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Knowledge-Based Economies and Basing Economies on Knowledge

Skills a Missing Link in GCC Countries

Krishna B. Kumar, Desiree van Welsum

The research described in this report was conducted in RAND's Justice, Infrastructure, and Environment and Labor and Population units with collaboration with the RAND-Qatar Policy Institute and the RAND Center for Middle East Public Policy, a center within RAND's International Programs.

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Preface and Summary

While an Information and Communication Technology (ICT) infrastructure is a crucial ingredient of a knowledge-based economy (KBE), a skilled labor force (human capital) and a supportive institutional and business environment are equally important ingredients to facilitate the appropriate use of knowledge for an economy's level of development to increase productivity in all its activities. While skills, education, and training are given their own importance in many countries, these factors are not given as much attention as technologies in discussions of the knowledge economy. Without sufficient human capital and the appropriate policies in place to take advantage of adopted technologies, their potential is unlikely to be realized. In this paper, we adopt a cross-country perspective to assess the progress of the Gulf Cooperation Council (GCC) countries on various dimensions of a knowledge economy, using indicators and sub-indicators developed by various organizations. We find that the GCC countries have performed well in providing a physical ICT infrastructure, but need to focus more on human capital and the business environment in order to foster the balanced development of their knowledge economies.

This work is a collaborative outcome of multiple research units. RAND's Justice, Infrastructure, and Environment and Labor and Population units provided research support. The RAND-Qatar Policy Institute (RQPI) provided travel support, and the RAND Center for Middle East Public Policy, a center within RAND's International Programs, provided publication support.

RAND Justice, Infrastructure, and Environment provides insights and solutions to public- and private-sector decisionmakers across numerous domains, including criminal and civil justice; public safety; environmental and natural resources policy; energy, transportation, communications, and other infrastructure; and homeland security. The work of RAND Labor and Population has focused on labor markets, social welfare policy, demographic behavior, aging issues, retirement, and international development with the common aim toward understanding why people make the decisions they do and how markets, society, and policy affect them. Research projects at RQPI, a collaboration between the RAND Corporation and Qatar Foundation, have spanned education, health care, energy, security, and many other topics. The RAND Center for Middle East Public Policy (CMEPP) provides expertise on the Middle East. CMEPP analysts are in touch with political, social, economic, and technological developments in and around the region.

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Unfortunately, Tora Bikson passed away before she could see this report published. We dedicate this report to her memory.

Abbreviations

FTTH	fibre-to-the-home
GCC	Gulf Cooperation Council
GNI	gross national income
ICT	Information and Communication Technology
IDI	ICT Development Index
IPB	ICT Price Basket
ITU	International Telecommunication Union
KAM	Knowledge Assessment Methodology
KBE	knowledge-based economy
KEI	Knowledge Economy Index
NRI	Networked Readiness Index
OECD	Organisation for Economic Cooperation and Development
PC	personal computer
R&D	research and development
TFP	total factor productivity
WEF	World Economic Forum

CHAPTER ONE

Introduction

The phrase *knowledge economy* is used in several ways in policy and popular discussions. For the purposes of this report, we first recognize knowledge as ". . . collected human expertise within a particular domain . . ." (Collins, 2007). It is neither raw data nor information, which can be viewed as processed data. We then follow the World Bank's definition that an economy becomes knowledge-based when the sustained use and creation of knowledge are at the center of its economic development process (Chen and Dahlman, 2005). In a knowledge-based economy (KBE), knowledge is the basis for decisions made by individuals, businesses, and the government.

The strand of endogenous growth theory going back to Lucas (1988) and Romer (1990) recognized knowledge as a fundamental engine of economic growth and development. According to Lucas (1988), increases in the stock of "human capital"—that is, the ever-increasing quality and innovative capability of the labor force—are the primary engine of economic growth. According to Romer (1990), the ever-increasing stock of technology (captured in his model by the variety of intermediate goods used in production) is the engine of growth. Though the models are intended to isolate the effects of human capital and technology, in reality knowledge is likely to be embodied in both technologies and people; for example, a computer that represents the latest technology can be exploited more productively if the person who uses it has a higher skill level. Technology and skills, therefore, are complements in the production of knowledge-based output. In a macroeconomic sense, knowledge has been associated with Total Factor Productivity (TFP). TFP growth represents an increase in the productivity of all factors of production, such as capital and labor. The extent of complementarity between people and the technologies they use continues to be an active area of theoretical and empirical research.[1]

Policy debates on knowledge economy place differing emphasis on technology and human capital. While skills, education, and training are given their own importance in many countries, these factors are not given as much attention as technologies in discussions of knowledge economy.[2] If a country has a sophisticated Information and Communication Technology (ICT) infrastructure but insufficient human capital to use it to generate value, it is not using its resources efficiently. Moreover, new technologies take time to learn, and rapidly adopting technologies without giving the labor force the chance to absorb them prevents the full potential of the technologies from being realized. In this sense, the debate on the appropriateness

[1] See Chanda and Farkas (2010) for a recent example and the references therein for an evolution of this literature.

[2] See, for instance, European Commission (2010), which focuses on e-skills or ICT literacy rather than human capital and value generation. Also see "ICT Can Make India a Knowledge Economy," 2009, which points to the importance of using ICT to disseminate knowledge rather than using skills with ICT to generate knowledge.

of technology in economic development (see, for instance, Basu and Weil, 1998) also has relevance to the knowledge economy.[3]

In this paper, we evaluate the Gulf Cooperation Council (GCC) countries on both their ICT development and the complementary factors that comprise the knowledge economy. The term *ecosystem*, often used to refer to an entire system of policies, institutions, and organizations that must be in place for success to be achieved, appears to have particular relevance for the knowledge economy. Therefore, in addition to evaluating the GCC countries on physical ICT infrastructure, we assess their standing in the areas of education and innovation, as well as their environment for business formation (entrepreneurship). We adopt a cross-country perspective to assess knowledge economy performance, as this will allow the GCC countries to learn lessons from the experience of other countries.

In particular, we have used a variety of indicators, such as the International Telecommunication Union's (ITU's) *ICT Development Index* (IDI), the World Bank's *Knowledge Economy Index* (KEI), the *Networked Readiness Index* (NRI) developed by INSEAD and the World Economic Forum (WEF), and the Word Bank's *Doing Business* indicators, all of which rank countries on dimensions of the knowledge economy that go beyond the ICT infrastructure. We then compare the overall ranking of GCC countries according to these indicators with their rankings in the categories comprising these indices. The closer these rankings are, the more balanced a country is in overall knowledge-economy development. We also examine a few macroeconomic indicators to study the extent of knowledge-based value addition in a few of the GCC economies. Clearly, detailed sector-level data from these countries are needed to draw definitive conclusions, but our aim in this paper is only to draw attention to a phenomenon we think is worth studying in more detail in the future.

Our analysis of existing indicators reveals that all GCC countries have a well-established ICT infrastructure. However, the analysis indicates that there is room for improvement among the other factors that comprise the knowledge economy, such as human capital and entrepreneurship. ICT is used extensively by individuals and the government, but business ICT usage and, consequently, the value added by business to the economy lag. A government can develop a solid ICT infrastructure and build knowledge clusters directly by mobilizing resources. However, it is much harder to develop broad-based human capital that can exploit this infrastructure and institute a business-friendly environment to encourage entrepreneurship and innovation. The government must institute appropriate economic incentives and policies to encourage these activities by individuals and firms in a decentralized fashion. In addition to ensuring a world-class ICT infrastructure, the GCC countries should increase their focus on the complementary factors necessary to take full advantage of this infrastructure.

The need for balanced development of the knowledge economy is not only intuitive, given the complementary nature of the multiple inputs used in producing goods and services, but also seems to have promoted the success of other countries' knowledge economies. South Korea provides a classic example of a country that has developed all facets of its knowledge economy in a way that is appropriate to its stage of development (World Bank, 2000). Malaysia (2004) and Ireland (2004) are also examples of countries that achieved success by following this approach.

[3] As we note in Chapter Three, inappropriate technology could even hurt productivity.

In Chapter Two of this report, we present a simple framework of the various constituents of the knowledge economy. In Chapter Three, we assess the performance of GCC countries in these areas in a cross-country context based on the above-mentioned indicators, so as to draw lessons for the GCC countries. In Chapter Four, we discuss policy implications for GCC countries.

