Financial Development, Growth, and the Distribution of Income

Jeremy Greenwood and Boyan Jovanovic
Journal of Political Economy, 1990

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Reading Group Presentation

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Introduction

- Two themes in the growth and development literature:
  1. Kuznets Curve
  2. Relationship between finance and growth

- This paper: focus on economic growth, institutional development, and the distribution of income

- Institutions (trading organizations) arise endogenously and have two main benefits:
  1. Help overcome information frictions
  2. Allow for risk pooling

- Development of institutions is costly
Environment

- Agents: continuum $\sim [0, 1]$ with Lebesgue measure $\lambda$
- Utility: $E_0 \left[ \sum_{t=0}^{\infty} \beta^t ln(c_t) \right]$
- Wealth $k_t$ used for consumption and investment. Heterogeneity in wealth; initial wealth distribution $\hat{H}_0 : \mathbb{R}_{++} \rightarrow [0, 1]$
- Technologies for investing $i_{t-1}$ units in period $t-1$:
  - **Safe** $\Rightarrow$ output $y_t = \delta i_{t-1}$ in period $t$
  - **Risky** $\Rightarrow$ output $y_t = (\theta_t + \epsilon_{jt})i_{t-1}$ in period $t$
- $\theta_t + \epsilon_{jt}$: composite technology shock
Composite technology shock

- Investor \( j \) only observes the composite shock

- **Assumption A** on the aggregate shock \( \theta_t \):
  - \( \theta_t \) has distribution \( F : [\bar{\theta}, \bar{\theta}] \rightarrow [0, 1] \)
  - \( \mathbb{E}\{ \ln[\phi \theta + (1 - \phi)\delta] \} > \ln(\delta) > -\ln(\beta) \) for all \( \phi \in (0, 1] \)
  - \( \Rightarrow \mathbb{E}[\theta] > \delta > 1/\beta \)

- **Assumption B** on the idiosyncratic shock \( \epsilon_{jt} \):
  - \( \epsilon_{jt} \) has distribution \( G : [\bar{\epsilon}, \bar{\epsilon}] \rightarrow [0, 1] \)
  - \( \mathbb{E}[\epsilon] = 0 \) and \( \bar{\theta} + \epsilon > 0 \)
Trading organizations

- Trading organization: coalition of agents that collects and processes information, coordinates production, and spreads risk across projects.

- Costs of forming organization:
  - Fixed cost $\alpha$ of incorporating an agent
  - Proportional cost $1 - \gamma$ each period

- If $A$ is a set of $j \in [0, 1]$ that forms a coalition, then the total costs are
  \[
  \text{Fixed: } \alpha \int_A d\lambda(j) \quad \text{Variable: } (1 - \gamma) \int_A i(j) d\lambda(j)
  \]
  when agent $j$ invests $i(j)$ in a given period.
Financial intermediation

- Consider agent who (at cost $\alpha$) has assumed role of intermediary for set of agents $A_{t-1}$ in period $t - 1$
- For one-time-fee $q$ agent promises return $r(\theta_{t+j})$ per unit invested in any period $t + j - 1$
- Intermediary has total capital $\gamma \int_{A_{t-1}} i_{t-1}(j) d\lambda(j)$
- He experiments to learn about $\theta_t$ (next slide)
- He then invests and obtains net return $\gamma \max(\delta, \theta_t)$
Experimentation — Intermediary . . .

- Selects a finite number of risky projects $\tau$ from $A_{t-1}$
- Funds each project with the average amount $\gamma K_t$
- Calculates return $\hat{\theta}_{t\tau}$

$$\hat{\theta}_{t\tau} = \frac{\gamma}{\tau} \left( \theta_{t\tau} + \sum_{j=1}^{\tau} \epsilon_{jt} \right)$$

- $\hat{\theta}_{t\tau} > \gamma \delta \Rightarrow$ funds remaining risky projects ($\gamma K_t$ units)
  otherwise: fund safe projects
- As $\tau \to \infty$, $\hat{\theta}_{t\tau} \to \gamma \theta_t$ almost surely
- Experimentation set countable $\Rightarrow$ does not affect overall returns
Returns and competition

