

SCIENTIFIC RESEARCH, INNOVATION, AND HUMAN CAPITAL AS PROPS FOR KNOWLEDGE ECONOMY IN EGYPT AND SOME COUNTRIES OF GCC” (A COMPARATIVE STUDY WITH SIGNAL TO CORONAVIRUS EFFECTS)

Dr. ATTALLA A. ABADEER^a and Dr. GABER M. M. ABDEL GAWAD^b

^aProfessor of Economics -Faculty of commerce-Helwan University.

^bProfessor of Economics – Faculty of Commerce – Helwan University- Egypt

Abstract

Scientific research, innovation and human capital are the most important pillars that the World Bank, the European Union and England have focused on, as basic pillars of the knowledge economy and the economic and digital transformation in most countries of the world, especially the developed countries. And these pillars along with the infrastructure of information and communication technology (ICT), the institutional framework and the appropriate macroeconomic environment are the main determinants of the knowledge economy as defined by the World Bank. The knowledge economy or the white economy that supported England after its stumbling block during the global financial crisis in 2008, so we focus in the current study on human capital as the most important pillars besides scientific research and innovation to build a knowledge economy. Therefore, the study will focus on testing the availability of these pillars or determinants in the Sultanate of Oman, Saudi Arabia and the United Arab Emirates from the Gulf Cooperation Council (GCC) countries and Egypt, as the most important countries that have made some progress in the field of knowledge economy, And determining, measuring, and comparing the competitive position of these countries in the field of knowledge economy, and what are the challenges and requirements for these countries to gain access to the ranks of developed countries in the knowledge economy and digital transformation, and improving their competitive position, especially in Egypt to achieve Vision 2030, and the Sultanate of Oman to achieve vision 2040.

Keywords: Knowledge Economy - Digital Transformation – GCC and Egypt- coronavirus effects.

INTRODUCTION

Knowledge Economy, one of the most attractive word in the world economy today, especially after fourth technological revolution or telecommunication revolution, and corona virus pandemic (Covid-19), where increasing the important of many e- phenomena like (e-learning, e- government, e-commerce, e-finance, e-banking. etc.) and many other phenomena like Cloud computing, 3rd dimensions printing, genetic engineering, internet of things. All of these phenomena make us life in digital edge. Which depend on digital economy. Actually we life in glass-hour economy, Knowledge economy conceptually is more than digital economy, it concerned with creating and producing knowledge and using it in all deferent sectors of traditional economy, it does not depend on agricultural sector, or industrial sector only, but also knowledge economy depends greatly on services sector and Information and Communication Technology (ICT). The knowledge economy is a system of consumption and production that is based on intellectual capital. In particular, it refers to the ability to capitalize on scientific discoveries and basic and applied research. This has come to represent a large component of all economic activity in most developed countries. In a knowledge economy, a significant component of value may thus consist of intangible assets such as the value of its workers' knowledge or intellectual property¹.

¹ Hayes, Adam (2020), “What is the Knowledge Economy?”. See:

<https://www.investopedia.com/terms/k/knowledge-economy.asp>

OECD Statistic's Definition: The knowledge based economy is an expression coined to describe trends in advanced economies towards greater dependence on knowledge, information and high skill levels, and the increasing need for ready access to all of these by the business and public sectors².

The World Bank defines knowledge economies according to four pillars:

1. Institutional structures that provide incentives for entrepreneurship and the use of knowledge
2. Availability of skilled labor and a good education system
3. Access to information and communication technology (ICT) infrastructures
4. A vibrant innovation landscape that includes academia, the private sector, and civil society.

From the four pillars of the world bank definition, we will concentrate on the three last pillars {skilled labor or human capital, Research and Development (R&D) in Information and Communication Technology (ICT) Sector, and Innovation}, we will summarize in two main pillars {Human Capital (HC), and Research, Development, and Innovation (RDI)}, with testing them in some Gulf Cooperation Council (GCC) countries and Egypt. By using deductive descriptive approach and some indicators in Knowledge Economy Index (KEI) in this paper. The Gulf Cooperation Council (GCC) is Economic and political organization established in Riyadh, Saudi Arabia in 25 May 1981, It Consists of six Arab Gulf Countries {Kingdom of Saudi Arabia (KSA), United Arab Emirates (UAE), Oman, Kuwait, Bahrain, Qatar}. The GCC countries are endowed with natural resources especially Oil and Gas, we will select three of them (Oman, Saudi Arabia, United Arab Emirates), which tended to depend on knowledge economy or knowledge based economy in recent years, as alternative strategy for sustainable development, and Egypt, which concentrate on knowledge-based-economy as a new strategy for sustainable development especially with 2030 Vision, like Oman in 2040 Vision.

