Role of Innovation and Technology in Building Knowledge-Based Economy in the Arab Region

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ESCWA Expert Group Meeting on Innovation and Technology for Advancing Knowledge-Based Economy in the Arab Region

Amman, June 3-4, 2015
Outline

- Innovation and Growth
- The Knowledge-Based Economy
- Innovation Policies
- Measuring Innovation and KBE
- Arab countries status in KBE and Innovation
- Challenges faced by Arab countries in their transition to KBE
- Recommendations
- Conclusion
- Annexes
  - Innovation Ecosystem
  - Innovation in Innovation: New Approaches
Innovation and Growth

- Innovation is a broad concept encompassing the introduction of new goods, methods of production, markets, sources of supply, or organization.
- Emergence of modern Science, Technology and Innovation (STI) closely correlated with GDP per capita growth.
All things being equal (Labor and Capital inputs) Innovation improves Total Factor Productivity (TFP) which acts as growth multiplier

Comparison between GDP growth of Ghana and Republic of Korea (1960-2005)
The Knowledge-Based Economy

- Concept emerged in the 1990’s in developed economies.
  - Developed economies increasingly based on knowledge and information.
  - Knowledge recognized as the driver of productivity and economic growth.

- Within a KBE production and services are based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence and where the key component resides on a greater reliance on intellectual capabilities than on physical inputs or natural resources.
KBE and Digital revolution impact on jobs and innovation

- Jobs polarization and great divide between skilled and wealthy few and the rest of society
- Technology empowering talented individuals
- Premature de-industrialization in developing countries
- New work for those with modest skill levels is scarce
- Intangible assets of firms in the form of Knowledge-Based Capital (KBC) acquire high importance
- A complex innovation model where ideas can stem from many sources and need/invoke open interaction networks both at national and international levels
Innovation Measurement and Policies

- Efforts to measure innovation started before outlining innovation policies principles
  - *Oslo Manual* of OECD and Eurostat
  - Outlines principles to conduct *firm surveys* but is equally an innovation primer
  - Defines Innovation as *the implementation of a new or significantly improved product (good or service), a new process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations*

- Innovation Strategy and associated compendium on Measuring Innovation (OECD, 2010) address a broader scope
  - Innovation Strategy aims at *leveraging Innovation for Growth*
  - Innovation measurement compendium addresses the priorities set by the policy document
Innovation Policy Priorities

- Innovation Strategy priorities (OECD, 2010)
  - Empowering people to innovate
  - Unleashing innovation in firms
  - Investing in innovation
  - Reaping returns from innovation
  - Addressing global challenges

- Innovation Policy priorities in developing countries (World Bank, 2010)
  - Providing basic support to innovative activity
  - Reducing obstacles to innovation
  - Sponsoring appropriate R&D
  - Fostering a receptive and creative population

- Headline priorities are similar but...details significantly differ
Innovation Policies:
Specific Developing countries challenges

- large informal sector of small firms with no R&D expenses
- Need to offer SMEs a significant share of public contracts
- Taxing of processed products (with added value) from developing countries in developed countries and costly licensing regimes
- R&D in developing countries is in public and university laboratories often ivory towers cut off from local needs and poorly funded and staffed.
- Address key challenges in education and training: develop soft skills, proper vocational training and, reform an education system characterized by traditional teacher-dominated classrooms and strong emphasis on rote learning
Measuring Innovation and KBE

- OECD’s database of firm surveys (Oslo Manual based) in 37 OECD and emerging countries
- UNESCO’s database on innovation in firms; limited to only 64 countries
- OECD’s STI Scoreboard: rich set of 260 variables discussing the larger context of Innovation and KBE; limited to OECD and large emerging countries
- Developing (and Arab) countries KBE and innovation assessment covered by:
  - The World Bank’s Knowledge Assessment Methodology (KAM) and Economy Index (KEI); database not maintained (last assessment 2012)
  - The Innovation Pillar of the WEF’s Global Competitiveness Index: seven indicators, six of them based on surveys
  - INSEAD’s Global Innovation Index (GII): the most comprehensive and up-to-date with 81 indicators most of them based on statistical data
Arab countries status in KBE and Innovation

**From the World Bank’s KAM**
- KEI: Arab countries *stagnated to lowered* their scores in the period of 2000-2011
- Innovation pillar of KEI (3 variables): Only the UAE, Oman and Qatar, improved their scores over the same period

