ORGANISATION OF THE ISLAMIC CONFERENCE

STATISTICAL, ECONOMIC AND SOCIAL RESEARCH
AND TRAINING CENTRE FOR ISLAMIC COUNTRIES

OIC OUTLOOK

January 2009

RESEARCH AND SCIENTIFIC DEVELOPMENT IN OIC COUNTRIES

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INTRODUCTION

Research in science and technology is of great importance and key to progress towards a knowledge-based, or an innovation-driven economy. On one hand, it promotes better understanding on different aspects of life while, on the other hand, it helps to improve the standard of living by creating new knowledge and technological innovation.

Today, there is severe competition among countries to become the most competitive and knowledge-based economy in the world. In this respect, gaining a competitive advantage against other countries, which is of particular importance to the OIC member countries in catching-up within this competitive world of knowledge economy, depends mostly on how well they perform in research activities.

This brief report presents an overview of achievements by the OIC member countries in the field of research and development (R&D) and science & technology (S&T).

HUMAN RESOURCES IN RESEARCH & DEVELOPMENT

The availability of abundant and highly qualified researchers is an essential condition to foster innovation and promote the scientific and technological development of a country. However, figures indicate that OIC member countries, on average, fall well behind the world average in terms of researchers per million people: 402 vs. 1,544, respectively[1].

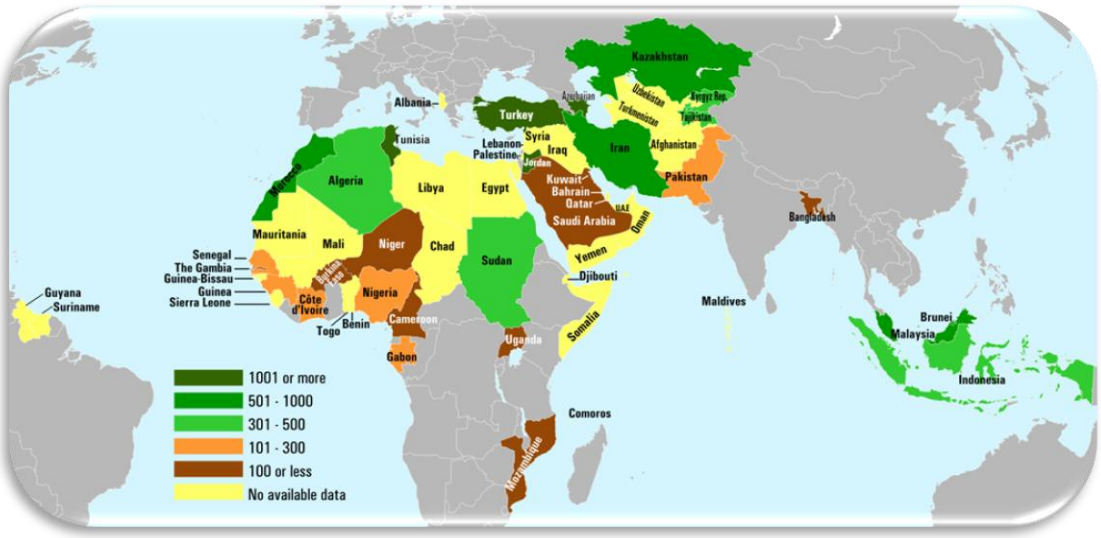

*Figure 1: Researchers per million people**

* Headcount data for the most recent year available.

Figure 1 illustrates the OIC map of distribution of researchers employed in R&D and reveals the following observations:

- Only 4 member countries have more than one thousand researchers per million people, two of which –Jordan and Tunisia– are above the world average.

[1] Figures are the weighted averages of countries for which data are available.

- 9 member countries have less than one hundred researchers per million people, most of which are in Sub-Saharan Africa.
- Great disparity exists among the member countries; Jordan has 2,910 researchers per million inhabitants while Niger has merely 10.

WOMEN IN RESEARCH ACTIVITIES

In the last decades, women, with better access to training and education facilities thanks to the rising awareness on gender in/equality, have become more qualified and motivated to participate in the labour force. Nevertheless, the progress achieved so far in the field of R&D seems to be unsatisfactory neither globally nor at the OIC level. Women, in the OIC, represent around 30% of the total researchers, slightly higher than the world average of 28%[2].