In both countries (Egypt and Oman) there are many efforts to transform toward knowledge economy, in all sectors of economy, such as ICT sector, E-Government, smart cities, E-Banking, and many other fields. We will discuss briefly knowledge based economy in both this country and to what extent they depend on human capital and R&D, and Innovation as a main pillar for knowledge economy, and the competitive position for both countries in Arab area and in the world knowledge economy.

LITERATURE REVIEW

The pioneer study in this field was (Knowledge for Development) world development report by the World Bank in 1998/99, it started with narrowing knowledge gaps, where knowledge is like light, it is critical for development, because everything we do depends on knowledge. The world development report proposed that they look at the problems of development in a new way- from the perspective of knowledge. In this report they focused on two sort of knowledge and two types of problems that are critical for developing countries: 1-knowledge about technology, which they also called technical knowledge or simply know-how. 2- Knowledge about attribute such as the quality of a product, the diligence of a worker. The report examined three critical steps that developing countries must take to narrow knowledge gaps:

- 1) Acquiring knowledge
- 2) Absorbing knowledge involves, for example, ensuring universal basic education, extending education to girls, creating opportunities for lifelong learning, and supporting tertiary education.
- 3) Communicating knowledge involves taking advantage of new information and communication technology.³

The second study was “the Knowledge Economy, The KAM Methodology and World Bank Operations” by Chen and Dahlman (2006), this paper highlights the importance of knowledge for long- term economic growth. It presents the concept of the knowledge economy, an economy where knowledge is the main engine of economic growth. The paper also introduces the knowledge economy framework, which asserts that sustained investments in education, innovation, information and communication technologies, and a conducive economic and institutional environment will lead to increases in the use and creation of knowledge in economic production, the Knowledge Assessment Methodology (KAM) was developed⁴. And from this paper we can deduced the four pillars of knowledge economy, (Human Capital, R&D with Innovation, Information and Communication Technologies, and Institutional environment & Economic incentives) which composed the Knowledge Economy Index (KEI) by the World Bank in the following in many of the different studies. In Middle East and North Africa (MENA) region, especially in United Arab Emirates (UAE), The Arab Knowledge Report was launched in 2007 as the first partnership initiative between the United Nations Development Program and the Mohammed Bin Rashid Al Maktoum Knowledge Foundation. This partnership is based on the shared vision of the two sides in supporting knowledge-based development efforts with the aim of achieving sustainable development in the Arab region. Accordingly, Arab knowledge reports focus on the goal of establishing a knowledge society and economy in the Arab region, i.e. a society in which knowledge plays the role of the instrument and mediator in the effective integration of technology, expertise and governance in order to achieve the most sustainable amount of human development.

Since the establishment of the Arab Knowledge Project in 2007, it issued three Arab Knowledge Reports (AKR), (2009, 2010/2011, and 2014) and two Arab Knowledge Indexes (2015, and 2016), then from 2017 until 2020 it established Knowledge for All , that is covered three years issues (2017, 2018, 2019) and It includes six main indicators (i.e. pre-university education, technical and vocational education and training (TVET), higher education, research, development and innovation (RDI), information and communications technology (ICT), and economy, in addition to the general enabling environment)⁵.

In Oman there was many attempts, especially in Oman s Vision 2020 and 2040, which assured that economic diversification and knowledge economy play a critical role for sustainable development, from the priorities of vision 2040, two of them about 1. Education, Learning, Scientific Research and National Talents and 6. Economic Diversification and Fiscal Sustainability, which have strategic direction that A diversified, sustainable and competitive economy that is based on knowledge and innovation, operates within integrated frameworks, adapts with the industrial revolutions, and achieves fiscal sustainability⁶.

Egypt like Oman, where in Egypt Vision 2030 Sustainable Development Strategy. It depends on knowledge economy and innovation as a main factor for diversification in traditional economic activities to achieve sustainable development so, “The new Egypt will possess a competitive, balanced and diversified economy, dependent on innovation and knowledge,

based on justice, social integrity and participation, characterized by a balanced and diversified ecological collaboration system, investing the ingenuity of place and humans to achieve sustainable development and to improve Egyptians' life quality," Egypt Vision 2030 Sustainable Development Strategy⁷.

² <https://stats.oecd.org/glossary/detail.asp?ID=6864>

³ The World Bank (1999), "*Knowledge for Development*". World Development Report: Oxford University Press, P2.

In Europe in March 2019, there was (Introducing the EBRD Knowledge Economy Index) by the European Bank for Reconstruction and Development, The new EBRD KE Index contains 38 indicators divided into four pillars: (1) institutions for innovation, (2) skills for innovation, (3) the innovation system and (4) the ICT infrastructure. Among the EBRD regions, Estonia scores highest and Turkmenistan lowest. Serbia made the greatest progress between 2011 and 2018. Weak institutions for innovation are the most significant drivers of KE gaps between the EBRD regions and their OECD comparators⁸.

