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The Impact of Information and Communication Technologies on the Human Development in the Gulf Cooperation Council Countries: An Empirical Study

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ABSTRACT:
The main goal of this study is to investigate the impact of information and communication technology (ICT) on human development in the six Gulf Cooperation Council countries (GCC), particularly, the effect of ICT development index on the three-key component of human development; income, health, and education. The study focused on the years 2005-2014. Based on the theoretical background explained in the literature, the main study's hypothesis tested using the Panel regression analysis to account for the existence of both cross sectional and time series relationship. The finding of the study shows different results ranging between positive, negative and insignificant relationship, which reflect the complexity that could associated with ICT implementation in the context of development. GCC countries spent a vast amount of financial resources to develop their ICT infrastructure, however, they failed to achieve the effective utilization of these technologies in socioeconomic development, due to mismatch between the ICT infrastructure and the availability of skilled human capital, adequate educational system, and public awareness about the importance of the ICT role in socioeconomic development. Therefore, ICTs as tool alone cannot improve human development; unless it occurs within broader context and multidimensional strategy aim to enhance the people's abilities to make the most use of these tools and techniques. Finally, the study recommends for the GCC policy makers to shift their paradigm of thinking about ICTs by changing their focus from the deployment of the ICT infrastructure to focus on analyzing and understanding the dynamic complementarities that could shape the potential role of these technologies.

Keywords: *Information and Communication Technology, Human development, Gulf Cooperation Council, ICT Development Index, Human Development Index*

INTRODUCTION

Over the past few years Information and Communication Technologies (ICTs) has been an exciting and interesting research issue by many scholars, researchers and even the decision makers, and became the underpinning of most social and economic progression in both developed and developing countries (Selwyn, 2004).

Efforts to define ICTs often provide a range of descriptions, there is not one agreed definition of ICTs. According to Hamelink (1997) ICTs includes all means and tools that can deals with information and provoke all kind of communication, for example, it can facilitate communication among people, between people and electronic systems, and even among

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electronic systems themselves.

Marcelle (2002) describe ICTs as a wide range of goods and services that facilitate information's processing, distributing, and transforming, it may include, broadcast network, hardware and software, computer services and electronic media.

Alternatively, the International telecommunication Union (ITU) (2003) defines ICTs as "the new breed of information technologies generated by the progressive merger between telecommunications and computing". While, the Economic Commission of Africa (ECA) state that ICTs include "internet service provision, telecommunications equipment and services, information technology equipment and network-based information services and other related information and communication activities (Adeya, 2002).

While the World Bank (2003) describes ICTs as technologies that allow information to be processed, stored and disseminated. Furthermore, Hong (2010) describes ICT's as tools that facilitate communication, process, transmit information, and share knowledge through electronic means.

In the context of developing countries, ICT's have been identified one of the main efforts that were done to escape poverty as they might contribute positively to increase the income of poor people, and enhance the overall national economic growth (UNDP, 2006).

Since the 1980s, ICT's captures the attention of many international development agencies in terms of their potential effect on developmental process. One of the first attempt to link ICT to the development discourse was the project handled by the International Telecommunications Union (ITU). This project tried to integrate the ICTs and the networks in different fields such as health, social services, commerce, in order to stimulate the economic growth and enhance the quality of life (Maitland, 1984).

Later in 1990s, the United Nations Development Program (UNDP) asserted the importance of ICT in improving the human development in developing countries, since it can act as an innovation driver that provide new solutions to the long-term development challenges of poverty, education, health care delivery and governance.

Moreover, the World Summit on the Information Society (WSIS) arranged by the United Nations in 2003 and 2005 highlighted the important role of ICTs, in development (WSIS, 2005). They called evenly to enable the human development role regarding participation and empowerment, and because they are significant to the Millennium Development Goals (Rezaian, 2006).

Officially, this field has become known as information and communication technology for development (ICT4D), which is a field for using ICT's tools and techniques to the practice of development. WSIS approved that funding of ICT4D needs to be one of the top priorities since they can lead to great stride in the field of development, particularly by enabling the developing countries to overcome the development obstacles and achieve the internationally agreed development goals and objectives, including the Millennium Development Goals (WSIS, 2005).

In the light of the above, this study will deal with the ICT's impact on the human development in the Gulf Cooperation Council Countries (GCC); United Arab Emirates, Saudi Arabia, Qatar, Bahrain, Kuwait and Oman. The aim of this study was to understand how ICTs can affect the human development.

More specifically, the study tries to determine the potential impact of the ICT-use and ICT-access on the human development index and its sub-indices; health index, income index, and education index. The main study's hypothesis will be tested by conducting panel data analysis to account for existence of both cross-sectional and time-series data. More specifically, three models; Panel OLS, fixed effect and random effects models will be tested, to use the most fitted model for our study.

We choose GCC countries, firstly, because human development is a challenging field in most Arabic countries. Secondly, few studies dealt with this debate, particularly in the GCC countries. Thirdly GCC countries are more relevance compared with other Arab countries in terms of ICT, since ICT's development is considered as an important role in their growth strategy as they delivered impressive results in the ICT development index.

According to the 2014 ITU report, five GCC countries ranked as the top five among Arab countries, and classified in the first 60 countries in the global ICT Development Index (IDI), (ITU, 2014). Therefore, the corresponding economic impacts are expected to be more important than the other Arab countries.

Finally, This Study is based on Two Hypothesis:

$\mathbf{H_1}$: There is a positive and significant impact of ICT on the human development index (HDI) in GCC countries.

$\mathbf{H_2}$: There is a positive and significant impact of ICT on the income index, education index, and health index in GCC countries.

And therefore, it addresses the following basic research questions: *What are the impacts of ICTs on human development in GCC countries? What are the impacts of ICTs on income index, education index, and health index in GCC countries?*

Literature Review

This Study will review the contemporary and relevant literature and research publications about the key research concepts and will demonstrate the uses of ICT in the field of human development.

ICT and Human Development

The role of ICT in human development has captured much attention among economists, schoolers, and policy makers. One of the first attempts to link the ICT with development was performed by the UNDP in their 2001 Human Development Report, this report quote from World Bank study by Jamison, Preker, Bos, Wang, and Peabody (1999) to emphasizes on the importance of ICT and its role in the development. According to this study, between 1960 and 1990 technical progress accounted for 40-50% of mortality reductions, which become more critical than other factors such as incomes level and education levels.

In addition, the report noted that the large differences in growth rates between countries related to differences in technological advances, especially information and communications technology, which has a critical role in enhancing people's capabilities, access to education, improving economic, social, political and cultural development. Therefore, technology innovation and development are mutually reinforcing, creating a virtuous circle (Jamison et al., 1999).

Since that report, most HDR addressed the importance of ICTs in improving the level of human development. For example, in 2002 the report argued that access to the Internet can enhance the role of democracy in human development (UNDP, 2002), in 2003 it claimed that the integration of technology and human development can facilitate accessing to global knowledge (UNDP, 2004b).

In 2004 the report discussed the relationship between the global communication and the cultural diversity and identity (UNDP, 2004a). Also, the UNDP regional report on nine Asian countries, titled by: Promoting ICT for Human Development in Asia 2004, which treated the role of ICTs in human development more deeply, especially the role of these technologies in improving and restructuring the economic environment, employment, fighting poverty, reduction of physical and social barriers to education, government services for the poor, basic processes of health care, and women's social and political participation.

Last but not least, the Lithuanian Human Development Report 2002–2003 focused mainly on knowledge and information society and their relationship with human development, it stressed that human development depends heavily on the information society and the extent of progress made by countries in the field of technology.

In addition, WSIS promoted ICT as one of the most important catalysts to achieve the developmental goals in developing countries, as it a driving force to achieve the Millennium Development Goals (WSIS, 2005). Likewise, the International Telecommunication Union (ITU) and the International Monetary Fund (IMF), highlighted the importance of ICT in overtaking the development obstacles in the least developing countries such as poverty, disease outbreaks and illiteracy.

For example, these organizations encouraged ICT adaption to harness their potentials to improve the health care services and facilitate communication between patients and the health care system, also these organizations worked on exploiting these technologies to improve the efficiency of government and public utilities and

enable the private sector to implement business projects that benefit the community and the economy.

On the other hand, some international organizations, especially UNDP developed some indicators that reflect the extent of the influence imposed by ICT on human development, for example, the Human Development Report in 2001 presented a Technology Achievement Index (TAI), which measures inequalities in ICTs diffusion, where the report showed a closer link between this indicator and the level of human development than income index.

In another report in 2004, the organization has developed indicators to measure the correlation between ICT and development goals, especially its contribution towards achieving the UN Millennium Development Goals. The report created an index and ranking based on 22 indicators to test five basic dimensions for the ICTs development (UNDP, 2005).

These indicators are not just measured the relationship between ICT and development only, but extend to understand the impact of these technologies in terms of use and access on the achievement of specific objectives and policies in developing countries, taking into account the enormous digital gaps in these countries and their readiness at the level of the human skills, infrastructure and methods of application in the field of human development (UNDP, 2005).

In the next part, ICT contributions in the field of human development will be demonstrated, and then, previous researches and experiences in this area will be presented and reviewed.

ICT Contribution to Human Development

Several studies and researches have find that ICT can impact social and economic development by contributions to individual's opportunities in health, education, income, empowerment and participation fields, especially in competitive markets, and where policies and investments are made to benefit the poor (Hamel, 2010).

ICT and Health

There has been a large concern about the contributions of using ICT in improving the health sectors in both developed and developing countries. (Bellows, Bhandari, Ibrahim, and Sandhu, 2006) find that ICT efforts can represent the greatest means to enhance development, as it contributes in reforming of health care system and improve their outcomes in human development dimensions.

Since several decades, in developed countries, particularly in the OECD nations, ICT had become a vital element in medicine, which restructure the delivery of public and private healthcare sectors, In developing countries, ICT's experience in the field of health are not as advance as developed countries, however, these countries are making continues efforts to take advantage of the opportunities offered by these technologies, especially in the field of medical consultations and diagnosis, as well as the wide benefits derived from the ease of access to medical databases available on the internet in form of medical journals and research publications (Garai, 2005).

From (Wresch, 2009) point of view, improving effective medical practice depends on the ability to expand access to these electronic resources and to harness the means of communication in the field of medical care application.

In the field of development, the process of using information and communication technology in the field of health can referred to the term e-health, which is a critical field that aims at improving health care services and achieving efficient and effective medical outcomes (UNDESA-GAID, 2009).

According the World Health Organization, e-Health includes five basic determinants, namely: strengthening the procedural structure of the health service delivery, collaboration between the public and private sector in providing and developing the appropriate technologies for health care delivery, learning and experience of using technological tools in effective way, creations of rules, values and uniform practice profession, and finally, assess and monitor the impact of ICT's application in health field and the extent of benefits gained (Hamel, 2010).