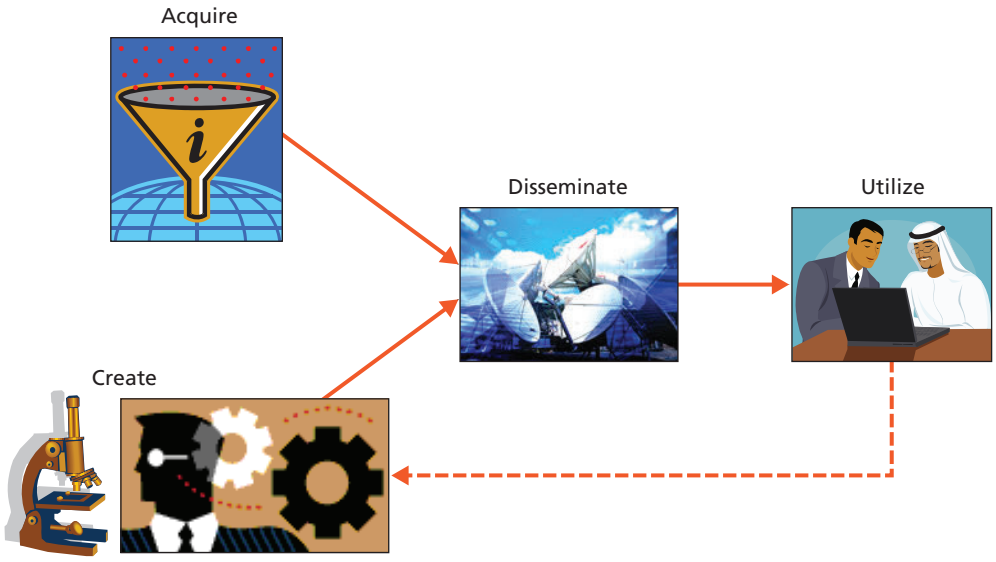
CHAPTER TWO

A Framework for a Knowledge-Based Economy

In this chapter, we present an overview of a KBE, with a focus on its various constituents. We first start with a description of the pathways of knowledge in an economy. As depicted in Figure 2.1, a knowledge economy involves the creation, acquisition, dissemination, and utilization of knowledge.

Knowledge can be created in an economy through research and development (R&D), education, and learning on the job. R&D primarily increases the quality of machines, or physical capital, while education primarily increases the quality of labor, or human capital. Knowledge is also generated through the interaction of these two types of capital, such as when a worker uses a computer, which can be an example of learning on the job. While nearly all countries develop their own human capital, few conduct the level of fundamental or disruptive R&D necessary to create new technologies.[1] Instead, most countries mainly acquire knowl-

Figure 2.1
Pathways of Knowledge



SOURCE: Authors' conceptualization.

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[1] In 2007, 95 percent of R&D was conducted in North America, Europe, and Asia-Pacific, with other regions accounting only for 5 percent (National Science Board, 2010). It must be noted, however, that transnational corporations are increasingly conducting R&D in developing countries (see, for instance, United Nations, 2005, Table IV.1, p. 120).

edge by importing or licensing technologies developed elsewhere,[2] and their R&D is often aimed at adapting existing technologies and products to the local market.

Dissemination involves the sharing of knowledge, typically via ICT, but also through channels other than physical infrastructure inside various organizations.[3] The disseminated knowledge is then utilized in decisionmaking by firms and individuals.[4] Utilization can also be expanded to include consumption (for example, using the Internet to read the news) or active value addition (such as using the Internet to sell products), a distinction that is important to our subsequent discussions.[5]

Another approach to understanding knowledge is by examining where it is embodied. We have already discussed its embodiment in people (human capital) and machines and technologies (physical capital). Additionally, knowledge can be embodied in firms (technology adoption and creation via R&D and learning, and reputational capital such as brands), universities (fundamental research), think tanks and applied research institutes (applied research), and the government (processes related to governance and regulation), which we collectively call *organizational capital*.[6] While it is true that the output of these organizations increases the physical and human capital of the economy at large, these organizations also have knowledge on the production of these outputs embodied within them. Knowledge is also embodied in the interactions among the various entities of an economy—individuals, firms, and the government—which we collectively refer to as *social capital*.[7] This concept captures the level of trust between individual entities at the micro level and policies and institutions, such as rules, regulations, and governance, at the macro level. These different types of capital can, in turn, be combined to produce new knowledge. Recent developments have given rise to the conceptualization of *socio-technical capital* to capture technology-mediated social relations (Resnick, 2002).

The World Bank, as part of its Knowledge for Development initiative, developed a Knowledge Assessment Methodology (KAM) framework. In particular, it identified four pillars that elegantly combine the different types of capital mentioned above with the innovation process to offer another way of viewing the knowledge economy (Chen and Dahlman, 2005). The four pillars are: Economic Incentive and Institutional Regime (policies and institutions for the protection of intellectual property, the rule of law, the ease of starting a business, etc.), Education (human capital), Innovation (universities, firms, and research institutes, similar to organizational capital), and ICT (physical capital). A particularly useful feature of the assessment methodology devised by the World Bank is the KEI, which combines performance in each of

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2 See Keller (1996) for an example.

3 It is often argued that the willingness to share information is one of the success factors of Silicon Valley, with people working there effectively sharing information by changing companies and exchanging ideas informally. For example, Saxenian (1990) identified the interaction of employees as key to the emergence of Silicon Valley and Boston's Route 128 as major innovation clusters. See Cummings (2003) and the references therein for more information on the importance of sharing knowledge.

4 Knowledge utilization is not limited to decisionmaking. The process of utilization can lead to further knowledge creation through improvements to existing products and processes (innovation) or can form the basis for new knowledge. This feedback process is shown as the dashed arrow in Figure 2.1; we do not focus on this feedback in this paper.

5 The four actions mentioned here follow closely the "knowledge actions" in Malaysia (2004, p. 10).

6 See Black and Lynch (2005) for a recent reference.

7 See Sobel (2002) for a discussion and a critical perspective on social capital.

these pillars into a single index that can be compared across countries and sub-indices that can be compared within a country (World Bank, 2012b).

Next, we turn to assessing the GCC countries as knowledge economies along the various facets of a KBE that we have discussed.

CHAPTER THREE

The GCC Knowledge-Economy Landscape

The various conceptualizations of a knowledge economy discussed in Chapter Two identify human capital as an important ingredient apart from the physical and institutional structure. This highlights the importance of achieving a balance between the ICT infrastructure and human capacity to best exploit the opportunities that infrastructure offers. The INSEAD eLab Skills Pyramid (Lanvin and Fonstad, 2009) offers a three-tier view of the skills that matter most for a knowledge economy: literacy and basic skills in tier one (such as math, science, and IT literacy), occupational skills in tier two (such as programming, architecture, and e-business skills), and global knowledge economy talents in tier three (such as virtual team management skills, innovation, and digital entrepreneurship). The data presented in this chapter show that in most GCC countries this balance is not yet in place because the focus on ICT infrastructure is not accompanied by sufficient development of knowledge, skills, and other factors that foster a knowledge economy, including innovation, increased competition, and reduced barriers to entrepreneurship.[1] In this chapter, we present and discuss data—on the physical infrastructure, human capital, and the human capital–ICT interface. In Chapter Four we discuss the implications of this analysis for policy.

The Physical Infrastructure

We assess the physical ICT infrastructure in GCC countries by first using telecommunications data from the ITU and then using the indices and sub-indices on ICT development generated by the ITU.

Basic ICT Infrastructure

We begin by examining the basic telecommunications infrastructure indicators (part of the physical capital discussed in Chapter Two) in Tables 3.1 and 3.2. In these and most other tables in this report, we present, in addition to the GCC countries, information for a comparison group of countries, including Finland, France, Ireland, South Korea, Malaysia, the United Kingdom, and the United States, all of which have been successful in various ways at

[1] When looking at the data presented in this chapter, it is important to bear in mind that GCC countries are characterized by two particularities that distinguish them from the benchmark countries, and it is not always obvious to know if and how these characteristics have been taken into account in the construction of the indices we present: (1) GCC countries tend to display significant income inequalities, and (2) they tend to have a relatively large expatriate population (which means that using either the total population or national population as a reference population in any per capita statistics will provide significantly different results).

Table 3.1
Basic Telecommunications Infrastructure Indicators: Fixed and Mobile Penetration Rates (per 100 inhabitants)

Country	Fixed Line	Mobile Cell	Fixed Internet	Fixed Broadband	Mobile Broadband*
Bahrain	18.1	124.2	5.4	5.4	21.3
Finland	23.3	156.4	26.8	28.6	78.1
France	56.1	99.7	34.7	34.0	35.8
India	2.9	61.4	1.5	0.9	0.9
Ireland	46.5	105.2	24.0	21.1	47.3
Korea (Rep. of)	59.2	105.4	35.7	35.7	91.0
Kuwait	20.7	160.8	12.5	1.7	
Malaysia	16.1	121.3	20.0	7.3	27.2
Oman	10.2	165.5	2.7	1.6	10.7
Qatar	16.9	132.4	8.6	8.2	28.4
Saudi Arabia	15.2	187.9	6.9	5.5	57.8
United Arab Emirates	19.7	145.5	18.3	10.5	58.4
United Kingdom	53.7	130.2	33.1	31.6	56.0
United States	48.7	89.9	28.7	27.6	54.0
Yemen	4.3	46.1	2.4	0.3	0.0

SOURCE: ITU World Telecommunication/ICT Indicators Database.

NOTE: All estimates are for 2010, except fixed Internet for Finland (2004), Kuwait (2005), and Malaysia (2009).

* Wireless Intelligence, active mobile broadband subscriptions per 100 inhabitants.

becoming KBEs. Even though India has not had the same level of success (as evidenced by the information presented), we include it as well because of its success in information technology and business processing services, such as software development and support and call centers. The GCC countries are shaded in the tables. Adopting a cross-country perspective allows us to benchmark GCC performance, as well as discuss lessons learned from other countries.

