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Overview of Knowledge Economy in the Arab Region

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Abstract This paper employs both the descriptive and comparative approaches and uses the definition of knowledge and knowledge indicators used in the literature to examine the existence and development of the knowledge economy in the Arab region. We fill the gap in the Arab literature and present a more comprehensive analysis of the development of knowledge indicators in the Arab region. Our findings support the first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region and support the third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region. Therefore, it is essential for the Arab region to enhance the knowledge economy and indicators to achieve economic development in the Arab region.

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JEL classification O10 · O11 · O30

Introduction

This paper presents an overview of knowledge economy in the Arab region and contributes to recently published research studies that aim to improve understanding of the development and performance of knowledge economy in the developing countries.[1] This paper addresses the following questions: Does the knowledge economy exist in the Arab region? Does the economic structure affect the knowledge indicators in the Arab region? How important is the development of knowledge indicators in the Arab region?

We examine three hypotheses: The first hypothesis argues that the knowledge economy exists in the Arab region but coincides with substantial knowledge gap compared to other world regions. This hypothesis implies that the Arab region has manifestly lagged far behind other world regions in terms of indicators related to knowledge economy. We examine the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region. We examine the third hypothesis concerning the stagnation or slow development in the trend of the major knowledge indicators in the Arab region.

We fill the gap in the Arab literature and present a more comprehensive analysis of the incidence and development of knowledge economy in the Arab region. Different from the conventional view in the literature and earlier studies in the Arab literature (Nour 2011) that use the conventional classification of countries according to income level, an interesting element in our analysis is that we use a different classification based on the structure of the economy to examine the knowledge economy in the Arab region. We believe that the selection of this criterion seems quite consistent with the well-known stylized facts and widely used standard classification of Arab countries according to their reliance on natural resources. The selection of this criterion seems sound since the knowledge economy are often linked to both the resources directly devoted to knowledge development and also to the whole economic structure that supports knowledge development. Moreover, we use recent and update data and provide a more updated study compared to few earlier studies on the knowledge economy in the Arab region (Nour 2011). We fill the gap in the Arab literature by explaining the relationship between knowledge economy and structure of the economy in the Arab region and the observed knowledge gap in the Arab region. Moreover, we support the efforts aim to enhance knowledge economy and institutions necessary for building knowledge economy in the Arab region. Moreover, we

[1] The Arab region is composed of 22 countries, including Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Mauritania, Morocco, Oman Occupied Palestine Territories, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, and Yemen.

investigate the recent development of knowledge indicators and knowledge economy index in the Arab region compared to other world regions.

Regarding research method, we use the descriptive and comparative methods of analysis. Similar to the studies in the literature, we define knowledge as decomposed of tacit knowledge and codified knowledge. We define tacit knowledge by the percentage share of high skilled people in total population, and we define tacit knowledge by tacit skills, which we define by both enrollment in tertiary education and the number of researchers or full-time equivalent researchers (FTER). We define codified knowledge by embodied knowledge distributed in many aspects including total spending on education and R&D. Codified knowledge is calculated as a total of the share of public spending on education and R&D spending as percentage of GDP. In addition, we use several variables and many other indicators in relation to the components of knowledge, such as the number of publications and scientific and technical journal articles, patents, and average schooling years across Arab countries. Moreover, we use other indicators such as knowledge index (KI) and knowledge economy index (KEI).

The rest of this paper is organized as follows: "Conceptual Framework and Literature Review" presents the conceptual framework and literature review. "General Socioeconomic Characteristics of the Arab Region" shows the general socio-economic characteristics of Arab region. "The Existence of Knowledge Economy and Development of Knowledge-Related Indicators in the Arab Region" discusses the existence of knowledge economy in the Arab region compared to the other world regions. "Knowledge Index and the Knowledge Economy Index" explains the major development in knowledge economy over the period (1995–2012) in the Arab region. Finally, "Conclusions" provides the conclusions and policy recommendations.

Conceptual Framework and Literature Review

In the recent years, the world economy is witnessing a fundamental structural change driven by both globalization and the revolution in information and communication technology (ICT) leading to a new economic system. The new economic system is characterizing by increasing significance of knowledge, the rapid diffusion of ICT, productivity growth and intensified competition and globalization trend. Hence, the role of knowledge has intensified and attracted a great deal of interest at the international level. More recent literature raised a debate on the interaction between these elements and the various influences or opportunities they might create for the new economy for both developed and developing countries.

Knowledge creation, accumulation, and acceleration intensified the pace of scientific and technological progress and have been at the heart of economic growth literature. The ability to invent, innovate, and create new knowledge and new ideas that are then either embodied in machines, products, processes, and organizations, or disembodied/codified in blueprints and operating instructions, has motivated the successful transfer of technology and enhanced economic development. The definition of knowledge in the literature is based on the distinction between codified and tacit knowledge (Dasgupta and David 1994) and between embodied flows of knowledge (knowledge incorporated in to machinery and equipment) and disembodied flows of knowledge (the use of

knowledge transmitted through scientific and technical literature, consultancy, education systems, movement of personnel, etc.). Often, investment in knowledge refers to public spending on education, training, R&D, and ICT. Moreover, in analyzing knowledge as specific input to innovative activities, economists on the one hand view knowledge as a public good generated via R&D activities that generate spillover and thus increasing returns (Romer 1994; Grossman and Helpman 1994). On the other hand, modern innovation theory views knowledge creation in a much more diffuse way. For instance, Langlois (2001) argues that: "knowledge, whether tacit or codified, is embodied in institutions and artefacts that make its transfer possible even in the absence of any codification." Moreover, Smith (2002) argues that:

> R&D is but one component of knowledge and innovation expenditures, and by no means the largest. Because, R&D data tend to either overemphasize the discovery of new scientific or technical innovations, or to exclude a wide range of activities that involve the creation or use of new knowledge in innovation. Thus, knowledge rests not only on discovery and R&D but also on learning, external environment (network) of the firm, non- R&D expenditures such as training, market research, design, trail production and tooling up and IPR costs. In addition to capital expenditure, which is a key mode of 'embodied' knowledge spillover from the capital good sector to using industries.

Drucker (1998) argues that "Knowledge has become the key economic resource and the dominant—and perhaps the only—source of competitive advantage." Powell and Snellman (2004) define the knowledge economy as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. The key component of a knowledge economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources.[2] Moreover, David and Foray (2001) discuss knowledge-based communities as agents of economic change. They argue that knowledge-based activities emerge when people, supported by information and communication technologies, interact in concreted efforts to co-produce (i.e., create and exchange) new knowledge, new information, and communication technologies that are intensively used to codify and transmit the new knowledge. Therefore, a knowledge-intensive community is one wherein a large proportion of members are involved in the production and reproduction of knowledge. David and Foray (2001) argue that access to the knowledge economy is highly limited and that there are great disparities between countries and social groups. According to the Organisation for Economic Co-operation and Development (OECD) (1996), the term "knowledge-based economy" results from a fuller recognition of the role of knowledge and technology in economic growth. Knowledge, as embodied in human beings (as "human capital") and in technology, has always been central to economic development. But only over the last few years has its relative importance been recognized, just as that importance is growing. The OECD economies are more strongly dependent on the production, distribution, and use of knowledge than ever before. The OECD economies are increasingly based on knowledge and information.[3]

[2] See Powell and Snellman (2004), p. 199.
[3] See OECD (1996), pp. 3, 9.

The World Bank uses KI and KEI to compare knowledge across the world countries. According to the World Bank, the KI measures a country's ability to generate, adopt, and diffuse knowledge. This is an indication of overall potential of knowledge development in a given country. Methodologically, the KI is the simple average of the normalized key variables in three knowledge economy pillars—education and human resources, the innovation system, and ICT. The KEI takes into account whether the environment is conducive for knowledge to be used effectively for economic development. It is an aggregate index that represents the overall level of development of a country or region toward the knowledge economy. The KEI is calculated based on the average of the normalized performance scores of a country or region on all four pillars related to the knowledge economy—economic incentive and institutional regime, education and human resources, the innovation system, and ICT. The economic incentive and institutional regime pillar includes tariff and nontariff barriers, regulatory quality, and rule of law. The education and human resources pillar includes average years of schooling, secondary enrollment, and tertiary enrollment. The innovation system pillar includes royalty and license fee payments and receipts, patent applications granted by the US Patent and Trademark Office, and scientific and technical journal articles. ICT pillar includes fixed telephones, mobile, and Internet users.[4,5]

According to the World Bank (2011):

> the application of knowledge is now recognized to be one of the key sources of growth in the global economy. The term Knowledge Economy (KE) has been coined to reflect this increased importance of knowledge. A knowledge economy is one where organizations and people acquire, create, disseminate, and use knowledge more effectively for greater economic and social development. This 'knowledge revolution' manifests itself in many different ways: there are closer links between science and technology; innovation is more important for economic growth and competitiveness; there is increased importance of education and life-long learning; and more investment is undertaken in intangibles (R&D, software and education) which is even greater than investments in fixed capital. And of course there is the Information and Communication Technologies (ICT) explosion which brings worldwide interdependency and connectivity. Increased importance of knowledge provides great potential for countries to strengthen their economic and social development by providing more efficient ways of producing goods and services and delivering them more effectively and at lower costs to a greater number of people. However, it also raises the danger of a growing 'knowledge divide' [rather than just a 'digital divide'] between advanced countries, who are generating most of this knowledge, and developing countries, many of which are failing to tap the vast and growing stock of knowledge because of their limited awareness, poor economic incentive regimes, and weak institutions. Combined with trade policy liberalization, the knowledge revolution is leading to greater globalization and increased international competition, which is eroding the natural resource and low labor cost advantage of most developing countries. To capitalize on the knowledge

[4] See the World Bank- KEI, 2012: http://siteresources.worldbank.org/INTUNIKAM/Images/KEIindex.jpg

[5] For the purposes of calculating KI and KEI, each pillar is represented by three key variables, see (www.worlbank.org):

revolution to improve their competitiveness and welfare, developing countries need to build on their strengths and carefully plan appropriate investments in human capital, effective institutions, relevant technologies, and innovative and competitive enterprises. Countries such as Korea, Ireland, Malaysia, and Chile illustrate the rapid progress that can be made. Framework for a Knowledge-based Economy consisting of four pillars that help countries articulate strategies for their transition to a knowledge economy: An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship. An educated and skilled population that can create, share, and use knowledge well. An efficient innovation system of firms, research centers, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology. Information and Communication Technologies (ICT) that can facilitate the effective communication, dissemination, and processing of information. Making effective use of knowledge in any country requires developing appropriate policies, institutions, investments, and coordination across the above four functional areas.[6]

Within this framework, the analysis of knowledge economy and their various influences in different economic systems have been an exciting and interesting recent research issues that received increasing interest among economists in both developed and developing countries. Few studies in the Arab literature discuss the knowledge economy (cf. United Nations Development Programme–Arab Human Development Report (UNDP-AHDR) 2003, 2009; Mohammed bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme/Regional Bureau for Arab States (UNDP/RBAS) 2009, 2010–2011). The lack of studies particularly addressing the case of the Arab countries is the major motivation behind this study. Therefore, it might be interesting in this paper to fill the gap in the literature by addressing the status and progress of knowledge economy and knowledge-related indicators in the Arab region compared to other world regions.

General Socioeconomic Characteristics of the Arab Region

Based on the above framework and before examining the existence and development of knowledge economy in the Arab region, in this section it is useful to begin with the general socioeconomic characteristics of Arab region. Table 1 shows the general socioeconomic and development characteristics of the Arab region and world regions as measured by (economic growth (GNI per capita), life expectancy, mean years of schooling, literacy rate, and gross enrollment ratios. Table 1 illustrates the substantial gap between Arab and other world regions in terms of population, standard of economic development as measured by GDP per capita, and human development index (HDI). In general, the Arab region is characterized by low standards of economic development together with high population numbers. According to the

[6] See the World Bank (2011).