Practically, application of ICT in the area of health can be drawn from some international organizations experience such as, the World Health Organization and other organizations concerned with this field, for example, they created an online databases that can be accessed through the websites classified by disease types,

so that physicians, specialists and researchers can share and participate in the body of medical knowledge.

Another experience related to electronic mails, which are able to create virtual communities aimed at sharing and exchanging of medical knowledge and facilitate the consultation process to solve medical problems faced by doctors in other communities (Garai, 2005).

ICT can be considered an important pillar of medical knowledge in the modern era, specifically with regard to the field of communication, since information is very critical issue in this field and can save lives, especially in less developed countries who lake experience and professionals (Hamel, 2010). Therefore, information and communications technology represent an important element that can contribute in improving the ability to develop health service quality, however, it need to be provided as a part of well-designed planned interventions at the national level.

ICT and Education

Kofi Annan; the former Secretary-General of the United Nations; stated that: "While education unlocks the door to development, increasingly it is information technologies that can unlock the door to education"(UN, 2003). The benefit of online information can represent a large source of opportunity in learning fields and could fill the wide gap of learning resource in the developing world. ICT can promote and empower both teachers and learners to change the way of learning and improve its outcomes in various disciplines.

ICT can facilitate the restructuring of learning methodologies, for example, many developing countries have been set up computer labs in primary, secondary and higher education institutions to foster their development and enhance their learning quality. Furthermore, ICT benefit these institutions through knowledge and experience sharing with other learning institutions across the world.

In the field of training, information and communication technology contribute in improving the professional skills and experience of teachers, which is critical for developing the educational community in developing countries. It offers effective training opportunity in terms of timing and continuity, without allocating costly training programs that could burdensome teachers and educational institutions.

Moreover, these technologies play a crucial role in the field of higher education, by reforming the education system, improving education management techniques and by easily and effectively access to educational resources, especially through allowing them to reach the marginalized and remote areas that suffer from lack of libraries and week educational infrastructure (World Bank, 2002). In other words, ICT can assist teachers in improving the teaching process, by using a wide range of ICT tools to enable his student to have an access to related assisting electronic resources (Selinger, 2009).

Distance education is one of the areas that have benefited from ICT, as it contributed in linking remote areas with advanced educational programs and materials. Nowadays, distance education includes electronic materials that can be available through direct and indirect means, and could take several forms, such as written materials, audio materials, and visual materials, that can be obtained from online sources.

One of the important experiences in this field is the Open Learning Systems Education Trust (OLSET), which includes a set of tools and techniques that facilitate the process of distance learning. OLSET seeks to share educational and training materials via advanced communication channels, such as Internet and satellite (Garai, 2005).

A good example on distance learning is the South African government's initiative in cooperation with OLSET program, which successfully reached more than 1.8 million students and 52,000 teachers in the country. This initiative attempted to improve the quality of education and override the inherent weaknesses in the traditional educational system (Mattson, 2006).

Another successful experience of ICTs use in education is the case of the EU-China Gansu Basic Education Project. It designed to provide advanced educational curricula and resources to rural areas by using mass communication and electronic publishing. The project reached more than 90,000 teachers in rural educational units all over the Gansu province.

Despite these successful experiences, it must be noted that any attempt to take advantage of information and communication technology in education requires strategies, policies and programs by governments and educational institutions, as well as the allocation of human and financial resources and ensuring adequate infrastructure that are sufficient to meet the needs of these new methodologies. There is a need for government commitment toward providing and promoting the intensive access ICT at the national level, especially the remote areas that suffer from weakness of the educational system (Hamel, 2010).

ICT and Economic Development

Many studies have concerned about of the importance of ICT in stimulating economic growth, where early discussion about this relationship was accompanied by the emergence of the ICT sector. For example, Jorgenson, Ho, and Stiroh (2008) found that this sector has contributed to raising productivity by 59% during the period between 1995 and 2000 in US, while the integration of ICT at the firm level assisted in achieving remarkable returns to investment results (Brynjolfsson & Hitt, 1998).

Despite the absence of clear evidence about the direct effect of these technologies in stimulating the economy, they were treated as synergetic technology and their growth leads to growth in another economic sectors of the economy (Hamelink, 1999).

Also ICT's tools and techniques can be seen as one of the important factors that could enhance the restructuring and modernization of the economic organizations by adding new capabilities to the working methods (Draca, Sadun, & Van Reenen, 2006) in addition, these tools and techniques can revolutionize the private sector through the value they added in terms of efficiency, potential growth opportunities, and improving the level of income, especially in developing countries (Best & Kenny, 2009).

For example, mobile phones, as a new channel of communication, are good evidence about the role of ICT in development of developing countries. It provides opportunities for social change in terms of roles, hierarchies and gender issues. It creates new channels for better interaction and effective exchange of information for economic, social and commercial activities (Hamel, 2010).

For instance, mobile banking is a creative way for developing the banking business in developing countries by enabling remote areas to have access to banking services, also there are many initiatives funded by international and local organizations to link Microfinancing to the use of ICT for capacity building, fighting poverty and unemployment (Attali, 2004).

In addition, internet has a critical role in business development. It adds a new effective trade methods and features that offered by e-commerce, these methods enable accessing to rural and remote areas, outsourcing business opportunities and jobs, and unlocking the international markets for local products and services (Garai, 2005).

According to (Saunders, Jeremy, and Wellenius, 1994) the telecommunication as a means offered by ICTs has the ability to shift up the economic development and growth by creation of information transparency in the markets, improving the efficiency of transportation, increasing security and enhancing the ability of the business actors to integrate into the international economic activity.

As an evidence to this idea, it can be referred to the World Bank study which found that every increase in broadband penetration in developing countries by 1% leads to increased economic growth rate of 0.14% (Qiang, Rossotto, and Kimura, 2009), moreover, Clarke and Scott (2006) founded that every increase in the number of Internet users by 1% is associated with of 4.3% increase in exports in general (developing and developed countries), while its associated with 3.8% increase in exports from low-income to high-income countries.

ICT and Human Development in GCC Countries

As we noted from the literature review, information and communication technology plays an important role in socioeconomic development, we have seen that the existence of variations in socioeconomic development between countries at the beginning of the twenty-first century is partly caused by the disparities in the level of development of the ICT sector (Al-Qubaisi, 2012).

In the GCC region, ICT has been early introduced and achieved a considerable amount

of investment in ICT infrastructure, however their utilization of these technologies in socioeconomic development has been far below that which has been achieved by developed countries (Vodanovich, Urquhart, and Shakir, 2010).

This is due to several reasons, including the lack of adequate infrastructure actually needed, the week of experience available to implement the policies needed to achieve adequate growth, the weakness of educational system and therefore the limited number of skilled personnel, and less public awareness about the importance of the ICT role in economy and social development (Al-Maliki, 2013).

This means that the GCC could achieve progress in providing the ICT infrastructure (tools), but it still need the ability to adapt these tools in optimal way to achieve their economic and social objectives especially the improving their Human Development Indicators.

The next part of this section will try to demonstrate the GCC experience of using the ICT initiatives in the field of human development, particularly in the health, education and economic growth.

ICT for Health in GCC

During the last decade, the healthcare sectors in the Gulf countries witnessed a remarkable improvement benefiting from boom in oil price and their revenues. This trend is expected to continue over the next decade, as the World Health Organization reported in 2006; the estimated total health-care spending in the region will reach US$60 billion in 2025.

There is no doubt that an important part of this development related to innovation and technologies as the GCC governments try to implement ICT initiatives in healthcare sectors, which has proven as an effective tool in fostering the quality of healthcare services in the developed countries.

According to Khalid and Ahmad (2011), the GCC countries exerted a huge effort to construct the most innovative and technological initiatives in the medical and clinical fields, in order to meet the international standards. But if we want to be more realistic, it can be said that, despite the Gulf countries launched a considerable ICT projects and initiatives related to the health sector, as we will see later, they are lagged in health information technology (HIT) due to the lake of skilled medical professionals in the public sector, and due to the insufficient fund in the private sector.

Telehealth or telemedicine; the process of connecting patients across the world in rural and remote areas to highly qualified physicians and specialists who are miles away, is a good example of using the ICT in health field. GCC lead the Middle East in terms of telemedicine enabling environments, particularly, Saudi Arabia, Qatar and the UAE, whose are keen adaptors of these technology. Government support Telehealth by constructing a long-term strategy and by investing in initiatives to integrate these facilities with wider healthcare system.

Furthermore, eHealth; the use of digital data in health field for clinical, educational and administrative purposes, is another example of integration between heath and ICT. Saudi Arabia and Qatar have developed the eHealth strategy, aiming to define national policies and regulations, establish standards for interoperability and data-sharing, and encourage the use of e-health (Economist Intelligence Unit, 2015).

In 2012, the UAE develop eHealth solutions through Etisalat and Du telecommunications companies, who are involved in developing eHealth service and in creating a new opportunity for analytics, which will help to improve healthcare outcomes for the UAE.

Another GCC initiative in this field was electronic medical records (EMR); a system used to capture and retrieve individual health record from Birth to Death as well as to provide medicinal services. The GCC countries are developing regional harmonization initiatives, by introducing a digital ID that help identifying people's health information and share them across the region.

The KSA government allocated 1.1 billion USD for developing the national EMR in the next coming years. Another example for EMR was in Bahrain and Qatar. Bahrain established a project has named I-Seha to improve the health information system and EMR in the country. While Qatar launched Sidra Hospital in 2012 with a $7.9 billion (USD) permanent endowment, which is fully digital hospital with an advanced EMR system (Weber, 2010).

But it is noted that these initiatives and efforts are still modest compared to developed countries and are facing many challenges such as poor health data, absence of clear health standards in terms of health database management, professional ethic and privacy, and the absence of clear policies and procedures. Also there is a challenge related to the availability of skilled medical professionals (Alkraiji et al., 2014).

ICT for Education in GCC

The education sector in the GCC is growing. It is expected that the total number of students at all education levels will grow from 9.5 million students in 2010 to 11.3 million students in 2020. This is attributed to an increased awareness of the importance of ICT as key role for reforming the educational systems, and achieve the best of its impact (Al-Qubaisi, 2012). Many GCC countries, has been trying to reform its educational system by incorporating ICT into the curriculum to meet the needs of the 21st Century society.

Early beginning was in 1996, when Kuwaiti government launched the first IT education in schools, with estimated cost of 24 million dollars. This project represents the base for the government educational strategy, that introduced later in order to reform the education system (AL Harbi, 2014).

In 2002, the Ministry of Education (MOE) initiated a large reform training project to apply the International Computer Driving License (ICDL) for all Kuwait in-service teachers which became a prerequisite for teachers to proceed in the ranking system. Furthermore, one of the main objectives of its 2005 strategic plan for education for the next 20 years was to fill the technological gap in the Kuwaiti educational system (Alrasheedi, 2009).