The previous studies are the main institutional efforts, but there are many individuals efforts such as (Abdel Gawad, Gaber Mohamed⁹) "The New Economy, Knowledge Economy", in this book the author discussed the concept, pillars, and indicators of Knowledge Economy, using approach of the world bank to determine the competitive position of Egyptian economy in KE, and another study with Rao Muramalla, Venkata S. S. about "Telecommunications Revolution and Its Effects on Economic Development: An Applied Study of Developing Economies Such as Egypt, Saudi Arabia, and India"¹⁰, through this paper they show the important and the role of telecommunication revolution and ICT in increase growth rate in traditional economy and building new economy or KE, and Kamla Ali Al Busaidi "Fostering the development of Oman's knowledge economy pillars through ICT"¹¹, the purpose of this article is to test the Information and Communication Technology ICT as Key factor drive KE, and it test the main pillars (education, innovation and economic and institutional regimes) in Oman. And Alexandros Papaspyridis and Tatiana Zalan "How GCC states can transition to knowledge-based economies"¹², the article used the approach of the world bank on some GCC countries to test how this countries can transition to KE, and the need to improve their innovation system and the regulatory regime must be improved.

In GCC Countries, there are many article like "The role of research in knowledge economy within GCC countries"¹³, and "The Arab Gulf States and the Knowledge Economy: Challenges and Opportunities"¹⁴, and many articles about Knowledge Economy, most of them depending on the first study by the World Bank.

Our study like the all previous study depend on the World Bank methodology, and choose the main pillar for KE, Human Capital which is building it by education and training, with Research, Development and Innovation. This are the main props for knowledge economy, we will test them in Oman and Egypt and other two countries Saudi Arabia and United Arab Emirates from GCC countries.

Coronavirus Pandemic and its Effects on Expenditure on Research, Development and Innovation as a pillar of Knowledge Economy.

In mid-December 2019, a novel and infectious coronavirus (COVID-19) struck Wuhan, the most populous city in central China. Similar to the severe acute respiratory syndrome (SARS) that emerged in 2003, COVID-19 is an airborne illness that is highly transmittable between humans. Immediately after the Chinese government shared information about the virus publicly in late January 2020, stricter preventive measures, such as community

quarantines and temporary business closures, swept across Chinese cities.

⁴ Chen, Derek H. C. and Carl J. Dahlman (2006), “The Knowledge Economy, The KAM Methodology and World Bank Operations”, The World Bank: World Bank Institute, Washington D. C. 20433, USA., P i.

⁵<https://www.knowledge4all.com/Methodology2019.aspx?language=en> ⁶ <https://www.2040.com/en/national-priorities/>

⁷ <https://brusselsresearchgroup.org/index.php/2019/02/03/sustainable-development-strategy-egypt-vision-2030/>

The local outbreak quickly developed into an emerging public health crisis to the extent that WHO recently declared it as an unprecedented global pandemic. In March, Europe has become the epicenter of the pandemic, and many countries imposed restrictions on human mobility. As of March 23, 2020, infections were confirmed in 190 countries/territories/areas, totaling 332,930 cases, more than 14,510 deaths, and an exponentially growing number of suspected cases worldwide (World Health Organization, 2020)¹⁵

The coronavirus disease (COVID-19) outbreak has infected more than 2,950,000 people and killed more than 202,000 worldwide to this date¹⁶.

Some studies estimated the economic effects of coronavirus on loss in GDP in Middle East and North Africa MENA will be US\$m 47,230. And Loss of consumption US\$m 71,475.4 in MENA region¹⁷.

The importance of stable, predictable research and development expenditures at times of crisis

On the one hand, countries with more knowledge-intensive economies and more developed innovation systems suffered less from the 2008 financial crisis and did not impose austerity on R&D expenditures.

On the other hand, countries that entered the 2008 financial crisis with weak budgetary efforts in science, technology and innovation STI and consequently weaker innovation systems showed less macroeconomic resilience, which led to budgetary tightening on R&D expenditure which in turn further weakened their innovation systems and their chances to move to more knowledge-intensive growth patterns.

Maintaining continuity and a long-term perspective in public support to STI is critical. There is evidence that government expenditures to encourage R&D in the business sector are more effective when they are stable over time: firms hesitate to invest in additional R&D if they are uncertain of the durability of government support. Predictability and long-term perspectives in funding are also critical for research undertaken by academic institutions.

Similarly, investment in human capital can suffer from stop-and-go policies and lead to difficulty in retaining skilled human resources.

⁸ Pospisil, Martin (et., al.) (2019), “Introducing the EBRD Knowledge Economy Index”, EBRD, March 2019, P. 1.

⁹ Abdel Gawad, Gaber Mohamed (2017), “The New Economy, Knowledge Economy: and the Economy based on Industry (Concept-Pillars- and Indicators) Application to the Egyptian Economy”, Germany: Verlag, Noor Publishing.

