Innovation Complementarities, Management Quality and Export Composition

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Research Department, World Bank
Ankara, December 2013

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Ancient Latin American Growth Mystery I: Same Good, Different Outcomes

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

Introduction of New Foreign Technologies
Ancient LA Growth Mystery II: Same Business Climate, Different Outcomes

Percentage of Firms Managed by Immigrants

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>% Immigrant Directors/Owners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>1900</td>
<td>80</td>
</tr>
<tr>
<td>Chile</td>
<td>1880</td>
<td>70</td>
</tr>
<tr>
<td>Colombia (Baranquilla)</td>
<td>1888</td>
<td>60</td>
</tr>
<tr>
<td>Mexico</td>
<td>1935</td>
<td>50</td>
</tr>
</tbody>
</table>

Source: Maloney 2013
Structure of the Presentation

• Part I: Export Composition: is this the missing ingredient?
• Part II: Innovation: the critical agenda
• Part III: Management quality as a missing complement
Export Composition-is this the critical ingredient?
Why might standard price signals be deceptive in choosing goods

- Marshallian externalities related to goods
  - local industry-level knowledge spillovers, input-output linkages, and labor pooling.
- Volatility externalities: Export diversification?
- Intervention warranted to shift to good with externalities against price signals.
Empirical concerns of policy makers about export composition

1. Yes, Externalities dictate that market will not generate optimal basket
2. How do we measure these externalities?
3. Doesn’t the whole world see the same benefit and drive the price down? (GE)
   • Interindustry spillovers, assymetries
   • Should we look for safe rents, too? Natural Resources
   • More generally, must think of demand side as well
4. Do externalities necessarily come with a good, or does it matter how we produce it?
   • Heterogeneity, Heterogeneity, Heterogeneity
In practice, measurement of MEs is difficult, so we take shortcuts

- Natural resources
  - Low productivity (Smith, Matsuyama, Sachs), few Externalities
  - Rent seeking
- High productivity goods
  - Rich Country Goods (Rodrik, Hausmann)
  - High tech (Lall) high inter-industry MEs
CURSED GOODS: NATURAL RESOURCES
Empirically, there is no resource curse

• In growth regressions
  • Minerals are good: Davis (1995), Sala-i-Martin et al. (2004), Stijns (2005), Brunnschweiler (2008, 2009)
  • Conditional on education (above 2 years of schooling): Bravo-Ortega & De Gregorio (2007)
  • Existing resource curse findings fragile: Lederman & Maloney (2007, 2008)
  • [Also, Jacob Viner and Douglass North years ago...]

[Image]
There is lots of heterogeneity in experiences with NR
Trees can be very high tech! Innovation policy is key

Nokia: Site of an early pulp mill in Finland
Learn how to learn
HIGH PRODUCTIVITY GOODS
Does It Matter What We Export? Hausmann, Hwang, Rodrik (2007)

• Model- broadly inter-industry spillover
  • Country should produce the highest productivity good within its CA
• Empirics:
  • PRODY= avg. income of countries producing good
  • EXPY= income value of our export basket
  • Similar to Lall (2000)
  • Find higher EXPY correlated with higher growth.
Caveats

- GE critique again?
- Rents- higher where rich countries already are?
  - Not generally the case- Nokia and TVs
  - If easy to move into these goods, then barriers to entry/rents low
- Empirical findings muddy
  - Animals, electrical machinery same PRODY
Again, high degree of heterogeneity
Caveats

- GE critique again?
- Rents- higher where rich countries already are?
  - Not generally the case- Nokia and TVs
  - If easy to move into these goods, then barriers to entry/rents low
- Empirical findings muddy
  - Animals, electrical machinery same PRODY
  - Finding of an impact on growth fragile
Empirically, some support for MODEL

