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KNOWLEDGE ECONOMY AND REGIONAL DEVELOPMENT IN MIDDLE EAST COUNTRIES

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—Abstract —

Empirical literature has shown that the stock of knowledge could be broadly defined as an important factor for economic growth. On the other hand, a number of studies provide evidence of the contribution of knowledge spillover to regional economic development. The aim of this study is to analyze the stylized facts related to knowledge economy, investment in R&D and technological improvement in the Middle East region, in order to adopt policies and strategies for the region countries to use the benefits of knowledge-based economy. The results of the study indicate that related investments in research and development, education, information structure and innovation have been insufficient in most countries of the region; and investment to develop knowledge-base economy as well as intra & inter regional knowledge spillovers could be a source of economic growth and development for the region.

Key Words: *Knowledge-base economy, Knowledge spillovers, Economic growth, Regional development, Middle East.*
JEL Classification: O18, R11, R12

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1. Introduction

Since the day of Adam Smith, economists have investigated to find out what is that makes some countries rich and others poor. These efforts have provided a better understanding of the sources of economic growth. However, the mystery of economic growth has remained unsolved (Helpman, 2004). One of the key findings of the empirical growth literature of the past half-century is that the accumulations of physical and human capital can only account for between half and two-thirds of economic growth in most countries. The remainder is driven by something else that is commonly referred to as the Total Factor Productivity (TFP) or the Solow residual (Uppenberg, 2009). TFP is a variable which accounts for effects on total output not caused by traditionally measured inputs of labor and capital (Helpman, 2004). Stock of knowledge, technological change and the externalities are the main derivers of TFP improvement. Empirical literature has also established that investment in Research and Development (R&D) is a key input into the process of innovation and the expansion of the knowledge stock (Uppenberg, 2009). Endogenous growth models suppose that accumulation of knowledge is an endogenous variable for economic growth, which is a function of investments in R&D and allocation of resource for inventive activates.

Knowledge, however, partly has the character of a public good, and part of the new knowledge generated by an economic agent in a region could flow to other economic agents in the same region and also to economic agents in other regions (Karlsson and Grasjo, 2012). Therefore, knowledge-flows among countries breed additional externalities and interdependence across countries; and international spillovers of learning-by-doing affects both the structure of foreign trade and the growth rates of countries (Helpman, 2004).

Since the industrial revolution, the Middle East (ME) region has been facing considerable economic challenges. Macroeconomic performance and institutional frameworks of the ME has been conspicuously weak, in terms of governance, competition, and productivity. ME countries need a more productive economic regime to boost development and economic growth (Aubert & Reiffers, 2003). The aim of this study is to analyze the current situation of knowledge economy in the Middle East region, in order to assess the readiness of ME countries to reap the benefits of knowledge-based economy.

The remainder of this paper is organized as follows: Section 2 provides the conceptual formwork and reviews the literature related to the role accumulation

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and spillover of knowledge in economic growth and regional development. Section 3, presents the stylized facts about knowledge economy in selective ME countries and analysis the potential of ME to take the advantages of intra & inter regional knowledge spillover. A summary of conclusions and policy implications of the paper is contained in the final section.

2. Knowledge Accumulation, Knowledge Spillover and Regional Economic Growth

Briefly, the role of knowledge and technology in economic growth could be organized around four themes. In the first theme, the accumulation of physical and human capital is important, but it explains only part of the variation across countries in income per capita and its rate of growth. Exogenous changes of knowledge and technological factors also affect economic growth. This kind of theme is so-called neoclassical model of economic growth, which founded simultaneously by Solow (1956) and Swan (1956). In the second theme, TFP is at least as important as accumulation. Knowledge accumulation and, in particular, the incentives for knowledge creation could shape TFP improvement. Investment in R&D, learning-by-doing, externalities, and increasing returns are the main drivers for knowledge creation and so TFP improvement. Such a theme is recognized as "endogenous" growth model which initiated by Romer (1986) and Lucas (1988). Grossman and Helpman (1995) have developed the third theme which stress that growth rates of different countries are interdependent, because of the flow of knowledge across national borders. Foreign trade and investment also affect the incentives to innovate, to imitate, and to use new technologies. Finally, the fourth theme emphasize that economic and political institutions affect the incentives to accumulate and to innovate, and they also affect the ability of countries to accommodate change (Helpman, 2004).