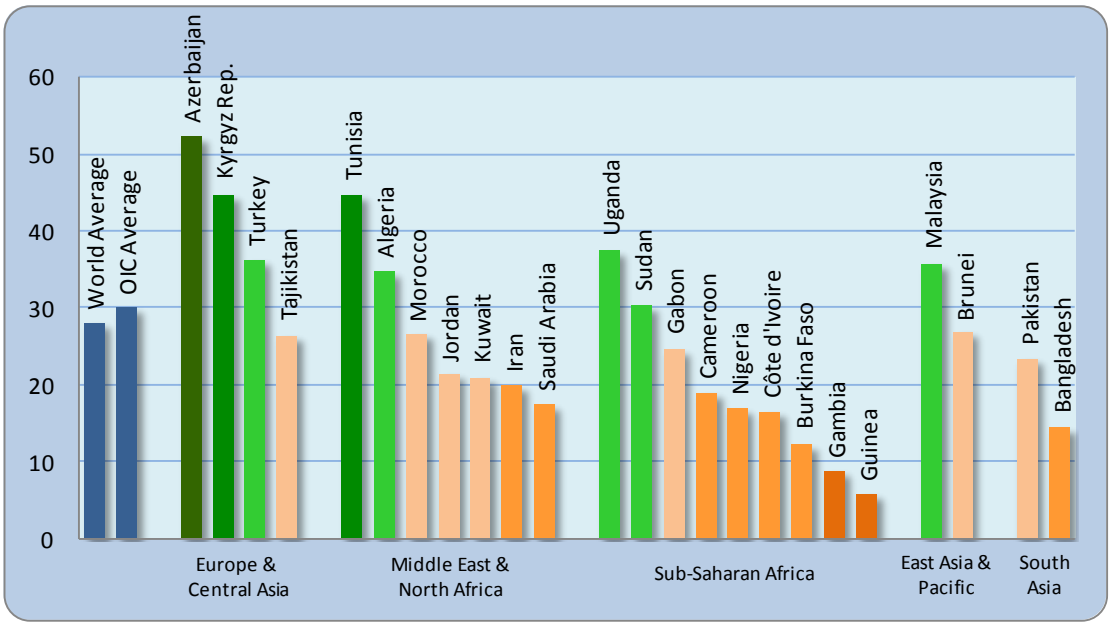

*Figure 2: Women as a share of total researchers (%)**

* Headcount data for the most recent year available.

With respect to the data demonstrated in Figure 2, the following observations can be drawn:

- The share of women in total researchers is above the world average in 8 of the 24 OIC member countries with available data.
- According to regional averages, OIC members in Central and East Asia report higher rates of women researchers, often above the world average.
- Members in the Middle East report lower rates of women researchers than those in North Africa. The share of women researchers range from 45% in Tunisia to 17% in Saudi Arabia.
- Intra-regional difference is even higher in Sub-Saharan Africa: on one hand, there are countries like Sudan and Uganda where women represent more than 30% of researchers while, on the other hand, there also are countries where women's share is less than 10% as in the case of Guinea and Gambia.
- Azerbaijan is the only member country to have more women researchers than men (52%). Kyrgyz Republic and Tunisia –both with 45% women researchers– are also very close to achieving gender parity.

[2] Calculations are based on countries with available headcount data –for the most recent year available.

EXPENDITURES ON RESEARCH & DEVELOPMENT

R&D intensity (Gross domestic expenditure on R&D –GERD– as a percentage of GDP) is a widely used indicator of S&T activities. It reflects the innovative capacity of a country in that a higher R&D intensity indicates that relatively more resources are devoted to the development of new products or production processes. Available data show that OIC member countries' spending on R&D activities is significantly lower than the world average (Figure 3).

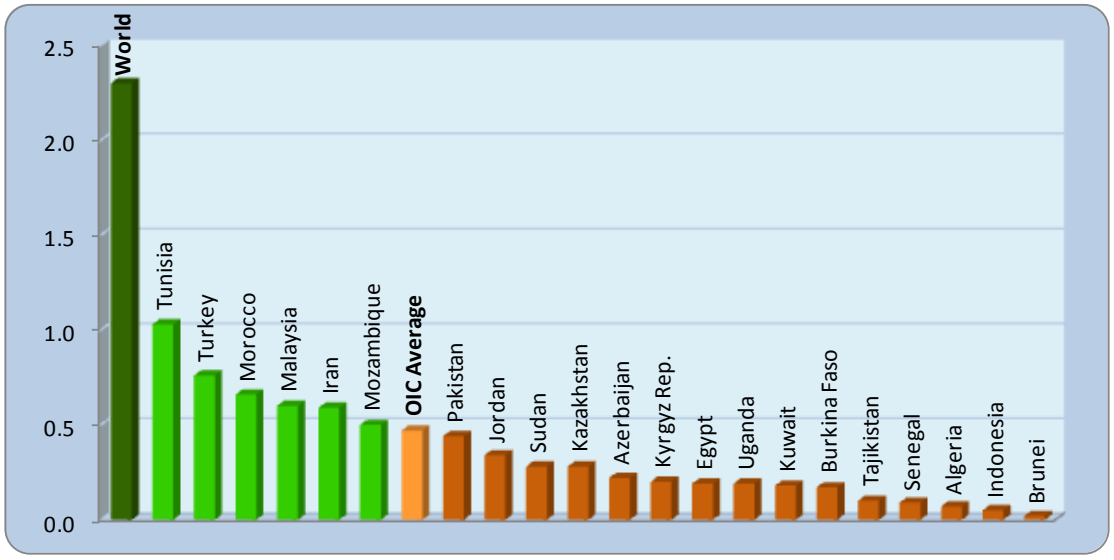

*Figure 3: R&D intensity (%)**

* Data for the most recent year available between 2000 and 2006.

