Straying Slowly: STI in Developing Economies

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I Critical Issues
II Perspectives on STI in DE
III Difficulties and Problems in DE
IV Constraints in STI Resources
V Obstacles in STI Policy-making
VI Bottlenecks in Technology System
VII Policy Recommendations
There are numerous studies and policy recommendations for STI development in Developing Economies (DE).

But, only few developing economies have successfully developed effective and efficient STI.

Why?
## Critical Issues

### 2. National Gaps in per capita GDP (World Bank, 2013)

<table>
<thead>
<tr>
<th>Developed Economies</th>
<th></th>
<th>Catch-up Economies</th>
<th></th>
<th>Developing Economies</th>
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<tbody>
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<tr>
<td><strong>Japan</strong></td>
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<td>6,807</td>
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<tr>
<td><strong>Germany</strong></td>
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<tr>
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<td><strong>Ethiopia</strong></td>
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</tr>
<tr>
<td><strong>UK</strong></td>
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<td><strong>Russia</strong></td>
<td>14,612</td>
<td><strong>Kenya</strong></td>
<td>994</td>
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<tr>
<td><strong>Italy</strong></td>
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<td><strong>Gabon</strong></td>
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<td><strong>Australia</strong></td>
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<td><strong>Argentina</strong></td>
<td>14,715</td>
<td><strong>Guatemala</strong></td>
<td>3,478</td>
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(US $)

(US $)

(US $)
## Critical Issues

### 3. R&D/GDP (World Bank, 2012 and Other Years)

<table>
<thead>
<tr>
<th>Developed Economies</th>
<th>Catch-up Economies</th>
<th>Developing Economies</th>
</tr>
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<tr>
<td>UK</td>
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<td>Russia</td>
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<td>Gabon</td>
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<td>Netherlands</td>
<td>2.16</td>
<td>South Africa</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.41</td>
<td>Brazil</td>
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<tr>
<td>Canada</td>
<td>1.73</td>
<td>Mexico</td>
</tr>
<tr>
<td>Australia</td>
<td>2.39</td>
<td>Argentina</td>
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</table>

<table>
<thead>
<tr>
<th>(%)</th>
<th>(%)</th>
<th>(%)</th>
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<tbody>
<tr>
<td>India</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>Vietnam</td>
<td>0.18</td>
<td></td>
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<tr>
<td>Ethiopia</td>
<td>0.24</td>
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<tr>
<td>Kenya</td>
<td>0.98</td>
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<tr>
<td>Egypt</td>
<td>0.43</td>
<td></td>
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<tr>
<td>Nigeria</td>
<td>0.22</td>
<td></td>
</tr>
<tr>
<td>Haiti</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Nicaragua</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td>0.05</td>
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</table>
## Critical Issues

### 4. Deindustrialization or Reindustrialization

<table>
<thead>
<tr>
<th></th>
<th>[Manufacturing]</th>
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<th>[Agriculture]</th>
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<tr>
<td></td>
<td>1950</td>
<td>2005</td>
<td>1950</td>
<td>2005</td>
</tr>
<tr>
<td>Average 15 Asian Countries</td>
<td>10</td>
<td>22</td>
<td>49</td>
<td>14</td>
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<tr>
<td>Average 25 Latin American Countries</td>
<td>15</td>
<td>15</td>
<td>29</td>
<td>10</td>
</tr>
<tr>
<td>Average 18 African Countries</td>
<td>11</td>
<td>10</td>
<td>43</td>
<td>28</td>
</tr>
<tr>
<td>Average 68 Developing Countries</td>
<td>12</td>
<td>15</td>
<td>37</td>
<td>28</td>
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<tr>
<td>Average 21 Advanced Economies</td>
<td>29</td>
<td>16</td>
<td>16</td>
<td>2</td>
</tr>
</tbody>
</table>