**From the WEF’s GCI (Innovation Pillar)**
- Arab countries underperform respective to their GCI rank
- Bright spot in the *Availability of Scientists and Engineers* in some lower-income countries
- *Government Procurement of Advanced Technology* indicator strong in many GCC
- Weak *PCT Patent per Million/pop* indicator but Lebanon, Egypt and Tunisia show relative good standings
Arab countries GII score 2011-2014
Arab countries GII Pillars scores (relative to global GII) - 2014

- Egypt
- Morocco
- Tunisia
- Lebanon
- Oman
- Kuwait
- Jordan
- Bahrain
- Qatar
- Saudi Arabia
- UAE
### Snapshots on STI in Arab Countries

#### 1- Human resources in R&D

<table>
<thead>
<tr>
<th>Country</th>
<th>Total (FTE)</th>
<th>Researchers per million inhabitants</th>
<th>% in Business enterprises</th>
<th>% in Government</th>
<th>% in Higher Education</th>
<th>% in Private Non-profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>41568</td>
<td>524</td>
<td>0.2</td>
<td>52</td>
<td>47.8</td>
<td>-</td>
</tr>
<tr>
<td>Iraq</td>
<td>13559</td>
<td>426</td>
<td>-</td>
<td>17.2</td>
<td>82.8</td>
<td>-</td>
</tr>
<tr>
<td>Kuwait</td>
<td>411</td>
<td>132</td>
<td>-</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Morocco</td>
<td>27714</td>
<td>864</td>
<td>0.7</td>
<td>5.1</td>
<td>94.8</td>
<td>-</td>
</tr>
<tr>
<td>Oman</td>
<td>484</td>
<td>160</td>
<td>7.2</td>
<td>35.3</td>
<td>57.4</td>
<td>-</td>
</tr>
<tr>
<td>Palestine</td>
<td>1312</td>
<td>327</td>
<td>-</td>
<td>17.8</td>
<td>57.9</td>
<td>24.2</td>
</tr>
<tr>
<td>Tunisia</td>
<td>19086</td>
<td>1837</td>
<td>4.3</td>
<td>8.5</td>
<td>87.1</td>
<td>-</td>
</tr>
</tbody>
</table>

- Only Tunisia and Morocco comparable to similar developing countries (Malaysia, Turkey)
- Concentration of Researchers within government and higher education
## Snapshots on STI in Arab Countries

### 2- Global Expenditure on R&D (GERD) and performance

<table>
<thead>
<tr>
<th>Country</th>
<th>% GDP</th>
<th>Per Capita in PPP $ (thousands)</th>
<th>% financed by Business enterprises</th>
<th>% financed by Government</th>
<th>% financed by Higher Education</th>
<th>% financed by Abroad</th>
<th>% financed (Not Specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>0.07</td>
<td>4.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.43</td>
<td>27.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Iraq</td>
<td>0.03</td>
<td>2.3</td>
<td>-</td>
<td>100(92)</td>
<td>-(8)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jordan</td>
<td>0.43</td>
<td>23.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.09</td>
<td>42.4</td>
<td>5.2 (20)</td>
<td>94.8 (80)</td>
<td>-</td>
<td>1.2</td>
<td>-</td>
</tr>
<tr>
<td>Morocco</td>
<td>0.73</td>
<td>35</td>
<td>29.9(29.9)</td>
<td>23.1(23.1)</td>
<td>45.3(47)</td>
<td>1.7</td>
<td>-</td>
</tr>
<tr>
<td>Oman</td>
<td>0.13</td>
<td>35.6</td>
<td>4.6 (23.9)</td>
<td>41.6 (30)</td>
<td>32.1 (46.1)</td>
<td>-</td>
<td>21.7</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.07</td>
<td>18.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sudan</td>
<td>0.3</td>
<td>5.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tunisia</td>
<td>1.1</td>
<td>99.2</td>
<td>20 (20)</td>
<td>65 (80)</td>
<td>-</td>
<td>14.9</td>
<td>-</td>
</tr>
<tr>
<td>UAE</td>
<td>0.49</td>
<td>196.7</td>
<td>-(28.6)</td>
<td>-(39.6)</td>
<td>-(29.3)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Snapshots on STI in Arab Countries

3- Quality of Research Output

- Low number of papers
- Specialization in engineering - energy sciences (47%)
- Low percentage in basic sciences (15%)
- Leading developed countries H-Index values at 500 and above (US 1380)
- Emerging countries like China (385), Brazil (305), and India (301) are closing the gap with developed countries

