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 technology)
- 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 $\theta_0$. To get to $\theta_S$ must pass through all intermediate states.

- Firm survives till date $t$ with prob. $\sigma^{t-1}$. Conditional on survival, prod. $\theta_t$ with prob. $\rho^t$, prod. $\theta_{t-1}$ with prob. $\rho^{t-1}(1 - \rho)$, prod. $\theta_{t-2}$ with prob. $\rho^{t-2}(1 - \rho)$, ..., prod. $\theta_1$ with prob. $\rho(1 - \rho)$, prod. $\theta_0$ with prob. $1 - \rho$

\[
\begin{align*}
\Pr(t, t) &= \rho^t \sigma^{t-1} \\
\Pr(t - 1, t) &= \rho^{t-1}(1 - \rho)\sigma^{t-1} \\
\Pr(t - 2, t) &= \rho^{t-2}(1 - \rho)\sigma^{t-1} \\
&\vdots \\
\Pr(1, t) &= \rho(1 - \rho)\sigma^{t-1} \\
\Pr(0, t) &= (1 - \rho)\sigma^{t-1}
\end{align*}
\]
Firm’s PV & Monitoring

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

$$\theta_s k(s, t)^\alpha - x(s, t)$$

(1)

- Assume exogenous constant DF, $\beta$
- Firm’s PV from date $t$ net CF

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

(2)

- Firm’s PV from all future net CF’s

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

(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

\[
\begin{align*}
\text{PV of firm at date } u \text{ when telling truth} & = \sum_{t=u}^{T} \beta^{t-u} \sum_{u \leq s \leq \min\{t, S\}} (\theta_s k(s, t)^{\alpha} - x(s, t)) \Pr(s, t) \\
\geq \sum_{t=u}^{T} \beta^{t-u} \sum_{u \leq s \leq \min\{t, S\}} (\theta_s k(u-1, t)^{\alpha} - x(u-1, t)) \prod_{n=u}^{t} [1 - p(u-1, n)] \Pr(s, t)
\end{align*}
\]
An optimal contract

- Leave the firm with zero net CF prior to terminal date, firm pays:
  \[ x(s, t) = \theta_s k(s, t)^\alpha \]  

- Return profits to firm at terminal date

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

- Initial investment

  \[
  \phi
  \]  

- Firm’s final payment

  \[
  x(S, T) = \theta_S k(S, T)^\alpha - \frac{pr}{\beta^T Pr(S, T)} \leq 0
  \]  

- Firm’s PV with optimal contract

  \[
  v^* = pr
  \]
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.
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, no stealing, 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, $\beta$, constant and same across countries
- Discount rates are stochastic and because of market segmentation not same in India as in US.
- Make $\beta$ higher in India
- Introduce stochastic discount factor, SDF dependent on aggregate state $s_a$ of the economy

\[ M(s_a, t) = \frac{1}{R_f} \times G(s_a, t) \]  

(11) martingale for risk pricing

- 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
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?

- ≈ 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.