

Overview of Knowledge Economy and Economic Structure in the Arab Region

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By Dr. Samia Satti Osman Mohamed Nour

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Abstract

This paper uses both the descriptive and comparative approaches and uses the OECD (1996) definition of knowledge-based economy, the World Bank Knowledge Index (KI) and Knowledge Economy Index (KEI) and other knowledge indicators often used in the international literature to examine the existence and development of knowledge economy and the interaction between knowledge economy and economic structure in the Arab region. We fill the gap in the Arab literature by explaining that the transition to knowledge-based economies in the Arab region is eminently impeded by the lack of efficient and appropriate economic structure, institutions, innovation and incentives in the Arab region. Our findings support the first hypothesis that the knowledge economy exists in the Arab region but coincides with a 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. Our results corroborate the third hypothesis that the prevalent economic structure (rent-seeking) natural resources (oil and natural gas) based-economies has seriously impeded the transition to knowledge-based economies in the Arab region. Our findings support the fourth hypothesis concerning public policy instruments to facilitate the transition towards knowledge-based economies in the Arab region. Therefore, the development of knowledge-based economies in the Arab region is reliant on the development of appropriate economic structure (shifting from the prevailing (rent-seeking) natural resources-based (oil) economies to knowledge-based economies). It is essential for the Arab region to implement sound and coherent public policies to enhance innovation, incentives and institutions of higher education, S&T, R&D and ICT to accelerate and enhance transition to knowledge-based economies and to achieve economic and sustainable development in the Arab region.

Keywords: Knowledge, Knowledge economy, tacit knowledge, codified knowledge, knowledge index, economic structure, Arab region

JEL classification: O10, O11, O30

¹ Corresponding Author: Dr. Samia Satti Osman Mohamed Nour, Affiliated Researcher – UNU-MERIT, School of Business and Economics, University of Maastricht, Maastricht, the Netherlands; Associate Professor of Economics, Economics Department, Faculty of Economic and Social Studies, Khartoum University, Khartoum, Sudan; and Associate Professor of Economics, Department of Economics, Faculty of Economics and Administration, King Abdulaziz University, Jeddah, Saudi Arabia, E-mail: samiasatti@yahoo.com; samia_satti@hotmail.com. The revised version of this paper was prepared for UNU-MERIT Conference "Future perspectives on innovation and governance in development" Maastricht, the Netherlands, November 26-28, 2014. The author gratefully acknowledges UNU-MERIT for the research grant. The author would like to thank the participants for their useful comments on this paper. The earlier version of this paper was published with the title "Overview of knowledge economy in the Arab region," UNU-MERIT Working Paper [2013-015](#), Maastricht, the Netherlands, January 2013. All the usual disclaimers apply.

Overview of Knowledge Economy and Economic Structure in the Arab Region

1. Introduction

This paper presents an overview of the knowledge economy in the Arab region and examines the interaction between knowledge economy and economic structure in the Arab region. This paper addresses the following questions: does the knowledge economy exist in the Arab region?; does the economic structure affect the transition to knowledge-based economies in the Arab region?; and what are the public policy instruments to facilitate the transition to knowledge-based economies in the Arab region?

We examine four 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 investigate the third hypothesis that the prevalent economic structure (which implies heavy reliance of the economy on natural resources (oil and natural gas), rather than knowledge-based economy) has significant effect in the transition to knowledge-based economies in the Arab region. This hypothesis implies that the transition to knowledge-based economies is seriously impeded by the prevalence of (rent-seeking) natural resources based-economies in the Arab region. We examine the fourth hypothesis concerning the public policy instruments to facilitate the transition towards knowledge-based economies in the Arab region.

We contribute to recently published research studies that aim to improve understanding of the interaction between the transition to knowledge-based economies and economic structure in the developing countries. We 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, 2011a) 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 interaction between knowledge economy and economic structure 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 data and provide a more comprehensive study compared to a few earlier studies on the knowledge economy in the Arab region (Nour, 2010; 2011a; b; 2012; 2013a; b; c; 2014a; b; c). We provide a new contribution and 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. Mainly, we explain that the transition to knowledge-based economies in the Arab region is eminently impeded by the lack of efficient and appropriate economic structure, institutions, innovation and incentives 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 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 recent secondary data obtained from different sources, and use the OECD (1996) definition of knowledge-based economy, the World Bank Knowledge Index (KI) and Knowledge Economy Index (KEI) and other knowledge indicators often used in the international literature to examine the existence, development and transition to knowledge-based economies and the interaction between knowledge economy and economic structure in the Arab region. 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 enrolment 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 and knowledge economy index.

The rest of this paper is organized as follows: Section 2 presents the conceptual framework and literature review. Section 3 shows the general socio-economic characteristics of Arab region. Section 4 discusses existence of knowledge economy in the Arab region compared to the other world regions, this section also explains the major development in knowledge economy over the period (1995-2012). Section 5 investigates the interaction between knowledge economy and economic structure in the Arab region. Finally, Section 6 provides the conclusions and policy recommendations.

2. Conceptual framework and literature review

In the recent years the world economy is witnessing a fundamental structural change driven by globalization and ICT leading to a new economic system characterizing by increasing importance of knowledge. Hence, knowledge creation, accumulation and acceleration is intensified the pace of scientific and technological progress and has been at the heart of economic growth literature. The definition of knowledge in the literature is based on the distinction between codified and tacit knowledge (Dasgupta and David, 1994), and embodied flows (knowledge incorporated in to machinery and equipment) and disembodied flows of knowledge (the use of knowledge transmitted via education systems, scientific and technical literature, consultancy, movement of personnel). Often investment in knowledge refers to public spending on education, training, R&D and ICT.

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 David and Foray (2001) discuss knowledge-based communities as agents of economic change, they find that knowledge-based activities emerge when people, supported by information

² See Powell and Snellman (2004), p. 199.

and communication technologies, interact in concreted efforts to co-produce (i.e. create and exchange) new knowledge, new information and communication technologies 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. According to 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. OECD (1996) discusses “knowledge-based economies” – economies which are directly based on the production, distribution and use of knowledge and information. The OECD economies are increasingly based on knowledge and information and are more strongly dependent on the production, distribution and use of knowledge than ever before. Indeed, it is estimated that more than 50 per cent of Gross Domestic Product (GDP) in the major OECD economies is now knowledge-based. This is reflected in the trend in OECD economies towards growth in high-technology investments, high-technology industries, more highly-skilled labour and associated productivity gains.³

The conceptual framework discussed in the international literature, implies the distinction between knowledge-based economies and resource-based economies. According to OECD (1996) knowledge-based economies- are economies which are directly based on production, distribution and use of knowledge and information, with important role of information, technology and learning in economic performance (cf. OECD, 1996). While a resource-based economy is the economy of a country whose gross national product or gross domestic product to a large extent comes from natural resources (e.g. oil and gas). Gorzelak (2001) defines a framework of knowledge-based economy based on the distinction between the old paradigm (resource driven economies) and the new paradigm (knowledge driven economies). Gorzelak (2001) argues that applying the concepts of the knowledge economy to urban management suggests the need for a paradigm shift from resource driven urban economies to knowledge driven urban economies (see Table 1).

Table 1- Knowledge Economy as an Agent of Change in Cities

Old Paradigm Resource driven economies	New Paradigm Knowledge driven economies
Quantitative factors Labor Raw materials Premises Bulk transportation Energy	Qualitative factors Qualifications Research and development Local suppliers Reliable infrastructure Good living conditions
Subsidization Tax allowances Grants and direct subsidies Low user charges and rents	Entrepreneurial Friendly and stable policy environment Effective and honest promotion Competitive attraction of capital, innovation and qualified labor

Source: Adapted from Gorzelak (2001).

The World Bank uses Knowledge Index (KI) and Knowledge Economy Index (KEI) to compare knowledge across the world countries. According to the World Bank, KI measures a country's ability to generate, adopt and diffuse knowledge. KI indicates overall potential of knowledge development in a given country. 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

³ See OECD (1996), pp. 3, 7, 9, 18-19.

towards the Knowledge Economy.⁴ According to the World Bank (2011) the term Knowledge Economy has been coined to reflect this increased importance of knowledge. Framework for a Knowledge-based Economy consisting of four pillars help countries articulate strategies for their transition to a knowledge economy: economic incentives regime, education and human resources, the innovation system and information and communication technology (ICT). Making effective use of knowledge in any country requires developing appropriate policies, institutions, investments and coordination across the four functional areas.⁵ According to OECD (1996) government policies, particularly those relating to science and technology, industry and education, will need a new emphasis in knowledge-based economies. Need for recognition of the central role of the firm, the importance of national systems and the requirements for infrastructures and incentives which encourage investments in research and training. Among the priorities, special emphasis should be given to enhancing knowledge diffusion, upgrading human capital and promoting organisational change. Governments can provide the conditions and enabling infrastructures for these changes through appropriate financial, competition, information and other policies.⁶

Within this framework, the analysis of the interaction between knowledge economy and economic structure in different economic systems have been an exciting and interesting recent research issues that received increasing interest amongst economists in both developed and developing countries. Few studies in the Arab literature discuss the knowledge economy (cf. UNDP-AHDR, 2003; 2009; UNDP-AKR, 2009, 2010-2011). The lack of studies particularly examining the interaction between economic structure and knowledge economy in 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 investigating the effect of economic structure on knowledge economy and knowledge-related indicators in the Arab region.

3. General socio-economic characteristics of the Arab region

Based on the above framework and before examining the interaction between knowledge economy and economic structure in the Arab region, in this section it is useful to begin with the general socio-economic characteristics of Arab region Table 2 shows the general socio-economic 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 enrolment ratios. Table 2 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. In general, the Arab region is characterised by low human development index together with high population numbers. According to the 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

⁴ 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 fees payments and receipts, patent applications granted by the US Patent and Trademark Office and scientific and technical journal articles. Information and Communication Technology (ICT) pillar includes fixed telephones, mobile and internet users. Methodologically, the KI is the simple average of the normalized the key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT). For the purposes of calculating KI and KEI, each pillar is represented by three key variables, see (www.worldbank.org): See the World Bank- KEI, 2012: <http://siteresources.worldbank.org/INTUNIKAM/Images/KEIindex.jpg>.

⁵ See the World bank (2011) "Knowledge for Development" accessed January 23, 2013.

⁶ See OECD (1996), pp. 3, 7, 9, 18-19.

the Arab region is near to the world high-income group and is, on average, higher than for those of the other world regions. Furthermore, the other HDI components: average life expectancy, mean years of schooling, expected years of schooling, literacy rate and gross enrolment 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 socio-economic development characteristics of the Arab region has serious implication on the development of knowledge economy and indicators as we explain in the next section.

Table 2- General socio-economic characteristics of the Arab region compared to other world regions (2005-2013)⁷

	Population	Gross national income (GNI) per capita(2011 PPP \$)	Human Development Index (HDI) Value	Life expectancy at birth (years)	Mean years of schooling (years)	Expected years of schooling	Adult Literacy rate (% ages 15 and older)	Gross enrolment ratios			
								Population with at least some secondary education(% aged 25 and above)	Primary (%)	Secondary (%)	Tertiary (%)
	2013	2013	2013	2013	2012	2012	2005-2012	2003-2012	2003-2012	2003-2012	
Human Development Index Groups											
Very high human development	1,189.7	40,046	0.890	80.2	11.7	16.3	..	86.9	103	101	76
High human development	2,485.5	13,231	0.735	74.5	8.1	13.4	94.2	64.9	118	87	35
Medium human development	2,262.1	5,960	0.614	67.9	5.5	11.7	71.7	47.5	111	70	23
Low human development	1,145.6	2,904	0.493	59.4	4.2	9.0	58.2	22.1	98	39	8
Regions											
Arab States	366.0	15,817	0.682	70.2	6.3	11.8	77.0	41.1	105	76	28
East Asia and the Pacific	2,035.9	10,499	0.703	74.0	7.4	12.5	94.4	..	120	84	..
Europe and Central Asia	233.4	12,415	0.738	71.3	9.6	13.6	97.7	75.6	101	95	50
Latin America and the Caribbean	611.3	13,767	0.740	74.9	7.9	13.7	91.5	54.7	106	85	44
South Asia	1,749.0	5,195	0.588	67.2	4.7	11.2	62.9	38.4	110	64	22
Sub-Saharan Africa	888.2	3,152	0.502	56.8	4.8	9.7	58.9	28.1	100	43	8
Least developed countries	898.4	2,126	0.487	61.5	3.9	9.4	59.3	..	105	42	9
World	7,162.1	13,723	0.702	70.8	7.7	12.2	81.2	63.6	108	74	31

Source: UNDP (2014), PPP – purchasing power parity.

4. The existence of knowledge economy and development of knowledge –related indicators in the Arab region⁸

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 and finally we examine the interaction between knowledge economy and economic structure. We define tacit sources of knowledge by tacit skills, which we define by the percentage share of high skilled people in total population, enrolment in tertiary education and the number of researchers or full time equivalent researchers (FTE). 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 The World Bank and United Nations Development Programme (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.

⁸ See, for example, Qasem (1998), Zahlan (1999) and Fergany (1999).

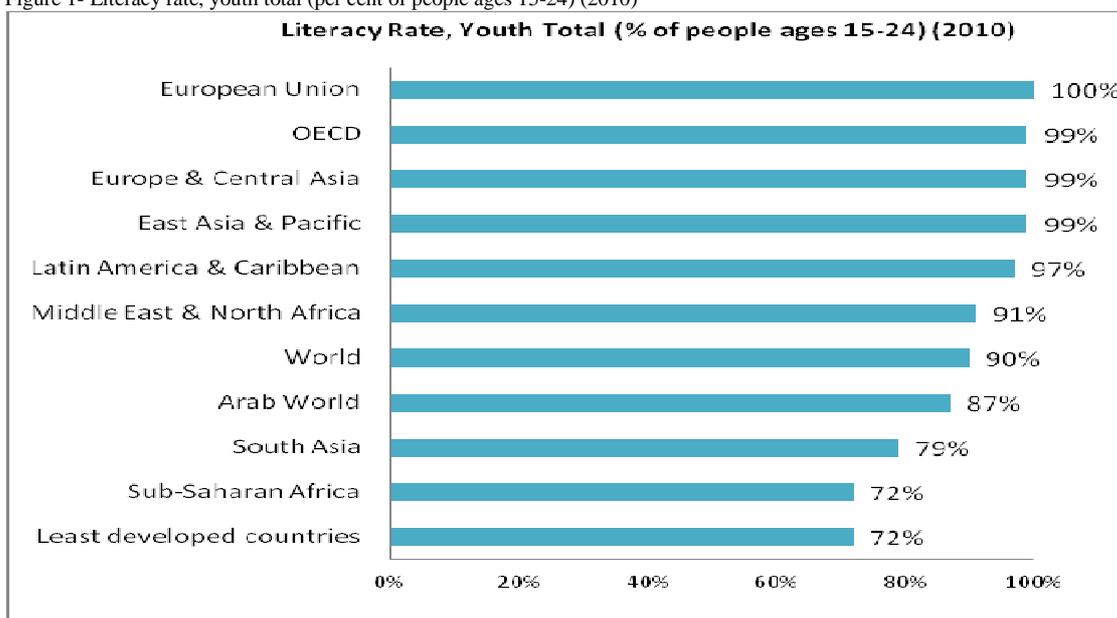
4.1. Tacit knowledge:

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 enrolment 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, Figure 1 illustrates that despite the relative increase in literacy rates, however, the illiterate population is accounting for 13 per cent 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 (per cent of ages 25 and older) represents only 38.4 per cent in the Arab region, compared to 65.1 per cent in Europe and Central Asia and 73.8 per cent in OECD, this result implies substantial gap in tacit sources of knowledge between Arab region and developed world regions- see Figure 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 (per cent 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 per cent of Arab population, while the majority (90 per cent) of Arab population possesses either medium or low educational attainment, particularly, near to three quarter of Arab population possesses low educational attainment- see Figure 3. The gap in tacit sources of knowledge between the Arab and world regions also appears in terms of tertiary education gross enrolment ratio (per cent) over the period (2008-2011). For instance, in 2011, tertiary education gross enrolment ratio (per cent) in the Arab region is only 23.11 per cent falls behind the standard rates of tertiary education gross enrolment ratio (per cent) 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 per cent, 61.4 per cent, 58.33 per cent, 40.54 per cent, 30.55 per cent, 29.11 per cent, and 28.99 per cent of respectively- see Figures 4-5 below. This result concerning the gap in tacit sources of knowledge that appears in terms of tertiary education gross enrolment ratio is consistent with the earlier results in the Arab literature that find that on average the share of gross enrolment 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 enrolment index and engineering enrolment index for the Arab region imply that the Arab region is lacking sufficient tacit knowledge and skills and is lagging far behind not only advanced countries but also developing countries. (cf. Nour, 2011).⁹ The gap in tacit knowledge between the Arab region and advanced world countries also appears from the number of total researchers, FTER, and total researchers per million inhabitants- see Figures 6-7. 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.

⁹ Harbison Myers Index is sum of secondary enrolment and tertiary enrolment times 5, both as % of age group. Technical enrolment index is tertiary total enrolment (times 1000) plus tertiary enrolment in technical subjects (times 5000), both as % of population, Engineering skills index is the same as previous index, with tertiary enrolments in engineering instead of enrolment in technical subjects.

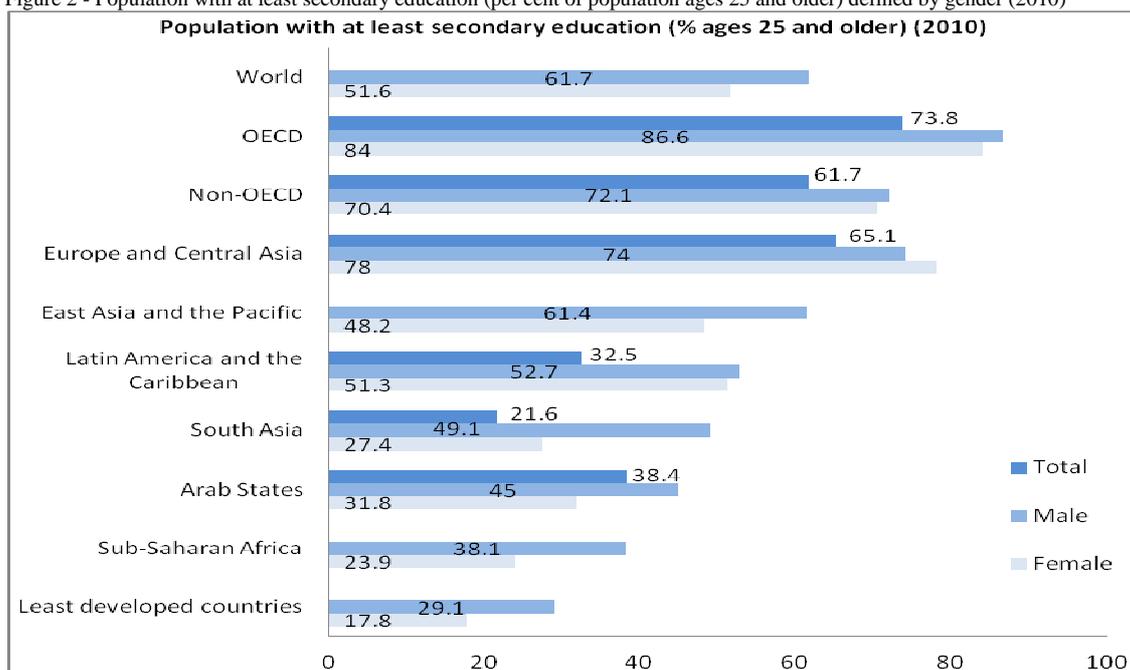
Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge related indicators. The poor progress in indicators related to tacit sources of knowledge in the Arab region appears from the observed poor progress and increasing trend in terms of gross enrolment in tertiary education over the period (2008-2011) and 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

Figure 1- Literacy rate, youth total (per cent of people ages 15-24) (2010)



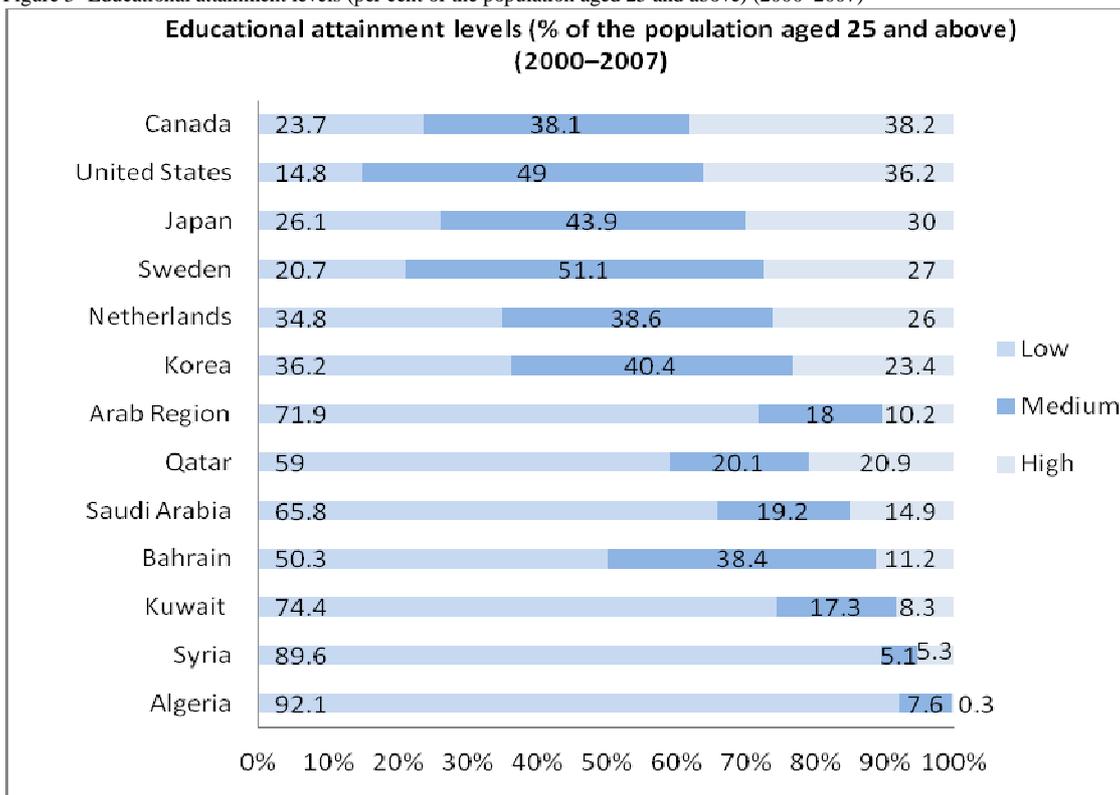
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 2 - Population with at least secondary education (per cent of population ages 25 and older) defined by gender (2010)



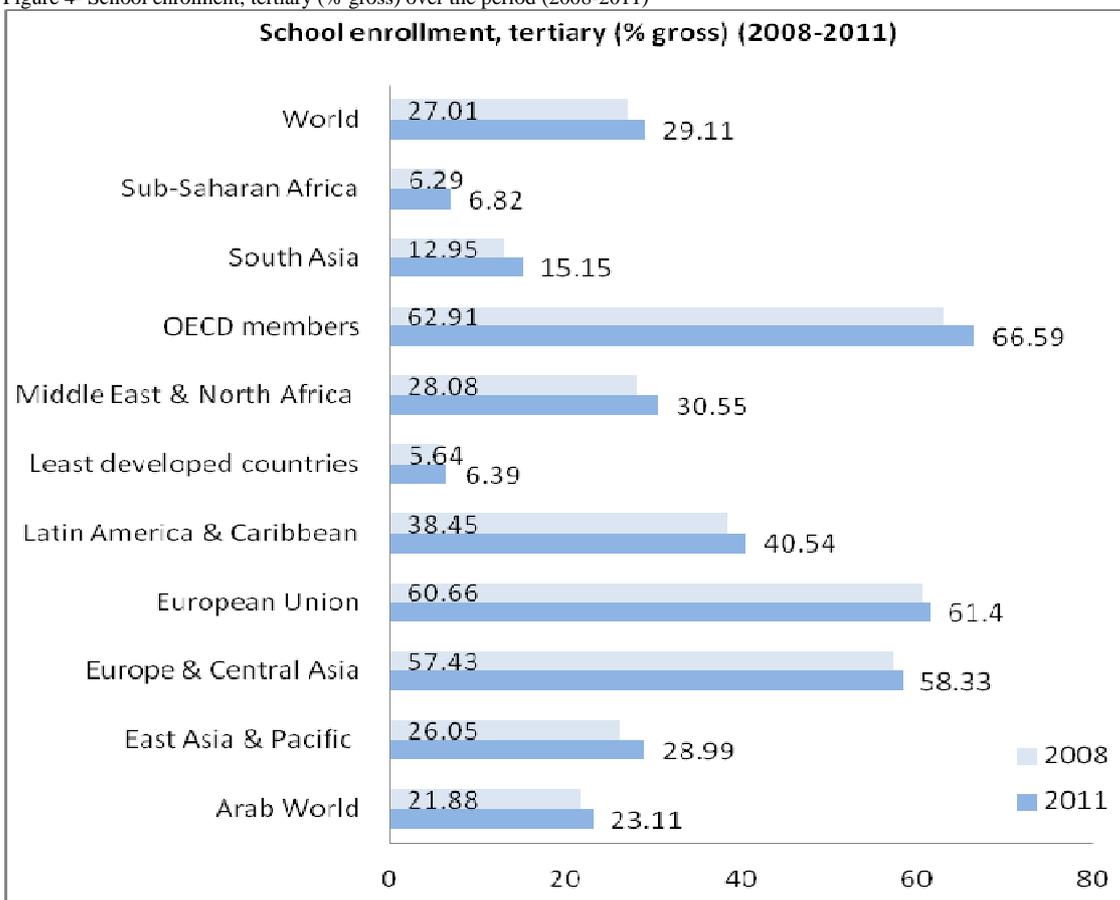
Source: Adapted from UNDP Human Development Report 2010, pp. 160, 196.