¹⁰ Abdel Gawad, Gaber M. M, and Rao Muramalla, Venkata S. S.(2014), “Telecommunications Revolution and Its Effects on Economic Development: An Applied Study of Developing Economies Such as Egypt, Saudi

Arabia, and India”, *British Journal of Economics and Sustainability Development*, Vol.1, No.1, pp.1-23.

¹¹ Al-Busaidi, Kamla Ali (2020), “Fostering the development of Oman’s knowledge economy pillars through ICT”, *VINE Journal of Information and Knowledge Management Systems*, <https://doi.org/10.1108/VJKMS-06-2019-0093>

¹² Papaspyridis, A. and Tatiana Zalan (2016), “How GCC States can Transition to Knowledge-based Economies”, *Gulf Business*, Saturday 27 August 2016.

¹³ Wirba, Asan V. (2017) “The Role of Research in Knowledge Economy within GCC Countries”, *European Journal of Business and Management*, Vol.9, No.3, PP 166-180.

¹⁴ Tadros, Mahfouz E. (2015), “*The Arab Gulf States and the Knowledge Economy: Challenges and Opportunities*”, Arab Gulf States Institute in Washington, Washington, DC 20036.

A science, technology and innovation policy response to the COVID-19 crisis

UNCTAD suggested some policies as respond to face COVID-19 in field of STI¹⁸, as Follow.

1. During the crisis, support research and development activities as part of emergency measures and of recovery packages
2. After the crisis, revisit and strengthen the budgetary commitments to support research and development
3. Support a systems approach to policymaking that includes natural sciences, engineering and social sciences
4. Ensure international cooperation and coordinated policy responses.

A global pandemic is a textbook example of a critical problem where the sum of isolated efforts by national governments provides much inferior outcomes than international collaboration. The positive externalities of STI investments in such a situation could be huge and decisive in the effort to ensure that the most vulnerable members of the international community are not left behind¹⁹

Coronavirus Pandemic and Its effect on Human Capital as a Pillar of Knowledge Economy.

The Coronavirus Disease 2019 (COVID-19) is a respiratory illness caused by a novel coronavirus, namely severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Symptoms range from fever, flu-like symptoms such as coughing, sore throat and fatigue, and shortness of breath. There is evidence that it spreads from person to person, but good hygiene can prevent infection²⁰.

Health is fundamental to a prosperous productive society, whereas panic and illness can stifle production, consumption, recreation, travel, and overall well-being (Marin, 2017; Adeola & Evans, 2018; Lawanson & Evans, 2019; Nwaogwugwu & Evans, 2019; Fourie, 2020). Health disasters such as the Ebola virus in West Africa, the Middle East Respiratory Syndrome (MERS) outbreak in the Republic of Korea, and the rise of COVID-19 not only have global health impacts but also wide-ranging socioeconomic disruptions. For example, during the Ebola virus in West Africa from 2013 to 2014, “government revenues declined across the board, including direct taxes on companies, VAT receipts, and indirect taxes; additionally, decline in private and foreign investors' confidence led to financing gaps of more than US \$600 million over the two years. These impacts cut across many sectors and undoubtedly have long-term consequences” in Guinea, Liberia and Sierra Leone (Smith et al, 2019).

¹⁵ Yang, Yang, H. Zhang and Xiang Chen (2020), “Coronavirus pandemic and tourism: Dynamic stochastic

general equilibrium modeling of infectious disease outbreak”, *Annals of Tourism Research* · March 2020. P. 1. See: <https://www.researchgate.net/publication/340210490>

¹⁶ WHO (2020). Coronavirus disease (COVID-19) Pandemic.

Available at <https://www.who.int/emergencies/diseases/novel-coronavirus-2019> (accessed on 29 April 2020).

¹⁷ PWC (2020), “The possible economic consequences of a novel coronavirus (COVID-19) pandemic”, *Australia Matters* | March 2020, PP 8-9.

¹⁸ UNCTAD (2020), “THE NEED TO PROTECT SCIENCE, TECHNOLOGY AND INNOVATION FUNDING DURING AND AFTER THE COVID-19 CRISIS”, Policy Brief NO. (80), May 2020.

¹⁹ Ibid, P 4.

²⁰ Available at https://www.researchgate.net/publication/339926334_Socio-economic_impacts_of_novel_coronavirus_The_policy_solutions (accessed on May 31, 2020).

In addition, after killing at least 800 people and infecting more than 8000, the total global economic loss due to SARS was estimated to \$40 billion. Much of this impact was due to consumer fears given the ease of transmissibility of the virus in public settings. Also, the wider economic impact of the 1998 Nipah outbreak in Malaysia was estimated at US \$582 million (Dimmock, Easton & Leppard, 2016)²¹.