In Table 3.1, we focus on fixed (wired) and mobile penetration (phone and Internet).[2] Among the GCC states, Yemen is an outlier with significantly lower penetration rates of all ICTs. Fixed-line penetration rates in GCC countries are relatively low in comparison to some of the Organisation of Economic Cooperation and Development (OECD) countries included in the table, ranging from 10.2 percent in Oman to 20.7 percent in Kuwait. Most of the OECD countries (except for Finland, which is a world leader in mobile phone infrastructure) have a penetration rate of around 50 percent or higher. At the same time, mobile cellular penetration rates in GCC countries tend to be much higher than in most OECD countries listed

[2] Over time, the distinction between fixed and mobile infrastructure will become less relevant. Indeed, in most countries that initially focused on rolling out fixed infrastructure, fixed-line penetration rates are declining while mobile penetration rates are increasing. In addition, mobility offers added benefits that are likely to further increase the impacts and benefits of the use of ICTs. Wireless infrastructure offers mobility; associates devices with people, not places; and appears to fundamentally change what ICT is capable of providing to innovators and users.

in the table, ranging from 124.2 percent in Bahrain to 187.9 percent in Saudi Arabia, which is understandable given that the most common example of technological leapfrogging has been for countries with only a basic wired telephone infrastructure to skip the expansion phase and transition directly to mobile telephony.[3]

While their fixed Internet and fixed broadband penetration rates are relatively low, GCC countries have somewhat better rates for mobile broadband, with Saudi Arabia and the UAE even outpacing the UK and the United States (though they remain far below the levels observed in South Korea and Finland).

In Table 3.2, we focus on Internet and computer statistics. Among GCC countries, Internet users range from 38.3 percent of the households in Kuwait to 78 percent in the UAE. While these penetration rates are high, they remain well below the 80 percent or higher rates seen in most of the OECD countries. Relatively high proportions of households in most GCC

Table 3.2
Basic Telecommunications Infrastructure Indicators: Internet and Computer Penetration Rates (per 100 inhabitants)

Country	Internet Users	Households with Computer	Households with Internet	International Bandwidth
Bahrain	55.0	87.0	74.0	*14409*
Finland	86.9	82.0	80.5	*107267*
France	80.1	76.4	73.6	*69596*
India	7.5	*6.1*	*4.2*	5825
Ireland	69.9	76.5	71.7	*64054*
Korea (Rep. of)	83.7	81.8	96.8	11878
Kuwait	38.3			
Malaysia	55.3	*41.0*	*25.1*	11652
Oman	62.6	*45.6*	*27.7*	4901
Qatar	69.0	89.6	84.0	20190
Saudi Arabia	41.0	*57.3*	*54.4*	28252
United Arab Emirates	78.0	76.0	65.0	*34135*
United Kingdom	85.0	82.6	79.6	*132749*
United States	79.0	*75.5*	*71.6*	*36704*
Yemen	10.9	*4.0*	*2.9*	1226

SOURCE: ITU World Telecommunication/ICT Indicators Database.

NOTE: Italics indicate ITU estimates. All estimates are for 2010.

* Wireless Intelligence, active mobile broadband subscriptions per 100 inhabitants.

[3] However, very high mobile penetration rates, especially those in excess of 100 percent, can also be explained by (1) the double counting of subscribers (one person may own multiple SIM cards, e.g., for both private and professional use, or to keep costs down when mobile termination rates are very high); (2) a lack of distinguishing between active and non-active subscriptions, so that inactive accounts remain included in the data; and (3) a relatively high share of foreigners and visitors among the population (as is the case in the UAE) who may take out a subscription while in the country, leading to relatively high penetration rates.

countries have a computer, ranging from an estimated 45.6 percent in Oman, to as much as 89.6 percent in Qatar (which has the highest figure in the table). A similar picture emerges for households with Internet, ranging from 27.7 percent in Oman to 84 percent in Qatar, but Korea outperforms all other countries with 96.8 percent Internet penetration. The international bandwidth is relatively low in the GCC countries.

In summary, while the penetration rate for fixed technologies has remained relatively low in GCC countries (explained, in part, by geography, population density, and later industrialization), GCC countries have instead relied on mobile technologies to give people Internet access and, in many cases, have surpassed industrialized countries in mobile penetration. Given the broader geographical reach and relatively lower costs of mobile technologies, the GCC countries in general have achieved a high degree of *access* to these technologies. In the next section we examine what types of *use* these technologies are put to and, in particular, whether they add value to the economies of these countries.

ICT Development Index and Sub-Indices

Another way of benchmarking ICT development in GCC countries is to look at the ITU's ICT Development Index (IDI), meant to capture levels of access, use (and intensity of use), and the skills required to use ICTs effectively (see Box 3.1 for more details). Table 3.3 presents the ranking of countries on the IDI, as well as in affordability of ICTs.[4]

Four of the GCC countries—the UAE, Qatar, Bahrain, and Saudi Arabia—are ranked among the top 50 on the IDI. The UAE is the highest-ranked GCC country on both the ICT development and affordability index. ICT access has increased over time and efforts are being made to improve high-user access with, for example, fibre-to-the-home (FTTH) and high-speed broadband packages for households (though the speeds often remain lower than those offered in the top IDI countries). The UAE's General Telecommunications Policy 2006–2010 recognized the role telecommunication infrastructure can play in economic development and in enabling growth in all sectors of the economy, notably with a strategy to increase the country's attractiveness to technology companies through, for example, public sector investments in an advanced ICT infrastructure. There is also strong demand for ICT products in the UAE.

Box 3.1: The ITU's ICT Development Index (IDI)

The IDI is a composite index made up of three sub-indices (containing a total of 11 variables):

1. **Access**: captured by fixed telephony, mobile telephony, international Internet bandwidth, households with computers, and households with Internet
2. **Use**: captured by Internet users, fixed broadband, and mobile broadband
3. **Skills**: captured by adult literacy, gross secondary, and tertiary enrollment.

SOURCE: ITU, 2011.

[4] "ITU's ICT Price Basket (IPB) is a composite affordability measure based on three sub-baskets—fixed telephone, mobile cellular and fixed broadband Internet services—and computed as a percentage of average Gross National Income (GNI) per capita. As a comprehensive benchmarking tool, the IPB monitors the relative price of ICT services and provides an indication of how affordable services are across countries, and over time" (ITU, 2011b).

Table 3.3
The ITU's ICT Development and "Affordability" Rankings

Country	IDI Rank 2010	IDI Value 2010	ICT "Affordability"* Rank	ICT "Affordability"* Value	GNI pc**
Bahrain	45	5.6	18	0.7	25420
Finland	5	7.9	14	0.6	45940
France	18	7.1	29	1.0	42620
India	116	2.0	87	4.1	1180
Ireland	23	6.8	25	0.9	44280
Korea (Rep. of)	1	8.4	26	0.9	19830
Kuwait					
Malaysia	58	4.5	52	1.8	7350
Oman	60	4.4	39	1.2	17890
Qatar	44	5.6	70	2.7	12000
Saudi Arabia	46	5.4	36	1.1	17700
United Arab Emirates	32	6.2	5	0.4	57340
United Kingdom	10	7.6	19	0.7	41370
United States	17	7.1	12	0.6	46360
Yemen	127	1.7	144	36.8	1060

SOURCE: ITU, 2011a.

* As approximated by the ITU "ICT Price Basket."

** USD, 2009, or latest available year.

Qatar has actively pursued ICT diffusion to individuals and households, a policy that has achieved increases in Internet use, households with a computer, and households with the Internet.

Bahrain is also encouraging ICT diffusion and use, including by stimulating market competition, providing public Internet facilities, and launching WiMax Internet services. Additionally, Bahrain is developing e-government services and encouraging ICT diffusion in the public sector. For example, a policy to fully equip all public schools with ICTs was put in place in 2005, and a policy to provide all government employees with a computer, e-mail account, and Internet access was implemented in 2008. Some community access facilities providing free Internet access also remain, as well as a number of widely used commercial access facilities and hotspots. At the same time, the cost of personal computers (PCs) and laptops has dropped significantly, partly because of a reduction in import taxes on these goods.

A more nuanced picture emerges when examining the three sub-indices of the IDI: access, use, and skills (see Table 3.4). We highlight in green those sub-index rankings that are better than a given country's overall ranking and highlight in red those rankings that are worse than the country's overall ranking. Bahrain and Qatar, in particular, score relatively high in the access indicators, and all countries except Bahrain fare better in the use ranking than in the overall ranking. However, all of the GCC countries do relatively worse in the skills rank-

Table 3.4
The ICT Development Sub-Indices

Country	IDI Rank 2010	Sub IDI—Access Rank	Sub IDI—Use Rank	Sub IDI—Skills Rank
Bahrain	45	36	47	51
Finland	5	17	4	1
France	18	14	18	35
India	116	115	124	116
Ireland	23	20	23	27
Korea (Rep. of)	1	10	1	2
Kuwait				
Malaysia	58	65	50	92
Oman	60	60	54	86
Qatar	44	28	42	98
Saudi Arabia	46	43	44	67
United Arab Emirates	32	35	25	68
United Kingdom	10	7	11	36
United States	17	23	17	12
Yemen	127	129	122	125

Source: ITU, 2011a.

ing (measured by literacy rates and gross secondary and tertiary enrollment rates) than in the overall IDI ranking. Qatar, for instance, ranks much higher in the access ranking and much lower in skills. Evidently, the GCC countries are not well positioned to exploit the available ICT infrastructure to generate knowledge and value in their economies.