Therefore new growth theories have shown that new knowledge is an especially valuable factor of production, by taking account of the unique characteristics of information and, in particular, its ability to be passed from user to user without losing its usefulness (i.e. it's non-rival character). Investments in equipment embodying new technological developments and in education, invention, and related knowledge-enhancing activities are seen to be the key to overcoming the impact of the diminishing returns that come into play as workers are equipped

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with increased capital. Technological progress makes it possible to extract greater value from limited resources and sustain the economy's growth over the long-term (Karagiannis, 2007).

Today, there exists a large literature which indicates knowledge flows, knowledge spillovers and knowledge externalities are the drivers of regional economic development. New knowledge is generated by economic agents through deliberate search for new knowledge in the form of R&D activities, and trough learning-by-doing, when carrying through different activities. The sources of knowledge can be classified into two groups: i) embodied knowledge including individuals, economic agents and products, and ii) disembodied knowledge, including books, articles, research and consultancy reports, patents, web pages.

Knowledge flows can be described as a special sort of communication related to the diffusion of messages, products, individuals or economic agents that embody new ideas, knowledge, concepts, blueprints, and so on (Rogers, 1983). Such flows occur whenever an idea generated by a certain economic agent is learned by another economic agent, and indicate a process where economic agents learn from another economic agent's ideas and combine these with internally generated ideas and internally existing ideas, thereby developing and extending the internally existing stock of ideas (cf. Griliches, 1992).

However, this learning can occur through many different mechanisms, such as markets, publications, social networks, professional networks, education and training and labour mobility, which indicates that the diffusion of knowledge is a complex matter to disentangle and to understand not least since it is also dependent upon formal and informal institutions and the level of social capital (Helpman, 2008).

When the knowledge flows are not fully compensated, we talk about knowledge spillovers. Griliches (1992) defined knowledge spillovers as "working on similar things and hence benefiting much from each other's research".

Since the knowledge generating activities are localized, regional knowledge externalities have two main spatial sources: i) intra-regional knowledge sources, i.e. knowledge sources characterized by geographical proximity, which lower the transaction costs and facilitates pure knowledge spillovers, and ii) inter-regional knowledge sources, i.e. knowledge sources in other regions, avail-able via different interregional links. Proximity implies that transactions and planned interactions between economic agents become less costly and that the probability

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for non-planned interactions increases. More advanced types of interactions between economic agents are dependent upon trust and proximity makes it easier to develop trust (Breschi & Lissoni, 2001).

Some authors claim that intra-regional knowledge spillover may generate dynamically increasing returns in the regional economics, thus stimulate innovation and regional economic growth. International spillovers of learning-by-doing affect both the structure of foreign trade and the growth rates of countries. This is very different from the neoclassical growth model, in which growth is driven by factor accumulation and the long-run growth rate does not depend on initial conditions (Uppenberg, 2009).

3. Knowledge Economy in Middle East Region

The economy of the Middle East (ME) is very diverse, composed of individual economies that include hydrocarbon exporting economies, government led socialist economies, and the free market economies. The oil industry has significantly affected the entire region economy, both through the wealth that it generates and through the movement of labor. Overly dependent on oil resources, a number of ME countries have undertaken efforts to diversify their economies in recent years in order to overcome economic stagnation, mounting unemployment, and increasing poverty. Some countries in the region have invested on education, innovation, and Information & Communication Technology (ICT) infrastructure from the source of oil revenues. Some countries also have invested R&D. However, there is considerable difference between region countries and advance economies in terms of knowledge economy and R&D investments.