<table>
<thead>
<tr>
<th></th>
<th>Base: HHR Regressions</th>
<th>Including the Export Herfindahl and the Investment Share</th>
<th>With Income Average Value</th>
<th>Including the Export Herfindahl and the Investment Share</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV GMM</td>
<td>IV GMM</td>
<td>IV GMM</td>
<td>IV GMM</td>
</tr>
<tr>
<td>Log (initial gdp)</td>
<td>-0.0382*** -0.0203**</td>
<td>-0.0414* -0.0177</td>
<td>-0.0166* -0.0177</td>
<td>-0.028 0.0215</td>
</tr>
<tr>
<td></td>
<td>(0.01) (0.01)</td>
<td>(0.02) (0.01)</td>
<td>(0.01) (0.04)</td>
<td>(0.02) (0.03)</td>
</tr>
<tr>
<td>Log (expy)</td>
<td>0.0925*** 0.0532**</td>
<td>0.107 -0.00687</td>
<td>0.102*** 0.0504**</td>
<td>0.124 0.00275</td>
</tr>
<tr>
<td></td>
<td>(0.02) (0.02)</td>
<td>(0.07) (0.03)</td>
<td>(0.02) (0.02)</td>
<td>(0.08) (0.03)</td>
</tr>
<tr>
<td>Category Log (expy)</td>
<td></td>
<td></td>
<td>-0.0577*** -0.00566</td>
<td>-0.0431 -0.119</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.02) (0.10)</td>
<td>(0.03) (0.08)</td>
</tr>
<tr>
<td>Log (primary schooling)</td>
<td>0.00468* 0.00565</td>
<td>0.00271 0.0101</td>
<td>0.00394 0.00582</td>
<td>0.00207 0.00958</td>
</tr>
<tr>
<td></td>
<td>(0.00) (0.01)</td>
<td>(0.00) (0.01)</td>
<td>(0.00) (0.01)</td>
<td>(0.00) (0.01)</td>
</tr>
<tr>
<td>Log (Investment Share)</td>
<td>0.0111* 0.0360**</td>
<td></td>
<td>0.00935 0.0566***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.01) (0.02)</td>
<td></td>
<td>(0.01) (0.02)</td>
<td></td>
</tr>
<tr>
<td>Root Herfindal Index</td>
<td>0.0551 -0.0381</td>
<td></td>
<td>0.0615 -0.0283</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.06) (0.04)</td>
<td></td>
<td>(0.06) (0.04)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.426*** -0.250*</td>
<td>-0.572 0.14</td>
<td>-0.186* -0.199</td>
<td>-0.449 0.699</td>
</tr>
<tr>
<td></td>
<td>(0.10) (0.13)</td>
<td>(0.44) (0.18)</td>
<td>(0.10) (0.47)</td>
<td>(0.40) (0.46)</td>
</tr>
<tr>
<td>Number of wbgroup</td>
<td>75 75</td>
<td>75 75</td>
<td>75 75</td>
<td>75 75</td>
</tr>
</tbody>
</table>

Regressions include decade dummies
Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
1b. A digression on Monkeys

- Being a tree in a dense area is like a ME with same GE concerns
- If easy to jump from one tree to others, then easy to jump to, i.e., no barriers to entry and rents
- Is past a good predictor?
  - iPhone didn’t exist, Saab already does
  - Would Chilean forestry produce Saab?
IS IT WHAT WE PRODUCE, OR HOW? BEYOND GOODS
Is High Tech Necessarily High Tech?

Comparative Advantage in Innovation: Electronics

Mexico: 1980 - 0.6, 2000 - 0.2
Korea: 1980 - 0.5, 2000 - 3.5

Fuente: Lederman and Maloney (2012)
Heterogeneity in product quality is also huge
(relative unit values, standardized)

Krishna and Maloney 2011
Quality ladders by product and countries (relative units, standardized)
Export Quality Growth

Krishna and Maloney 2011
Growth in Quality Driven by Both What and How

Source: Krishna and Maloney 2011
GOODS OR TASKS
Goods or Tasks: Does China really export the iPOD?

Table 2 China: 10 Exports with the Lowest Domestic Value Added

<table>
<thead>
<tr>
<th>Product</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic computer</td>
<td>4.6</td>
</tr>
<tr>
<td>Telecommunication equipment</td>
<td>14.9</td>
</tr>
<tr>
<td>Cultural and office equipment</td>
<td>19.1</td>
</tr>
<tr>
<td>Other computer peripheral equipment</td>
<td>19.7</td>
</tr>
<tr>
<td>Electronic element and device</td>
<td>22.2</td>
</tr>
<tr>
<td>Radio, television, and communication equipment</td>
<td>35.5</td>
</tr>
<tr>
<td>Household electric appliances</td>
<td>37.2</td>
</tr>
<tr>
<td>Plastic products</td>
<td>37.4</td>
</tr>
<tr>
<td>Generators</td>
<td>39.6</td>
</tr>
<tr>
<td>Instruments, meters and other measuring equipment</td>
<td>42.2</td>
</tr>
</tbody>
</table>

China: 10 Exports with the Highest Domestic Value Added

<table>
<thead>
<tr>
<th>Product</th>
<th>Value Added</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry, animal husbandry and fishing machinery</td>
<td>81.8</td>
</tr>
<tr>
<td>Hemp textiles</td>
<td>82.7</td>
</tr>
<tr>
<td>Metalworking machinery</td>
<td>83.4</td>
</tr>
<tr>
<td>Steel pressing</td>
<td>83.4</td>
</tr>
<tr>
<td>Pottery, china and earthenware</td>
<td>83.4</td>
</tr>
<tr>
<td>Chemical fertilizers</td>
<td>84.0</td>
</tr>
<tr>
<td>Fireproof materials</td>
<td>84.7</td>
</tr>
<tr>
<td>Cement, lime and plaster</td>
<td>86.4</td>
</tr>
<tr>
<td>Other non-metallic mineral products</td>
<td>86.4</td>
</tr>
<tr>
<td>Coking</td>
<td>91.6</td>
</tr>
</tbody>
</table>

