5 Growth Mysteries in Search of a Broader Innovation Policy

William F. Maloney
Policy Research Talk
Development Research Group
World Bank
May 19, 2014
References

• “Engineers, Innovative Capacity, and Development” (2014) with Felipe Valencia Caicedo
• “Why Don’t Poor Countries Do R&D?” (2014) with Edwin Goñi Pacchioni
• “Immigrants, Entrepreneurship and Development”
• “Risk and Quality Upgrading” with Pravin Krishna

Mystery I:
Same good, different development results

Copper in Chile, 1870-1950:
Production and Share of World Production
Mystery I:
Same good, different development results

Copper in Chile, 1870-1950:
Production and Share of World Production

Introduction of New Technologies

Share of World Production

Chilean Production
**Mystery II: Same climate, differing abilities to introduce new products/firms**

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Immigrants as % Owners</th>
<th>Immigrants as % Population</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1900</td>
<td>80</td>
<td>30</td>
<td>2.7</td>
</tr>
<tr>
<td>Brazil (Sao Paulo)</td>
<td>1920-1950</td>
<td>50</td>
<td>16.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Chile</td>
<td>1880</td>
<td>70</td>
<td>2.9</td>
<td>24.1</td>
</tr>
<tr>
<td>Colombia (Antioquia)</td>
<td>1900</td>
<td>5</td>
<td>4.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Colombia (Barranquilla)</td>
<td>1888</td>
<td>60</td>
<td>9.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Colombia (Santander)</td>
<td>1880</td>
<td>50</td>
<td>3</td>
<td>16.7</td>
</tr>
<tr>
<td>Mexico</td>
<td>1935</td>
<td>50</td>
<td>0.97</td>
<td>51.5</td>
</tr>
<tr>
<td>Japan (Shizoku)</td>
<td>1868-1912</td>
<td>50</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

*Source: Maloney (2014)*
Weak innovative capacity explains why new technologies introduced by foreigners.

Density of Engineers and GDP/Capita (1900)

Fuente: Maloney y Valencia (2014)
**Mystery III:** Why are we not seeing catch up in export quality?

*Fuente: Krishna and Maloney (2011)*
Innovation implies risk

Fuente: Krishna and Maloney (2013)
Summary

• Goods can be produced with very different levels of sophistication and quality.

• Not enough to focus on narrow measures of technological progress - # engineers, patents, R&D.
  • Management
  • Financial Markets etc?
MYSTERY IV: WHY DON’T POOR COUNTRIES DO R&D?
Estimated returns to R&D are very high

- US firm level/industry data - social returns
  - Bloom et al (2013) US 55%
  - Jones and Williams (1998) US 28%

- Jones and Williams (1998): US should quadruple investment in RD
  - Doraszelski and Jaumandreu (2013) Spain 40%
...and get higher with distance from the frontier

- Two Faces of R&D (Cohen and Levinthal 1989)
  - Invention
  - Learning\Catch-up
  - Poor countries should have much greater returns


<table>
<thead>
<tr>
<th></th>
<th>Dist.</th>
<th>Frontier</th>
<th>RoR R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>-.18</td>
<td></td>
<td>57%</td>
</tr>
<tr>
<td>UK</td>
<td>-.53</td>
<td></td>
<td>77%</td>
</tr>
<tr>
<td>Italy</td>
<td>-.73</td>
<td></td>
<td>88%</td>
</tr>
</tbody>
</table>

What should the rate of return be for Korea (-1.33), Malaysia (-2.28), Indonesia (-3.74)? 200%? 300%?
When we consider that

1. 50% of growth is attributed to factor productivity a large part of which is probably innovation.

2. Innovation is essential for the diversification of the economy, and taking advantage of FTAs.

3. Key to address Dutch Disease and resource curse.

4. Essential to generate more challenging jobs.

To paraphrase Lucas (1978), it’s hard to think of anything else!!!!!!
Mystery IV: So why don’t poor countries do more R&D?

R&D/GDP vs. Income/capita

- Predicted and Observed R&D/GDP (%)
- Log GDP per Capita

Countries: Finland, Korea, Japan, Spain, Taiwan, China, India, Malaysia, Brazil, Turkey, Mexico, Colombia.
Because maybe they don’t get Griffith et al.’s high returns to R&D!