Regarding the R&D intensity in the OIC member countries, the situation can be summarized as below:

- Most of the member countries spend less than 0.5% of GDP on R&D.
- R&D intensity in all of the member countries, averaging 0.47% for the OIC, is quite lower than the world average of 2.3%.
- Tunisia reports the highest level of R&D intensity (1.03%), followed by Turkey (0.76%) and Morocco (0.66%), while the lowest spending level is recorded for Brunei (0.02%).
- Among the few Sub-Saharan members that can provide data, Mozambique with 0.5% R&D intensity, is the only country to spend above the OIC average.

Figure 4 illustrates the change in R&D intensity between 1996 and 2006 for the OIC member countries for which data are available. Accordingly;

- In most of the member countries, R&D intensity remained relatively stable.
- Tunisia, Malaysia, Morocco, Pakistan, and Turkey managed to increase their R&D intensity. Except in Turkey, R&D intensity was more than doubled in these countries.
- Sudan, Uganda, and Algeria reported a significant decrease in their R&D intensity.

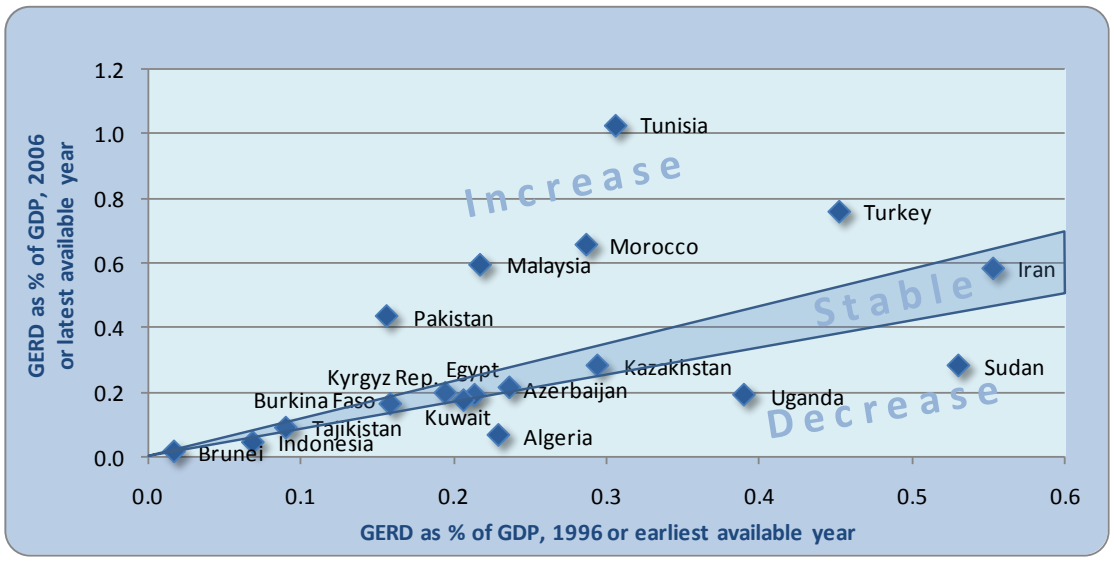

Figure 4: Trends in R&D intensity

R&D EXPENDITURES BY SECTOR

Given that the GERD is the sum of R&D expenditures of the performing sectors, it is useful to disaggregate it into individual sectors to see how much R&D each sector performs. This sectoral disaggregation is based on the United Nations classification that defines four major sectors of performance: Government, Business Enterprise, Higher Education, and Private Non-Profit. In this respect, Figure 5 presents the distribution of GERD among these sectors in the OIC member countries for which data are available. The figures are based on total available resources, regardless of their source of funds.

