change in the land concentration of the largest landowners was -2.6%. Cotton production was most prevalent in the South, accounting for over 40% of the value of agricultural production, and land ownership by the largest farms declined.
Instrumental Variable

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Among states that produced some cotton in 1860, the average change in the land concentration of the largest landowners was -2.6%.

Cotton production was most prevalent in the South, accounting for over 40% of the value of agricultural production & Land ownership by the largest farms declined.
Instrumental Variable

- The interaction between state-specific, but time invariant, climatic conditions and the nationwide changes in the price of cotton relative to corn instruments for the concentration of land ownership.
The interaction between state-specific, but time invariant, climatic conditions and the nationwide changes in the price of cotton relative to corn instruments for the concentration of land ownership.

These instruments appear to satisfy the exclusion restriction, since there is no evidence that the human capital intensity in the production of cotton over this period differs from the average in all other agricultural crops, and changes in the relative price of cotton, therefore, would not have a direct effect on education expenditure, but only indirectly through their effect on concentration of landownership, and possibly via changes in income, that are controlled for in the regressions.
### Instrumental Variable Regression

Change in log educational expend per child ($\Delta \ln e_{it}$)

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>2SLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Change in land concentration ($\Delta S_{i,t-1}$)</td>
<td>-2.34***</td>
<td>-3.23***</td>
</tr>
<tr>
<td></td>
<td>(0.80)</td>
<td>(0.91)</td>
</tr>
<tr>
<td>Change in income per capita ($\Delta \ln y_{i,t-1}$)</td>
<td>0.72***</td>
<td>0.72***</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.17)</td>
</tr>
<tr>
<td>Change in % of the black pop. ($\Delta B_{i,t-1}$)</td>
<td>-2.90***</td>
<td>-2.58***</td>
</tr>
<tr>
<td></td>
<td>(0.96)</td>
<td>(0.92)</td>
</tr>
<tr>
<td>Change in % of the urban pop. ($\Delta U_{i,t-1}$)</td>
<td>-0.66*</td>
<td>-0.51</td>
</tr>
<tr>
<td></td>
<td>(0.40)</td>
<td>(0.37)</td>
</tr>
<tr>
<td>National time fixed effects</td>
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<td>Yes</td>
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<td>Observations</td>
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<td>R-squared</td>
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<td>First stage p-value</td>
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<td>Sargan test p-value</td>
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Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1


Main Source:


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