This section provides evidences that reveal the gap between ME region and other regions of the world; and also cross-country differences among the region countries in terms of knowledge economy. The set countries were considered as Middle East composed of 15 countries including: Bahrain, Cyprus, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen.[1]

[1] . Palestine and Israel are also in the Middle East region, but we just selected 15 above mentioned countries.

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In order to compare knowledge economy ME with other regions, the indicators of four regions of the world including North America (NAC), East Asia & Pacific (EAS), Europe & Central Asia (ECS), and Latin America & Caribbean (LCN) as well as the average for the world were reported in the tables.

Table 1, reports R&D expenditures (% of GDP) for ME countries and other regions. As illustrated by the table, ME countries to spend notably less on R&D than other regions of the world. The average share of R&D expenditure in GDP for ME countries during the past decade was around 0.34% while the ratio for NAC, ECS, and EAS were 2.67, 2.37 and 1.80 respectively. More importantly, the gap between ME and other regions has been remarkably stable over a long period of time, and ME have made little progress in closing this gap in the past decade countries.

There are also large and persistent differences across individual ME countries. While R&D intensity in Iran and Turkey is more than 0.60%, R&D spending in other countries is less than 0.1% of GDP. Even, there is no available data for R&D expenditure in 8 countries of the region.

Moreover, what actually matters for economic growth is the stock of knowledge, as represented by the R&D capital stock. The R&D capital stock accumulates gradually as a result of many years of investment in R&D, but it also depreciates as older knowledge becomes obsolete. If ME countries would suddenly their level of R&D intensity, this alone would not have an immediate impact on its economic performance. What is needed is a sustained increase in the level of investment that would over time expand ME's R&D capital stock.

Table 1: Research and development expenditure (% of GDP)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Ave.
NAC	2.53	2.65	2.68	2.58	2.57	2.51	2.55	2.58	2.64	2.75	2.81	**2.62**
ECS	1.72	2.38	2.34	2.43	2.41	2.51	2.5	2.45	2.53	2.44	na	**2.37**
World	2.05	2.13	2.15	2.11	2.09	2.04	2.04	2.05	2.02	2.13	2.21	**2.09**
EAS	2.33	1.71	1.68	1.77	1.75	1.8	1.77	1.79	1.77	1.72	1.73	**1.80**
LCN	0.53	0.59	0.58	0.56	0.55	0.55	0.62	0.63	0.65	0.68	0.77	**0.61**
Iran	na	0.55	0.55	0.67	0.59	0.73	0.67	na	0.79	na	na	**0.65**
Turkey	0.45	0.54	0.53	0.48	0.52	0.59	0.58	0.72	0.73	0.85	0.84	**0.62**
Jordan	na	na	0.34	na	na	na	na	na	0.43	na	na	**0.39**
Cyprus	0.23	0.25	0.3	0.35	0.37	0.4	0.43	0.44	0.42	0.49	0.5	**0.38**

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Egypt	0.20	na	na	na	0.27	0.24	0.26	0.26	0.27	0.21	na	**0.24**
Kuwait	0.20	0.18	0.18	0.14	0.13	0.1	0.08	0.09	0.09	0.11	na	**0.13**
Saudi A.	na	na	na	0.06	0.05	0.04	0.04	0.05	0.05	0.08	na	**0.05**
ME	**0.27**	**0.38**	**0.38**	**0.34**	**0.32**	**0.35**	**0.34**	**0.31**	**0.40**	**0.35**	**0.67**	**0.35**

Source: World Bank, WDI, 2012

Abbreviations: East Asia & Pacific (**EAS**), Europe & Central Asia (**ECS**), Latin America & Caribbean (**LCN**), North America (**NAC**), Middle East (**ME**), and United Arab Emirates (**UAE**).