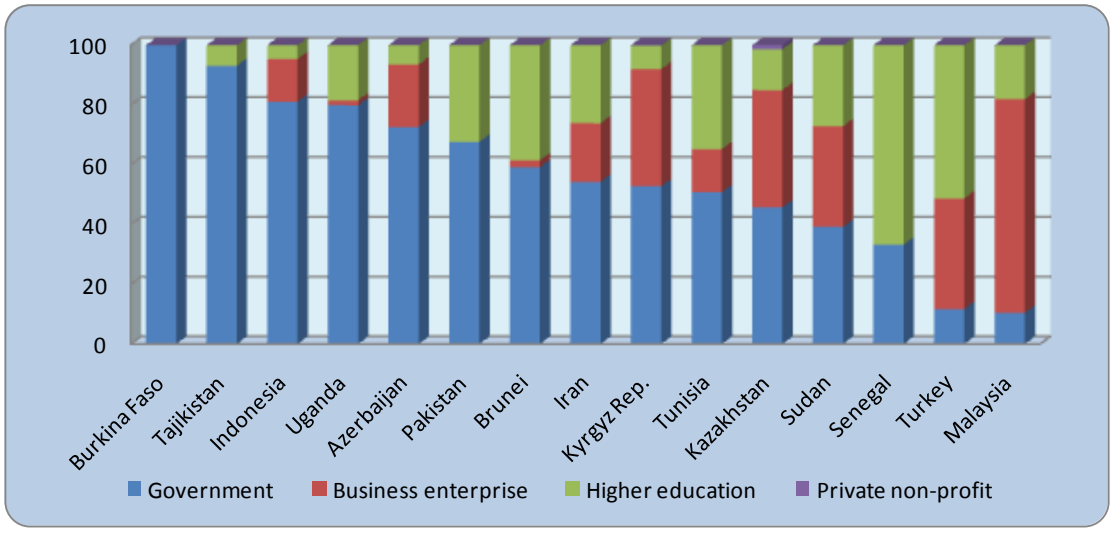

*Figure 5: Distribution of GERD by sector of performance (%)**

* Data for the most recent year available.

Considering the data illustrated in Figure 5, sectoral distribution of GERD can be summed up as below:

- In most of the OIC member countries (10 out of 15 with available data), more than 50% of GERD is spent by government sector.
- Despite having a share of less than 50%, government sector in Kazakhstan and Sudan is the dominant sector, spending more on R&D than the other sectors.
- GERD in Burkina Faso is completely performed by government sector.

- The share of Business Enterprise in GERD is highest in Malaysia with 71.5%. Moreover, in Kazakhstan, Kyrgyz Republic, Turkey, and Sudan, Business Enterprise is responsible for more than one third of the GERD.
- Higher Education is the leading sector in Senegal and Turkey, accounting respectively for 66.7% and 51.3%. Furthermore, around one third of the GERD in Brunei, Tunisia, and Pakistan is also performed by this sector.
- The share of R&D expenditures by the Private Non-Profit sector is at a negligible level in all of the member countries.

R&D EXPENDITURES BY SOURCE OF FUNDS

Figure 6 presents information on the funding sources of R&D in OIC member countries. Source distribution of the GERD has been made again on a sectoral basis as specified above, yet including additionally the funds from abroad..

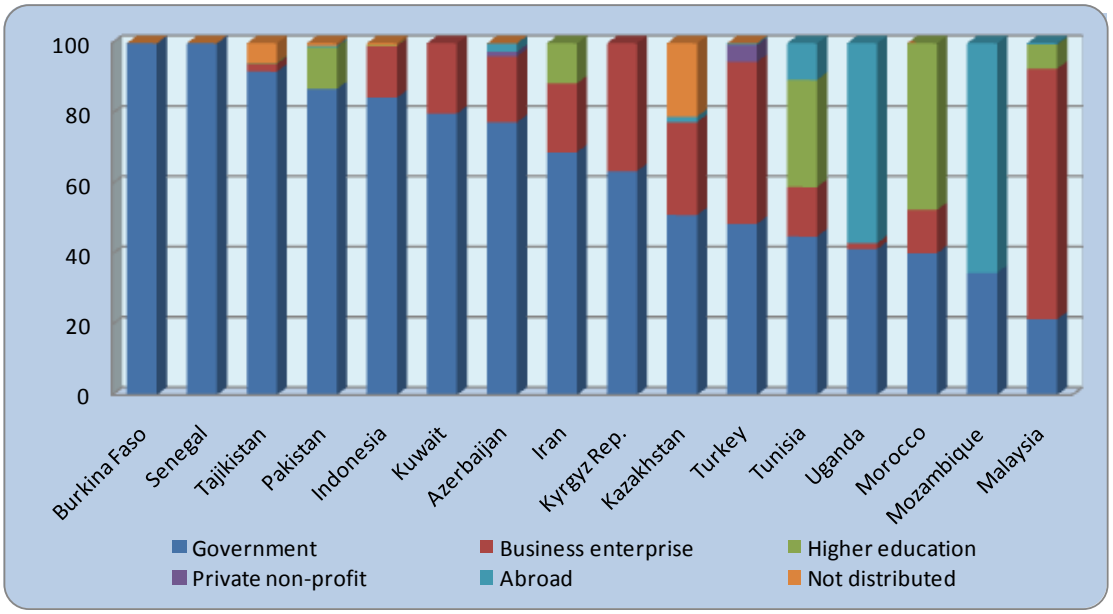

*Figure 6: Distribution of GERD by source of funds (%)**

* Data for the most recent year available.

Figure 6 illustrates the sectoral distribution of GERD by source of funds. Accordingly, the situation in OIC member countries can be summarized by the following observations:

- In most of the OIC member countries, R&D is mainly financed by the government sector. Out of 16 member countries, for which data are available, 10 countries are receiving more than %50 of R&D funds from the government.
- Despite having a share of less than 50%, government sector in Tunisia and Turkey is the dominant sector, providing more R&D funds than the other sectors.
- GERD in Burkina Faso and Senegal is completely funded by government sector.
- Funding of Business Enterprise is dominant only in Malaysia, accounting for 71.2% of the total R&D funds. Yet, in Turkey and Kyrgyz Republic, the share of Business funds is also at significant levels.
- Only in Morocco, the primary source of R&D funds is Higher Education sector, accounting for 47.4% of the total R&D funds.
- Mozambique and Uganda deserve special attention as their R&D funds mostly come from abroad, 65.3% and 56.9% respectively.