Table 1 General socioeconomic characteristics of the Arab region compared to other world regions (2001–2011)

	Population total (millions)	GDP per capita (PPP US$)	Human development index value	Life expectancy at birth (years)	Mean years of schooling (years)	Expected years of schooling (years)	Adult literacy rate (% ages 15 and older)	Gross enrollment ratio		
								Primary (%)	Secondary (%)	Tertiary (%)
	2011	2009	2011	2011	2011	2011	2005–2010	2001–2010	2001–2010	2001–2010
Human development index groups										
Very high human development	1,129.50	35,768	0.889	80	11.3	15.9	..	102.7	99.7	72.9
High human development	972.9	12,861	0.741	73.1	8.5	13.6	93.2	110.3	90.4	49.3
Medium human development	3,545.50	5,077	0.63	69.7	6.3	11.2	81.9	113.3	69.7	20.5
Low human development	1,259.70	1,671	0.456	58.7	4.2	8.3	59.8	96.5	35	6.2
Regions										
Arab states	360.7	8,256	0.641	70.5	5.9	10.2	72.9	95	66.5	25.8
East Asia and the Pacific	1,978.50	6,227	0.671	72.4	7.2	11.7	93.5	112.3	76.9	24.9
Europe and Central Asia	480.5	14,244	0.751	71.3	9.7	13.4	98	98.5	90.7	57.1
Latin America and the Caribbean	591.2	10,739	0.731	74.4	7.8	13.6	91	116.8	90.7	42.7
South Asia	1,728.50	3,368	0.548	65.9	4.6	9.8	62.8	109.8	55.9	13.1
Sub-Saharan Africa	877.6	2,181	0.463	54.4	4.5	9.2	61.6	100.2	35.3	5.9
Least developed countries	851.1	1,379	0.439	59.1	3.7	8.3	59.2	99.6	35.6	5.7
Small island developing states	53.2	5,241	0.64	69.6	7.3	10.8	..	95.1	76.9	51.6
World	6,974.00	10,715	0.682	69.8	7.4	11.3	80.9	106.9	68.4	27.6

The World Bank and UNDP Human Development Report classify world countries differently according to income level. We use the World Bank classification of economies that puts the majority of the Arab countries in the middle-income and low-income categories or groups of economies (UNDP 2011)

PPP purchasing power parity

World Bank classification of economies, the majority of the Arab countries are classified among medium-income economies. In addition, according to the classification of the UNDP HDI, the average GDP per capita for the Arab region is classified among the world medium-income group and is, on average, lower than for those of the other world regions. Furthermore, the other HDI components are average life expectancy, mean years of schooling, expected years of schooling, literacy rate, and gross enrollment ratios for the Arab region on average, lower than for those of the world countries. Moreover, the Arab region is comparable to other developing countries and regions in terms of the widespread and high rates of both unemployment and poverty. This general socioeconomic development characteristic of the Arab region has serious implication on the development of knowledge economy and indicators as we explain in the next section.

Despite the great heterogeneity in economic and development indicators/performance across the Arab countries, it is evident that none of the Arab country presents a sufficient, coherent, and convincing performance in terms of knowledge economy, while the rich Arab Gulf oil economies are leading the Arab states in terms of GDP per capita, human development indicators, spending, and diffusion of ICT. They fail to present a coherent and convincing performance in terms of knowledge economy due to unpredictable and volatile trend in growth rates coupled with increasing unemployment, insignificant economic impacts of ICT,[7] and failure to attract FDI, to promote efficient educational system, local technological capabilities, skills, and heavy dependence on foreign technologies.

The Existence of Knowledge Economy and Development of Knowledge-Related Indicators in the Arab Region

Based on the above background, this section discusses the research questions and hypotheses concerning the existence of knowledge economy and development of knowledge-related indicators in the Arab region. First, we discuss the existence of knowledge economy in the Arab region; next, we investigate the development of knowledge-related indicators in the Arab region using the definition of tacit and codified sources of knowledge. We define tacit sources of knowledge by tacit skills, which we define by the percentage share of high skilled people in total population, enrollment in tertiary education, and the number of researchers or FTER. We define codified sources of knowledge by embodied knowledge distributed in many aspects including spending on education and R&D that measured by the share of public spending on education and R&D as percentage of GDP. In addition, we use other knowledge-related indicators, such as the literacy rate, average schooling years, the number of publications, and scientific and technical journal articles and patents across Arab countries. Moreover, we use other indicators, particularly, the World Bank knowledge index and knowledge economy index.

[7] See Nour (2002) for evidences of insignificant impacts of ICT in developing countries.

Tacit Knowledge

Starting with tacit sources of knowledge, Table 1 illustrates the substantial gap between Arab region and world regions in terms of several indicators related to tacit knowledge such as gross enrollment ratios in primary, secondary, and tertiary education; mean years of schooling; and literacy rate. We observe that the literacy rates have been insufficient for the spread of knowledge within the Arab region; for instance, Fig. 1 illustrates that despite the relative increase in literacy rates; however, the illiterate population is accounting for 13 % of total Arab population in 2011. The illiteracy rates for the Arab region remain higher than the World rate, LCD's, Asia, Latin America, and the Caribbean and seem comparable to those of Africa and Sub-Saharan Africa. The shortage and gap related to tacit sources of knowledge also appears in terms of the population with at least secondary education; for instance, the share of population with at least secondary education in total population (% ages 25 and older) represents only 38.4 % in the Arab region, compared to 65.1 % in Europe and Central Asia and 73.8 % in OECD; this result implies substantial gap in tacit sources of knowledge between Arab region and developed world regions (see Fig. 2). The shortage and gap between the Arab region and advanced world countries in tacit sources of knowledge also appears in terms of educational attainment levels (% of the population aged 25 and above) (2000–2007). For instance, in the Arab region, the share of population with high education attainment represents only 10 % of Arab population, while the majority (90 %) of Arab population possesses either medium or low educational attainment, particularly near to three quarter of Arab population possesses low educational attainment (see Fig. 3). The gap in tacit sources of knowledge between the Arab and world regions also appears in terms of tertiary education gross enrollment ratio

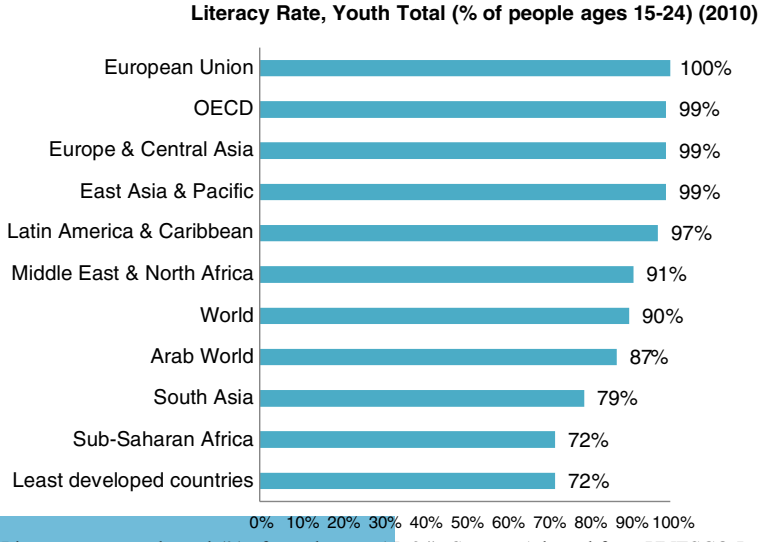


Fig. 1 Literacy rate, youth total (% of people ages 15–24). Source: Adapted from UNESCO Institute for Statistics (2012)

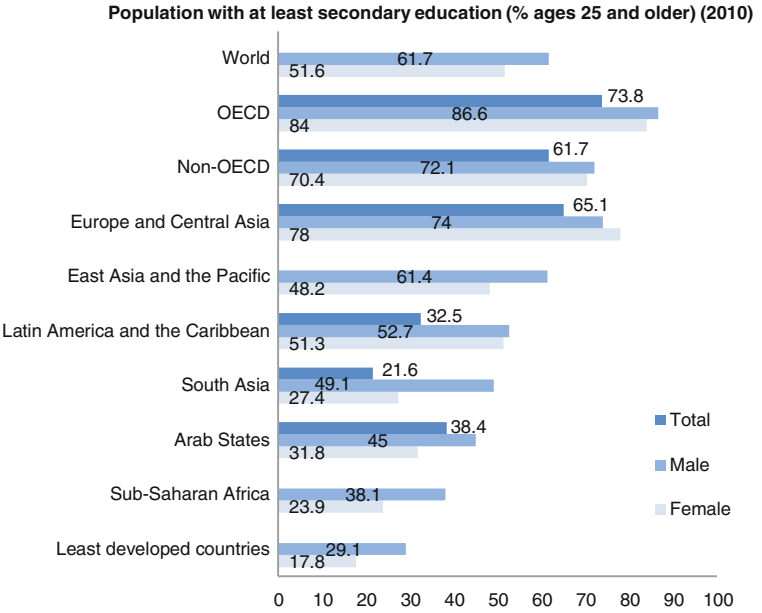


Fig. 2 Population with at least secondary education (% ages 25 and older) defined by gender. Source: Adapted from UNDP Human Development Report 2010, pp. 160, 196

(in percent) over the period (2008–2011). For instance, in 2011, tertiary education gross enrollment ratio (in percent) in the Arab region is only 23.11 % which

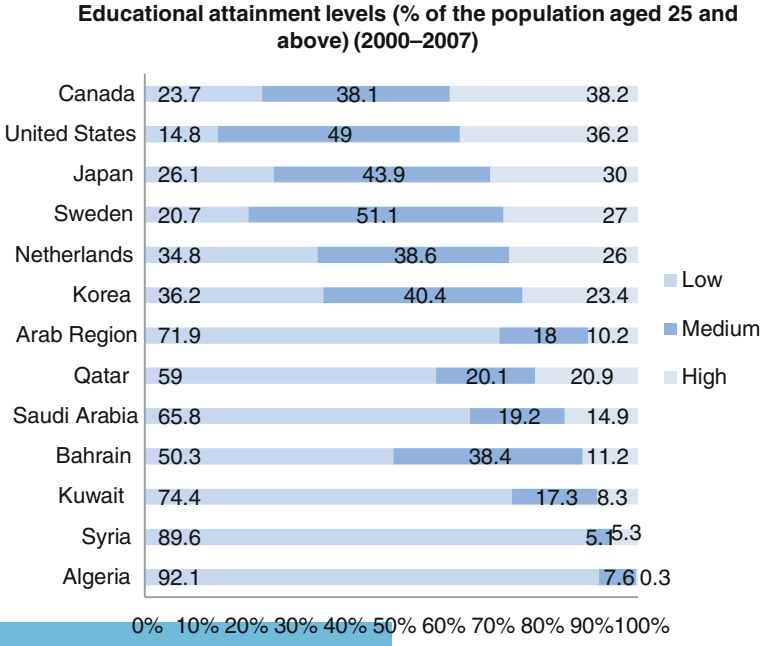


Fig. 3 Educational attainment levels (% of the population aged 25 and above) (2000–2007). Source: Adapted from UNDP Human Development Report 2009, pp. 199–200

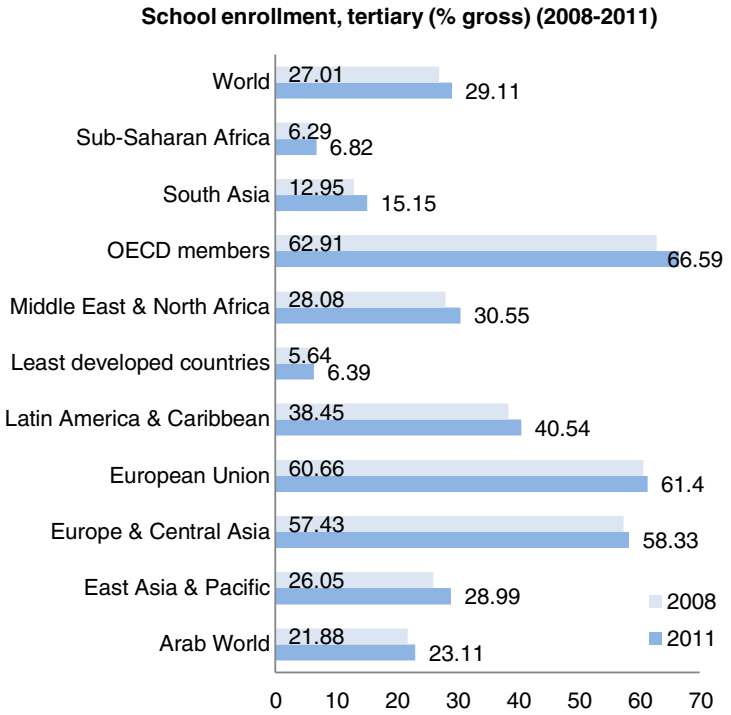


Fig. 4 School enrollment, tertiary (% gross) over the period (2008–2011). Source: Adapted from UNESCO Institute for Statistics (2012)