Knowledge Assessment Methodology (KAM) is also an interactive benchmarking tool created by the World Bank to identify the challenges and opportunities which countries face in making the transition to the knowledge-based economy. The KAM measures countries performance on the 4 Knowledge Economy (KE) pillars: Economic Incentive and Institutional Regime, Education, Innovation, and Information and Communications Technologies. Variables are normalized on a scale of 0 to 10 relative to other countries in the comparison group. The KAM also derives a country's overall Knowledge Economy Index (KEI) and Knowledge Index (KI).[2]

Table 2 reports KAM for ME countries and other regions. The region's overall knowledge economy index (KEI) is notably less than either NAC or EAS. KEI index of ME region also experienced a slight deterioration over the period 1995–2012.

As a whole, ME countries' Economic Incentive and Institutional Regime has slightly improved throughout the 1995–2012; Whereas, the average level of ME for Information and Communication Technology (ICT) also diminished from 6.36 to in 1995 to 5.56 in 2012. In the case of innovation and education pillars there were no considerable changes. Moreover ME countries show great dispersion on this index. Some countries rank quite high, relative to the global position, while others have a much lower rank. Cyprus, UAE, Bahrain and Oman not only have higher level than to rest of the region, they also well positioned in terms of the knowledge economy in the world. On the other hand, Yemen, Pakistan, Syrian and Egypt do not have suitable situation in knowledge base economy in the world. The changes in the rank of individual countries are notable. Overall ranking of KAM for Saudi Arabia and Oman has remarkably progressed since the year 1995, whereas the rank of Turkey, Jordan and Lebanon has notably worsened (Table 2).

[2] . See the KAM booklet and the User Guide for more information.

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The comparison of high-technology exports for ME with other regions unfolds the gap between ME and advanced region practically with EAC and NAC (Table 3). While the average share of High-technology in manufactured exports for ME was 2.17% during the last decade, more than 25 percent of manufactured exports in East Asia & Pacific and North America are due to the High-technology. Except Cyprus with 14.20%, the average share of High-technology for most of ME countries are less than 2 percent, especially in oil exporting countries.

Table 2: Knowledge Assessment Methodology (KAM)

Rank	Change	Country	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
			recent	1995	recen	1995	recen	1995	recen	1995	recen	1995
		NAC	8.8	n/a	9.11	9.13	9.45	9.55	8.13	n/a	8.51	9.81
		EAS	8.6	n/a	8.39	8.29	9.16	8.97	8.46	n/a	8.37	8.99
		ECS	5.32	n/a	5.75	5.89	7.43	7.31	3.94	n/a	4.14	6.17
		LCN	5.15	n/a	4.66	4.85	5.8	6.06	5.11	n/a	5.02	6.23
		World	5.12	n/a	5.45	5	7.72	7.91	3.72	n/a	3.58	7.16
35	**-3**	**Cyprus**	7.56	7.68	7.71	8.43	7.71	7.47	7.23	6.75	7.57	8.05
42	**6**	**UAE**	6.94	6.39	6.5	6.9	6.6	6.59	5.8	4.46	8.8	7.62
43	**-2**	**Bahrain**	6.9	6.97	6.69	6.95	4.61	6.93	6.78	6.49	9.54	7.52
47	**18**	**Oman**	6.14	5.34	6.96	6.33	5.88	5.48	5.23	3.65	6.49	5.89
50	**26**	**Saudi A.**	5.96	5.02	5.68	4.45	4.14	5	5.65	4.11	8.37	6.51
54	**-5**	**Qatar**	5.84	5.86	6.87	5.64	6.42	4.79	3.41	5.52	6.65	7.49
64	**-18**	**Kuwait**	5.33	5.71	5.86	5.36	5.22	5.5	3.7	4.51	6.53	7.46
69	**-7**	**Turkey**	5.16	5.46	6.19	6.23	5.83	5.04	4.11	4	4.5	6.55
75	**-18**	**Jordan**	4.95	5.55	5.65	5.67	4.05	6.17	5.55	4.48	4.54	5.89
81	**-13**	**Lebanon**	4.56	5.38	4.28	4.29	4.86	4.26	5.51	6.65	3.58	6.32
94	**1**	**Iran**	3.91	3.59	0.73	0.63	5.02	2.86	4.61	4.47	5.28	6.41
97	**-9**	**Egypt**	3.78	4.68	4.5	4.14	4.11	5.08	3.37	4.64	3.12	4.87
112	**-1**	**Syrian**	2.77	3.49	2.04	2.05	3.07	3.07	2.4	3.11	3.55	5.73
122	**6**	**Yemen**	1.92	2.44	2.91	1.85	1.96	2.03	1.62	1.38	1.17	4.5
		ME	**4.94**	**5.09**	**4.97**	**4.75**	**4.82**	**4.87**	**4.43**	**4.38**	**5.56**	**6.36**