- The net return obtained is thus $\gamma \max(\delta, \theta_t)$

- Any agent can become an intermediary $\Rightarrow$ zero profits:

$$[\gamma \max(\delta, \theta_t) - r(\theta_t)] \int_{A_{t-1}} i_{t-1}(j) d\lambda(j)$$

$$+ \gamma \max(\delta, \theta_t)[q - \alpha] \int_{A'_{t-1}} d\lambda(j) = 0$$

- where $A'_{t-1} \subseteq A_{t-1}$ is the set of agents entering at $t - 1$
Returns and competition (2)

- ZPC $\Rightarrow r(\theta_t) = \gamma \max(\delta, \theta_t)$ and $q = \alpha$

- **Assumption C**: $\gamma$, $\delta$, and $F$ specified such that
  \[
  \int \theta dF(\theta) < \int \gamma \max(\delta, \theta) dF(\theta)
  \]
Participation

- Agent outside intermediated sector:

\[ w(k_t) = \max_{s_t, \phi_t} \left\{ \ln(k_t - s_t) + \beta \int \max \left[ w(s_t[\phi_t(\theta_{t+1} + \epsilon_{j,t+1}) + (1 - \phi_t)\delta]) , \right. \right. \]
\[ \left. \left. v(s_t[\phi_t(\theta_{t+1} + \epsilon_{j,t+1}) + (1 - \phi_t)\delta] - q) \right] dF(\theta_{t+1}) dG(\epsilon_{j,t+1}) \right\} \]

- Agent inside the intermediated sector:

\[ v(k_t) = \max_{s_t} \left\{ \ln(k_t - s_t) + \beta \int \max \left[ w(s_t r(\theta_{t+1})) , v(s_t r(\theta_{t+1})) \right] dF(\theta_{t+1}) \right\} \]
Participation

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- Agent inside the intermediated sector:

\[ v(k_t) = \max_{s_t} \left\{ \ln(k_t - s_t) + \beta \int \max\left[ w(s_tr(\theta_{t+1})), v(s_tr(\theta_{t+1})) \right] dF(\theta_{t+1}) \right\} \]
Participation

- Agent outside intermediated sector:

\[
\begin{align*}
    w(k_t) &= \max_{s_t, \phi_t} \left\{ \ln(k_t - s_t) + \beta \int \max \right. \\
    &\left. w(s_t[\phi_t(\theta_{t+1} + \epsilon_{j,t+1}) + (1 - \phi_t)\delta]), \right. \\
    &\left. v(s_t[\phi_t(\theta_{t+1} + \epsilon_{j,t+1}) + (1 - \phi_t)\delta] - q) \right] dF(\theta_{t+1}) dG(\epsilon_{j,t+1}) \}\end{align*}
\]

- Agent inside the intermediated sector:

\[
\begin{align*}
    v(k_t) &= \max_{s_t} \left\{ \ln(k_t - s_t) + \beta \int v(s_t r(\theta_{t+1})) dF(\theta_{t+1}) \right. \\
    &\left. \right. \end{align*}
\]
Some results

- **Lemma 2**: \( v(k) > w(k) \).

- \( \Rightarrow \) an agent in the intermediation network never leaves

- **Lemma 3**: \( \exists 0 < k \leq \bar{k}, \text{ s.t.} \)
  - \( v(k_t - q) < w(k_t) \) for \( 0 < k_t < k \), and
  - \( v(k_t - q) > w(k_t) \) for \( k_t > \bar{k} \)

- \( \Rightarrow \) the sets \( B^c \) and \( B \) are non-empty:
  \[
  B^c = \{ k_t : v(k_t - q) < w(k_t) \}, \quad B = \{ k_t : v(k_t - q) \geq w(k_t) \}
  \]

- Capital \( k_t \in B \) \( \Rightarrow \) establish link with network
Implications for savings and growth

- Agents inside the intermediated sector save $s_t = \beta k_t$
- Agents outside have decision rule $s_t = s(k_t)$