The government of UAE also take a considerable initiative to apply ICT in the education sector to reap their potential, for instance, UAE is investing in R&D initiatives by Universities and other bodies including investments in infrastructure, equipment and projects. The fund is encouraging R&D in companies and colleges and giving grants for research in IT to develop products, solutions and services to boost growth and governance. Besides funding projects, the UAE technology fund also extends support for patent filings and commercial applications

The country is also committed to producing talent in the industry by offering scholarship to those students interested in entering the ICT sector. In addition, the UAE government is paying attention to increasing the number of IT teachers at the school level to ensure all the children are computer literate, for instant Abu Dhabi has advocated that all schools must have ICDL certified teachers in 2008.

Furthermore, the UAE Ministry of Education has an educational website for its primary and secondary school students, this can be accessed by private and public schoolchildren and it has contained links, information, educational resources, instructional tools among others etc.

Companies such as Microsoft, Cisco Systems and Shell are partnering with the government and Higher Colleges of Technology (HCT) to create training platforms. HCT has also started a commercial division called the Center of Excellence for Applied Research and Training (CERT) to provide enterprise solutions and a basket of services for the corporate industry. HCT has given 28600 credits to over 14400 students so far.

Finally, Etisalat which is the largest national telecom company in the region has set up an academy for the public and it provides training for professionals not only from its own company but is open to other technology companies as well. The Etisalat Academy represents international training companies form the US and Europe and provides high impact quality training under international standards (Al-Qubaisi, 2012).

In Bahrain, the government is making some considerable efforts to reform its economy's structure to meet the knowledge-based economy requirement, these reforms spread to many social and economic aspects, such as education, health, trade, finance and ICTs. For example, the University of Bahrain introduced "state-of-art technologies" to improve the teaching and learning methods.

Also, the university established the E-Learning Centre in 2004 to improve the quality of educational output. Actually, all GCC countries, have invested in improving the e-learning resources during the past five years (Weber, 2010). The GCC private school market

is the biggest buyers of e-Learning in the world with annual tuition fee of approximately US$5.2bn in 2010.

Saudi Arabia's government has spent huge financial resources to modernize the educational system and raise its ability to keep pace with the technological development, for example, investment in this area amounted in 2007 by about $ 2.48 billion. A large portion of these investments was allocated to reform the education system and develop the teacher's skills (Tatweer, 2015).

Furthermore, ICT initiatives in the education sector led to biggest education budget in 2015, where 25% of the overall budget in KSA was allocated for the ICT projects implementation in educational field and for the modernizing the curricula in general (Oman, MOE, 2008).

This huge investment in education is in line with the ten-year education plan; developed by the Saudi Ministry of Education in 2008, which include all sectors of education and relevant government institutions. The plan is designed to meet the challenges faced by the KSA, including the technological and cognitive development, and how can the government successfully invest in education to build knowledge and facilitate the application of information and communication technology in the country (Maroun et al., 2008).

But, in spite the large investment to support the application of information and communication technology in education, KSA still behind in this area compared to developed countries. the main reason for this weakness is the large gap between the available technological tools in educational institutions and the methods of application and use of these tools (Albugami & Ahmed, 2015).

Also, Oman country extends the use of ICT in all areas of the curriculum and at all levels. The Ministry of Education has undertaken a comprehensive reform of its education system to improve the quality of education for all students in Oman.

It believes that information and communications technology can act as an important change agent to facilitate these educational reforms. Its education policy insists that learning experiences must have associated with ICT and need to be integrated into all subject areas (Oman, MOE, 2008), this why the country introduced the International Computer Driver's License (ICDL) Program to the basic education since September 2004.

The Ministry of Education has created a comprehensive Electronic Educational Portal System (EEPS) in 2007. The portal serves as Oman's educational gateway by providing access to a group of programs and services using the internet. It is intended to serve everyone interested in education such as students, teachers, administrators, or government institution.

Furthermore, the Internet-assisted instruction (IAI) is also becoming increasingly common in Oman and is now available in more than one-half of educational institutions (Oman, MOE, 2008).

Finally, a good example of using ICT in education in Qatar is ictQatar, which maintained and developed electronic resources in local elementary and high schools, also the American branch campuses in Qatar Foundation's Education City have been using teleconferencing technology to connect main campuses with branch campuses to deliver the most up-to-date live lectures by faculty in specialized fields of medicine, political science, and history.

Also, the government allocated $19 million (USD) in 2009 to biotechnology research and to the creation of the Qatar Science and Technology Park (QSTP) for commercial development of innovative technologies.

Finally, ictQatar and the Supreme Education Council are pursuing the development of Knowledge Net (K-Net), in the primary and secondary education system, Knowledge Net is a learning management system portal based on Microsoft Learning Gateway that allows for three-way communication between parents, students, and teachers (Weber, 2010).

ICT for Economic Growth in GCC

In the last decades, the growth of ICT spending in GCC increased by more than twice the average of the OECD countries, and exceeds the global average by about 50%. This progress in the ICT spending reflects the importance of these technologies in shaping the new direction of both public and private sectors. ICTs have become a key determinant of success in various aspects of the GCC economy such, oil sectors, construction, healthcare services, and public institution.

ICT integrated in these sectors to generate new fields of value, such as, digital oil fields, smart-city technologies, integrated health networks, and e-government. Furthermore, GCC introduced the ICT parks which are the most dynamic initiative in the GCC to become ICT-enhanced economies by improving the availability of ICT services and capabilities for technological companies. For example, Dubai Internet City, Qatar Science & Technology Park (QSTP), Oman's Knowledge Oasis Muscat and Saudi Arabia's King Abdullah Bin Abdul Aziz Science Park. These parks designed to develop the local ICT resources and to meet the growing need for ICT by both local and international ICT companies (Sabbagh, Shehadi, and Oknayan, 2009).

An indication of the size and growth of ICT in the GCC is the IT service industry in the region. The IT services industry in the GCC (not including the Kingdom of Saudi Arabia) was valued at $5 billion (Dh18.36 billion) in 2014. The average year on year growth of the industry until 2019 is predicted to be 8.64 per cent, which would value the industry at $7.9 billion by the end of the decade. We can already see value added services and consultation becoming more important to the public and private sector in the GCC.

By far, the largest share of the IT services sector market value is the added services that systems integrators provide. For example, client servicing in the UAE IT industry was valued at $1.7 billion last year and predictions suggest this will grow to $3.14 billion by 2019. In Qatar, servicing accounted for $335.5 million of the IT services provided to clients in the State in 2014 and this will grow to $735.8 million by 2019 with similar trends expected in Kuwait, Oman and Bahrain (JarreSpecial, 2015).

However, the Demand for IT skills in the GCC has led to the development of an IT workforce of about 350,000 professionals by end 2009, and the demand for IT products and services over the next five years is expected to create 110,000 new IT jobs in the region.

E-Commerce in the region is still in the initial stage, but it is forecast to grow at over 20% annually in the next 5 years. With almost 30% of companies in the GCC having websites, B2B e-Commerce value registered $45 billion in 2009, while B2C was valued at $3 billion (Sudairy, 2010).

In spite the impressive growth in e-commerce, Small and Medium Enterprises (SMEs) have not utilized it as another consumer sales channel, as they face several challenges in setting up their own e-commerce platform. For example, in Saudi Arabia, most SMEs are still at the early stage in adopting e-commerce. In countries, such as Qatar, SMEs are also reluctant to adopt e-commerce as they do not trust it as a viable platform. Lack of transaction security, poor delivery services and lack of affordable and reliable payment platforms were all cited in a recent SME survey as reasons inhibiting e-commerce adoption.

However, the analysis by Kumar and Welsum (2013), indicated that GCC countries allocated huge investment to build ICT infrastructure, while they invest less in developing their human capital to be able to use these technologies effectively.

Furthermore, the diffusion of ICT uses in business filed still behind the international rate, since the most use of ICT remains concentrated on the individual and government use. This pattern of ICT use resulted in lowering the value add by ICT in the economy. In other words, the proportion of investment in the ICT infrastructure exceeded the capacity of use and the ability to benefit from their potential compared with successful experiences in developed countries, especially in business sectors.

These results demonstrate the frustrating lack of strategic planning, which leads to wasting of financial resources and hindering the development process, also the weakness of ICT readiness to use in business sector restrain creativity and innovation and reflect negatively on the opportunities to improve the current competitiveness of the economy.

Therefore, it is important for these countries to develop the added value of ICT by paying attention to the area of improving the quality of education, labor force training, development of knowledge-based economy, balanced ecosystem, which includes skilled manpower, institutional environment and a political will, especially to promote entrepreneurship (Kumar and Welsum, 2013).

Empirical Study

Depending on the reviews of previous literature, this study will provide in details the guideline for the research design and methodologies conducted to test the research hypotheses, while also giving a general overview of data collection methods and the main variables under analysis.

Research Design

This study tries to examine the relationship between independent variables and dependent variable, using the quantitative research method. The Quantitative method used for two reasons, firstly, the impact of ICT variables and HDI indices have been tested by previous researchers and results are available from different literature, and therefore, it is most appropriate way in exploring answers to the research questions, furthermore, all Variables in this study are quantifiable and measurable and therefore, result can be generalized from samples of a population.

Due to the nature of our research data, particularly, existence of both cross sectional and time series data, panel data analysis is conducted, which is a quantitative technique aims to get a handle on the time ordering of variables and to monitor the individual trends over time (Berrington, Smith, and Patrick, 2006). This technique has been utilized in previous studies, for example: (Bankole, 2009; Farhadi, Ismail, and Fooladi, 2012), In this study all data analysis and test will be conducted through E-views 9.0 econometric software.

Sampling Design

For this research work, the sample used comprises of six GCC countries; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and United Arab Emirates. The sample selected out of a total population of 153 developing countries in the world (International Monetary Fund, 2015). This set of countries is homogeneous in terms of geographic, economic and political backgrounds. Also, they share some characteristics in terms of ICT market value and ICT spending.

Data Sources and Descriptions

The study focuses on the years 2005-2014, the period of rapid growth in ICT sectors in the world. This period is selected for two important reasons. First, data on ICT in general and in developing countries specifically, prior to 2005 are not widely available due to the poor ICT infrastructure in these countries. Second, at the time of writing, available data sources provide information on ICT for the GCC countries only go through 2014.

Although some observations exist for 2015 and 2016 in the data utilized, the data coverage is not complete for most countries. As such, observations beyond 2014 are excluded from the economic estimates.

When analyzing data that collected from developing countries, it is important to be handled carefully in terms of its accuracy and quality, this because of different methods of data collection and reporting between countries and organizations, and even different methods within the same country from time to time.