The above data indicate that, while the physical infrastructure and access to that infrastructure are good in the GCC countries, the skills necessary to exploit them may be lacking. It is important to note that the sub-index for use in Table 3.4 does not give an indication of whether individuals are using ICT for "consumption" (for example, browsing the web) or "investment" (for example, building a web-based business). To gain some insight into this distinction, we first explore the trends in education in these countries and then consider the relationship between skill level and the adoption of ICT, working under the assumption that higher skill levels lead to better quality of usage.

Human Capital

Human capital is an important source of value addition in the knowledge sector. We use data from UNESCO to examine trends in enrollment, then compare them with trends in Internet subscriptions found using ITU data to gauge whether human capital accumulation is keeping pace with ICT improvements in the GCC countries.

Education indicators have been largely stagnant in the GCC countries, even as the ICT indicators have been soaring. Figure 3.1 shows the net secondary enrollment rates from 1998 to 2009 for GCC countries, and Figure 3.2 shows the tertiary enrollment rates, using both South Korea and Malaysia as benchmarks.[5]

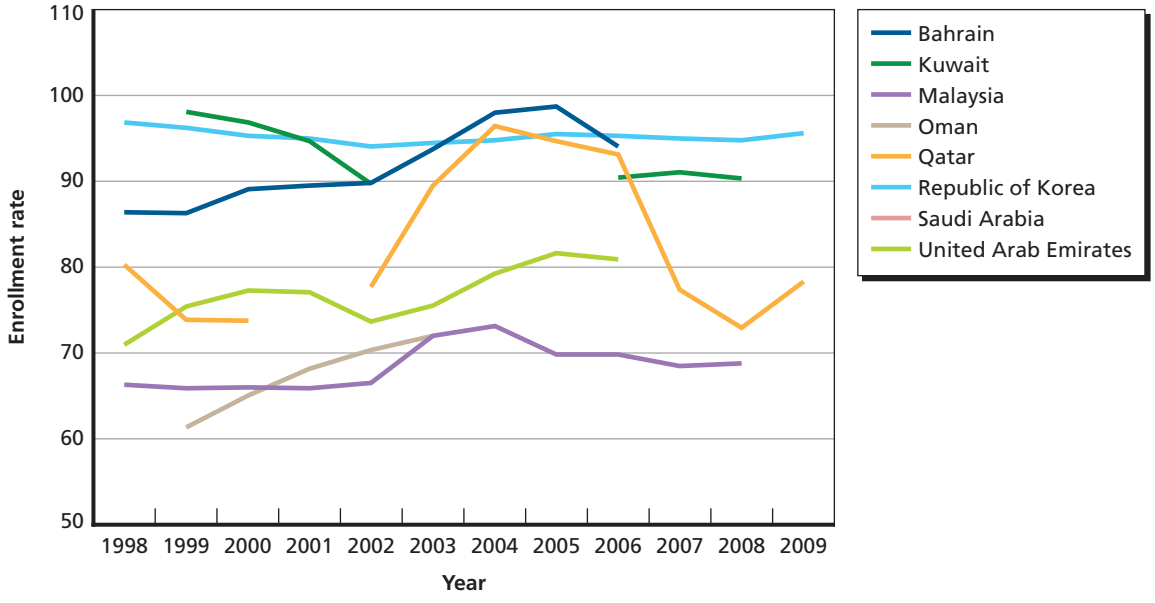
Except for Kuwait, GCC countries do not come close to the South Korean ideal in secondary enrollment rates. The difference is even starker for tertiary enrollment rates. South Korea is an outlier in tertiary enrollment rates, even by OECD standards, but what is striking is the flatness of enrollment trends for all countries except Saudi Arabia. Tertiary education is a particularly important input in knowledge value addition, and improving outcomes in this area is of particular importance to GCC countries.

ICT indicators, however, have shown clear upward trends for many GCC countries over the same timeframe. Figure 3.3 shows fixed Internet subscription rates per 100 inhabitants as an example. Even though South Korea still leads in this category, the UAE has caught up with Malaysia. Of particular note is the rapid increase in subscriptions in the UAE between 2000 and 2007.

The imbalance between trends in enrollment and ICT indicators is particularly stark for the UAE, as shown in Figure 3.4. Even though education data are not available for all years, the uneven and generally lower slopes of their trends relative to the ICT trend is readily apparent.

Based on the education indicators we use, it appears that the progress of education in GCC countries has not kept pace with growth in their ICT infrastructure.

Figure 3.1
Secondary Enrollment Rates

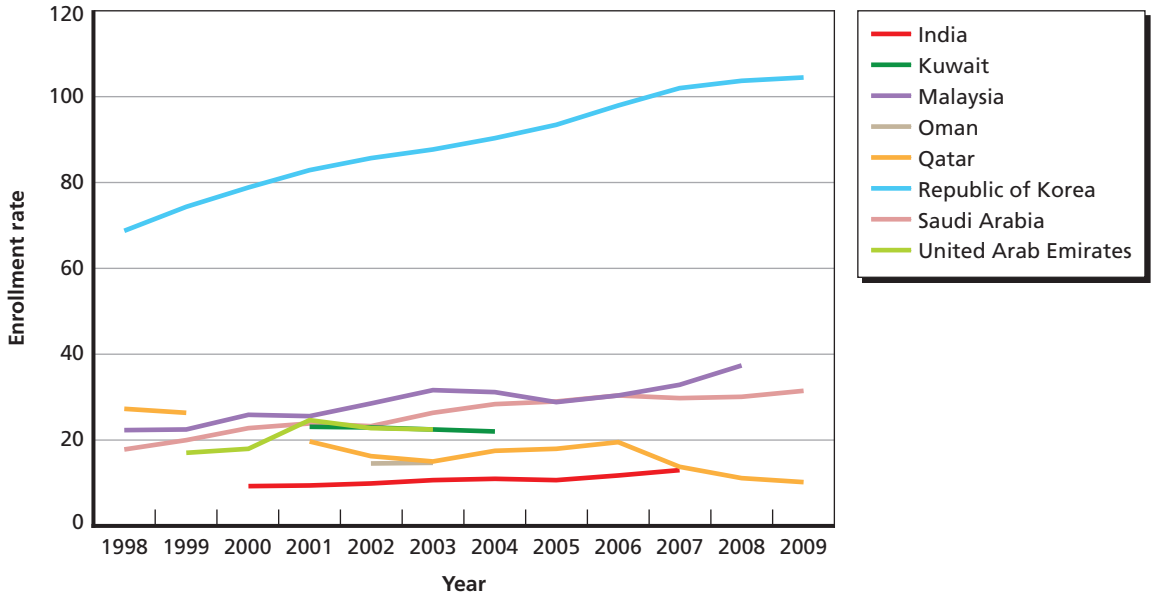


SOURCE: UNESCO Institute of Statistics.

RAND *RR188-3.1*

[5] We acknowledge that enrollment measures only the flow of human capital, not its stock. We use these readily available data as indicative rather than conclusive measures. Moreover, the stability of enrollment rates over many years suggests that we might not be missing much by using flow measures instead of stock measures.

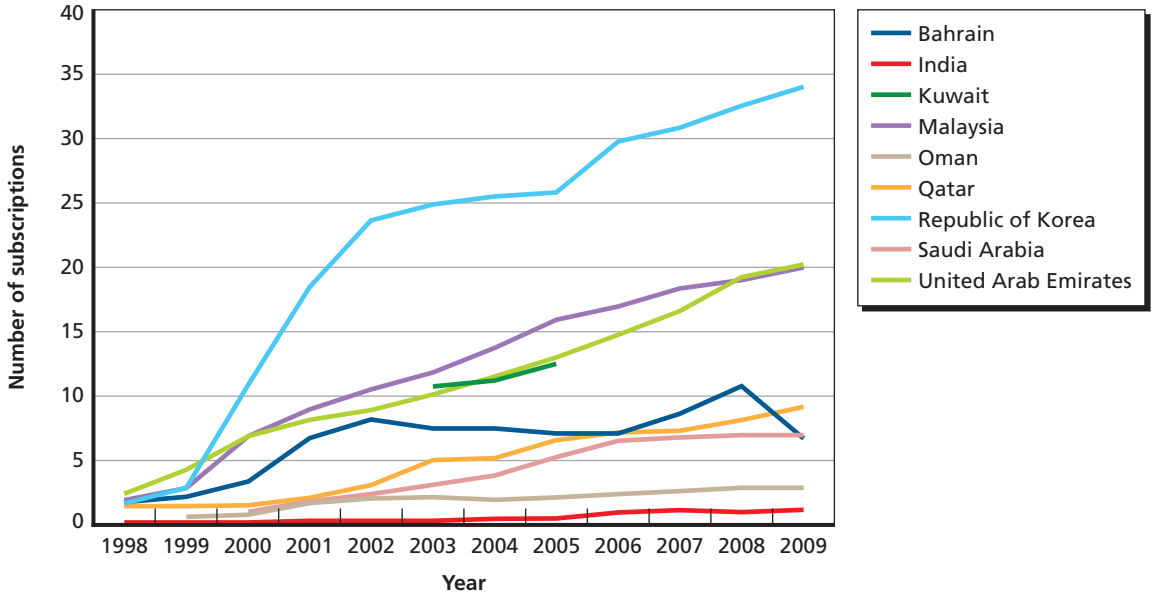
Figure 3.2
Tertiary Enrollment Rates



SOURCE: UNESCO Institute of Statistics.