HIGH TECHNOLOGY EXPORTS

High technology exports (HTE) are products with high R&D intensity, including aerospace, computers, software and related services, consumer electronics, semiconductors, pharmaceuticals, scientific instruments and electrical machinery, which mostly depend on an advanced technological infrastructure and inward FDI in high-tech industries. Confirming the lack of adequate infrastructure and FDI in most of the OIC member countries, data for the year 2006 shows that 26 of the member countries –for which data are available– account for only 4% of the world high technology exports.

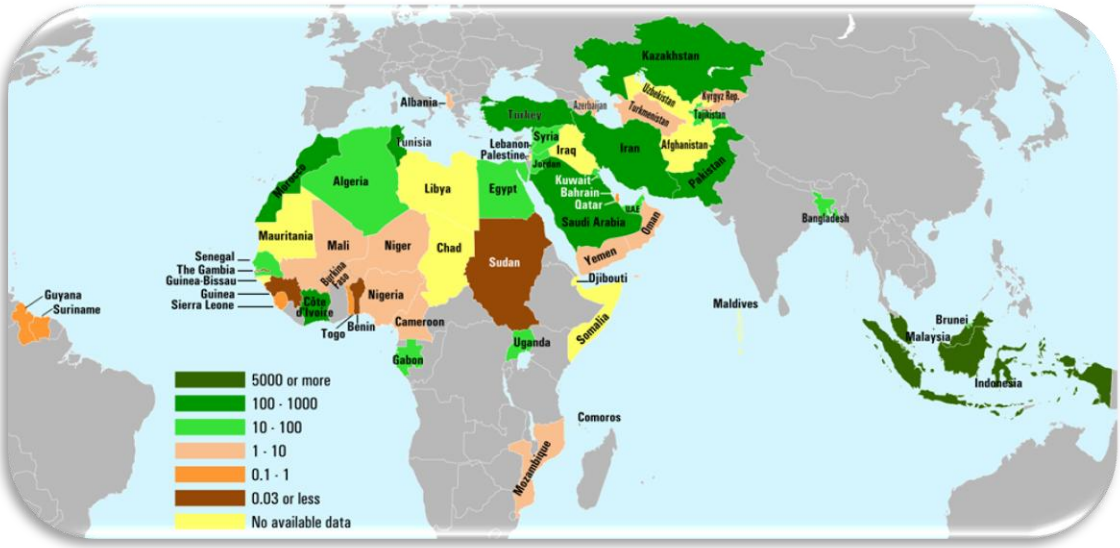

*Figure 7: High technology exports (Million US$)**

* Data for 2006 or latest available year.

Data for these countries are illustrated in Figure 7, which yield the following observations:

- Malaysia and Indonesia are, by far, the top ranking OIC member countries by high technology exports, together representing 95% of the total HTE of the OIC.
- With US$ 63.4 billion, Malaysia, on its own, accounts for about 87% of the total HTE of the OIC, and 3.5% of those of the world.
- HTE of the other leading member countries ranges from US$ 100 million to US$ 1 billion.
- In Sub-Saharan Africa, Benin, Guinea, and Sudan records even less than US$ 30 thousand of HTE.
- Cote d'Ivoire, with more than US$ 500 million of HTE, gets far ahead of the other Sub-Saharan members.

For a better understanding of the importance of HTE to a country, it is useful to look at the share of these exports in its total manufactured exports. Figure 8 presents these shares for 42 member countries for which data are available in a comparative manner to reflect any change over time.