This maybe represents the major challenge and difficulty that faced the author of the current research. Therefore, to minimize these obstacles, research depends on the international source, particularly three main sources; the ITU, the UNDP and the World Bank, as they are rich in current and historic secondary data needed in this research.

Variables and Measurements

The variables used in this research are selected according to the work of Bankole (2009), (Kim, Kang, Sanders, and Lee, 2008), Morawczynski and Ngwenyama (2007), Gholami and et al. (2010) and Monsef, Sameti, and Mojahednia (2011). The independent variables are ICT variables; ICT-access and ICT-use, where they are used by many literatures as the adequate indicators for ICT to reflect the readiness of countries in terms of ICT infrastructure and access, and the actual level if ICT usage of these available infrastructure and access indicators respectively (ITU, 2009b). The dependent variables are the human development index and its three key components; income index, education index and health index.

Measurement of Dependent Variables: Human Development

To measure the level of the country's human development, this study has employed the human development index (HDI), which is introduced by the UNDP in 1990 to measure and compare the progress of human development of

the countries (UNDP, 1990). The HDI measures based on three factors; longevity (health index), knowledge (education index) and GNI per capita (income index). As mentioned in literature review, life expectancy at birth used to measure the status of health by using the minimum and maximum value to obtain the health index (HI). For the education Index (EI), the calculation based on the arithmetic mean of the population's mean years of schooling and expected years of schooling. The Income Index (II) is based upon the natural logarithm of the actual, minimum and maximum values of GNI per (UNDP, 2011b).

Measurement Independent Variable: ICT

The ICT indicator used in current study based on the ICT Development Index (IDI) methodology which is published by the International Telecommunication Union (ITU, 2009b). This indicator can be interpreted as most comprehensive as it is built upon experience from several earlier indicators. Experts from different countries participated in the construction of the indicator and a principal component analysis helped to identify the most relevant factors. The indicator aims to measure the information society by giving an indication of the extent to which countries have advanced in the area of ICT (ITU, 2009b).

The IDI is constructed based on the three-stage framework, which addresses the evolution of the application of ICT in the community, by going through three stages; ICT readiness, ICT intensity, and ICT impact. Since there is insufficient data about the third stage, IDI indicator only covers the first two stages, which measure three important factors; ICT access, ICT use and ICT skills.

ICT-access consist of five individual indicators; fixed telephone subscriptions, mobile cellular subscriptions, and international internet bandwidth in bits per user, Percentage of households with a computer, and Percentage of households with Internet access.

However, the data for the last two indicators are not available for the required time span and the selected countries, thus they are omitted from the present study. ICT- use are measured by Percentage of individuals using the Internet, fixed broadband subscriptions and mobile-broadband subscriptions. ICT skills are measured by secondary and tertiary gross school enrolment ratios and adult literacy rate. However, the data about ICT-skills is again not available for all GCC countries and, in particular, not for the required time period, thus this sub-indicator will be omitted from the present study (ITU, 2009b).

The individual indicators were collected from ITU, and then aggregated to the two sub-indicators; ICT-access and ICT-use, using the ITU ICT Development Index (IDI) methodology (ITU, 2009b), which use the following statistical processes:

- **First Step:** Normalizing the data using the reference measures which is the ideal value that could be reached for each indicator. Since the reference values are not available for the all required time period, this study used the reference values of the year 2007 for the all required years (ITU, 2009b).

In table 1 the reference value for Internet users and Mobile broadband subscribers are 100. For fixed telephone subscriptions, Mobile cellular subscriptions, and fixed broadband subscribers, the ideal value was computed by adding two standard deviations to the average of the observed 2007 values, resulting in a rounded value of 60, 150 and 60 per 100 inhabitants respectively.

Finally, for International Internet bandwidth per Internet user, the data were first transformed to a logarithmic (log) scale, in order to diminish the effect of the large number of outliers at the high end of the value scale, and the ideal value was then computed by adding two standard deviations to the average of the observed 2007 values, resulting in a log value of 5, which corresponds to 100'000 bits/s (ITU, 2009b).

- **Second Step:** to calculate the value of each sub-index (access and use), equal weights were applied to the individual indicators within each sub-index.

Control Variables

Firstly, country's economic growth is considered as an important element in improving human development, however, it also affects the level of ICT readiness. Thus, HDI model will control for income index to differentiate development levels across countries.

Table 1: Reference and weighted values of ICT indicators

ICT access	Ref. Values	Weight (%)
Fixed telephone lines per 100 inhabitants	60	33
Mobile cellular telephone subscriptions per 100 inhabitants	150	33
International Internet banzdwidth (bit/s) per Internet user	100000	33
ICT use	**Ref. Values**	**Weight (%)**
Internet users per 100 inhabitants	100	33
Fixed broadband Internet subscribers per 100 inhabitants	60	33
Mobile broadband subscribers per 100 inhabitants	100	33

Source: Author based on ITU, 2009

Secondly, several studies have shown that there is a strong correlation between health, education and GNI for example (Sachs, 2001), for this reason it's important to control for them in the model; In other words, for every dependent variable in the model (GNI, Health, and Education), the study will use the other two variables as control variables; in order to isolate the role of these variables from all of the others in the model.

Empirical Model Specification

In order to analyze the effects of ICT on human development in GCC countries, the study follows the work of Bankole (2009), Gholami and et al. (2010), Monsef et al. (2011) and (Kaur, 2015). developed the model used by Kim et al. (2008) and Morawczynski and Ngwenyama (2007) to investigate the impact and the interaction effects of the four aspects of ICT investments on the three key components of human development in the 51 countries with the largest ICT markets in the world. however, instead of using ICT investment as an independent variable as used in Bankole (2009) model, the study will use the IDI indicator used by S. Kaur (2015), particularly the ICT access sub index and ICT use sub index. Specifically, it will use the following models:

$$HDI_{it} = \beta_0 + \beta_1(A_{it}) + \beta_2(U_{it}) + \beta_3(II_{it}) + \beta_4(HI_{it}) + \beta_5(EI_{it}) + \epsilon_{it} \dots \quad (1)$$

$$II_{it} = \beta_0 + \beta_1(A_{it}) + \beta_2(U_{it}) + \beta_3(HI_{it}) + \beta_4(EI_{it}) + \epsilon_{it} \dots \quad (2)$$

$$HI_{it} = \beta_0 + \beta_1(A_{it}) + \beta_2(U_{it}) + \beta_3(II_{it}) + \beta_4(EI_{it}) + \epsilon_{it} \dots \quad (3)$$

$$EI_{it} = \beta_0 + \beta_1(A_{it}) + \beta_2(U_{it}) + \beta_3(HI_{it}) + \beta_4(HI_{it}) + \epsilon_{it} \dots \quad (4)$$

Where i indexes the six GCC countries in this study, t is time period (2005-2014), β_0 is a constant, $\beta_1$through β_5 are the Regression Coefficient; the parameters to be estimated, and ϵ_{it} is the standard error of coefficient.

The dependent variable in the equation (1) is HDI_{it} denotes the human development index in individual country i in year t, and the independent variables are A_{it}, and U_{it}, denotes ICT-access and ICT-use for a country i in year t respectively. Finally, II_{it}, HI_{it}, and EI_{it}, denote the income index, health index, and education index respectively, are the control variables since they are considered as a critical element in improving human development.

In equation (2) the dependent variable is II_{it} denotes the income index in individual country i in year t, however, HI_{it} and EI_{it} are health index and education index; denote control variables that can be related to income index for a country i in year t. In equation (3) the dependent variable is HI_{it} denotes the health index in individual country i in year t. II_{it} and EI_{it} are income index and education index; denote control variables that can be related to health index for a country i in year t. Finally, in

equation (4) the dependent variable is EI_{it} denotes the education index in individual country i in year$t$. II_{it} and HI_{it} are income index and health index; denote control variables that can be related to health index for a country i in year t.

Summary Statistics and Description of Variables

This section will provide and explain both summary of descriptive statistics and the correlation matrix of the main and control variables used in the study.

Summary Statistics

Table 2 presents the descriptive statistics of the variables under study; namely human development index (HDI), health index (HI), education index (EI), income index (II), ICT-access index and ICT-use index. The data reflect the status of development of each variable across the six GCC countries, during the period between 2005 and 2014.

All indices values are ranging between zero and one. Zero being associated with very low levels of the selected indicator and one being associated with very high levels of that indicator. As seen in table (2) there is a relatively large variation in all included variables. For instance, the HDI varies between 0.693 from Oman in 2006 and 0.855 from Qatar in 2008, with a mean of 0.808 and standard deviation 0.035. These variations reflect the great development improvements as captured by the human development index in the last decade (UNDP, 2014).

However, the trend of progress in HDI differ from its sub-indices components, for example, the highest value of education index (0.741901) is lower than the maximum for the HDI (0.855000), and therefore, this progress in HDI can explained by variable other than education, mainly by the higher income index value and partly by the improvement of health index value. These results shed a light on the imbalance development between the human development sub components and highlight the role of oil prices in improving the GNP and healthcare services.

For the ICT indices, the average ICT-access and ICT-use across all countries for the selected years are 0.650 and 0.332 respectively, while the minimum value is 0.382 from Saudi Arabia in 2005 and 0.024 from Oman in 2005 and the maximum value is 0.868 from Kuwait in 2014 and 0.834 from Bahrain in 2014 respectively.

Again, the variation of ICT index reflects the dynamic improvements of IDI rankings and values in the GCC countries since 2010 (ITU, 2014); With respect to Global average, figure (2-7), show that the average of ICT-access and ICT-use indices in the GCC countries are above the global average along all years between 2005 and 2014.

As we mentioned in the previous chapters, GCC countries witnessed a revolution in terms of ICT development index, according to ITU, five GCC countries lead the Arab region in terms of ICT development and positioned in the top 60 in the global rankings. Again, the oil price increase, side by side with the strategic direction of policy maker in the GCC toward knowledge-based economy, both lay beyond the major improvement ICT sector.

The Correlation Matrix

Table 3, shows the correlation between the selected variable used in the study, it will try to gain some insight into the behavior of these variables. Beginning with ICT variables (access and use), we can note that there is a moderate, positive and statistically significant correlation with HDI, HI and EI. This correlation suggests that ICT access and ICT use will be able to explain variation in human development, health and education index, as more ICT access and use in the selected countries tend to have higher levels of human development.

However, both ICT variables have insignificant relationship with the income index (II), furthermore income index is weekly correlated with ICT-access index and ICT-use index with (0.114) and (0.094) respectively. This seems to be justified, since the oil price variable are a significant driver of the income level in these countries, where the absence of this variable makes the result much confused (ITU, 2012).

Another interesting finding is that, except for the income index, all variables are highly correlated with each other, which may lead to issues of imperfect multicollinearity. So, there is a need to take care when performing regression analysis.