<table>
<thead>
<tr>
<th>Country</th>
<th>H-Index Score</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>132</td>
<td>44</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>123</td>
<td>53</td>
</tr>
<tr>
<td>Morocco</td>
<td>99</td>
<td>65</td>
</tr>
<tr>
<td>Lebanon</td>
<td>97</td>
<td>67</td>
</tr>
<tr>
<td>UAE</td>
<td>87</td>
<td>71</td>
</tr>
<tr>
<td>Tunisia</td>
<td>85</td>
<td>74</td>
</tr>
<tr>
<td>Kuwait</td>
<td>83</td>
<td>76</td>
</tr>
<tr>
<td>Jordan</td>
<td>82</td>
<td>78</td>
</tr>
<tr>
<td>Algeria</td>
<td>78</td>
<td>82</td>
</tr>
<tr>
<td>Oman</td>
<td>63</td>
<td>93</td>
</tr>
<tr>
<td>Sudan</td>
<td>52</td>
<td>109</td>
</tr>
<tr>
<td>Qatar</td>
<td>50</td>
<td>111</td>
</tr>
<tr>
<td>Bahrain</td>
<td>39</td>
<td>124</td>
</tr>
<tr>
<td>Yemen</td>
<td>37</td>
<td>127</td>
</tr>
</tbody>
</table>
4- Innovation in firms (Egypt, 2010)

<table>
<thead>
<tr>
<th></th>
<th>Innovative firms</th>
<th>Product Innovation</th>
<th>Process Innovation</th>
<th>Organizational Innovation</th>
<th>Marketing Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>9.35</td>
<td>6.15</td>
<td>8.27</td>
<td>3.69</td>
<td>6.48</td>
</tr>
<tr>
<td>Large firms</td>
<td>26.2</td>
<td>17.73</td>
<td>24.82</td>
<td>7.8</td>
<td>14.89</td>
</tr>
<tr>
<td>Medium firms</td>
<td>14.4</td>
<td>9.73</td>
<td>11.67</td>
<td>6.61</td>
<td>7</td>
</tr>
<tr>
<td>Small firms</td>
<td>6.8</td>
<td>3.57</td>
<td>6.55</td>
<td>2.38</td>
<td>6.55</td>
</tr>
<tr>
<td>Micro firms</td>
<td>1.9</td>
<td>1.59</td>
<td>1.32</td>
<td>1.32</td>
<td>2.91</td>
</tr>
</tbody>
</table>

- Percentage of innovative firms significantly lower compared to other emerging and culturally similar countries (Turkey: 35%, Malaysia 53%)

- Marked differences reside in small and medium firms as well as in innovation in firms’ intangible assets of organization and marketing
Challenges faced by Arab countries in their transition to KBE (I)

- Global socio-economic challenges:
  - Rentier economies in most Arab countries did not facilitate the growth of an entrepreneurial small and medium productive enterprises
  - Jobs created in the region are largely in the informal low value-added sectors
  - High unemployment among youth despite advancements in education
  - Formal private sector employment is very small
  - Investment focused in mining and real estate which do not create much employment (and Innovation)
Challenges faced by Arab countries in their transition to KBE (II)

- **Education and Human Capital**
  - Advancements in education even among women
  - Problems in learning methods, soft and communication skills
  - Brain Drain: million+ highly qualified people among Arab diasporas in developed countries

- **Science Production and Research**
  - Low in quantity, spending (relative to GDP) and quality
  - Business sector is minor actor
  - Broken link between STI and socio-economic concerns
Challenges faced by Arab countries in their transition to KBE (III)

- **Innovation in the Economy**
  - Small R&D effort in business sector
  - Feeble network of innovative SMEs
  - Small percentage of high-tech exports
  - Arab countries competitiveness still essentially factor driven

- **Innovation in E-Services**
  - Good ICT infrastructure and e-government
  - But other e-services (e-commerce, e-health, e-payment,...) not significantly taken off

- **Innovation System**
  - Credit and investment are weak in the region even in GCC
  - Limited technical talent and fragmented research landscape
  - Innovation not yet a clearly stated political priority
  - Limited trust in science and social environment not encouraging research and innovation
Recommendations (I)

- Transform education system to produce innovators
  
  I. Evolve education methods
  II. Enlarge enrollment in scientific disciplines at tertiary education and vocational training
  III. Improve schools and universities interaction with society and firms

- Shift Research and Development priorities towards potential innovations and societal problems
  
  IV. Leverage ICT-driven innovations
  V. Leverage the potential of addressing environmental and sustainability challenges
  VI. Shift R&D towards socio-economic priorities and Youth
Recommendations (II)

