The Changing Landscape of Higher Education, Science & Technology in the Arab World: Jordanian -Greco in Focus

Adnan Badran
Amman – Jordan
2/12/2012

Main reference: Badran & Zoubi, UNESCO World Science report 2010: Arab States
Higher Education's Perspectives, Dynamics & Implication:

Higher Education is the key to Development:

- Build up the human capital.
- Generate K-workers.
- Create knowledge through basic research.
- Knowledge feeds innovation.
- Develop technology & Innovation & K-economy.
- Outreach for the K-society.
What to do:

- Invest in quality higher education (HE).
- Invest in scientific research.
- HE should be flexible to react quickly to demands, and create new demands.
- To graduate vehicles of development: entrepreneurs.
- HE should deliver quality and relevance.
- HE builds brain-intensive knowledge and stimulate growth.
How to be effective:

- The university should enjoy full governance & autonomy, sustainable financial resources, transparency.
- Decides on admission policy.
- Competitive and enjoys full freedom of expression and thought.
- Conducive environment for enquiry and cleverly R&D.
- Strive for excellence in research and teaching.
- Links with industry.
Establish alliance:

- Liaze with universities abroad & companies to develop technologies.
- Convert R & D outputs to business.
- Int’l cooperation in teaching, research, joint programs and projects.
- Bridging public–private to stimulate commercialization.
Develop science culture:

- Invest in science.
- Recognize value of knowledge for progress.
- Funding R & D to a level of 1% of GDP by 2015 by all Arab countries.
- Involve private sector in R & D.
What progress in higher education in the Arab region recently:

- HE students of 3.2 millions (1996) more than doubled (7.2) millions (2010).
- 2230 HE student per 100,000 inhabitants.
- 300 universities. Newly, private institutions are competing with older public universities.
- One university per one million compared to world average of one university per 700,000 population.
- 125000 faculty members in Arab universities, 30% women.

Prof-student ratio

OECD: 1:14
World average: 1:16
Arab region: 1:32
Shanghai Ranking of OIC Universities 2011

Source: Academic Ranking of World Universities 2011/top 500 universities/Shanghai Ranking
Hope & Change
To Combat Uncertainties:

- 30% of Arab population less than 15 years of age.
- 60% of Arab youth is below 25 years of age.
- 100 million jobs to be created by 2050, for youth.
- Otherwise, 40% of Arab youth will not be employed (UNESCWA 2007).
Therefore,

Investment in quality and relevant higher education, and smart scientific R & D will increase the potential of new jobs and new opportunities in the market place.
GDP per capita in the Arab region, 2011

Source: from the website “The World Factbook”
Global Competitiveness Index 2011-2012 ranking of (131) countries of the World

Source: Global Competitiveness Report 2011-2012
Priorities of R&D at Global & Regional Levels

1. **UN World Summit 2002** identified five priorities: water, energy, health, agriculture, biodiversity (WEHAB)

2. **UN MDGs priorities** to be reached by 2015: on poverty, education, gender, child mortality, health, environment, sustainable development.

3. **Arab summit priorities (2009):** water, energy, food, agriculture.
R&D expenditure in the Arab region

GERD/GDP ratio for Arab countries, 2007
Other countries & regions are given for comparison

Note: For Tunisia, Turkey and Sudan, the data are an estimation; for Egypt, Kuwait, Algeria and Saudi Arabia, the data are either underestimated or partial; for Mauritania, Qatar, Lebanon and Oman, the data are for gross national expenditure on R&D as a percentage of GDP.
Gross Domestic Expenditure on R&D, 1999-2009
as a percentage of GDP

As a % of total OECD R&D expenditure, 2008

OECD (1999-…)

ISL (1999, 2008)

SWE (2000, 2008)

DNK (2000, 2008)

USA (2000, 2008)

DEU (2000, 2008)

AUT (2000, 2008)

ISL (1999, 2009)

OECD (1999-2009)

AUS (2000, 2008)

FRA (2000, 2008)

BEL (2000, 2008)

CAN (2000, 2008)

NL (2000, 2008)

IRL (2000, 2008)

NOR (2000, 2008)

CHN (2000, 2008)

EU27 (2000, 2008)

SVN (2000, 2008)

HUN (2000, 2008)

ZAF (2000, 2008)

GRC (1999, 2007)