Table 2: Summary of descriptive statistics

Summary of Descriptive Statistics					
	Observations	**Mean**	**Std. Dev.**	**Min**	**Max**
HDI	60	0.808229	0.035781	0.693000	0.855000
HI	60	0.847604	0.044319	0.698000	0.898000
EI	60	0.657898	0.050165	0.526737	0.741901
II	60	0.948824	0.049046	0.865000	1.000000
ICT_ACCESS	60	0.650656	0.112676	0.382340	0.868833
ICT__USE	60	0.332609	0.216514	0.024904	0.834405

Source: Author calculation

Table 3: The Correlation Matrix

The Correlation Matrix						
variables	**HDI**	**HI**	**EI**	**II**	**ICT-ACCESS**	**ICT-USE**
HDI	1.000000 -----					
HI	0.863095 0.0000	1.000000 -----				
EI	0.824021 0.0000	0.679143 0.0000	1.000000 -----			
II	0.442810 0.0004	0.174082 0.1834	-0.055998 0.6709	1.000000 -----		
ICT_ACCESS	0.531425 0.0000	0.405028 0.0013	0.561514 0.0000	0.114774 0.3825	1.000000 -----	
ICT__USE	0.481066 0.0001	0.430192 0.0006	0.477787 0.0001	0.094065 0.4747	0.852109 0.0000	1.000000 -----

Source: Author calculation

Scatter plots with fit lines as seen in figures (1 through 4), shows the pairwise correlations between the dependent variables HDI, HI, EI and II and the main independent variables ICT-access and ICT- use. These Scatter plots provide further illustration of the behavior of each independent variable (x-axis) with the dependent variables (y-axis).

First investigation of the data indicates that a GCC's level of human development has positive and linear relationship with the level of ICT-access and ICT-use. In other words, more ICT infrastructure and individual's access to basic ICTs, and more the strength of use of ICT based on the available infrastructure and access indicators, the more is the level of human development achieved in these countries. Both correlations are also in line with the hypothetical expectations.

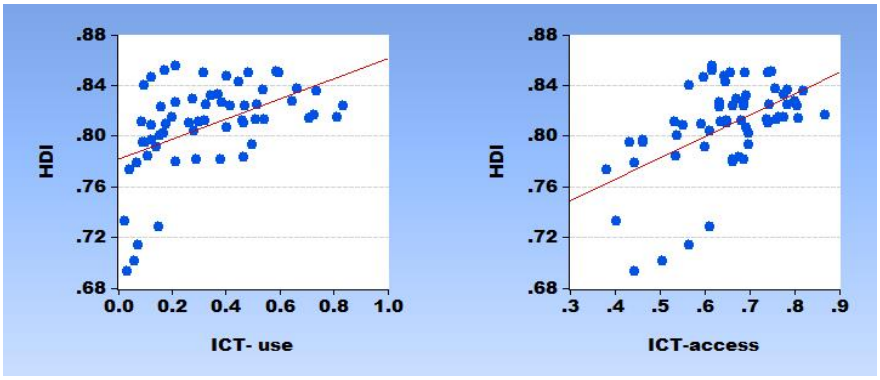

Figure 1: The pairwise correlations between HDI and ICT variables

Source: Author Calculation

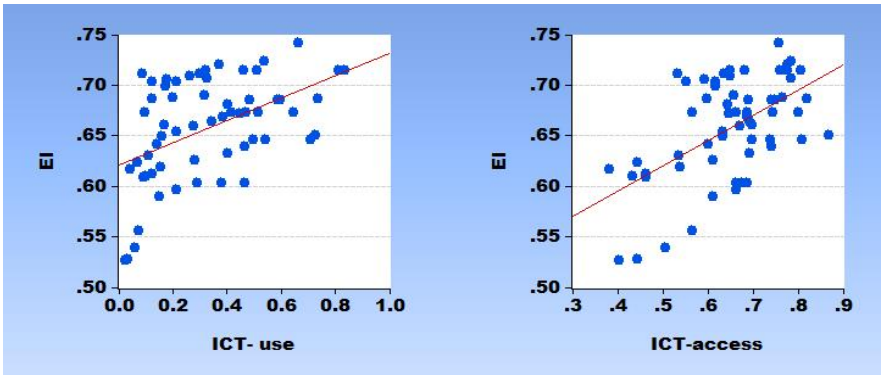

Figure 2: The pairwise correlations between HI and ICT variables

Source: Author Calculation

In the same line, with respect to the HDI key sub indicator, we can notice that, each sub indicator is positively correlated with both ICT indicators. However, there is some interesting difference, for instance, the correlation between education index and ICT-access is much stronger than its correlation with ICT-use as it shown in figure 2.

In contrast, as shown in figure 3, the positive link between health index and the use of ICT is much stronger than its relationship with ICT infrastructure and access.

The trend line over all countries suggests that there is a weak linear positive link between II and ICT – use and ICT- access (figure 4). However, the relationship seems to be very fragile which may be an indication of lack of relationship between the two factors, this due to a small number of records or to the existing of other factors that affect the income other than the ICT (i.e. oil prices).

However, these important finding, need further investigations since the correlation does not imply causation, but the first step in causation, and suggests that there may potentially be a relationship. Where by including other variables in analysis can change the significance of these relations.

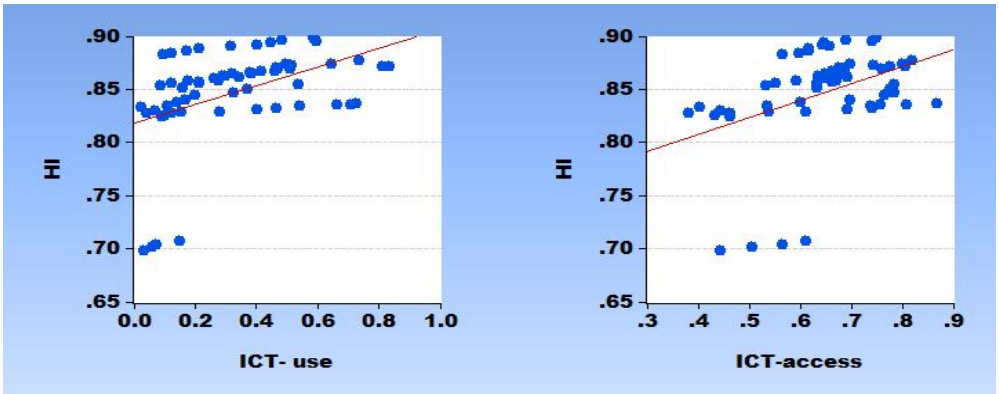

Figure 3: The pairwise correlations between EI and ICT variables

Source: Author Calculation

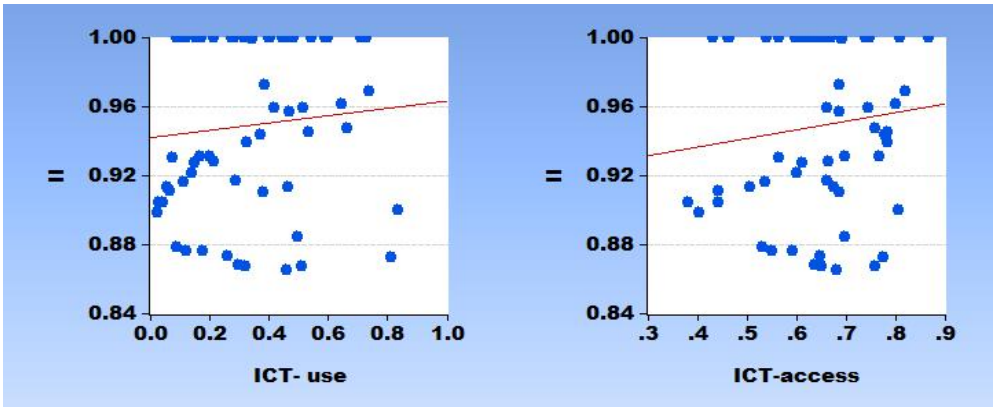

Figure 4: The pairwise correlations between II and ICT variables

Source: Author Calculation

Model Results

In this part, analysis results and discussions are presented in detail. The first section shows results of analysis of the three models (Panel OLS, fixed effects and random effects). The second section reports the selection of fitted models. And the last section reports and analyzes the results of hypotheses testing.

The theoretical model used in this study is panel model that formalized the hypothesized relationships among the ICT and human development key variables. This model was statistically analyzed using panel analysis with E-views 9.0 statistical software. Also, the study used the Gretl statistical software to conduct the Wooldridge test for autocorrelation, since the E-views 9.0 doesn't perform this kind of test for the panel data.

As mentioned in previous section, Panel OLS, Fixed Effects and Random Effects methods are performed to estimate the parameters of the models. Then, Hausman test used to select the fitted model for this dataset. Finally, the coefficient of determination (R-squared) is presented to observe the goodness-of-fit of the model.

Before the regression model was run, a multicollinearity and serial correlation issues

was tested (Wooldridge, 2002). The multicollinearity is measured by Variance Inflation Factor (VIF), which measures the effect of collinearity on the value of the variance of the estimated regression coefficient. Table 4, shows that the mean VIF values for the panel data of the four models are lower than 30; the server multicollinearity value, and therefore the multicollinearity issue doesn't exist.

Serial correlation or autocorrelation, occurs when error terms from one-period is correlated with future time periods in a time-series data panel. To test this issue, the study conducts the Wooldridge test for serial correlation using the Gretl software. In Table (3-5), the Prob. > F is significant at the 1% level, therefore the null hypothesis of no first order autocorrelation can be rejected, confirming that there is a first-order autocorrelation. Autocorrelation tends to be an issue when there are 20-30 years of panel data, as it tends to understate the actual standard errors of coefficients and overstate the R-squared calculation (Barro, 1999). The problem of autocorrelation and the possible heteroscedasticity issue are corrected with the white-cross section method.

Table 4: Multicollinearity and serial correlation tests

	Model 1 HDI	Model 2 EI	Model 3 HI	Model 4 II
Wooldridge test for autocorrelation H0: no first-order autocorrelation	F (1,47) = 410.223 Prob. > F = 0000.	F (1,47) = 47.7353 Prob. > F = 0000	F (1,47) = 33541.2 Prob. > F = 0000	F (1,47) = 46.8363 Prob. > F = 0000
Mean VIF value >30 server multicollinearity	2.776	2.483	2.586	3.082

Source: Author calculation

Table 5: The impact of ICT on the human development index: A Panel Data analysis of selected GCC countries

MODEL 1			
Dependent variable: HDI			
	POLS	**FE**	**RE**
Constant	-0.019339***	-0.027499***	-0.019339***
	(0.001876)	(0.007827)	(0.001876)
Regressors:			
ICT-access	0.004445***	0.001849	0.004445***
	(0.001336)	(0.001340)	(0.001336)
ICT-use	-0.002701***	-0.001178**	-0.002701***
	(0.000441)	(0.000507)	(0.000441)
II	0.294623***	0.308372***	0.294623***
	(0.001450)	(0.009295)	(0.001450)
EI	0.406757***	0.399253***	0.406757***
	(0.003637)	(0.005767)	(0.003637)
HI	0.328485***	0.329939***	0.328485***
	(0.003038)	(0.003798)	(0.003038)
N	60	60	60
R squared	0.999476	0.999736	0.999476
F-statistics	20585.47	18574.55	20585.47
Prob.	0.0000	0.0000	0.0000
Hausman Test		48.4245	
Prob.		0.0000	

Source: Author's research outputs via E-Views 9.0 using ITU and UNDP data.
Notes: The standard errors are in parenthesis, *, ** and *** indicate significant at 10%, 5%, and 1% respectively.

