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Knowledge economy and economic development in the Arab region**Samia Mohamed Nour**

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By Professor Dr. Samia Satti Osman Mohamed Nour,

(January 29, 2019)

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Abstract

This paper aims to discuss the relationship between knowledge, knowledge economy and economic development in the Arab region. It aims to contribute to improve understanding and provide valuable contribution to the increasing debate in the international literature concerning the relationship between knowledge economy and economic development in the Arab region. We use the descriptive and comparative approaches and methods of analysis and use the conceptual framework and indicators often used in the international literature to discuss the relationship between knowledge, knowledge economy and economic development in the Arab region. Different from previous studies in the Arab literature, we fill the gap in the Arab literature, we present an in-depth and a more comprehensive analysis of the relationship between knowledge economy and economic development in the Arab region defined by income level using recent secondary data related to knowledge economy obtained from the Global Innovation Index Report (2018) and the World Bank (2012). Our results support the first hypothesis concerning the considerable variation in the promotion of knowledge economy depending on the level of economic development across the Arab countries. Our findings verify the second hypothesis that the relationship between knowledge economy and economic development in the Arab region is determined by several factors including economic development, economic incentives and institutional regime, education and human resources, innovation system and Information and Communication Technology. Our results support the third hypothesis that sound and coherent policies for the promotion of knowledge economy through the promotion of economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology would contribute to accelerate achievement of inclusive growth and sustainable development in the Arab countries. Our results in the Arab region show positive relationship between income level and knowledge index, knowledge economy index and knowledge economy index and most of knowledge economy indicators including knowledge workers, knowledge-intensive employment, knowledge absorption, knowledge and technology outputs, knowledge impact and knowledge diffusion. Our findings in the Arab region show positive relationship between income level and all knowledge economy index pillars (economic incentive and institutional regime pillar, education and human resources pillar, the innovation system pillar, and information and communication technology (ICT) pillar) and all factors facilitating the promotion of knowledge economy including institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies, and innovation. The major policy implication and recommendation that the promotion of knowledge economy depends on promotion of institutions, economic incentive and institutional regime, education, human resources and research (human capital, education, tertiary education, research & development (R&D)), innovation system (innovation input, output and efficiency) infrastructure, and information and communication technologies.

Keywords: Knowledge, Knowledge economy, economic development, Arab countries

JEL classification: O10, O11, O30

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Introduction

This paper aims to discuss the relationship between knowledge economy and economic development in the Arab region. In our view the topic discussed in this paper is both important and interesting in view of recent increasing concern about the importance of knowledge and knowledge economy for enhancing economic development in all world countries, including Arab countries.

1. The research problem, significance, relevance, objectives, and method of analysis:

Since long time, knowledge has been at the heart of economic growth and the gradual rise and fall in levels of social well-being. More recently the new growth literature highlights the significance of knowledge at the macro and micro levels. Several studies in the literature use several indicators to discuss the importance of knowledge, knowledge, economy and the interaction between knowledge development and economic development (see for example, Powell and Snellman, 2004; David and Foray, 2001; Freeman and Soete, 1997; Andersson and Karlsson, 2005; Vinychuk, et al., 2014; Thanh Tuyen, 2010; Shiryaev, et al., 2016). Drucker (1998) argues that “Knowledge has become the key economic resource and the dominant—and perhaps the only—source of competitive advantage.”

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.²

The World Bank uses Knowledge Index (KI) and Knowledge Economy Index (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, it indicates overall potential of knowledge development in a given country and it includes 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. The KEI indicates the overall level of development of a country or region toward the knowledge economy.

The increasing concern and interest amongst economists confirm the role of knowledge in enhancing economic development in all world countries. In the Arab region several factors contribute to poor status of knowledge indicators, poor knowledge-based economies and limited role of knowledge in the Arab region (cf. UNDP-AHDR, 2003; UNDP-MBRF-Arab Knowledge Report, 2009; 2010–2011, 2014; Nour, 2010; 2013, 2014). Therefore, in our view, it is imperative for the Arab region to improve the status of knowledge indicators, improve the factors facilitating the development of knowledge economy and enhance the role of knowledge in enhancing inclusive economic growth and sustainable development in the Arab region.

Based on the above, this paper aims to discuss the relationship between knowledge economy and economic development in the Arab region defined by income level and to investigate the determinants of knowledge economy and ways of enhancing knowledge economy in the Arab countries. We fill the gap in the literature, different from earlier studies in the Arab literature (Nour, 2010; 2011; 2012; 2013; 2014; 2016) which examine the incidence,

² See OECD (1996), pp. 3, 9.

existence and development of knowledge and its transference, and potential opportunities and challenges for transition to knowledge-based economies in the Arab region, we present an in-depth analysis of the interaction between knowledge economy and economic development in the Arab region defined by income level using recent secondary data related to knowledge economy obtained from the Global Innovation Index Report (2018) and the World Bank (2012). Different from previous studies that discuss the knowledge economy in the Arab region using the classification of Arab countries according to the structure of the economy (Nour, 2013) and using the classification of countries according to income level over the period (1990-2002) (Nour, 2010; 2011) an interesting element in our analysis is that we investigate the relationship between knowledge economy and economic development in the Arab region according to income level over the period (2000-2018). A novel element in our analysis is that we discuss the relationship between knowledge economy and economic development using more comprehensive and recent data related to knowledge economy obtained from the Global Innovation Index Report (2018) and the World Bank (2012). We provide an interesting analysis of promotion of knowledge economy in the Arab region. We examine the factors that impede (and those contribute towards) promotion of knowledge economy in the Arab countries.

Regarding research method, this paper uses the descriptive and comparative approaches and methods of analysis to discuss the interaction between knowledge economy and economic development in the Arab region over the period (2000-2018). We use the OECD (1996) framework and definition of a knowledge-based economy: economies which are directly based on production, distribution and use of knowledge and information. We also use the World Bank framework and definition of KI and KEI and KEI four pillars related to the knowledge economy: economic incentive and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) pillars. We believe that the selection of this method and these indicators seem quite consistent and relevant for our analysis in this paper.

We examine the first hypothesis concerning the considerable variation in the promotion of knowledge economy depending on the level of economic development across the Arab countries. We investigate the second hypothesis that the relationship between knowledge economy and economic development in the Arab region is determined by several factors including economic development, economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT). We examine the third hypothesis that sound and coherent policies for the promotion of knowledge economy through the promotion of economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) would contribute to accelerate achievement of inclusive growth and sustainable development in the Arab countries.

Concerning the structure, this paper will be organized as follows: Section 1 provides introduction and explains the research problem, significance, relevance, objectives, and method of analysis. Section 2 presents the conceptual framework and literature review on the definition of the concepts of knowledge economy and the relationship between knowledge economy and economic development. Section 3 explains the general socio economic characteristics of the Arab countries. Section 4 discusses the interaction between knowledge economy and economic development in the Arab region. Section 5 provides the conclusions and policy recommendations.

2. The conceptual framework and literature review

This section presents the conceptual framework and literature review on the definition of the concepts of knowledge economy and the relationship between knowledge economy and economic development.

The concept knowledge economy has been widely used in the international literature. The conceptual framework discussed in the international literature implies a 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 an important role given to information; technology and learning in economic performance (cf. OECD, 1996). In contrast, 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 for a knowledge-based economy based on the distinction between the old paradigm (resource-driven economies) and the new paradigm (knowledge-driven economies).

Moreover, the World Bank uses the Knowledge Index (KI) and the Knowledge Economy Index (KEI) to compare knowledge across the world's countries. According to the World Bank, the Knowledge Index (KI) measures a country's ability to generate, adopt and diffuse knowledge. This is an indication of the overall potential of knowledge development in a given country. Methodologically, the KI is the simple average of the normalised key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT). The Knowledge Economy Index (KEI) takes into account whether the environment is conducive for knowledge to be used effectively for economic development. The KEI indicates the overall level of development of a country or region toward the knowledge economy and it includes 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.³

Many studies in the literature use many indicators to explain the importance of knowledge, knowledge, economy and the relationship between knowledge development and economic development. Some studies indicate that 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 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; Cowan, David, and Foray, 1997; Cowan and Foray, 1997), and also between embodied flows of knowledge (knowledge incorporated in to machinery and equipment) and

³ The KEI is calculated based on the average of the normalised 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. For the purposes of calculating KI and KEI, each pillar is represented by three key variables. See the World Bank- KEI, 2012: <http://siteresources.worldbank.org/INTUNIKAM/Images/KEIindex.jpg>

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, total R&D and software and ICT. 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.⁴ 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.

The economic analysis of knowledge as a specific input to innovative activities has been approaching following two largely independent methodological approaches, on the one side, knowledge is seen 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 side, modern innovation theory sees 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. 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, trial 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.

Economists have long recognized the importance of knowledge for endogenous technological progress, innovation and economic growth. In the endogenous growth theories, the sole source of growth is knowledge accumulation. For instance, in the Lucas (1988) model knowledge accumulation is at the heart of the growth process, it could directly but partly determine growth performance. For Romer (1994); Grossman and Helpman (1994), knowledge is seen as a public good generated via R&D activities that generate spillover and thus increasing returns. Aghion and Howitt (1998) endogenous growth model predicts that long run growth should be positively correlated with R&D productivity and the rate of growth of human capital. Klette and Griliches (1998) propose a model of endogenous firm growth in which R&D and innovations are the engines of growth. Moreover, the evolutionary framework developed by Nelson and Winter (1982) makes the nature of knowledge and firms’ investment in it a central factor in explaining the size, structure and dynamic of industries.

Moreover, nowadays differential in the productivity and growth of different countries is significantly related to improvement in the quality of human capital and factors of production, in particular, the capacity to create new knowledge and ideas and incorporate them in equipment and people. Recent growth literature show increasing evidences of the growing relative importance of intangible capital in total productive wealth and the rising relative share of GDP attributable to intangible capital (Abramovitz and David, 1996; Abramovitz and David, 1998). Intangible capital largely falls into two main categories: on the one hand, investment geared to the production and dissemination of knowledge (i.e. training, education, R&D, information and co-ordination); on the other hand,

⁴ See Powell and Snellman (2004), p. 199.

investment geared to sustaining the physical state of human capital (health expenditures). In the US, the current value of the stock of intangible capital (devoted to knowledge creation and human capital) began to outweigh that of tangible capital (physical infrastructure and equipment, inventories, natural resources) at the end of the 1960s. Moreover, since 1960s annual investment rates in R&D, public education and software have grown steadily at an annual rate of 3% in the OECD countries. (David and Foray, 2001).