AUT (1999, 2008)

CHE (2000, 2008)

DNK (2000, 2008)

CHL (1999, 2007)

MEX (2000, 2008)

NZL (1999, 2007)

HUN (2000, 2008)

TUR (2000, 2008)

POL (2000, 2008)

SVK (2000, 2008)

CHL (1999, 2007)

MEX (1999, 2007)
Greece: R&D profile 2009

R&D Intensity (Gross domestic expenditure on R&D (GERD) as % of GDP)

Business enterprise expenditure on R&D (BERD) as % of GDP

Public expenditure on R&D as % of GDP

New doctoral graduates (ISCED 6) per thousand population aged 25-34

Researchers (FTE) per thousand labour force

International scientific co-publications per million population

Scientific publications within the 10% most cited scientific publications worldwide as % of total scientific publications

PCT patent applications in societal challenges per billion GDP (PPS€)

PCT patent applications per billion GDP (PPS€)

Licence and patent revenues from abroad as % of GDP

Contribution of high-tech and medium-high-tech manufactured goods to the trade balance

Employment in knowledge intensive activities as % of total employment

Source: DG Research and Innovation
Researchers per million population in the Arab world, 2007

FTE researchers per million

Selected countries

<table>
<thead>
<tr>
<th>Country</th>
<th>FTE Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jordan</td>
<td>3030</td>
</tr>
<tr>
<td>Greece</td>
<td>1873</td>
</tr>
<tr>
<td>Tunisia</td>
<td>1588</td>
</tr>
<tr>
<td>Turkey</td>
<td>685</td>
</tr>
<tr>
<td>Morocco</td>
<td>647</td>
</tr>
<tr>
<td>Egypt</td>
<td>617</td>
</tr>
<tr>
<td>Qatar</td>
<td>588</td>
</tr>
<tr>
<td>Sudan</td>
<td>290</td>
</tr>
<tr>
<td>Oman</td>
<td>252</td>
</tr>
<tr>
<td>Algeria</td>
<td>170</td>
</tr>
<tr>
<td>Kuwait</td>
<td>166</td>
</tr>
<tr>
<td>Libya</td>
<td>60</td>
</tr>
<tr>
<td>Yemen</td>
<td>23</td>
</tr>
</tbody>
</table>

Note: The figures for Jordan & Tunisia represent FTE researchers. For Algeria, Mauritania, Morocco & Oman, the figures include FTE researchers at government universities. The figures for the other countries can be classified as partial data, as they do not include FTE researchers at government universities.

* Source: ChartsBin website
R&D output: scientific publications (SCI)

1. Output of Arab region was 13574 research papers, (2009) increased form 7446 (2000).

2. Egypt leads this indicator in total publications of the 3963 published, one-third 1057 co-authored by others abroad.

3. Per million population, Kuwait ranked 1st among Arab countries.

4. Average Arab per million population was 41 scientific papers as compared to world average of 147.
R&D output: scientific publications (SCI) per million population in Arab countries, 2008

Source: Thomson Reuters (Scientific) Inc. Web of Science. Science Citation Index Expanded, compiled for UNESCO by the Canadian Observatoire des sciences et des technologies; for population data: World Bank, World Development Indicators, June 2010
R&D output:
Total scientific publications (SCI) published in the Arab world, 2008

Source: Data from Thomson Reuters (Scientific ) Inc. Web of Sciences, Science Citation Index Expanded, compiled for UNESCO by the Canadian Observatoire des sciences des techniques.
R&D output: scientific co-publications (SCI) co-authored by others abroad in the Arab world, 2008

Source: Thomson Reuters (Scientific) Inc. Web of Science, Science Citation Index Expanded, compiled for UNESCO by the Canadian Observatoire des sciences et des technologies
R&D output: patents in Arab region

Patents as indicator of technology, increased to 67 registered patents in U.S. but still behind (i.e. Finland 894 in 2008)

US patents granted to residents of Arab countries, 2008
Investment in Science
R&D output: patents in selected OIC countries

US patents granted to residents of selected countries, 2011

Source: as reported by: www.WIPO.com
Knowledge Economy Index for selected Arab countries, 2012

