Spring 4-9-2014

The Role Of Information And Communications Technologies On The Development Of Knowledge Economy: Research-In-Progress

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Abstract

This research-in-progress study illustrates and assesses the role of information and communications technologies (ICT) on knowledge economy and its main pillars. According to the World Bank, the main pillars of knowledge economy are: (1) economic and institutional regimes, (2) education and human resources, (3) information and communications technologies, and (4) innovation systems. ICT plays a major role on the development of knowledge economy and its main pillars. Based on simple correlation analysis of 2012 knowledge economy indices of 145 countries worldwide and several worldwide examples, this paper illustrates the role of ICT on the development of knowledge economy and its pillars. These findings can assist less-developed countries in further developing their knowledge economy.

Keywords: Knowledge Economy, Knowledge-based economy, ICT, Information and Communications Technologies.

1. Introduction

In the Knowledge Age, knowledge empowers individuals and organisations, as well as national economies. A knowledge economy (KE) is defined as the "production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence" (Powell and Snellman, 2004, p. 199). What differentiates knowledge economy from traditional economies is that the former rely upon intellectual capabilities more often than upon physical inputs or natural resources. Furthermore, a knowledge economy involves a workforce dominated by knowledge workers, who work with their brains instead of their hands (*Encyclopedia of the New Economy*, 2000). Governments, organisations, and individuals that manage and harness knowledge most likely improve their operational and innovative performance and, consequently, achieve competitive advantages.

According to the World Bank, the four pillars of a knowledge economy are: (1) economic and institutional regimes, (2) education and human resources, (3) information and communications technologies (ICT), and (4) innovation systems. These pillars are prerequisites for the effective use of knowledge for economic growth. Sweden, Finland, Denmark, the Netherlands, Norway, New Zealand, Canada, Germany, Australia, and Switzerland, in that order, currently lead the knowledge economy index (KEI) of 146 countries (World Bank, 2012).

This study aims to assess and illustrate the role of ICT on the development on knowledge economy and its pillars. Thus far, several studies have theoretically illustrated the role of ICT on the development of knowledge-based economy as indicated earlier (Al-Obaidy, 2010; Ghosh and Ghosh, 2009; Kamiñska, 2009; Kim, 2008; Tripathi, 2006, Wilson and Segal, 2005).

2.0 Role of ICT on KE and its Pillars

2.1 ICT and KE

Information and communications technologies (ICT) can provide significant support for the development of diversified and knowledge-based economy as well as for its three pillars: economic and institutional regimes, education and skills, and innovation systems. ICT are the backbone of any knowledge-based economy and, as such, are imperative for the development of a knowledge-based economy.

According to the World Bank, ICT is one of four main pillars of any knowledge-based economy, and the organisation formulates the ICT index based on telephones, computers, and Internet users. Moreover, a dynamic information infrastructure is needed to facilitate effective communication and both the dissemination and processing of information and knowledge. Thus far, several international reports have highlighted the power of knowledge for national economy. For example, the 1998 World Bank report titled "Knowledge for Development" and the 2003 World Bank Technical Cooperation Program brief on the Gulf Cooperation Council underscore the continual need of developing countries to take advantage of new technologies in order

to acquire and disseminate knowledge, as well as for ongoing interactive collaboration and cultivating human resources.

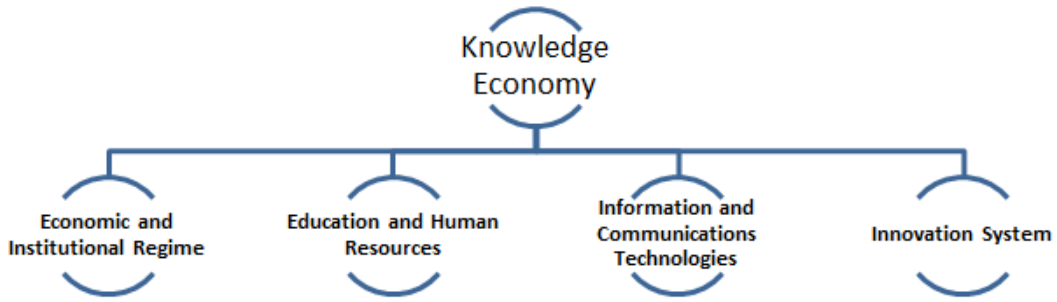

Figure 1. The Main Pillars of a Knowledge Economy (the World Bank).