Source: World Bank, KAM, 2012

Table 4 also reports the Number of scientific and technical journal articles per million people in the region. As illustrated in this table the degree of scientific activities is very divers across individual countries. In some of countries particularly in Kuwait, Cyprus and Turkey the number of scientific articles per

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million people is more than 90, whereas in Yemen, Iraq and Syria the number is less than 5. The significant divergence across individual countries reveals the lack of scientific interaction among member countries.

As results, the evidences in this chapter indicate that despite the investments in R&D, infrastructure, education and knowledge, there is significant gap between ME region and other regions, particularly with NAC, EAC and EAS in terms of knowledge-based economy performance. The countries of ME need to adopt appropriate polices and strategies- like as Lisbon Strategy for Europe- in order to close the gap with other regions. If the region's governments wish to keep up with the pace in the advanced economies, they should move towards knowledge-based economy by investing in R&D, education, ICT infrastructure and incentive for innovation. ME countries should raise their level of R&D investment; but also some countries should establish institutions to collect the data related to R&D activities.

Table 3: High-technology exports (% of manufactured exports)

Country	≥2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Ave.
EAC	29.80	30.81	30.62	30.02	30.72	30.76	30.27	26.96	25.61	27.37	26.62	24.37	**28.95**
NAC	29.13	28.88	27.66	26.71	25.84	25.74	26.06	23.89	23.18	20.47	18.75	17.13	**25.63**
World	23.13	22.90	22.17	21.07	20.89	20.68	20.75	17.53	16.65	18.26	17.92	17.67	**20.45**
EAS	17.27	19.89	18.83	17.57	17.15	17.31	17.51	13.60	13.13	15.00	14.92	15.07	**16.88**
LCN	18.71	15.2	14.5	13.5	12.6	12.1	11.9	11.5	10.0	11.4	10.7	10.7	**12.2**
Cyprus	3.26	2.03	1.79	3.89	8.58	16.97	22.73	29.37	30.45	30.86	36.90	27.20	**14.20**
Lebanon	12.26	2.49	2.38	2.14	2.42	2.83	2.76	2.24	2.44	4.53	12.80	2.38	**3.38**
Iran	5.81	1.11	1.53	1.67	1.86	2.49	6.31				4.46		**1.89**
Syrian	2.82	0.41	0.61	0.80	1.02	2.08	0.80	1.27	1.81	1.56	1.34		**1.11**
Turkey	0.34	3.87	1.79	1.93	1.90	1.47	1.85	1.89	1.62	1.74	1.93	1.84	**2.30**
Jordan	0.53	7.05	4.16	1.78	1.90	1.39	1.23	1.13	0.92	1.41	2.86	2.51	**3.18**
Pakistan	2.98	0.30	0.67	1.21	1.09	1.38	1.45	1.38	1.85	1.71	1.69	1.76	**0.96**
Saudi A.	1.89	0.47	0.38	1.37	0.36	0.67	0.94	0.66	0.46	0.26	0.73		**0.63**
Egypt	5.35	0.90	0.78	0.53	0.58	0.40	0.55	0.19	0.97	0.84	0.88	0.71	**0.57**
Oman	0.19	3.10	2.17	5.74	0.68	0.28	0.31	0.46	0.74	0.30	0.57	2.62	**3.26**
Yemen	0.63	0.00	0.01	0.52	0.26	0.24	0.51	0.38	0.28	0.37	0.36	0.32	**0.30**
Bahrain	0.34	0.01	0.01	0.12	0.07	0.07	0.06	0.05	2.53	0.03	0.11	0.15	**0.59**
Qatar	7.05	0.01	0.00	0.00	0.02	0.01	0.01	0.08	0.01	0.02		0.04	**0.02**