- UAE is leading 6.94  -  Djibouti 1.34

Knowledge Economy Index for selected Arab countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greece</td>
<td>7.51</td>
</tr>
<tr>
<td>UAE</td>
<td>6.94</td>
</tr>
<tr>
<td>Bahrain</td>
<td>5.96</td>
</tr>
<tr>
<td>Oman</td>
<td>5.84</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>5.33</td>
</tr>
<tr>
<td>Qatar</td>
<td>5.16</td>
</tr>
<tr>
<td>Kuwait</td>
<td>4.95</td>
</tr>
<tr>
<td>Turkey</td>
<td>4.56</td>
</tr>
<tr>
<td>Jordan</td>
<td>3.79</td>
</tr>
<tr>
<td>Lebanon</td>
<td>3.78</td>
</tr>
<tr>
<td>Morocco</td>
<td>3.61</td>
</tr>
<tr>
<td>Tunisia</td>
<td>2.77</td>
</tr>
<tr>
<td>Egypt</td>
<td>1.92</td>
</tr>
<tr>
<td>Algeria</td>
<td>1.65</td>
</tr>
<tr>
<td>Yemen</td>
<td>1.48</td>
</tr>
<tr>
<td>Syria</td>
<td>1.34</td>
</tr>
<tr>
<td>Sudan</td>
<td></td>
</tr>
<tr>
<td>Djibouti</td>
<td></td>
</tr>
</tbody>
</table>

Per million population

Note: Data are weighted by population ranges from a low of 0 to a high of 10.
Investment in Science
Who funds what in R&D?
Internet Users per 100 population (2009)

Source: UNESCO Institute for Statistics database, July 2010

Source: International Telecommunications Union, World Telecommunications/ICT Indicators, July 2010
Internet penetration in the Arab Region (2011) as % of population

% Penetration of Population

Note: The most recent information on usage comes mainly from data published by Samer Baydoun’s Blog
In Summary

1. Although higher education expanded in quantity, but was falling behind in quality and relevance.

2. R&D was hampered by:
   - lack of smart conducive environment.
   - Heavy teaching load
   - Lack of university autonomy.
   - Lack of funding.
   - Unstable governance.
   - Lack of research culture.
   - Slow Liberalization & democratization
General Information

Greece is a country of less than 11 million inhabitants occupying an area of 131,990 square kilometers. It is situated on the Balkan Peninsula and includes numerous islands in the eastern part of the Mediterranean Sea, in the Aegean Sea, and in the Ionian Sea.
Education in Greece

The Greek educational system is mainly divided into three levels:

1. Primary
   - kindergarten lasting one or two years
   - primary school spanning six years (ages 6 to 14)

2. Secondary education comprises two stages:
   - Gymnasio (variously translated as Middle or Junior High School), a compulsory three-year school, after which students can attend Lykeion (an academically-oriented High School)
   - or Vocational training.

3. Tertiary, Higher Tertiary education is provided by Universities and Polytechnics,
Tertiary Education in Greece is public and funded primarily by the state. It comprises two parallel sectors:

a. the University sector, which includes the universities, the technical universities, and the School of Fine Arts.

b. the Technological sector, which includes the (Higher) Technological Education Institutions (TEIs), and the School of Pedagogical and Technological Education (ASPETE).
The Greek R&D system
Greek R&D expenditure

Gross expenditure on R&D (GERD) by its components (i.e. where research activities occur showing more research conducted in higher education than elsewhere)

- Business enterprise
- Higher education
- Government
- Private not for profit

Sources of funding for GSRT RCs (i.e. where the money comes from, with 90% coming from government or EU sources)

- Business enterprise
- Private non profit
- Government
- European Commission
- Other

- Greece has one of the lowest levels of R&D spending in the EC and OECD.
- For 2006, the year for which the most recent figures are available, gross expenditure on GERD was c€1.3b, accounting for 0.6% of GDP (against a European average of 1.9%).
- As illustrated in the pie-graphs, the majority of funding comes from public sector sources.
- The majority of GOVERD is made up of expenditure supporting the public RCs.
Greek R&D and the EC

- The Greek R&D system is heavily dependent on EC support—a third of public sector research (e.g. universities and RCs) is funded by the EC.
- As illustrated opposite, Greece ‘punches above its weight’ in participations in EC-funded FPs.
- In a system where public and private R&D expenditure is low this support is welcomed.
- However, there are three significant risks associated with dependence on EC funding:
  1. There could be a substitution effect, with the state withdrawing funding if there is confidence that the EC would pick it up.
  2. Greek researchers will by necessity follow the priorities of the EC over Greece’s.
  3. EU funding will become more inaccessible for Greek researchers because the Greek state is not able to provide the level of co-funding needed.