Returns to R&D vs Distance to the Frontier

Distance from the technological frontier

Source: Goñi, and Maloney (2014)
MISSING INGREDIENTS IN THE NATIONAL INNOVATION SYSTEM?
The Greater National Innovation System

Innovation Supply
- Universities/Thinktanks/Technology Extension Centers

Accumulation/Allocation
- K
- A

Demand
- The Firm

Barriers to Accumulation/Allocation
- Credit
- Entry/Exit Barriers
- Business/Regulatory Climate

Barriers to Knowledge Accumulation
- Market Failures (& IP)
- Seed/Venture Capital
- Rigidities (Labor etc.)

Macro Context
- Competitive Structure
- Trade Regime
- International Marketing
- Entrepreneurship

Human Capital
- Quality Systems
- Process/Best Practice Dissemination
- Science and Technology System
- International Linkages
SUPPLY SIDE
The Greater National Innovation System

**Innovation Supply**
- Universities/Thinktanks/Technology Extension Centers
- Human Capital
- Quality Systems
- Process/Best Practice Dissemination
- Science and Technology System
- International Linkages

**Accumulation/Allocation**
- K
- A

**Demand**
- The Firm

**Barriers to Accumulation/Allocation**
- Credit
- Entry/Exit Barriers
- Business/Regulatory Climate

**Barriers to Knowledge Accumulation**
- Market Failures (& IP)
- Seed/Venture Capital
- Rigidities (Labor etc.)

**Macro Context**
- Competitive Structure
- Trade Regime
- International Marketing
- Entrepreneurship
The Greater National Innovation System

Innovation Supply
- Universities/Thinktanks/Technology Extension Centers
- Human Capital
- Quality Systems
- Process/Best Practice Dissemination
- Science and Technology System
- International Linkages

Accumulation/Allocation
- K
- A

Barriers to Accumulation/Allocation
- Credit
- Entry/Exit Barriers
- Business/Regulatory Climate

Barriers to Knowledge Accumulation
- Market Failures (& IP)
- Seed/Venture Capital
- Rigidities (Labor etc.)

Demand
- The Firm
- Macro Context
- Competitive Structure
- Trade Regime
- International Marketing
- Entrepreneurship
BARRIERS TO ACCUMULATION
Policy Issues

- Measurement
  - Can’t focus on accumulation of Knowledge capital without overall system of accumulation
- Whole business climate
- Is the financial sector diversifying risk?
- Entry and Exit. Bankruptcy laws?
- Social attitudes toward failure?
- Clear property rights in distributing winnings?
DEMAND SIDE
The Greater National Innovation System

- Innovation Supply
  - Universities/Thinktanks/Technology Extension Centers
    - Human Capital
    - Quality Systems
    - Process/Best Practice Dissemination
    - Science and Technology System
    - International Linkages

- Accumulation/Allocation
  - K
  - A
  - Barriers to Accumulation/Allocation
    - Credit
    - Entry/Exit Barriers
    - Business/Regulatory Climate
  - Barriers to Knowledge Accumulation
    - Market Failures (IP)
    - Seed/Venture Capital
    - Rigidities (Labor etc.)

- Demand
  - The Firm
  - Macro Context
    - Competitive Structure
    - Trade Regime
  - International Marketing
    - Entrepreneurship
Management Quality and GDP

Source: Bloom, Van Reenen et al. World Management Survey 2014
Sub-Dimensions of Management

Fuente: Bloom et al. 2010, DNP, WB
So why is Antioquia not Boston?

### Percentage of Firms Managed by Immigrants

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Immigrants as % Owners</th>
<th>Immigrants as % Population</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1900</td>
<td>80</td>
<td>30</td>
<td>2.7</td>
</tr>
<tr>
<td>Brazil (Sao Paulo)</td>
<td>1920-1950</td>
<td>-</td>
<td>16.5</td>
<td>3.0</td>
</tr>
<tr>
<td>Chile</td>
<td>1880</td>
<td>70</td>
<td>2.9</td>
<td>24.1</td>
</tr>
<tr>
<td>Colombia (Antioquia)</td>
<td>1900</td>
<td>5</td>
<td>4.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Colombia (Barranquilla)</td>
<td>1888</td>
<td>60</td>
<td>9.5</td>
<td>6.3</td>
</tr>
<tr>
<td>Colombia (Santander)</td>
<td>1880</td>
<td>50</td>
<td>3</td>
<td>16.7</td>
</tr>
<tr>
<td>Mexico</td>
<td>1935</td>
<td>50</td>
<td>0.97</td>
<td>51.5</td>
</tr>
<tr>
<td>Japan (Shizoku)</td>
<td>1868-1912</td>
<td>50</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Maloney (2014)
Antioquia lost its Mojo!!!
Antioquia is where US South was in 1900. Lack of demand for innovation?