Furthermore, Drucker (1998) argues that “Knowledge has become the key economic resource and the dominant—and perhaps the only—source of competitive advantage.” Drucker (1998) suggests that: “knowledge is now becoming the one factor of production, sidelining both capital and labour”. Along the same line, the OECD (1999) has suggested that “... the role of knowledge (as compared with natural resources, physical capital and low skill labour) has taken on greater importance”. Smith (2002) argues that in recent years, learning and knowledge have attracted increasing attention as a result of the claims that knowledge intensive industries are now at the core of growth, knowledge driven economy or even a knowledge society. The role of knowledge as an input to economic processes has fundamentally changed probably due to rapid technological changes/ advances in ICT, which is seen as factor enhancing knowledge. For instance, Van Zoon (2001), extends Lucas (1988) model by incorporating the effect of ICT – capital investment and assuming that ICT has positive influence on growth performance not only through improving the intensity of production and total factor productivity, but also through enhancing the efficiency of knowledge accumulation and learning process. David and Foray (1995) and Smith (2002) show that ICT revolution is increasing the common availability of codified knowledge.

Within this framework, the analysis of the factors facilitating and those hindering the development of knowledge economy have been an exciting and interesting recent research issue that has received increasing interest amongst economists. Few studies in the Arab literature show the weak knowledge-based economies in the Arab region (cf. UNDP-AHDR, 2003; UNDP-MBFR-Arab Knowledge Report, 2009; 2010–2011, 2014; Nour, 2010; 2013, 2014). Analysis of the relationship between knowledge, knowledge economy and economic development in the Arab region is important in view of the well-known stylised fact in the international literature concerning the role of knowledge in economic growth and development, and the relationship between level of economic development and promotion of knowledge-based economy. In our view, since the relationship between knowledge or promotion of knowledge-based economies and the level of economic development in the Arab region has not been adequately discussed in the Arab literature, therefore, it might be interesting in this paper to fill the gap in the Arab literature by discussing the relationship between knowledge economy and economic development in the Arab region.

3. The general socio economic characteristics of the Arab countries

Based on the above framework and before examining the interaction between economic development and knowledge economy in the Arab region, in this section it is useful to begin with the general socio-economic characteristics of the Arab region and differences in the socio-economic characteristics across the Arab countries.

The regional and international literature uses different classifications for Arab countries, for instance, according to the United Nations Development Programme classification of world countries according to human development and the World Bank classification of world countries according to income level. In this paper, we use the classification of Arab countries based on the World Bank classification of world countries according the level of

economic development as measured by income level (defined by GNI per capita).⁵ In our view for operational and analytical purposes the definition of Arab countries based on the World Bank classification of world countries according to economic development level as measured by income level is more appropriate for our analysis in this paper, since it provides a more precise definition that seem consistent with our objective to examine the relationship between economic development and promotion of knowledge in the Arab region. According to the World Bank classification of world countries, the Arab region is composed of six countries classified as high income countries (namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates) and four countries classified as low income countries (namely, Comoros, Somalia, Syria and Yemen). According to the World Bank definition, eleven, the majority or nearly half of the Arab countries are classified as middle income countries (namely, Algeria, Djibouti, Egypt, Iraq, Jordan, Lebanon, Libya, Morocco, Sudan, Tunisia, and West Bank and Gaza). This definition implies that five of the Arab countries are included in the category of upper middle income economies (namely, Algeria, Iraq, Jordan, Lebanon and Libya), while the other six of the Arab countries are included in the category of lower middle income (namely, Djibouti, Egypt, Morocco, Sudan, Tunisia and West Bank and Gaza). According to the United Nation Development Programme definition or classification by human development eleven of the Arab countries are included in the high human development (namely, the United Arab Emirates, Qatar, Saudi Arabia, Bahrain, Oman, Kuwait, Lebanon, Algeria, Jordan, Tunisia and Libya), four of the Arab countries are included in the medium human development (namely, Egypt, Palestine, Iraq and Morocco) and six of the Arab countries are included in the low human development (namely, Syria, Comoros, Sudan, Djibouti, Yemen and Somalia).

Table 1 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 1 illustrates the substantial gap between Arab and other world regions in terms of population, standard of economic development as measured by GNI per capita and human development index. In general, the Arab region is characterised by low standards of economic development 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 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: average life expectancy, mean years of schooling, expected years of schooling, literacy rate and gross enrolment ratios for the Arab region on average, are lower than for those of other world countries. Moreover, as in most other developing countries and regions the Arab region suffers from the widespread and high rates of both unemployment and poverty. These general socio-economic development characteristics of the Arab region have serious implications, impose challenges and impede the promotion knowledge, as they lower allocation of resources for promotion of knowledge and knowledge based economies and role of knowledge in inclusive economic growth and sustainable development in the Arab region.

⁵ See the World Bank (2018): <https://data.worldbank.org/country>. <https://data.worldbank.org/income-level/>. Accessed on 27 November 2018. The Arab countries can be classified in the following income groups: low-income economies are those in which 2016 GNI per capita was \$1,006 or less; middle-income economies are those in which 2016 GNI per capita was between \$1,006 and \$12,235 (lower-middle-income economies are those in which 2016 GNI per capita was between \$1,006 and \$3,956; upper-middle-income economies are those in which 2016 GNI per capita was between \$3,956 and \$12,235); and high-income economies are those in which 2016 GNI per capita was \$12,235 or more.

Table 1 - General socio-economic characteristics of the Arab region compared to other world regions (2012-2017)

	Population	Human Development Index (HDI)		SDG 8.5	SDG 3	SDG 4.3	SDG 4.6	SDG 4.6	SDG 4.6	SDG 4.1	SDG 4.1	SDG 4.3	SDG 1.a
	Total (millions)	HDI rank	HDI Value	(2011 PPP \$)	(years)	(years)	(years)	(years)	Population with at least secondary education	Primary (%)	Secondary (%)	Tertiary (%)	(% of GDP) (%)
	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2017	2012-2017
High human development													
United Arab Emirates	9.4	34	0.863	67,805	77.4	13.6	10.8	..	69	111	96	37	..
Qatar	2.6	37	0.856	116,818	78.3	13.4	9.8	97.7	60	104	93	15	3.6
Saudi Arabia	32.9	39	0.853	49,680	74.7	16.9	9.5	94.4	72.8	116	117	67	..
Bahrain	1.5	43	0.846	41,580	77	16	9.41	94.6	59.2	101	104	47	2.7
Oman	4.6	48	0.821	36,290	77.3	13.9	9.5	93	66.4	109	107	45	6.2
Kuwait	4.1	56	0.803	70,524	74.8	13.6	7.3	95.7	51.2	101	98	33	..
Lebanon	6.1	80	0.757	13,378	79.8	12.5	8.7	91.2	54.3	89	60	38	2.5
Algeria	41.3	85	0.754	13,802	76.3	14.4	8	75.1	37.7 b	114	..	43	..
Jordan	9.7	95	0.735	8,288	74.5	13.1	10.4	97.9	83.5	..	70	36	3.9
Tunisia	11.5	95	0.735	10,275	75.9	15.1	7.2	79	51.8	115	93	33	6.6
Libya	6.4	108	0.706	11,100	72.1	13.4	7.3	..	57.4	..	..	..	..
Medium human development													
Egypt	97.6	115	0.696	10,355	71.7	13.1	7.2	75.1	64.5	104	86	34	..
Palestine	4.9	119	0.686	5,055	73.6	12.8	9.1	96.9	60.4	94	84	43	5.7
Iraq	38.3	120	0.685	17,789	70	11	6.8	43.7	47.7	..	..	..	..
Morocco	35.7	123	0.667	7,340	76.1	12.4	5.5	69.4	31.3	110	70	32	..
Low human development													
Syria	18.3	155	0.536	2,337	71	8.8	5.1	..	41	76	49	39	..
Comoros	0.8	165	0.503	1,399	63.9	11.2	4.8	49.2	..	105	61	9	4.3
Sudan	40.5	167	0.502	4,119	64.7	7.4	3.7	53.5	17	74	46	17	..
Djibouti	1	172	0.476	3,392	62.6	6.2	4.1	..	..	64	44	..	..
Yemen	28.3	178	0.452	1,239	65.2	9	3	..	27.1	92	51	..	..
Somalia	14.7				56.7								..
Human development groups													
Very high human development	1,439.30		0.894	40,041	79.5	16.4	12.2	..	89.3	102	106	71	4.9
High human development	2,378.90		0.757	14,999	76	14.1	8.2	94.2	72.1	103	96	50	..
Medium human development	2,732.90		0.645	6,849	69.1	12	6.7	74.3	51.1	110	73	24	3.9
Low human development	926.2		0.504	2,521	60.8	9.4	4.7	52.5	24.8	98	43	9	..
Developing countries	6,259.90		0.681	10,055	70.7	12.2	7.3	81.1	59.8	105	75	32	..
Regions													
Arab States	409.5		0.699	15,837	71.5	11.9	7	73.4	50.4	98	74	36	..
East Asia and the Pacific	2,091.40		0.733	13,688	74.7	13.3	7.9	94.4	71	103	92	41	..
Europe and Central Asia	243.9		0.771	15,331	73.4	14.1	10.3	98.2	81.2	102	99	62	4.3
Latin America and the Caribbean	640.2		0.758	13,671	75.7	14.4	8.5	92.8	59.6	107	96	49	5.5
South Asia	1,869.00		0.638	6,473	69.3	11.9	6.4	68.7	50.4	112	71	25	3.6
Sub-Saharan Africa	1,005.80		0.537	3,399	60.7	10.1	5.6	59.9	34	100	46	9	4.9
Least developed countries	1,002.50		0.524	2,506	64.8	9.8	4.7	59.6	29.6	103	48	10	3.1
Small island developing states	64.90		0.722	15,113	72.3	12.1	8.6	83.3	60.3	106	75	..	..
Organisation for Economic Co-operation and Development	1,292.60		0.895	39,595	80.6	16.2	12	..	86	102	105	68	5
World	7,550.30		0.728	15,295	72.2	12.7	8.4	82.1	66.5	105	79	36	4.8

Source: UNDP Human Development Report (2018), pp. 22-25, 46-49, 54-57. PPP – Purchasing Power Parity.

4. The relationship between knowledge, knowledge economy and economic development in the Arab region.

This section uses the conceptual framework and indicators often used in the international literature to discuss the relationship between knowledge, knowledge economy and economic development in the Arab region.

Our results support the first hypothesis concerning the considerable variation in the promotion of knowledge economy depending on the level of economic development across the Arab countries (see Tables 2-5; Figures 1-2; Figures 7-8). Our findings verify the second hypothesis that the relationship between knowledge economy and economic development in the Arab region is determined by several factors including economic development, economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) (see Tables 2-5; Figures 1-8). Our results support the third hypothesis that sound and coherent policies for the promotion of knowledge economy through the promotion of economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) would contribute to accelerate achievement of inclusive growth and sustainable development in the Arab countries.