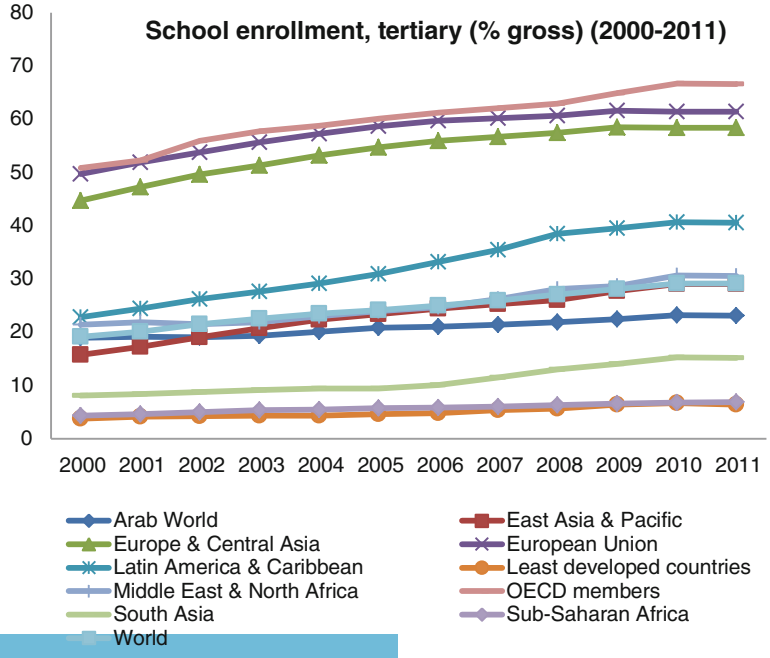


Fig. 5 School enrollment, tertiary (% gross) over the period (2008–2011). Source: Adapted from UNESCO Institute for Statistics (2012)

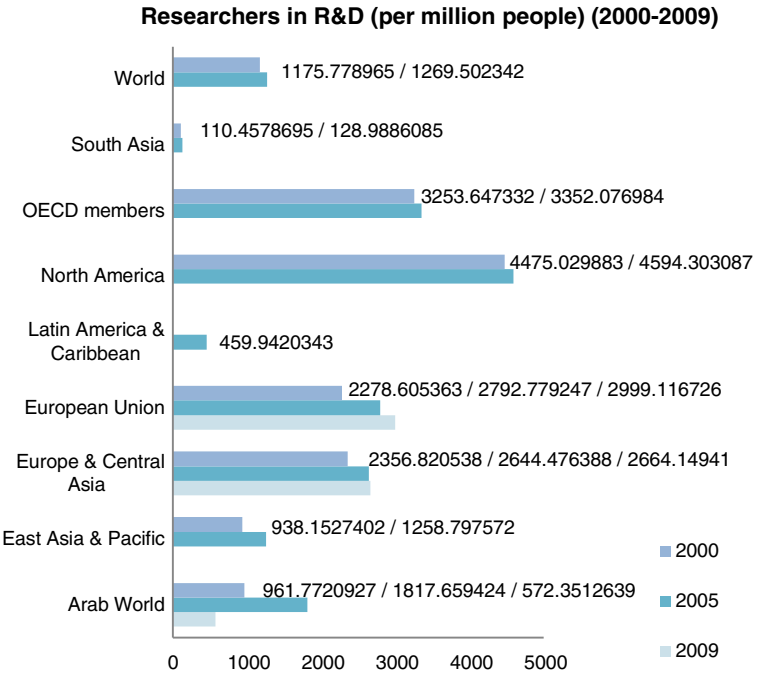


Fig. 6 Researchers in R&D (per million people) (2000–2009). Source: Adapted from UNESCO Institute for Statistics (2012)

falls behind the standard rates of tertiary education gross enrollment ratio (in percent) in the OECD, European Union, Europe and Central Asia, Latin America and Caribbean, MENA countries, World, and the East Asia and the Pacific, which account for 66.59, 61.4, 58.33, 40.54, 30.55, 29.11, and 28.99 %, respectively (see Figs. 4 and 5). This result concerning the gap in tacit sources of knowledge that appears in terms of tertiary education gross enrollment ratio is consistent with the earlier results in the Arab literature that find that on average the share of gross enrollment ratio in tertiary education; the share of tertiary students in science, math, and engineering; school life expectancy and average skill indices measured by Harbison–Myers index; technical enrollment index; and engineering enrollment index for the Arab region imply that the Arab region is lacking sufficient tacit knowledge and skills and is lagging far behind not only in advanced countries but also in developing countries (cf. Nour 2011).[8] The gap in tacit knowledge

[8] Harbison–Myers index is the sum of secondary enrolment and tertiary enrolment times 5, both as % of age group. Technical enrolment index is tertiary total enrolment (times 1,000) plus tertiary enrolment in technical subjects (times 5,000), both as % of population. Engineering skills index is the same as with the previous index, with tertiary enrolments in engineering instead of enrolment in technical subjects.

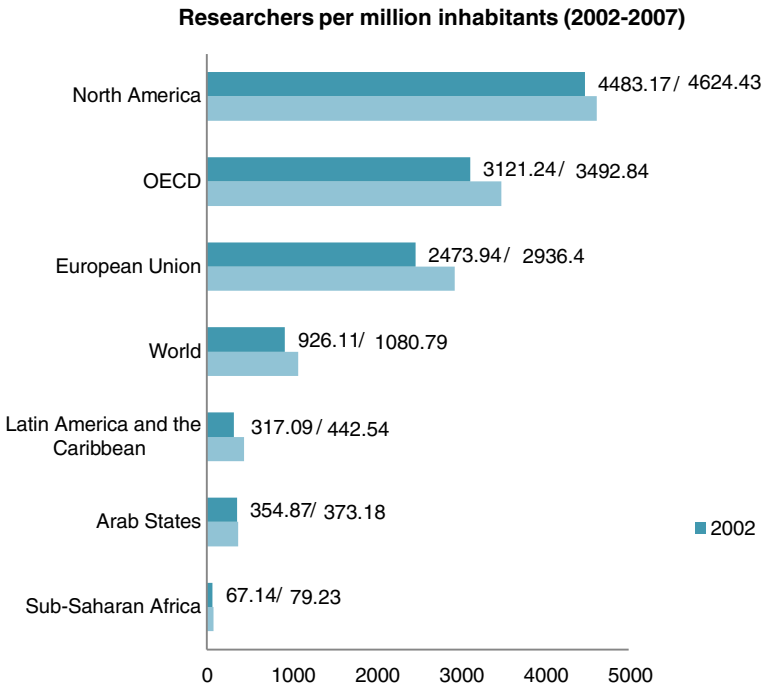


Fig. 7 Researchers in R&D (per million inhabitants) (2002–2007). Source: Adapted from UNESCO Institute for Statistics (2012)

between the Arab region and advanced world countries also appears from the number of total researchers, FTER, and total researchers per million inhabitants (see Figs. 6 and 7). These results support part of our first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions.

Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge-related indicators. The poor progress in indicators related to tacit sources of knowledge in the Arab region appears from the observed poor progress and increasing trend in terms of gross enrollment in tertiary education over the period (2008–2011), total number of researchers in R&D (per million inhabitants) over the period (2002–2007), and the declining trend in terms of total number of researchers in R&D (per million people) over the period (2000–2009). These results support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region

We find that the knowledge indicators show considerable variation across the Arab countries based on the classification according to the structure of the economy. For instance, the variation in tacit sources of knowledge appears in terms of the share of population with at least secondary education in total population that account for 38.4, 51.98, 36.73, 25.9, and 11.5 % for all Arab states, oil economies, diversified economies, mixed oil economies, and primary export economies, respectively. Moreover, the share of population with at least secondary education in total population (% ages 25 and older) defined by gender implies that the share of population with at least secondary education in total population represents only 45 % for males and 31.8 % for females. These results imply the existence of critical gap in tacit sources of knowledge across the Arab countries and critical gender gap in tacit sources of knowledge in the Arab region. Differences in tacit sources of knowledge across the Arab countries also appear in terms of tertiary education gross enrollment ratio over the period (2008–2011) and number of researchers in R&D (per million people) over the period (2000–2009). For instance, tertiary education gross enrollment ratio in 2011 accounts for 23.11, 57.65, 32.09, 23.13, and 7.32 % for all Arab states, diversified economies, mixed oil economies, oil economies, and primary export economies, respectively (see Figs. 8, 9, 10, and 11). These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

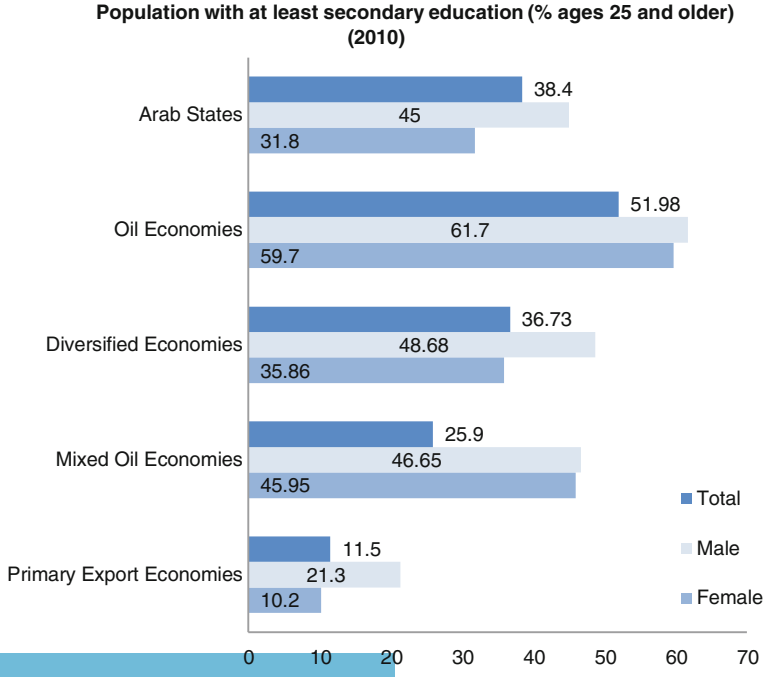


Fig. 8 Population with at least secondary education (% ages 25 and older). Source: Adapted from UNDP Human Development Report 2010, pp. 156–159, 192–195

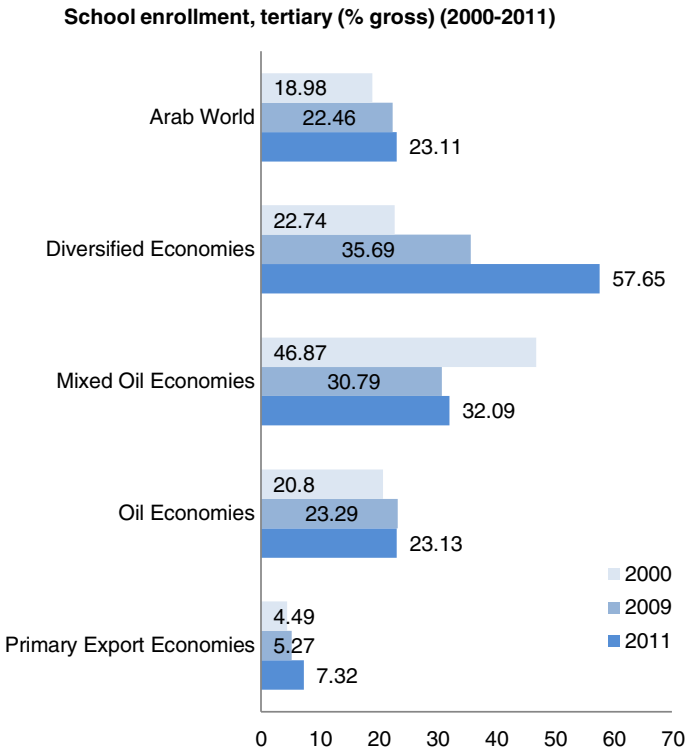


Fig. 9 School enrollment, tertiary (% gross) over the period (2008–2011). Source: Adapted from UNESCO Institute for Statistics (2012)