- Develop policies that include and empower the actors of change
  
  VII. Enlarge access to credit particularly for innovative SMEs
  
  VIII. Encourage Smart specialization initiatives
  
  IX. Develop Inclusive innovation projects

- Evolve cultural attitudes
  
  X. Develop a culture that supports innovation and value knowledge
Conclusions

- STI in Arab countries still embryonic and not properly linked with socio-economic concerns
- Becoming a KBE still a long term objective for Arab countries
- Despite long-standing efforts to raise education level and more recent efforts to nurture entrepreneurship and innovation
- Challenges are structural and suggested recommendations provide some immediate levers for action
- A new development model away from ‘rentier economy’ and new cultural attitudes towards knowledge and innovation are needed
- Transition to KBE must be seen as a lever to address the region’s dramatic socio-economic plights.
‘Death valley’ is the critical phase of early technology development where both government and investment funding are scarce.

Issue of funding technology demonstration and early development lies in cost and high percentage of failure not necessarily linked with intrinsic quality of the innovative idea.

Falling in Death Valley should not become a dead end for entrepreneurs but transformed into an enriching experience.

Innovation Eco-System: The Death Valley of innovative entrepreneurs
Innovation Eco-System: Transforming the Death Valley into a Challenge Basin

- Shifting the left wall rightward: provide means of subsistence for innovators to stay within the eco-system
- Shifting the right wall leftward: lower the perceived risk for investors
- Reducing the depth: develop rapid prototyping infrastructure
Innovation in Innovation: Smart Specialization

- Concept emerged from *regional development* in the EU
- Key driver is *entrepreneurial discovery* by involved actors establishing a *vision* of a *new domain of opportunities* potentially *rich in innovations* that will subsequently occur
- Competency for entrepreneurial discovery involves *different bodies of knowledge*: technologies, markets and competitors and the whole set of inputs and services required for launching a new activity
- Essentially a *vertical approach* focusing on a narrow set of technologies and businesses. Main policy challenge: take the *right risk* by choosing a sector for potential specialization
- Adopted by the *EU 2020 Innovation Union Initiative* leading to its application in the EU 153 regions
- Lessons learned will be of benefit for developing countries where the approach is still not applied
- Main issue for developing (and Arab countries): lack/absence of *actors capable of entrepreneurial discovery*
- Smart Specialization *was not conceived* as a planning doctrine
Innovation in Innovation: Open and inclusive Innovations

- **Open innovation**
  - A *de facto situation* observed in developed countries where firms more and more rely on external ideas to advance their technology
  - Involves a complex web of relationship and networking *crossing countries boundaries*
  - An opportunity for (Young) entrepreneurs and innovators from developing countries largely facilitated by the Internet, Social networks and open development platform
  - Equally an opportunity to attract experts among *diaspora* to develop innovation within their own home country

- **Inclusive Innovation**
  - Primarily addresses the needs of the poor considered as an *accessible mass market*
  - Innovations *not necessarily at the frontier of knowledge* but leveraging on growth of technological capabilities in developing countries and significant involvement of the private sector
  - ICT such as *mobile phones* play a key role in developing inclusive innovation due to their potential to lower cost and address shortages in other infrastructure
  - Concept to ‘handle with care’ through *proper involvement of concerned communities*: avoid ‘window-dressing’ marketing initiatives without lasting effects and/or poor communities exploitation under nice slogans
ICT-enabled Innovation: e-Government and m-payment

- **E-Government**
  - Arab countries’ governments made significant efforts to develop their online presence offering e-Government services to their citizens as reflected by UN e-government surveys.
  - Effective interaction through Open Government Data (OGD) opens avenues for innovation in service delivery; only three Arab countries have implement proper OGD licensing.

- **M-payment**
  - Financial inclusion still limited in most Arab countries particularly outside GCC.
  - Mobile payment and still very low in the majority of Arab countries (three best in class reach 10-15% of population aged 15+).
  - Beyond m-payment Mobile Financial Services (MFC) offer an avenue for innovation and service offer (e.g., micro-credit) to unbanked populations.
  - Regulatory environment, reluctance to credit and sharia-compliance issues to be addressed.
Innovation in Innovation: Policies to develop RET

- High relevance of RET in Arab countries facing dramatic environmental issues reflected by the highest CO2 emissions in the world among GCC countries.
- Green technologies are available but key issue lies in development of knowledge and capabilities transfer into Arab countries.
- High innovation potential particularly in application of RETs to provide: energy to rural areas, identification of special natural asset to develop, green technologies clusters (e.g., Masdar in the UAE).
- Policy approaches might focus on training, education, awareness and outreach as well as opportunities to develop innovation and human resources development through targeted projects at national and local levels.