For our analysis of the relationship between knowledge economy and economic development in the Arab region over the period (2000-2012) we use the data from the World Bank (2000-2012) and also we use the World Bank framework and definition of KI and KEI and KEI four pillars related to knowledge economy: economic incentive and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) pillars. Our results in the Arab region show that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and knowledge index, knowledge economy index and all knowledge economy index pillars. For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of knowledge index, knowledge economy index and all knowledge economy index pillars over the period (2000-2012). Our findings concerning the high performance of high income countries compared to medium income countries and low income countries in terms of Knowledge Index (KI) over the period (2000-2012) demonstrate that ability to generate, adopt and diffuse knowledge are generally higher in the high income countries compared to medium income countries and low income countries. This also implies that the overall potential of knowledge development in high income countries is generally higher compared to medium income countries and low income countries. Our results concerning the high performance of high income countries compared to medium income countries and low income countries in terms of Knowledge Economy Index (KEI) over the period (2000-2012) demonstrate that the environment is more conducive for knowledge to be used effectively for economic development in the high income countries compared to medium income countries and low income countries. Our results regarding the high performance of the high income countries compared to medium income countries and low income countries regarding the KEI indicates that the overall level of development of the high income countries toward the knowledge economy is generally higher than the medium income countries and low income countries. Our findings also imply high performance of the high income countries compared to medium income countries and low income countries in terms of the four pillars related to the knowledge economy—economic incentive and institutional regime pillar, education and human resources pillar, the innovation system pillar, and information and communication technology (ICT) pillar.

For our analysis of the relationship between knowledge economy and economic development in the Arab region in 2018, we use the data obtained from the World Economic Forum the Global Innovation Index Report GII (2018) and we use the OECD (1996) framework and definition of a knowledge-based economy: economies which

are directly based on production, distribution and use of knowledge and information. Our findings in the Arab region show that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and most of knowledge economy indicators (with the exception of knowledge creation). For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of knowledge workers, knowledge-intensive employment, knowledge absorption, knowledge and technology outputs, knowledge impact and knowledge diffusion respectively. Our results illustrate that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and all factors facilitating the promotion of knowledge economy (with the exception of innovation efficiency ratio). For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies (ICTs), and innovation (GII (2018, 2017), GII output (2018), GII input (2018)). Our findings imply that the high performance of high income countries compared to middle income and low income countries in terms of knowledge economy indicators is consistent with the high performance of high income countries compared to middle income and low income countries in terms of enabling factors facilitating the promotion of knowledge economy. This implies that the high performance of high income countries is not surprising and can be interpreted most probably along with the strategies of the high income countries to create the enabling factors facilitating the promotion of knowledge economy, including for instance, institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies (ICTs), and innovation (innovation input and output: GII, GII output and GII input). Our results indicate that on average the performance of middle income countries is higher than high income countries and low income countries only in terms of knowledge creation and GII efficiency ratio (2018). This implies that for the high income countries, the promotion of knowledge economy is seriously impeded by the deficient performance in terms of knowledge creation and innovation efficiency; therefore, more efforts are needed to improve the knowledge economy by improving both knowledge creation and innovation efficiency.

We find considerable variation in the promotion of knowledge economy across the Arab countries that demonstrated from the substantial difference in the performance in terms of KI and KEI and KEI four pillars related to the knowledge economy: economic incentive and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) pillars. That also demonstrated from the large disparity in the performance in terms of knowledge workers, knowledge-intensive employment, knowledge absorption, knowledge and technology outputs, knowledge creation, knowledge impact and knowledge diffusion and also in terms of all factors facilitating the promotion of knowledge economy including institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies (ICTs), and innovation (innovation input, output and efficiency).

For instance, concerning knowledge workers the United Arab Emirates and Saudi Arabia ranked at the top of high income countries, while Lebanon and Tunisia ranked at the top of middle income countries, in terms of knowledge-intensive employment the United Arab Emirates and Saudi Arabia ranked at the top of high income countries, while Egypt and Tunisia ranked at the top of middle income countries. Regarding knowledge absorption

the United Arab Emirates and Qatar ranked at the top of high income countries, while Lebanon and Algeria ranked at the top of middle income countries, concerning knowledge and technology outputs Kuwait and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Egypt ranked at the top of middle income countries. In terms of knowledge creation Saudi Arabia and Kuwait ranked at the top of high income countries, while Tunisia and Lebanon ranked at the top of middle income countries, concerning knowledge impact the United Arab Emirates and Bahrain ranked at the top of high income countries, while Egypt and Morocco ranked at the top of middle income countries, and regarding knowledge diffusion Kuwait and the United Arab Emirates ranked at the top of high income countries, while Morocco and Lebanon ranked at the top of middle income countries. Our results illustrate that regarding the factors facilitating the promotion of knowledge economy, mainly, concerning, institutions the United Arab Emirates and Qatar ranked at the top of high income countries, while Jordan and Morocco ranked at the top of middle income countries. Regarding human capital and research Saudi Arabia and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Jordan ranked at the top of middle income countries, concerning education Saudi Arabia and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Morocco ranked at the top of middle income countries, regarding tertiary education Oman and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Jordan ranked at the top of middle income countries, concerning research & development (R&D) Saudi Arabia and the United Arab Emirates ranked at the top of high income countries, while Lebanon and Egypt ranked at the top of middle income countries. Regarding infrastructure, Qatar and the United Arab Emirates ranked at the top of high income countries, while Morocco and Tunisia ranked at the top of middle income countries. Concerning information and communication technologies (ICTs) the United Arab Emirates and Bahrain ranked at the top of high income countries, while Morocco and Tunisia ranked at the top of middle income countries. Regarding innovation as defined by the GII rank (2017-2018) the United Arab Emirates and Qatar ranked at the top of high income countries, while Tunisia and Morocco ranked at the top of middle income countries, regarding innovation input index the United Arab Emirates and Saudi Arabia ranked at the top of high income countries, while Tunisia and Morocco ranked at the top of middle income countries, regarding innovation output index Kuwait and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Jordan ranked at the top of middle income countries, regarding innovation efficiency ratio Kuwait and Qatar ranked at the top of high income countries, while Egypt and Jordan ranked at the top of middle income countries.

Regarding KI the United Arab Emirates and Bahrain ranked at the top of high income countries, while Tunisia and Jordan ranked at the top of middle income countries. Concerning KEI the United Arab Emirates and Bahrain ranked at the top of high income countries, while Jordan and Lebanon ranked at the top of middle income countries. Concerning the four pillars related to knowledge economy, mainly, regarding economic incentive and institutional regime pillar Oman and Qatar ranked at the top of high income countries, while Jordan and Morocco ranked at the top of middle income countries, concerning education and human resources pillar Bahrain and the United Arab Emirates ranked at the top of high income countries, while Jordan and Lebanon ranked at the top of middle income countries, regarding the innovation system pillar the United Arab Emirates and Qatar ranked at the top of high income countries, while Tunisia and Lebanon ranked at the top of middle income countries. Concerning

information and communication technology (ICT) pillar Bahrain and the United Arab Emirates ranked at the top of high income countries, while Tunisia and Jordan ranked at the top of middle income countries.

Our results regarding the considerable variation across Arab countries in terms of development of the knowledge economy and the factors facilitating the promotion of knowledge implies advantages in terms of some indicators along with disadvantage in other indicators in some of the high and medium income countries. This implies that despite the significant progress in the promotion of the knowledge economy in high income countries, but high income countries show inadequate performance regarding knowledge creation which is important for development of knowledge economy. Since the Arab high income countries includes the Arab Gulf countries that are characterized by heavy reliance on oil. Therefore, this implies that the recent efforts for development of knowledge economies should not hide the fact that development of knowledge economies in high income oil countries is still limited since high income oil countries are still resources driven economies rather than knowledge based economies. This also implies that development of knowledge based economies in high income countries is seriously impeded by the prevalence of the resources or oil based economies.

The major policy implication from our results implies that the major factors impede and those contribute to the promotion of knowledge economy across the Arab countries related to institutions, economic incentive and institutional regime, education, human resources and research (human capital, education, tertiary education, research & development (R&D)), the innovation system (innovation input, output and efficiency) infrastructure, and information and communication technologies (ICTs).

Table 2 – Development of Knowledge Index and Knowledge Economy Index indicators in the Arab region (Arab countries defined by income level) compared to other world regions (2000-2012)