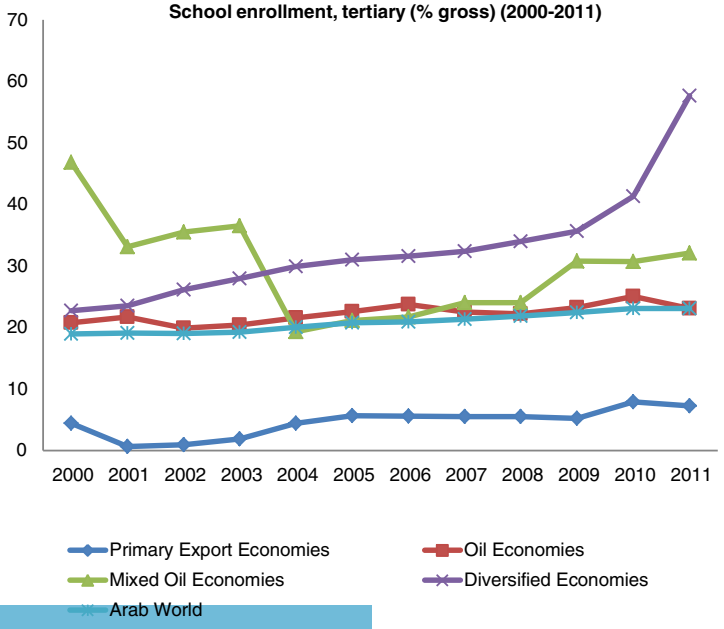


Fig. 10 School enrollment, tertiary (% gross) over the period (2008–2011). Source: Adapted from UNESCO Institute for Statistics (2012)

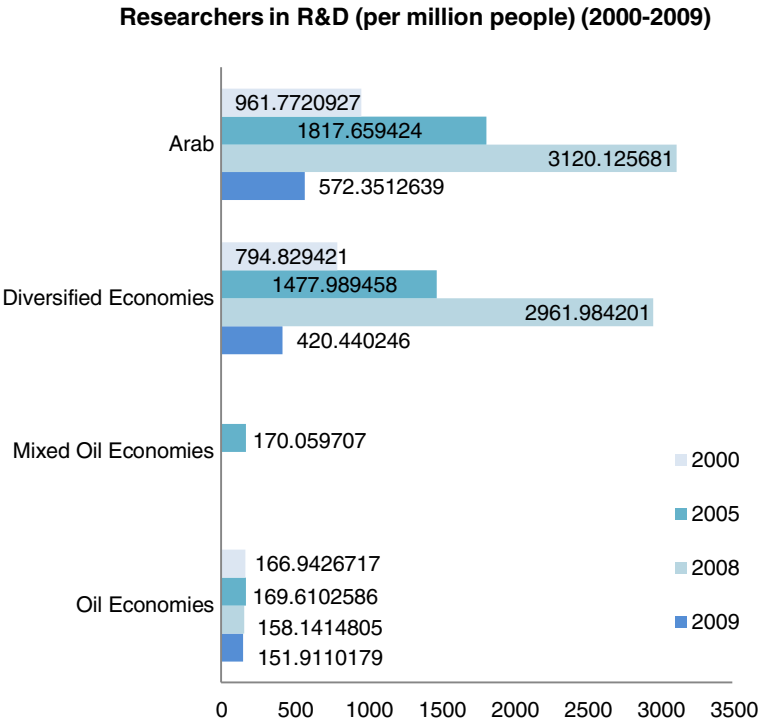


Fig. 11 Researchers in R&D (per million people) (2000–2009). Source: Adapted from UNESCO Institute for Statistics (2012)

Codified Knowledge

The knowledge gap also appears in many indicators related to codified sources of knowledge which is embodied knowledge distributed in many aspects including spending on education, and R&D can be measured by the share of public spending on education and the share of public spending on R&D as percentage of GDP and GERD. For instance, Fig. 12 shows that the share of public spending on R&D as percentage of GDP for all Arab countries together is accounting only for 0.38 of GDP, indicating that the Arab region is lagging far behind the comparable range of the other world regions and the advanced countries and even behind those of the developing countries. Knowledge gap in codified sources of knowledge also appears in terms of public spending on education, for instance, while the share of public spending on education as percentage of government expenditure seems comparable and near to the standard of the world region; however, the share of public spending on education as percentage of GDP is lagging behind and near to a half the standard of the world region. These results imply that the Arab region is lacking sufficient spending on indicators necessary for the promotion of codified sources of knowledge and therefore shows substantial gap in terms of codified sources of knowledge, mainly measured by the share of public spending on education and the share of public spending on R&D as

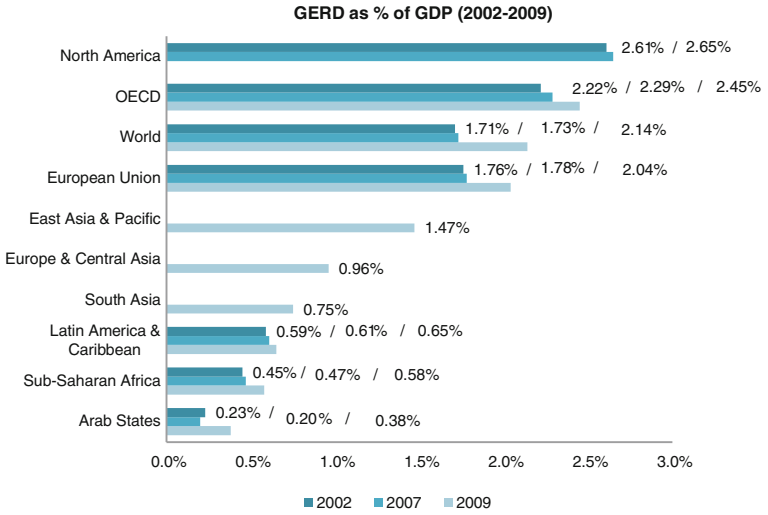


Fig. 12 Research and development expenditure (% of GDP) (2002–2009). Source: Adapted from UNESCO Institute for Statistics (2012)

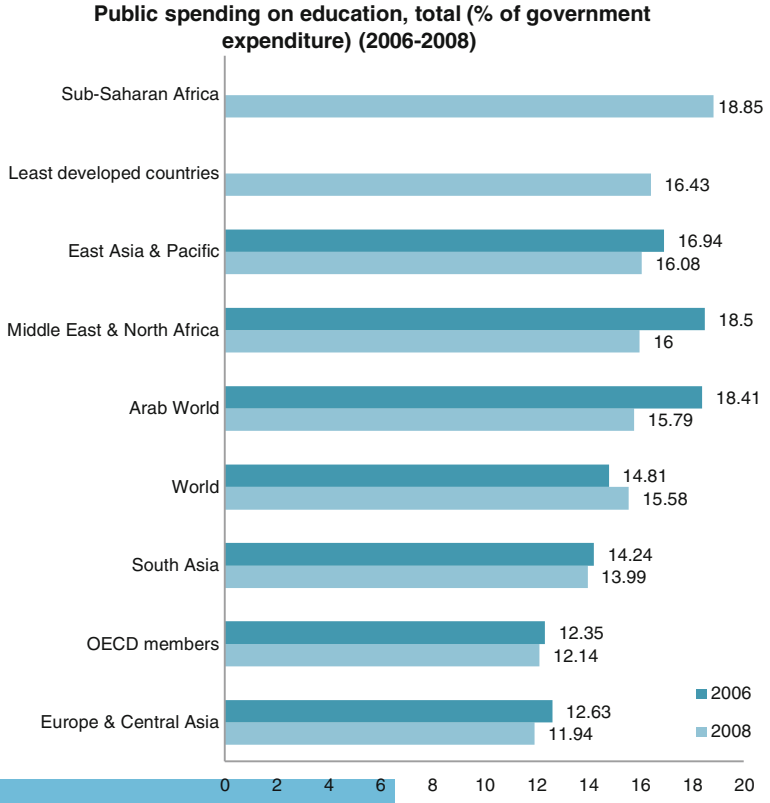


Fig. 13 Public spending on education, total (% of government expenditure). Source: Adapted from UNESCO Institute for Statistics (2012)

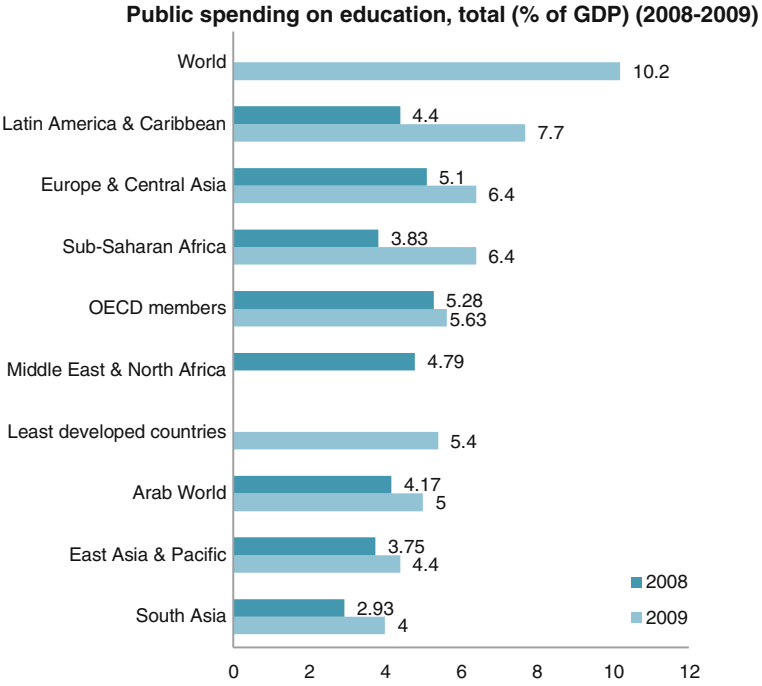


Fig. 14 Public spending on education, total (% of GDP). Sources: Adapted from (a) UNESCO Institute for Statistics (2012) and (b) UNDP Human Development Report 2011, p. 165

percentage of GDP and GERD over the period (2002–2009) (see Figs. 12, 13, and 14). These results support part of our first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions.

Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge-related indicators. The poor progress in indicators related to codified sources of knowledge in the Arab region appears from the observed poor progress and increasing trend in terms of the share of public spending on education as percentage of GDP over the period (2008–2009), the share of public spending on R&D as percentage of GDP and GERD over the period (2002–2009), and even the declining trend in terms of the share of public spending on education as percentage of government expenditure over the period (2006–2008) (see Figs. 12, 13, and 14). These results support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region.