Source: STEP TO RJVs Database, Laboratory of Industrial and Energy Economics, National Technical University of Athens, 2021
SWOT analysis

**Strengths**

- Successful in securing competitive EU funding
- Examples of entrepreneurial administration
- Committed and loyal staff
- Some high-quality equipment and infrastructure
- Some internationally high-profile research
- Pockets of interdisciplinary and inter-institution collaboration

**Weaknesses**

- Lack of consistent and reliable funding: irregularity of cycle of ITTs; unreliability of timing of payment
- Lack of national strategy, leading to a lack of prioritisation, and of a cohesive research community
- Poor collaboration with industry and universities, and between research institutions, with an overreliance on state funding
- No level playing field (differences in legal status of RCs, funding and salary differences)
- Lack of critical mass in certain areas
- Few incentives to attract/retain good (younger) researchers
- Heavy bureaucracy and micro-management
- Low-profile support for technology transfer and a lack of entrepreneurial culture

**Opportunities**

- High-quality researchers responsive to funding opportunities
- Capacity for increasing collaboration with other centres and universities (both domestically and abroad)
- Reduced bureaucracy that would allow for greater flexibility and mobility between RCs and universities (dual appointments)
- Untapped commercialisable products and services
- Opportunities for government and industry to become ‘research customers’
- Focus research priorities on national needs where Greece has a comparative advantage
- Availability of a highly educated workforce, in Greece and as part of the Greek diaspora
- Recognition of the need for change

**Threats**

- Lack of reform
- Constraints on the state budget and global economic environment
- Increasing competition for EU funding
- Financial difficulties of RCs
- Low morale of staff
- Ageing researchers and constraints on personnel hiring
- Constitutional/legal limitations to restructuring
Opportunities

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- Constraints on the state budget and global economic environment
- Increasing competition for EU funding
- Financial difficulties of RCs
- Low morale of staff
- Ageing researchers and constraints on personnel hiring
- Constitutional/legal limitations to restructuring
Support the next generation of research leadership

- Over the next five years an estimated 20% of the senior leadership (Grade A) will retire from the RCs and universities.

- Combined with the current 1:5 (7) rule on recruitment, this is a major threat to the sustainability of the R&D system.

- The establishment of fellowships for the leading (c50) mid-career researchers in Greece should be considered; these would:
  
  - be awarded through an open competitive process based on research excellence, as judged by international peer review
  
  - provide generous and timely funding for salaries, research expenses, international conferencing, etc.
  
  - support and develop through an intensive programme of leadership training and mentorship
  
  - facilitate the establishment of a network to ensure a mutual learning environment.

More than half of researchers at GSRT RCs are at Grades A and B, and more than half of these researchers are above 50 years of age.
Figure 8: Researchers (FTE) in Southeast Europe by sector of employment, 2008 (%)

- Bulgaria
  - Business enterprise: 33.2%
  - Government: 53.0%
  - Higher education: 13.1%
  - Private non-profit: 0.7%

- Croatia
  - Business enterprise: 55.3%
  - Government: 28.2%
  - Higher education: 16.4%
  - Private non-profit: 0.1%

- Greece-1
  - Business enterprise: 59.5%
  - Government: 10.6%
  - Higher education: 29.3%
  - Private non-profit: 0.7%

- FYR of Macedonia-2
  - Business enterprise: 51.0%
  - Government: 43.5%
  - Higher education: 10.6%
  - Private non-profit: 0.5%

- Moldova-1
  - Business enterprise: 75.0%
  - Government: 14.2%
  - Higher education: 10.8%
  - Private non-profit: 0.4%

- Romania
  - Business enterprise: 35.3%
  - Government: 73.1%
  - Higher education: 0.4%
  - Private non-profit: 31.8%

- Serbia-1
  - Business enterprise: 25.5%
  - Government: 25.4%
  - Higher education: 25.5%
  - Private non-profit: 0.2%

- Slovenia
  - Business enterprise: 30.7%
  - Government: 43.5%
  - Higher education: 0.3%
  - Private non-profit: 30.7%

- n = data refer to n years before reference year

Source: UNESCO Institute for Statistics database, August 2010
Starting Grants from European Research council per million inhabitants, 2007

Note: The data concern the first round of grants in 2007. A recipient is associated with the country where his or her institution is located, irrespective of nationality. No grants were awarded in 2007 in those EU countries not listed here.