Country	Knowledge Index		Knowledge Economy Index		Education and Human Resources Pillar		Economic Incentive and Institution Pillar		Innovation Pillar		ICT Pillar		Change in rank since 2000 and since 1995	Rank		
	2000	2012	2000	2012	2000	2012	2000	2012	2000	2012	2000	2012	2000	2012		
Arab countries																
United Arab Emirates	5.56	7.09	6.05	6.94	4.44	5.8	7.51	6.5	4.32	6.6	7.92	8.88	-2	6	48	42
Bahrain	6.66	6.98	6.85	6.9	6.34	6.78	7.45	6.69	6.37	4.61	7.26	9.54	-5	-2	41	43
Oman	4.53	5.87	5.28	6.14	4.22	5.23	7.51	6.96	4.25	5.88	5.12	6.49	0	18	65	47
Saudi Arabia	4.67	6.05	4.6	5.96	4.28	5.65	4.4	5.68	4.24	4.14	5.49	8.37	2	26	76	50
Qatar	5.81	5.5	6.01	5.84	4.85	3.41	6.64	6.87	5.51	6.42	7.05	6.65	5	-5	49	54
Kuwait	5.88	5.15	6.16	5.33	5.17	3.7	7	5.86	5.38	5.22	7.09	6.53	11	-18	46	64
High income countries	5.52	6.11	5.83	6.19	4.88	5.10	6.75	6.43	5.01	5.48	6.66	7.74				
Jordan	5.68	4.71	5.58	4.95	5.62	5.55	5.28	5.65	6.2	4.05	5.22	4.54	4	-18	57	75
Tunisia	4.24	4.8	4.15	4.56	3.92	4.55	3.89	3.81	4.24	4.97	4.54	4.89	0	9	89	80
Lebanon	5.58	4.65	4.95	4.56	5.77	5.51	3.04	4.28	4.47	4.86	6.49	3.58	-5	-13	68	81
Algeria	3.44	4.28	2.85	3.79	3.96	5.27	1.09	2.33	3.25	3.54	3.11	4.04	-2	14	110	96
Egypt	4.49	3.54	4.29	3.78	4.66	3.37	3.68	4.5	5.03	4.11	3.77	3.12	-1	-9	88	97
Morocco	3.33	3.25	3.74	3.61	2.02	2.07	4.99	4.66	4.04	3.67	3.93	4.02	4	-10	92	102
Djibouti	1.43	1.17	1.59	1.34	0.35	0.73	2.07	1.85	1.34	1.44	2.6	1.33	-21	-3	136	139
Mauritania	1.89	1.52	2.09	1.65	1.19	0.71	2.72	2.05	1.66	1.68	2.81	2.18	11	-11	123	134
Sudan	1.62	1.82	1.35	1.48	1.38	0.84	0.54	0.48	1.38	1.44	2.1	3.16	-1	1	139	138
Medium income countries	3.52	3.30	3.40	3.30	3.21	3.18	3.03	3.29	3.51	3.31	3.84	3.43				
Yemen	1.95	1.58	1.98	1.92	1.96	1.62	2.07	2.91	1.58	1.96	2.3	1.17	4	6	128	122
Syria	3.23	3.01	2.85	2.77	2.57	2.4	1.72	2.04	3.53	3.07	3.58	3.55	-2	-1	111	112
Low income countries	2.59	2.295	2.415	2.345	2.265	2.01	1.895	2.475	2.555	2.515	2.94	2.36				
Arab World	4.14	4.34	4.12	4.37	3.69	3.91	4.21	4.44	3.93	4.12	4.73	4.99				
World Region																
North America	9.2	8.7	9.18	8.8	8.67	8.13	9.1	9.11	9.54	9.45	9.39	8.51	1	0	1	1
Europe and Central Asia	7.84	7.64	7.56	7.47	7.38	7.13	6.72	6.95	8.38	8.28	7.78	7.5	3	0	2	2
East Asia and the Pacific	5.69	5.17	5.79	5.32	3.68	3.94	6.07	5.75	7.43	7.43	5.98	4.14	-1	1	4	3
Latin America	5.67	5.31	5.54	5.15	5.07	5.11	5.14	4.66	6.14	5.8	5.8	5.02	1	1	5	4
The world	6.06	5.01	5.95	5.12	3.89	3.72	5.61	5.45	7.75	7.72	6.53	3.58	-2	-2	3	5
Middle East and North Africa (MENA)	5.07	4.51	5.16	4.74	3.8	3.48	5.41	5.41	6.44	6.14	4.97	3.92	1	0	6	6
South Asia	2.7	2.77	2.98	2.84	2.22	2.17	3.79	3.05	3.56	4.23	2.33	1.9	-4	1	8	7
Africa	3	2.43	3.04	2.55	1.7	1.44	3.13	2.91	3.95	3.95	3.36	1.9	1	-1	7	8

Source: The World Bank Data base (2012) – accessed on 10 October 2017.

Table 3 – The Global Innovation Index in the Arab countries defined by income level (2018)

	GII 2018		GII 2017		GII Output (2018)		GII Input (2018)		GII Efficiency ratio (2018)	
	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank
United Arab Emirates	42.58	38	35	56.8	54	28.36	24	0.5	95	
Qatar	36.56	51	49	46.63	60	26.49	47	0.57	81	
Kuwait	34.43	60	56	39.5	49	29.36	81	0.74	26	
Saudi Arabia	34.27	61	55	46.73	78	21.81	46	0.47	104	
Oman	32.8	69	77	43.43	75	22.18	57	0.51	92	
Bahrain	31.73	72	66	41.05	74	22.41	70	0.55	84	
High income	35.40			45.69		25.10		0.56		
Tunisia	32.86	66	74	40.25	63	25.47	77	0.63	55	
Morocco	31.09	76	72	38.69	69	23.5	84	0.61	65	
Jordan	30.77	79	83	37.36	67	24.19	88	0.65	50	
Lebanon	28.22	90	81	37.74	94	18.7	87	0.5	98	
Egypt	27.16	95	105	32.69	79	21.62	105	0.66	45	
Algeria	38.87	110	108	33.67	116	14.07	100	0.42	115	
Middle income	31.50			36.73		21.26		0.58		
Yemen	15.04	126	127	22.18	126	7.09	126	0.36	122	
Low income	15.04			22.18		7.09		0.36		

Source: World Economic Forum – the Global Innovation Index Report (2018)

Table 4- Main Pillars of the Global Innovation Index in the Arab countries defined by income level (2018)

	Institutions		Human capital & research		Education		Tertiary education		Research & development (R&D).		Infrastructure		Information & communication technologies (ICTs)	
	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank
United Arab Emirates	77.8	29	46.5	29	62.5	15	56.6	9	20.3	42	57.4	28	78.9	23
Qatar	67.9	47	35.7	50	43.2	78	56.5	10	7.5	66	58	27	70.4	36
Kuwait	54.1	89	25.5	81	46.7	67	26.3	79	3.6	84	49.8	46	62.7	58
Saudi Arabia	51.9	94	47.7	24	62.7	14	38.9	39	41.4	25	49.4	51	66.9	44
Oman	62.1	64	40.3	39	53.9	44	62.7	4	4.3	82	48.3	54	61.4	61
Bahrain	50.7	99	27.6	74	42	85	35.7	50	5.1	77	54.1	33	78.5	25
High income	60.8		37.2		51.8		46.1		13.7		52.8		69.8	
Tunisia	56.4	77	43.2	33	62	16	58.7	5	9	61	43.1	70	58.4	67
Morocco	57	75	25.1	84	46.2	68	21	92	8.2	64	49.5	50	63.6	53
Jordan	60.6	68	31	62	35.9	96	49.8	18	7.2	69	40.4	79	52.3	79
Lebanon	49.4	104	26.6	79	26.7	115	38.4	42	14.8	47	38.5	86	58	68
Egypt	44.3	120	23	89	45.3	74	11.3	106	12.3	53	37.9	90	43.8	91
Algeria	49.6	102	25.9	80	38	90	39.6	37	0.01	117	40.3	80	25.9	113
Middle income	52.9		29.1		42.4		36.5		10.3		41.6		50.3	
Yemen	28.7	126	13.7	115	26.7	114	14.5	101	0	117	21.2	125	16.5	121
Low income	28.7		13.7		26.7		14.5		0		21.2		16.5	

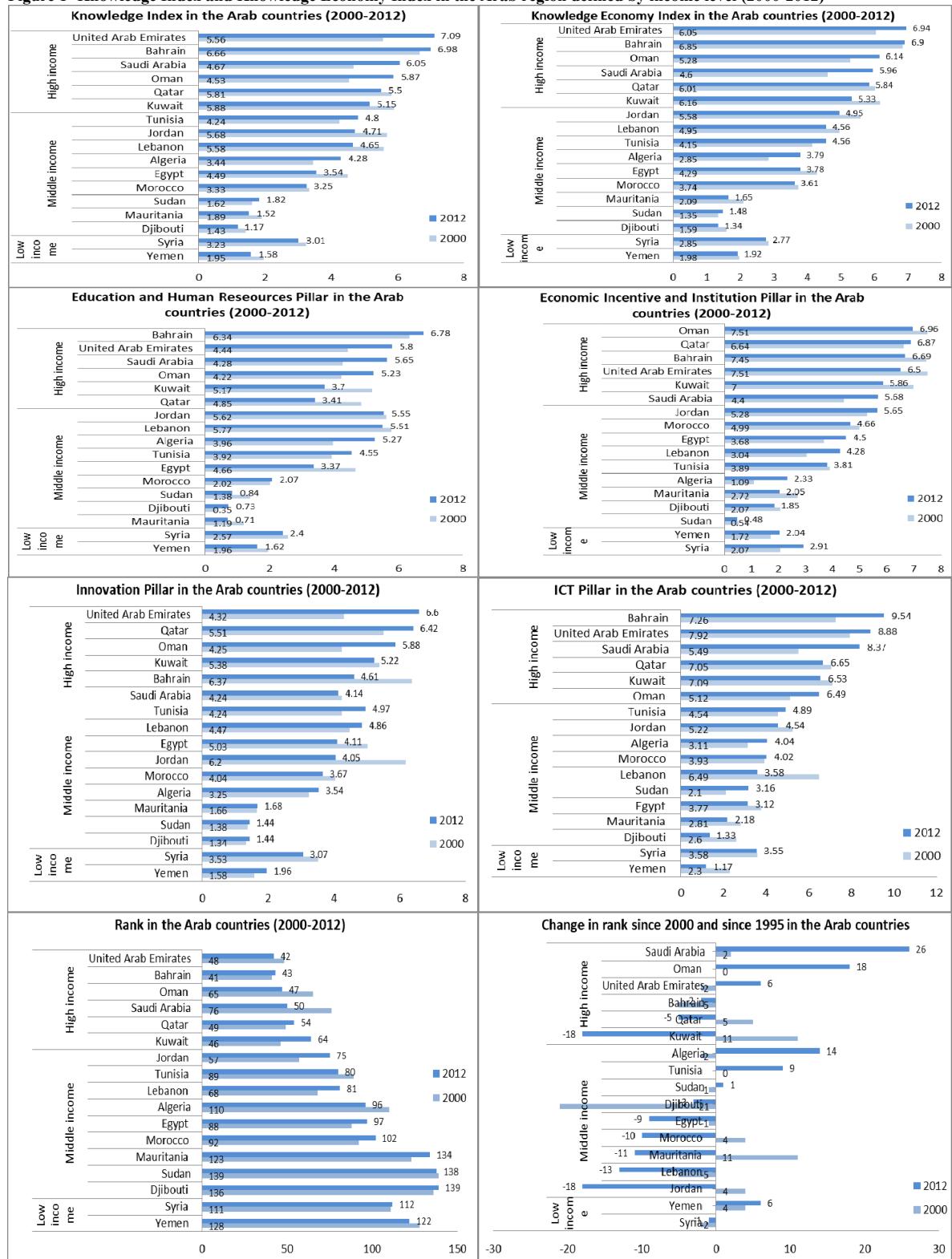
Source: World Economic Forum – the Global Innovation Index Report (2018)

Table 5- Knowledge workers, absorption, output, creation, impact and diffusion in the Arab countries defined by income level (2018)

