Why Doesn't Technology Flow from Rich to Poor Countries? by Cole, Greenword, and Sanchez

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My view of paper's aim:

- Study how **monitoring ability** of lending institutions impacts decision of a firm to adopt a technology.
- Use this model to explain **differences in TFP and firm size** between India, Mexico and US

Why do we care?

- Choosing a less efficient technology leads to slower growth and lower income
- Lower income has huge negative implications for welfare.
- Would be useful to understand what drives cross country differences in income levels – essential if we want to increase income levels in poorer countries
- In international dollars, GDP per capita (2010)
  - US: 46569
  - Mexico: 13500
  - India: 4148

- Why don't people in India just copy what Americans do? What stops them from having a firm like Apple?
- Why don't Americans invest in India and capture high returns? (Lucas (1990))
  - In real life, Indians may well prefer to invest in the US: capital flowing from poor to rich countries! Opposite of basic theory.
- Must be some frictions
  - Poor monitoring: harder to audit firm – lower investment
  - Corruption. To do business you may need to pay bribes – less capital available for investment – cannot invest in more expensive (and probably more efficient) technologies
  - Illiteracy: 82.14% for men and 65.46% for women in India.
- This paper focuses on poor monitoring and corruption

Model Outline

- Firm which can lie about productivity and steal
- Financial Intermediary (FI)
- FI provides capital to Firm, FI receives payments from firm, FI also chooses when and how closely to monitor firm (optimal contract dependent on techology)
- Firm chooses technology, which depends on optimal contract
- **How is technology choice impacted by monitoring costs and stealing**

Firm's Productivity

- S productivity states, $\{\theta_0, \theta_1, \ldots, \theta_S\}$. Start at θ_0. To get to θ_S must pass through all intermediate states.
- Firm survives till date t with prob. σ^{t-1}. Conditional on survival, prod. θ_t with prob. ρ^t, prod. θ_{t-1} with prob. $\rho^{t-1}(1-\rho)$, prod. θ_{t-2} with prob. $\rho^{t-2}(1-\rho)$, ..., prod. θ_1 with prob. $\rho(1-\rho)$, prod. θ_0 with prob. $1-\rho$

$$\begin{aligned}
\Pr(t,t) &= \rho^t \sigma^{t-1} \\
\Pr(t-1,t) &= \rho^{t-1}(1-\rho)\sigma^{t-1} \\
\Pr(t-2,t) &= \rho^{t-2}(1-\rho)\sigma^{t-1} \\
&\vdots \\
\Pr(1,t) &= \rho(1-\rho)\sigma^{t-1} \\
\Pr(0,t) &= (1-\rho)\sigma^{t-1}
\end{aligned}$$

Firm's PV & Monitoring

- At date t with prod. θ_s, firm's capital input is $k(s,t)$ and net CF is

$$\overbrace{\theta_s k(s,t)^{\alpha}}^{\text{output}} - \overbrace{x(s,t)}^{\text{CF to FI}} \tag{1}$$

- Assume exogenous constant DF, β
- Firm's PV from date t net CF

$$\beta^t \sum_{0 \leq s \leq \min\{t,S\}} (\theta_s k(s,t)^{\alpha} - x(s,t)) \Pr(s,t) \tag{2}$$

- Firm's PV from all future net CF's

$$v = \sum_{t=1}^{T} \beta^t \sum_{0 \leq s \leq \min\{t,S\}} (\theta_s k(s,t)^{\alpha} - x(s,t)) \Pr(s,t) \tag{3}$$

- Contract: $k(s,t)$, $x(s,t)$, and $p(s,t)$ (probability of detecting a lie in reported productivity at date t when true state is s)
- Monitoring is costly. Cost function, C, increasing in $p(s,t)$ and parameterized by z. When z is larger, monitoring is easier, C is smaller.

Incentive compatibility: want a contract that ensures truth telling dominates telling lies

$$\overbrace{\sum_{t=u}^{T} \beta^{t-u} \sum_{u \leq s \leq \min\{t,S\}} \left(\theta_s k(s,t)^{\alpha} - x(s,t)\right) \Pr(s,t)}^{\text{PV of firm at date } u \text{ when telling truth}} \tag{4}$$

$$\geq \overbrace{\sum_{t=u}^{T} \beta^{t-u} \sum_{u \leq s \leq \min\{t,S\}} \left(\theta_s k(u-1,t)^{\alpha} - x(u-1,t)\right) \Pi_{n=u}^{t} [1 - p(u-1,n)] \Pr(s,t)}^{\text{PV of firm at date } u \text{ when reporting productivity of } \theta_{u-1} < \theta_s} \tag{5}$$