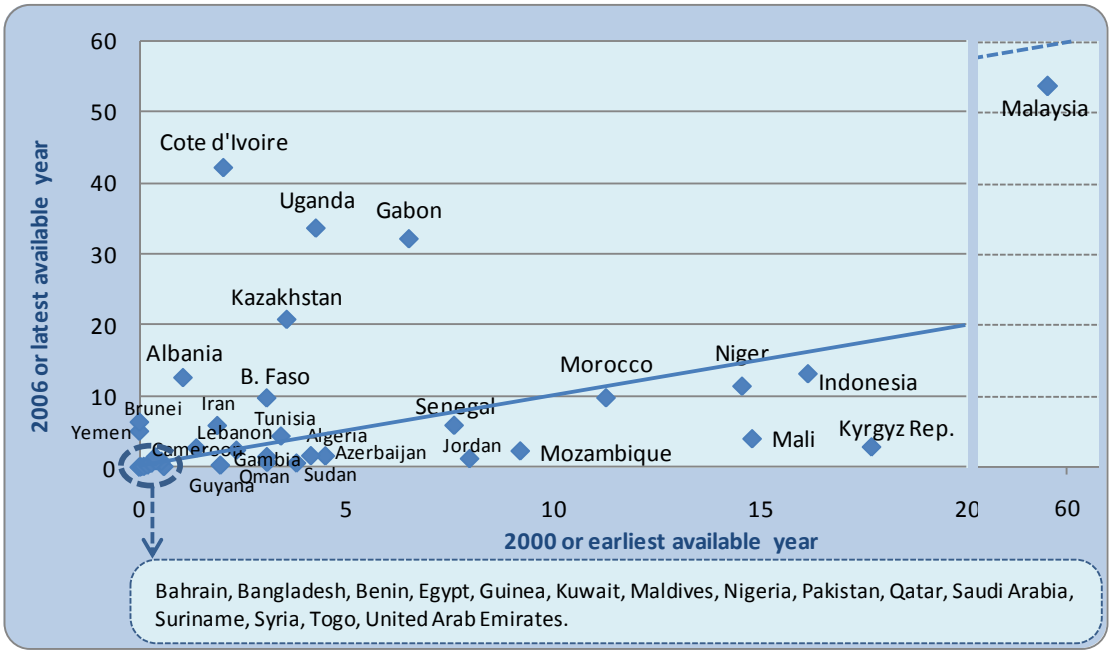

Figure 8: High technology exports: 2000 vs. 2006 (% of manufactured exports)

With respect to the data illustrated in Figure 8, the evolution of high technology exports in the OIC member countries can be summarized as below:

- In 15 member countries listed at the bottom of the Figure, HTE continue to account for less than 2% of their manufactured exports. Though rather limited, there have been improvements in all of them except in Togo and Guinea.
- Largest improvements across the OIC are recorded by three Sub-Saharan members, namely Cote d'Ivoire, Uganda, and Gabon, which have managed to increase the share of HTE from below 7% to above 30% of their manufactured exports.
- Kazakhstan and Albania have also reported relatively high expansion rates in the share of HTE; 17.3 and 11.6 percentage points, respectively, to reach 20.8% and 12.6%.
- Decline in the share of HTE in manufactured exports has also been observed in many countries, particularly in Kyrgyz Republic and Mali with more than 10 percentage points, and in Mozambique and Jordan with about 7 percentage points.
- Representing 95% of the total HTE of the OIC, Malaysia and Indonesia have also witnessed a decrease in the share of HTE in their manufactured exports, 5.8 and 3.0 percentage points, respectively. Yet again, Malaysia continues to have the largest share of HTE in manufactured exports (53.8%).

SCIENTIFIC PUBLICATIONS

Academic research is an important component of all research activities conducted in a country. To a certain extent, the performance in academic research can be well reflected by the number of scientific articles published in indexed journals. In this regard, the quantity and the growth of the research output, i.e. articles, are common indicators used to measure the research performance of a given institution or country. Indeed, such bibliometric indicators have been widely used in

national science and technology statistics publications to measure scientific capacity and linkages to world science[3] and particularly in national and international rankings of universities[4].

PUBLISHED ARTICLES

In 2008, OIC member countries published 54,400 articles in journals that are covered by Science Citation Index Expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI)[5]. Figure 9 presents information on the contribution of each member country to this output.

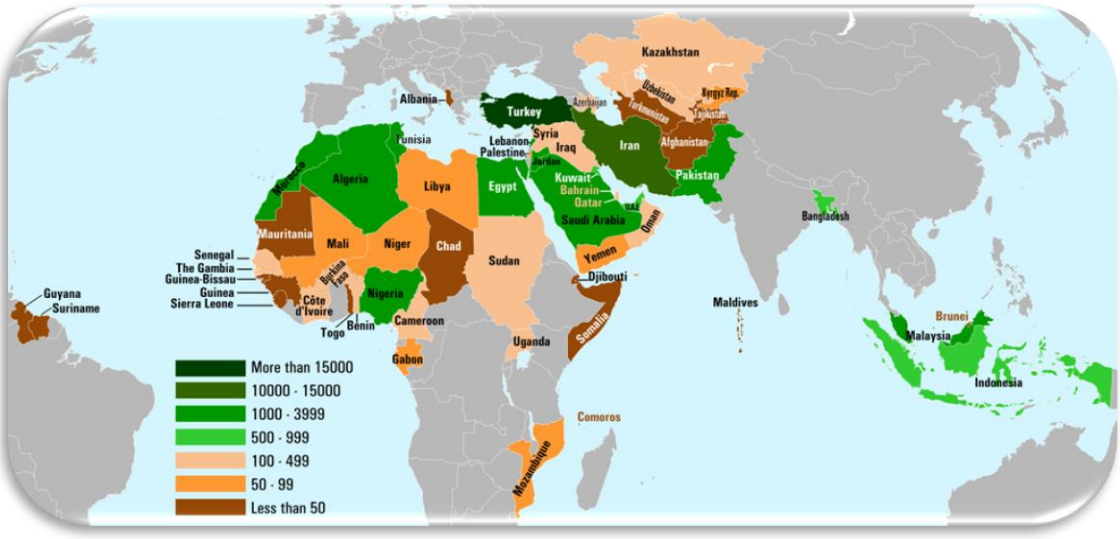

*Figure 9: Articles published in international journals, 2008**

* Total number of articles published in journals covered by Science Citation Index Expanded (SCI-EXPANDED), Social Science Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI).