	Knowledge workers		Knowledge-intensive employment, %		Knowledge absorption		Knowledge & technology outputs		Knowledge creation		Knowledge impact		Knowledge diffusion	
	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank	Score/Value	Rank
United Arab Emirates	55.2	29	31.4	44	38.2	34	25.7	53	4.8	93.1	39.5	50	32.6	27
Qatar	15.8	112	17.9	80	33.7	47	23.6	59	4.6	97	37.2	60	29.1	34
Kuwait	18.7	105	17.9	79	23.2	89	30.2	45	6	86	36	67	48.5	12
Saudi Arabia	35.2	64	27.3	52	28.7	71	20.2	73	10.1	69	34.1	71	16.6	83
Oman	27	85	24.6	62	15.7	123	16.3	97	4.2	99	28.1	93	16.5	85
Bahrain	24.5	92	21.9	68	16.8	120	20.8	69	1.5	123	39.5	51	21.3	54
High income	29.4		23.5		26.1		22.8		5.2		30.3		27.4	
Tunisia	26.8	88	21	73	19.5	105	23.4	63	22	43	31.7	83	16.5	84
Morocco	19.7	104	6.9	104	19.3	106	19.9	78	7.7	79	33.4	77	1.6	59
Jordan	0	126	n/a	n/a	21.5	98	18.6	85	13.4	59	30.8	85	11.6	112
Lebanon	30.6	77	n/a	n/a	30.7	63	14.3	107	14.2	56	20.3	116	8.5	63
Egypt	21.7	101	32.8	41	18.6	111	21.1	66	9.2	73	40.5	45	13.7	103
Algeria	14.9	114	10	99	24.8	86	13.4	111	5.1	91	25.2	101	9.9	124
Middle income	22.7		17.7		22.4		18.5		11.9		35.7		10.3	
Yemen	13	119	12.3	93	16.8	119	5.6	126	1.9	120	0.4	126	14.4	96
Low income	13		12.3		16.8		5.6		1.9		0.4		14.4	

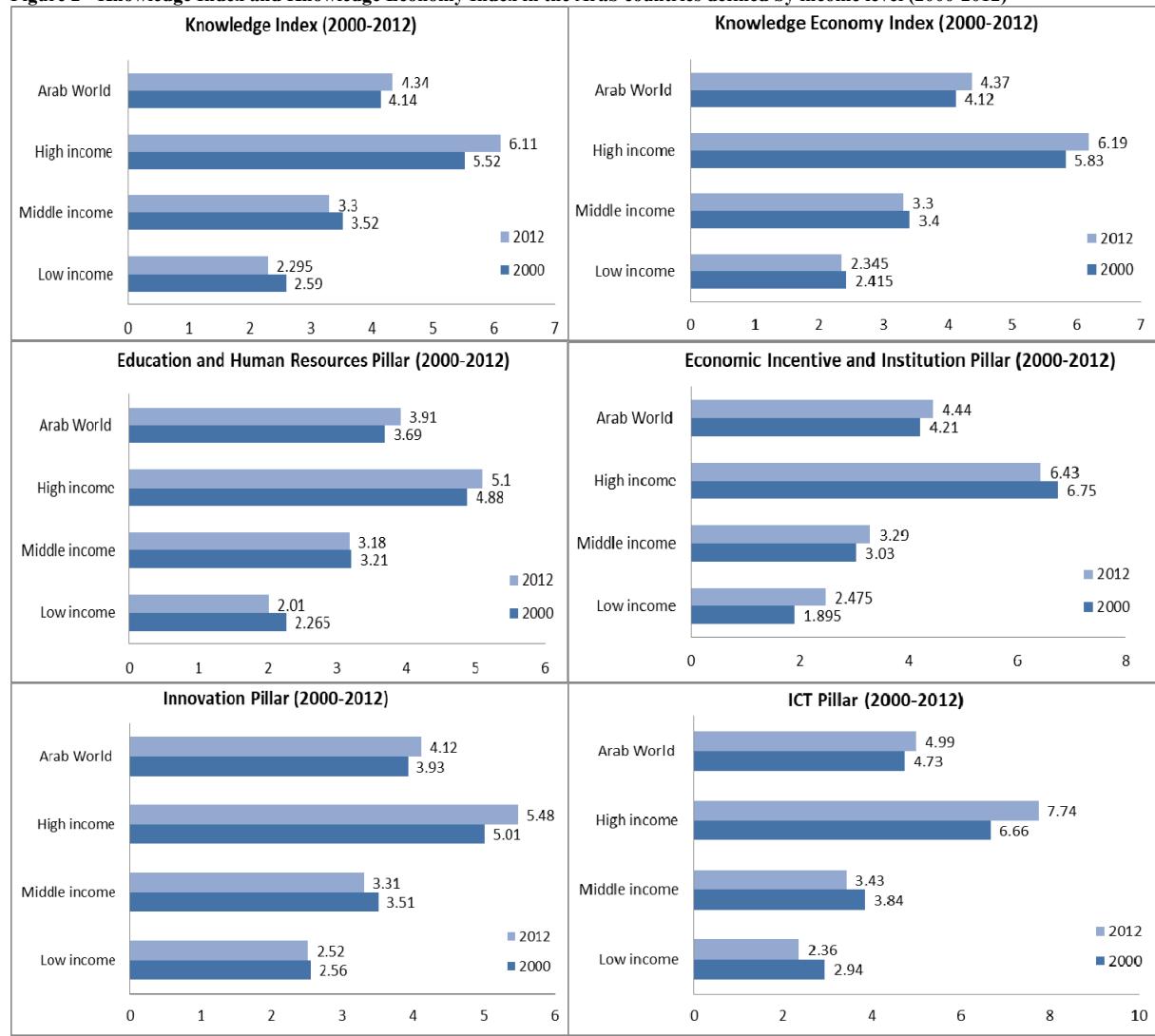
Source: World Economic Forum – the Global Innovation Index Report (2018)

Figure 1- Knowledge Index and Knowledge Economy Index in the Arab region defined by income level (2000-2012)



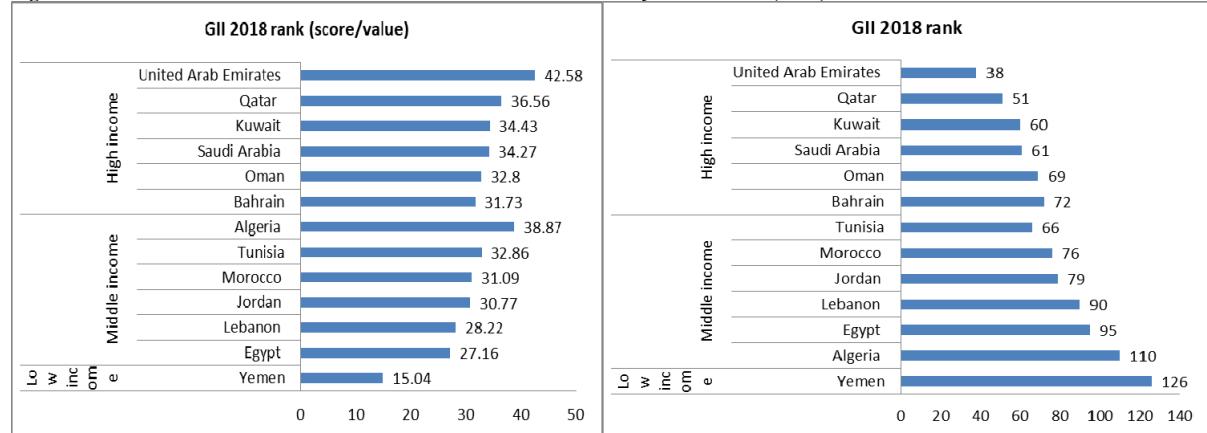
Source: Adapted from the World Bank Data base (2012)

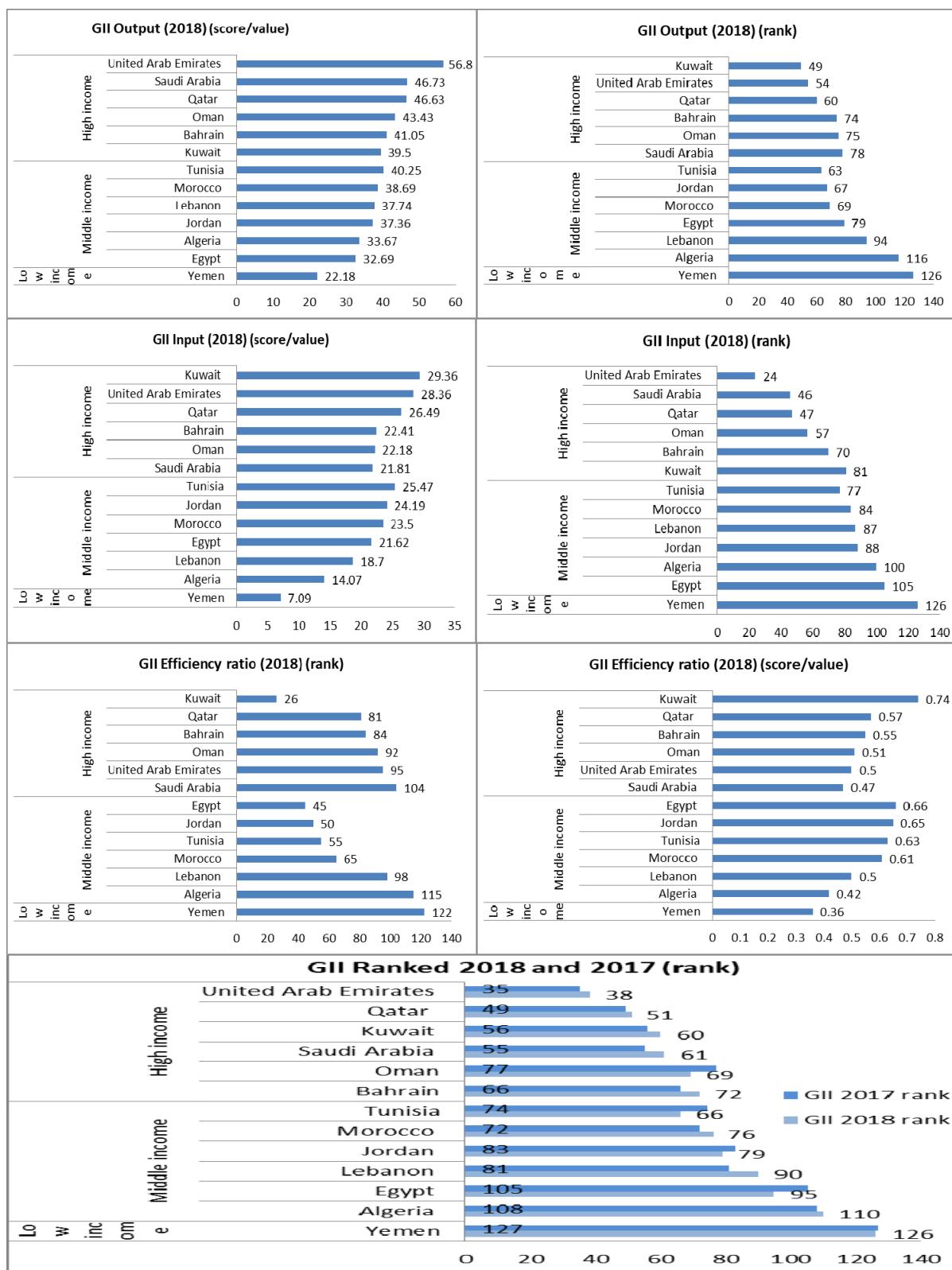
Figure 2 - Knowledge Index and Knowledge Economy Index in the Arab countries defined by income level (2000-2012)