In the same fashion, the incidence of the COVID-19 is growing at a disturbing rate with significant impacts on global economies and public health. According to Bloomberg, China's first-quarter GDP growth may drop to 4.5%; the global GDP is also expected to decline by roughly 0.42% in the first quarter of 2020. Economists have estimated that, without urgent global actions to curtail the virus in time, China is expected to lose up to \$62 billion in the first quarter of 2020, while the world will lose over \$280 billion. Ayittey et al (2020) compared these values to the World Bank's estimate that even a weaker flu pandemic, such as the 2009 H1N1 viruses, would still wipe 0.5% off global GDP, which is approximately \$300 billion.

Over the past four decades, much of manufacturing production world-wide has been organized in what has become known as global value chains (GVCs). Raw materials and intermediate goods are shipped around the globe multiple times and then assembled in yet another location. The final output is re-exported to final consumers located in both developed and developing markets. For many goods, China is at the heart of such GVCs – for example, as a primary producer of high-value products and components, as a large customer of global commodities and industrial products, and as a major consumer marketplace. China is also producing many intermediate inputs and is responsible for processing and assembly operations. Foxconn, an electronics contract manufacturer, is a well-known example. Its assembly plants, located in mainland China, produce for many world-leading electronics companies, among them Apple, Intel and Sony. China, along with Japan, the United States and the European Union, forms the very core of the global production network.

The effect of coronavirus containment measures is visible in data on industrial production in China, which has fallen by 13.5 per cent in January and February combined, compared with the previous year. This drop in production is severe, in particular when putting it into a longer perspective: neither the SARS outbreak in 2002/2003 nor the financial crisis in 2008/2009 was associated with any such stark drop in production.

The ‘second shock’ is not confined to production and trade only, but is quickly spilling over to investments as well. Most recently, the International Monetary Fund (IMF) has reported a staggering US\$83 billion of capital outflows from emerging markets, which were the largest outflows ever recorded, while at the same time an unprecedented number of more than 80 countries have requested emergency financing. While foreign direct investment (FDI) is usually considered less volatile, the impact of COVID-19 on investment is going to be

substantial. In its most recent forecast, UNCTAD estimates a 30-40 per cent reduction in global FDI during 2020-21, based on the latest earnings revisions of major multinationals. Thus it is to be expected that this ‘second shock’ from the collapse of demand and production in many industrialized economies and the divestment from developing countries will have far more long-lasting effects on global production than the temporary supply chain disruptions caused by COVID-19²².

²¹ Ibid, P 6.

Now in June, 1st, 2020, period of coronavirus crisis all over the world, the important of knowledge based economy is increased especially in field of e-learning, e-commerce, and telecommunication through the web becomes the main method in meeting in all fields, economics, politics, and education. With applied of social distance and stop traveling among countries make the physical wave of globalization decrease to replace it by virtualization globalization. This leads to all the world depend greatly on knowledge economy.

The main two pillars of KE are human capital (HC) and research, development, and innovation (RDI), which are more affected by COVID-19 than other pillars, because HC is the main subject to disease of the virus, and the increasing number of people those who are infected and those who die effects on productivity, trade, investment, and all activity of human being. Also coronavirus pandemic increase the money that each country allocates for spending on RDI to fight the pandemic. Egypt, Oman, Saudi Arabia, and United Arab Emirates like GCC, MENA countries, and all over the world were affected by COVID-19, consequently this will have different impacts on HC and RDI, so the results on knowledge economy in each country will be differ. In the next section we will analysis the competitive position of each country of them in these two pillars and on knowledge economy as well.

FINDINGS AND INDICATORS OF MEASUREMENT

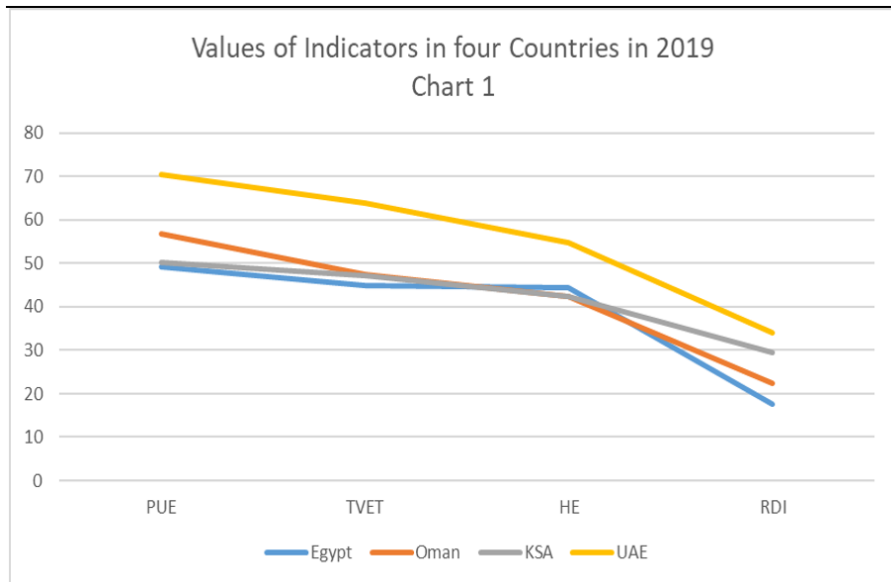
To analysis the competitive position of four countries (Egypt, Oman, KSA, and United Arab Emirates), we selected some indicators, which measures human capital {such as pre-university education (PUE), technical vocation education and training (TVET), and higher education (HE)} and research, development, and innovation (RDI) from knowledge economy index through period 2015 to 2019, depending on knowledge for all site²³, the same methodology of the world bank in 2012, where this methodology was developed by UNDP and Mohamed Ben Rasheed foundation in UAE from 2015, to introduce Arab and world data about KEI in Arab countries. In the following table number 1, the indicators values range from 100 to 1, where 100 means the highest value and 1 is the lowest value according to knowledge economy index.