2.2 ICT and Economic and Institutional Regimes

ICT can significantly contribute to a country's economic and institutional regimes, which must provide incentives for the efficient use of existing knowledge, the acquisition of new knowledge, and the application of both to economic activity. Knowledge-intensive business services and products (e.g., consulting and design) are major contributors to the GDP of developed countries in North America and Western Europe. In these countries, ICT have proven essential to the effective and efficient development and distribution of such digitisable products and services. Even for firms with physical products, information technologies can add great value, for any firm can use information technologies to improve its business operations according to different functions. E-commerce, for example, enables organisations to reach the global market and, consequently, to increase sales.

In North America and Western Europe, the ICT industry is crucial to national economies and is also crucial in several Asian countries, including Malaysia, South Korea, and Singapore (Aubert and Reiffers, 2003). For instance, according to Bank of Korea, the contributions of the information technology (IT) industry to South Korea's GDP was estimated to have increased from 7.7% in 1997 to 12.0% in 2003 (Kim, 2008). In 2007, Singapore was the best performer in global IT rankings and outpaced the U.S. as the long-time leader. In 2012 rankings for the same, Singapore was ranked second after Sweden according to the World Economic Forum (Dutta and Bilbao–Osorio, 2012). In the Middle East, Bahrain—the region's smallest country—

significantly furthered its knowledge economy via ICT development (Al-Obaidy, 2010).

2.2 ICT and Education and Human Resources

ICT can also play a major role in developing education and skills, which together form a major pillar of any knowledge economy. The country's people need education and skills that enable them to create, share and use knowledge. Using ICT improves the effectiveness and efficiency of both national and organisational efforts to manage knowledge and to cultivate human resources. For instance, Malaysia developed an ICT program that successfully drove growth in human resources and bridged the digital gap. This program includes constructing ICT centres (40 IT community centres for 1.2 million people) throughout the country, as well as investments in education and human resources (Aubert and Reiffers, 2003). Traditional learning entities (e.g., physical schools and universities) in any given nation may not have the capacity to enable cultivating human resources. Thus, ICT tools, including learning management systems and e-learning, enable governments to grow education capacities and the reach of education. The continuous availability of online learning and training programs to everyone enables individuals to tailor their learning to their needs. Online academic programs and virtual universities have lately formed a trend, while worldwide the e-learning market has grown. The global market for self-paced e-learning reached USD $27.1 billion in 2009 according to a new report by Ambient Insight Research (2011). Meanwhile, demand for such e-learning grows by a five-year compound annual growth rate (CAGR) of 12.8%, and revenues will reach $49.6 billion by 2014. The U.S. market for self-paced e-learning products and services reached $18.2 billion in 2010, while its demand grows by a five-year CAGR of 5.9%, the revenues of which will reach $24.2 billion by 2015.

2.4 ICT and Innovation System

ICT also can play a major role in innovation. IT markets, including both hardware and software, are ripe for innovation and the production of new innovative products. The top 10 global companies ranked in 2010 by U.S. patents are electronics and IT companies: IBM, Samsung, Microsoft, Canon, Panasonic, Toshiba, Sony, Intel, LG, and Hewlett-Packard (Pentland, 2011). Moreover, ICT provides significant support

for innovation as well as research and development for businesses, governments, and scientific and social fields.

3.0 Analysis and Findings

3.1 Data and Analysis

This study's analysis uses 2012 World Bank data regarding the KEI and its pillars' indices for 146 countries worldwide (only 145 countries have complete information). According to the World Bank, KEI is measured by the average of its pillars indices, the ICT pillar of which is measured by telephones, computers, and Internet users. For other indices, the pillar of education and human resources is measured by average years of schooling as well as secondary and tertiary enrolment; economic incentive and institutional regime is measured by tariff and nontariff barriers, regulatory quality, and rule of law; and the innovation systems pillar is measured by royalty and licensing fee payments and receipts, patent applications granted by the U.S. patent and trademark office, and quantity of scientific and technical journal articles. Data analysis used Microsoft Excel software.

3.2 Results

Figure 2 shows the correlation analysis among the ICT index and each of the following: the KEI, the economic and institutional regime pillar index, the education and skills pillar index, and innovation systems pillar index. Figure 2 shows significant correlations between ICT and knowledge economy (0.951), innovation systems (0.896), education and human resources (0.861), and economic and institutional regimes (0.791).