Source: Adapted from the World Bank Data base (2012)

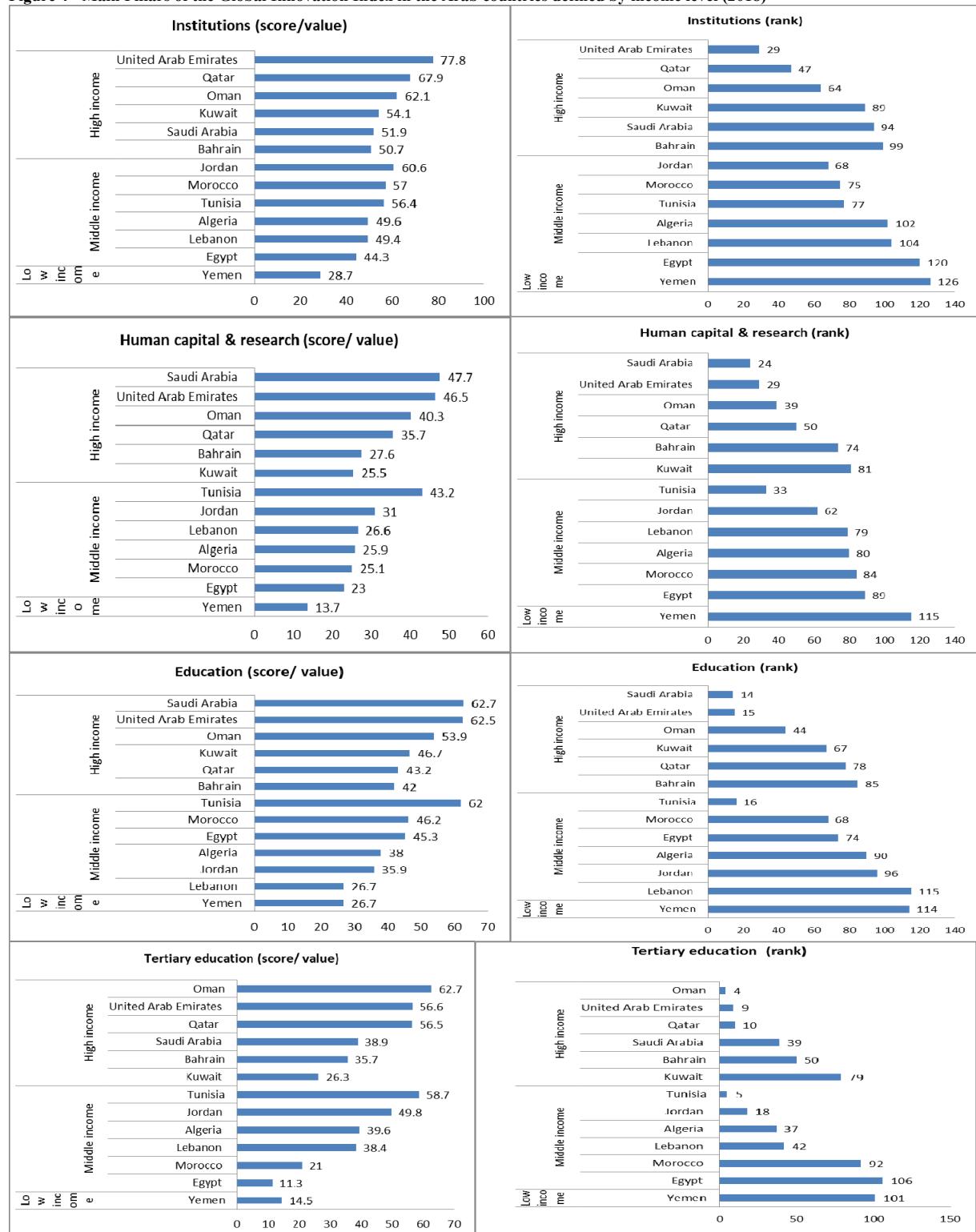
Figure 3 - The Global Innovation Index in the Arab countries defined by income level (2018)

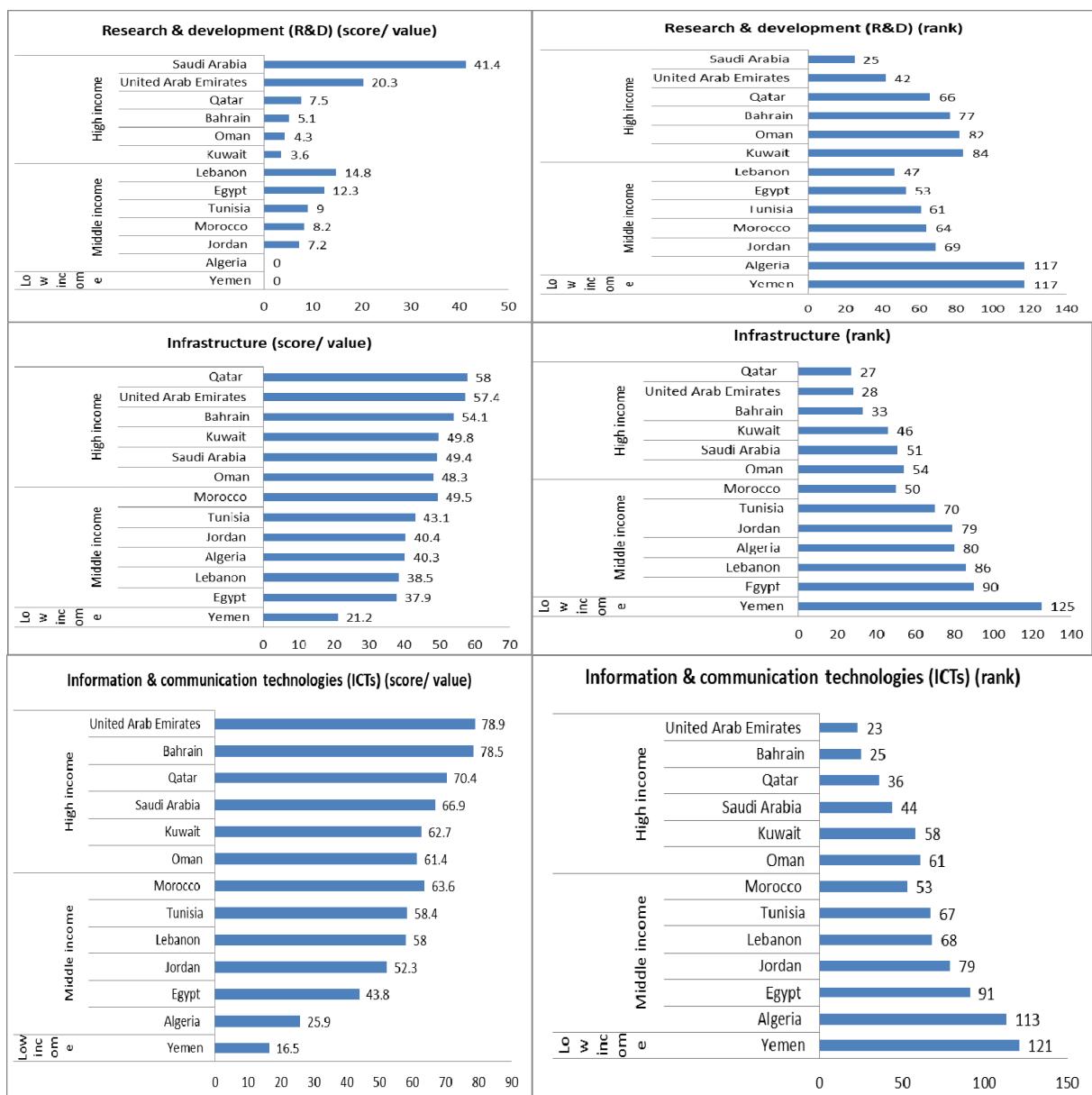




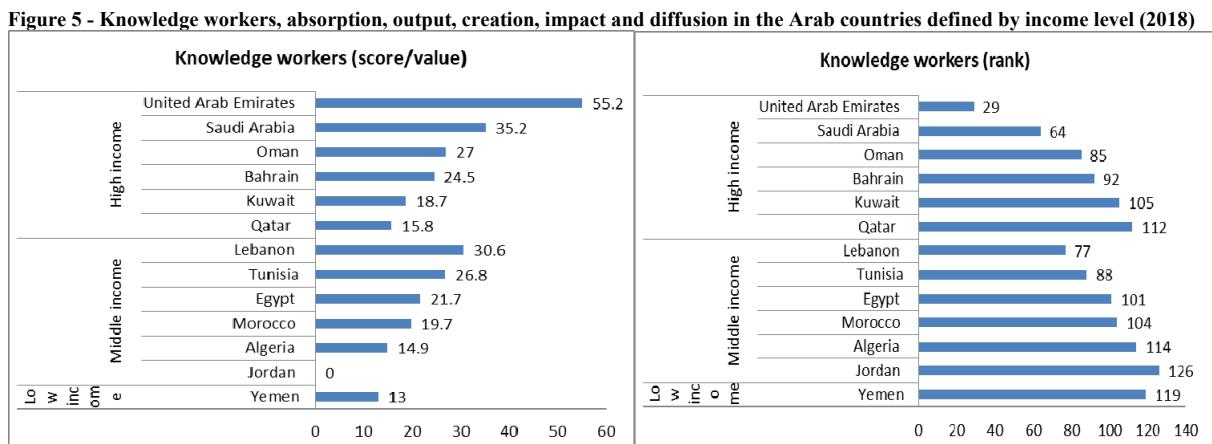
Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