Differences in codified sources of knowledge across the Arab countries also appear in terms of public spending on education over the period (2006–2009) and the share of public spending on R&D as percentage of GDP and GERD over the period (2000–2009). For instance, the share of public spending on R&D as percentage of GDP and GERD in 2009 accounts for 0.38, 0.66, 0.1, 0,

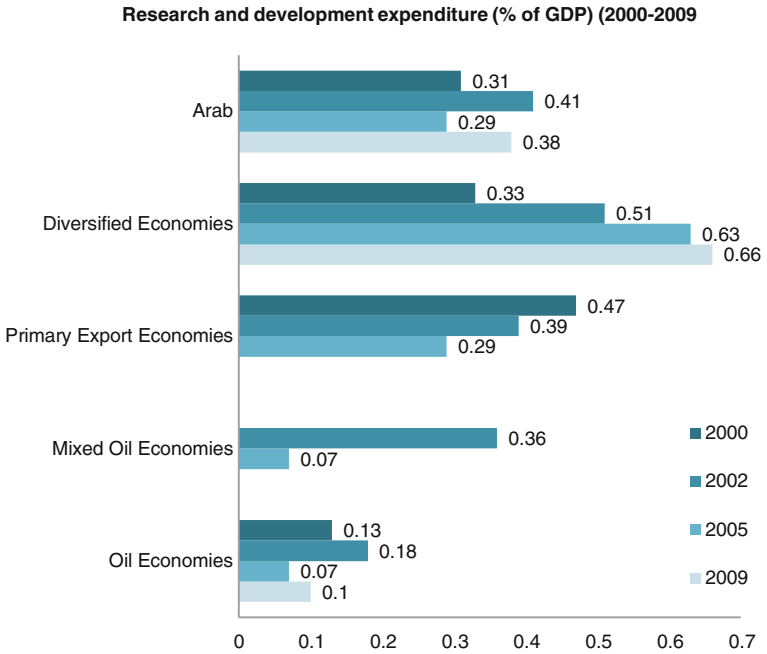


Fig. 15 Research and development expenditure (% of GDP) over the period (2000–2009). Source: Adapted from UNESCO Institute for Statistics (2012)

and 0% for all Arab states, diversified economies, oil economies, mixed oil economies, and primary export economies, respectively. The share of public spending on education as percentage of GDP in 2009 accounts for 4.17, 6.38, 4.34, 4.32, and 3.59 % for all Arab states, primary export economies, mixed oil economies, oil economies, and diversified economies, respectively. The share of public spending on education as percentage of government expenditure in 2009

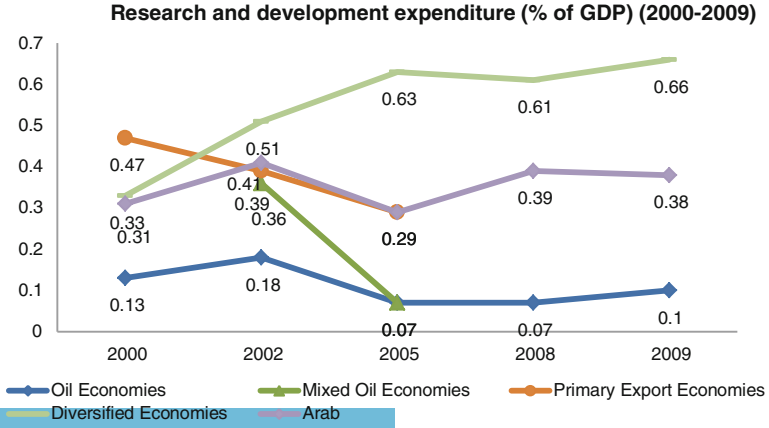


Fig. 16 Research and development expenditure (% of GDP). Source: Adapted from UNESCO Institute for Statistics (2012)

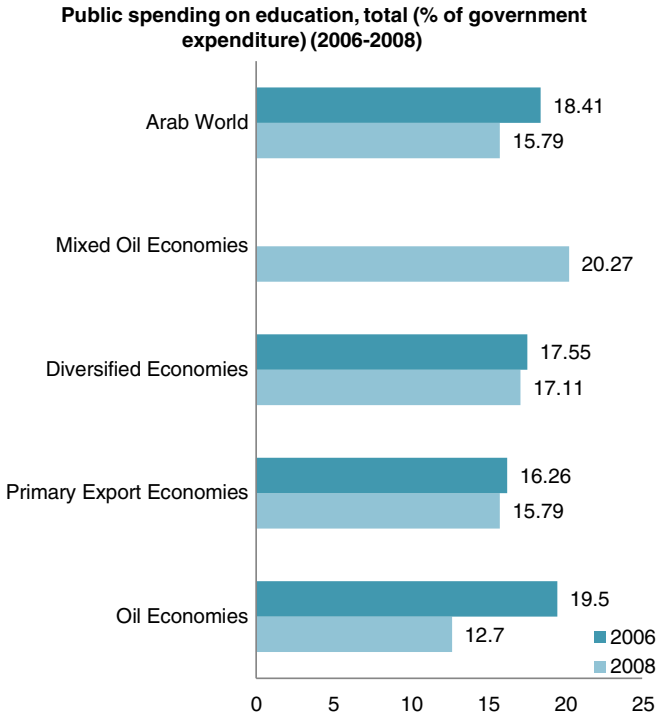


Fig. 17 Public spending on education, total (% of government expenditure). Source: Adapted from UNESCO Institute for Statistics (2012)

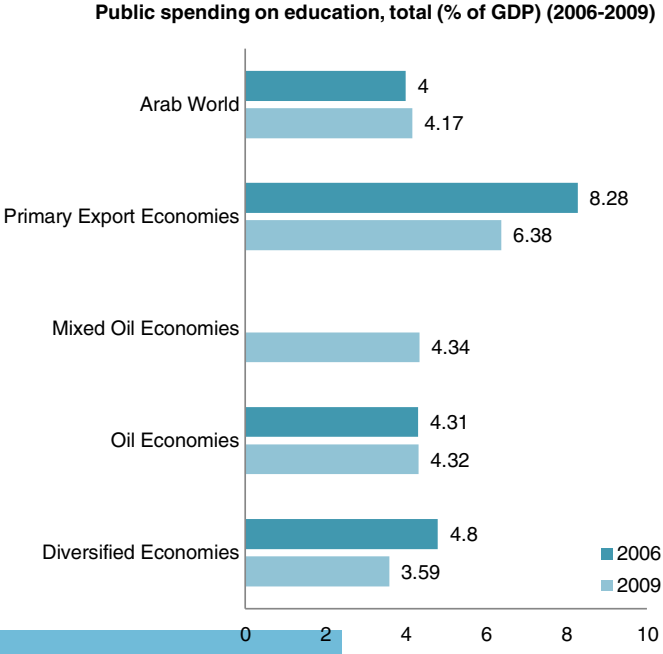
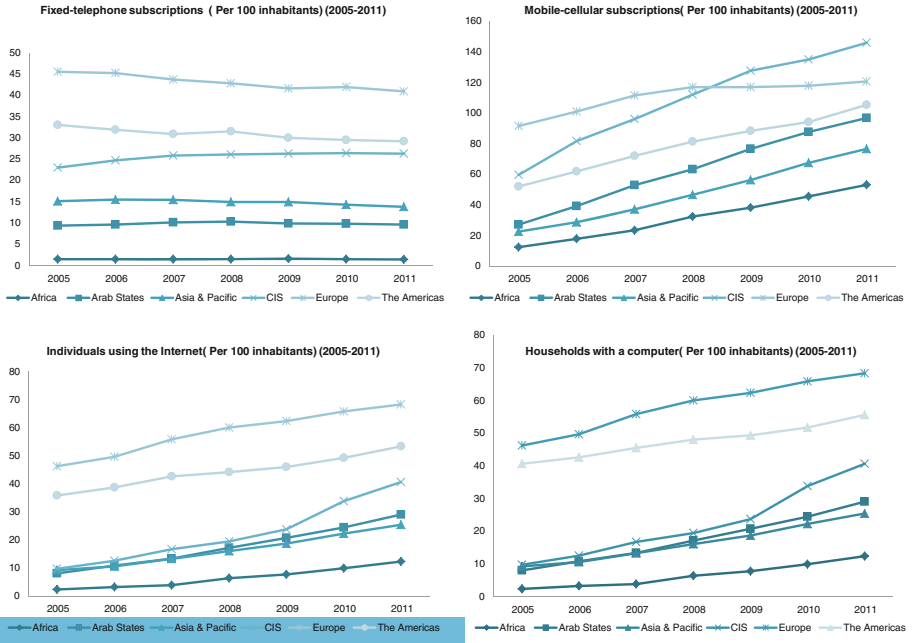


Fig. 18 Public spending on education, total (% of GDP). Source: Adapted from UNESCO Institute for Statistics (2012)

accounts for 15.79, 20.27, 17.11, 15.79, and 12.7 % for all Arab states, mixed oil economies, diversified economies, primary export economies, and oil economies, respectively (see Figs. 15, 16, 17, and 18). These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

The knowledge gap and shortage of codified sources of knowledge also appear in terms of total spending on ICT and the diffusion of ICT defined by the percentage of population accessing the Internet, telephone, and mobile that account for 29.1, 9.6, and 96.9 %, respectively, that imply the gap between the Arab region and other advanced world regions (see Figs. 19–22). This finding is consistent with earlier findings in the Arab literature, which argue that

> when we define the status of ICT spending in the Arab region represented by both Egypt and Saudi Arabia we find them below those of the world countries. For instance, data from WISTA (2002) show that ICT spending and IT variables in both Egypt and Saudi Arabia are lagging far behind the world total and especially the developed countries such as the United States, Japan, United Kingdom and Germany. For instance, while, the total ICT spending in Egypt and Saudi Arabia are ranged between 6,194 and 2,383, the comparable amount for the advanced countries is ranged between 812,635 and 137,726. Moreover, priority of ICT spending in the economy of Egypt and Saudi Arabia when measured by the percentage share of ICT spending in GDP is accounting only for 2.5 % and 3.6 % respectively, while the comparable percentages of the advanced countries is ranged between 9.7 % and 7.6 %. Furthermore, the amount of ICT/



Figs. 19–22 Key ICT indicators for the ITU/BDT regions (totals and penetration rates (per 100 inhabitants). Source: Adapted from International Telecommunication Union 2012. Accessed 16 January 2013

Capita in Egypt and Saudi Arabia is accounting for 36.8 and 309.4, whereas the comparable amount for the advanced countries is ranged between 3,256.2 and 1,880.4. In addition, the Arab states represented by Egypt and Saudi Arabia are lagging behind the world and the advanced countries in terms of total personal computers installed in education, home, business and government (cf. Nour 2002, 2010).

The incidence of knowledge gap between Arab region and world regions appears also in terms of number of patents awarded to firms and individuals and the total number of scientific and technical journal articles as the total numbers for some of the Arab countries fall far below the total of the World, OECD, East Asia and the Pacific, North America, Europe and Central Asia, European Union, Latin America and Caribbean, South Asia, and MENA countries. The low patenting activities indicate low innovative activities and shortage in knowledge-related indicators in the Arab countries compared to advanced countries and developing countries. Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge-related indicators. The poor progress in indicators related to knowledge in the Arab region appears from low progress and increasing trend in terms of scientific and technical journal articles over the period (2000–2009) and patents over the period (2002–2007) (see Figs. 23, 24, and 25). Differences in knowledge-related indicators across the Arab countries also appear in terms of the total scientific and technical journal articles over the period (2000–2009), which is higher for the diversified economies followed by oil economies, mixed oil economies, and primary export economies, respectively-(see Figs. 26 and 27).