(Szirmai)
5. Critical Discussions

- Incorrect diagnosis limits the chance to find a right solution
- Western practices/solutions are forced to fit afterwards, without prior modification for local circumstances
- Lack of local capabilities and strategies to find out tailored solutions to overcome specific local problems
II Prior Perspectives on STI in DE

Balanced Growth

Dependency Theory Unbalanced Growth

Technological Outsourcing Big Push Technological Learning

Technological Capability Building ISI Appropriate Technology
Prior Perspectives on STI in DE

1. Big Push
   ■ Secure minimum amount of investments in the initial industrialization

2. Balanced Growth
   ■ Expansion of sectors increases the market size of others

3. Unbalanced Growth
   ■ Deliberate unbalancing of the economy is the best method

4. Import Substitution Industrialization
   ■ To reduce foreign dependency and protection of infant industries

5. Dependency Theory
   ■ Poor countries should not purchase manufactured products of rich ones
6. Appropriate Technology
- Technological choice of small-scale, labor-intensive, decentralized, etc.

7. Technological Capability Building
- Dynamic technological capabilities: existing capabilities + new capabilities

8. Technological Outsourcing
- Foreign buyers are important sources of technology and market

9. Technological Learning
- Assimilation, improvement, incremental innovation are key to competence
Recent Perspectives on STI in DE

Practical Action Programs?

- Self-Discovery
- Entrepreneurship
- Green Growth
- Resource-led Development
- Manufacturing Capability
- Post East Asian Model
- Global Production Networks

DEVELOPED COUNTRIES
INTERNATIONAL ORGANIZATIONS
DEVELOPING ECONOMIES
Recent Perspectives on STI in DE

1. Self-Discovery
   - DE should identify what can be produced with profit

2. Manufacturing Capabilities
   - Manufacturing is the primary engine of economic growth/catch-up

3. Global Production Networks
   - Access to foreign sources to offset the weak domestic capabilities

4. Post East Asian Model
   - Simply imitating the East Asian Model is no longer valid
Recent Perspectives on STI in DE

5. Resource-led Development
   ■ Develop resource-processing technology for export and diversification

6. Green Growth
   ■ Utilize opportunity from huge global market for green

7. Entrepreneurship
   ■ New sources of growth by combining factors for promising opportunities
II Review of Existing Perspectives

☐ **Key Recommendations**

- Unique paths and distinctive capabilities
- Expansion and upgrade of local knowledge base
- Promotion of private sector
- Establishment of right institutions
- Enhancement of policy capacity

☐ **Missing Elements**

- Highly meaningful implications, but less practical solutions
- Outsider’s observations, no tailored bottlenecks to challenge
- Need to chart own paths suited to particular obstacles
Difficulties and Problems in DE

1. No Contributions from STI

- Many challenging agenda still remain
  - Economic growth, industrial expansion, social welfare, sustainability

- Critical basic needs are not solved
  - Food, housing, sanitation, health, education, public transport, etc.

- LDCs (Least Developed Countries): 48 countries
  - Africa: 34
  - Asia and the Pacific: 13
  - Latin America: 1
Difficulties and Problems in DE

2. Poverty Traps

Progress in MDGs (Millennium Development Goals)
- Target for extreme poverty: to cut the 1990 rate in half by 2015
- Attained the target, 5 years ahead of schedule, in 2010

However, Extreme Poverty remains unacceptably high
- Post-2015 agenda is under preparation, by September 2015
- Extreme poverty: $1,25/day is applied (World Bank)

Extreme Poverty status in DE
- 17% of people in 2011 (43% in 1990, 52% in 1981)
- 1.2 billion people in 2011 (1.91 billion in 1990, 1.93 billion in 1981)
- 2.2 billion people, less than $2/day in 2011 (2.59 billion in 1981)
### 3. Current Status in LDCs