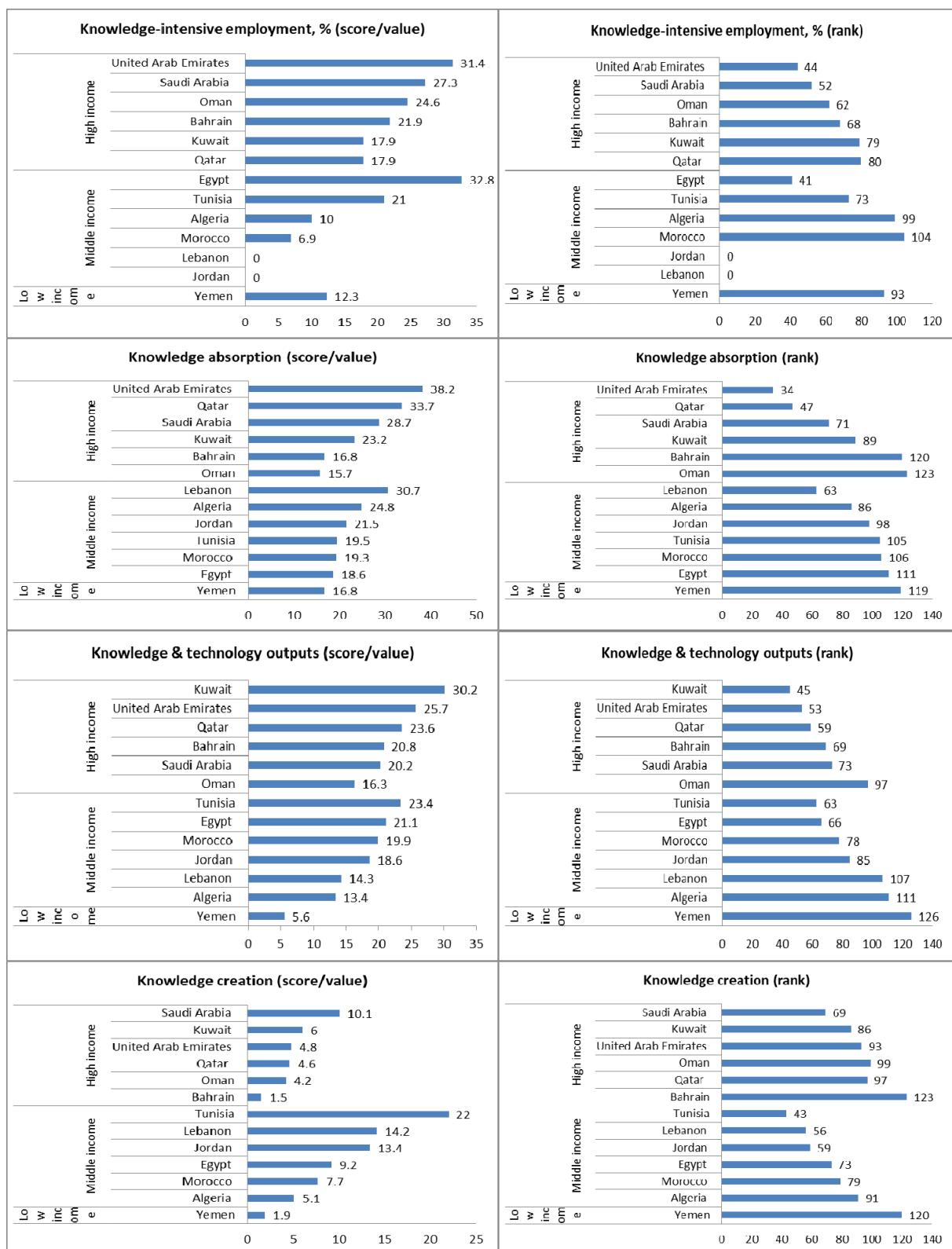
Figure 4 - Main Pillars of the Global Innovation Index in the Arab countries defined by income level (2018)

