Productivity and Innovation Challenges to Colombia’s Take Off

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Soon in Spanish UNIANDES Press!!

The Innovation Paradox
Developing-Country Capabilities and the Unrealized Promise of Technological Catch-Up
Xavier Giro and William F. Maloney

Productivity Revisited
Shifting Paradigms in Analysis and Policy
Ana Paula Coutinho and William F. Maloney

High-Growth Firms
Facts, Fiction, and Policy Options for Emerging Economies
Arti Grover Goyal, Danilo Medard, and Ellen Odell

Harvesting Prosperity
Technology and Productivity Growth in Agriculture
Aruny Hoyos, Mofazinuzzaman, Apurba Sanyal, and William F. Maloney

World Bank Productivity Project

The Productivity Project: www.worldbank.org/productivity
Next volumes—stay tuned

- Spatial Dimensions of Productivity
- Services and Productivity
- Finance and Productivity
Second Wave Productivity Analysis- New challenges for Policy Making
Sources of Productivity Growth

- Improved factor use across firms and sectors (Reallocation)
- Improved firm performance (Within)
- Improved quality of entering firms (Selection)

Total Factor Productivity Growth

Cusolito and Maloney 2018
FIGURE 1.11  Which Dimension Contributes Most to Productivity Growth?


Source: Cusolito and Maloney (2018).
2 Drivers: 1. Operating Environment and 2. Human capital and Innovative Capabilities
1. Upgrading Firms: Efficiency, Market Power, Quality
FIGURE 2.1  Decomposing Firm Performance

Factors of production
(K, L, M)

Firm revenue

Revenue TFP (TFPR)

Market power

Quality

Demand

Firm performance

Rents

Price

Marginal costs

Physical TFP (TFPQ)

Note: K = capital; L = labor; M = materials; TFP = total factor productivity.
FIGURE 2.1 Decomposing Firm Performance

Firm revenue
- Factors of production (K, L, M)
  - Revenue TFP (TFPR)
- Market power
  - Price
    - Marginal costs
      - Physical TFP (TFPQ)
  - Rents
    - Quality
      - Demand
        - Firm performance

Note: K = capital; L = labor; M = materials; TFP = total factor productivity.
Mark-ups: is competition high in Colombia?

- Garcia Garcia - no
- De Loecker and Eeckhout (2020) - no
- Autoparts sector suffers from Chinese competition.

- If not, TFPR is overestimating “true” performance
FIGURE 2.1 Decomposing Firm Performance

Firm revenue

Factors of production \((K, L, M)\)

Revenue TFP (TFPR)

Marginal costs

Physical TFP (TFPQ)

Price

Market power

Rents

Demand

Firm performance

Quality

Note: \(K\) = capital; \(L\) = labor; \(M\) = materials; TFP = total factor productivity.
Quality: The Understudied Dimension of Firm Performance

**FIGURE 2.4 Average Product Quality Increases with the Level of Development**

Source: Krishna, Levchenko, and Maloney 2018.
Colombia: Room for improvement
FIGURE 2.1 Decomposing Firm Performance

Firm revenue
- Factors of production ($K, L, M$)
  - Revenue TFP (TFPR)
  - Physical TFP (TFPQ)
- Market power
  - Price
  - Marginal costs

Demand
- Quality
  - Rents

Note: $K =$ capital; $L =$ labor; $M =$ materials; TFP = total factor productivity.
Increased demand, not efficiency, drives firm growth

Efficiency vs. Demand Contribution to Firm Growth
Colombia

Note: The data include year and sector fixed effects. TFPQ = physical total factor productivity.
2. Why don’t Colombian Firms invest more in raising quality, market share and productivity?:

The Innovation Paradox
History: Low innovative capacity meant LA had trouble managing new technologies.

- History offers many cases of success and failure *within* same products
  - US vs. Chile with copper
  - Japan, too!: Hitachi, Sumitomo, Fujitsu- all mining companies.

- More *how* than *what* you produce

Maloney and Valencia 2017
Technological capabilities drive tech adoption


Note: The figure plots the average adoption lag in the United States minus the lag in country c for technologies invented after 1900 against the number of engineers per 100,000 male workers in country c in year 1900.
Why? Returns to investments R&D rise with distance from the frontier

<table>
<thead>
<tr>
<th>Country</th>
<th>Distance to Frontier</th>
<th>Rate of Return to R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>-0.18</td>
<td>57%</td>
</tr>
<tr>
<td>UK</td>
<td>-0.53</td>
<td>77%</td>
</tr>
<tr>
<td>Italy</td>
<td>-0.73</td>
<td>88%</td>
</tr>
<tr>
<td>Korea</td>
<td>-1.33</td>
<td>?</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-2.28</td>
<td>?</td>
</tr>
<tr>
<td>Colombia</td>
<td>-3.74</td>
<td>?</td>
</tr>
</tbody>
</table>


To paraphrase Lucas: Why don’t firms invest? How could policy makers think of anything else?
Maybe they don’t expect high rates of return

Returns to R&D vs. Distance to Frontier

Distinct convergence clubs?