Models Estimation

The regression estimates and significances were calculated using E-views, version 9.0, as it is shown in tables 5 and 6. In table 5, the econometric estimates for the impact of ICT on the human development index are reported. In table 6, the impact of ICT - access and ICT - use on human development sub-indices; HI, EI and II are reported. For ensuring the significance and accuracy of overall regression, control variables were added in the model, since they strongly influence the dependent variable.

Analysis of Table 5

Model 1: Firstly, the results show that ICT-access influences positively the HDI and it is significant at1% for POLS and RE method of estimations, while it's insignificant for FE. Therefore, it can be stated that an increase in ICT access by 1%, increase the HDI by around 0.0045%, 0.002% and 0.0045%, holding all the other variables constant, according to the Panel OLS, Fixed effects and Random effects models respectively. Regarding ICT use index, it has a negative and significant association with HDI; according to the Panel OLS, Fixed effects or Random effects models.

In reference to the control variable in the model, income index (II), education index (EI), and health index (HI) is significantly and positively related to HDI, which means that the human development improves whether the level of income, education, and health increase in GCC countries according to the Panel OLS, fixed and random model.

The P-value of the F-statistic was zero for all method of estimations (PLS, FE and RE), this means that all models are statistically significant. Also, we notice that estimating the regressions equation using Panel OLS, fixed effect and RE model increase the significance of the whole model.

This is manifested in the values for R-squared, the criterion to measure the goodness-of-fit. More specifically, these values mean that for the POLS, FE and RE 99% of the HDI variations are explained by this model respectively.

However, it must be noticed that R-squared cannot be the only method to measure the goodness-of-fit, since it is sensitive to the number of variables included in the model. Meaning that, as the number of variables in the model increases, R-squared is artificially higher.

Analysis of Table 6

Model 2: Firstly, the results show that ICT access influences negatively the HI and it is significant only when using RE method of estimation at a level of 10%. Therefore, it can be stated that an increase in ICT access by 1%, increase the HI by around 0.09%, holding all the other variables constant, according to Random effects models. Regarding ICT use index, it has a positive association with HI; however, this association is insignificant according to fixed effects and Random affects methods, and significant at 10% for the PLS method.

In reference to the control variable in the model, income index (II) is has a positive and significant relation to HI using POLS method and has a negative and significant relation using FE method; however, this relation is insignificant using RE method. While education index (EI) has a positive and significant association with health index (HI) at a level of 1% according to all methods of estimations used in the analysis.

The P-value of the F-statistic was zero for all method of estimations (POLS FE and RE), this means that all models are statistically significant. However, again, we notice that estimating the regressions equation using the fixed effect model increase the significance of the whole model, compared with the Panel OLS and RE estimation techniques since the R-squared value, are higher in FE 0.63 compared to Panel OLS 0.53 and RE 0.32. More specifically, these values mean that for the PLS FE and RE 53%, 63% and 32% of the HI variations are explained by these models respectively.

Model 3: with respect to education index (EI), the results show that ICT access influences it positively and it is significant at level of 1% for the three methods of estimations. Therefore, it can be stated that an increase in ICT access by 1%, increase the EI by around 0.22%, 0.17% and 0.18% holding all the other variables constant, according to PLS, FE and RE respectively. Regarding ICT use index, it has a negative association with EI; however, this association is insignificant according to three methods.

In reference to the control variable in the model, income index (II) is has a positive relation to HI where this relation is significant only according to PLS method. For the health index (HI), it has a positive and significant relation with the main dependent variable at a level of 1% according to the three methods of estimations.

The P-value of the F-statistic was zero for all method of estimations (PLS FE and RE), this means that All models are statistically significant. However, again, we notice that estimating the regressions equation using the fixed effect model increase the significance of the whole model, compared with the Panel OLS and RE estimation techniques since the R-squared value, are higher in FE 0.91 compared to Panel OLS 0.60 and RE 0.62. More specifically, these values mean that for the PLS FE and RE 60%, 91% and 62% of the EI variations are explained by these models respectively.

Table 6: The impact of ICT on human development sub-indices; HI, EI and II: A Panel Data analysis of selected GCC countries

	MODEL 2			MODEL 3			MODEL 4		
	Dependent variable: HI			Dependent variable: EI			Dependent variable: II		
	POLS	FE	RE	POLS	FE	RE	POLS	FE	RE
Constant	0.3073**	1.098***	0.4777**	0.1530	0.1622	0.2631	0.772***	0.934***	0.935***
Regressors	(0.1535)	(0.3323)	(0.2731)	(0.0627)	(0.1325)	(0.1363)	(0.0683)	(0.0699)	(0.0674)
ICT-access	-0.1102	-0.0445	-0.0988*	0.2253***	0.1723***	0.1845***	0.1392	0.0747**	0.0754**
	(0.0556)	(0.0667)	(0.0843)	(0.0552)	(0.0318)	(0.0403)	(0.0843)	(0.0320)	(0.0178)
ICT-use	0.0645*	0.0294	0.0593	-0.0436	-0.0126	-0.0178	-0.0320	-0.034**	-0.0341**
	(0.0256)	(0.0237)	(0.0330)	(0.0312)	(0.0184)	(0.0235)	(0.0448)	(0.0164)	(0.0150)
II	0.1949**	-0.7262**	0.0028	-0.203**	0.2159	0.0958			
	(0.0581)	(0.2633)	(0.1338)	(0.0259)	(0.1237)	(0.0943)			
EI	0.6166***	0.6946***	0.6259***				-0.4349**	0.1020	0.0974
	(0.1618)	(0.2361)	(0.2822)				(0.0609)	(0.0961)	(0.0593)
HI				0.667***	0.21***	0.22***	0.4508**	-0.106**	-0.1046**
				(0.0695)	(0.0657)	(0.0706)	(0.1263)	(0.0529)	(0.0507)
N	60	60	60	60	60	60	60	60	60
R squared	0.5337	0.6344	0.3246	0.6059	0.9114	0.6291	0.1193	0.9562	0.2380
F-statistics	15.7357	9.6413	6.6082	21.1371	57.1189	23.3210	1.8617	121.2135	4.294505
Prob.	0.0000	0.0000	0.0002	0.0000	0.0000	0.0000	0.1303	0.0000	0.00428
Hausman Test		5.6627			6.3714			1.9828	
Prob.		0.2258			0.1731			0.7389	
Breusch-Pagan LM test			0.02975			58.6040			172.852
Prob.			0.8631			0.0000			0.0000

Source: Author's research outputs via E-Views 9.0 using ITU and UNDP data

Model 4: with respect to income index (II), the results show that ICT access influences it positively and it is significant at level of 5% according to FE and RE method of estimation. Therefore, it can be stated that an increase in ICT access by 1%, increase the II by around 0.074% and 0.175% holding all the other variables constant, according to FE and RE respectively.

Regarding ICT use index, it has a negative association with II; however, this association is insignificant according to PLS method and significant at 5% for FE and RE methods.

In reference to the control variable in the model, education index (EI) is has a negative and significant relation to II only according to PLS method, where this relation is insignificant according to FE and RE methods. For the health index (HI), it has a positive and significant relation with the main dependent variable at a level of 5% according to the PLS method of estimations and negative and significant relation at 5% according to both FE and RE methods.

The P-value of the F-statistic was zero for FE and 0.004 for RE and 0.13 for PLS, this means that both FE and RE models are statistically significant, while PLS model is not. However, again, we notice that estimating the regressions equation using the fixed effect model increase the significance of the whole model, compared with RE estimation techniques since the R-squared value, are higher in FE 0.95 compared to RE 0.23.

Selecting the Fit Model

Following the methodology stated previously, Hausman test was conducted to verify whether the FE model or the RE model is better selected. Hausman test compare the coefficients of the two models, to decide if we accept or reject the null hypothesis; the fixed effect model does not improve the explanatory power (Wooldridge, 2002).

This can be drawn from analyzing the probability value (P-value) of Hausman test; if P-value is less than 1%, 5% and 10% then fixed effects model is better specification for panel data estimation, otherwise, the random effects model is.

In tables (5) and (6), the test result shows that the P-value for model 1, 2, 3 and 4 are 0.00, 0.23, 0.17 and 0.74 respectively. Therefore, this study fails to reject the null hypothesis within the significant level for model 2,3, and 4. So it can statistically confirm that the random effects model would improve the explanatory power and fit the study better than the fixed effects model.

However, for model 1, we notice that P-value equal to zero, which means that the model rejects the null hypothesis and fixed effect fit the study better than random effect model.

To choose between random effects and POLS, the Breusch-Pagan LM (Lagrange Multiplier) test is applied. The Breusch-Pagan LM facilitates the choice of Panel OLS estimators or the random effects estimators. The null hypothesis of the test supposes the existence of homoscedasticity in the model and the Panel OLS is the fitted model.

The P-value of Breusch-Pagan LM test for model 2, 3 and 4 are 0.86, 0 and 0 respectively. In view of that, the null hypothesis is rejected for model 3 and 4, since their P-values are Significance at level of 1%, In other words, homoscedasticity is rejected in favor of heteroscedasticity; thus, the random effects model is preferred rather than the Panel OLS.

However, for model 2, the P-value is very close to one, which means it fails to reject the null hypothesis, so; the Panel OLS model is adequate, in favor of the random effects alternative.

Findings from the Fit Models

For each of the four models used for this study, the estimated impact of ICT variables is introduced in a table 7 with a column for each model with adequate estimation method.

Column (1) presents the panel fixed effect estimate (FE) between ICT variables and Human development index, (2) is the Panel OLS estimate between ICT variables and Health index, column (3) is the panel random effect estimate (RE) between ICT variable and education index, and (4) is the panel random effect estimate (RE) between the ICT variable and income index. Heteroscedasticity robust standard errors are reported in parenthesis for each coefficient.

The following section will present and analyze the results of the four models; the relationship between ICT development index and human development index and its sub-indices.