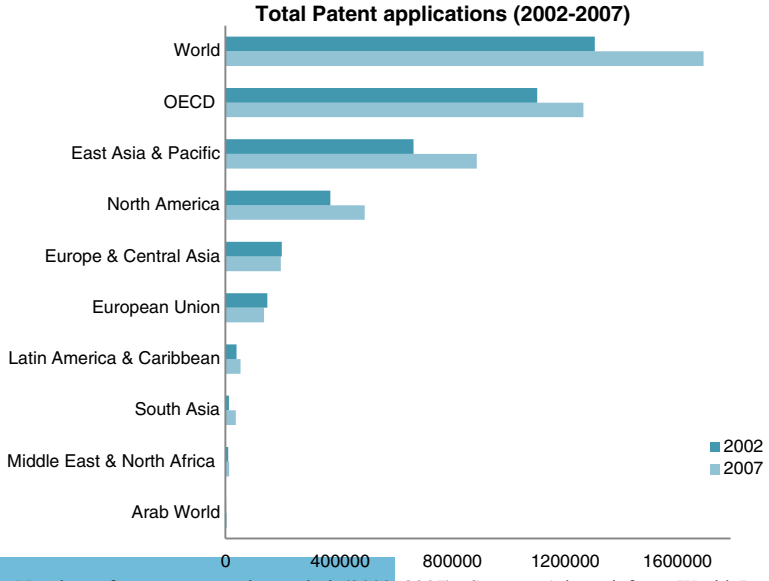


Fig. 23 Number of patents over the period (2002–2007). Source: Adapted from World Intellectual Property Organization (WIPO), World Intellectual Property Indicators

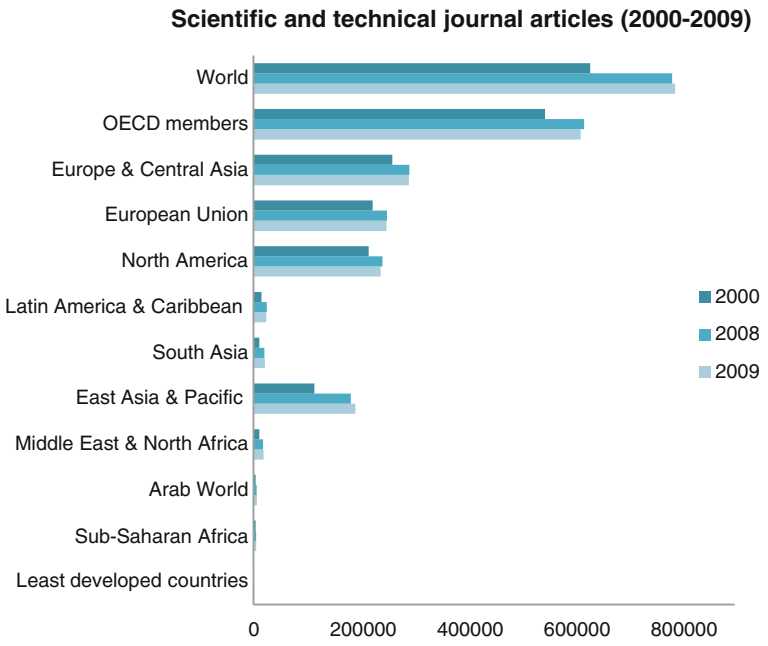


Fig. 24 Scientific and technical journal articles (2000–2009). Source: Adapted from (National Science Foundation, Science and Engineering Indicators 2012)

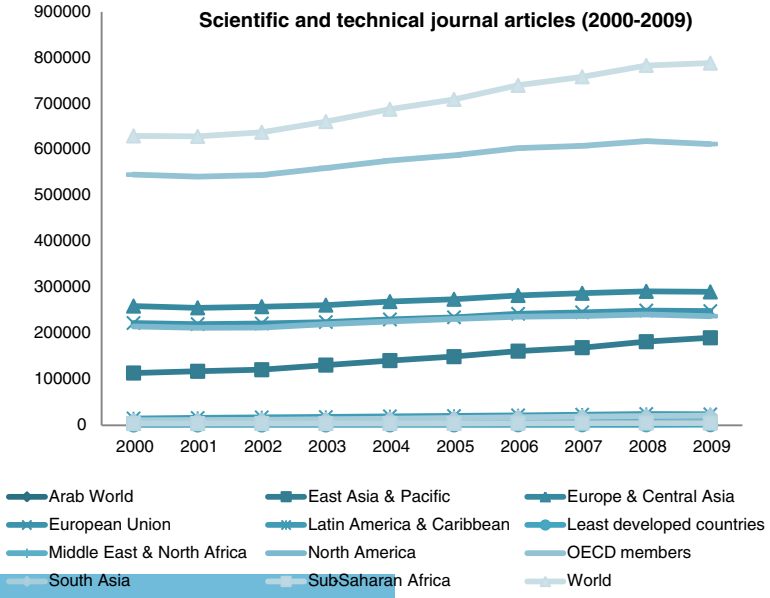


Fig. 25 Scientific and technical journal articles (2000–2009). Source: Adapted from (National Science Foundation, Science and Engineering Indicators 2012)

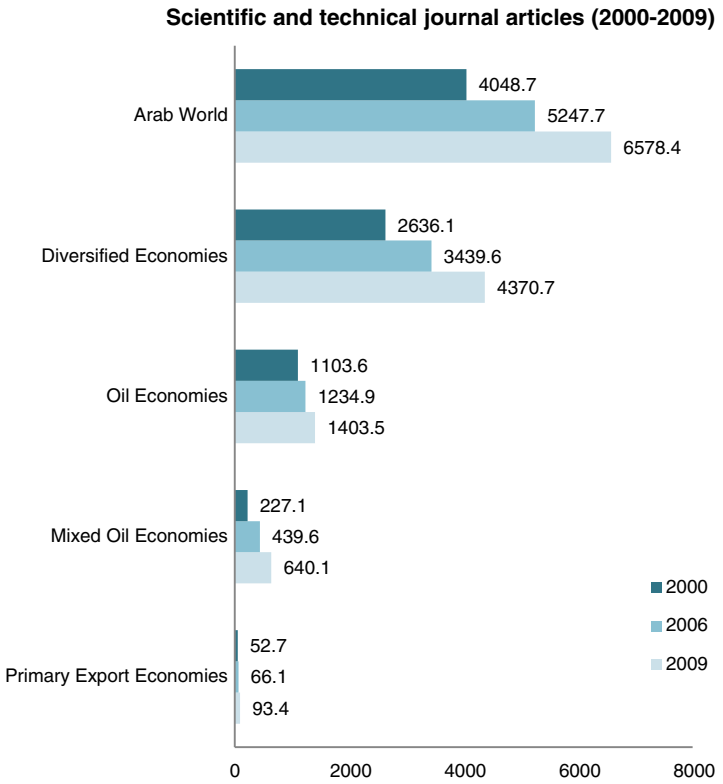


Fig. 26 Scientific and technical journal articles (2000–2009). Source: Adapted from (National Science Foundation, Science and Engineering Indicators 2012)

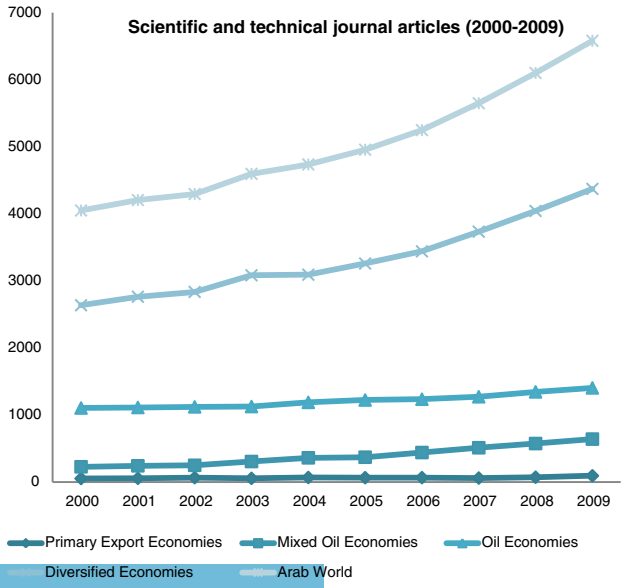


Fig. 27 Scientific and technical journal articles (2000–2009). Source: Adapted from (National Science Foundation, Science and Engineering Indicators 2012)

Knowledge Index and the Knowledge Economy Index

The knowledge gap and shortage of knowledge also appears from the World Bank KI and the KEI index over the period (1995–2012). The poor performance of the Arab region in terms of KI and KEI, mainly the KI, implies the limited ability of the Arab region to generate, adopt, and diffuse knowledge. This is an indication of overall poor potential of knowledge development in the Arab region. The poor KI reflects the poorness with respect to the key variables in three knowledge economy pillars—education and human resources, the innovation system, and ICT. The poor performance in terms of KEI implies that the environment is not conducive for knowledge to be used effectively for economic development and this reflects the constraint in the overall level of development of the Arab region that hinders the movement toward the knowledge economy. The KEI reflects the poor performance of the Arab region on all four pillars related to the knowledge economy—economic incentive and institutional regime, education and human resources, the innovation system,

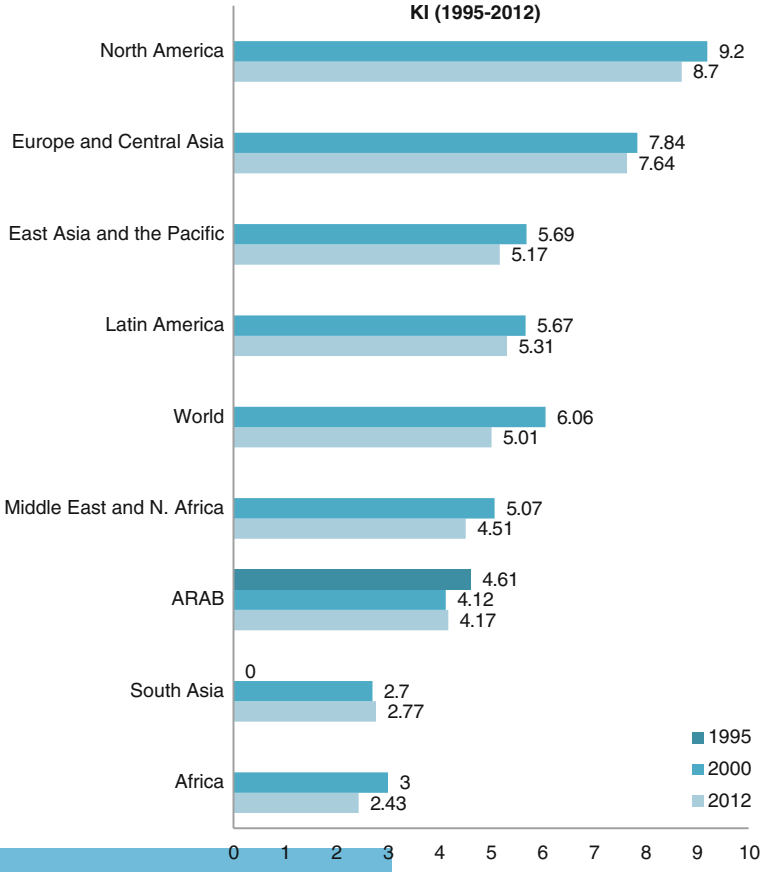


Fig. 28 The KI in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

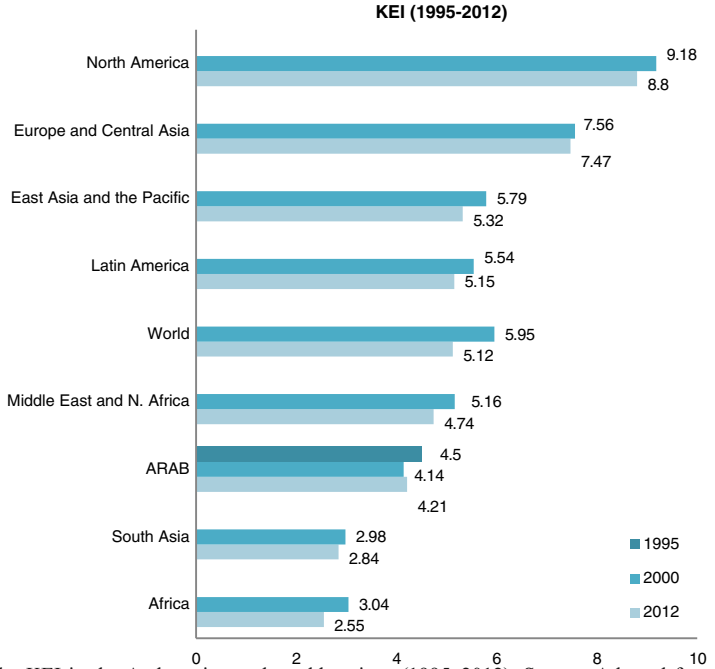


Fig. 29 The KEI in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

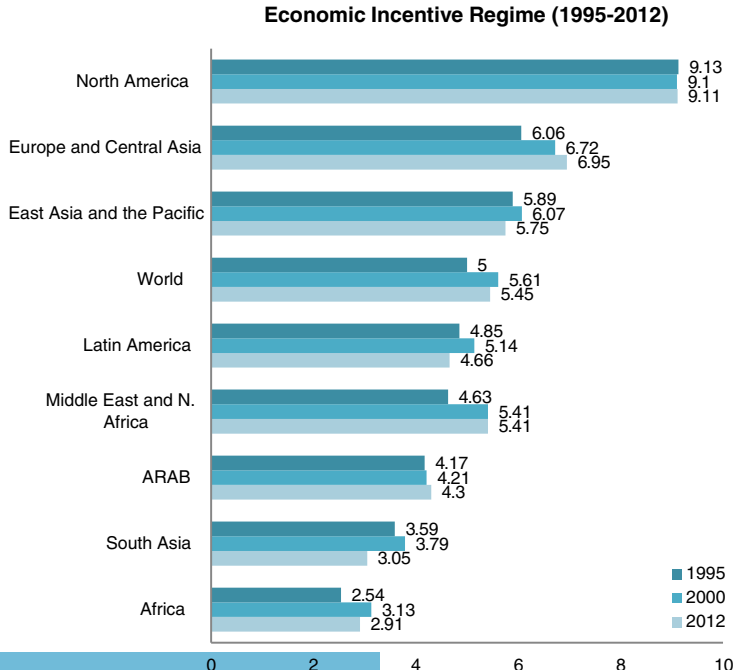


Fig. 30 The economic incentive regime index in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