Density of Engineers and GDP/Capita (1900)

Antioquia 1976 = 40

Fuente: Maloney y Valencia (2014)
# China, too, lacks management skills for innovative firms

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-component</th>
<th>Mean all countries</th>
<th>China’s Value</th>
<th>Rank (of 21 countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>Average of all management questions</td>
<td>2.9391</td>
<td>2.8757</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td><strong>Sub-subcomponents</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O1</td>
<td>Introduction to Lean (Modern) Manufacturing</td>
<td>2.8464</td>
<td>2.5917</td>
<td>16</td>
</tr>
<tr>
<td>O2</td>
<td>Rationale for Lean (Modern) Manufacturing</td>
<td>2.9161</td>
<td>2.6095</td>
<td>17</td>
</tr>
<tr>
<td>M1</td>
<td>Process Documentation</td>
<td>3.1904</td>
<td>2.9588</td>
<td>16</td>
</tr>
<tr>
<td>M2</td>
<td>Performance Tracking</td>
<td>3.3595</td>
<td>3.3941</td>
<td>8</td>
</tr>
<tr>
<td>M3</td>
<td>Performance Review</td>
<td>3.3236</td>
<td>3.4647</td>
<td>6</td>
</tr>
<tr>
<td>M4</td>
<td>Performance Dialogue</td>
<td>3.1674</td>
<td>2.9647</td>
<td>18</td>
</tr>
<tr>
<td>M5</td>
<td>Consequence Management</td>
<td>3.1082</td>
<td>2.8765</td>
<td>19</td>
</tr>
<tr>
<td>T1</td>
<td>Type of Targets</td>
<td>2.9063</td>
<td>2.5706</td>
<td>19</td>
</tr>
<tr>
<td>T2</td>
<td>Interconnection of Goals</td>
<td>3.0623</td>
<td>3.0882</td>
<td>9</td>
</tr>
<tr>
<td>T3</td>
<td>Time Horizon</td>
<td>2.8714</td>
<td>2.6294</td>
<td>17</td>
</tr>
<tr>
<td>T4</td>
<td>Goals are Stretching</td>
<td>2.9744</td>
<td>2.7588</td>
<td>17</td>
</tr>
<tr>
<td>T5</td>
<td>Clarity of Goals and Measurement</td>
<td>2.6862</td>
<td>3.1824</td>
<td>1</td>
</tr>
<tr>
<td>P1</td>
<td>Instilling a Talent Mindset</td>
<td>2.4244</td>
<td>2.5647</td>
<td>7</td>
</tr>
<tr>
<td>P2</td>
<td>Building a High-Performance Culture</td>
<td>2.5484</td>
<td>3.0765</td>
<td>2</td>
</tr>
<tr>
<td>P3</td>
<td>Making Room for Talent</td>
<td>3.0080</td>
<td>2.8765</td>
<td>14</td>
</tr>
<tr>
<td>P4</td>
<td>Developing Talent</td>
<td>2.9888</td>
<td>2.7353</td>
<td>17</td>
</tr>
<tr>
<td>P5</td>
<td>Creating a Distinctive EVP</td>
<td>3.0270</td>
<td>2.9941</td>
<td>13</td>
</tr>
<tr>
<td>P6</td>
<td>Retaining Talent</td>
<td>2.4948</td>
<td>2.4294</td>
<td>11</td>
</tr>
</tbody>
</table>

See Annex for detail on categories. Rank: 1 correspond to the country with the highest value

**Source:** Maloney 2014
In sum

• Latin America
  • Potemkin Industrialization? No capital goods, no potential for advance?
  • Never developed either managerial or innovative capacity
  • Doomed to do whatever it does in a low-tech fashion?

• China???
Mystery V: So why does China do so much R&D?: China imported US and Taiwan’s NIS!

Source: Branstetter 2012
Policies

- Japan, Korea, Singapore: All employ programs supporting management-Kaizen, 5S- see SME’s being left behind by Chaebol and MNCs
  - Japan: National Productivity Center; Deming Quality System.
  - Korea: The Small and Medium Industries Promotion program
  - Singapore: Local Industry Upgrading Program (LIUP)
  - India: (Bloom, McKenzie... 2013)

- Colombia Technology Extension Pilot (Maloney, McKenzie, Iacovone)

- Establish the foundation to progressively better adoption of new technologies.
Conclusion

• Perhaps *ad nauseum*: Not what, but how you produce
• Effort to improve productivity through adoption of existing technologies is one of central development tasks
•Requires a broad view of the National Innovation System.
Fin