In this respect, the following observations outline the performance of the OIC member countries in publishing articles:

- Production of scientific publications –here articles– in the OIC is heavily concentrated in a few of the member countries.
- More than half of the articles (51.8%) originate from only two member countries, namely Turkey (17,730 or 32.6%) and Iran (10,451 or 19.2%).
- Adding Egypt, Malaysia, and Pakistan, these five countries account for more than two-thirds of all published articles.
- Some other member countries in the Middle East & North Africa, South Asia, and East Asia & Pacific also perform well while those in Latin America, Sub-Saharan Africa, and Central Asia are generally lagging behind.
- Individually, there are 17 countries publishing less than 50 articles. These countries are not concentrated in one region but dispersed across regions: for example; from Albania in Europe to Somalia in Sub-Saharan Africa, and from Guyana in Latin America to Tajikistan in Central Asia.
- Nigeria stands out as the only Sub-Saharan member to produce over one thousand articles.

[3] UNESCO Institute for Statistics, "What do bibliometric indicators tell us about world scientific output?", *UIS Bulletin on Science and Technology Statistics*, Issue 2, September 2005.

[4] For example, Academic Ranking of World Universities by Shanghai Jiao Tong University (SJTU), World University Rankings by the Times Higher Education Supplement (THES), and also the OIC University Ranking make use of the research output as an important indicator in their ranking methodologies.

[5] See ISI Web of Knowledge Online Database.

THE EVOLUTION OF PUBLICATION OUTCOME

The growth in the number of articles on a per-capita basis reflects a better indicator of productivity in scientific publications as it takes into account the relative size of the population in the countries compared. In this respect, Figure 10 presents data on articles per million people (pmp) in OIC member countries, comparing two periods of time: 1999-2003 and 2004-2008. Accordingly:

- On average, OIC member countries produced 16 articles (pmp) in the first period while this number increased only to 28 in the second period, which is still far below the world average.
- 46 out of 57 countries recorded an increase between these two periods, but this increase in 36 of them was no more than 10 articles. This implies, in general, that the expansion recorded in countries with low number of articles (pmp) remained quite limited compared to those with high numbers.
- Turkey, in absolute terms, took the lead in boosting scientific productivity with an increase of 100 articles (pmp), followed by Qatar, Iran, Lebanon, Tunisia, and Bahrain, all of which recorded an increase of more than 50 articles (pmp).
- The remaining 11 out of 57 members, mostly in Central Asia and Sub Saharan Africa, recorded a decrease in their articles (pmp). Yet, the highest decreases were reported for Kuwait (-13.0), Morocco (-3.7), and Saudi Arabia (-2.5), which had and still have quite higher rates than the others. On the whole, Kuwait continues to rank in the second place after Lebanon.