RAND *RR188-3.2*

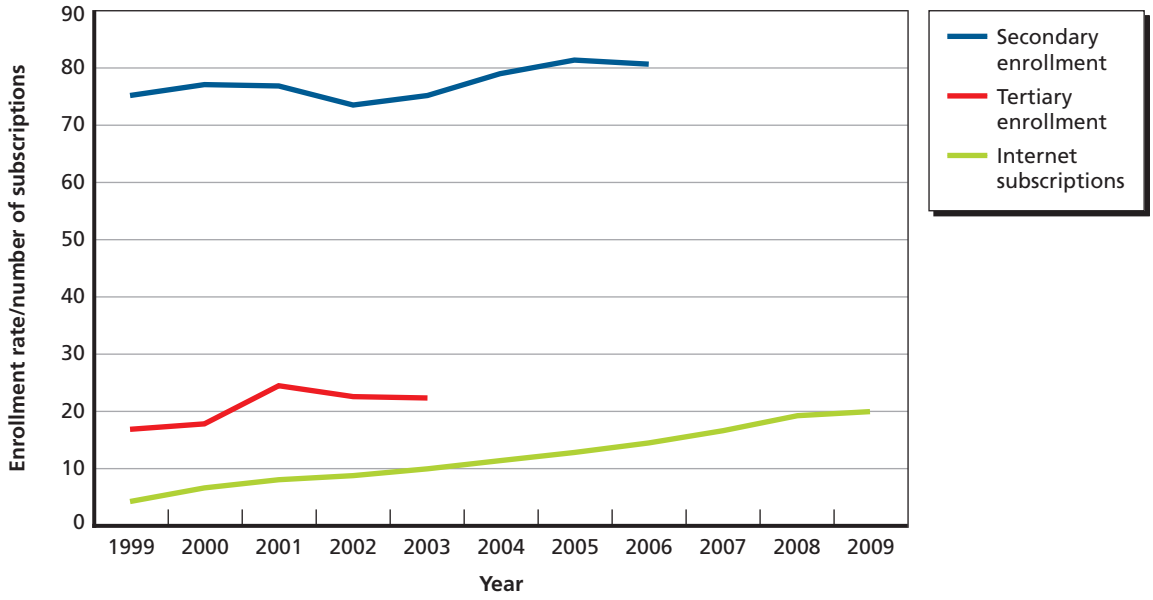
Figure 3.3
Fixed Internet Subscriptions per 100 Inhabitants



SOURCE: ITU World Telecommunication/ICT Indicators database.

RAND *RR188-3.3*

Figure 3.4
UAE Enrollment Rates and Fixed Internet Subscriptions per 100 Inhabitants



SOURCE: ITU World Telecommunication/ICT Indicators database.
RAND *RR188-3.4*

The Skills-ICT Interface

We next examine whether skills and language are a barrier to successful ICT adoption and use the INSEAD-WEF Network Readiness Index to gauge how effectively GCC countries use ICT to add value to their knowledge economies. We then explore how well the "ecosystem" facilitates the skills-ICT interface through an examination of the World Bank's *Doing Business* Indicators.

Barriers to ICT Adoption and Effective Usage

The GCC countries' relatively high rankings on the IDI sub-index of use (shown in Table 3.4) mask any challenges to ICT adoption at the household level these countries face due to reasons of skill. In Europe, for instance, a lack of perceived need, cost (of equipment or service), and a lack of ICT skills are often cited as the top barriers to ICT uptake or reasons for not having an Internet connection at home (European Commission, 2009). A recent U.S. Federal Communications Commission (FCC) survey also highlights the importance of teaching people who are not yet connected how to use the Internet to find content that is relevant for them (Horrigan, 2010). Such education may be particularly important in GCC countries, where ICT and Internet use are still relatively low. Indeed, digital literacy (knowing the concepts, methods, and skills to use and exploit ICTs) and information literacy (having the skills to process data and transform them into information, knowledge, and decisions—including methods of searching and evaluating information, information culture and its ethical aspects, and the methodological and ethical aspects of communication in the digital world) are crucial to being able to reap the benefits of ICTs (van Welsum, 2011).

A lack of skills and a perception that the technology is too complicated to use were popular barriers to Internet/PC use reported in Qatar's 2008 ICT Landscape Residents Survey (see Table 3.5). Not knowing how to use a computer was the most frequently cited reason in Saudi Arabia for not accessing the Internet (34 percent), followed by non-affordability (19 percent) (CITC, 2008).

It is also important for content (and even computer operating systems) to be available in local languages, as people evidently prefer using ICTs and the Internet in their mother tongue. For example, a 2007 survey in Saudi Arabia showed that the majority of individuals and professionals use Arabic language operating systems on their PCs (Figure 3.5).[6]

A lack of ICT adoption by users (demand) can cause an imbalance between the infrastructure available (supply) and its utilization, but the question arises as to whether an excessive supply of ICT can also cause the same imbalance. We explore this next.

Is There Too Much Investment in ICT?

We highlighted the challenge some GCC countries have regarding skills and ICT usage. One potential pitfall for countries rapidly investing in ICT is that they may overreach relative to their capabilities to use and benefit from the new technologies. Young (1992, p. 16), for instance, noted in the case of Singapore:

> Singapore is a victim of its own targeting policies, which are increasingly driving the economy ahead of its learning maturity into the production of goods in which it has lower and lower productivity. According to this argument, although Singapore might be experiencing learning-induced improvements in total factor productivity within individual sectors, this is masked at the aggregate level by a movement into industries in which the economy is less productive.

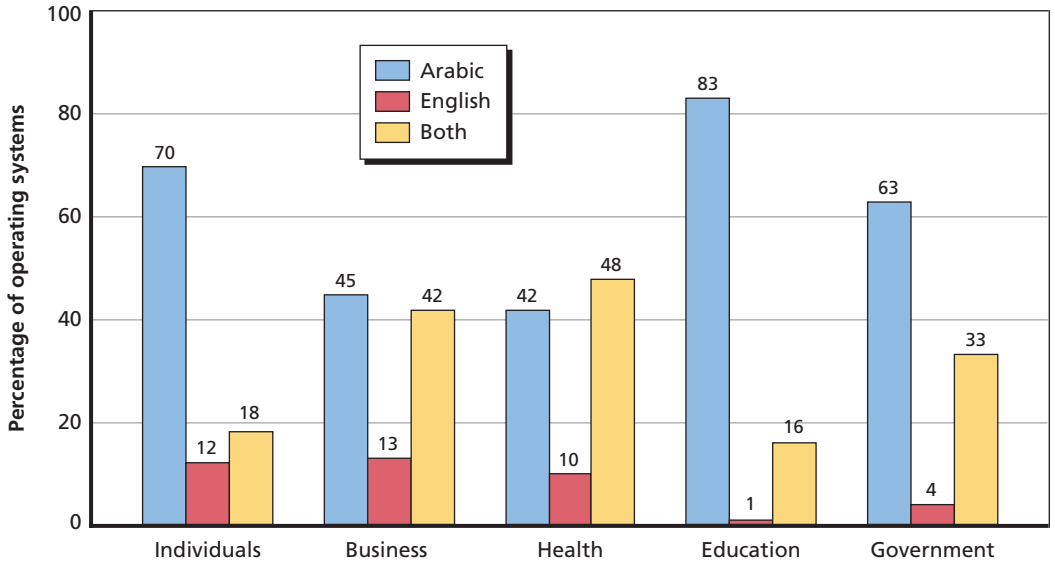
Table 3.5
Barriers Limiting Internet/PC Use by Residents—Qatar, 2008

Barrier to ICT Adoption	Percentage of Respondents
High cost of Internet connection	42.0
Internet not available at work	33.2
Lack of skills	32.8
Internet not available at home	26.3
Risk of viruses too high when using the Internet	21.3
Maintenance cost	20.2
Technology is too complicated	18.8
Lack of trust	16.8
Not secure to do business/purchase transactions over the Internet	14.2

Source: Qatar's ICT Landscape—Residents Survey, 2008, as reported in ITU, 2010.

[6] This intensity of Arabic language usage on computers is in stark contrast to the low share (less than 2 percent) of digital Arabic content on the Internet (see, for instance, ITU News, 2012).