Figure 3- Educational attainment levels (per cent of the population aged 25 and above) (2000–2007)



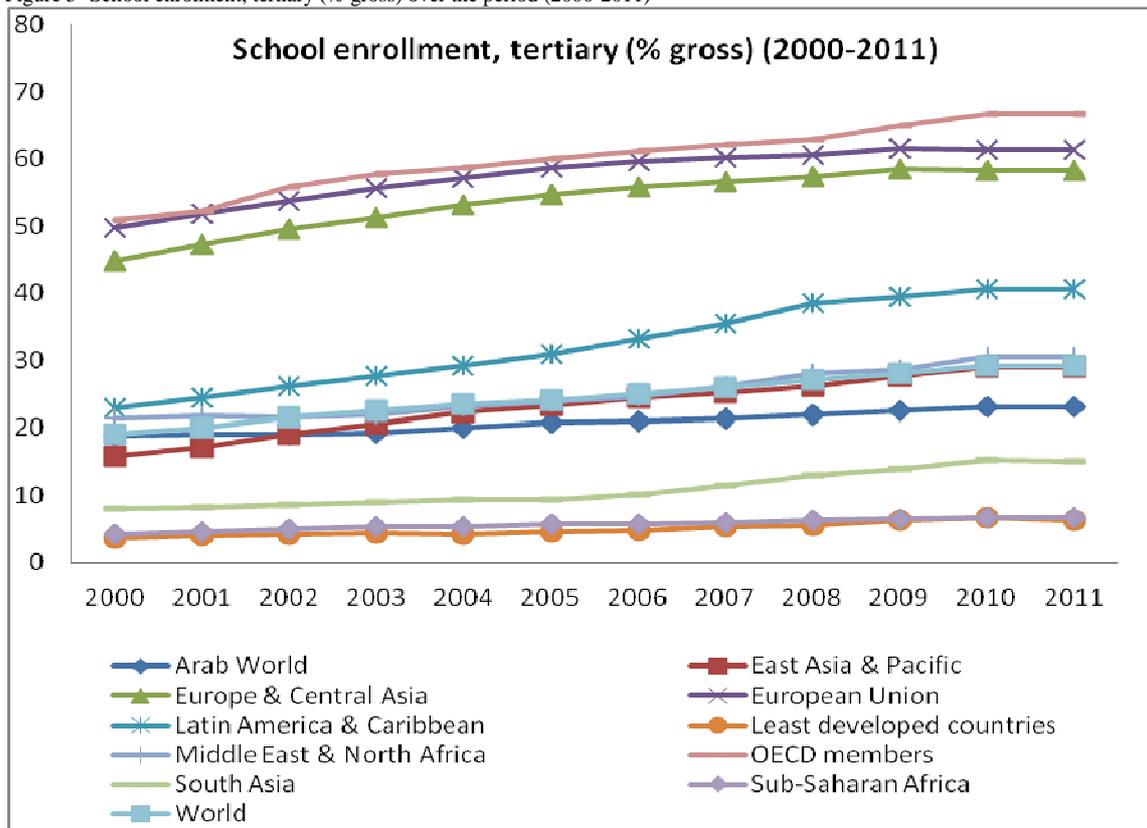
Source: Adapted from UNDP Human Development Report 2009 - pp. 199-200.

Figure 4- School enrolment, tertiary (% gross) over the period (2008-2011)



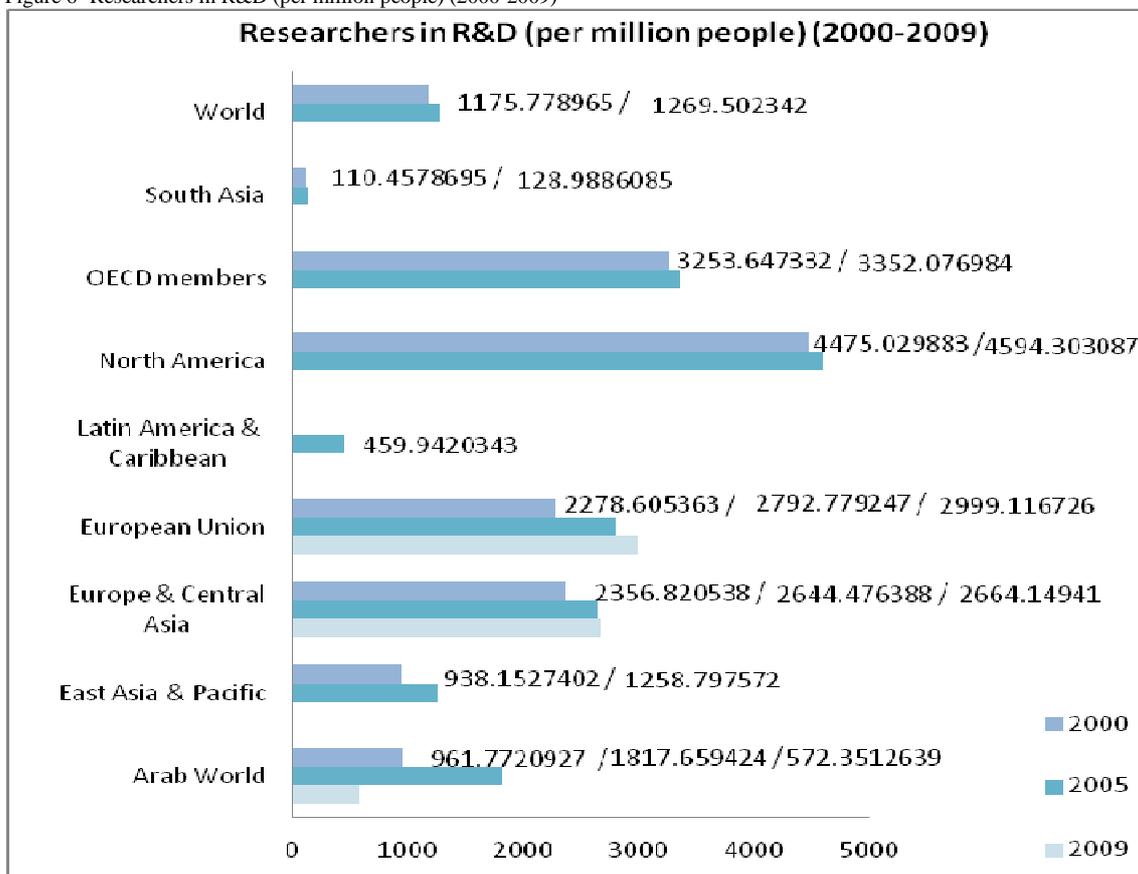
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 5- School enrolment, tertiary (% gross) over the period (2000-2011)



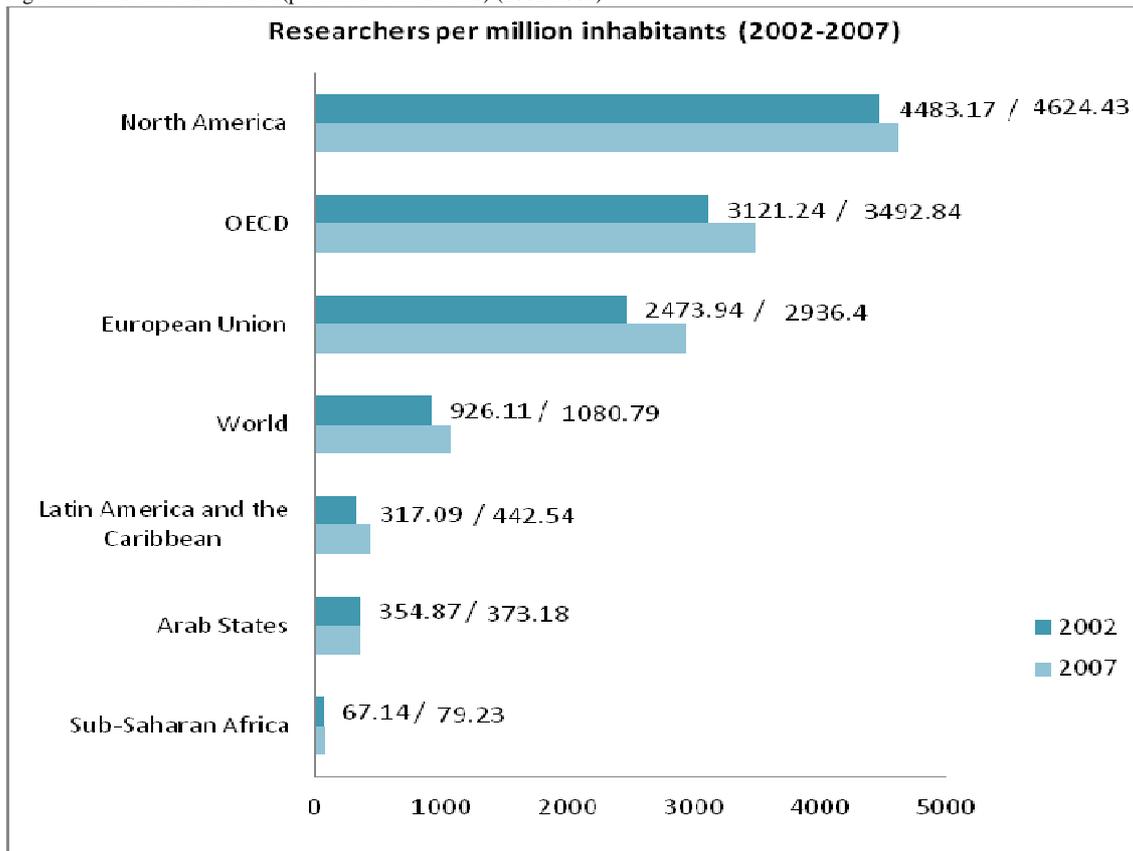
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 6- Researchers in R&D (per million people) (2000-2009)



Source: Adapted from UNESCO Institute for Statistics (2012)

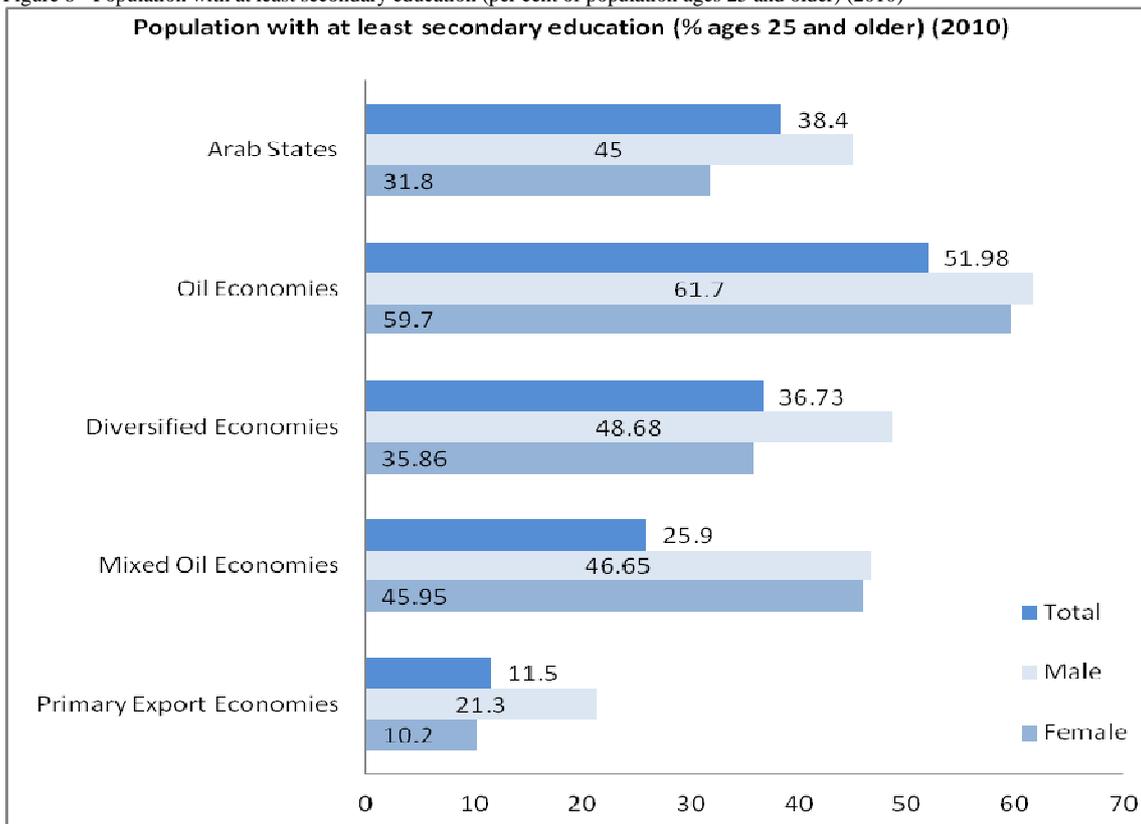
Figure 7 – Researchers in R&D (per million inhabitants) (2002-2007)



Source: Adapted from UNESCO Institute for Statistics (2012)

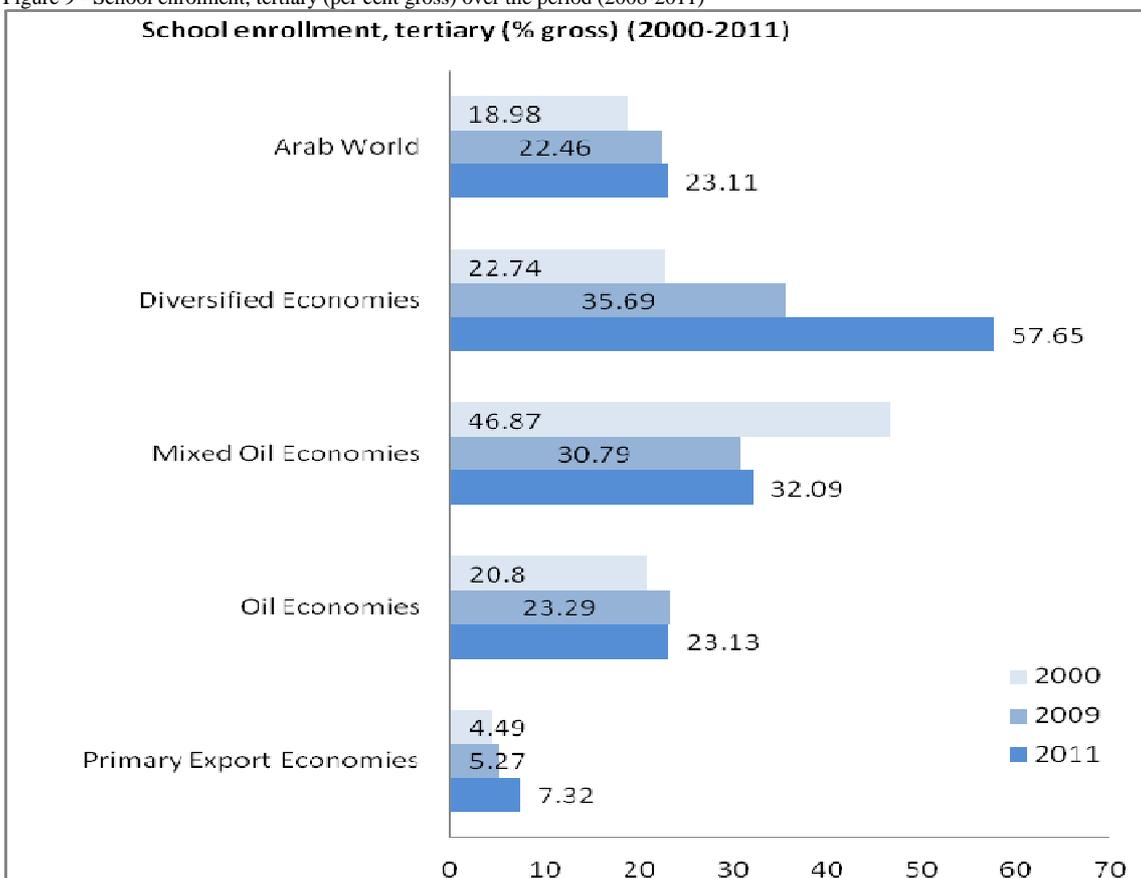
We find that the knowledge indicators show considerable variation across the Arab countries based on the classification according to the structure of the economy. For instance, the variation in tacit sources of knowledge appears in terms of the share of population with at least secondary education in total population that account for 38.4 per cent; 51.98 per cent; 36.73 per cent; 25.9 per cent and 11.5 per cent 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 (per cent of ages 25 and older) defined by gender imply that the share of population with at least secondary education in total population represents only 45 per cent for males and 31.8 per cent 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 enrolment 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 enrolment ratio in 2011, account for 23.11 per cent; 57.65 per cent; 32.09 per cent; 23.13 per cent and 7.32 per cent for all Arab states, diversified economies, mixed oil economies, oil economies and primary export economies respectively- see Figures 8-11. These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure 8 - Population with at least secondary education (per cent of population ages 25 and older) (2010)



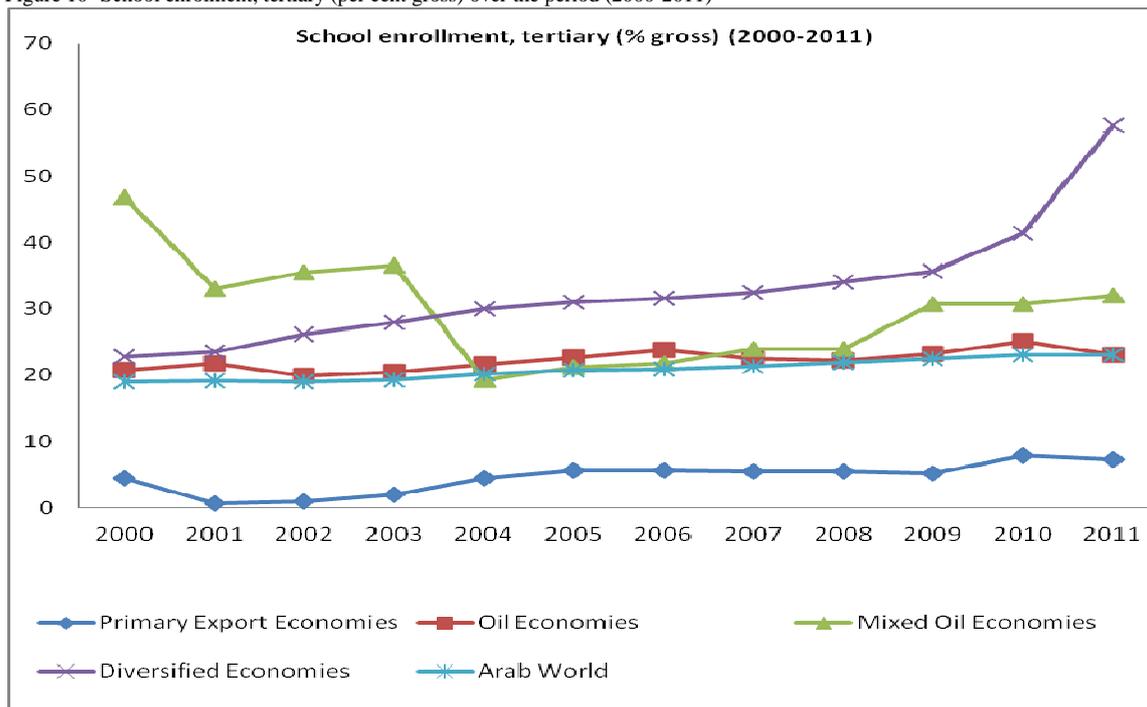
Source: Adapted from UNDP Human Development Report 2010, pp. 156-159, 192-195.

Figure 9 - School enrolment, tertiary (per cent gross) over the period (2008-2011)



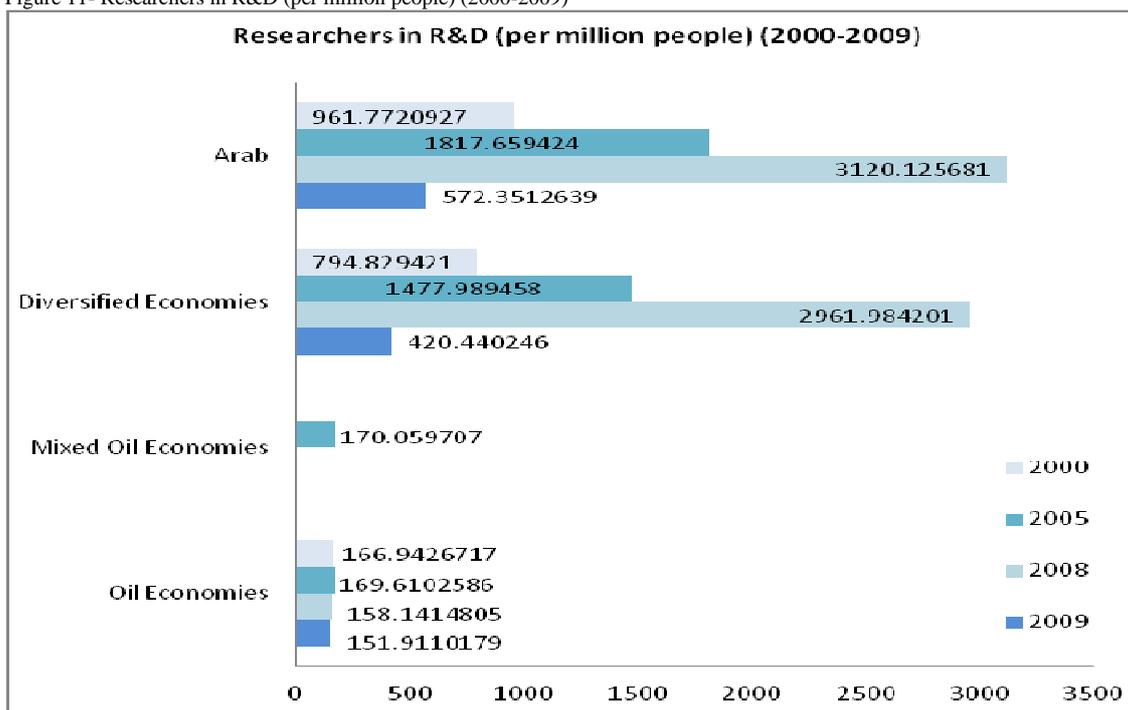
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 10- School enrolment, tertiary (per cent gross) over the period (2000-2011)



Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 11- Researchers in R&D (per million people) (2000-2009)



Source: Adapted from UNESCO Institute for Statistics (2012)

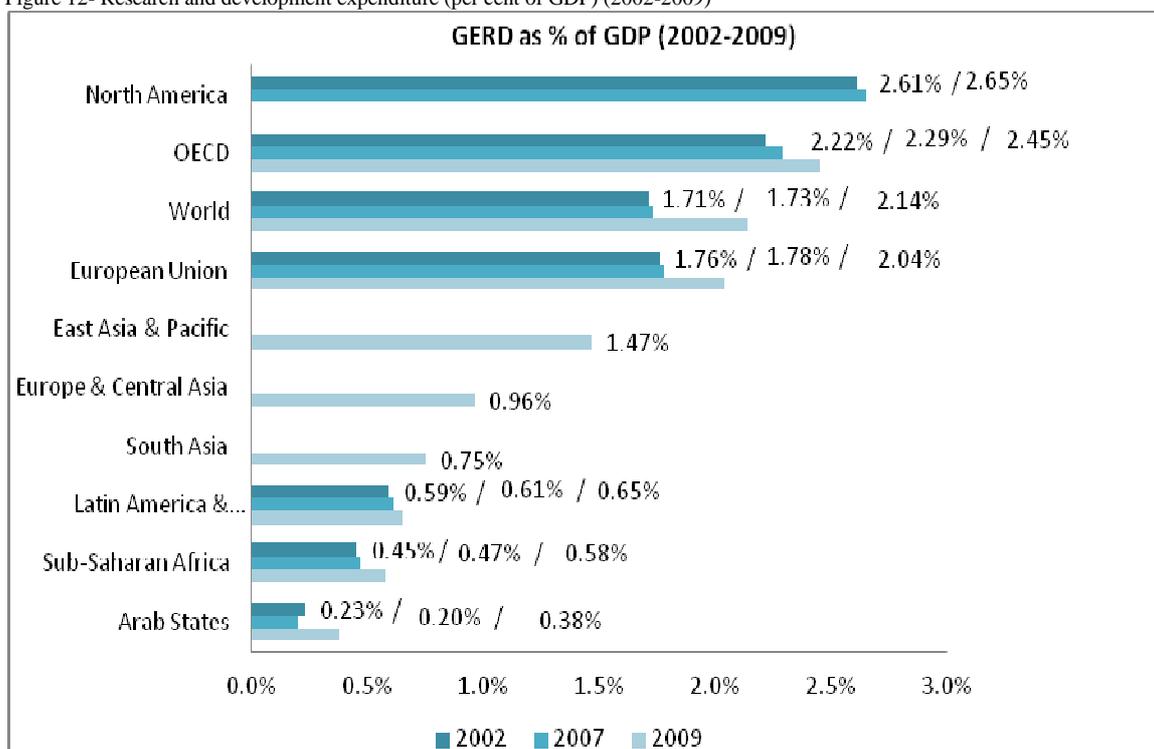
3. 2. Codified knowledge:

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, Figure 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 seem 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 show 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 percentage of GDP and GERD over the period (2002-2009)- see Figures 12-14. 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.