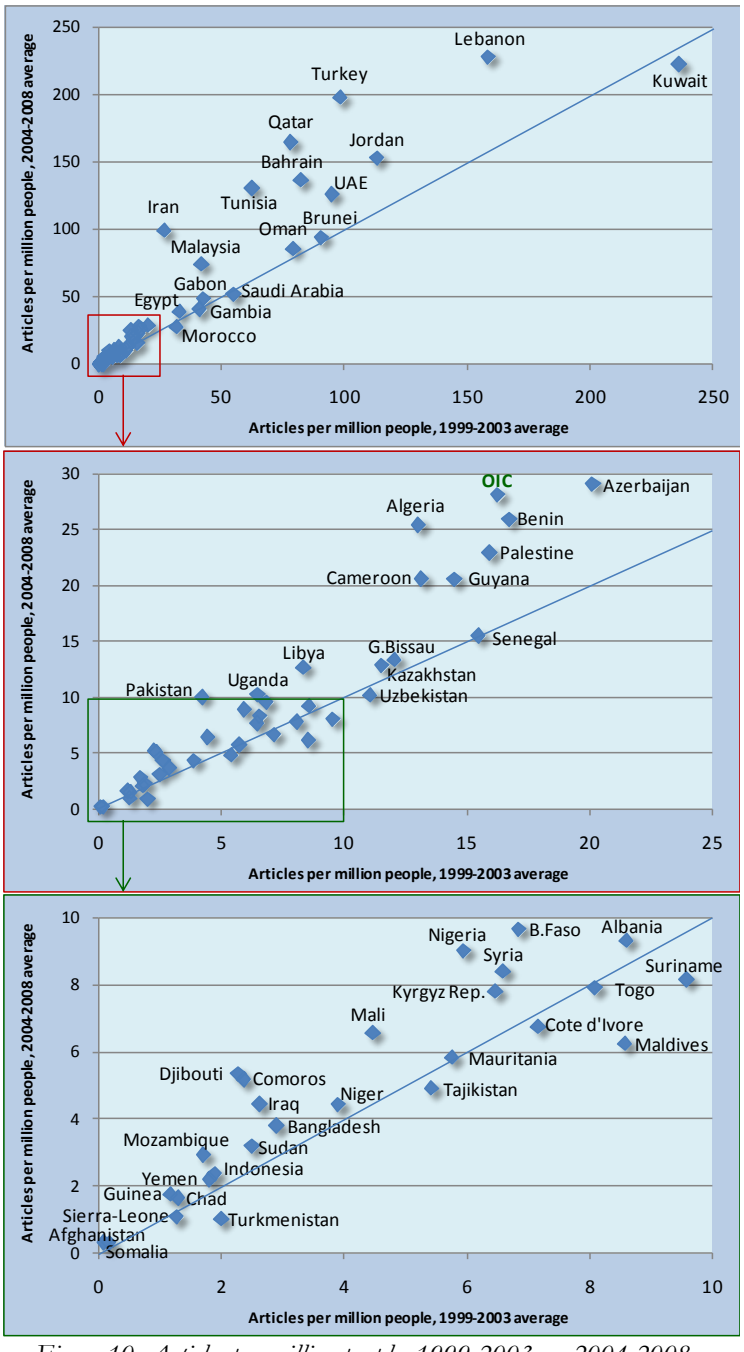

Figure 10: Articles per million people: 1999-2003 vs. 2004-2008

- Overall, according to the data on 2004-2008 average, there are only 17 members performing above the OIC average in terms of articles (pmp), with Lebanon, Kuwait, Turkey, Qatar, and Jordan ranking at the top.
- Most of the high ranking member countries are located in the Middle East, producing up to 229 articles (pmp).
- At the other side of the spectrum, there are member countries with less than one article (pmp), like Somalia and Afghanistan.

PATENT APPLICATIONS

Intellectual property rights, especially patents, are the key factors contributing to advances in innovation and scientific development. As a product of R&D activities, patents strengthen the link between science and technology, as the outcomes of research translate into new products or services. In this regard, although not all inventions are patented, the quantity of patent applications may be considered as a proxy for the degree of innovative capability in a country.

According to WIPO statistics, the total number of patent applications around the world in 2006 is estimated to have been 1.72 million, and only 1.03% of them were filed in OIC member countries –for which data are available. To shed light on the situation in individual countries, Figure 11 presents statistics on patent applications in countries for which data are available.

Figure 11: Patent applications by office: residents and non-residents

In this respect, the following observations can be made to summarize the situation in the OIC member countries:

- Patent activity is highest in Malaysia, Indonesia, and Turkey and lowest in Uganda, Tajikistan and Kyrgyz Republic.
- None of the members reaches to the world average patent applications even when the top countries – USA, Japan, China, and Republic of Korea that account for 70.5% of the total patent applications in the world– are excluded (the corresponding average is 4,984).
- In most of the countries, applications by non-residents are higher than those filed by residents; in fact, in half of the 18 countries with available data, they account for

more than 80% of the total applications. In quantity, they are highest in Indonesia and Malaysia, exceeding 4,000.

- Applications by residents dominate only in seven of the member countries, and, in quantity, they are highest in Turkey and Kazakhstan, exceeding 1,800 and 1400 respectively.

POLICY IMPLICATIONS

Given the importance of evidence-based policy making and the role of S&T in the development of countries, national statistical offices of the member countries should give special attention to the collection and dissemination of statistical data on science and technology. Considering the available data, the following conclusions can be drawn for the member countries:

- Although the availability of researchers varies considerably among the OIC member countries, most of them lag behind the world, with inadequate quantity of researchers employed in R&D activities.
- Women, as researchers, are underrepresented in R&D activities, yet the OIC average is even slightly higher than that of the world.
- R&D intensity is quite low in the OIC, with only one country spending more than 1% of GDP on R&D while the world average is above 2%. On the other hand, some countries have recorded significant increases in their R&D intensity while most of the other countries have reported stable expenditures on R&D. The Ten-Year Programme of Action that was adopted by the Third Extraordinary Session of the Islamic Summit Conference called upon the member countries –under the domain of Higher Education, Science and Technology– to encourage R&D programmes and ensure their individual R&D intensity is not inferior to half of the world average.
- In most of the member countries, R&D activities are financed and performed by the public sector while, in few cases, business sector or higher education takes the lead.
- In parallel with the low R&D intensity and inadequate technological infrastructure, high technology exports of the OIC member countries remain quite limited, accounting for only 4% of the world high technology exports, yet again mostly originated from only two members.
- Moreover, high technology products do not occupy much part in manufactured exports of the members, and this does not seem to improve significantly over time except for few of them.
- Production of scientific articles is also concentrated in a few of the members. In 2008, the OIC member countries produced more than 54 thousand articles, yet, 69% of them originated from only 5 countries and almost one third of the members each produced less than 50 articles.
- From 1999-2003 to 2004-2008, the number of articles per million people, on average, increased only by 12 articles to reach 28.
- Patent statistics are not available for most of the member countries. Available data on 18 members indicate that patent applications are below the world average and mostly filed by non-residents, implying that indigenous innovation capability in most of these countries is at low levels.

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