Figure 3.5
Language of Operating Systems Used in Saudi Arabia, 2007



SOURCE: CITC, 2008.
RAND *RR188-3.5*

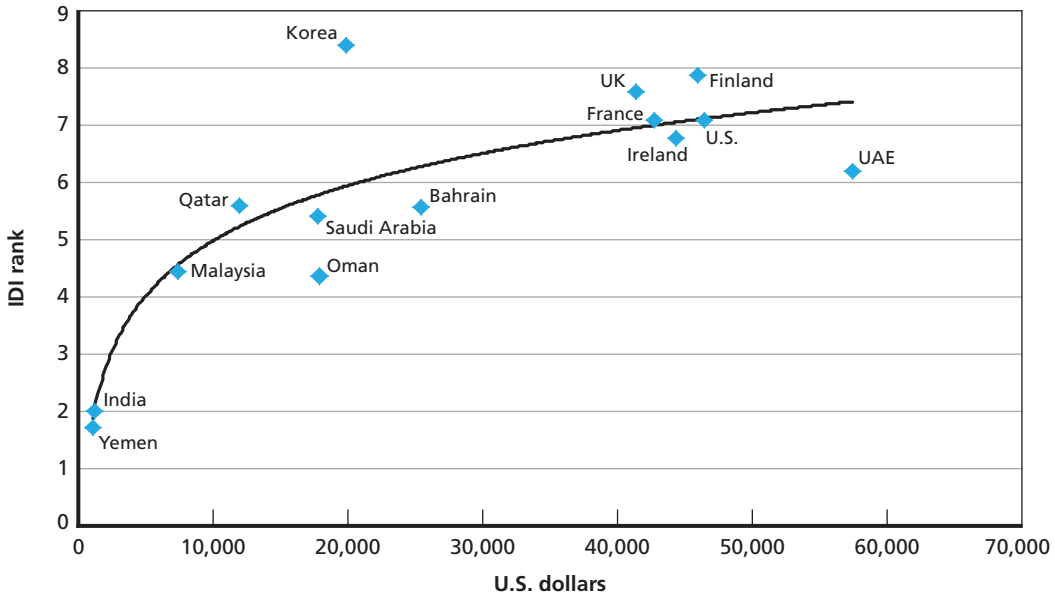
To explore the potential of GCC countries overinvesting in ICT relative to their levels of development in a very simple way, we fit a logarithmic trend line between each country's per capita Gross National Income (pcGNI) and its IDI ranking. Those countries positioned above the trend line in Figure 3.6 have an IDI rank that is higher than what is warranted by their income. In these countries, factors other than income typically play an important role in driving ICT development, such as targeted ICT policies (for example, Korea, as outlined by the World Bank [2006]) or having a strong ICT sector (for example, in 2005, telecommunications equipment exports comprised 8.4 percent of Finland's GDP, as seen in Figure 3 of Lesser, 2008). While the benefits of focusing on technology are obvious, it could also come at a cost if policies emphasize the sector beyond what is warranted by the comparative advantage and capabilities of a country. The only GCC country above the trend line is Qatar.

Countries below the trend line have lower ICT development than would be expected based on their income level. Despite the healthy infrastructure indicators seen for GCC countries in Tables 3.1 and 3.2, and the strong use indicators seen in Table 3.4, nearly all of these countries fall below the trend line in Figure 3.6 because inadequate skills, among other factors, are lowering their composite IDI rankings.

At least from this simple analysis, it does not appear that GCC countries have overreached in ICT relative to their levels of development.[7] It is important to bear in mind that investing in infrastructure alone is not enough; the impact of ICTs (on growth and develop-

[7] When all available countries are included, instead of only the GCC countries and the countries used for comparison in this paper, Qatar too drops below the trend line. Also note that we do not control for other factors beyond per capita income that could affect the IDI and cannot make any causal statements (for example, income could be driving the IDI or vice versa; in addition, there may be income threshold effects).

Figure 3.6
IDI Rank and Per Capita Gross National Income, 2010



SOURCE: Authors' calculations based on data from ITU, 2011a.
RAND *RR188-3.6*

ment) depends on the use that is made of them—in other words, how much value they add to the economy using skills and other complementary inputs.

The Networked Readiness Index (NRI) and Business Usage

The NRI framework was developed in 2002 by INSEAD in collaboration with the WEF. It is used as a tool to assess the drivers of national capacity to leverage ICT advances. Box 3.2 provides details of the NRI.

Table 3.6 examines how the GCC countries perform in the overall NRI, as well as in the environment, readiness, and usage sub-indices. As in Table 3.4, the sub-index rankings that are better than the corresponding overall NRI ranking are shaded in green and the sub-index rankings that are lower than their corresponding overall ranking are shaded in red. Qatar and the UAE, along with Saudi Arabia, rank significantly higher in the readiness ranking than in the overall NRI ranking. Kuwait's performance in the environment ranking is much higher than in the overall ranking, while its ranking in the readiness sub-index is significantly lower than its ranking in the overall NRI. While most GCC countries (except Kuwait) perform relatively well in the readiness index, they rank lower in the environment and use indices, which suggests an imbalance among the various knowledge-economy factors.

The NRI environment sub-index is, in turn, made up of several components (see Box 3.3), and it is informative to study how the countries perform along these dimensions as well (see Table 3.7).

All GCC countries score better in the market environment ranking than in the overall environment ranking. Nearly all GCC countries perform worse in the political and regulatory

Box 3.2: The WEF and INSEAD's NRI

The 2011 version of the NRI is based on 71 variables spread over three sub-indices: environment, readiness, and usage. These variables are a combination of quantitative data collected by international organizations and data from the Executive Opinion Survey, conducted annually by the WEF.

1. **Environment**: aims to capture "the conduciveness of national environments for ICT development and diffusion, including the broad business climate, some regulatory aspects, and the human and hard infrastructure needed for ICT."
2. **Readiness**: aims to capture "the degree of preparation for and interest in using ICT by the three main national stakeholders in a society (i.e., individuals, the business sector, and the government) in their daily activities and operations."
3. **Usage**: aims to capture "the actual use of ICT by individuals, the business sector, and the government."

SOURCE: WEF/INSEAD, 2011.

Table 3.6
Networked Readiness Index Rankings

Country	NRI Rank	Environment Rank	Readiness Rank	Usage Rank
Bahrain	30	30	30	27
Finland	3	3	2	6
France	20	18	29	17
India	48	58	33	67
Ireland	29	20	36	29
Korea (Rep. of)	10	27	17	1
Kuwait	75	52	95	72
Malaysia	28	36	10	25
Oman	41	43	34	43
Qatar	25	26	4	34
Saudi Arabia	33	32	24	39
United Arab Emirates	24	25	6	30
United Kingdom	15	9	31	9
United States	5	14	8	5
Yemen	—	—	—	—

SOURCE: WEF/INSEAD, 2011.

Box 3.3: The NRI Environment Sub-Index

This sub-index aims to capture the conduciveness of a country's market, regulatory, and infrastructure environments to innovation and ICT development. It is composed of 31 variables covering three aspects of the networked readiness environment (WEF/INSEAD, 2011):

1. **The market environment**: aims to capture the quality of the business environment for ICT development and diffusion. It includes, for example, the availability of appropriate financing sources (notably venture capital), business sophistication (captured by cluster development), the ease of doing business (including the presence of red tape and excessive fiscal charges), and the freedom of exchanging information over the Internet (proxied by the freedom of the press).
2. **Political and regulatory environment**: aims to capture the extent to which the national legal framework facilitates innovation and ICT penetration. It includes, for example, general features of the regulatory environment (such as the protection afforded to property rights, the independence of the judiciary, and the efficiency of the law-making process), and ICT-specific dimensions (the development of ICT laws and the protection of intellectual property, including the software piracy rate and the level of competition in the Internet and telephony sectors).
3. **Infrastructure**: aims to capture the development of the national innovation-related infrastructure, both in its physical elements (namely, the number of telephone lines and secure Internet servers, electricity production, mobile network coverage rate, Internet bandwidth, and accessibility of digital content) and in its human aspects (including the tertiary enrollment rate, the quality of research institutions, and the availability of scientists and engineers).

SOURCE: WEF/INSEAD, 2011.

environment and infrastructure categories.[8] The infrastructure component of this sub-index includes human capital, which explains why the infrastructure performance of GCC countries is worse here than on indicators based on physical infrastructure alone.

The NRI readiness sub-index is further broken down into individual, business, and government readiness (see Box 3.4) to capture the readiness or willingness of an economy's main actors to use new technologies. Table 3.8 shows the performance of our focus countries in these areas. The main picture emerging from Table 3.8 is that nearly all GCC countries perform better in the government readiness rankings, while all of them perform worse, in some cases much worse, in the business readiness rankings. This poor performance is particularly worrying because the use of ICTs by business is likely to bring about important economic impacts, notably through growth and development. In particular, value addition through entrepreneurship is both a good use of ICT and a source of innovation and knowledge creation.[9] This topic warrants further investigation, especially in GCC countries characterized by particular sec-

[8] This can potentially constitute a major barrier to improving innovation performance, for example, by hampering the sharing of knowledge and information, which has been identified as key to the emergence of Silicon Valley as an innovation cluster (Saxenian, 1990).

[9] See Audretsch and Keilbach (2005) on the positive effects of entrepreneurship in a knowledge economy.

Table 3.7
Country Rankings for Components of the NRI Environment Sub-Index

Country	Environment Rank	Market Rank	Regulatory and Political Rank	Infrastructure Rank
Bahrain	30	9	38	41
Finland	3	6	4	9
France	18	32	17	16
India	58	41	52	81
Ireland	20	34	16	22
Korea (Rep. of)	27	53	41	15
Kuwait	52	44	78	49
Malaysia	36	33	27	51
Oman	43	31	45	71
Qatar	26	10	30	35
Saudi Arabia	32	19	25	54
United Arab Emirates	25	18	34	28
United Kingdom	9	17	10	7
United States	14	13	20	5
Yemen	—	—	—	—

Source: WEF/INSEAD, 2011.

toral and industry distributions (dominated by natural resource industries, banking, to some extent, and a relatively large public sector).