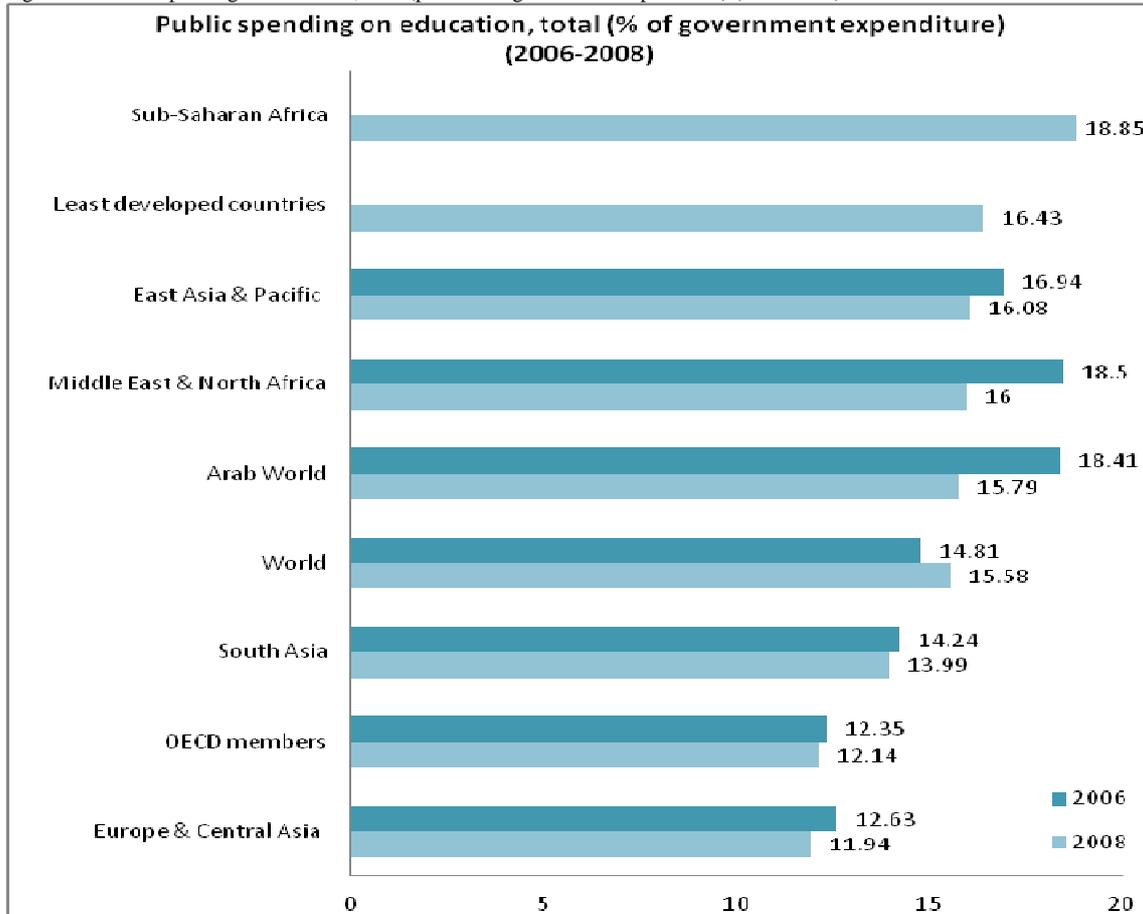
Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge related indicators. The poor progress in indicators 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) and 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 Figures 12-14. 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

Figure 12- Research and development expenditure (per cent of GDP) (2002-2009)



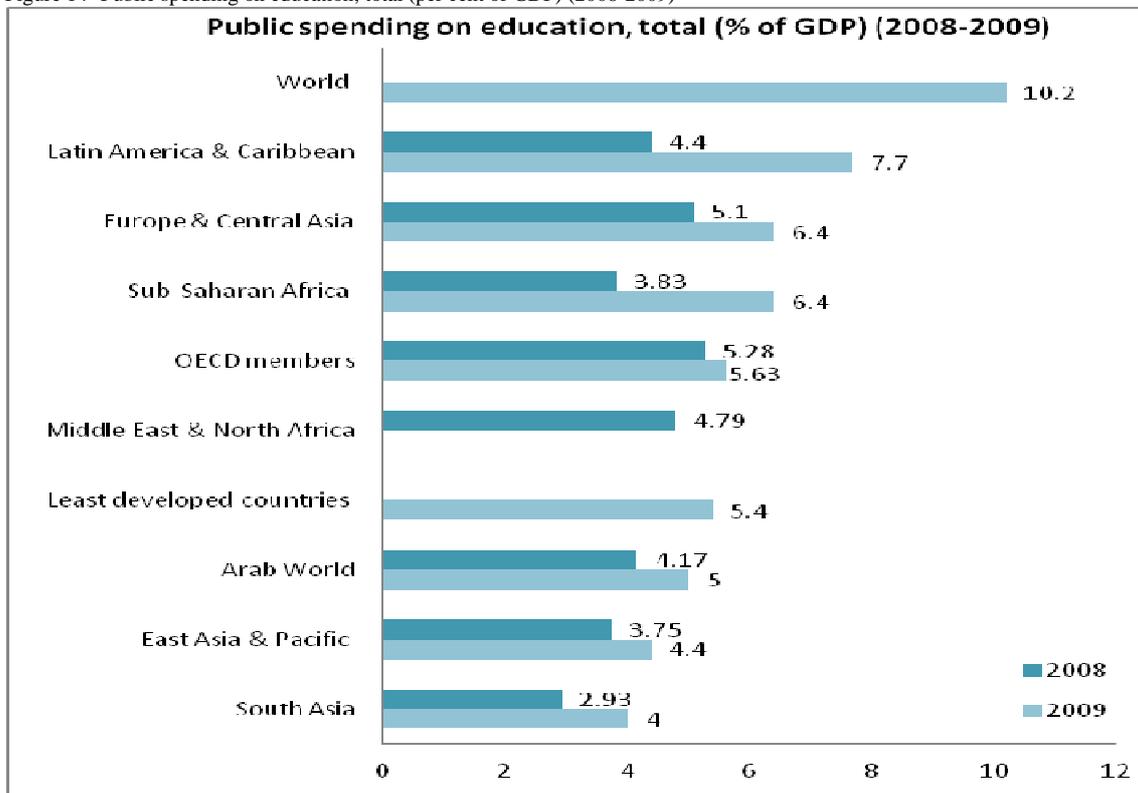
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 13- Public spending on education, total (per cent of government expenditure) (2006-2008)



Source: Adapted from UNESCO Institute for Statistics (2012)

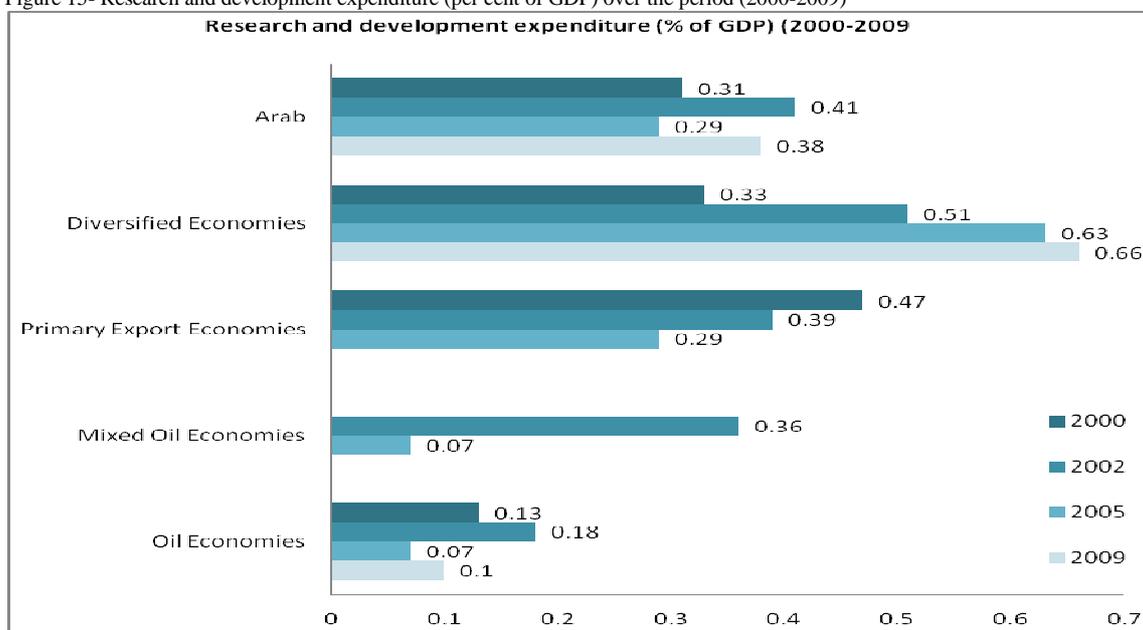
Figure 14- Public spending on education, total (per cent of GDP) (2008-2009)



Sources: Adapted from (a) UNESCO Institute for Statistics (2012), (b) UNDP Human Development Report 2011, p. 165.

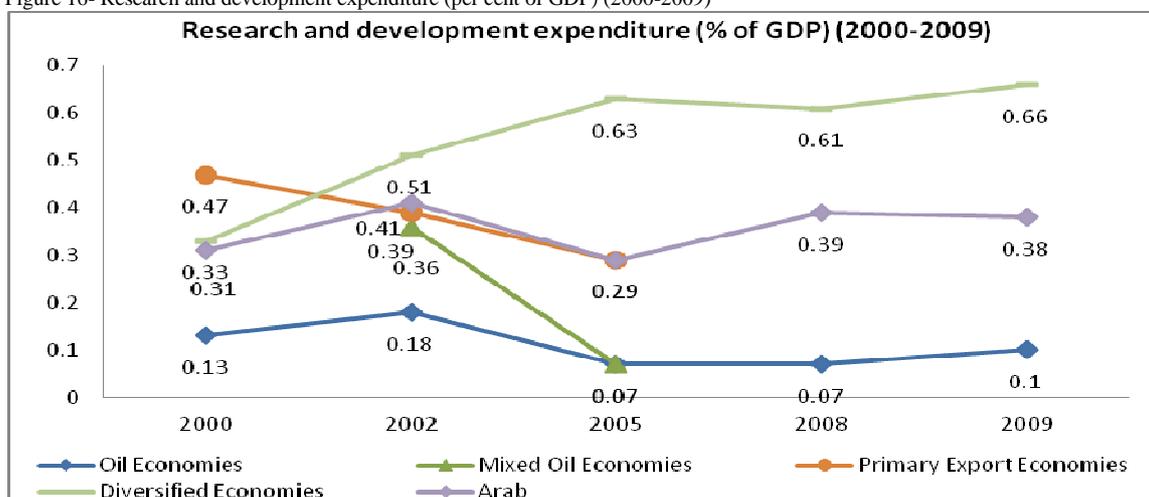
Differences in codified sources of knowledge across the Arab countries also appear in terms of public spending on education over the period (2006-2009) and the share of public spending on R&D as percentage of GDP and GERD over the period (2000-2009). For instance, the share of public spending on R&D as percentage of GDP and GERD in 2009, account for 0.38 per cent; 0.66 per cent; 0.1 per cent; 0. per cent and 0. per cent 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, account for 4.17 per cent; 6.38 per cent; 4.34 per cent; 4.32 per cent; and 3.59 per cent 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, account for 15.79 per cent; 20.27 per cent; 17.11 per cent; 15.79 per cent and 12.7 per cent for all Arab states, mixed oil economies, diversified economies, primary export economies and oil economies, respectively - see Figures 15-18. These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure 15- Research and development expenditure (per cent of GDP) over the period (2000-2009)



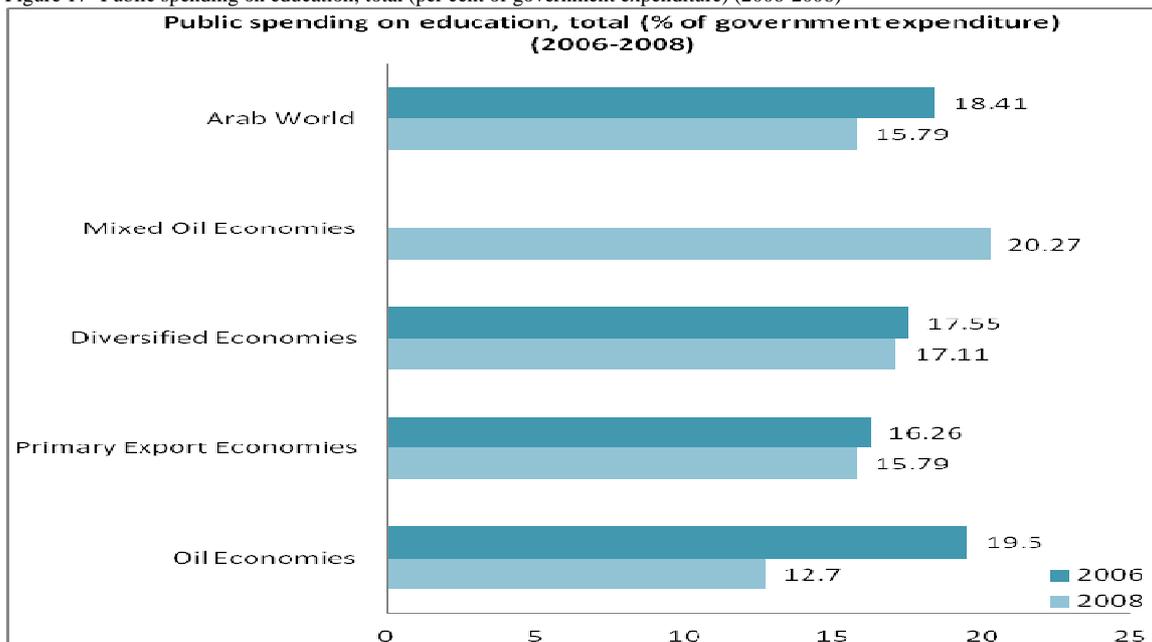
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 16- Research and development expenditure (per cent of GDP) (2000-2009)



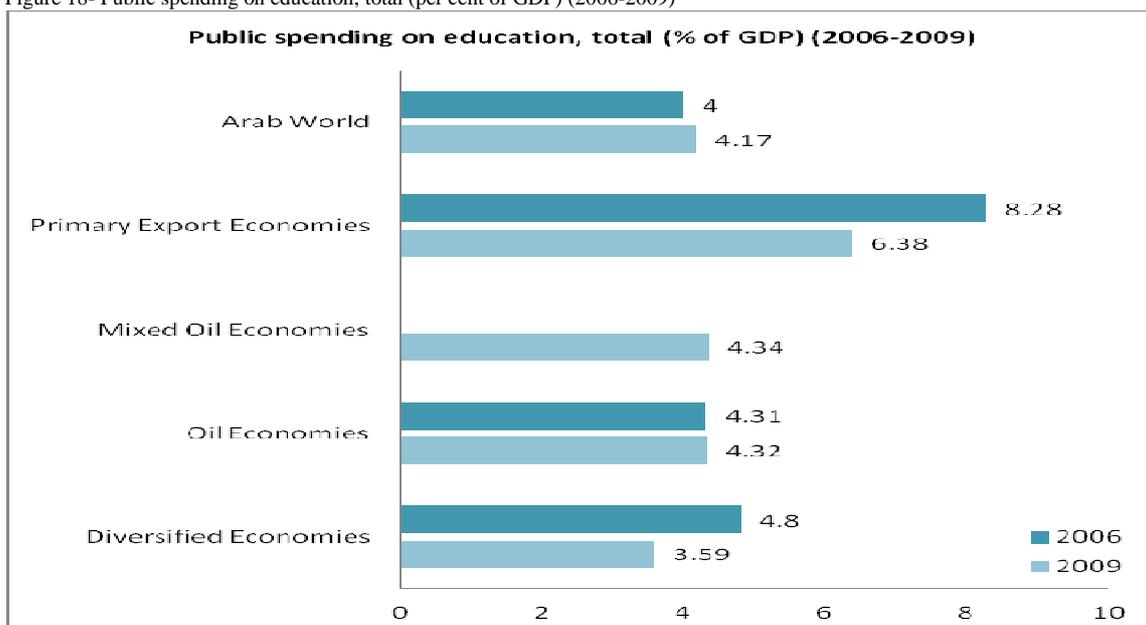
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 17- Public spending on education, total (per cent of government expenditure) (2006-2008)



Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 18- Public spending on education, total (per cent of GDP) (2006-2009)

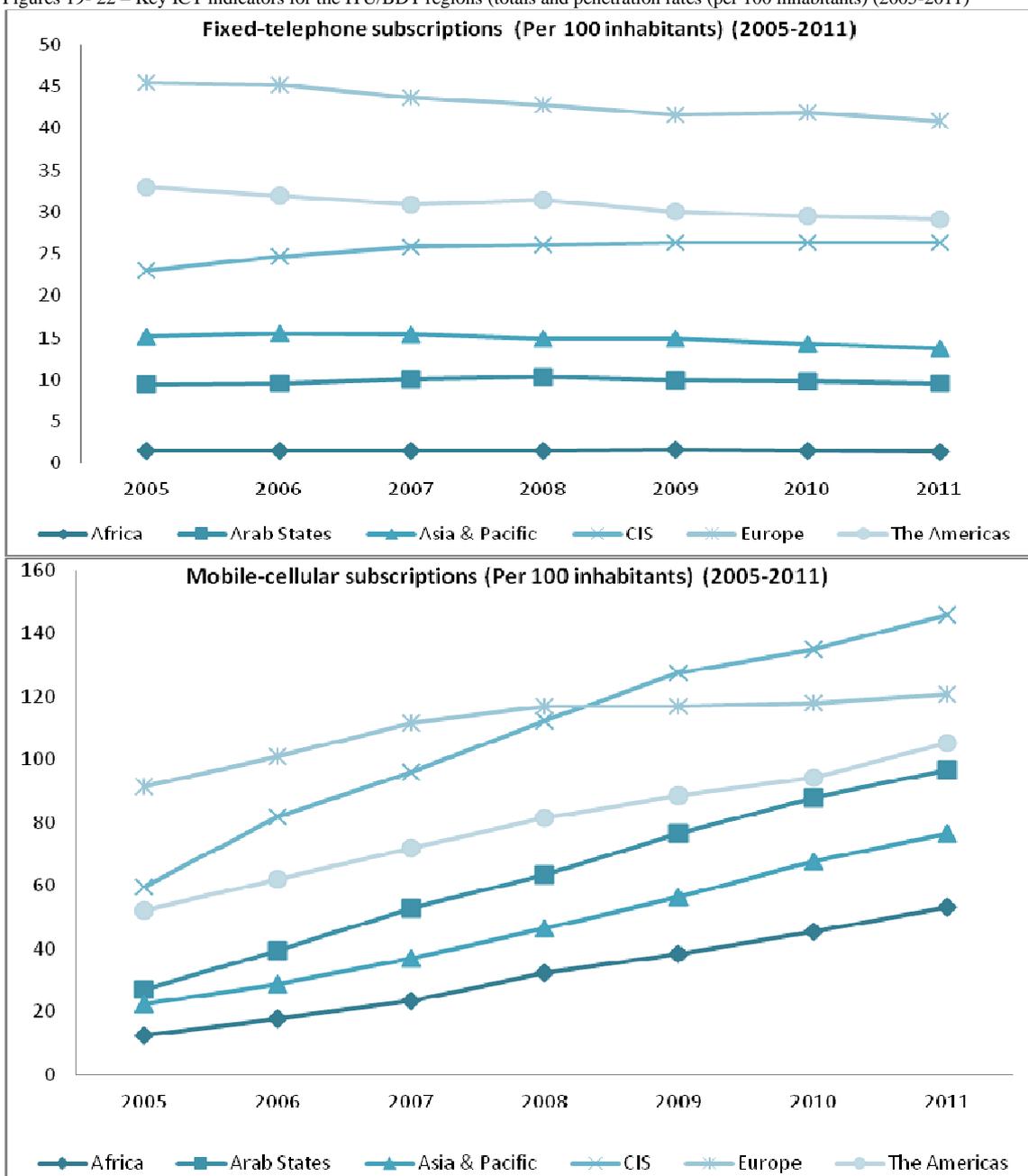


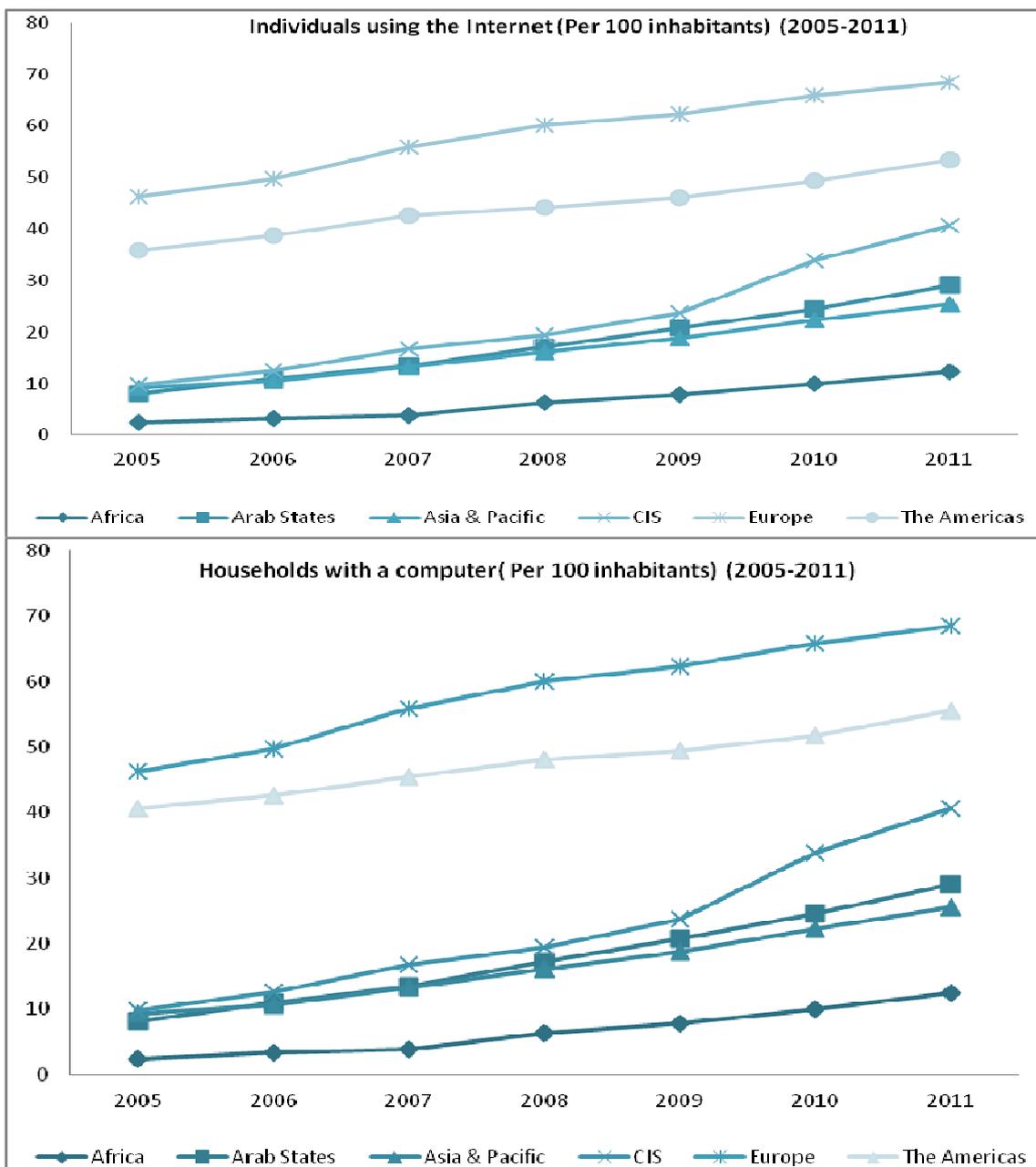
Source: Adapted from UNESCO Institute for Statistics (2012)

The knowledge gap and shortage of codified sources of knowledge also appears 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 per cent, 9.6 per cent and 96.9 per cent respectively that imply the gap between the Arab region and other advanced world regions- see Figures 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 per cent and 3.6 per cent respectively, while the comparable percentages of the advanced countries is ranged between 9.7 per cent and 7.6 per cent. Furthermore, the amount of ICT/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).

