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 λ
- Utility: $\mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t ln(c_t)\right]$
- 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 $t-1$:

$$\begin{array}{lll} \textbf{Safe} \Rightarrow & \text{output } y_t = \delta i_{t-1} & \text{in period } t \\ \textbf{Risky} \Rightarrow & \text{output } y_t = (\theta_t + \epsilon_{jt}) i_{t-1} & \text{in period } t \end{array}$$

- $\theta_t + \epsilon_{jt}$: composite technology shock

Composite technology shock

- Investor j only observes the composite shock
- **Assumption A** on the aggregate shock θ_t:
  - θ_t has distribution $F : [\underline{\theta}, \bar{\theta}] \rightarrow [0, 1]$
  - $\mathbb{E}\{ln[\phi\theta + (1 - \phi)\delta]\} > ln(\delta) > -ln(\beta)$ for all $\phi \in (0, 1]$
  - $\Rightarrow E[\theta] > \delta > 1/\beta$
- **Assumption B** on the idiosyncratic shock ϵ_{jt}:
  - ϵ_{jt} has distribution $G : [\underline{\epsilon}, \bar{\epsilon}] \rightarrow [0, 1]$
  - $\mathbb{E}[\epsilon] = 0$ and $\underline{\theta} + \underline{\epsilon} > 0$

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 α 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

$$\text{Fixed: } \alpha \int_A d\lambda(j) \qquad \text{Variable: } (1-\gamma)\int_A i(j)d\lambda(j)$$

when agent j invests $i(j)$ in a given period

Financial intermediation

- Consider agent who (at cost α) 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 θ_t (**next slide**)
- He then invests and obtains net return $\gamma \max(\delta, \theta_t)$

Experimentation — Intermediary . . .

- Selects a finite number of risky projects τ from A_{t-1}
- Funds each project with the average amount γK_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 (γK_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**: γ, δ, and F specified such that

$$\int \theta dF(\theta) < \int \gamma \max(\delta, \theta) dF(\theta)$$

Participation

- Agent outside intermediated sector:

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

- Agent inside the intermediated sector:

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

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Some results

- **Lemma 2**: $v(k) > w(k)$.
- $\Rightarrow$ an agent in the intermediation network never leaves
- **Lemma 3**: $\exists 0 < \underline{k} \leq \bar{k}$, s.t.
  - $v(k_t - q) < w(k_t)$ for $0 < k_t < \underline{k}$, 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**: $s(k_t) > \beta k_t$

Agents...	Save $s_t =$	Expected rate of growth $\mathbb{E}[k_{t+1}/k_t]$
...inside:	βk_t	$\beta\gamma \int \max(\delta, \theta_{t+1}) dF(\theta_{t+1})$
...outside:	$s(k_t)$	$\left[\frac{s(k_t)}{k_t}\right] \left\{\phi(k_t) \int \theta_{t+1} dF(\theta_{t+1}) + [1 - \phi(k_t)]\delta\right\}$

Implications for savings and growth (2)

- Agents in autarky face an inferior distribution of returns, but save more $\Rightarrow$ unclear whose wealth is growing faster
- For very poor agents however $s(k_t) \approx \beta k_t$ (Prop. 3)
- $\Rightarrow$ 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 $\rightarrow \beta\gamma\mathbb{E}[\max(\delta, \theta)]$
- Asymptotically all agents' wealth growing at the same rate $\Rightarrow$ stable distribution of relative wealth levels
- The paper adresses the two issues raised initially:
  - Link between growth and financial structure
  - Evolution of income distribution

Agents outside intermediated sector

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

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

- $\hat{\psi}(k^{'}; k) \equiv \text{prob}[k_{t+1} \leq k^{'} | k_t = k]$
- $\Rightarrow$ 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:

$$\text{Developed sec.: } \int_B d\hat{H}_0(k) \qquad \text{Less developed sec.: } \int_{B^c} d\hat{H}_0(k)$$

- 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

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