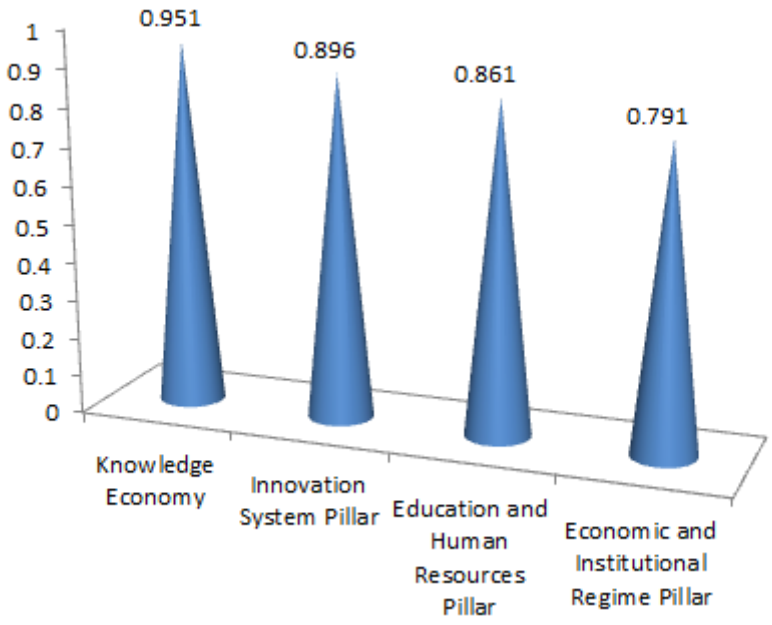

Figure 2. Correlations of Information and Communications Technologies and Knowledge Economies and Their Pillars.

4. Discussion and Conclusion

International organisations and local governments have emphasised that the ICT sector is imperative for knowledge economy transformation. ICT can play a major role in the development of economic and institutional regimes, education and skills, innovation, and the overall knowledge economy. In identifying the role of ICT on knowledge economy development and its pillars, this study also identifies some best practices of ICT use for knowledge economy development.

Based on a simple correlation analysis of 2012 data of knowledge economy indices, this study empirically shows a significant link among ICT, knowledge economy and its pillars. These results provide insights into less developed nations that can empower themselves with ICT, including e-learning and mobile learning, both of which extend their capacities in education and building human resources. To improve innovation in any domain, other kinds of ICT such as groupware, knowledge management systems, and business intelligence technologies can be used. Furthermore, the ICT sector and industry in any nation, if developed well and invested into, can be a source of innovation and contribute greatly to national GDP, as exemplified in the U.S., Singapore, and South Korea.

This study also aims to specify a comprehensive list of significant ICT indicators on the development of the knowledge economy and each of its pillars (i.e., education, innovation, and economic). Thus, this study seeks first to conduct more advanced detailed econometric longitudinal analysis of World Bank data in recent years to analyse the role of ICT and its indicators on development of knowledge economy and its pillars. Based on World Bank data, ICT is currently assessed by indicators related to telephones, computers, and Internet penetration, which suggests that detailed analysis is needed to identify which one of these indicators is critical to education and innovation, among others, or which of these ICT indicators is critical to each pillar's indicators. For instance, it is unclear how telephones, computers, and Internet penetration are critical to an innovation pillar indicator such as journal article publications.

Second, current World Bank ICT indicators are quite limited. Other organisations, including the Organisation for Economic Co-operation and Development (OECD) and Asia-Pacific Economic Cooperation (APEC), have developed different, more detailed key ICT indicators. For instance, the OECD listed 15 indicators to assess ICT (OECD, 2014). Furthermore, World Bank indicators do not cover the most recent ICT indicators such as mobile penetration and different types of social media penetration. Thus, to keep pace with current ICT development, a more comprehensive literature review is needed to develop a comprehensive and updated list of critical ICT indicators to the development of knowledge economy. Moreover, further quantitative analysis is needed to assess the significance of these comprehensive ICT indicators on the development of knowledge economy and its pillars. Some studies, such as Chen's (2008), even call for new pillars to assess knowledge economy.

Finally, reviewing the best practices and lessons learned will provide richer, more extensive information about the role of ICT on the development of knowledge economy. Some successful practices in small and/or developing countries can also provide good insights for other developing countries. Some studies, including Al-Obaidy's (2010) in Bahrain, Ghosh and Ghosh's (2009) and Tripathi's (2006) in India, Kamiñska's (2009) in Poland, Kim's (2008) in South Korea, Wilson and Segal's (2005) in China, Wong's (2008) in Singapore, and Shapira et al.'s (2006) in Malaysia, have illustrated theoretically or through case studies the role of ICT on the

development of knowledge economy. A systematic evaluation of these practices can also provide insights into using ICT in order to leverage knowledge economy and its pillars. These best practices can be a useful for developing countries.

The above proposed studies can also critically contribute to researchers and practitioners alike, as there are limited empirical quantitative studies. For any study on the topic, regional perspective is also a top priority.

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