Table 1: The Competitive Position of (Egypt, Oman, KSA, and UAE)

| | | | | | | |
|------|-----|-------|-------|-------|-------|-------|
| 2015 | HC | PUE | 55.35 | 57.39 | 67.39 | 68.56 |
| | | TVET | 54.38 | 48.95 | 56.01 | 60.79 |
| | | HE | 57.51 | 49.67 | 62.43 | 72.56 |
| | RDI | 27.10 | 39.02 | 56.84 | 50.08 | |
| 2016 | HC | PUE | 60.38 | 62.45 | 69.31 | 73.58 |
| | | TVET | 53.14 | 53.08 | 54.33 | 71.81 |
| | | HE | 52.04 | 43.80 | 56.54 | 61.44 |

| | | | | | | |
|------|----|------|-------|-------|-------|-------|
| | | RDI | 45.72 | 48.96 | 61.12 | 68.53 |
| 2017 | HC | PUE | 44.9 | 50.3 | 48.4 | 70.3 |
| | | TVET | 44.0 | 45.5 | 40.3 | 61.0 |
| | | HE | 42.1 | 34.4 | 40.3 | 50.0 |
| | | RDI | 16.3 | 20.8 | 30.2 | 28.7 |
| 2018 | HC | PUE | 41.0 | 54.9 | 52.9 | 72.7 |
| | | TVET | 41.5 | 45.2 | 41.0 | 63.4 |
| | | HE | 41.7 | 39.5 | 40.1 | 53.4 |
| | | RDI | 17.2 | 23.7 | 30.3 | 31.3 |
| 2019 | HC | PUE | 49.2 | 56.8 | 50.2 | 70.4 |
| | | TVET | 44.8 | 47.4 | 47.1 | 64.0 |
| | | HE | 44.3 | 42.4 | 42.3 | 54.8 |
| | | RDI | 17.7 | 22.4 | 29.4 | 34.1 |

Source: www.Knowledge4all.com



We use the average value of three indicators of human capital (pre-university education, technical vocation education and training, and higher education) as an average indicator of (HC) as followin table 2.

Table 2: The average value of (HC) and (RDI) for Egypt, Oman, KSA, and UAE. From 2015 to 2019

| year | Average value of indicators | Egypt | Oman | KSA | UAE |
|------|-----------------------------|-------|------|------|------|
| 2015 | HC | 55.8 | 52.0 | 61.9 | 67.3 |
| | RDI | 27.1 | 39.0 | 56.9 | 50.1 |
| 2016 | HC | 55.2 | 53.1 | 60.1 | 68.9 |
| | RDI | 45.7 | 49.0 | 61.1 | 68.5 |
| 2017 | HC | 43.7 | 43.4 | 43.0 | 60.4 |
| | RDI | 16.3 | 20.8 | 30.2 | 28.7 |
| 2018 | HC | 41.4 | 46.5 | 44.7 | 63.2 |
| | RDI | 17.2 | 23.7 | 30.3 | 31.3 |

| | | | | | |
|------|-----|------|------|------|------|
| 2019 | HC | 46.1 | 48.9 | 46.5 | 63.1 |
| | RDI | 17.7 | 22.4 | 29.4 | 34.1 |

The average value of human capital was calculated from the previous table 1

Source: www.Knowledge4all.com

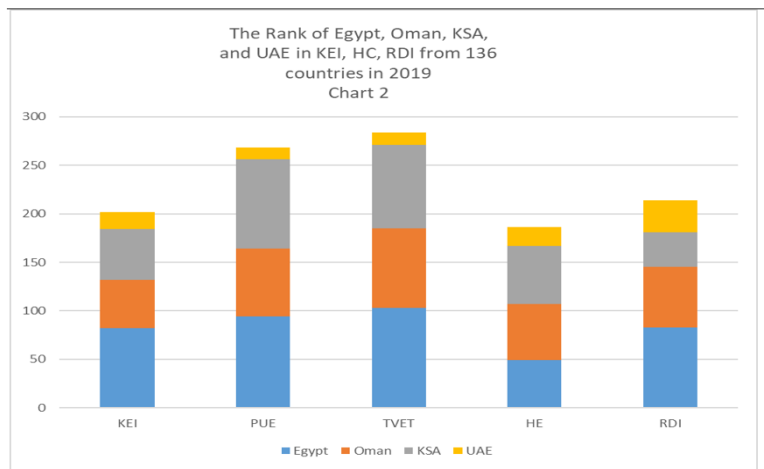
²² Available at 31, 2020).