Goni and Maloney 2017
The Expanded National Innovation System

Integrated approach to innovation

Government oversight, resolution of market and systemic failures, coordination

**SUPPLY**

- Universities / think-tanks / technology extension centers
  - Human capital
  - Support to firm capability upgrading
    - Productivity/quality extension services
    - Process/best practice dissemination
    - Advanced consulting services
  - Domestic science and technology system **Sabios**
  - International NIS

**ACCUMULATION/ALLOCATION**

- K Physical capital
- H Human capital
- A Knowledge

**DEMAND**

- The firm
  - Incentives to accumulate
    - Macro context
    - Competitive structure
    - Trade regime and int. networks
  - Firm capabilities
    - Core competencies (management)
    - Production systems
    - Technological absorption and production

Barriers to all accumulation
- Credit
- Entry/exit barriers
- Business/regulatory climate
- Rule of Law

Barriers to knowledge accumulation
- Rigidities (labor etc)
- Seed/venture capital
- Innovation externalities
2. Context for innovation
Would more competition help?

- In the LR- critical
  - US cars in 1970s
  - 1968 Ford Falcons in BA 1988
  - Coltejer?
  - Alpina- Better cheese is possible.

- Medium term- less clear (CGM 2020)
  - Leaders (high TFPQ) increase
  - Laggards and average- decrease everything.
  - Rents help also

- Complementarity with managerial and technical skills.

Impact of Increased Chinese Competition on R&D in Chile

R&D Spending (Full sample)

Cusolito, Garcia and Maloney (2020)
Risk and risk mitigation institutions
Risk taking societies grow faster

Need well developed financial markets
And
Risk-able entrepreneurs

Source: Krishna, Levchenko, and Maloney 2018.
3. Capabilities and innovation
Need a good enabling environment, but also firm capabilities to take risks and manage projects.

<table>
<thead>
<tr>
<th>Country</th>
<th>Year(s)</th>
<th>Percentage of immigrants among business owners</th>
<th>Percentage of immigrants in the population</th>
<th>Ratio of male immigrant business owners to male population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1900</td>
<td>80.0</td>
<td>30.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Brazil (São Paulo)</td>
<td>1920–50</td>
<td>50.0</td>
<td>16.50</td>
<td>1.5</td>
</tr>
<tr>
<td>Brazil (Minas Gerais)</td>
<td>1870–1900</td>
<td>3.6</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Chile</td>
<td>1880</td>
<td>70.0</td>
<td>2.90</td>
<td>12.1</td>
</tr>
<tr>
<td>Colombia (Antioquia)</td>
<td>1900</td>
<td>5.0</td>
<td>4.70</td>
<td>0.5</td>
</tr>
<tr>
<td>Colombia (Barranquilla)</td>
<td>1888</td>
<td>60.0</td>
<td>9.50</td>
<td>3.2</td>
</tr>
<tr>
<td>Colombia (Santander)</td>
<td>1880</td>
<td>50.0</td>
<td>3.00</td>
<td>8.3</td>
</tr>
<tr>
<td>Mexico</td>
<td>1935</td>
<td>50.0</td>
<td>0.97</td>
<td>25.8</td>
</tr>
<tr>
<td>USA (5 percent census sample)</td>
<td>1900</td>
<td>31.0</td>
<td>13.60</td>
<td>1.1</td>
</tr>
<tr>
<td>USA (Fortune 500 firms)</td>
<td>Various</td>
<td>18.0</td>
<td>10.50</td>
<td>0.7</td>
</tr>
<tr>
<td>Comparator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan (Shizoku, former Samurai)</td>
<td>1868–1912</td>
<td>50.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Source: Maloney and Zambrano 2016.

Note: The final column shows the ratio of foreign entrepreneurs to the local male population because women were largely precluded from productive entrepreneurship during the study period.
Management Technology (Quality)
Entrepreneurial and Technological Capabilities to innovate. Key to Asian Miracles.

- Wartime Production
- Japanese Productivity Movement (1945)
  - Japan Management Association (efficiency)
  - Japan Productivity Center
  - Union of Japanese Scientists and Engineers (Quality)
  - Singapore: SPRING and Productivity Movement
  - Colombia: Centro Nacional de Productividad

Japanese Industrial Standards Committee
Managerial Extension Program shows promise in Colombia—although with fewer impacts on productivity

Iacovone, Maloney and McKenzie (2020)
Firms don’t know what they don’t know.....
Knowledge of the Frontier

Share of tertiary graduates who study in US

- Percentage of population
- GDP per capita (constant US$)

Countries represented include:
- South Korea
- Hong Kong
- Taiwan
- Singapore
- Jamaica
- Oman
- Qatar
- Sweden
- Norway
- Mongolia
- Nepal
- China
- Jordan
- El Salvador
- Malta
- Chile
- Mexico
- Japan
- United Arab Emirates
- Denmark
- Ireland
- United Kingdom
- Canada
- Australia
- Switzerland
- France
- Belgium
- Italy
- Greece
- Spain
- Portugal
- Argentina
- Brazil
- Colombia
- Indonesia
- Malaysia

Categories:
- All
- Asia
- LAC
- HI OECD
- SSA
- MENA
“Fortune favors the prepared mind” (and countries)

Pasteur (1854)