Figures 19- 22 – Key ICT indicators for the ITU/BDT regions (totals and penetration rates (per 100 inhabitants) (2005-2011)



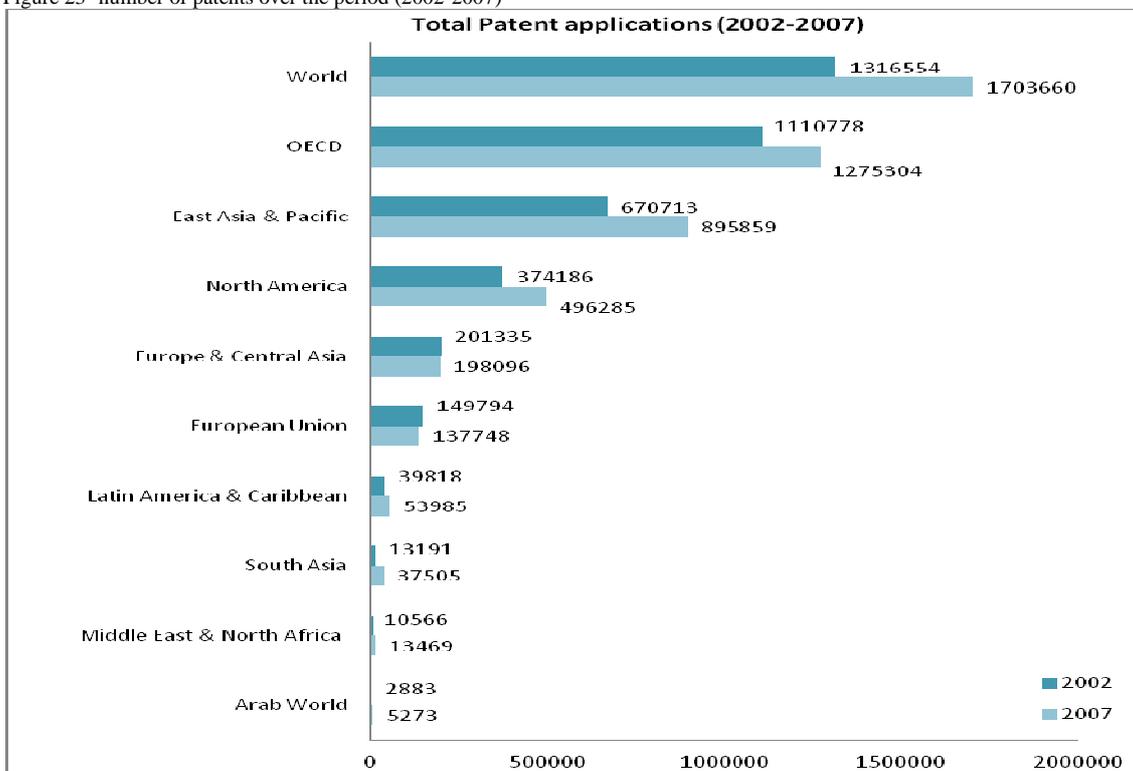


Source: Adapted from International Telecommunication Union, 2012. Accessed 16 January 2013

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

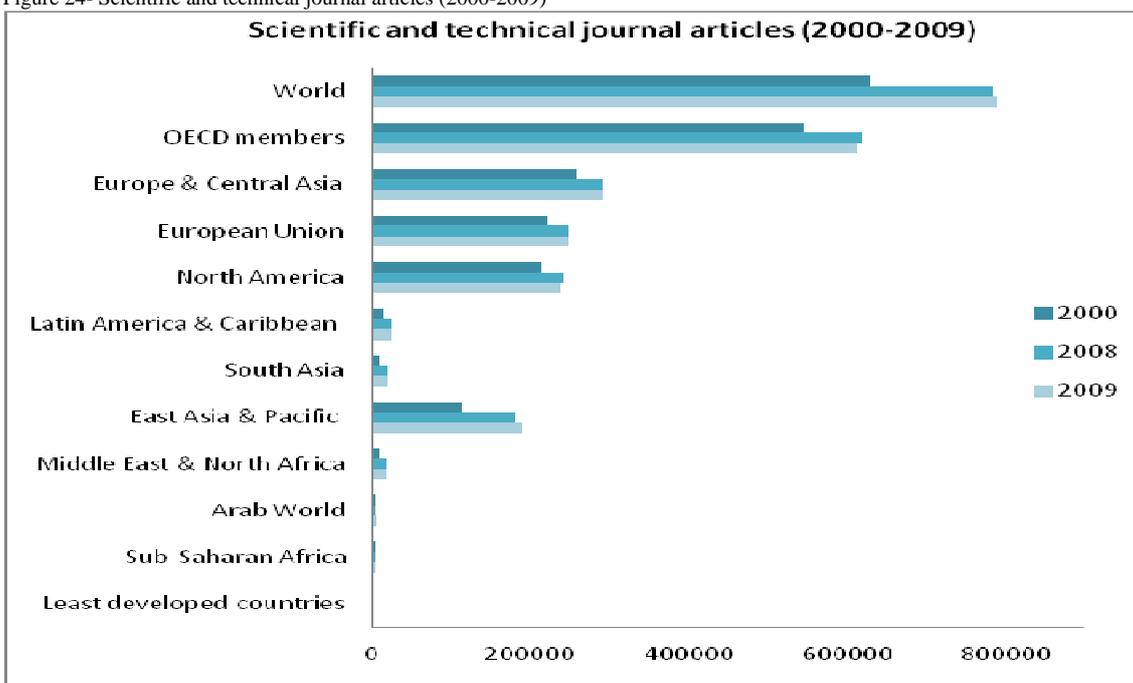
period (2002-2007) - see Figures 23-25. Differences in knowledge related indicators across the Arab countries also appear in terms of the total scientific and technical journal articles over the period (2000-2009), which is higher for the diversified economies followed by oil economies, mixed oil economies and primary export economies respectively- see Figures 26-27.

Figure 23- number of patents over the period (2002-2007)



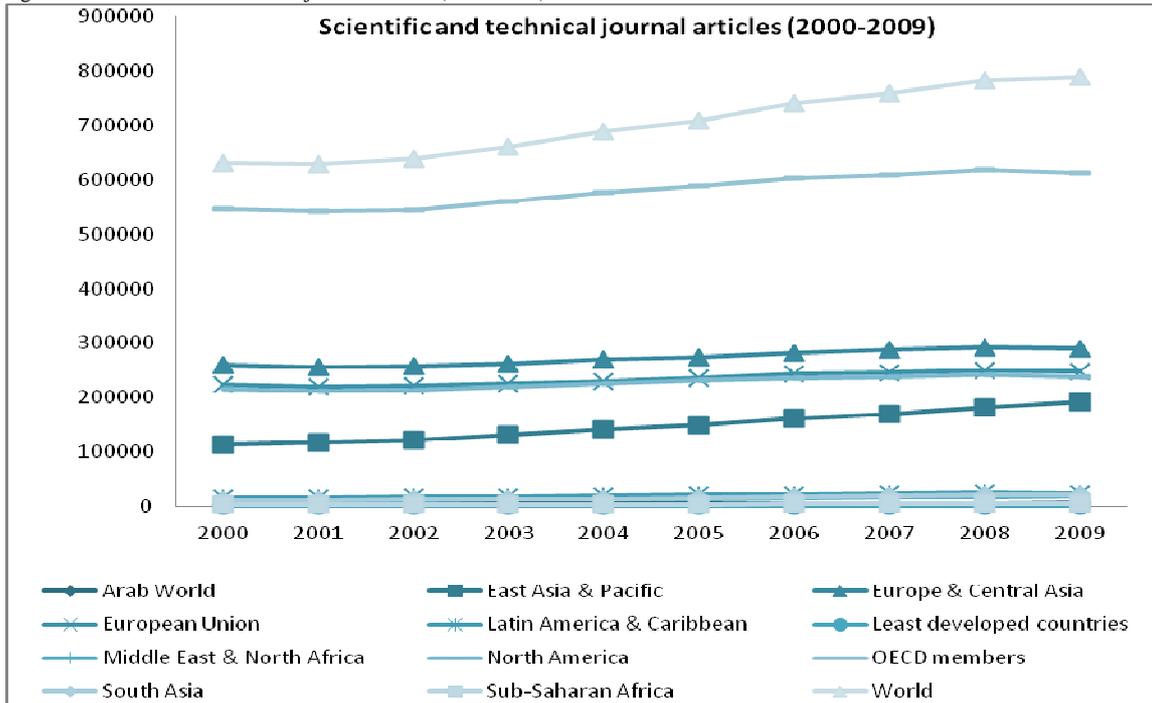
Source: Adapted from World Intellectual Property Organization (WIPO), World Intellectual Property Indicators

Figure 24- Scientific and technical journal articles (2000-2009)



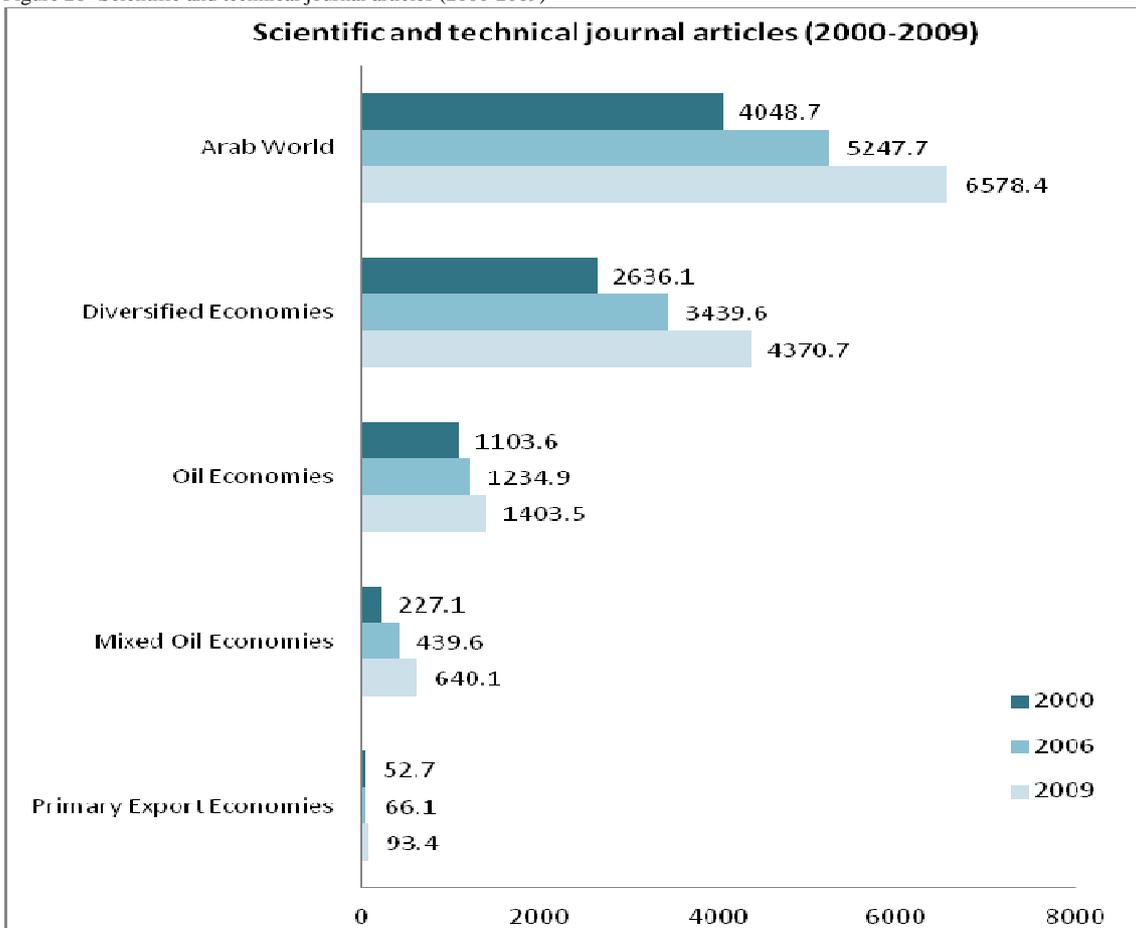
Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure 25- Scientific and technical journal articles (2000-2009)



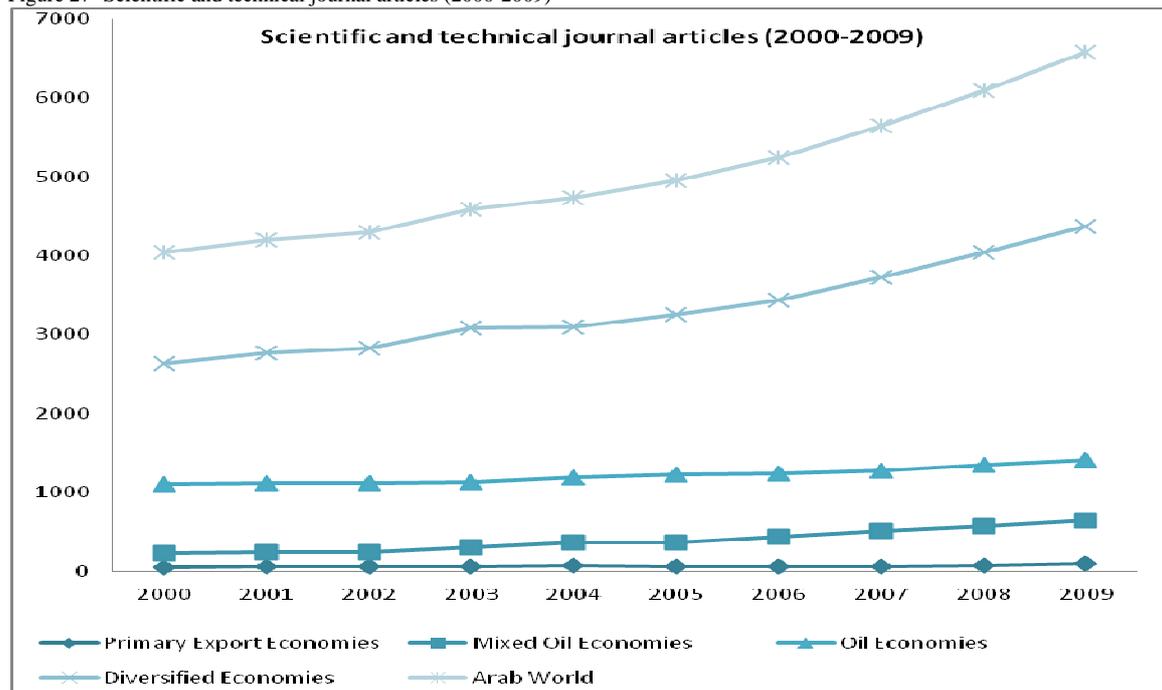
Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure 26- Scientific and technical journal articles (2000-2009)



Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure 27- Scientific and technical journal articles (2000-2009)



Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

4.3. Knowledge Index (KI) and the Knowledge Economy Index (KEI)

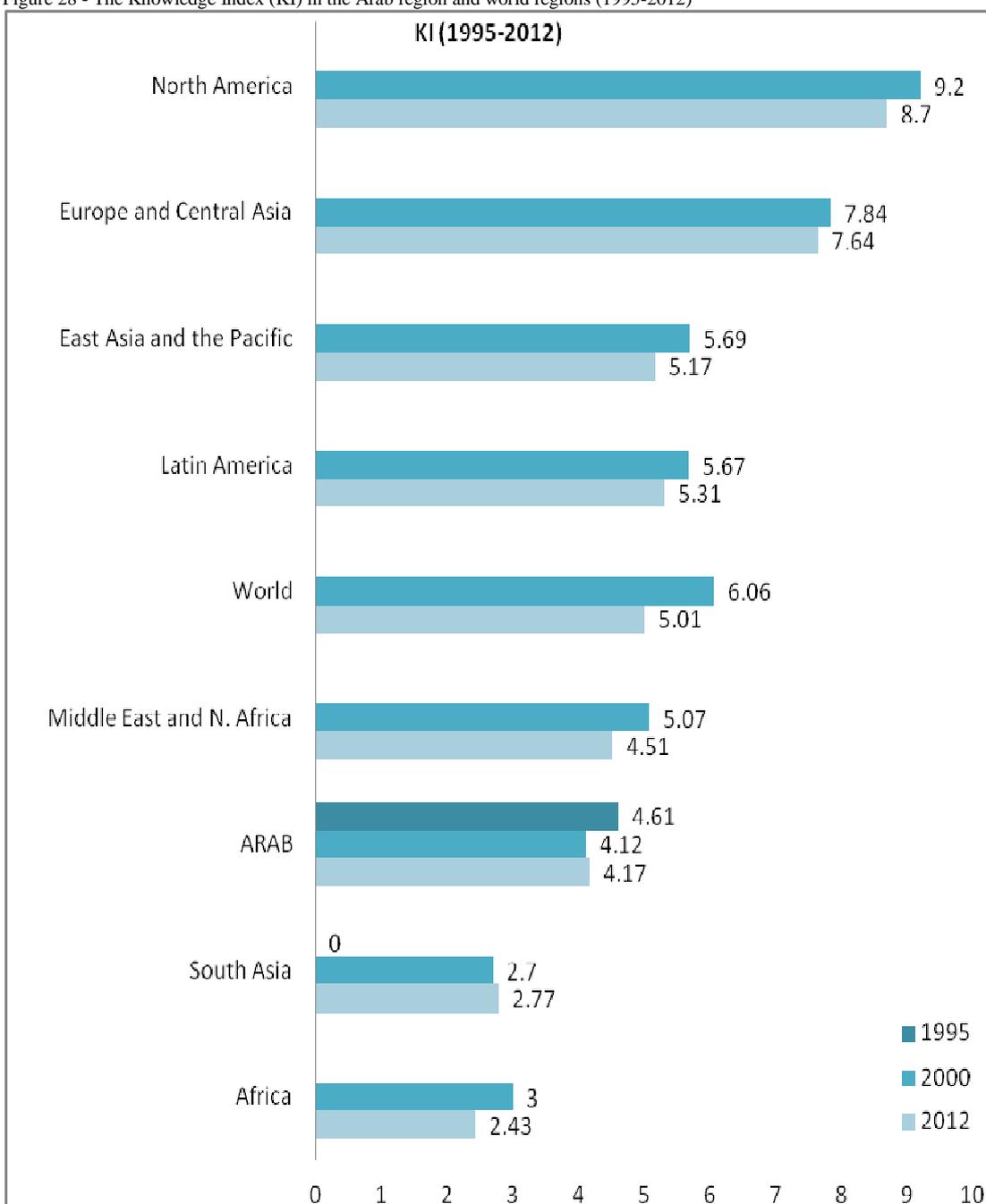
The knowledge gap and shortage of knowledge also appears from the World Bank Knowledge Index (KI) and the Knowledge Economy index (KEI) index over the period (1995-2012). The poor performance of the Arab region in terms of Knowledge Index (KI) and Knowledge Economy Index (KEI), mainly, the Knowledge Index (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 information and communication technology (ICT). The poor performance in terms of Knowledge Economy Index (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 towards 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 and ICT- see Figures 28-34.¹⁰ The declining trends over the period (1995-2012) and small increasing trend over the period (2000-2012) imply poor performance of both the Knowledge Economy Index (KEI) and Knowledge Index (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), they show declining trend over the period (1995-2000) that turned into small increasing trend over the period (2000-2012) – see Figures 35-36. 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. These results also support part of our

¹⁰ 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.worldbank.org.

third hypotheses concerning the poor and slow progress in the trend of the knowledge – related indicators in the Arab region

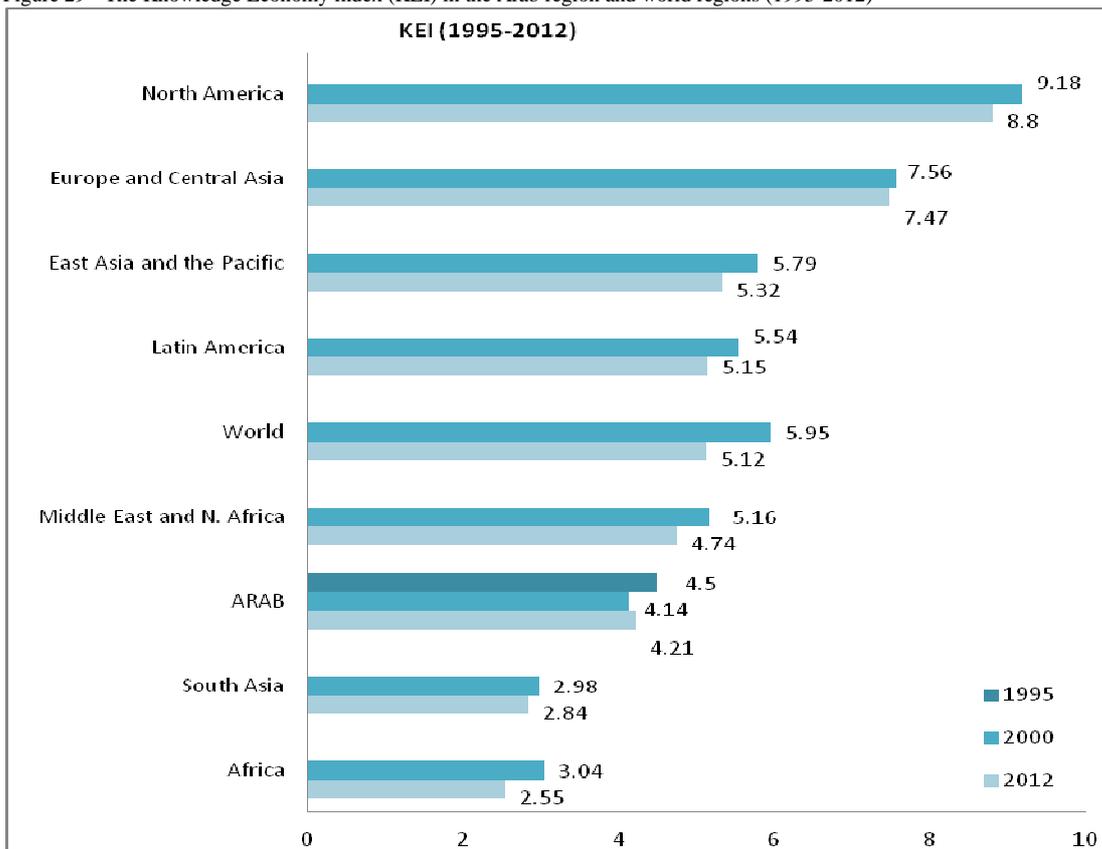
Differences in knowledge related indicators across the Arab countries also appear in terms of Knowledge Economy Index (KEI) and Knowledge Index (KI) and all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system 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 Figures 37-44. These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure 28 - The Knowledge Index (KI) in the Arab region and world regions (1995-2012)



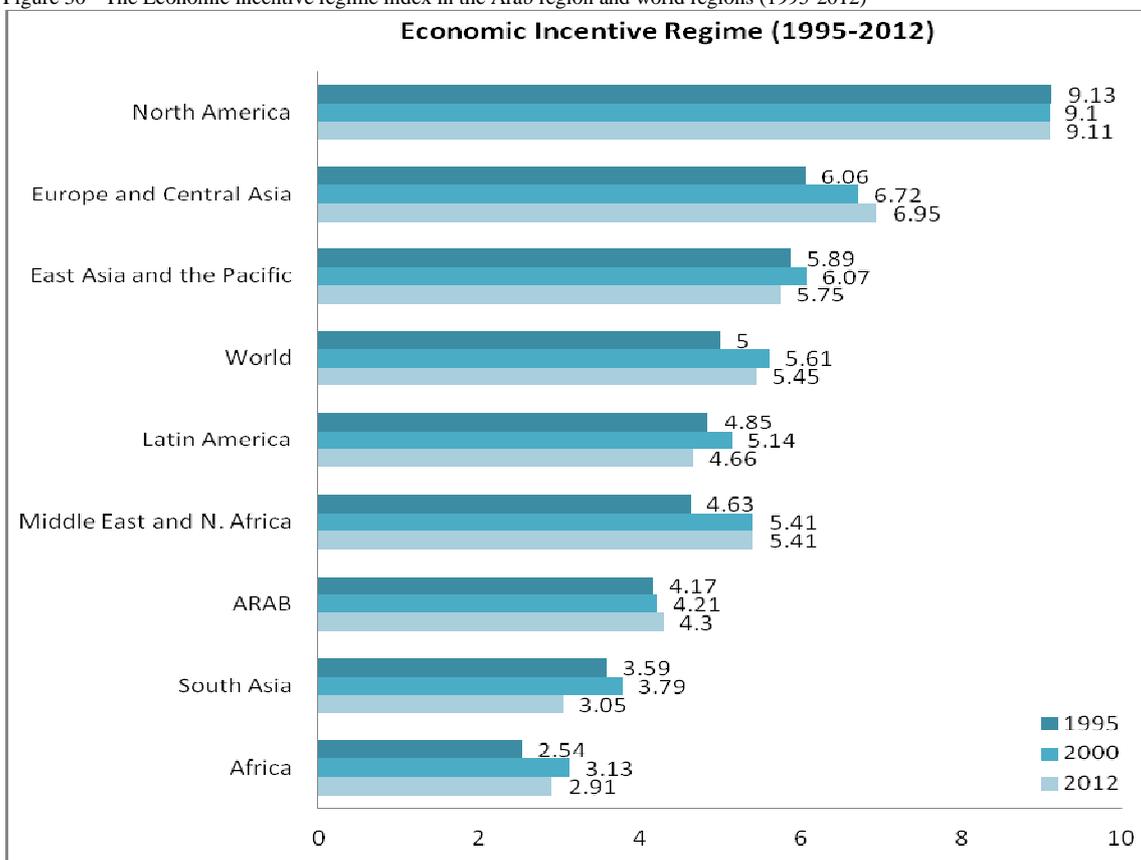
Source: Adapted from the World Bank (2012)

Figure 29 - The Knowledge Economy index (KEI) in the Arab region and world regions (1995-2012)



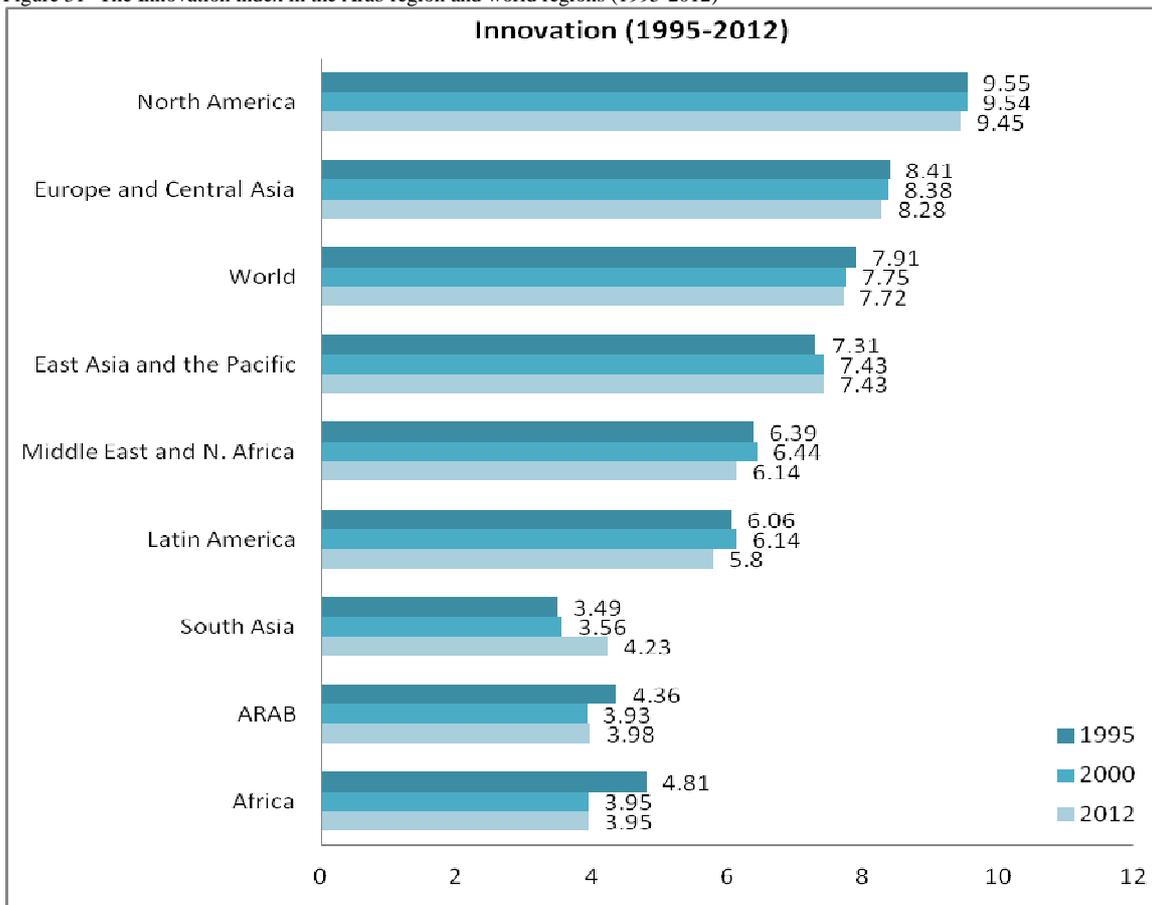
Source: Adapted from the World Bank (2012)