Also we take the rank of four countries in the same indicators and the general rank in knowledge economy in three years (2017, 2018, and 2019) to the world wide, the number of countries is different every year, it started from 131 countries in 2017, and 134 countries in 2018, and reach to 136 countries in 2019 included in knowledge economy index, where the small number is better than the big number because UAE has rank 25 is the best rank in four countries in knowledge economy index in 2017, and Egypt has rank 95 is the worst rank in four countries in KEI in the same year, as follow in table 3

Table 3: The Rank of Egypt, Oman, KSA, and UAE in Knowledge 4 all Index In 2017, 2018, and 2019

| year | Indicators Rank | Egypt | Oman | KSA | UAE | |
|------|----------------------|-------|------|-----|-----|----|
| 2017 | KEI to 131 countries | 95 | 45 | 68 | 25 | |
| | HC | PUE | 106 | 88 | 96 | 16 |
| | | TVET | 113 | 109 | 119 | 24 |
| | | HE | 54 | 82 | 58 | 27 |
| | RDI | 101 | 73 | 36 | 37 | |
| 2018 | KEI to 134 countries | 99 | 62 | 66 | 19 | |
| | HC | PUE | 110 | 70 | 74 | 13 |
| | | TVET | 113 | 97 | 117 | 14 |
| | | HE | 59 | 66 | 63 | 20 |
| | RDI | 108 | 64 | 38 | 36 | |
| 2019 | KEI to 136 countries | 82 | 50 | 52 | 18 | |
| | HC | PUE | 94 | 70 | 92 | 12 |
| | | TVET | 103 | 82 | 86 | 13 |
| | | HE | 49 | 58 | 60 | 19 |
| | RDI | 83 | 62 | 36 | 33 | |

Source: www.Knowledge4all.com



The average rank for (HC) from three indicators (PUE, TVET, and HE) was calculated as followin table 4.

Table 4: The average rank of (KEI, HC, and RDI) for Egypt, Oman, KSA, and UAE) in 2017, 2018, and 2019

| year | Rank of indicators | Egypt | Oman | KSA | UAE |
|------|--------------------|-------|------|-----|-----|
| 2017 | KEI | 95 | 45 | 68 | 25 |
| | Average HC | 91 | 93 | 91 | 22 |
| | RDI | 101 | 73 | 36 | 37 |
| 2018 | KEI | 99 | 62 | 66 | 19 |
| | Average HC | 94 | 78 | 85 | 16 |
| | RDI | 106 | 64 | 38 | 36 |
| 2019 | KEI | 82 | 50 | 52 | 18 |
| | Average HC | 82 | 70 | 79 | 15 |
| | RDI | 83 | 32 | 36 | 33 |

The average rank of HC was calculated from table 3.

Source: www.Knowledge4all.com

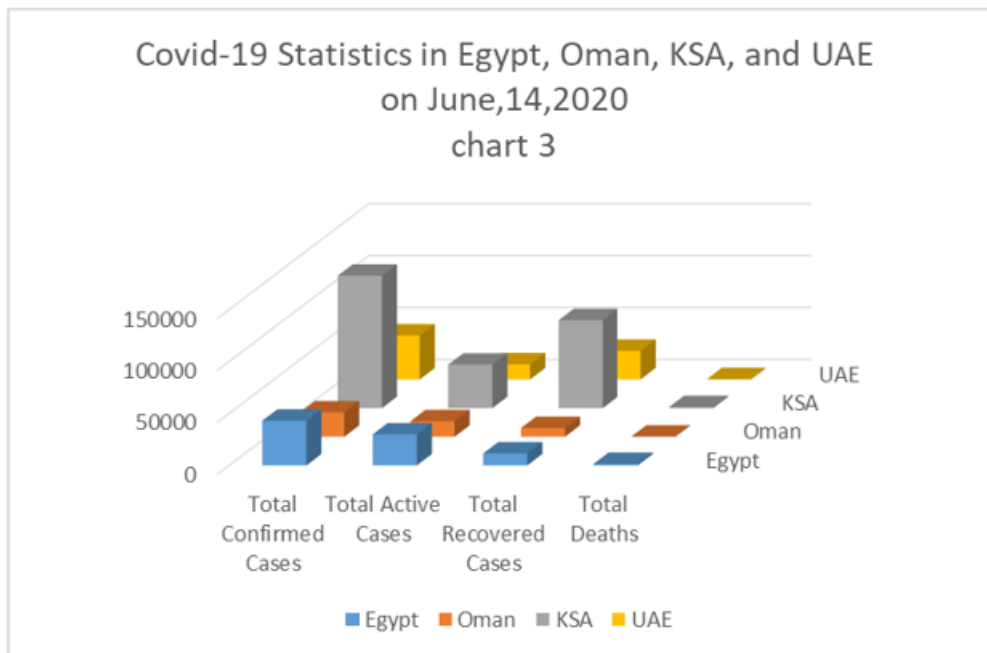
I. SARS-Cov-2 and HC in Egypt, Oman, KSA, UAE.