An optimal contract

- Leave the firm with zero net CF prior to terminal date, firm pays:

$$x(s,t) = \theta_s k(s,t)^{\alpha} \tag{6}$$

- Return profits to firm at terminal date

$$pr = \sum_{t=1}^{T} \beta^t \sum_{0 \le s \le \min\{t,S\}} \left(\theta_s k(s,t)^{\alpha} - \overbrace{C(p(s,t),k(s,t))}^{\text{monitoring costs}} - \overbrace{qk(s,t)}^{\text{cost of input}} \right) \Pr(s,t) \tag{7}$$

$$- \overbrace{\phi}^{\text{initial investment}} \tag{8}$$

- Firm's final payment

$$x(S,T) = \theta_S k(S,T)^{\alpha} - \frac{pr}{\beta^T \Pr(S,T)} \le 0 \tag{9}$$

- Firm's PV with optimal contract

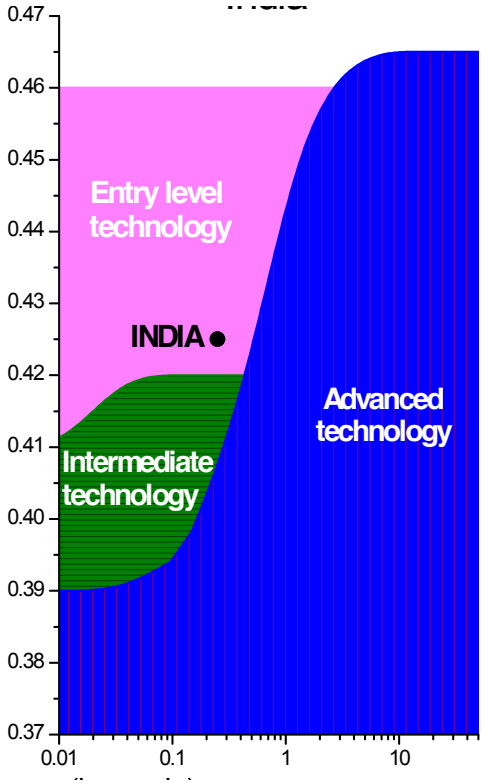
$$v^* = pr \tag{10}$$

Corruption and Bribes

- Include the possibility of firm stealing some output.
- Need to change to contract so that incentive to steal is gone.
- To discourage firm from exercising option to steal, optimal contract is altered to reduce payments made by firm to FI. This occurs at intermediate and final dates. **A bribe?**
- May have unpleasant consequences not modelled here. Danegeld in Anglo-Saxon England.

Technology Choice

- Close model: demand for inputs=supply
- Firms choose technology: $\{\theta_0, \theta_1, \ldots, \theta_S\}$
- Technology choice depends on optimal contract. Optimal contract depends on technology choice. Fixed point problem.
  - Stronger monitoring: better technology (x-axis)
  - More stealing: worse technology (y-axis)



US, Mexico & India

- US: good monitoring, no stealing, efficient workers but high wages, expensive inputs, high fixed costs
- Mexico: poor monitoring, nostealing, reasonably efficient workers ok wages and reasonably expensive inputs, low fixed costs
- India: poor monitoring, stealing, inefficient workers, low wages and cheap inputs, low fixed costs
- US gets advanced technology
- Mexico gets intermediate technology
- India gets entry level technology

Comments: discounting

- Discount rate, β, constant and same across countries
- Discount rates are stochastic and because of market segmentation not same in India as in US.
- Make β higher in India
- Introduce stochastic discount factor, SDF dependent on aggregate state s_a of the economy

$$M(s_a, t) = \frac{1}{R_f} \times \underbrace{G(s_a, t)}_{\text{martingale for risk pricing}} \tag{11}$$

- Need to think carefully about state s for technologies: when is it related to the aggregate state s_a
- Equivalent to using risk-neutral probabilities for evaluation (change of measure from $\mathbb{P}$ to $\mathbb{Q}$)

Comments: discounting II

- Why bother with a SDF?
- Can use information on risk premia to tie down economic losses associated with poor monitoring and stealing
  - How does poor monitoring reduce value of human capital?
- Could introduce uncertainty shocks at aggregate level: study how uncertainty shocks (Bloom (2009)) impact how technology choice is affected by poor monitoring and stealing
- Would expect that a more uncertainty leads to smaller regions in which better technology shocks are adopted

Comments: FI's and competition

- In paper: large number of competitive intermediaries are seeking to lend to each firm, so the optimal contract will maximize the expected payoff of the firm
- Is there that much competition in the banking sector?
  - $\approx$ 6500 banks in the United States
  - India has 88 scheduled commercial banks (SCBs) - 27 public sector banks, 31 private banks, 38 foreign banks
  - Banks may be involved in corruption.