Figure 30 - The Economic incentive regime index in the Arab region and world regions (1995-2012)



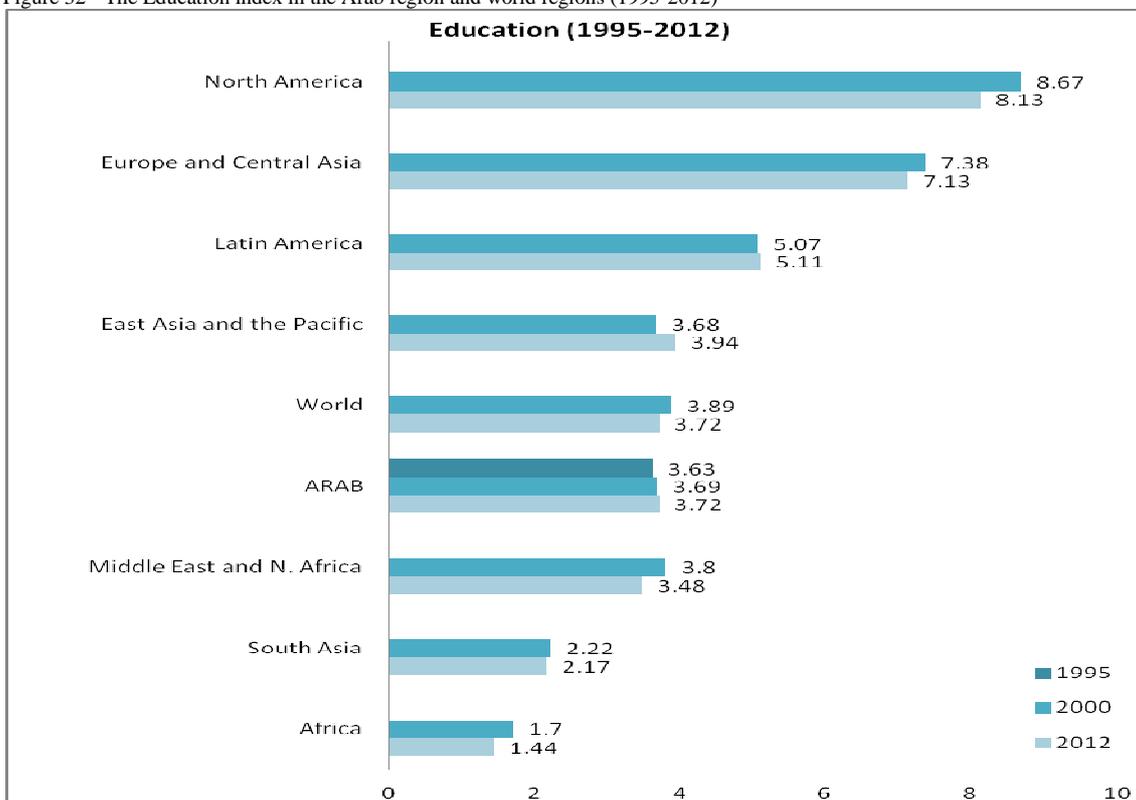
Source: Adapted from the World Bank (2012)

Figure 31- The Innovation index in the Arab region and world regions (1995-2012)



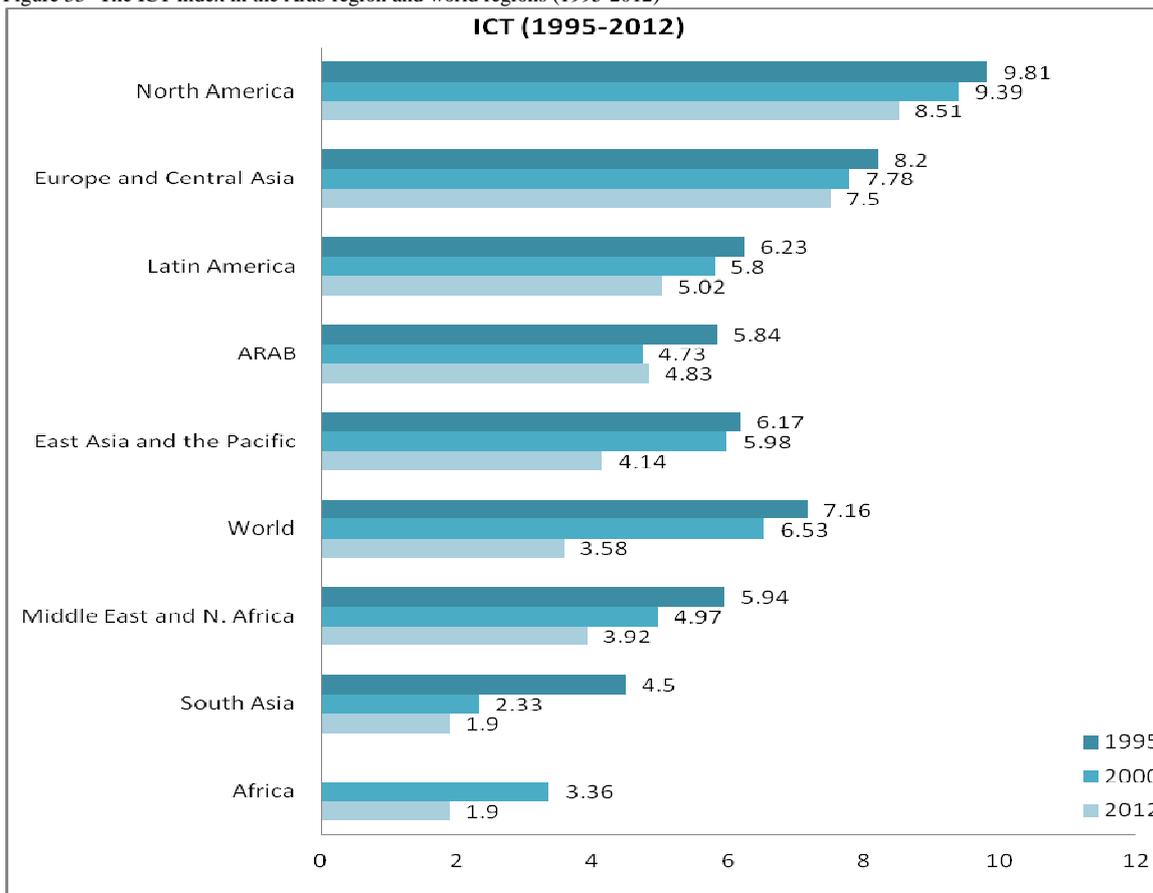
Source: Adapted from the World Bank (2012)

Figure 32 - The Education index in the Arab region and world regions (1995-2012)



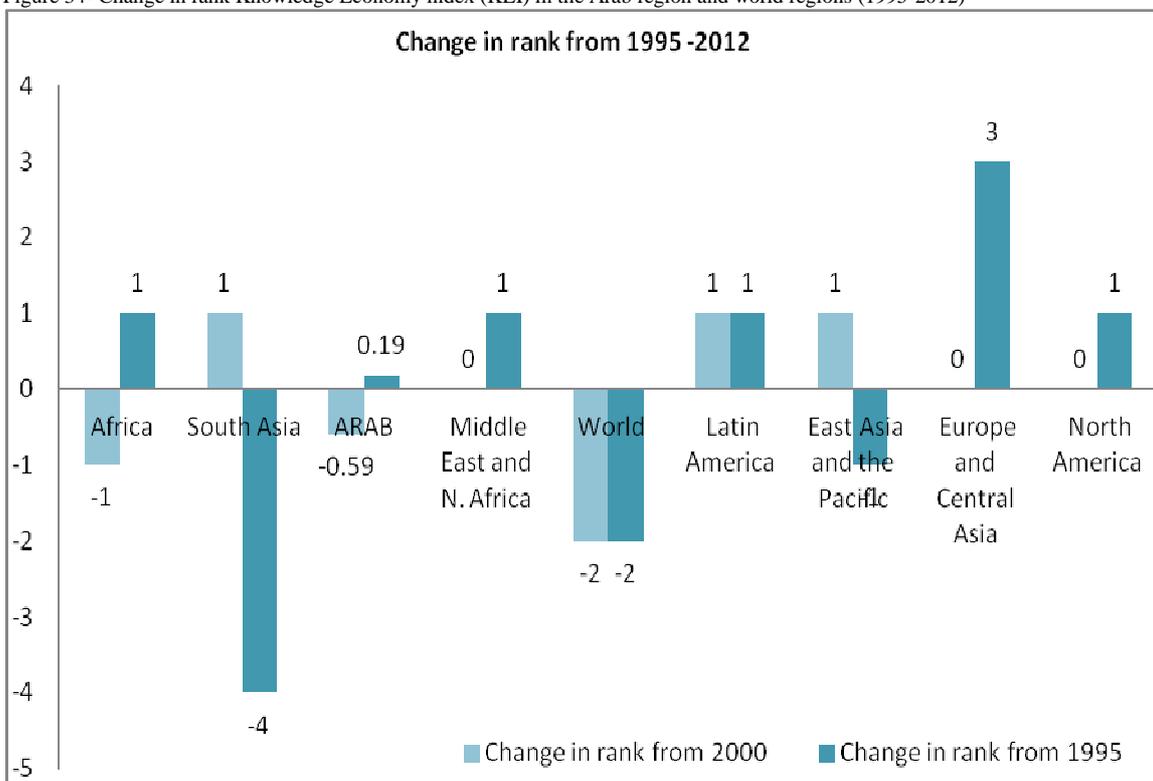
Source: Adapted from the World Bank (2012)

Figure 33- The ICT index in the Arab region and world regions (1995-2012)



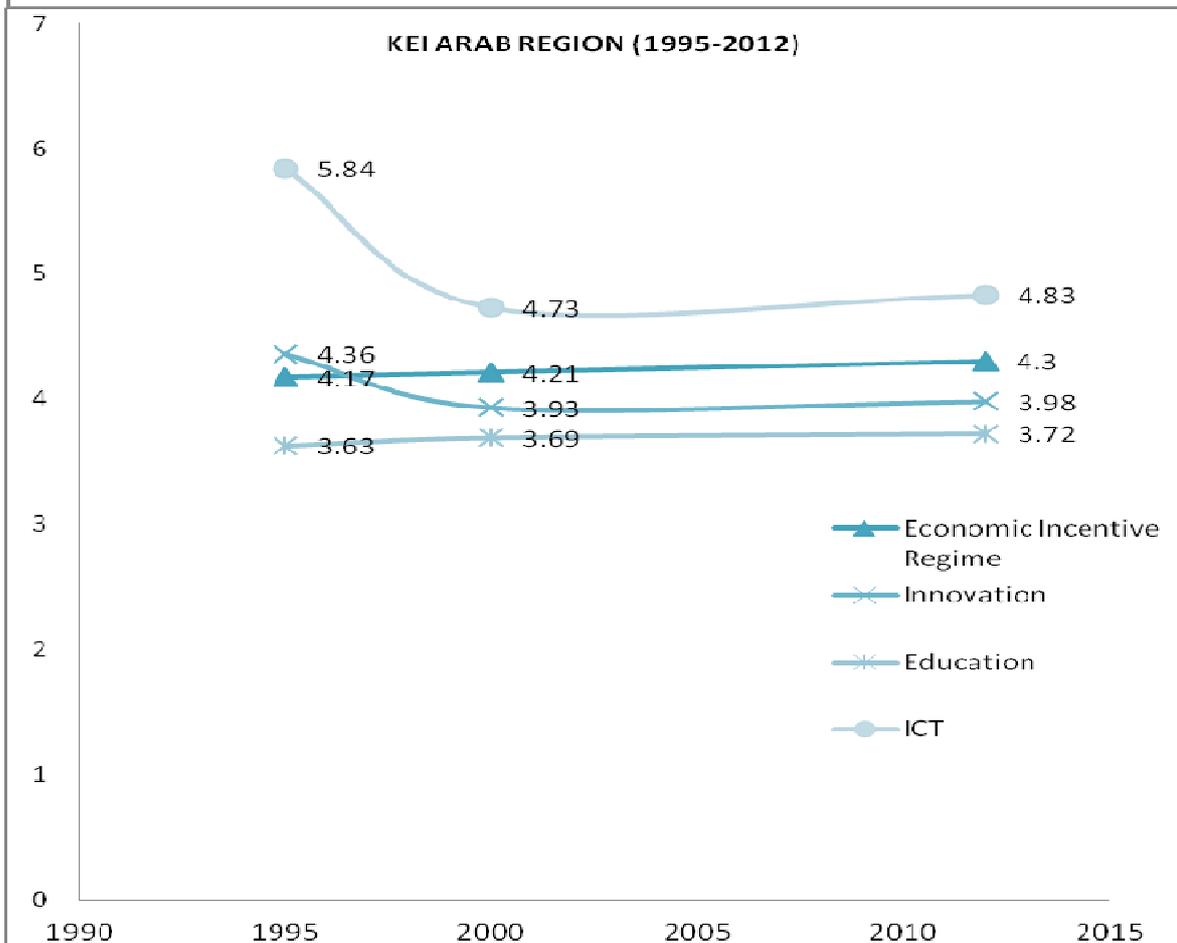
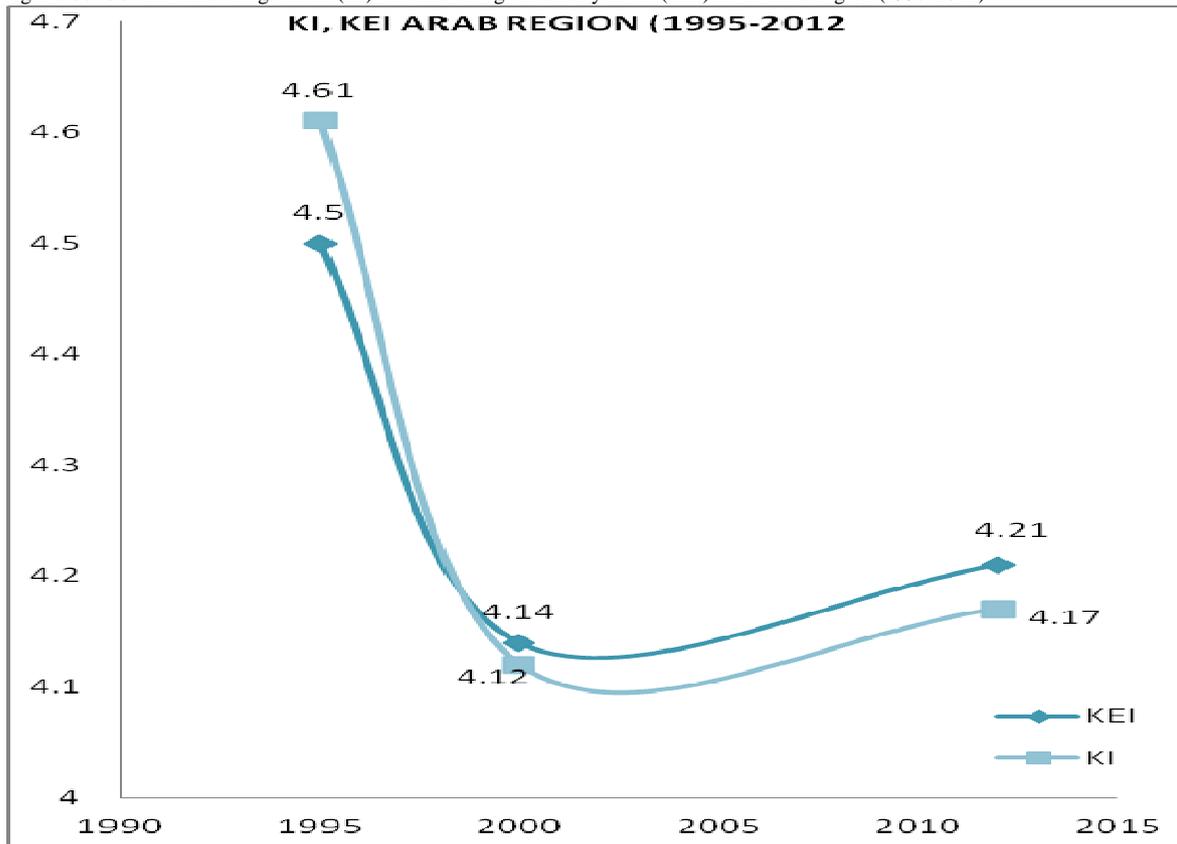
Source: Adapted from the World Bank (2012)

Figure 34- Change in rank Knowledge Economy index (KEI) in the Arab region and world regions (1995-2012)



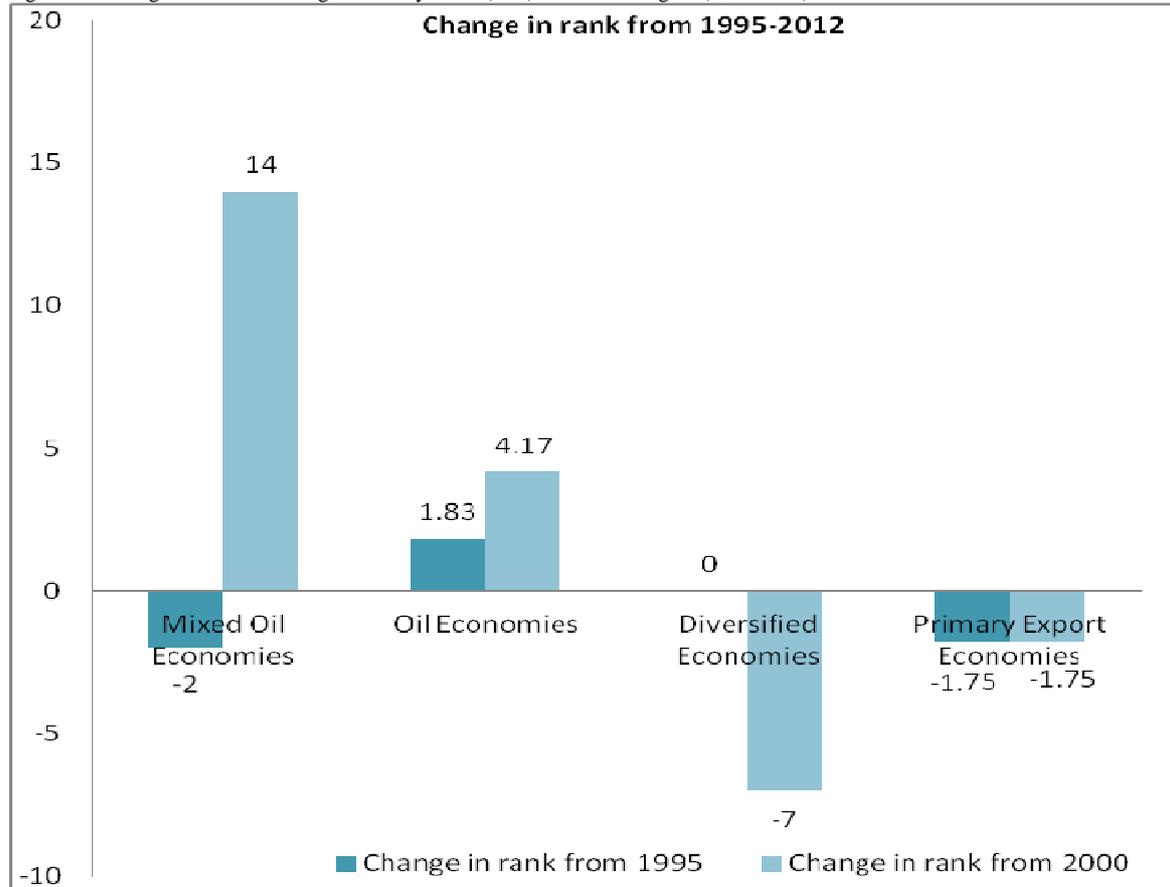
Source: Adapted from the World Bank (2012)

Figures 35- 36- The Knowledge index (KI) and Knowledge Economy index (KEI) in the Arab region (1995-2012)



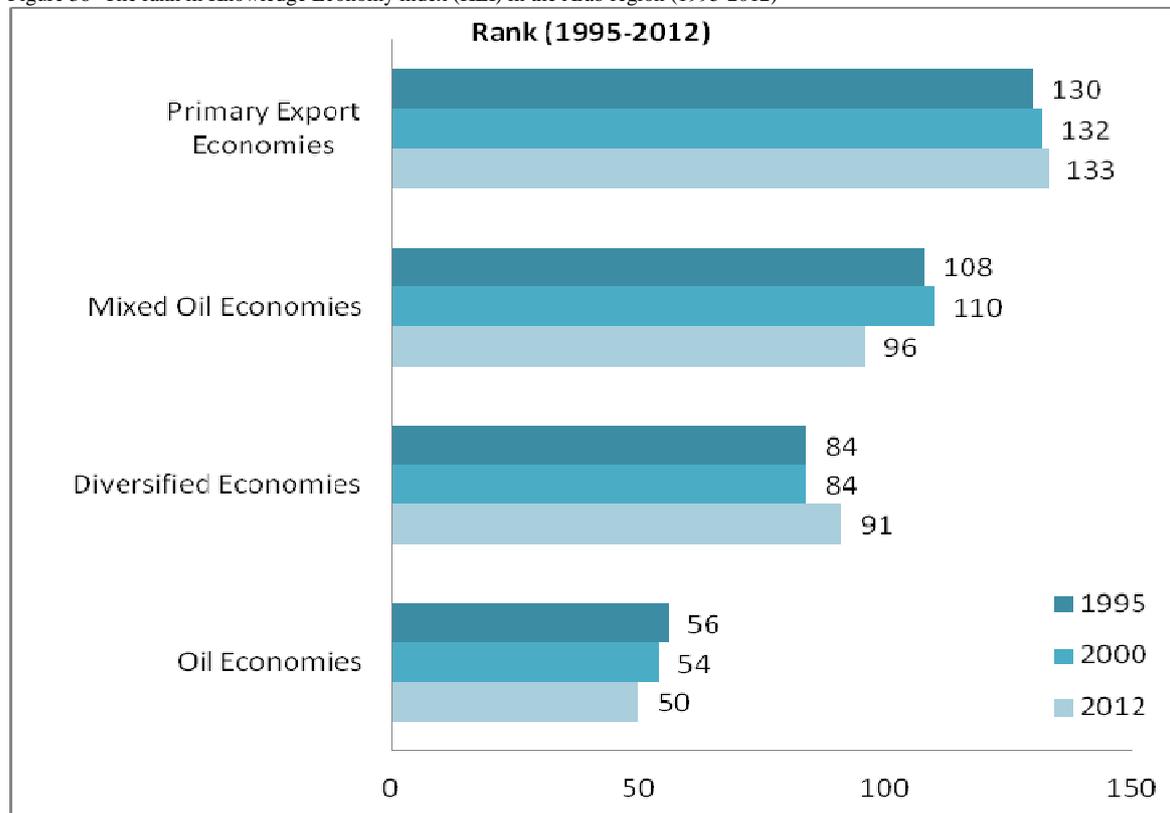
Source: Adapted from the World Bank (2012)

Figure 37- Change in rank Knowledge Economy index (KEI) in the Arab region (1995-2012)



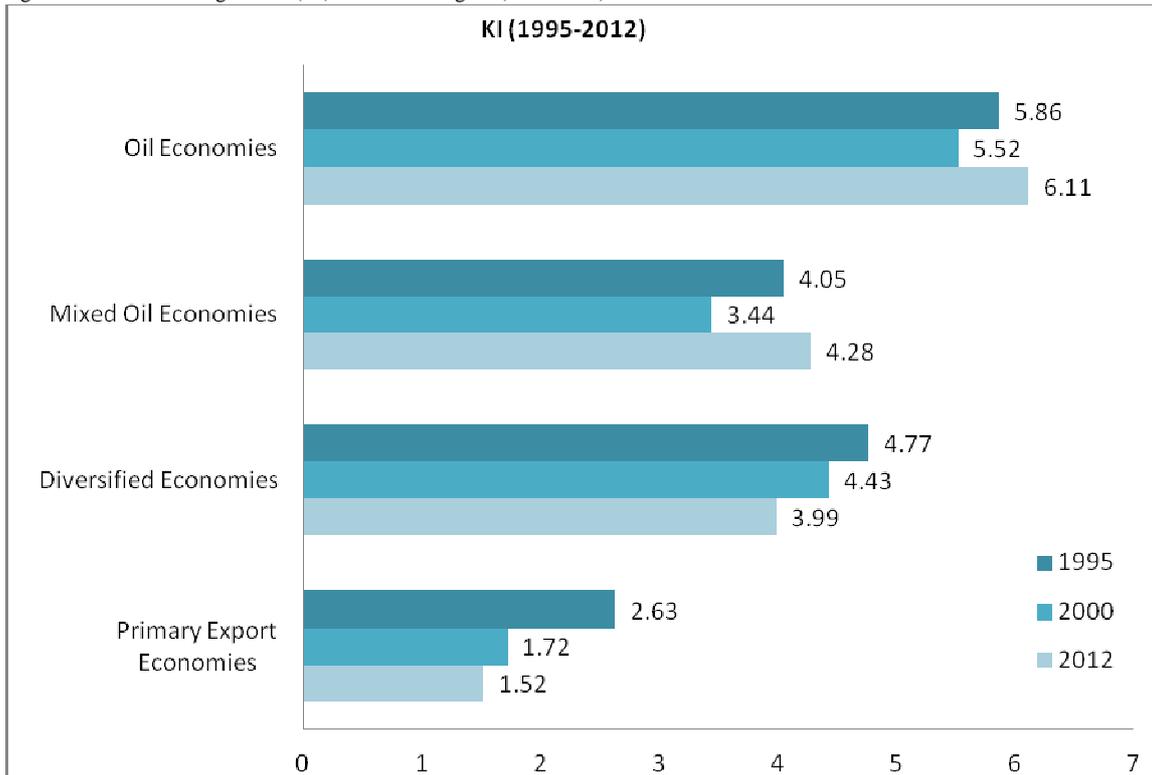
Source: Adapted from the World Bank (2012)