To analysis the effect of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) on knowledge economy in four countries especially on the main pillar human capital, we will illustrate the situation of coronavirus pandemic statistic in four countries in the first half of 2020 as follow. In table 5

Covid-19 statistics in Egypt, Oman, KSA, and UAE. ON June, 14, 2020Table 5

| Indicators | Egypt | Oman | KSA | UAE |
|-----------------------|-------|-------|--------|-------|
| Total Confirmed Casas | 42980 | 23481 | 127541 | 42294 |
| Total Active Cases | 29967 | 14923 | 41899 | 14543 |
| Total Recovered Cases | 11529 | 8454 | 84720 | 27462 |
| Total Deaths | 1484 | 104 | 972 | 289 |

Source: <https://www.worldometers.info/coronavirus/> (accessed on June/14/2020)



Human capital is more affected by SARS-Cov-2 than research, development, and innovation, so all economic activities in four countries are consequently affected by this virus, in spite of this fact the importance of knowledge economy increased especially in education, and banking sector. As well as e-commerce, and e-government in four countries.

II. Data Analysis and Conclusions.

From the previous two sections we can analysis data in table 1, as follow, Egypt is the lowest value in pre-university education through period 2015 to 2019, and Oman has the lowest value in technical vocation education and training, and higher education in 2015, 2016. But the situation of lowest value of higher education is Interchange arrangement between Oman and KSA through period from 2017 to 2019. The position of Egypt in higher education is better than Oman and KSA in 2019. And United Arab Emirates is the highest value in all indicators of human capital (PUE, TVET, and HE) and in research, development, and innovation through period of 2015 to 2019, except in 2015 and 2017 Saudi Arabia was the highest value in RDI.

From chart 1, the remarkable improvement in Egypt in higher education 2019 due to higher education policy and the increased interest of the political leadership in Egypt in education and health 2019. Oman always is better than Egypt in research, development, and innovation through the all period according to KEI, it may be because of share of person of expenditure on R&D in Oman is greater than inEgypt, where it reached \$73.66 and \$73.18 in Oman and Egypt in 2013 respectively.

The data in table two showed the same analysis, but the average value of indicators of HC was calculated to show the summarize the situation of four countries in human capital as a single indicator. It changed the position of Egypt and Oman in the first three years, where Egypt was better than Oman in HC through period of 2015 to 2017, but Oman was better than Egypt in 2018 and 2019 respectively, the other data unchanged like table one.

Table three showed the rank of four countries in KEI, HC, and RDI indicators through period

of 2017 to 2019 as follow, Oman is better than KSA and Egypt in knowledge economy index's rank in three years from 2017 to 2019, but UAE is better than Oman in the same three years. Egypt is better than Oman and KSA in higher education's rank through the period from 2017 to 2019, but UAE is the best rank in all indicators (KEI, PUE, TVET, HE, and RDI) of four countries in the same three years.

The same rank is noticed from chart 2 in 2019, where UAE is the highest rank and smallest number in all indicators, also Egypt is better than Oman and KSA in HE, and Oman is better than KSA and Egypt in KEI, PUE, and TVET). We can note also KSA is better than Oman and Egypt in RDI's rank in 2019.

When we summarized three indicators of human capital in average rank in table 4, the rank of Egypt became the same rank of KSA in HC in 2017 equal 91 from 134 countries. The other rank for four countries is unchanged significantly in the rest of indicators through the same period from 2017 to 2019.

To analysis the effect of coronavirus on human capital in four countries in point of time in 2020 according the recent available data (in June, 14, 2020), we showed in table five and chart 3 covid-19 statistics for four countries, which showed Oman is the smallest nation in number of total confirmed, recovered cases, and total deaths, and UAE is the smallest nation in number of total active cases. KSA is the highest nation in number of total confirmed, active, and recovered cases, but Egypt is the highest nation in number of total deaths.

On the other hand, Egypt followed many procedures of WHO and reserve big fund to fight this pandemic disease, also Egypt has support e-learning and e-finance, with e-government to introduce many services to avoid spread of infection of this disease, and Oman as well.

The future paper was suggested to be about the effects of coronavirus on knowledge economy in Oman and Egypt. To reduce the negative effects of this virus and enhance the positive effect in more depending the knowledge based economy.

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