**Proposition 2**: $s(k_t) > \beta k_t$

<table>
<thead>
<tr>
<th>Agents...</th>
<th>Save $s_t =$</th>
<th>Expected rate of growth $\mathbb{E}[k_{t+1}/k_t]$</th>
</tr>
</thead>
<tbody>
<tr>
<td>... inside:</td>
<td>$\beta k_t$</td>
<td>$\beta \gamma \int \max(\delta, \theta_{t+1}) dF(\theta_{t+1})$</td>
</tr>
<tr>
<td>... outside:</td>
<td>$s(k_t)$</td>
<td>$\left[ \frac{s(k_t)}{k_t} \right] \left{ \phi(k_t) \int \theta_{t+1} dF(\theta_{t+1}) + [1 - \phi(k_t)] \delta \right}$</td>
</tr>
</tbody>
</table>
Agents in autarky face an inferior distribution of returns, but save more ⇒ unclear whose wealth is growing faster

For very poor agents however $s(k_t) \approx \beta k_t$ (Prop. 3)

⇒ Difference in wealth between agents in the intermediated sector and the very poor widens over time.
Implications for savings and growth (3)

- However, growth \(\Rightarrow\) measure of agents outside intermediated sector shrinks over time
- Economy’s expected growth rate \(\rightarrow \beta \gamma E[\max(\delta, \theta)]\)
- Asymptotically all agents’ wealth growing at the same rate \(\Rightarrow\) stable distribution of relative wealth levels
- The paper addresses the two issues raised initially:
  - Link between growth and financial structure
  - Evolution of income distribution
Agents outside intermediated sector

\[ w(k_t) = \max_{s_t, \phi_t} \{ \ln(k_t - s_t) + \]
\[ \beta \int_{D_c(s_t, \phi_t)} w(s_t[\phi_t(\theta_{t+1} + \epsilon_{t+1}) + (1 - \phi_t)\delta]) dF(\theta_{t+1})dG(\epsilon_{t+1}) \]
\[ + \beta \int_{D(s_t, \phi_t)} v(s_t[\phi_t(\theta_{t+1} + \epsilon_{t+1}) + (1 - \phi_t)\delta] - q) dF(\theta_{t+1})dG(\epsilon_{t+1}) \}

where

\[ D_c(s_t, \phi_t) = \{(\theta_{t+1}, \epsilon_{j,t+1}) : s_t[\phi_t(\theta_{t+1} + \epsilon_{t+1}) + (1 - \phi_t)\delta] \in B^c \} \]
\[ D(s_t, \phi_t) = \{(\theta_{t+1}, \epsilon_{j,t+1}) : s_t[\phi_t(\theta_{t+1} + \epsilon_{t+1}) + (1 - \phi_t)\delta] \in B \} \]
Evolution of the distribution

- \[ \hat{\psi}(k'; k) \equiv \text{prob}[k_{t+1} \leq k' \mid k_t = k] \]

- \( \Rightarrow \) prob. that agent outside in \( t \) with wealth \( k \) remains outside in \( t + 1 \) with wealth \( \leq k' \) given by

\[ \psi(k'; k) \equiv \int_{B^c \cap (0, k']} d\hat{\psi}(z; k) \]

- Initial sizes:

  Developed sec.: \( \int_B d\hat{H}_0(k) \)

  Less developed sec.: \( \int_{B^c} d\hat{H}_0(k) \)

- Evolution of distr. of capital in less developed sector:

\[ H_{t+1}(k') = \int_{B^c} \psi(k'; k) dH_t(k) \]
Evolution of the distribution (2)

- $H_{t+1}$'s have all their mass on $B^c$
- $\Rightarrow$ size of less developed sector = $H_{t+1}(\bar{k})$
- Growth in the economy $\Rightarrow \lim_{t \to \infty} H_{t+1}(\bar{k}) = 0$
- It follows that the economy’s expected growth rate converges to $\mathbb{E}[\beta R_t(\theta)] = \beta \gamma \mathbb{E}[\max(\delta, \theta)]$, since

$$R_t(\theta) \equiv \int_0^{\bar{k}} \{\phi(k)\theta + [1 - \phi(k)]\delta\}dH_{t-1}(k) + [1 - H_{t-1}(\bar{k})]\gamma \max(\delta, \theta)$$