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Poverty</td>
<td>50.8% (2012)</td>
</tr>
<tr>
<td>Share of World Export</td>
<td>1.11% (2012)</td>
</tr>
<tr>
<td>Share of Primary Commodities in Export</td>
<td>78.7% (2012) &gt;&gt;&gt; 67% (2001)</td>
</tr>
<tr>
<td>Duty-free and Quota-free Market Access</td>
<td>80% (2010): unchanged since 2004</td>
</tr>
<tr>
<td>External Debt Stock of GNI</td>
<td>28% (2012)</td>
</tr>
<tr>
<td>Under-five Mortality Rate per 1,000 Children</td>
<td>85 (2012)</td>
</tr>
</tbody>
</table>
### 3. Current Status in LDCs

<table>
<thead>
<tr>
<th>Critical Issues</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to Electricity</td>
<td>31.5% (2010)</td>
</tr>
<tr>
<td>Improved Drinking Water Source</td>
<td>65.1% (2011)</td>
</tr>
<tr>
<td>Improved Sanitation</td>
<td>31.2% (2011)</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>62 (2013)</td>
</tr>
<tr>
<td>Population Growth Rate</td>
<td>2.3% (2012)</td>
</tr>
</tbody>
</table>
1. Fundamental Conditions

**Enterprises**
- Lack of basic knowledge for technologies/products
- Relying on imported technologies
- Low degree of cooperation with research institutes

**Universities**
- Mainly teaching-focused *(not research)*
- Research has weak linkage to ongoing issues in industries

**Public Research Institutes**
- Mainly supports the interests of government
- No enough experience/expertise to support private industries
Constraints in STI Resources

2. Backward, Lagged and Stagnant (1)

- Weight of GDP in the World (2010)
  - Latin America: 8.2%
  - Africa: 2.7%

- Weight of GERD in the World (%)

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</tr>
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<tbody>
<tr>
<td>Latin America</td>
<td>0.8</td>
<td>1.7</td>
<td>2.8</td>
<td>2.8</td>
<td>2.9</td>
<td>3.1</td>
</tr>
<tr>
<td>Africa</td>
<td>0.1</td>
<td>0.3</td>
<td>1.3</td>
<td>0.8</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>(South Africa)</td>
<td>-</td>
<td>-</td>
<td>0.7</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
</tr>
<tr>
<td>(Sub-Saharan)</td>
<td>0.1</td>
<td>0.3</td>
<td>0.5</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
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</table>
IV Constraints in STI Resources

2. Backward, Lagged and Stagnant (2)

Weight of GERD to GDP (%)

<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td>Latin America</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.7</td>
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<tr>
<td>Africa</td>
<td>0.3</td>
<td>0.4</td>
<td>0.6</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>(South Africa)</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>0.8</td>
<td>1.0</td>
<td>0.9</td>
</tr>
<tr>
<td>(Sub-Saharan)</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>World Total</td>
<td>2.1</td>
<td>1.8</td>
<td>1.8</td>
<td>1.7</td>
<td>1.7</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Africa’s Share of World Scientific Output

- <1.5% (1996), 2.0% (2007), 2.51% (2011)
- Korea 2.71% (2011)
IV Constraints in STI Resources

3. Neglected, Isolated World

- Majority of STI comes from developed countries
  - More than 84% of world scientific production

- 1/3 of world’s population is technologically deprived
  - Never experience their own technological developments

- STI activities are biased to agenda for developed countries
  - Motivation of researchers is at odds with development goals
1. Wrong Assumption: Market Failure

- Early stage of industrialization, “Market Failure” is irrelevant
- Overseas demand does not function
- Local demand is very weak
- Market economy does not exist in the majority of DE

Therefore, “Creation by Government” is the key function
Obstacles in STI Policy-making

2. Implementation Capability is Totally Ignored

- No introduction of feasibility check in STI plans and policies
- Feasibility check: cost/benefit analysis, possibility of resource mobilization, strict performance evaluation
- STI policy: just a collection of "Wish List" of stakeholders
- Priority setting and strategic choices are very difficult
3. Poor Quality of Governance