Figure 38- The rank in Knowledge Economy index (KEI) in the Arab region (1995-2012)



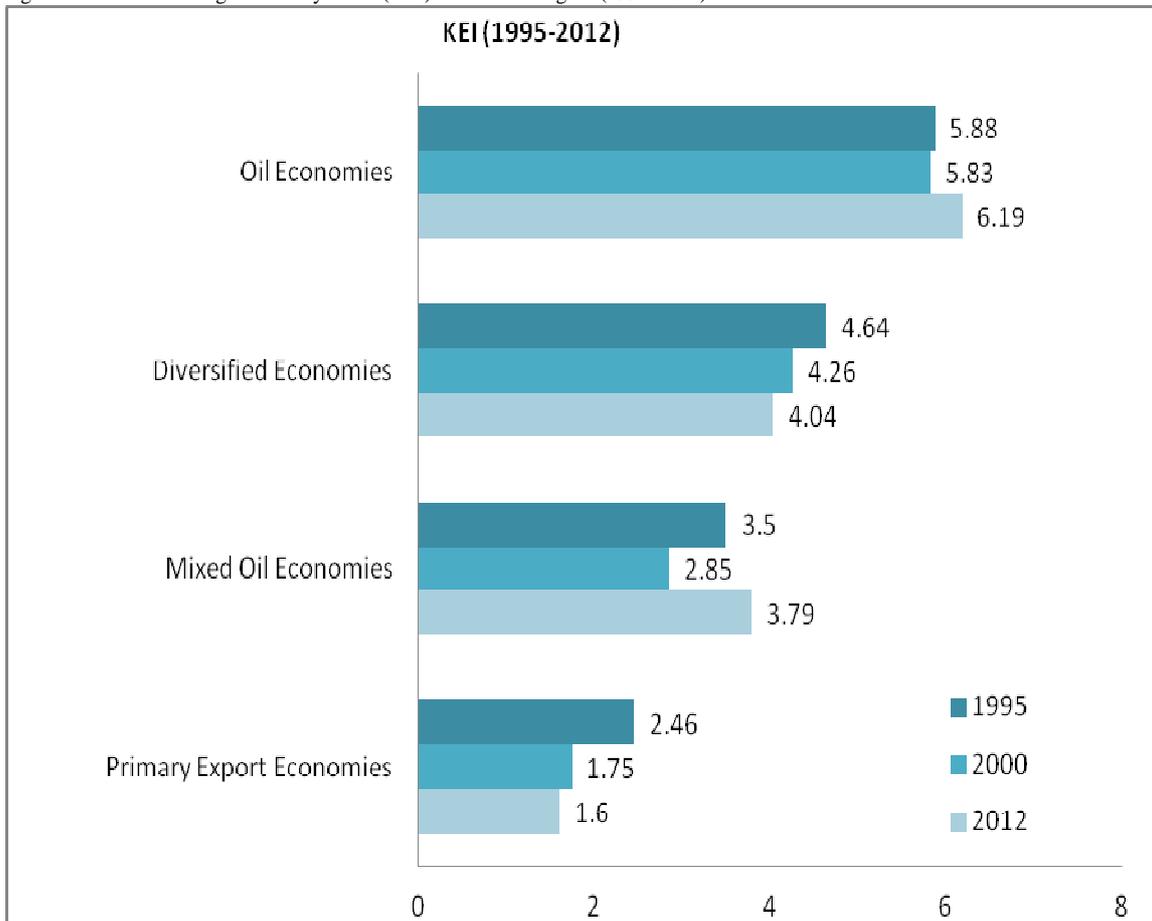
Source: Adapted from the World Bank (2012)

Figure 39- The Knowledge index (KI) in the Arab region (1995-2012)



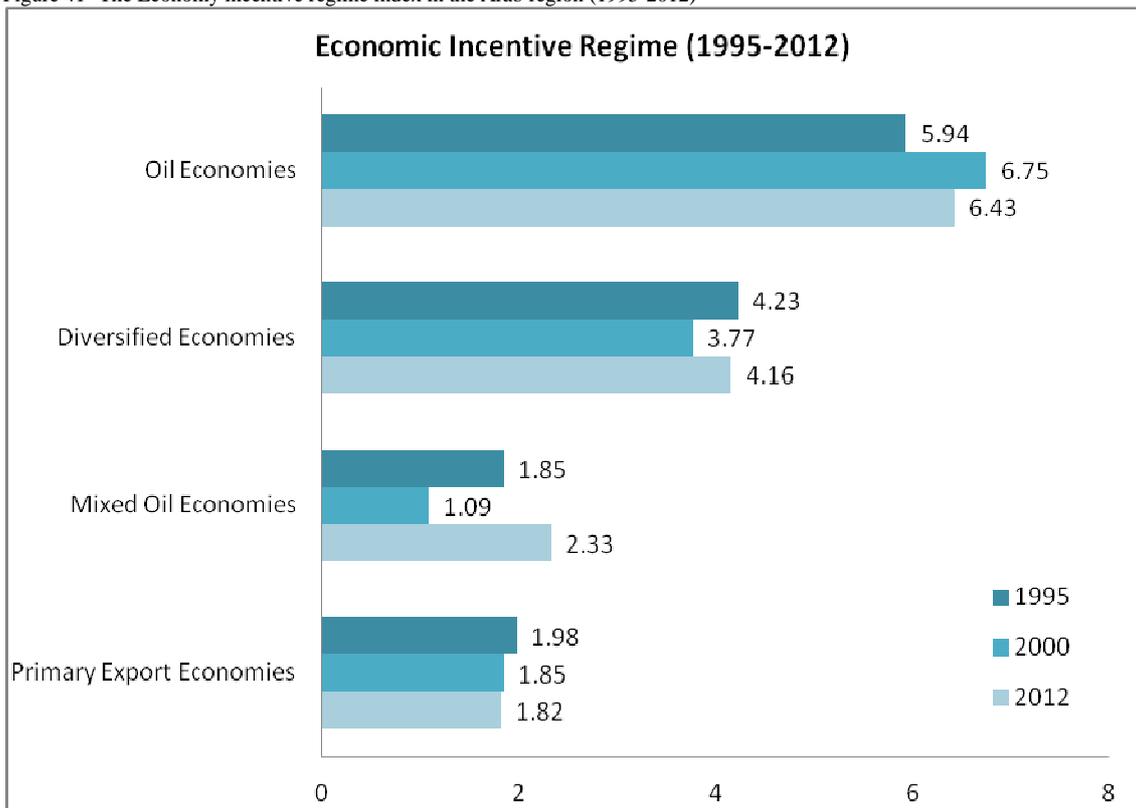
Source: Adapted from the World Bank (2012)

Figure 40- The Knowledge Economy index (KEI) in the Arab region (1995-2012)



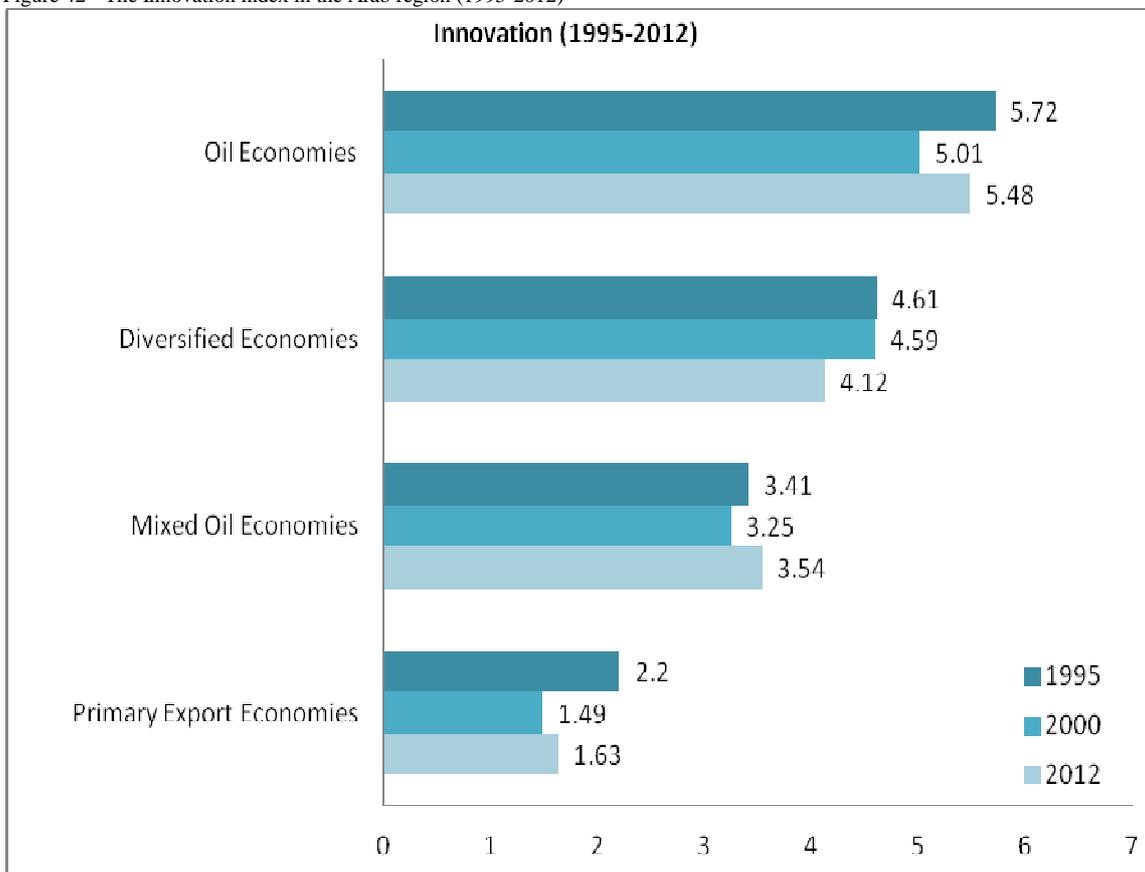
Source: Adapted from the World Bank (2012)

Figure 41- The Economy incentive regime index in the Arab region (1995-2012)



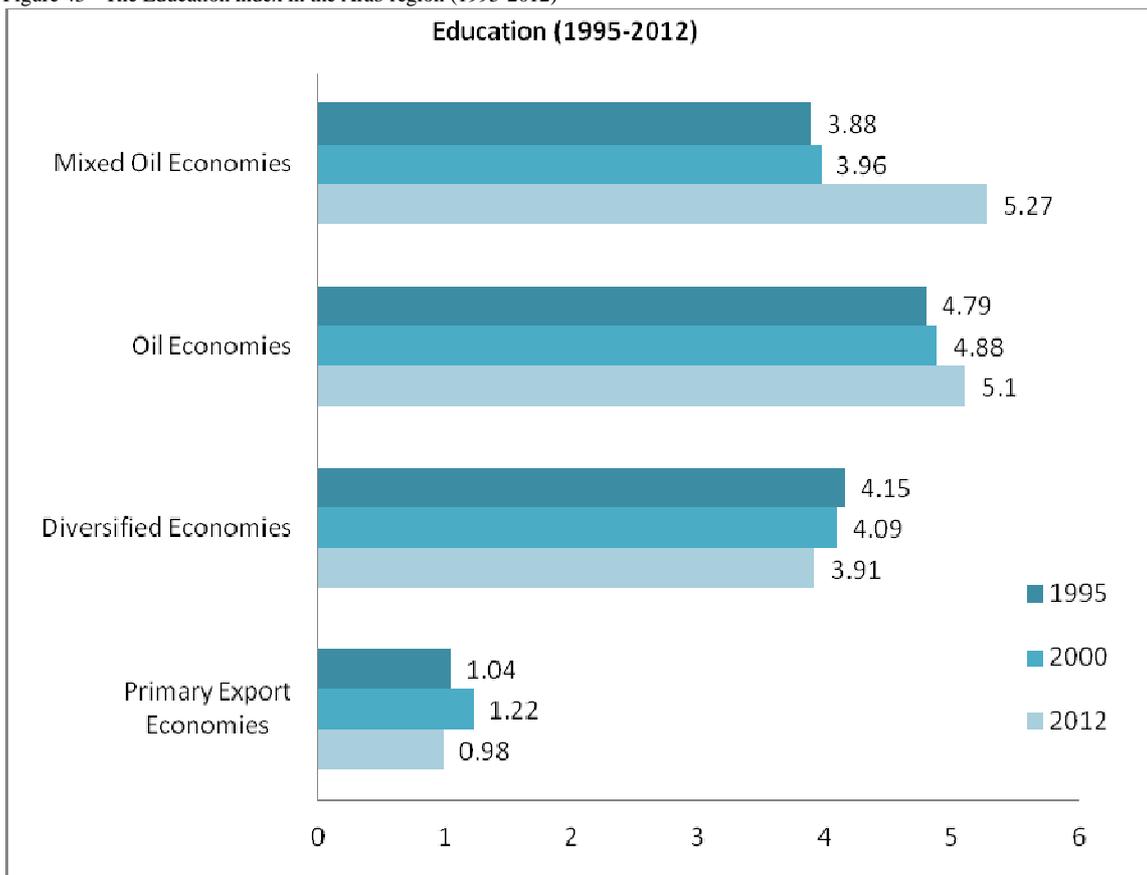
Source: Adapted from the World Bank (2012) accessed on October 10, 2012

Figure 42 - The Innovation index in the Arab region (1995-2012)



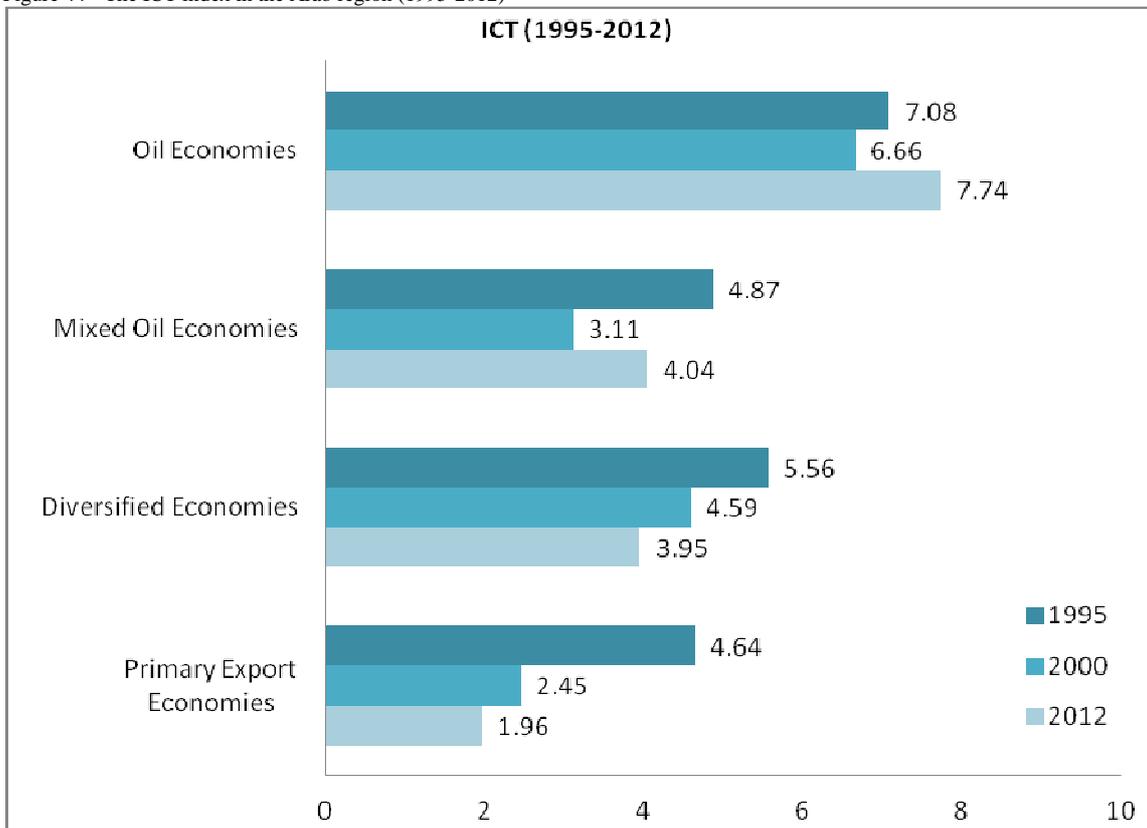
Source: Adapted from the World Bank (2012)

Figure 43 - The Education index in the Arab region (1995-2012)



Source: Adapted from the World Bank (2012)

Figure 44 - The ICT 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.

5. The interaction between knowledge economy and economic structure in the Arab region

Based on the above background this section discusses the research questions and hypotheses concerning the interaction between knowledge economy and economic structure in the Arab region using the OECD (1996) definition of knowledge-based economy and the World Bank Knowledge Index and Knowledge Economy Index. This section therefore explains that such a transition is seriously impeded by economic structure.

We find that 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, KI, KEI. They fail to present a coherent and convincing performance in terms of transition to knowledge based economy partly due to unpredictable and volatile trend in growth rates coupled with increasing unemployment, insignificant economic impacts of ICT¹¹ and failure to attract FDI, to promote efficient educational system, local technological capabilities, skills and heavy dependence on foreign technologies.¹² And also mainly because of the structural problem of Arab Gulf economies, notably, the heavy reliance on rent-seeking and natural resource- (oil and natural gas) based economies impeded transition to knowledge-based economies.

From economic perspective, since the structure of the economies in the Arab region is related to oil, it will be useful to explain the interaction between economic structure and the transition to knowledge based-economies in the Arab countries. From economic perspective, the transition to knowledge-based economies in the Arab region is probably seriously impeded by the prevalence of rent-seeking economic structure, mainly; the economic structure that characterizes the Arab region. The stylized facts in the Arab literature confirm that oil provides a significant contribution for developing the economies and social welfare, mainly, in Arab Gulf countries; in particular, it leads to higher per capita income. Oil provides opportunity and challenge for transition to knowledge based economy in Arab countries. Concerning the challenge, the heavy reliance on oil, gas and natural resources in the Arab countries implies challenge for transition to knowledge based economy. Similar to typically rent-seeking and oil-based (natural resources-based) economies; the transition to knowledge-based economies in Arab countries is impeded by the prevalence of the oil based economic structure. Notably, the rent-seeking and oil-based economy implies heavy reliance of the economy on natural resources (oil and natural gas), rather than knowledge resources. This challenge of weak knowledge based economies in the Arab region is well documented in the Arab literature (cf. UNDP-AHDR, 2002; 2003; 2009; UNDP-MBRF-Arab Knowledge Report, 2009; 2010;

¹¹ See Nour (2002b) and Pohjola (2002) and Kenny (2002) for evidences of insignificant impacts of ICT in developing countries.

¹² See, for example, Muysken and Nour (2006).

Nour, 2010; 2013a; 2014a, b). The dominance of rent-seeking economic structure and oil-based economies in the Arab region implies great risk and uncertainty because the heavy reliance on production and export of oil implies dependence on a single, decreasing, exhaustible and non-renewable economic resource. This impedes the creation of enabling economic environment for transition to knowledge-based economy that depends on knowledge, which is an abundant and renewable economic resource that can be easily diffuse and accumulate to prevent the diminishing returns to scale and ensure the increasing returns and dynamic growth in the economy. So Arab countries face the challenge to utilise current oil revenues to build the economy on new and renewable sources of income, to facilitate transition and shift from the oil-based economy to knowledge-based economy and sustainable development in Arab countries.

The impact of the economic structure on knowledge index can be explained also by the innovation index for instance, the Global Innovation Index Report *GII (2014)* shows that "*Three of the six countries of the Gulf Cooperation Council (GCC) come next (to the top two positions in the Northern Africa and Western Asia region): the United Arab Emirates (36th), Saudi Arabia (38th), and Qatar (47th). With per capita incomes ranging from PPP\$29,813.16 (Oman, 75th) to PPP\$98,813.66 (Qatar), most GCC economies achieve rankings below those of their peers in GDP per capita (with the exception of the UAE, which performs on par with those of its peers), a feature common to most resource-rich economies. The regional rankings are now more dispersed: Bahrain (62nd) comes behind Turkey (54th), Armenia (65th) and Kuwait (69th) come behind Jordan (64th), and Oman (75th) comes behind Georgia (74th). At the bottom of the regional rankings we find Lebanon (77th), Tunisia (78th), Morocco (84th), Egypt (99th), Azerbaijan (101st), Algeria (133rd), and Yemen (141st). [in the Arab region], Jordan remains in the group of innovation learners, while Saudi Arabia, Lebanon, Yemen, Algeria, Bahrain, Oman, Kuwait, and Qatar show below-par performances compared to their income levels.*"¹³ The GIIR (2014) indicates the incidence of the paradox of plenty phenomenon in the Arab region that implies *below-par performances or relative weaknesses in innovation ecosystems when compared with income levels. The GIIR (2014) indicates that in the Middle East, with the exception of the United Arab Emirates, the resource-rich economies of the Gulf Cooperation Council (GCC) are in this group: Qatar, Oman, Kuwait, Saudi Arabia, and Bahrain. Although the scaling by GDP of a few indicators penalizes these relatively wealthy countries, they often exhibit relative shortcomings in important areas in which this effect does not prevail, such as Institutions, Market sophistication, and Business sophistication. These countries, however, are uniquely positioned to do better in the years to come. Many of them have been diversifying towards innovation-rich sectors already. But several of these countries are resource-rich in oil, gas, or some other natural resource, and their resource-extracting activities tend to crowd out investment in other productive sectors and hinder innovation. This phenomenon—reminiscent of what has been called the ‘resource curse’ or the ‘paradox of plenty’—has been well documented historically and across regions, and is noted by the GII.*

The weak performance and deterioration in terms of innovation in the Arab countries that appears from the performance in the World Bank KI and KEI, as explained above, also appears from the performance in terms of Global Innovation Index (GII) issued by INSEAD (2009-2014). Mainly, that appears in score value and ranking of global indicators of innovation related to knowledge in Arab countries compared to other world countries, which implies that the score value and rank of some Arab

¹³ See the Global Innovation Index Report GIIR (2014): pp.28, 35. See also the Global Innovation Index Report GIIR (2013), p. 32.

countries deteriorated and for other improved by both international and regional standards over the period (2013-2014). For instance, in the International Standard Classification the performance and place of Arab countries in GII ranking over the period (2013-2014) implies that the United Arab Emirates maintained its top position in the Arab region for the second year, it is ranked at the top in the Arab regions and is ranked (36th) globally, followed by Saudi Arabia that maintained its second top position in the Arab region for the second year, it is ranked (38th) globally and Qatar that maintained its third top position in the Arab region for the second year, it is ranked (47) globally. The poor performance in innovation also appears from the poor progress in terms of score value of GII. For instance, the performance of the Arab countries regarding GII score value implies that in 2014 the United Arab Emirates UAE) (43.25, ranked 36 globally), ranked at the top in the Arab countries, followed by Saudi Arabia (41.61, ranked 38 globally), Qatar (40.31, ranked 47 globally), Bahrain (36.26, ranked 62 globally), Jordan (36.21, ranked 64 globally), Kuwait (35.19, ranked 69 globally), Oman (33.87, ranked 75 globally), Lebanon (33.6, ranked 77 globally), Tunisia (32.94, ranked 78 globally), Morocco (32.24, ranked 84 globally), Egypt (30.03, ranked 99 globally) and Algeria (24.2, ranked 133 globally) respectively. And finally at the bottom of the regional and global rankings we find Yemen (19.53, ranked 141 globally) and Sudan that ranked at the bottom place globally (12.66, ranked 143 globally) respectively. (See Table 3 and Figures 45-54)

The performance of the Arab countries concerning innovation input sub-index implies that in 2014 the United Arab Emirates (56.23, ranked 25 globally) ranked at the top in the Arab countries, followed by Qatar (50.38, ranked 34 globally), Saudi Arabia (47.85, ranked 39 globally), Bahrain (45.45, ranked 48 globally), Oman (42.82, ranked 59 globally), Lebanon (42.22, ranked 61 globally), Jordan (40.29, ranked 72 globally), Tunisia (39.75, ranked 77 globally), Kuwait (39.44, ranked 79 globally), Morocco (37.99, ranked 89 globally), Egypt (34.05, ranked 104 globally) and Algeria (31.65, ranked 122 globally) respectively. And finally at the bottom of the regional and global rankings we find Yemen (24.36, ranked 141 globally) and Sudan (23.2, ranked 142 globally) respectively. (See Table 3 and Figures 45-54)

The performance of the Arab countries concerning innovation output sub-index implies that in 2014 Saudi Arabia (35.37, ranked 41 globally) ranked at the top in the Arab countries, followed by Jordan (32.13, ranked 57 globally), Kuwait (30.94, ranked 62 globally), the United Arab Emirates (30.27, ranked 68 globally), Qatar (30.24, ranked 69 globally), Bahrain (27.08, ranked 80 globally), Morocco (26.49, ranked 86 globally), Tunisia (26.14, ranked 87 globally), Egypt (26.01, ranked 89 globally), Lebanon (24.98, ranked 95 globally), Oman (24.92, ranked 96 globally) and Algeria (16.74, ranked 132 globally) respectively. And finally at the bottom of the regional and global rankings we find Yemen (14.7, ranked 139 globally) and Sudan (2.11, ranked 143 globally) respectively. (See Table 3 and Figures 45-54)

The performance of the Arab countries concerning innovation efficiency index implies that in 2014 Jordan (0.8, ranked 40 globally) ranked at the top in the Arab countries, followed by Kuwait (0.78, ranked 50 globally), Egypt (0.76, ranked 59 globally), Saudi Arabia (0.74, ranked 70 globally), Morocco (0.7, ranked 83 globally), Tunisia (0.66, ranked 98 globally), Yemen (0.6, ranked 111 globally), Qatar (0.6, ranked 114 globally), Bahrain (0.6, ranked 117 globally), Lebanon (0.59, ranked 119 globally), Oman (0.58, ranked 121 globally), and the United Arab Emirates (0.54, ranked 127 globally) respectively. And finally at the bottom of the regional and global rankings we find Algeria (0.53, ranked 130 globally) and Sudan (0.09, ranked 143 globally) respectively. (See Table 3 and Figures 45-54)

The GII reports (2009-2014) show the performance of Arab countries concerning some indicators related to knowledge absorption, creation, impact and diffusion. The use of GII reports (2009-2014) and application of the OECD (1996) definition of knowledge-based economies- economies which are directly based on production, distribution and use of knowledge and information, also imply slight improvement in the performance concerning progress in transition to knowledge-based economy in the Arab countries that appears from the trend over the period (2011-2014) that implies that the performance of Arab countries has improved in some indicators, but has deteriorated in other indicators (see Table 3 and Figures 45-54).