“..the electronic components we make in Singapore require less skill than that required by barbers or cooks, involving mostly repetitive manual operations”

Goh Keng Swee, Minister of Finance Singapore (1972)

Innovation: The Critical Agenda
Weak innovative capacity meant LA missed the 2nd Industrial Revolution.
Current literature focusing on R&D is not credible...
Estimated returns to R&D are very high...

- US firm level/industry data- social returns
  - Grilliches and Lichtenberg (1984) 71%
  - Terleckyj 1980, Scherer (1982) >100%
  - Griffith, Redding, Van Reenen (2004) 57%
  - Jones and Williams (1998) 28%

- X country
  - Coe and Helpman (1995) G7 123%
  - Van Pottlesberghe and Lichtenberg (2001) G7 68%

...And imply social rates of return far above private
- Jones and Williams (1998): US should quadruple investment in RD
...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>Dist. Frontier</th>
<th>RoR R&amp;D</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>-.18</td>
</tr>
<tr>
<td>UK</td>
<td>-.53</td>
</tr>
<tr>
<td>Italy</td>
<td>-.73</td>
</tr>
</tbody>
</table>

- What should the rate of return be for Korea (-1.33), Malaysia (-2.28), Turkey (-2.5), Indonesia (-3.74)? 200%? 300%?
But poor countries do generally less R&D than rich countries...Why?

\[
\frac{R \& D}{GDP} = \beta_1 \frac{GDP}{CAP} + \beta_2 \left( \frac{GDP}{CAP} \right)^2
\]
Innovation Superstars?

Source: Goni, Lederman, Maloney 2006
Rates of Return suggest missing complementary factors

Source: Goni and Maloney 2012
Innovation
“supply”
Universities/
Think tanks/CTs

Barriers to Innovation
Market Failures (&IP)
Seed/Venture capital
Poorly articulated S&T system (including discovery, oversight)
Labor regulation
Deficient human capital

Accumulation
K
A

Barriers to Accumulation
Credit
Entry/Exit barriers
Business/Regulatory Climate

Demand Side
The firm

Barriers to Demand
Macro Context
Trade Regime
International Marketing Externalities
Competitive Structure
Entrepreneurship

Innovation Ecosystem
Perceived Quality of Research Institutions

Distance to the economic frontier (1996-2000) vs. Quality
University-Industry Collaboration

Distance to the economic frontier (1996-2000)
Business Share in R&D

Distance to the economic frontier (1996-2000)

GERD-performed by Business enterprise % (year=2000)

-5.5 -5.0 -4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0

0,0 10,0 20,0 30,0 40,0 50,0 60,0 70,0 80,0 90,0 99,0

Business Share in R&D

AUS BEL CAN CHE CHN DEU ESP FIN FRA GBR HUN IRL ISL ISR JPN KOR MYS NLD ROM USA ARG BRA CRI HUN IDN ITA MEX PER POL URY TUN TUR
Managing Risky Ventures

Krishna and Maloney 2011
Ability to manage risk

Export Quality Growth and Risk

Krishna and Maloney 2011
So, China: Waste or Wisdom?

Predicted & Observed R&D/GDP

\[ \frac{R & D}{GDP} = \beta_1 \frac{GDP}{CAP} + \beta_2 \left( \frac{GDP}{CAP} \right)^2 \]

Log GDP per Capita

GDP per Capita

India
China
Korea
Finland
Israel
Argentina
Mexico

4 5 6 7 8 9 10 11
Who’s doing R&D? Patents granted by the USPTO to inventors based in China
China differs from Taiwan and Korea in the composition of their innovation surges

Branstetter (2012)
Pros and Cons

- MNCs providing eco-system: complementary factors
  - Most patents owned by MNCs
  - 50% are co-patented

- But will it maintain an autonomous innovative capacity?
Management Quality: A Missing Complement?
Management Quality and Productivity

Management Quality and Productivity

Fuente: Bloom et al. 2010+LAC, Sarrias and Maloney (2013)
China: Unprepared for indigenous Innovation