Table 7: The impact of ICT on human development and its sub-indices; HI, EI and II. Finding from fitted models

Analysis Results				
Method	**MODEL 1 (FE)**	**MODEL 2 (PLS)**	**MODEL 3 (RE)**	**MODEL 4 (RE)**
Dep. Var.	**HDI**	**HI**	**EI**	**II**
Constant	-0.027499*** (0.007827)	0.3073** (0.1535)	0.2631 (0.1363)	0.935*** (0.0674)
ICT-access	0.001849	-0.1102	0.1845***	0.0754**
	(0.001340)	(0.0556)	(0.0403)	(0.0178)
ICT-use	-0.001178**	0.0645*	-0.0178	-0.0341**
	(0.000507)	(0.0256)	(0.0235)	(0.0150)
II	0.308372***	0.1949**	0.0958	
	(0.009295)	(0.0581)	(0.0943)	
EI	0.399253***	0.6166***		0.0974
	(0.005767)	(0.1618)		(0.0593)
HI	0.329939***		0.22***	-0.1046**
	(0.003798)		(0.0706)	(0.0507)
N	60	60	60	60
R squared	0.999736	0.5337	0.6291	0.2380
F-statistics	18574.55	15.7357	23.3210	4.294505
Prob.	0.0000	0.0000	0.0000	0.00428

Source: Author's research outputs via E-Views 9.0 using ITU and UNDP data
Notes: The standard errors are in parenthesis, *, ** and *** indicate significant at 10%, 5%, and 1% respectively.

Results and Hypothesis Testing

$\mathbf{H_1}$: tested by Equation (1): ICT and Human Development Index

1. Equation (1) tests hypothesis one, which regressed ICT access and ICT use with HDI, controlling the effect of income index, education index, and health index. The P-value of the F-statistic was zero, this means that the model is statistically significant, and has extremely high R-square with 0.99. The R-squared value indicates that this model explains relatively much, somewhere 99 percent, of the variation in human development levels. This also gives some initial support to the hypothesis that the ICT is important determinant of human development index (HDI) in GCC countries.

2. As we can see, the coefficient of ICT access is around 0.002, which reveals that one percentage increase in ICT access index would increase HDI by 0.002 percentage points. However, this relation is insignificant, which could be resulted due to limited time span.

This result provides a baseline for exploring the relationship between the availability of ICT infrastructure and individual's access to basic ICTs and the human development in GCC countries, which are consistent with some recent literature indicating the growing effects of ICT access in the developing countries such as Bankole (2009), Gholami and et al. (2010), Monsef et al. (2011), Morawczynski and Ngwenyama (2007), S. Kaur (2015), Kelly, Kim, and Raja (2010) and Nour (2008).

According to Dreze and Sen (1989) the link between access to information and development is embedded in the fact that the first step in overcoming challenges in human life consists of evaluating the predicament and identifying the

alternatives that would make life better, where ICTs entail a set of capabilities that can be harnessed and fostered to further human development through access to information and increased potentials for communication (Haq, 1995).

However, these benefits to human development require human capabilities and skills to handle such technologies (Lee, 2001) where these capabilities will be reflected on the intensity of use of ICT.

3. Moving to ICT use, the relation is significantly negative with HDI, which reveals that one percentage increase in ICT use index would decrease HDI by 0.001 percentage points. The negative relation maybe due to the limited time frame used in this study, or due to the week ICT intensity of use in GCC countries compared with ICT infrastructure and access.

According to Kumar and Welsum (2013), GCC countries rapidly investing in ICT is that they may overreach relative to their capabilities to use and benefit from the new technologies. (UNDP, 2009b), clearly stated that the ICT use is the second stage in the process of evolution towards information societies, where access to ICT infrastructure is always prerequisite for subsequent use; the level of absorption of the technologies.

During the ICT use stage, countries increase their use in terms of numbers (i.e. more users of a specific ICT) and in terms of level of intensity (for example, more SMS being sent) and sophistication of use (for example, online banking or purchasing). In this point, ITU conclude in their 2009 report that the highest value gains for developing countries made on the access sub-index, not yet for the ICT use.

4. Finally, for the control variable II, EI, and HI, all they have a positive and significant impact on HDI. These results are consistent with the nature of these indices, since they are the main components of HDI itself, where standard theory and empirical literature prove a strong relation.

H_2: tested by Equation (2) through (4), which regressed ICT-access and ICT-use with human development sub-indices; health index, education index and income index, controlling for the effect of EI and II, HI and II, and EI and HI respectively.

Equation (2): ICT and Health Index

1. The P-value of the F-statistic was zero, this means that the model is statistically significant, and has extremely high R-square with 0.53. The R-squared value indicates that this model explains relatively much, somewhere 53%, of the variation in health index. This result consists with the hypothesis that the ICT is important determinant of health index in GCC countries.

2. There is a negative and insignificant relationship between ICT access and health index, here this effect is not clear since its corresponding coefficient is not statistically significant, and we cannot rely on this result in analysis. However, some recent literature can shed a light on this situation.

For example, Balsa and Gandelman (2010), conclude that the insignificant effect on health outcome in developing country compared with developed countries is related to different stages of progress of both health care system and ICT development. This is in the line of the study conducted by the Economist Intelligence Unit (EIU) in 2004, which attributed the weak association, in developing countries, to the absence of a critical mass in ICT adoption, suggesting that significant effect will only be attained if a minimum threshold of ICT penetration and usage is achieved (Fong, 2009).

Although GCC countries spent a billion dollars on ICT projects in healthcare sector, however, the implementation of effective ICT strategies still far from those in developed countries, since these projects face many challenges such as absence of health data standards, weak medical information management, ethical and privacy concerns, the lack of clinician's engagement, the shortage of professionals, the complexity of the health ecosystem, the lack of policies and procedures, and the lack of an authority of regulation. (Alkraiji et al., 2014).

These pitfall, make the huge financial resource to spend on the expense of the resources needed for basic health services. Furthermore, according to Mansell (1999), most developing countries developed their ICT strategies without giving sufficient attention to local concerns and requirements. Such strategies are often tailored to strengthening domestic ICT production aimed at export markets rather than

at building up the capabilities of the majority of citizens, businesses and industrial sectors for using ICTs. This is often attributable to the fact that these technologies are promoted as a panacea for social and economic disadvantage.

3. The coefficient of ICT-use is positive and significant at level of 10%, This finding asserts that increasing the application of ICTs might significantly improve the health index and assess the life expectancy at birth in GCC countries. The results also indicate that if the ICT-use increase by one percent, HI will rise by 0.064%. The positive relation can provide some evidence to confirm the hypothesis of this dissertation in the line of many studies whose have found the same result.

For example, Farhadi and et al. (2013), Fong (2009), and Bankole (2009). According to Kuyoro, Awodele, and Okolie (2012) the use of ICTs always be combined to broader efforts at reform of health care delivery and strategies to increase outcomes in this dimension of human development.

However, despite the great potential of ICT use in health as has been noted in developed countries, GCC countries still far from these great benefits, due to the weakness in the readiness for their adoption and adaptation to country-specific needs, circumstances and resources.

Knowing that the GCC population in the age group of 65 and above is expected to surge from 1.2 million in 2015 to 14.2 million in 2050, GCC will face an increasing number of elderly people requiring care, this situation increase the need to overcome the obstacles that hinder the potential if ICT use in health sector. This is necessary based on the idea that the intersection of ICT into health may be one of the greatest means to positively enhance development.

4. Finally, with respect to control variables, it's noted that the improvement of GNI per capita and educational attainment can enhance the health index in GCC countries. There is a strong positive and significant relationship between heath index and income index and between health index and education index, with regression coefficient 0.1949 and 0.6166, and level of significantly 5% and 1%, respectively.

These results are in the line with the mainstream literature, such as Felix Bankole, Farid Shirazi, and Irwin Brown (2011), Ngwenyama, Andoh-Baidoo, Bolou, and Morawczynski (2006), and others. It's supposed that the improvement of standard of living will affect positively on the life expectancy at birth, furthermore, education attainment can affect health index in two ways, in one hand, human capital development is an essential condition for assisting the quality of healthcare services, in the other hand, improving educational level will enhance the use of ICT by the citizen, which in turn affecting positively the healthy living.

Equation (3): ICT and Education Index

1. The P-value of the F-statistic was zero, this means that the model is statistically significant, and has extremely high R-square with 0.63. The R-squared value indicates that this model explains relatively much, somewhere 63 percent, of the variation in education index levels. This also gives some initial support to the hypothesis that the ICT is important determinant of education index in GCC countries.

2. As we can see, the coefficient of ICT access is 0.1845, with significant level at 1% which reveals that one percentage increase in ICT access index would increase EI by 0.1845 percentage points. The resulted signs quite match the expected signs as discussed in the literature review, and confirm the hypnotized impact of ICT infrastructure and individual's access to basic ICTs on educational level, which also consistent with the recent studies such as Al-Maliki (2013), Albugami and Ahmed (2015), Bankole (2009), Gholami and et al. (2010), Monsef et al. (2011), Morawczynski and Ngwenyama (2007), and Nour (2008).

According to Nour (2008), spending on ICT shows a positive correlation with schooling, it is generally believed that ICTs can empower teachers and learners, promote change and foster the development of the 21st century skills. On the other hand, ICTs are also believed to be able to contribute to the enhancement of learning since these tools can play a role in reforming education systems, increasing access to pedagogical resources, improving the management of education and enhancing pedagogical techniques (Kuyoro et al., 2012).

This means that ICT investment is important to manage knowledge about computer resources, software applications in order to have a positive

impact on education; it allows individuals to utilize accumulated knowledge in the form of software packages in an effective manner which facilitates improvement in literacy and the school's enrolment level Bankole (2009).

However, Albugami and Ahmed (2015), suggest that these relations can be strengthen by overcoming the challenges that could affect the application of ICT in education sector, such as the lack of ICT skills among school along with the lack in ICT training and the lack of clear ICT policies.

3. There is a negative and insignificant relationship between ICT use and education index. Failure to find a causal relationship is either due to the absence of causal relationship as estimated or weak instruments having been chosen (Ryu, 2014).

Alternatively, it may be because the panel data is not long enough or due to the early stage of the level of ICT use in GCC countries, that doesn't reach the minimum required level needed to affect the education level. In fact, there is a mutually exclusive relationship between ICT use and education attainment.

In other word, experience drown from developed and even some developing countries, showed a strong evident that increasing the level of ICT usage in a country, will improve the education attainment, since ICT play a key role for reforming the educational systems, and achieve the best of its impact (Al-Qubaisi, 2012).

However, developing the ICT use in itself need an adequate educational system, skills and technical skills (Kenny, 2002), since the intensive use of ICT tools in various aspect of life (education, heath, business..) need a leap frog improvement of educational conditions, raising the quality within schools and universities, and effective ICT training policy.