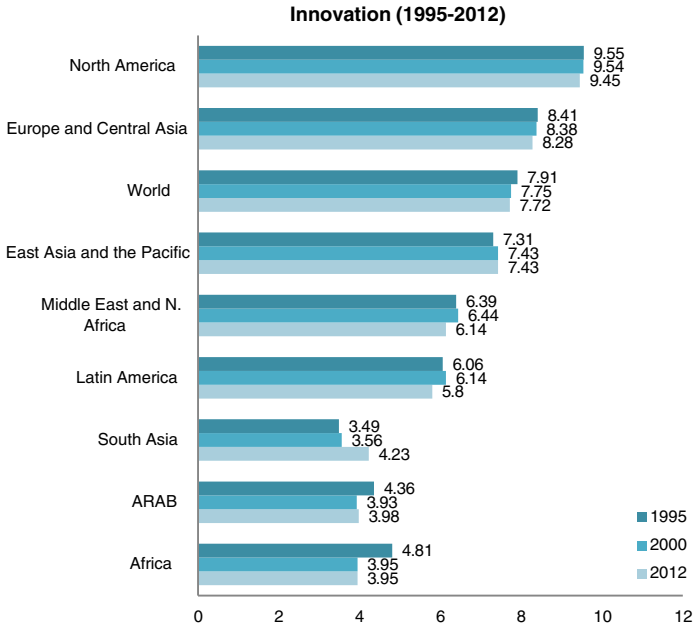


Fig. 31 The innovation index in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

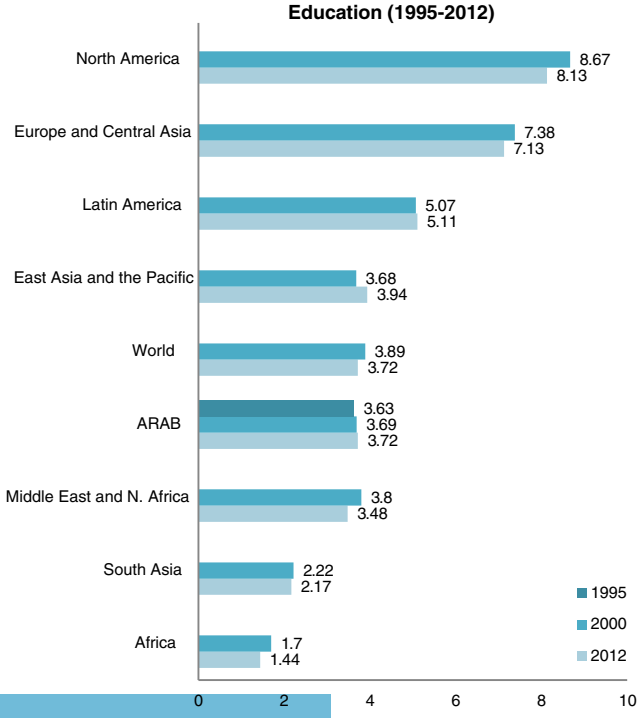


Fig. 32 The education index in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

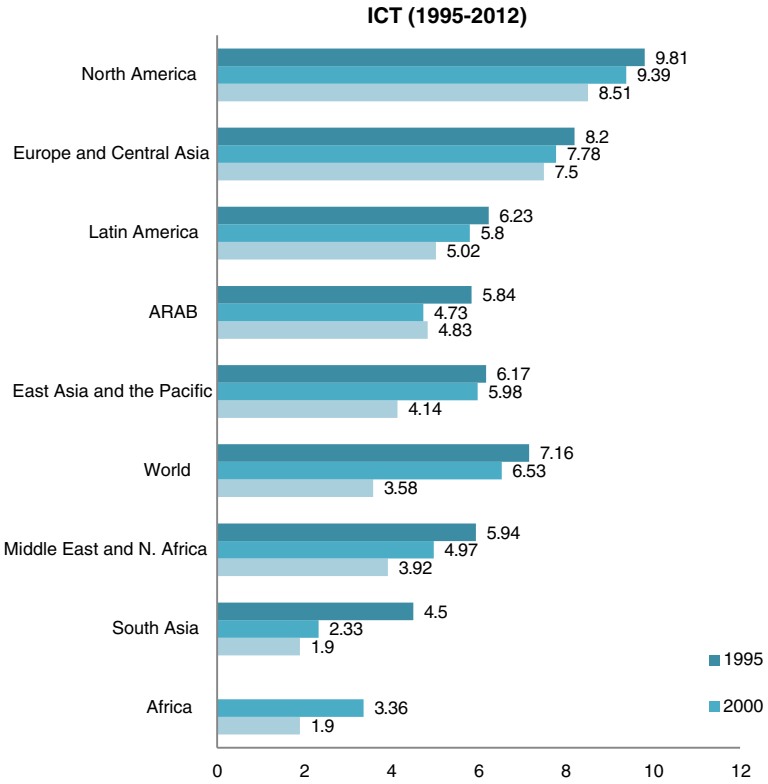


Fig. 33 The ICT index in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)

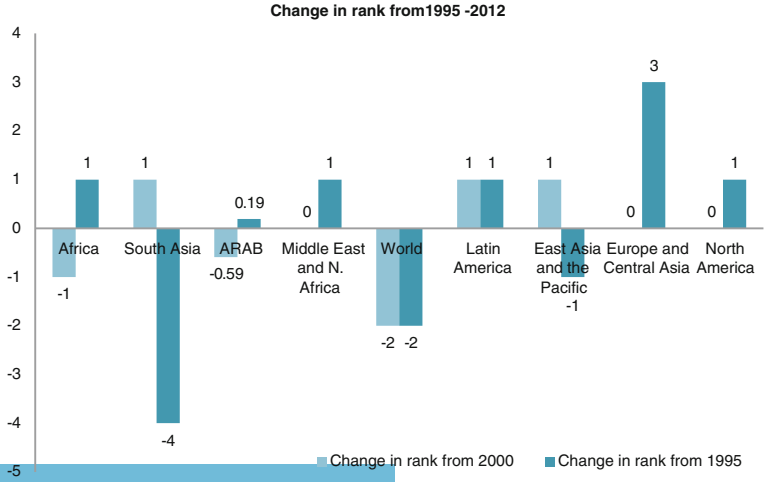
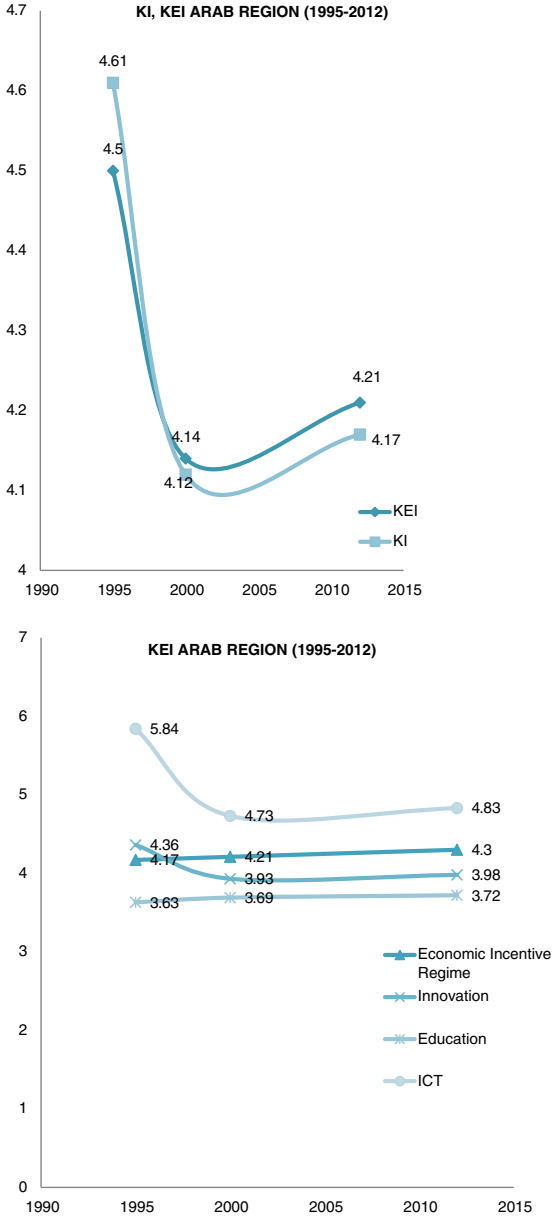


Fig. 34 Change in rank KEI in the Arab region and world regions (1995–2012). Source: Adapted from the World Bank (2012)



Figs. 35–36 The KI and KEI in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

and ICT (see Figs. 28, 29, 30, 31, 32, 33, and 34).[9] The declining trends over the period (1995–2012) and small increasing trend over the period (2000–

[9] For the purposes of calculating KI and KEI, each pillar is represented by three key variables, for more information on these variables see the world bank: www.worlbank.org.