The indicators used by the NRI in the government readiness sub-index illustrate that government use of ICT can not only help to disseminate it, improve transparency, and reduce red tape, but can also be proactive through its procurement and through "leading by example." However, while the government can mandate the use of ICT in its organizations, it is entrepreneurship that will ensure its usage by businesses to create economic value. Indeed, entrepreneurship and creativity are crucial to using ICT in a value creating way—for example, by creating new business models and new business opportunities, and by developing new applications, new products and services, and new ways of delivering them.

Could it be that GCC countries are too highly focused on the hydrocarbon sector and government services, and that ICT usage for knowledge addition is constrained as a result? As Samba Financial Group (2010, p. 5) notes: "Despite the still prominent role of hydrocarbons, GCC economies have become increasingly diversified, particularly in the UAE and Bahrain, where the non-hydrocarbons sectors account for between 60–70 percent of GDP." Sectors such as manufacturing, finance and insurance, trade and hospitality, transport and communication, and construction are contributing a greater share to the national GDP of GCC countries.[10]

[10] The revenues from the hydrocarbon economy could have provided the initial resources for development of these other sectors and the ICT infrastructure in the first place.

Box 3.4: The NRI Readiness Sub-Index

This sub-index aims to capture the preparation and willingness of individuals, business, and government to use technology, and ICT in particular, in their day-to-day activities and transactions (20 variables).

1. **Individual readiness**: aims to capture citizens' preparedness to use ICTs, taking into account both basic educational skills (e.g., the quality of the educational system, math and science education in particular, and the literacy rate) and ICT accessibility (e.g., residential telephone connection charges and monthly subscription costs, as well as fixed broadband, mobile cellular, and fixed telephone line tariffs).
2. **Business readiness**: aims to capture firms' capacity and inclination to incorporate ICT into their operations and processes. It looks at variables such as quality of on-the-job training, spending on R&D, collaboration between academia and industry (which is key to fostering applied innovation and intrinsic to effective clusters), the quality of suppliers in the economy, and the affordability of telecommunication for business (i.e., business telephone connection and monthly telephone subscription fees).
3. **Government readiness**: aims to capture the government's vision and prioritization of ICT in its national agenda and competitiveness strategy, including the extent to which public procurement of high-tech products is used as a tool to promote efficiency and innovation.

SOURCE: WEF/INSEAD, 2011.

Therefore, they might have the industrial structure in place to add knowledge-based value in these emerging sectors.

The NRI's usage sub-index shows actual ICT usage by individuals, businesses, and the government (Box 3.5), and Table 3.9 shows country rankings in these subcategories.

As in the readiness sub-index (Table 3.8), all GCC countries perform worse than the overall usage rank, in some cases much worse, in the business usage indicators. Unlike the readiness sub-index, however, the government usage ranking is worse for most countries, especially Saudi Arabia and the UAE.[11]

Again, it is particularly worrying that GCC countries perform relatively worse in the business component of this indicator, which, as mentioned in Box 3.5, measures the effective usage of technology to generate productivity gains and innovation. Indeed, large economic impacts (including on innovation) can be expected to arise from the business use of ICT. If they do not put the infrastructure to good use, however, countries miss out on opportunities to improve their growth potential and hamper their creativity and innovative capacity, putting current and future competitiveness of their firms and economies at risk.

[11] This is somewhat surprising for Saudi Arabia given the Saudi National e-Government Program, specifically put in place to "provide better government services, enhance efficiency and effectiveness in the public sector, and contribute to creating a Saudi information and knowledge-based society. Simultaneously, a large number of regulatory and policy actions focused on fostering competitiveness and establishing a business environment supportive of information and communication technologies (ICT) were adopted" (WEF/INSEAD, 2011, in particular, Chapter 2.2, by Badger, Khan, and Lanvin, 2011).

Table 3.8
Country Rankings for Components of the NRI Readiness Sub-Index

Country	Readiness Rank	Individual Readiness Rank	Business Readiness Rank	Government Readiness Rank
Bahrain	30	15	67	14
Finland	2	3	3	10
France	29	48	18	38
India	33	21	33	47
Ireland	36	51	10	63
Korea (Rep. of)	17	19	16	22
Kuwait	95	45	128	105
Malaysia	10	14	19	11
Oman	34	40	52	13
Qatar	4	10	21	2
Saudi Arabia	24	34	38	12
United Arab Emirates	6	5	24	3
United Kingdom	31	54	17	39
United States	8	11	6	17
Yemen	—	—	—	—

SOURCE: WEF/INSEAD, 2011.

World Bank's Knowledge Indices and Doing-Business Indicators

Based on the KAM framework presented in Chapter Two, the World Bank has developed a Knowledge Economy Index (KEI) and Knowledge Index (KI) (Box 3.6). Table 3.10 presents rankings on these indices for the set of countries we examine.

Qatar and the UAE are the highest-ranked GCC countries (44th and 45th, respectively) in part as a result of their relatively high scores in the ICT pillar of the index. Unsurprisingly, GCC countries perform relatively well on the ICT indicators. However, they lag in the innovation and education pillars, further lending credibility to the claim that GCC countries are not adding as much value as they could through their ICT infrastructure due to lagging behind on complementary inputs.

The World Bank's knowledge indices are broader than the ITU's IDI in that they not only include ICT-related variables but also take so-called "framework conditions" for the knowledge economy into account, which are crucial for being able to exploit the benefits of ICT and maximize its impact on economic growth and development. Indeed, the KEI takes into account whether the environment is conducive to using knowledge effectively for economic development.

Comparing the IDI and KEI rankings (Table 3.11) also provides some insights. Being ranked lower in the KEI, which includes framework conditions indicators, than in the IDI, which focuses on ICT and ICT-related indicators, may indicate problems in the framework conditions (e.g., business climate, rule of law, etc.), which can lessen the impact of ICT on

Box 3.5: The NRI Usage Sub-Index

This sub-index aims to capture the actual ICT usage by an economy's main social actors (20 variables). It is the intention of WEF and INSEAD to let this sub-index evolve over time to capture ICT impact in terms of the inclusiveness of society, business innovation, and better governance.

1. **Individual usage**: measures ICT penetration and diffusion at the individual level with variables such as the number of mobile and broadband Internet subscribers, Internet users, PCs, cellular subscriptions with data access, and the level of Internet access in schools. The use of virtual social networks and ICT impact on basic services are also measured.
2. **Business usage**: measures businesses' capacity to effectively use technology to generate productivity gains and innovation by capturing firms' technology absorption and capacity for innovation (including the number of utility patents per 100 population and high-tech exports), as well as the extent to which businesses use the Internet in their daily transactions and operations. The impact of ICT on the creation of new models and products and organizational models is also included.
3. **Government usage**: aims to capture the government's implementation of its vision for ICT, (e.g., the quality of e-government services provided and the extent of e-participation achieved), as well as ICT impact on the government's efficiency.

SOURCE: WEF/INSEAD, 2011.

development of the knowledge economy. Four GCC countries rank lower in the KEI than in the IDI, suggesting that the knowledge "ecosystem" might not be off balance in those countries.

As mentioned earlier, promoting a creative and entrepreneurial environment is key to developing the knowledge economy. This includes reducing barriers to entrepreneurship and facilitating business. The World Bank's *Doing Business* indicators, which measure such initiatives, are summarized in Table 3.12.

Relative to the overall *Doing Business* ranking, most GCC countries score better in the "paying taxes" indicator, followed by the "registering property" and "dealing with construction permits" indicators. Most GCC countries perform worse in "starting a business," "getting credit," "protecting investors," and "enforcing contracts." This is very worrying, as these factors are all key to developing entrepreneurship and a dynamic business environment in which the knowledge economy can prosper.

Value Addition

A symptom of the imbalance we have identified between the physical infrastructure and human capital and its resulting challenges to the skills-ICT interface is likely to be low value addition by knowledge-intensive sectors. Financial services are often identified as a sector that is intensive in its knowledge usage (see, for example, OECD, 2005).[12] The value added by this sector in the UAE peaked at 7.7 percent in 2009 (United Arab Emirates National Bureau of

[12] We use the financial sector only as an example of a sector that uses knowledge intensively to add economic value. Clearly there are other sectors that use and even create knowledge.

Table 3.9
Country Rankings for Components of the NRI Usage Sub-Index

Country	Usage rank	individual Usage Rank	Business Usage Rank	Governemnt Usage Rank
Bahrain	27	29	58	8
Finland	6	2	8	24
France	17	25	11	16
India	67	98	45	47
Ireland	29	31	23	35
Korea (Rep. of)	1	4	2	1
Kuwait	72	57	94	69
Malaysia	25	45	15	11
Oman	43	48	56	45
Qatar	34	28	42	37
Saudi Arabia	39	40	44	52
United Arab Emirates	30	21	39	40
United Kingdom	9	12	12	10
United States	5	19	3	4
Yemen	—	—	—	—

SOURCE: WEF/INSEAD, 2011.