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Kuwait		0.18	0.15	0.11	0.12		0.34	0.48	0.30	0.52			**0.42**
Iraq								0.09					**0.09**
ME	2.03	1.57	1.17	1.56	1.49	2.33	2.85	2.83	3.41	3.40	5.38	3.96	**2.17**

Source: World Bank, KAM, 2012

The fact that there are notable differences across individual countries in most of the indicators, and divergence of region's countries in terms of knowledge economy performance, implicitly means that intra-regional knowledge spillover was weak and countries should promote their scientific interactions, knowledge diffusion and economic cooperation.

Also, regional economic development seems increasingly to be dependent upon internal network structures to exploit fully the internal knowledge base, while at the same time absorbing new knowledge from outside the region.

Table 4: Number of scientific and technical journal articles per million people of population

Country	≥2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Ave
World	102	102	102	104	107	109	113	114	116	116	**107**
Kuwait	141	124	111	109	111	102	106	95	89	75	**112**
Cyprus	59	71	80	76	86	88	114	131	157	179	**97**
Turkey	51	65	80	92	111	115	119	124	121	117	**91**
Jordan	50	47	48	49	53	51	52	61	71	65	**54**
Lebanon	39	58	45	57	51	59	61	58	67	60	**53**
UA E	50	50	51	53	57	55	47	37	38	34	**48**
Oman	40	45	49	45	40	44	42	50	48	43	**44**
Qatar	40	34	20	32	67	47	44	42	44	41	**41**
Bahrain	45	35	28	49	43	38	43	47	39	30	**41**
Iran	11	15	19	26	31	38	48	61	72	86	**36**
Saudi A.	32	27	27	24	23	23	22	23	24	27	**26**
Egypt	20	22	23	25	24	23	24	26	27	29	**24**
Syrian	3	4	3	4	4	4	3	4	3	3	**4**
Iraq	1	1	1	1	1	1	2	3	2	2	**2**
Yemen	1	1	1	0	1	0	1	1	1	1	**1**
ME	**74**	**78**	**78**	**81**	**87**	**87**	**94**	**97**	**104**	**102**	**86**

4. Conclusions and policy implications

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The empirical growth literature has confirmed that more than half of the variation in income per capita and differences in growth rates of income per capita results from differences in TFP and TFP growth respectively. Stock of knowledge and technological change are the most important determinants of TFP. Investment in R&D is a key input into the process of innovation and the expansion of the knowledge stock. Other things being equal, countries and sectors devoting a larger share of their resources to R&D also tend to enjoy a higher productivity growth. On the other hand, knowledge spillovers and knowledge externalities are the drivers of regional economic development.

The results of the study revealed that, in most ME countries of the region, related investments in education, information infrastructure, R&D, and innovation have been insufficient. Moreover, inadequate economic and institutional frameworks prevent these investments from yielding desired results. There is also significant divergence of region's countries in terms of knowledge economy performance as a result of weak Intra-regional knowledge spillover.

If the region’s countries aim to keep up with the pace in the advanced economies, and move forward to knowledge-base economy, they need to:

adopt a strategy to promote region's overall knowledge-base economy, to increase R&D investment and to motivate innovation- like as Lisbon Strategy in Europe,

promote intra-regional knowledge diffusion and spillovers,

expand the relationship with advanced economies in terms of knowledge, sciences and technology,

encourage investment in human capital as a source of economic growth through investment in education, learning-by-doing and inventive activities,

enhance ICT infrastructure as well as high technology export,

establish economic and political institutions affect the incentives to accumulate and to innovate, and they also affect the ability of countries to accommodate change.

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