**Table 2: China’s Relative Ranking on Management scores**

<table>
<thead>
<tr>
<th>Subcomponents</th>
<th>Mean all countries</th>
<th>China’s Value</th>
<th>Rank (of 21 countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operations</td>
<td>2.9311</td>
<td>2.8757</td>
<td>14</td>
</tr>
<tr>
<td>Monitor</td>
<td>3.2298</td>
<td>3.1318</td>
<td>11</td>
</tr>
<tr>
<td>Target</td>
<td>2.9001</td>
<td>2.8459</td>
<td>14</td>
</tr>
<tr>
<td>People</td>
<td>2.7485</td>
<td>2.7794</td>
<td>10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sub-subcomponents</th>
<th>Mean all countries</th>
<th>China’s Value</th>
<th>Rank (of 21 countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1 Introduction to Lean (Modern) Manufacturing</td>
<td>2.8464</td>
<td>2.5917</td>
<td>16</td>
</tr>
<tr>
<td>O2 Rationale for Lean (Modern) Manufacturing</td>
<td>2.9161</td>
<td>2.6095</td>
<td>17</td>
</tr>
<tr>
<td>M1 Process Documentation</td>
<td>3.1904</td>
<td>2.9588</td>
<td>16</td>
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<tr>
<td>M2 Performance Tracking</td>
<td>3.3595</td>
<td>3.3941</td>
<td>8</td>
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<tr>
<td>M3 Performance Review</td>
<td>3.3236</td>
<td>3.4647</td>
<td>6</td>
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<tr>
<td>M4 Performance Dialogue</td>
<td>3.1674</td>
<td>2.9647</td>
<td>18</td>
</tr>
<tr>
<td>M5 Consequence Management</td>
<td>3.1082</td>
<td>2.8765</td>
<td>19</td>
</tr>
<tr>
<td>T1 Type of Targets</td>
<td>2.9063</td>
<td>2.5706</td>
<td>19</td>
</tr>
<tr>
<td>T2 Interconnection of Goals</td>
<td>3.0623</td>
<td>3.0882</td>
<td>9</td>
</tr>
<tr>
<td>T3 Time Horizon</td>
<td>2.8714</td>
<td>2.6294</td>
<td>17</td>
</tr>
<tr>
<td>T4 Goals are Stretching</td>
<td>2.9744</td>
<td>2.7588</td>
<td>17</td>
</tr>
<tr>
<td>T5 Clarity of Goals and Measurement</td>
<td>2.6862</td>
<td>3.1824</td>
<td>1</td>
</tr>
<tr>
<td>P1 Insulating a Talent Mindset</td>
<td>2.4244</td>
<td>2.5647</td>
<td>7</td>
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<tr>
<td>P2 Building a High-Performance Culture</td>
<td>2.5484</td>
<td>3.0765</td>
<td>2</td>
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<tr>
<td>P3 Making Room for Talent</td>
<td>3.0080</td>
<td>2.8765</td>
<td>14</td>
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<tr>
<td>P4 Developing Talent</td>
<td>2.9888</td>
<td>2.7353</td>
<td>17</td>
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<tr>
<td>P15 Creating a Distinctive EVP</td>
<td>3.0270</td>
<td>2.9941</td>
<td>13</td>
</tr>
<tr>
<td>P6 Retaining Talent</td>
<td>2.4948</td>
<td>2.4294</td>
<td>11</td>
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</tbody>
</table>

Source: Maloney 2013
Convergence to the management frontier—not just more competition

Figure 5: Change in distributions relative to the frontier with convergence: Quantile coefficients relative to the frontier (US) vs Mean Z-Score

Source: Maloney and Sarrias 2013
Direct interventions in management quality?

- Japan, Korea, Singapore: All employed management promotion programs for SMEs
  - Korea: The Small and Medium Industries Promotion program
  - Singapore: Local Industry Upgrading Program (LIUP)
- India
- Colombia
- Lays the foundation for progressively more adoption and invention of new technologies.
India-Successful Management Intervention

Source: Bloom, et al 2013
Colombia

• Technological Extension pilot-Autoparts
• RCT 180 firms
  • Individual company intervention
  • Group intervention- Lower cost, more dynamism?
• Current plans to scale up to whole sector
Thank You
Distribution relative to the US

Decomposition: Manager having a degree, important. Otherwise…?

Sarrias and Maloney (2012)
Do Chinese managers know what they don’t know?

Self Perceived vs. Actual Management Ability

Sarrias and Maloney (2012)
Figures 9: Distribution of Chinese Management by Sub Category

<table>
<thead>
<tr>
<th>Operations</th>
<th>Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>China</td>
<td>China</td>
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</table>

<table>
<thead>
<tr>
<th>Targets</th>
<th>Personnel Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>USA</td>
</tr>
<tr>
<td>China</td>
<td>China</td>
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