The performance of the Arab countries regarding knowledge absorption implies that in 2014 Jordan (25.5, 69 ranked globally) ranked at the top in the Arab countries, followed by Lebanon (24, ranked 78 globally), Qatar (21.4, ranked 93 globally), the United Arab Emirates (19.5, ranked 104 globally), Sudan (19, ranked 110 globally), Saudi Arabia (17.7, ranked 113 globally), Tunisia (17.5, ranked 116 globally), Egypt (16.6, ranked 119 globally), Bahrain (13.5, ranked 128 globally), Morocco (13.3, ranked 130 globally), Algeria (12.1, ranked 135 globally) and Kuwait (9.5, ranked 138 globally) respectively. And finally at the bottom of regional and global rankings we find Oman (8.9, ranked 139 globally) and Yemen (3.4, ranked 142 globally) respectively. (See Table 3 and Figures 45-54)

The performance of the Arab countries concerning knowledge creation implies that in 2014 Jordan (19.6, ranked 52 globally) ranked at the top in the Arab countries, followed by Lebanon (16.3, ranked 64 globally), Tunisia (13.8, ranked 67 globally), Egypt (11.5, ranked 71 globally), Saudi Arabia (10, ranked 78 globally), Morocco (9.3, ranked 86 globally), Kuwait (7.7, ranked 91 globally), the United Arab Emirates (7.7, ranked 92 globally), Algeria (5.5, ranked 108 globally), Oman (5.3, ranked 111 globally), Qatar (4.7, ranked 115 globally) and Yemen (3.6, ranked 129 globally) respectively. And finally at the bottom of the regional and global rankings we find Bahrain (3, ranked 131 globally) and Sudan (2.6, ranked 134 globally) respectively. (See Table 3 and Figures 45-54)

The performance of the Arab countries regarding knowledge impact implies that in 2014 Bahrain (42.8, ranked 53 globally) ranked at the top in the Arab countries, followed by Saudi Arabia (42.3, ranked 56 globally), Kuwait (37.3, ranked 73 globally), Jordan (35.3, ranked 80 globally), the United Arab Emirates (34.9, ranked 82 globally), Egypt (33.2, ranked 89 globally), Oman (32.8, ranked 92 globally), Algeria (32.4, ranked 93 globally), Morocco (31, ranked 101 globally), Qatar (29.5, ranked 106 globally), Tunisia (29.4, ranked 107 globally) and Lebanon (24.7, ranked 116 globally) respectively. And finally at the bottom of the regional and global rankings we find Yemen (18.5, ranked 119 globally), and Sudan (0.7, ranked 142 globally) respectively. (See Table 3 and Figures 45-54)

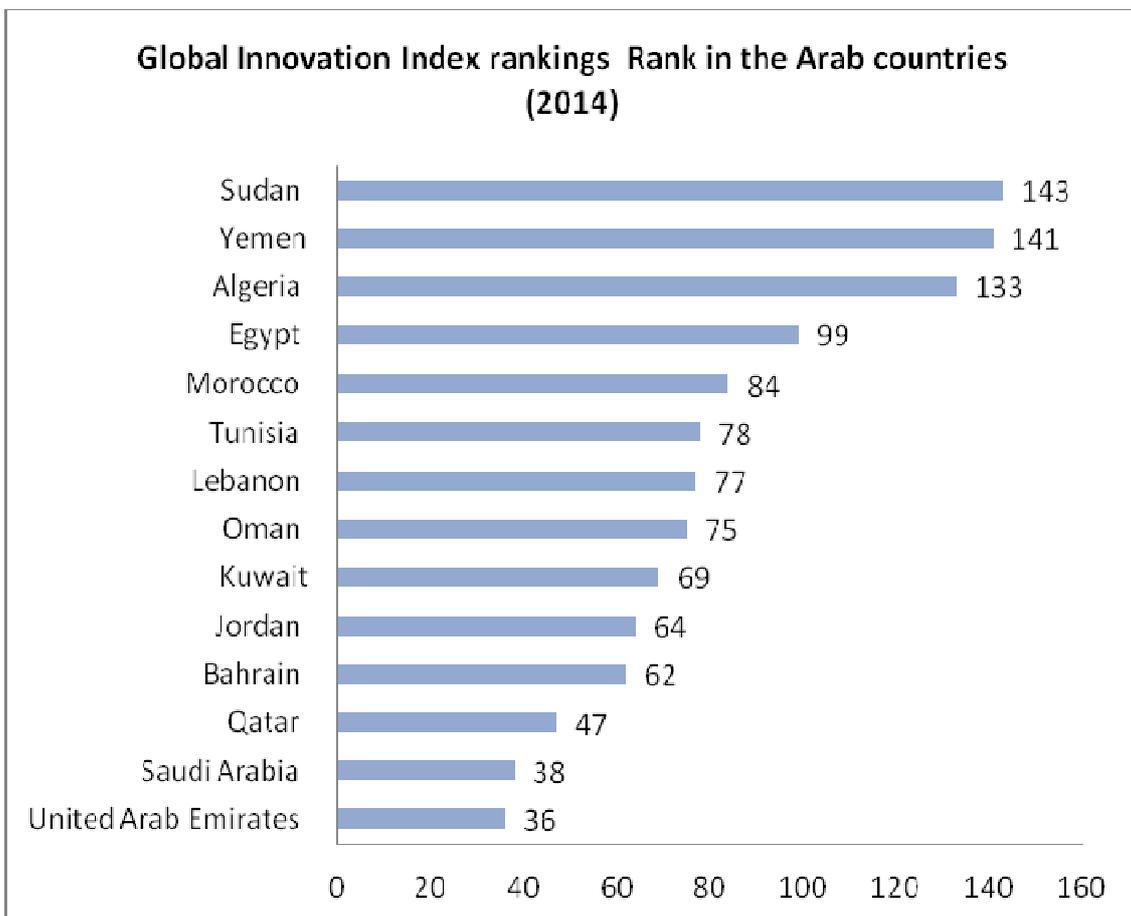
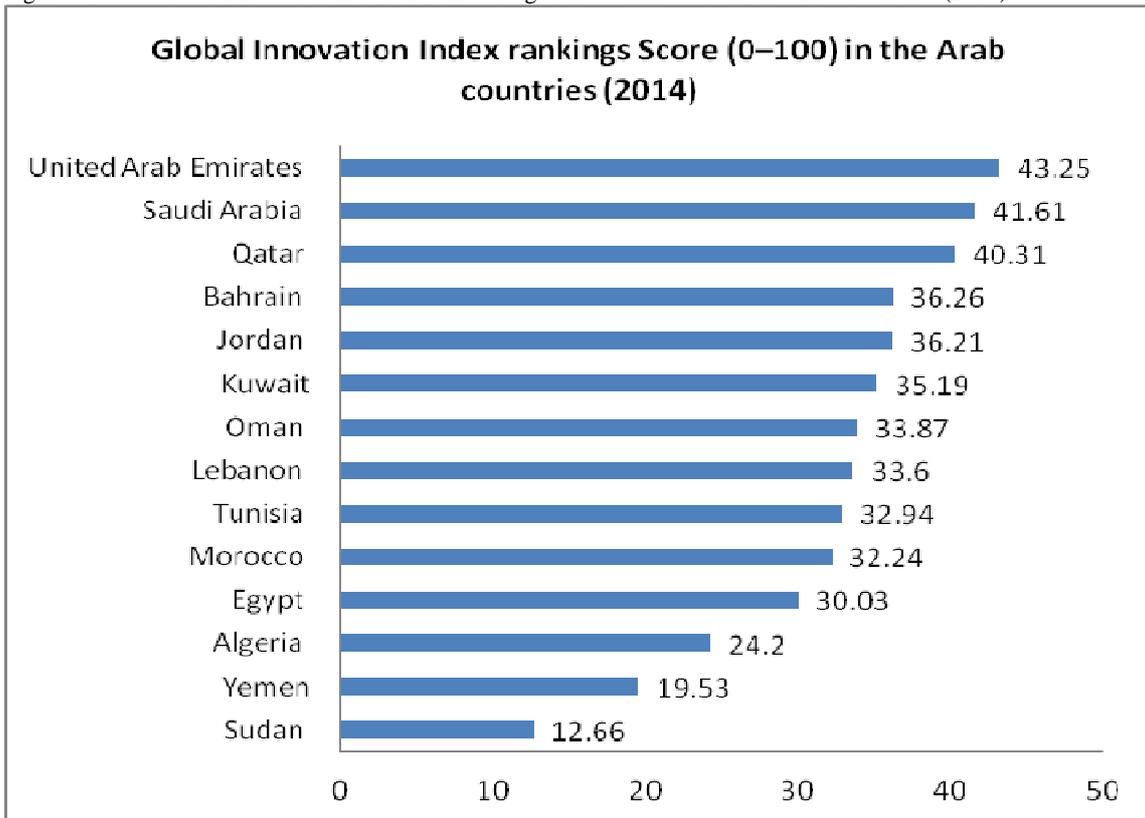
The performance of the Arab countries concerning knowledge diffusion implies that in 2014 Kuwait (56.4, ranked 6 globally) ranked at the top in the Arab countries, followed by Bahrain (39.4, ranked 34 globally), Morocco (36.3, ranked 43 globally), Jordan (33.3, ranked 57 globally), Egypt (31.4, ranked 69 globally), Qatar (27, ranked 94 globally), Lebanon (26.7, ranked 97 globally), Oman (25.6, ranked 107 globally), Saudi Arabia (25, ranked 109 globally), Algeria (20.5, ranked 129 globally), Tunisia (20.4, ranked 130 globally) and, Yemen (19.1, ranked 133 globally) respectively. And finally at the bottom of the regional and global rankings we find Sudan (3.8, ranked 137 globally) and the United Arab Emirates (0.3, ranked 141 globally) respectively. (See Table 3 and Figures 45-54).

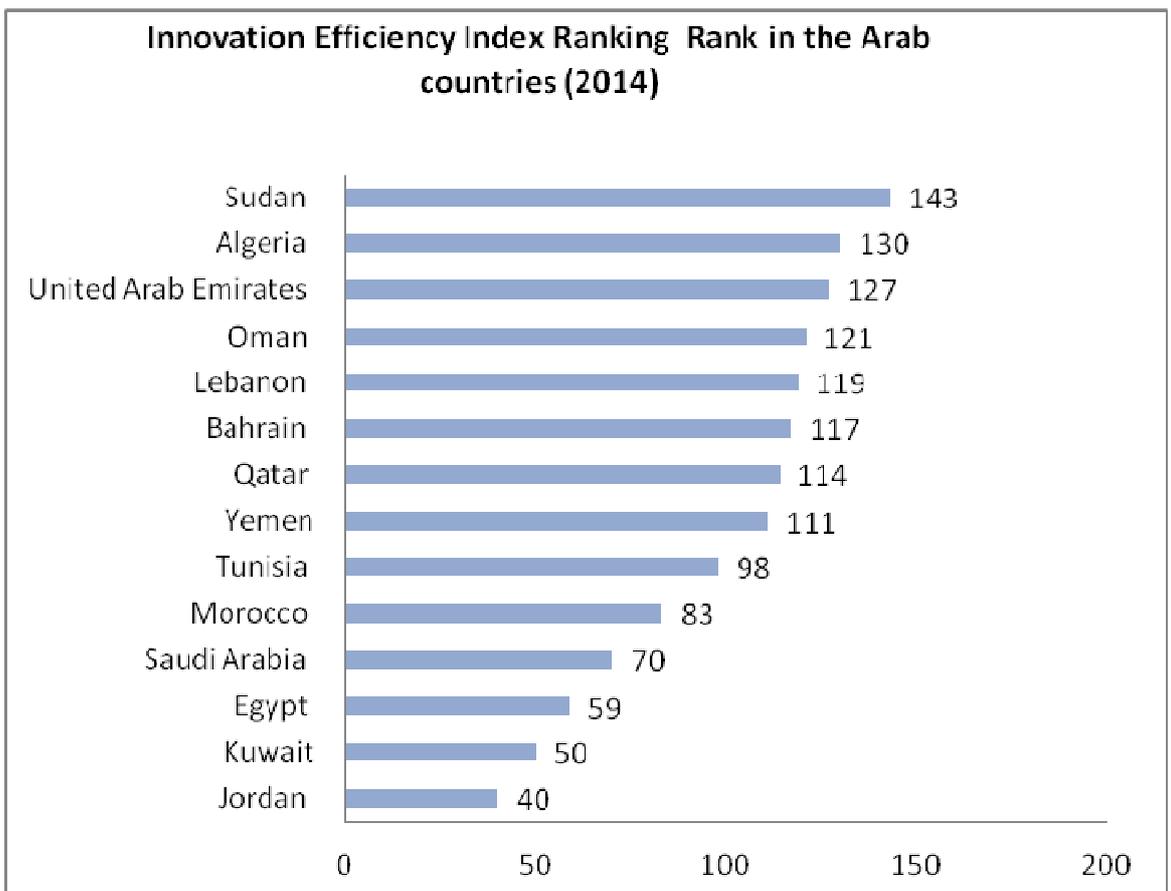
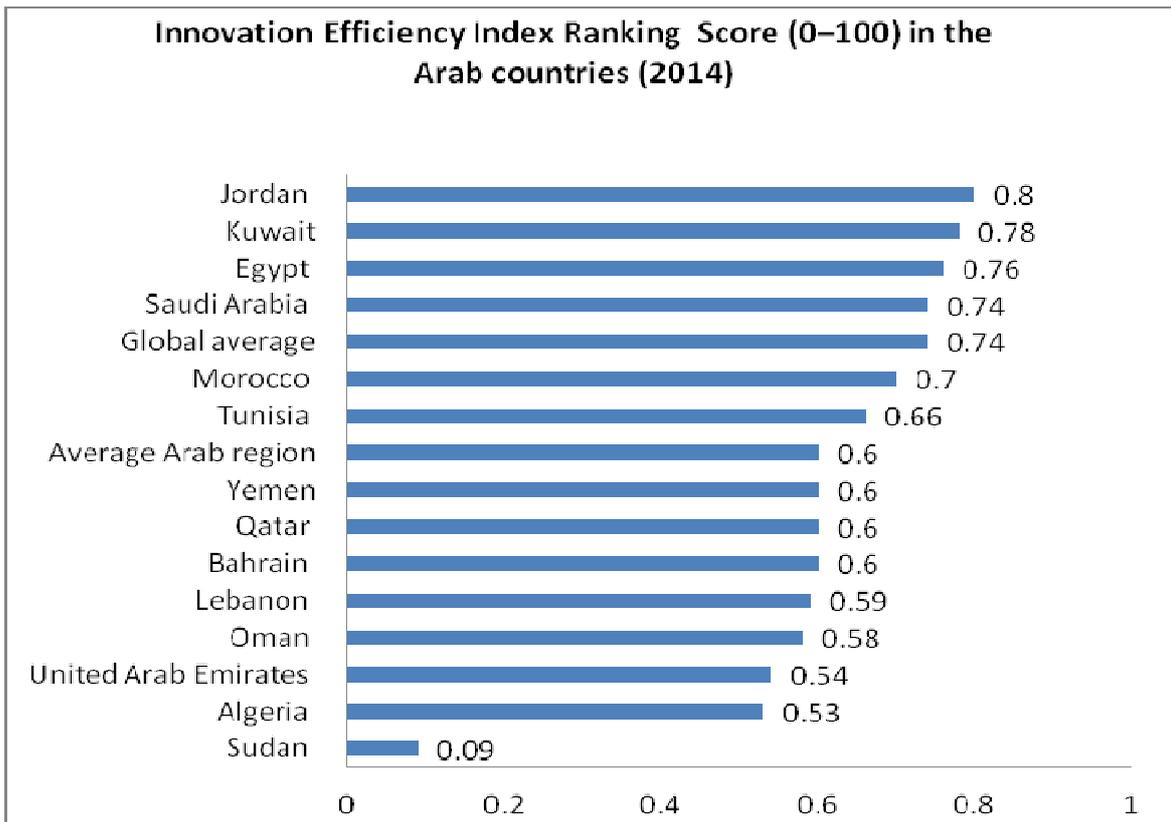
Table - 3- Global Innovation Index, knowledge indicators in the Arab countries (2014)

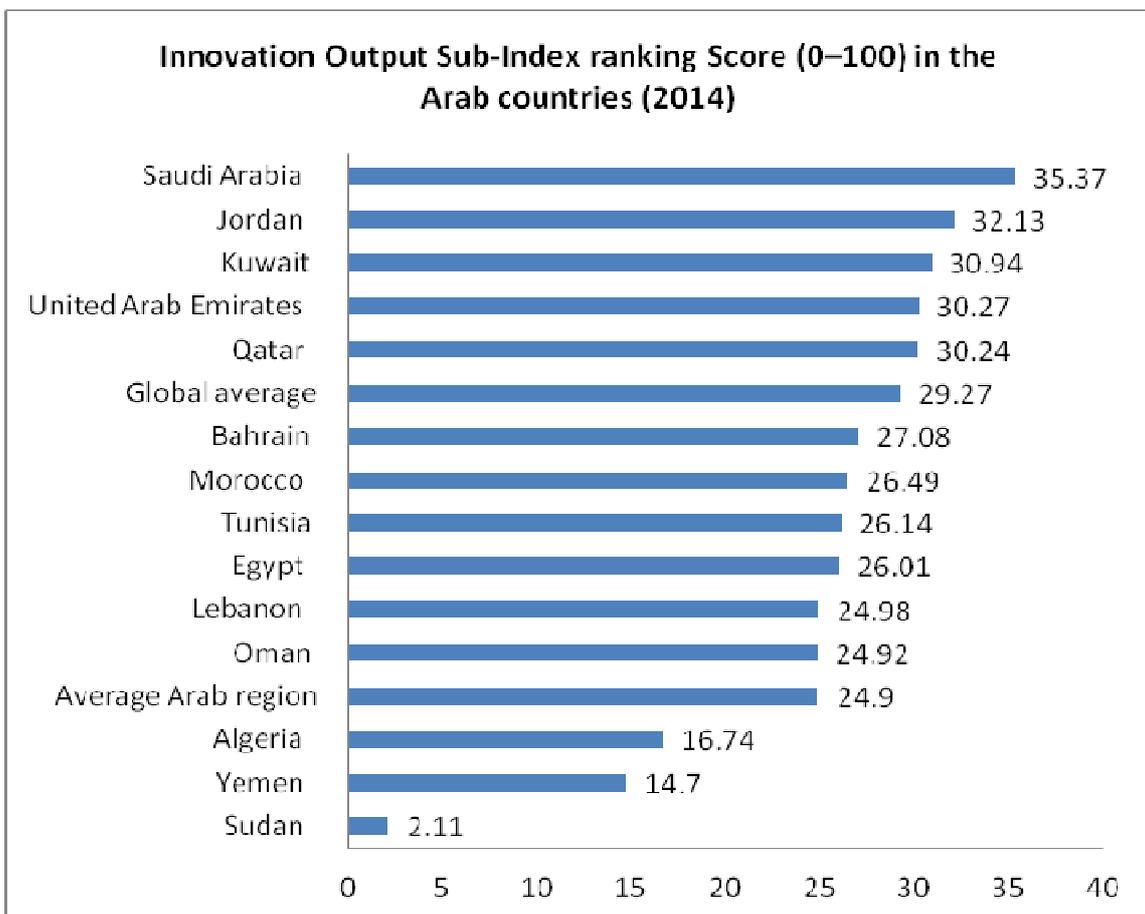
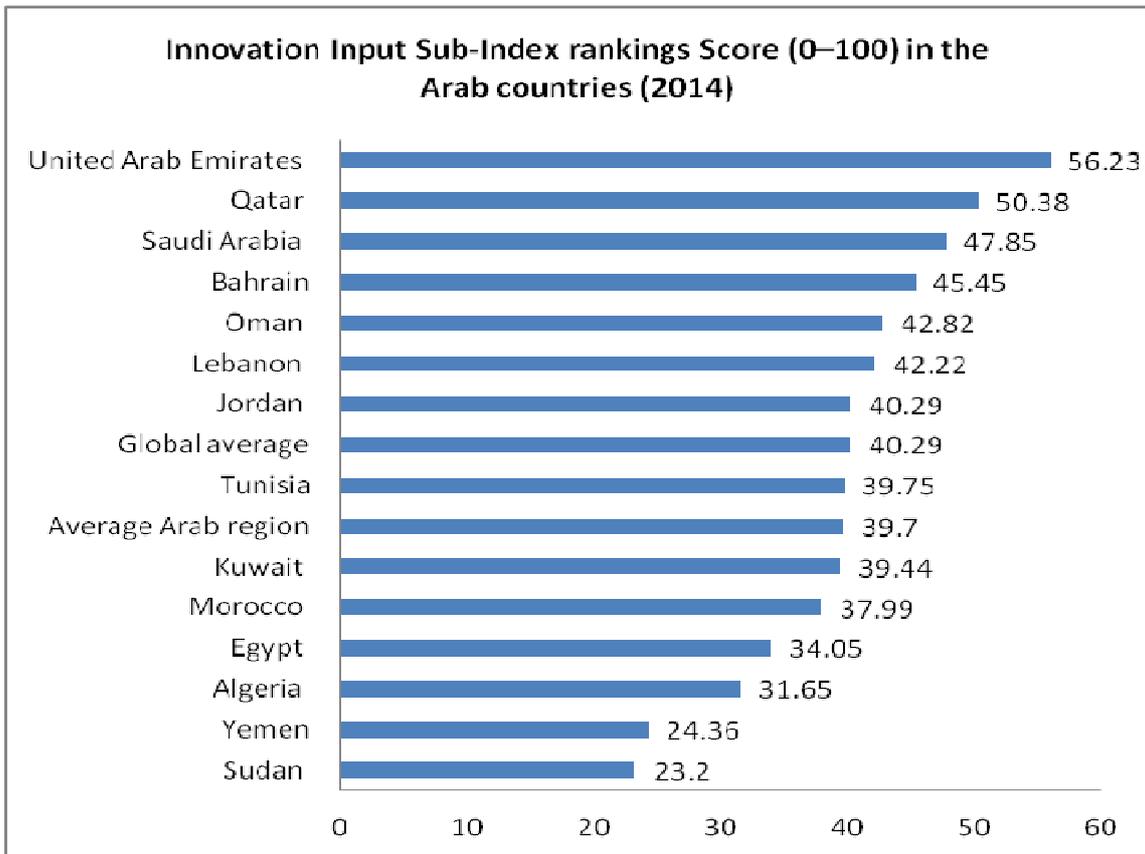
Country/ Economy	Global Innovation Index (GII)		Innovation Input Sub-Index		Innovation Output Sub-Index		Innovation Efficiency Index		Knowledge absorption		Knowledge creation		Knowledge impact		Knowledge diffusion	
	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank	Score (0-100)	Rank
United Arab Emirates (UAE)	43.25	36	56.23	25	30.27	68	0.54	127	19.5	104	7.7	92	34.9	82	0.3	141
Saudi Arabia	41.61	38	47.85	39	35.37	41	0.74	70	17.7	113	10	78	42.3	56	25	109
Qatar	40.31	47	50.38	34	30.24	69	0.6	114	21.4	93	4.7	115	29.5	106	27	94
Bahrain	36.26	62	45.45	48	27.08	80	0.6	117	13.5	128	3	131	42.8	53	39.4	34
Jordan	36.21	64	40.29	72	32.13	57	0.8	40	25.5	69	19.6	52	35.3	80	33.3	57
Kuwait	35.19	69	39.44	79	30.94	62	0.78	50	9.5	138	7.7	91	37.3	73	56.4	61
Oman	33.87	75	42.82	59	24.92	96	0.58	121	8.9	139	5.3	111	32.8	92	25.6	107
Lebanon	33.6	77	42.22	61	24.98	95	0.59	119	24	78	16.3	64	24.7	116	26.7	97
Tunisia	32.94	78	39.75	77	26.14	87	0.66	98	17.5	116	13.8	67	29.4	107	20.4	130
Morocco	32.24	84	37.99	89	26.49	86	0.7	83	13.3	130	9.3	86	31	101	36.3	431
Egypt	30.03	99	34.05	104	26.01	89	0.76	59	16.6	119	11.5	71	33.2	89	31.4	69
Algeria	24.2	133	31.65	122	16.74	132	0.53	130	12.1	135	5.5	108	32.4	93	20.5	129
Yemen	19.53	141	24.36	141	14.7	139	0.6	111	3.4	142	3.6	129	18.5	119	19.1	133
Sudan	12.66	143	23.2	142	2.11	143	0.09	143	19	110	2.6	134	0.7	142	3.8	137
Average Arab countries	32.3		39.7		24.9		0.6		15.9		8.6		30		26	
Global average			40.29		29.27		0.74									

