Technology Adoption and the Latin American TFP Gap: A discussion

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Introduction

- Differences in income per capita primarily reflect differences in TFP.
- Differences in TFP = differences in technology or differences in misallocation.
- This paper proposes an empirical methodology to estimate differences in technology focusing on the dynamics of technology adoption.
- Trick of the paper is to exploit the lagged co-movement of GDP growth to identify the technological component of productivity growth.

Methodology

- The paper's identification strategy: any shock to productivity growth in the frontier country (the US) that affects the adopting countries (LAC) with a lag is indeed a technology shock.

- The paper then use the technological component to study the effects of a technology shock on TFP growth in LAC, both in terms of timing and in terms of magnitude.

- Start with a standard production function $Y_{i,t} = A_{i,t} F\left(K_{i,t}, L_{i,t}, ...\right)$

- Write total factor productivity as the product of a technology (X) and a non-technology (Z) component: $A_{i,t} = X_{i,t} Z_{i,t}$

- The paper assumes that technology adoption in the developing region (LAC) evolves according the following law of motion:

$$x_{lac,t} = \sum_{j \geq 0} \lambda_j x_{us,t-j} \text{ with } x_{i,t} = \ln X_{i,t} - \ln X_{i,t-1} \tag{1}$$

Methodology

- In this technology adoption model, λ_0 is the *instantaneous* technological adoption rate, $\sum_{j\geq 0}\lambda_j$ is the *long-run* technological adoption rate.
- Denoting $\overline{x} = E(x_{us,t})$ average technology growth in the leading country,
  - Growth differential: $E\left(x_{us,t} - x_{lac,t}\right) = \overline{x}.(1 - \sum_j \lambda_j)$
  - Output differential: $E\left(\ln x_{us,t} - \ln x_{lac,t}\right) = \overline{x}.\sum_{\tau\geq 0}(1 - \sum_{j=0}^{\tau}\lambda_j)$
- Parametric assumption to estimate the λ's:

$$\lambda_j = p_1 exp\left(-\frac{(j-p_2)^2}{p_3}\right)$$

Methodology

- The model for technology adoption is as follows:

$$a_{us,t} - \overline{a}_{us} = z_{us,t} - \overline{z}_{us} + x_t - \overline{x}$$

$$a_{lac,t} - \overline{a}_{lac} = z_{lac,t} - \overline{z}_{lac} + \sum_{j \geq 0} \lambda_j (x_{t-j} - \overline{x})$$

$$z_{i,t} - \overline{z}_i = \rho_i (z_{i,t-1} - \overline{z}_i) + \nu_{i,t}$$

$$x_t - \overline{x} = \alpha (x_{t-1} - \overline{x}) + \epsilon_t$$

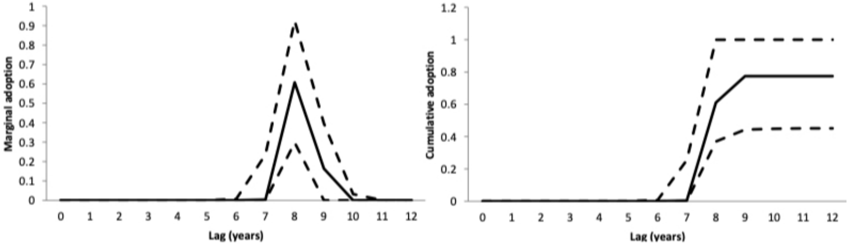
- Main assumptions underlying the estimation:
  - Technology and non-technology growth processes are stationary, they follow AR 1 processes.
  - Technology and non-technology growth processes are independent: the disturbances (ϵ) and (ν_{us} and ν_{lac}) are uncorrelated.

Comment 1. The empirical results

Estimation results for the LAC region as a whole seems totally reasonable

- Technology adoption lag is estimated at about 7-8 years
- Average long-run adoption rate still below 1, even after 12 years
- But full technology adoption cannot be rejected after 9-10 years

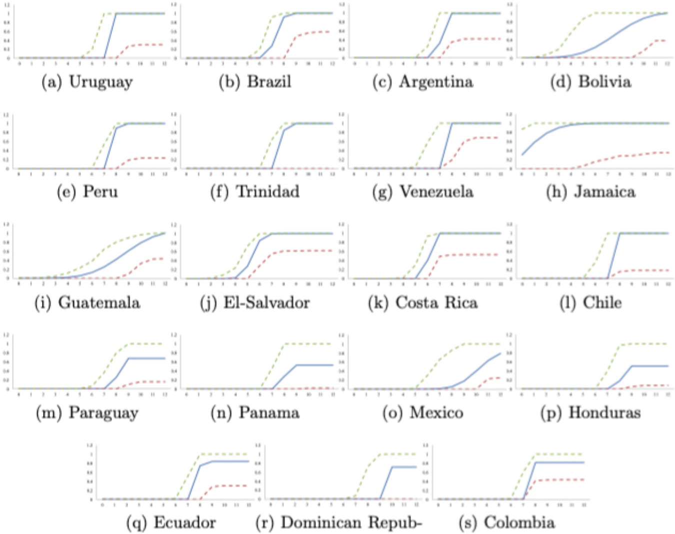
Figure 2: Estimated marginal and cumulative adoption rates in the baseline



(a) Marginal adoption rates (b) Cumulative adoption

Comment 1. The empirical results

There are more surprises in the country-by-country estimation results



(a) Uruguay (b) Brazil (c) Argentina (d) Bolivia

(e) Peru (f) Trinidad (g) Venezuela (h) Jamaica

(i) Guatemala (j) El-Salvador (k) Costa Rica (l) Chile

(m) Paraguay (n) Panama (o) Mexico (p) Honduras

(q) Ecuador (r) Dominican Repub- (s) Colombia

Comment 2

- The estimation assumes some separation between the evolution of technology growth (X) and that of non-technology growth (Z)
  - In the leading country, as well as in the LAC region $\Rightarrow$ technology vs. misallocation
- This may be partly true in the leading country
- but in the LAC region, may factors, that pertain to non-technology including misallocation or government regulations affect the rate/speed of technology adoption
- For instance, liberalising price setting, firm entry or improving product market competition are likely to reduce misallocation (Z $\nearrow$) and raise incentives for technology adoption (X $\nearrow$).
- The speed at which innovation gets disseminated (λ_j), either within an economy, or from the leading to the lagging countries should therefore depend on non-technology TFP factors.

Comment 3

- The estimation assumes some stationary time series process for technology and non-technology growth
- In reality, there has been a slow-down in TFP growth
- if so, TFP growth may have been stationary, but around a decreasing a trend
- This would matter for the growth differential with LAC
  - slow technological adoption is less problematic if latest technologies are less TFP-enhancing
- Another fact is that technology and non-technology improvements come in waves:
  - technology: combustion engine, internet, AI, etc...
  - non-technology: deregulation wave in the 1980's
- None really squares with the stationarity assumption, rather jump processes.