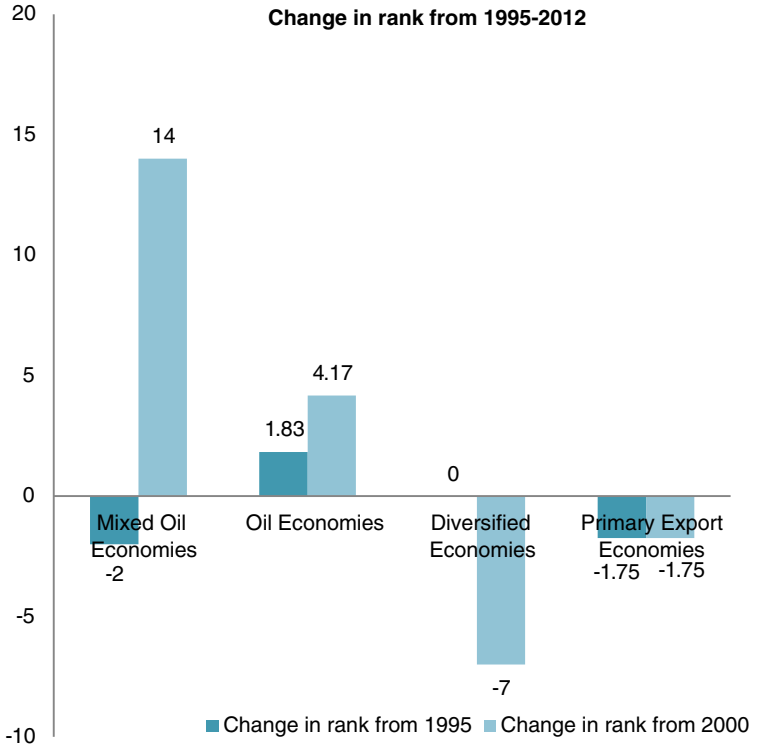


Fig. 37 Change in rank KEI in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

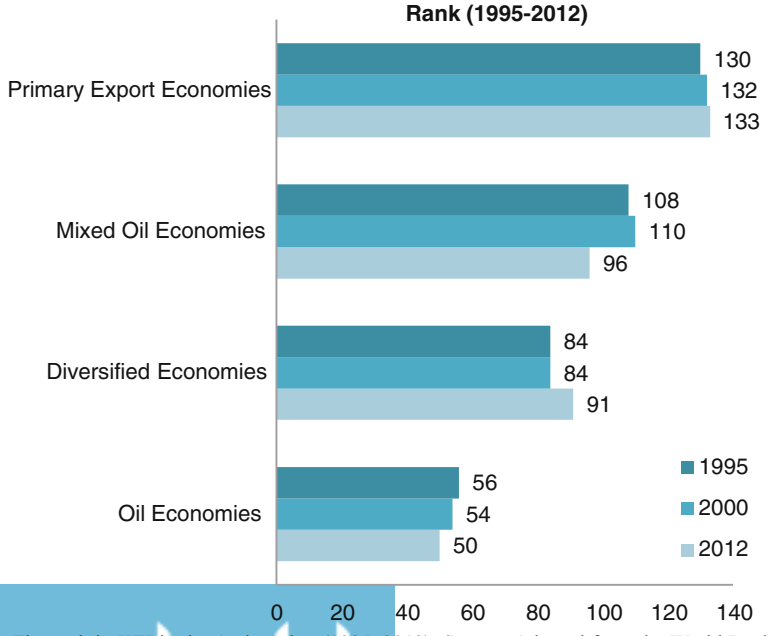


Fig. 38 The rank in KEI in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

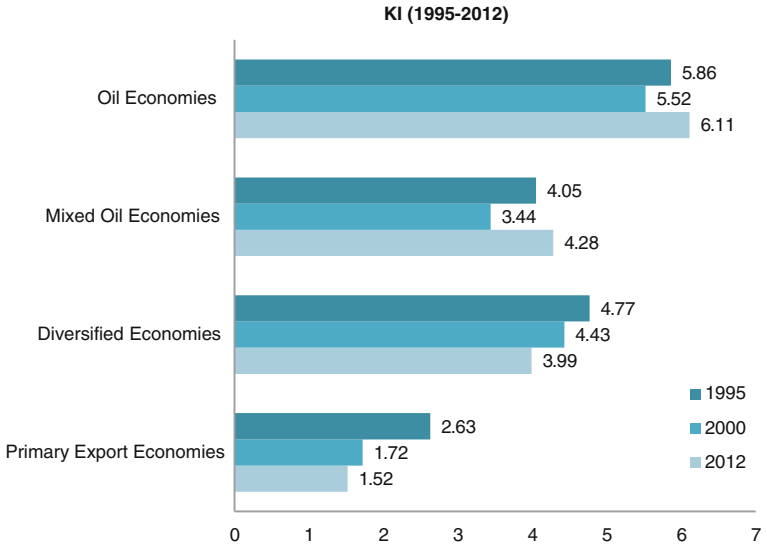


Fig. 39 The KEI in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

2012) imply poor performance of both the KEI and KI. Both the economic incentive and institutional regime and education show small increasing trend over the period (1995–2012). Both innovation and ICT show small decreasing trend over the period (1995–2012), and they show declining trend over the period (1995–2000) that turned into small increasing trend over the period (2000–2012) (see Figs. 35–36). These results support part of our first

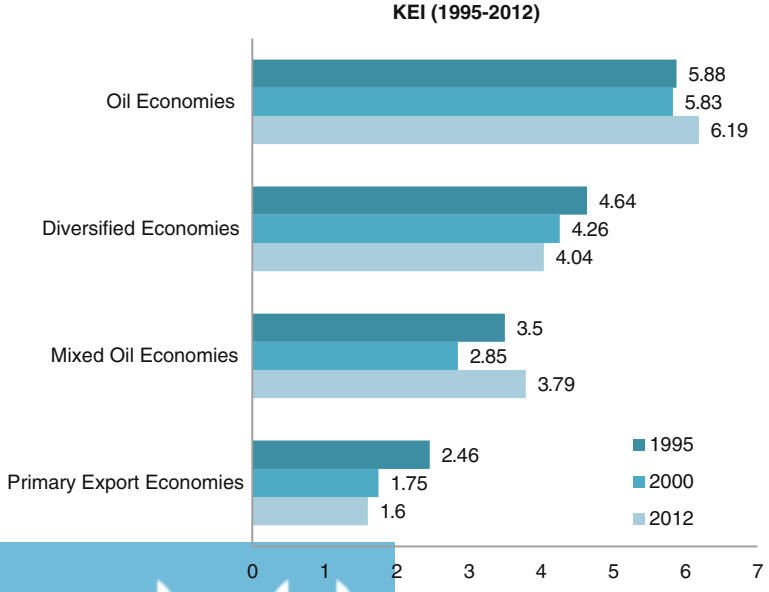


Fig. 40 The KEI in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

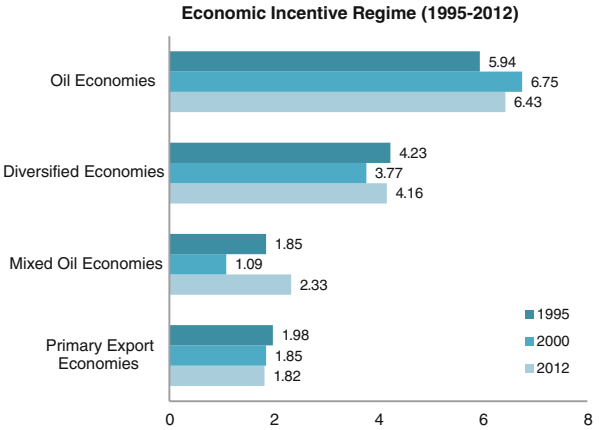


Fig. 41 The economy incentive regime index in the Arab region (1995–2012). Source: Adapted from the World Bank (2012), accessed on October 10, 2012

hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. These results also support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region

Differences in knowledge-related indicators across the Arab countries also appear in terms of KEI and KI and all four pillars related to the knowledge economy—economic incentive and institutional regime, education and human resources, the innovation system, and ICT—over the period (1995–2012), which are higher for the oil economies followed by the diversified economies, mixed oil economies, and primary export economies, respectively (see Figs. 37, 38, 39, 40, 41, 42, 43, and 44). These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

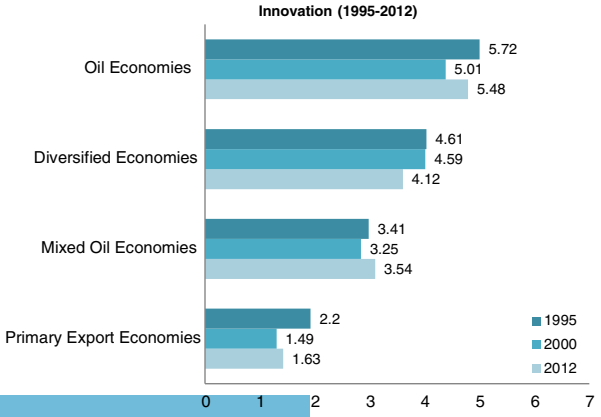


Fig. 42 The innovation index in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

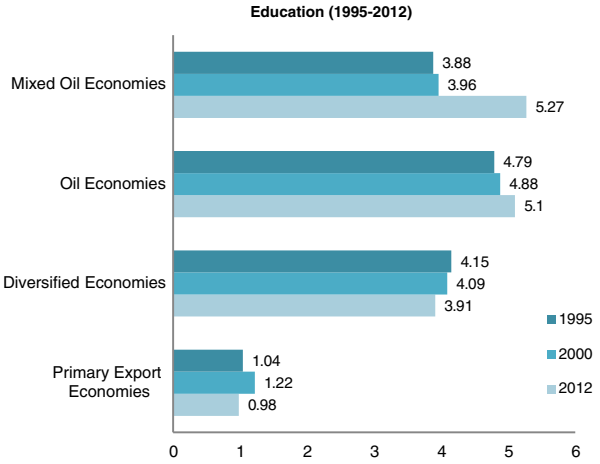


Fig. 43 The education index in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

Therefore, our findings in this section support the first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region and support the third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region.

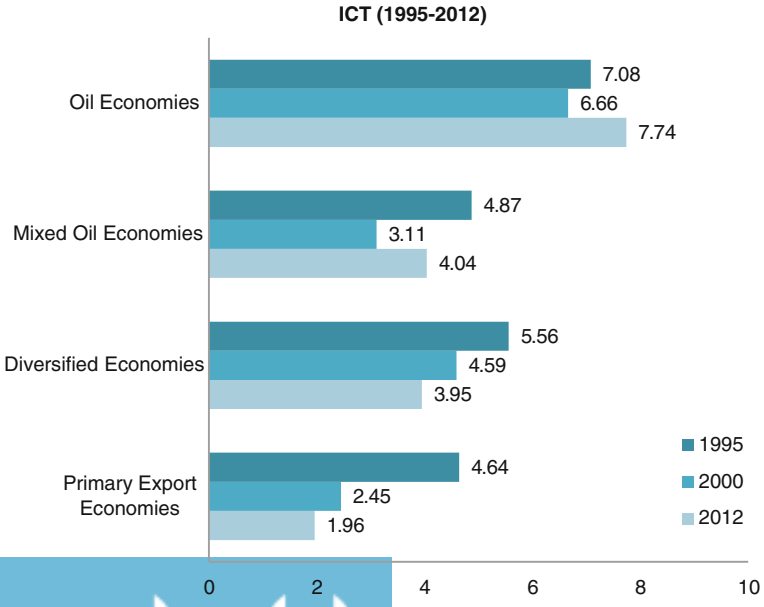


Fig. 44 The ICT index in the Arab region (1995–2012). Source: Adapted from the World Bank (2012)

Conclusions

In this paper, we present an overview of knowledge economy in the Arab region and contribute to recently published research studies that aim to improve understanding of the development and performance of knowledge economy in the developing countries. This paper addresses three following questions and examines three hypotheses.

This paper employs both the descriptive and comparative approaches and uses the definition of knowledge and knowledge indicators used in the literature to examine the existence and development of the knowledge economy in the Arab region. We fill the gap in the Arab literature and present a more comprehensive analysis of the development of knowledge indicators in the Arab region. Different from the conventional view in the literature that use the conventional classification of countries according to income level, an interesting element in our analysis is that we use a different classification by the structure of the economy to examine the knowledge economy in the Arab region.

Our findings in this paper support the first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region and support the third hypotheses concerning the poor and slow progress in the trend of the knowledge-related indicators in the Arab region.

Therefore, it is important for the Arab region to bridge the knowledge gap with other world regions. Mainly it is important for the Arab region to improve the investment in knowledge-related indicators, mainly tacit and codified sources of knowledge. It is also important for the Arab region to improve KEI and KI and all four pillars related to the knowledge economy—economic incentive and institutional regime, education and human resources, the innovation system, and ICT.

Acknowledgments The research work presented in this paper is based on a research project supported by a grant offered by the Global Development Network (GDN) Fourth Round Regional Research Grant Competition administered by the Economic Research Forum for the Arab Countries, Iran and Turkey (ERF) in collaboration with GDN and a grant offered by the Middle East Research Grant Competition (MERC) (2003–2004) administered by the Center for the Study of Developing Countries (CICS), Faculty of Economics and Political Science, Cairo University, Cairo, Egypt in collaboration with Ford Foundation. The author gratefully acknowledges the ERF, GDN, MERC, and Ford Foundation for the research grants. The author would like to thank the participants for their useful comments on this paper. The author would like to gratefully thank Dr. Elias G. Carayannis, Editor-in-Chief of this journal, and two anonymous referees for their good cooperation and for their useful comments on the first draft of this paper. All the usual disclaimers apply.

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