Source: European Research Council
GERD per capita in Southeast Europe, 2007

Source: UNESCO institute for Statistics database, August 2010
Growth in numbers of tertiary graduates in Southeast Europe, 2002-2008 (%)

Note: For Greece, the period covered for undergraduates is 2002-2007. For Romania, it is 2004-2008 for graduates.
### R&D output in Southeast Europe, 2006 in terms of patents, publications & royalty payments

<table>
<thead>
<tr>
<th></th>
<th>Total royalty payments &amp; receipts (US$ per capita) 2006</th>
<th>University-company research collaboration (scale of 1-7) 2007</th>
<th>Patents granted by USPTO (per million population) annual average 2002-2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>2.39</td>
<td>1.7</td>
<td>0</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>10.38</td>
<td>2.7</td>
<td>0.74</td>
</tr>
<tr>
<td>Bosnia &amp; Herzegovina</td>
<td>-</td>
<td>2.4</td>
<td>0.10</td>
</tr>
<tr>
<td>Croatia</td>
<td>50.02</td>
<td>3.6</td>
<td>2.45</td>
</tr>
<tr>
<td><strong>Greece</strong></td>
<td><strong>42.53</strong></td>
<td><strong>2.9</strong></td>
<td><strong>1.87</strong></td>
</tr>
<tr>
<td>FYR Macedonia</td>
<td>6.64</td>
<td>2.9</td>
<td>0.10</td>
</tr>
<tr>
<td>Moldova</td>
<td>1.48</td>
<td>2.3</td>
<td>0.33</td>
</tr>
<tr>
<td>Romania</td>
<td>10.22</td>
<td>2.7</td>
<td>0.34</td>
</tr>
<tr>
<td>Serbia</td>
<td>-</td>
<td>3.1</td>
<td>-</td>
</tr>
<tr>
<td>Slovenia</td>
<td>85.62</td>
<td>3.8</td>
<td>9.40</td>
</tr>
</tbody>
</table>

R&D output in Southeast Europe, 2006 in terms of patents, publications & royalty payments

Source: Thomson Reuters (Scientific) Inc. Web of Science. (Science Citation Index Expanded), compiled for UNESCO by the Canadian Observatories des science et des technologies. Population data from Eurostat and World Ban, March 2009.
### Scientific publications in Southeast Europe, 2002 and 2008

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2008</th>
<th>Change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albania</td>
<td>35</td>
<td>52</td>
<td>48.6%</td>
</tr>
<tr>
<td>Bosnia &amp; Herzegovina</td>
<td>35</td>
<td>287</td>
<td>720.0%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>1,825</td>
<td>2,227</td>
<td>45.7%</td>
</tr>
<tr>
<td>Croatia</td>
<td>1,254</td>
<td>2,348</td>
<td>87.2%</td>
</tr>
<tr>
<td>Greece</td>
<td>5,588</td>
<td>9,296</td>
<td>66.4%</td>
</tr>
<tr>
<td>FYR Macedonia</td>
<td>104</td>
<td>197</td>
<td>89.4%</td>
</tr>
<tr>
<td>Moldova</td>
<td>160</td>
<td>223</td>
<td>39.4%</td>
</tr>
<tr>
<td>Montenegro</td>
<td>-</td>
<td>93</td>
<td>-</td>
</tr>
<tr>
<td>Romania</td>
<td>2,127</td>
<td>4,975</td>
<td>133.9%</td>
</tr>
<tr>
<td>Serbia*</td>
<td>1,003</td>
<td>2,729</td>
<td>172.1%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1,609</td>
<td>2,766</td>
<td>71.9%</td>
</tr>
</tbody>
</table>

*Serbia includes Montenegro for 2002*

Source: Thomson Reuters (Scientific) Inc. Web of Science. (Science Citation Index Expanded), compiled for UNESCO by the Canadian Observatories des science et des technologies.
Internet users per 100 population in Southeast Europe, 2001 & 2008

Source: United Nations Statistical Division, Millennium Development Goals Indicators
THANK YOU