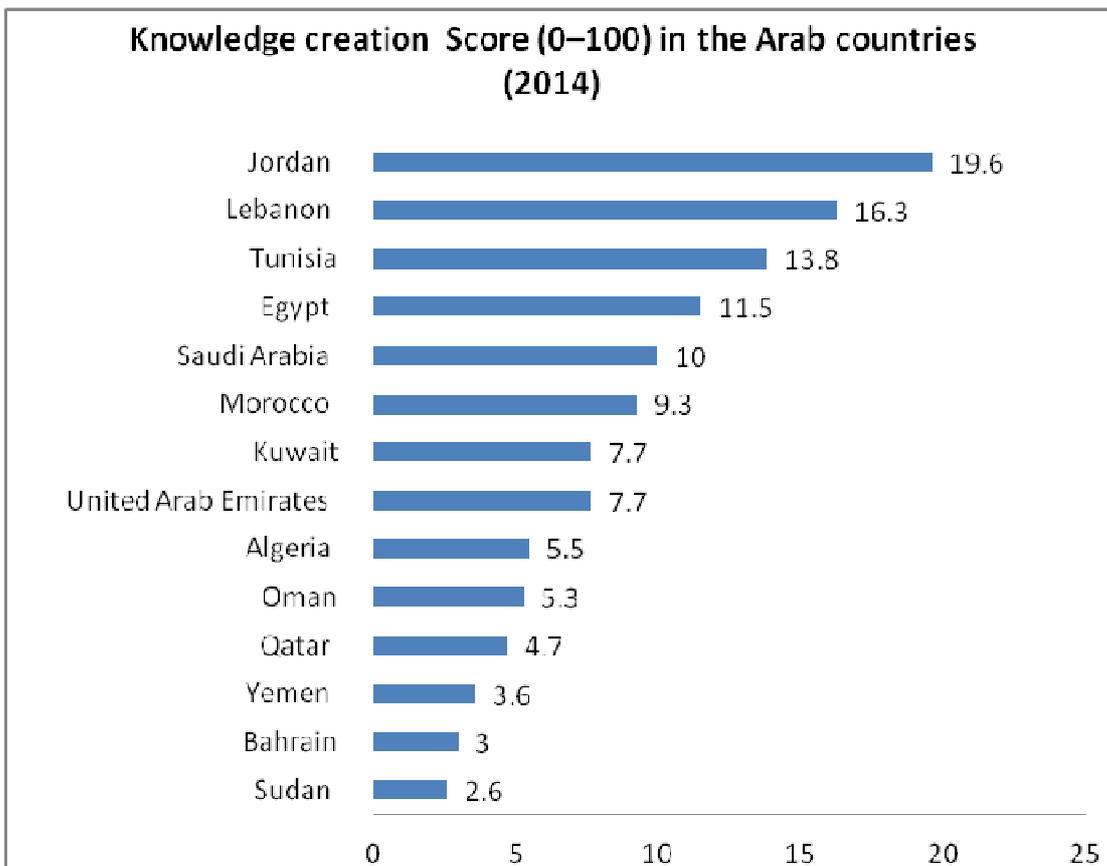
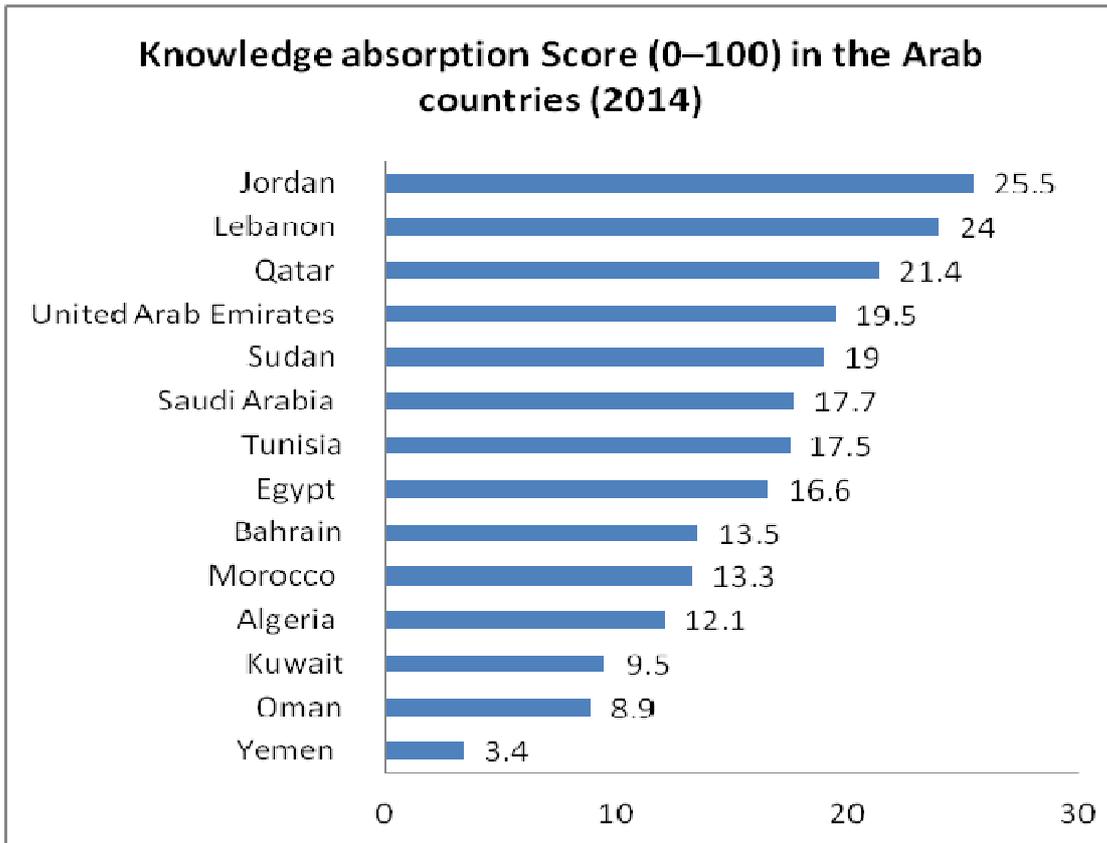
Source: The Global Innovation Index Report: GIIR (2014), pp. 14-19, 141, 148, 178, 205, 209, 212, 226, 237, 245, 249, 259, 269, 273, 280.

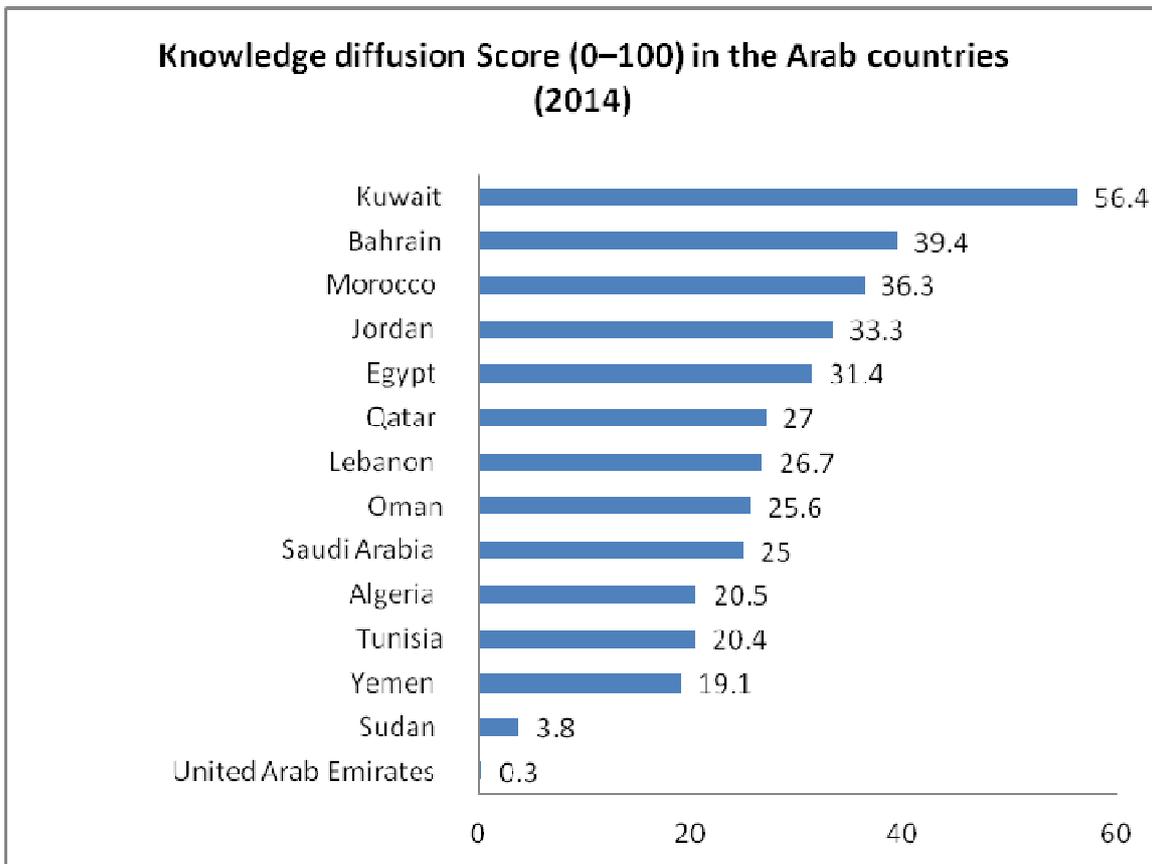
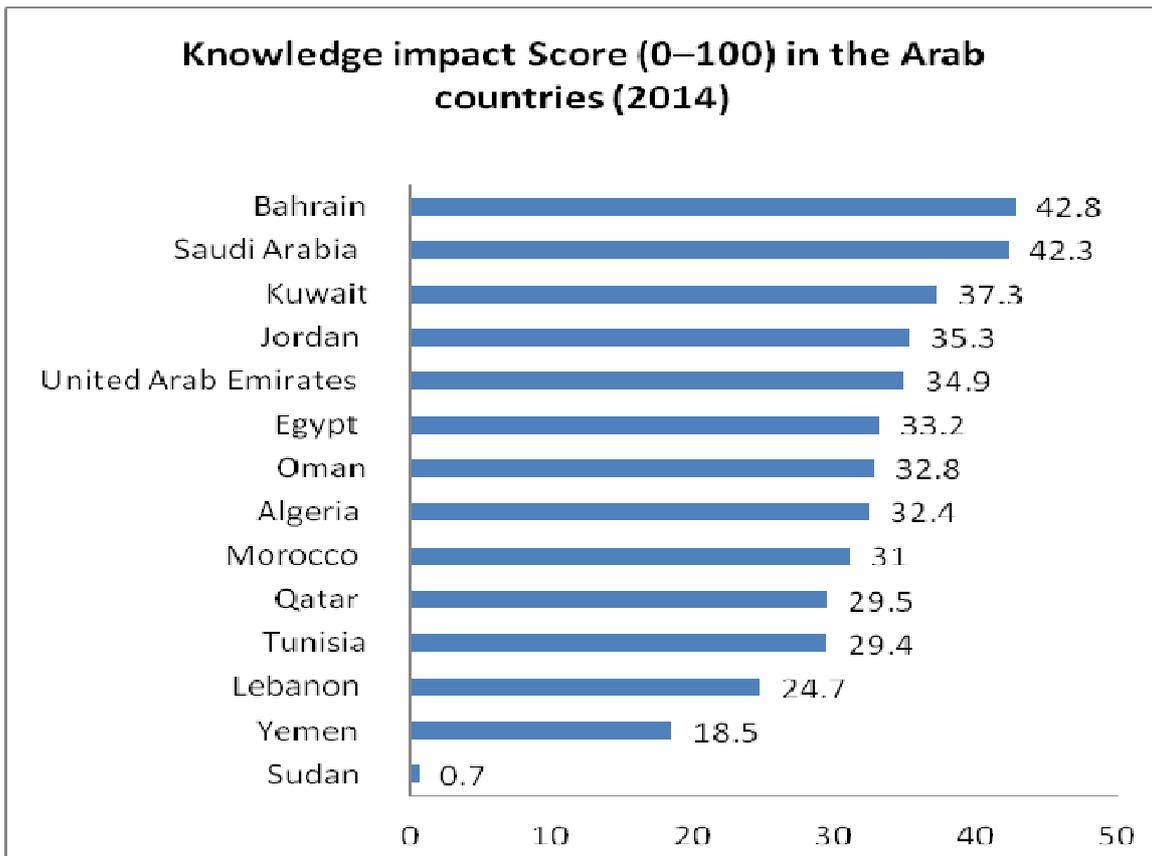
Figures 45-54- Global Innovation Index and Knowledge related Indicators in the Arab Countries (2014)











Source: The Global Innovation Index Report: GIIR (2014), pp. 14-19, 141, 148, 178, 205, 209, 212, 226, 237, 245, 249, 259, 269, 273, 280.

Therefore, our findings in this section implies relative progress to knowledge-based economy in the Arab countries that appears from slight improvement in some indicators, this slight improvement was reduced by the observed deterioration in terms of both GII and knowledge absorption index. This implies that to improve the performance and transition to knowledge economy, it is essential for the Arab countries to strengthen and improve the performance of GII and knowledge absorption index.

Therefore, based on the above findings, the transition to the knowledge-based economies should be a top priority in the Arab countries. Overcoming the major challenges hinder the transition to knowledge-based economies implies changing the economic structure, by shifting from natural resources-oil-based economies (rent-seeking economies) to knowledge based economies in Arab countries. To facilitate the transition to knowledge-based economies, Arab countries need to articulate strategies for their transition to the knowledge economies and build on their strengths and carefully plan appropriate investments in human capital, effective institutions, relevant technologies, and innovative and competitive enterprises. Arab countries need to strengths investment in four knowledge index pillars: efficient economic and institutional regime and incentives; efficient education and human resources and adequate availability of educated and skilled population, an efficient science, technology and innovation system, effective information and communication technologies, and coordination across these four pillars. Recognition of the importance of entrepreneurship, the central role of the private sector and collaboration between public and private sectors for enhancing the provision of infrastructure and incentives and encouragement of investment in research and training. In view of the fact that the public sector across Arab countries is still dominant, this may hinder transition to knowledge based economies, so the Arab countries face the challenge to reinforce the role private sector plays to facilitate transition to knowledge-based economies in Arab countries, by encouraging private sector participation and involvement in knowledge creation and diffusion. Among the priorities, special emphasis should be given, to enhancing knowledge diffusion, upgrading human capital, promoting organizational change and provision of enabling infrastructures through appropriate financial, competition, information and other policies. Learning from the experiences of other countries, e.g. Korea, the Arab countries need to implement coherent strategies for transition to knowledge – based economies by investing heavily in education and training, boosting innovation through intensive research and development, developing a modern and accessible information infrastructure, and creating stable and enabled economic and institutional regime and environment conducive to the transition to knowledge-based economies in the Arab region. Based on the findings the paper recommends that to improve transition to knowledge economy, it is essential for Arab countries to strengthen and improve KI and KEI by investing heavily in human capital, mainly, education and training, boosting innovation through intensive spending on research and development, improve innovation pillar, capacity for innovation, localization of technology, Global Innovation Index and knowledge absorption index.

Therefore, our results in this section corroborate the third hypothesis that the prevalent economic structure (rent-seeking) natural resources (oil and natural gas) based-economies has seriously impeded the transition to knowledge-based economies in the Arab region. Our findings support the fourth hypothesis concerning public policy instruments to facilitate the transition towards knowledge-based economies in the Arab region.

6. Conclusions

This paper we presents an overview of the knowledge economy in the Arab region, examines the interaction between knowledge economy and economic structure in the Arab region and contributes to recently published research studies that aim to improve understanding of the interaction between the transition to knowledge-based economies and economic structure in the developing countries.

This paper uses both the descriptive and comparative approaches and uses the OECD (1996) definition of knowledge-based economy, the World Bank Knowledge Index (KI) and Knowledge Economy Index (KEI) and other knowledge indicators often used in the international literature to examine the existence and development of knowledge economy and the interaction between knowledge economy and economic structure in the Arab region. We fill the gap in the Arab literature by explaining that the transition to knowledge-based economies in the Arab region is eminently impeded by the lack of efficient and appropriate economic structure, institutions, innovation and incentives in the Arab region. We provide 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 interaction between economic structure and knowledge economy in the Arab region.

Our findings support the first hypothesis that the knowledge economy exists in the Arab region but coincides with a 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. Our findings corroborate the third hypothesis that the prevalent economic structure (rent-seeking) natural resources (oil and natural gas) based-economies has seriously impeded the transition to knowledge-based economies in the Arab region. Our results support the fourth hypothesis concerning public policy instruments to facilitate the transition towards knowledge-based economies in the Arab region.

Our results illustrate that from economic perspective, the transition is seriously impeded by the prevalence of the rent-seeking economic structure that characterises the Arab region. The structural problem of Arab economies, notably, oil economies, implies heavy reliance on rent-seeking and natural resource- (oil and natural gas) based economies, rather than knowledge-based economies.

Therefore, the development of knowledge-based economies in the Arab region is reliant on the development of appropriate economic structure (shifting from the prevailing (rent-seeking) natural resources-based (oil) economies to knowledge-based economies). 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 Knowledge Economy Index (KEI) and Knowledge Index (KI) and all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT. It is essential for the Arab region to implement sound and coherent public policies to enhance innovation, incentives and institutions of higher education, S&T, R&D and ICT to accelerate and enhance transition to knowledge-based economies and to achieve economic and sustainable development in the Arab region.

References

- Dasgupta, P., David, P. (1994) "Toward a new economics of science," *Research Policy* 23 (5): 487-521.
- David, P.A. and Foray, D. (1994), "Dynamics of competitive technology diffusion through local network structures," in Leydesdorff and Van den Besselaar (eds.), *Evolutionary Economics and Chaos Theory*, Pinter.
- David, P. A. and Foray, D. (2001) "An Introduction To The Economy of the Knowledge Society." December 2001. MERIT – Infonomics Research Memorandum Series No. 2001- 041.
- Drucker, P (1998) "From Capitalism to Knowledge Society," in D. Neef (ed.) "The Knowledge Economy" Woburn MA: Butterworth (1998). P. 15.
- Gorzalak, G. Warsaw University (2001), Cited in World Bank, Discussion Paper incorporated in Cleaver, Kevin (2002): A Preliminary Strategy to Develop A Knowledge Economy in European Union Accession Countries, World Bank). URL link: <http://lnweb18.worldbank.org/ECA/ECSSD.nsf/ECADocByLink/Knowledge+Economy?OpenDocument>
- Grossman and Helpman, (1994) "Endogenous Innovation in the Theory of the Growth," *Journal of Economic Perspectives* 8 (1):23-44.
- International Telecommunication Union, 2012. Accessed 16 January 2013
- Langlois, R. N. (2001) "Knowledge, consumption, and endogenous growth," *Journal of Evolutionary Economics*, 11:77-93.
- Mohammed bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme/Regional Bureau for Arab States (UNDP/RBAS). (2009) "Arab Knowledge Report. 2009. Towards productive intercommunication for knowledge" Dubai: Al Ghurair Printing and Publishing House L.L.C..
- Mohammed bin Rashid Al Maktoum Foundation (MBRF) and the United Nations Development Programme/Regional Bureau for Arab States (UNDP/RBAS). (2010-2011) "Arab Knowledge Report. 2010-2011. Preparing Future Generations for the Knowledge Society." Dubai: Al Ghurair Printing and Publishing House L.L.C..
- National Science Foundation, Science and Engineering Indicators (2012)
- Nour, S. (2002), "ICT Opportunities and Challenges for Development in the Arab World,," UNU-WIDER Discussion Paper DP2002/83. Helsinki. Finland (Chapter 8 in: A. P. D'Costa (ed.), *The New Economy in Development: ICT Challenges and Opportunities* series of Technology, Globalization, and Development, Vol. 2, Palgrave Macmillan's, UK, pp. 161-187.
- Nour, S. (2010), "The incidence and transfer of knowledge in the Arab countries," UNU-MERIT Working Paper 2010-064, Maastricht, the Netherlands, December 2010: <http://www.merit.unu.edu/publications/wppdf/2010/wp2010-064.pdf>.
- Nour, S. (2011a), "Arab Regional Systems of Innovation: Characteristics and Implications," UNU-MERIT Working Paper 2011-058, Maastricht, the Netherlands, October 2011: <http://www.merit.unu.edu/publications/wppdf/2011/wp2011-058.pdf>
- Nour, S. (2011b), "Arab Spring: Will more freedom boost knowledge transfer?," the United Nations University Headquarters (UNU-HQ), Academic Feature Article, Science, Technology and Society Theme, UNU-HQ, Tokyo, Japan, June 14, 2011: <http://unu.edu/articles/science-technology-society/knowledge-transfer-in-arab-world>.
- Nour, S. (2012), "The Incidence and Transfer of Knowledge within the Arab Societies," *the Journal of the Knowledge Economy*, Springer, Berlin, Germany, Springer, New York, USA, Vol. 4, No. 4, December 2013, pp. 406-422.
- Nour, S. (2013a), "Overview of knowledge economy in the Arab region," *the Journal of the Knowledge Economy*, 2013, Springer, Berlin, Germany, Springer, New York, USA, Vol. 4, No. 2, June, 2013. (published online: 23 April 2013). DOI: 10.1007/s13132-013-0153-8.
- Nour, S. (2013b), "Overview of knowledge economy in the Arab region," UNU-MERIT Working Paper 2013-015, Maastricht, the Netherlands, January 2013. <http://www.merit.unu.edu/publications/wppdf/2013/wp2013-015.pdf>.
- Nour, S. (2013c), "Regional systems of innovation in the Arab region," UNU-MERIT Working Paper 2013-012, Maastricht, the Netherlands, January 2013: <http://www.merit.unu.edu/publications/wppdf/2013/wp2013-012.pdf>.
- Nour, Samia (2014a), "Challenges and Opportunities for transition to a Knowledge- Based Economy in Arab Gulf countries," UNU-MERIT Working Paper 2014-30, April 2014, Maastricht, the Netherland. <http://www.merit.unu.edu/publications/working-papers/abstract/?id=5413>.
- Nour, Samia (2014b), "Transition to a Knowledge- Based Economy in Saudi Arabia," UNU-MERIT Working Paper 2014-29, April 2014, Maastricht, the Netherlands. <http://www.merit.unu.edu/publications/working-papers/abstract/?id=5412>.
- Nour, Samia (2014c), "Overview of knowledge transfer in MENA countries - The case of Egypt," UNU-MERIT Working Paper 2014-17, Maastricht, the Netherlands, January 2014. (English): <http://www.merit.unu.edu/publications/wppdf/2014/wp2014-017.pdf>.
- Organisation for Economic Co-operation and Development (1996) "The Knowledge-Based Economy" Paris 1996, OECD/GD(96)102. pp. 3, 9.
- Powell, W. and Snellman, K. (2004) "The Knowledge Economy," *Annual Review Sociology*. 2004. 30:199–220,
- Romer, P. M. (1994) "The origin of Endogenous Growth," *Journal of Economic Perspectives* 8:3-22
- Smith, K. (2002) "What is Knowledge Economy? Knowledge Intensity and Distributed Knowledge Bases," UNU/INTECH Discussion Paper Series No. 2002-6. June (2002).
- The Global Innovation Index Report: GIIR (2014), pp. 14-19, 141, 148, 178, 205, 209, 212, 226, 237, 245, 249, 259, 269, 273, 280.
- The World Bank (2011) "Knowledge for Development" accessed January 23, 2013. <http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/0,,contentMDK:20269026~menuPK:461205~pagePK:64156158~piPK:64152884~theSitePK:461198,00.html>
- The World Bank (2012) accessed on October 10, 2012: http://info.worldbank.org/etools/kam2/KAM_page5.asp#fc103
- UNDP (United Nations Development Programme) (2009) "Human development report 2007/2008: Overcoming barriers: Human mobility and development " New York, NY: UNDP. Palgrave Macmillan. pp. 199-200
- UNDP (United Nations Development Programme) (2010) "Human development report 2010: The real wealth of nations: Pathways to human development," *Human Development Report 2010—20th anniversary edition sustainability and equity: A better future for All*. New York, NY: UNDP, Palgrave Macmillan. pp. 156-160, 192-196.
- UNDP (United Nations Development Programme). (2011), "Human development report 2011: Sustainability and equity: A better future for all". New York, NY: UNDP, Palgrave Macmillan. p. 165
- United Nations Development Programme (UNDP)-Arab Human Development Report (AHDR) (2002), "UNDP Arab Human Development Report (2002) "Creating opportunities for future generations," The UNDP. New York: Icons Printing Services.
- United Nations Development Programme (UNDP)-Arab Human Development Report (AHDR). (UNDP-AHDR). (2003). *Arab human development report 2003: Building a knowledge society*. Amman, Jordan: UNDP-RBAS; New York, NY: National Press.
- United Nations Development Programme (UNDP)-Arab Human Development Report (AHDR) (2009) "Arab human development report 2009: Challenges to Human Security in the Arab Countries." Amman, Jordan: UNDP-RBAS; New York, NY: National Press.
- UNESCO Institute for Statistics (2012),
- World Intellectual Property Organization (WIPO), World Intellectual Property Indicators and www.wipo.int/econ_stat.