4. Finally, with respect to control variables, the relation education index and income is positive but not significant. This insignificancy may due to limited number of record or due to other factors than those used in the study; i.e. oil prices. For health index, the result shows a positive and significant impact on the education index with coefficient 0.22 at 1% level of significance. The later result is consistent with many studies such as (Suhrcke & Nieves, 2011), and (Jukes, Drake, & Bundy, 2008), these studies has shown a body of evidence to link health status to educational enrolment and achievement in developing countries.

Equation (4): ICT and Income Index

1. The P-value of the F-statistic was 0.00428; this means that the model is statistically significant, with R-squared value of 0.2380. The R-squared value is very small, which indicates that this model explains only 24 percent, of the variation in income index levels. However, this initial result supports the hypothesis that the ICT is important determinant of income index in GCC countries.

2. As we can see, the coefficient of ICT access is positive, with significant level at 5% which reveals that one percentage increase in ICT access index would increase II by 0.0754 percentage points. This result confirms the hypnotized impact of ICT infrastructure and individual's access to basic ICTs on GNI per capita and match the potential relation as discussed in the literature review, especially in the line of Bollou (2010) Bankole (2009), Gholami and et al. (2010), Castells (1996), Morawczynski and Ngwenyama (2007), Kumar and Welsum (2013), Jorgenson et al. (2008), and Nour (2008).

For example, Jorgenson et al. (2008), found that ICTs had contributed as much as 59% of productivity growth within the United States as a whole during the second half of the 1990s. ICTs were always seen as catalyst for broader economic impacts; ICTs are synergetic technologies and their growth therefore leads to growth in other sectors of the economy (Hamelink, 1999).

Furthermore, R. J. Saunders et al. (1994) argued that telecommunications could contribute to economic development in various ways: better market information, improved transport efficiency, more distributed economic development, reduction of isolation, increase in security and increased connectivity with international economic activity. Finally, the World Bank (2009) reported a 1.8% increase in economic growth for every 10% increase in broadband penetration in developing countries.

In GCC, Nour (2008) noticed that spending on ICT as percentage to GDP shows a positive significant correlation with GDP. According to

AlKaabi (2014) ICTs has become a huge segment of the service sector in the GCC countries because these advance technologies have become an essential part in the development of high quality services including education and health care, which are powerful tools for development. ICT today plays a key transformation role in telecommunications, oil and gas, construction, healthcare, and public institutions. Benefiting from the oil prices boom, huge financial resources have been allocated in the region to diversify from oil-based economies to knowledge-based economies to address the dangers of potential depletion of oil and gas reserves during the next two decades.

For instant, more than 400 major IT and telecom projects have been released between 2009 and 2010, which led to critical economic and social transformation in these countries by improving access to services, enhancing connectivity, creating business and employment opportunities, and changing the ways people communicate, interact, and engage among themselves and with their governments.

One of the most dynamic initiative in the GCC to become ICT-enhanced economies, was creating ICT parks for both international and national companies. Also the IT services industry is predicted to grow by 8.64 per cent until 2019, which would value the industry at $7.9 billion by the end of the decade.

We can already see value added services and consultation becoming more important to the public and private sector in the GCC, while E-Commerce in the region is still in the initial stage, but it is forecast to grow at over 20% annually in the next 5 years (Sudairy, 2010).

3. There is a negative and significant relationship between ICT use and income index. In fact, this surprising result can be explained in various manners. The negative sign of the coefficient could be due to the fluctuation in oil prices that affect the trend of GNI and hide the actual effect of ICT-use on it.

Another reason, could be due to the “dark side of ICT”, according to C. Saunders (2007) impacts of ICT are not always positive, since the introducing of ICT services could cause a digital inequality throughout the marginalized groups of less educated and those who do not have access to ICT, this can occur, for example, if ICT accelerates the automation processes that substitute capital for labor, especially unskilled labor. Such considerations would then suggest that developing countries should be cautious about investing in ICT.

Another important reasons maybe related to early stage of the intensity of use that have been achieved by the GCC, according to the analysis by Kumar and Welsum (2013), GCC countries rapidly investing in ICT infrastructure in a way that may overreach relative to their capabilities to use and benefit from the new technologies.

The GCC countries have made great strides in building physical ICT infrastructures. However, they face challenges in developing a balanced knowledge economy ecosystem that includes a skilled labor force and a suitable institutional and policy environment, especially for fostering entrepreneurship.

According to Iammarino and Jona-Lasinio (2013) ICT production and ICT adoption should be seen as complementary forces influencing productivity and that the degree of interdependence and relatedness of knowledge generation and diffusion, and of competences and capabilities across industrial and technological structures, are all critical factors underlying productivity trends.

Therefore, the Gulf countries need to upgrade skill levels and motivate development of local technologies to narrow the technological gap and enhance economic development in the region. The upskilling of workers through enhancing the system of education and training will encourage R&D activities and the adoption of appropriate foreign technologies and so motivate both the development of local technologies and the bridging of the technological gap (Nour, 2013).

4. Finally, with respect to control variables, the relation between education index and income index is positive but not significant. For health index, the result shows a negative and significant impact on the income index with coefficient 0.1046 at 5% level of significance. This insignificancy of education effect and the negative sign of health index may due to limited number of record or due to other factors than those used in the study; i.e. oil prices, since these results contradict with the main stream theories and literatures.

CONCLUSION

This study adds to the existing body of research on human development by providing evidence of how HDI and its key components are affected by ICT variables, especially confirming considerable effects of ICTs on improving the level of human development in GCC countries.

In general, the findings of the study are mostly consistent with those of other scholars such Bankole (2009), Gholami and et al. (2010), Monsef et al. (2011), Morawczynski and Ngwenyama (2007), S. Kaur (2015), Kim et al. (2008), Nour (2008), Fong (2009), and Farhadi and et al. (2013). However, the findings provide a better explanation than those has been provided by previous studies, since most of them have examined how economic development was impacted by the individual components of ICT investments such as hardware, software telecommunications and internal service (Bankole et al., 2011; Kim et al., 2008).

Only a few studies used ICT Development index, especially the level of ICT-access and ICT-use, which extend beyond the narrow concept of ICT investment. Furthermore, as we have seen in the literature review, there is some limitations of traditional perspective of development that focus on GDP only, so this study drawn from the notion of human development as defined by UNDP to look at the three dimensions of development; standard of living, health, and education.

We learned from the finding that the assumption about a positive relationship between ICT and human development do not simply hold. The impact of ICT on human development and its dimensions may not necessarily be positive; they may in fact be negative or insignificant according to the development situation of the countries and their interaction factors.

This explains the paradoxical results of previous studies on the impact of ICT on development in general. Impacts of ICT isn't straightforward and direct, usually there is a clear complexity associated with ICT implementation in the context of development, which reflect the need to take into consideration the interaction effect of ICT dimensions and other complementarities of investments in other sectors that are prerequisites for the successful ICT strategies and policies.

As we note from the descriptive statistics, GCC region spent a vast amount of financial resources, in the last decade, to develop their ICT infrastructure; and they achieved a considerable rank compared with other developing countries. However, they are far from the effective utilization of these technologies in socioeconomic development. The week experience available in the region, the mismatch between needed infrastructure and the actually available, the unskilled human capital, the weakness of educational system, and less public awareness about the importance of the ICT role in socioeconomic development, all these reasons hinder the effective implementation of the policies needed to achieve adequate growth (Al-Maliki, 2013).

Furthermore, the GCC countries failed to exploit the ICT in developing human capital and entrepreneurship, ICT is used widely by public institutions and individuals, however, there is a limited use of these technologies in business sectors which lead to hindering their potential value. Furthermore, the percentage of investment in ICT infrastructure exceeds the capacity of these countries to use and benefit (Kumar & Welsum, 2013).

This could explain the week impact of ICT-use on the human development indicators, since the GCC was able to achieve progress in providing the ICT tools, but they still need the ability to adapt these tools in optimal way to achieve their economic and social objectives especially the improving their Human Development Indicators.

Therefore, a summary conclusion from this study, and even from several literatures surveyed, is that ICTs as tool alone cannot improve human development; unless it occurs within broader context and multidimensional strategy aim to enhance the people's abilities to make the most use of these tools and techniques (Gasco-Hernandez, Equiza-Lopez, & Acevedo, 2006), "It is not enough to provide access to the technology, but the most adaptable and supported tools that are valued by the users" (Hameed, 2008).

Hence, ICTs effectively impact human development, to the extent that they become

tools for generating useful knowledge and contributing to the transformation of our reality (Gomez & Casadiego, 2002). Therefore, a paradigm shift is needed to alter the prevailing ICT strategies that focus on deploying technology to focusing on the interaction effect of ICT development indices and other complimentary variables that are prerequisites for the successful ICT strategies and policies.

It is necessary to overcome several obstacles such as physical access, access sustainability, access to basic literacy, linguistic localization, technological ownership, empowerment and social innovation that are the key to success in obtaining a positive societal impact (Pimienta, 2011).

RECOMMENDATIONS

Policy attention in GCC countries should focuses on correcting the imbalance in knowledge economy ecosystem.

Firstly, by improving the adequate numbers of skilled labor force to meet the anticipated growth in ICT -use, this could be attained through reforming the educational system, developing effective ICT training programs and policies, developing the education output to cater for the skills and competencies required by the market, and providing incentives to the private sector to invest more in R&D and build the human capital of GCC by producing national knowledge workers (Tadros, 2015).

Secondly, including a suitable institutional and policy environment that encourages competition, especially for fostering entrepreneurship and allowing more private firms to enter the ICT market. These policies will improve the financial markets and facilitate further investment in ICT. Furthermore, increasing the competition will enhance not only the accessibility of ICT services, but also the affordability of these services by lowering their prices.

Thirdly, GCC countries should focus on broadening the ICT tools among public through e-applications that are beneficial for economic, social and administrative aspect like e-government, e-health and e-education, this will motivate the demand side of the market and leverage the use of ICT technologies and raising the public's awareness of the importance of ICT to the county's prosperity (Kumar & Welsum, 2013).

Additionally, there is a need to increase the role of the GCC states as "producers" and not only "consumers" of knowledge and ICT technologies, GCC should encourage and facilitate the establishment of R&D networks linking ICT production and use to priority development issues. Also, there is a need to customize ICTs for more effective use, by considering demographic, social, cultural, linguistic, and gender aspects.

Finally, ICT efforts should be tailored to the various needs of a broad cross-section of the population in GCC countries, where successful ICT strategy to ensure the participation of larger segments of the population in the information society (Tadros, 2015).

This requires an innovative assessment and selection of ICT social applications which oriented toward strengthening the provision of public services and environmental protection. These applications can contribute to the improvement of the social and economic conditions (Mansell, 1999), however, financing of such initiatives is likely to be more difficult to justify than it is for ICT production oriented activities or for ICT applications that respond to the business need, this is because the benefits are more difficult to demonstrate in the short term.

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