- Statism controls most aspects of public life
- Absence of a clear cut philosophy of national development
- Paths from policy goals to policy tools remains as “black box”
- One-direction of hierarchical order: PPP does not exist
4. Weak Policy Capacity

- Top priority is political objectives, intention and reasoning
- Government lacks analytical and administrative capacity to formulate and implement complex STI plans
- Government guided private sector development
- No autonomous bottom-up decision-making
Obstacles in STI Policy-making

5. No Consideration on Global Competitiveness

- Global perspectives/standards are relatively neglected
- Lack of strategic analysis for international competition
- Mainly focus on producing goods for safe local market
- Incomplete technological capabilities for global competition
1. No Concrete and Comprehensive Technology Paths

- Insufficient efforts to discover own distinctive paths

- Unclear indication for “where to go” and “what to do”

- Too much discussions and programs only for “how to do”

- No consensus building for shared vision and goals
2. No Continuous Accumulation and Evolution

- Discontinuity in technology paths hinders further progress
- Lack of long-term commitment and continuous new inflows
- R&D does not increase without any stagnant period
- Weak incremental technology improvements on products
3. No Interrelatedness and Synergy

- No interconnection among national core technologies
- Poor university-industry linkage, each follows own paths
- Weak linkage between leading sectors and supporting sectors
- Vicious cycle between limited resources and poor performance leads to low degree of specialization
4. No Key Driving Forces

- Over-emphasis on agriculture and natural resource industries

- Over-emphasis on equal distribution of resources
  - No strong enterprise, supportive university, effective public research institute

- Thus, key driving forces for rapid growth are not articulated

- No strong manufacturing capabilities
  - R&D must rest primarily with private enterprises
5. Skewed Resource Concentration

- Inclined to STI elitism to a handful of small elite groups

- “Science first, then technology follows” makes constraints for prominence of engineering

- R&D is mainly carried out in university and research center
  - R&D is largely divorced from productive activities

- Failure in producing well-qualified scientists and engineers to expand the pyramid of human resources
Policy Recommendations

1. Fitness between National Development and STI

- Systematic integration of STI into development agenda
- STI primarily supports the goals of growth, employment creation and poverty reduction
- Clear vision and shared goals through consensus building
- To integrate macroeconomic policies with sectoral policies
Policy Recommendations

2. Concrete STI Strategies

- “Dual Growth Strategy”: (Agriculture/Resources) + (Industry)

- Moving away from “Do-no-harm” approach

- “Right” sectors, “Right” investment, “Right” technologies

- Concrete and comprehensive STI Master Plans
Policy Recommendations

3. Enhancement of STI Policy Capacity

- Recruitment of best manpower as government officials
- Administrative capacity to coordinate interest groups
- Powerful implementation capabilities of STI policies
- Empowerment to bottom-up approach in policy-making
4. Accelerated Mobilization of Resources

- Expansionary policies for acceleration of demand growth
- Proactive public financing to provide investment capitals
- Expansion of public revenue, bank financing, FDI and ODA
- Fostering financial sector for productive investment with particularly bank credit
Policy Recommendations

5. Enforcement of Production Capabilities

- Fiscal and monetary tools/incentives for manufacturing
- Minimization of uncertainty and risks of private enterprises in their investments
- Progressive reduction of informal sectors and fostering of small enterprises to medium/larger firms
- Development of production clusters of primary commodities, with corporate network of forward and backward linkages
Policy Recommendations

6. Global STI Community

- STI must occupy a central place on international cooperation
- More incentives for industries in developed countries to expand their participation in STI cooperation
- ODA should not be driven by donor priorities
- Expansion of global joint programs to support DE’s enhancement of STI policy capacity (e.g., PICMET)
Concluding Remarks

New Perspectives + Concrete STI Policies: Successful STI Achievement
Thank You!!