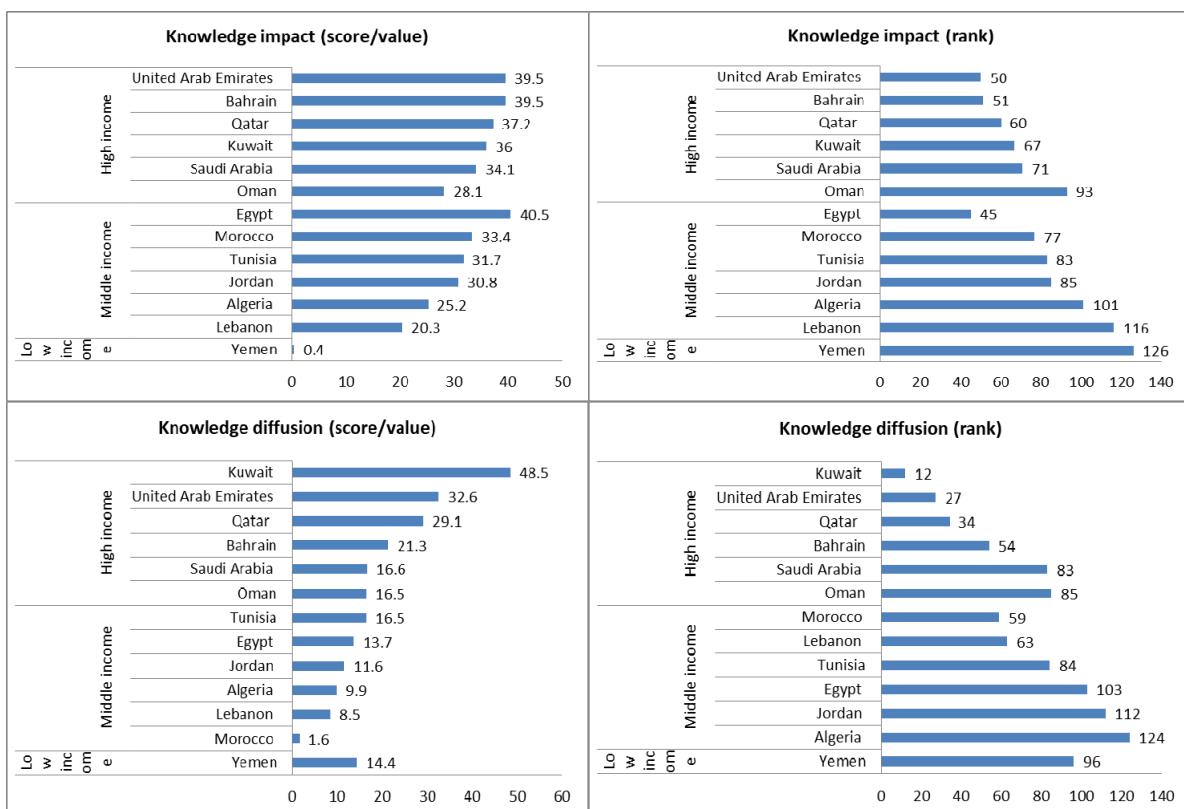




Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

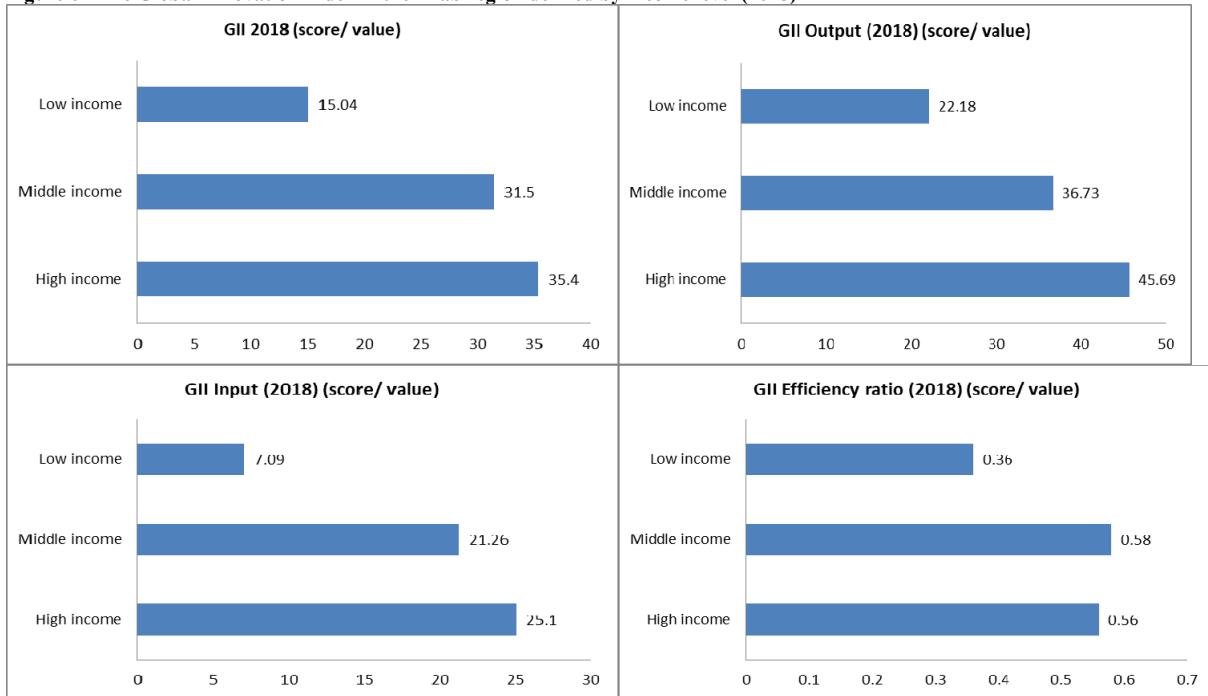






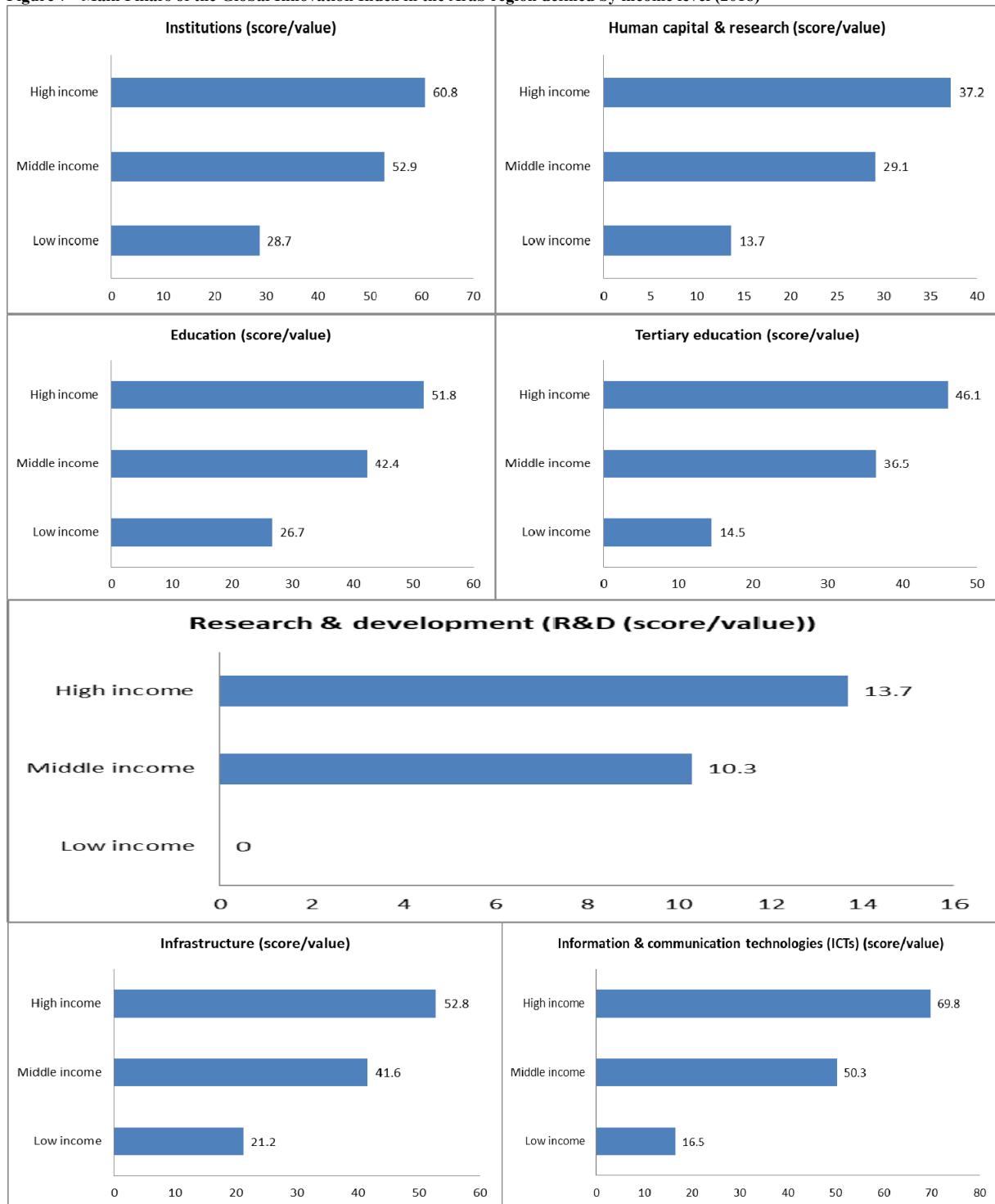
Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

Figure 6 - The Global Innovation Index in the Arab region defined by income level (2018)



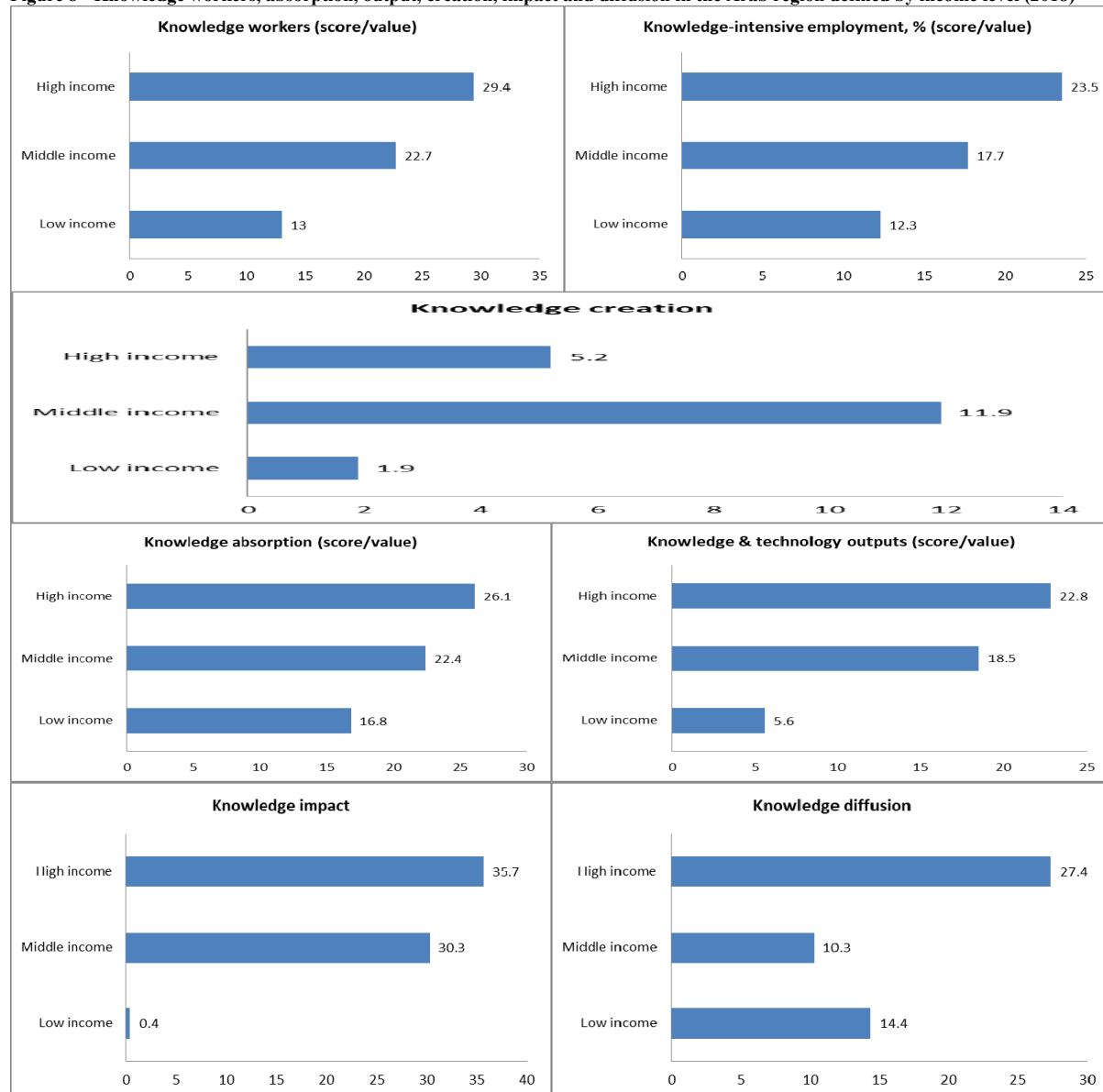
Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

Figure 7 - Main Pillars of the Global Innovation Index in the Arab region defined by income level (2018)



Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

Figure 8 - Knowledge workers, absorption, output, creation, impact and diffusion in the Arab region defined by income level (2018)



Source: Adapted from the World Economic Forum – the Global Innovation Index Report (2018)

5. Conclusion, policy implications and policy recommendations

This paper aims to discuss the relationship between knowledge, knowledge economy and economic development in the Arab region. It aims to contribute to improve understanding and provide valuable contribution to the increasing debate in the international literature concerning the relationship between knowledge economy and economic development in the Arab region. We use the conceptual framework and indicators often used in the international literature to discuss the relationship between knowledge, knowledge economy and economic development in the Arab region. Different from previous studies in the Arab literature, we fill the gap in the Arab literature, we present an in-depth and a more comprehensive analysis of the relationship between knowledge economy and economic

development in the Arab region defined by income level using recent secondary data related to knowledge economy obtained from the Global Innovation Index Report (2018) and the World Bank (2012).

Our results support the first hypothesis concerning the considerable variation in the promotion of knowledge economy depending on the level of economic development across the Arab countries. Our findings verify the second hypothesis that the relationship between knowledge economy and economic development in the Arab region is determined by several factors including economic development, economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT). Our results support the third hypothesis that sound and coherent policies for the promotion of knowledge economy through the promotion of economic incentives and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) would contribute to accelerate achievement of inclusive growth and sustainable development in the Arab countries.

For our analysis of the relationship between knowledge economy and economic development in the Arab region over the period (2000-2012) we use the data from the World Bank (2000-2012) and also we use the World Bank framework and definition of KI and KEI and KEI four pillars related to the knowledge economy: economic incentive and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) pillars. Our results in the Arab region show that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and knowledge index, knowledge economy index and all knowledge economy index pillars. For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of knowledge index, knowledge economy index and all knowledge economy index four pillars related to the knowledge economy—economic incentive and institutional regime pillar, education and human resources pillar, the innovation system pillar, and information and communication technology (ICT) pillar.

For our analysis of the relationship between knowledge economy and economic development in the Arab region in 2018, we use the data obtained from the World Economic Forum the Global Innovation Index Report GII (2018) and we use the OECD (1996) framework and definition of a knowledge-based economy: economies which are directly based on production, distribution and use of knowledge and information. Our findings in the Arab region show that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and most of knowledge economy indicators (with the exception of knowledge creation). For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of knowledge workers, knowledge-intensive employment, knowledge absorption, knowledge and technology outputs, knowledge impact and knowledge diffusion respectively. Our results illustrate that the average for high income countries, middle income countries and low income countries implies positive relationship between income level and all factors facilitating the promotion of knowledge economy (with the exception of innovation efficiency ratio). For instance, on average the performance of high income countries is higher than the middle income countries and the low income countries in terms of institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies (ICTs), and innovation (GII (2018, 2017), GII output (2018), GII input (2018)).

We find considerable variation in the promotion of knowledge economy across the Arab countries that demonstrated from the substantial difference in the performance in terms of KI and KEI and KEI four pillars related to the knowledge economy: economic incentive and institutional regime, education and human resources, the innovation system and Information and Communication Technology (ICT) pillars. That also demonstrated from the large disparity in the performance in terms of knowledge workers, knowledge-intensive employment, knowledge absorption, knowledge and technology outputs, knowledge creation, knowledge impact and knowledge diffusion and also in terms of all factors facilitating the promotion of knowledge economy including institutions, human capital and research, education, tertiary education, research & development (R&D), infrastructure, information and communication technologies (ICTs), and innovation (innovation input, output and efficiency).

The major policy implication from our results implies that the major factors impede and those contribute to the promotion of knowledge economy across the Arab countries related to institutions, economic incentive and institutional regime, education, human resources and research (human capital, education, tertiary education, research & development (R&D)), the innovation system (innovation input, output and efficiency) infrastructure, and information and communication technologies (ICTs). The major policy implication and recommendation that sound and coherent policies for the promotion of knowledge economy through the promotion of institutions, economic incentive and institutional regime, education, human resources and research (human capital, education, tertiary education, research & development (R&D)), the innovation system (innovation input, output and efficiency) infrastructure, and information and communication technologies (ICTs) would contribute to accelerate achievement of sustainable development and inclusive growth in the Arab countries.

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