Statistics, 2012). Qatar's financial sector contributed only a slightly higher percentage of GDP (9.9 percent) in 2009 (*Qatar Economic Review*, 2009). In contrast, at its peak, the U.S. financial sector contributed one-seventh (or close to 14 percent) of the country's GDP (Banternghansa and Peralta-Alva, 2009). The fraction of employees in financial intermediation in the UAE and Qatar is also quite low—around 2 percent in the UAE in 2006 and 1 percent in Qatar in 2009 (REED Specialist Recruitment, 2009a, 2009b). The corresponding figure in the United States was 5.4 percent in 2008 (U.S. Bureau of Labor Statistics, undated).

Box 3.6: The World Bank's KEI and KI

Each of the pillars included in the KEI (4) and KI (3) includes three key variables:

1. **Education**: (1) adult literacy rate, (2) secondary enrollment, (3) tertiary enrollment
2. **Innovation**: (1) royalty and license fees payments and receipts, (2) patent applications granted by the U.S. Patent and Trademark Office, (3) scientific and technical journal articles
3. **ICT**: (1) telephones per 1,000 people, (2) computers per 1,000 people, (3) Internet users per 10,000 people
4. **Economic incentive and institutional regime**: (1) tariff and nontariff barriers, (2) regulatory quality, (3) rule of law.

SOURCE: World Bank, 2012b.

Table 3.10
Country Scores for the World Bank's Knowledge Economy Index and Knowledge Index

Rank	Country	KEI	*KI*	Economic Incentive Regime	Innovation	Education	ICT
49	Bahrain	6.0	*5.8*	6.8	4.3	5.8	7.3
3	Finland	9.4	*9.4*	9.3	9.7	9.8	8.7
22	France	8.4	*8.6*	7.7	8.7	9.0	8.3
109	India	3.1	*3.0*	3.5	4.2	2.2	2.5
8	Ireland	9.1	*9.0*	9.3	9.1	9.1	8.7
29	Korea (Rep. of)	7.8	*8.4*	6.0	8.6	8.1	8.6
52	Kuwait	5.9	*5.6*	6.5	5.0	4.9	7.0
48	Malaysia	6.1	*6.1*	6.1	6.8	4.2	7.1
66	Oman	5.4	*4.8*	7.2	4.9	4.5	4.9
44	Qatar	6.7	*6.6*	7.1	6.5	5.4	8.1
68	Saudi Arabia	5.3	*5.1*	5.9	4.0	4.9	6.4
45	United Arab Emirates	6.7	*6.7*	6.8	6.7	4.9	8.6
7	United Kingdom	9.1	*9.1*	9.2	9.2	8.5	9.5
9	United States	9.0	*9.0*	9.0	9.5	8.7	8.8
121	Yemen	2.2	*2.0*	2.7	2.7	1.8	1.7

SOURCE: World Bank, 2012b.

Clearly, further research based on detailed sectoral data is needed, but there are clues indicating that value addition in the knowledge sectors is low in the GCC countries. If this is, in fact, the case, the GCC countries would need to focus on the investment aspect of ICT rather than the consumption aspect alone if they want to add value based on the ICT infrastructure they have developed.

Table 3.11
Comparison of IDI and KEI Rankings

Country	IDI Rank	KEI Rank	IDI–KEI
Bahrain	45	49	–4
Finland	5	3	2
France	18	22	–4
India	116	109	7
Ireland	23	8	15
Korea (Rep. of)	1	29	–28
Kuwait	—	—	—
Malaysia	58	48	10
Oman	60	66	–6
Qatar	44	44	0
Saudi Arabia	46	68	–22
United Arab Emirates	32	45	–13
United Kingdom	10	7	3
United States	17	9	8
Yemen	127	121	6

SOURCE: ITU, 2011a and World Bank, 2012b.

Table 3.12
World Bank's *Doing Business* Rankings

Economy	Ease of Doing Business	Starting a Business	Dealing with Construction Permits	Registering Property	Getting Credit	Protecting Investors	Paying Taxes	Trading Across Borders	Enforcing Contracts	Resolving Insolvency
Bahrain	38	82	7	30	126	79	18	49	114	25
Finland	11	39	45	25	40	65	28	6	11	5
France	29	25	30	149	48	79	58	24	6	46
India	132	166	181	97	40	46	147	109	182	128
Ireland	10	13	27	81	8	5	5	21	62	10
Korea (Rep. of)	8	24	26	71	8	79	38	4	2	13
Kuwait	67	142	121	88	98	29	15	112	117	48
Malaysia	18	50	113	59	1	4	41	29	31	47
Oman	49	68	64	21	98	97	9	47	107	76
Qatar	36	116	24	37	98	97	2	57	95	37
Saudi Arabia	12	10	4	1	48	17	10	18	138	73
United Arab Emirates	33	42	12	6	78	122	7	5	134	151
United Kingdom	7	19	22	68	1	10	24	13	21	6
United States	4	13	17	16	4	5	72	20	7	15
Yemen	99	66	35	55	159	133	116	118	38	114

SOURCE: World Bank, 2012a.

CHAPTER FOUR

Policy Implications and Conclusions

While GCC countries have made great strides in establishing an ICT infrastructure (physical capital), which is an essential prerequisite for a KBE, they need to look beyond infrastructure to other complementary factors—such as human capital and the requisite institutional and regulatory environment. The GCC countries, however, face challenges to ensuring the availability of these complementary factors. In Chapter Three, we presented data to support this theme by examining KBE indices developed by various organizations, focusing on the *components* of these indices. Without these complementary inputs and a balanced knowledge ecosystem, an economy cannot fully exploit its ICT infrastructure. Here, we examine the implications of this analysis for policy.

In the previous chapter, Figure 3.3 showed that most of the GCC countries are below the trend line of ICT development, given their per capita GNI. Policies can contribute to the improvement of their ICT development level by helping them to perform better in some of the sub-indices, notably the skills sub-index, and further exploit gains from ICTs. Moreover, based on the KEI information presented in Table 3.10, it appears that an increased focus on education would allow the ICT to be used more effectively for innovation and knowledge creation.

Unfortunately, progress in education has not kept pace with improvements to ICT infrastructure in the GCC countries. Nationals in most of these countries have guarantees of public employment, leaving a large part of the private-sector work, including in many technical fields, to expatriates (Shediac and Samman, 2010). It might be tempting to view this as the human capital analogue of the leapfrogging we alluded to in the previous chapter while discussing ICT infrastructure in Tables 3.1 and 3.2 (moving straight to mobile telephony rather than expanding fixed-line telephony). However, this dependence is more "a symptom of the region's limited success in developing critical skills internally" (Shediac and Samman, 2010) and does not appear to be sustainable in the long run, given the high level of unemployment among the national youth and the potential for increased social tension.

Therefore, the GCC countries need to ensure progress in education as much as in ICT infrastructure if they want to facilitate balanced development of their knowledge economies and full utilization of their infrastructure.

From an infrastructure point of view, the data presented in Tables 3.1 and 3.2 showed strong growth in mobile telephony, low numbers of fixed telephone line and Internet users per 100 inhabitants, and broadband development still in its early stages. This can be explained, at least in part, by business regulations limiting the share of foreign ownership in these countries, which have lessened the pace and degree of telecommunication market liberalization, especially during its early stages. Other factors include a lack of extensive, reliable fixed networks to cover the majority of the country; late liberalization of the fixed and data markets; low levels

of digital literacy among the native population; a relative lack of Arabic content online; and an investment bias toward the energy and real-estate sectors (van Welsum, 2011). It is therefore important to further liberalize the fixed, mobile, and Internet and broadband markets and roll out high-speed broadband networks. This should be accompanied by complementary ICT policies aimed at improving ICT skills and digital literacy and raising ICT awareness. Migration to the next-generation ICT environment should also be facilitated (ITU, 2010).

Table 3.7 (NRI environment sub-index) in Chapter Three highlighted the fact that more efforts could be made to enhance national innovation (for example, improving the regulatory environment and human capital). This is crucial not only to improving the degree to which ICTs can contribute to the national economy, but also to ensuring the international competitiveness of the GCC countries. The *Doing Business* indicators in presented in Table 3.12 also indicate that policies to foster entrepreneurship will prove helpful, since new businesses in new technologies is an important source of innovation. The performance of GCC countries in the indicators of starting a business and getting credit, as well as conducting business (protecting investors and enforcing contracts) is worse than in the overall rankings.

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. Policy attention in these countries could be more fruitfully focused on correcting this imbalance, which would allow the full potential of the ICT infrastructure to be realized. There are specific initiatives under way in the GCC countries not only to promote ICT skills but also to use ICT itself to improve the delivery of education (Lightfoot, 2011). However, broader reforms to correct the macroeconomic imbalance between physical and human capital are worth exploring.

We have presented multiple indicators and their components to guard against drawing conclusions on a single or a narrow set of indicators. However, there are limits to drawing rigorous conclusions based on rankings. Therefore, this paper is best viewed as setting the stage for a more detailed and systematic inquiry examining value addition by sector and over time to gauge how effective investments in the GCC countries have been in developing their knowledge economies.

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