Jordan Software Industry: Investigating the Role of Human Capital

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Abstract

Software industry is realized as one key opportunity for socio-economic development, especially for developing countries. Human Capital heavily plays a critical role in such knowledge-based sectors as software. This paper describes and analyzes the role of human capital in the development of Jordan software industry between 1980's and 2005. In doing so, different roles in software industry are identified, described and analyzed. The study suggests that the existence of some levels of professional, technical and ICT graduates, will not guarantee the development of the sector. Quality, proper utilization, collaboration and policy coherency of Human Capital is needed for software sector development. Moreover, we argue that challenges such as Diaspora can have a positive impact through technology transfer and entrepreneurship as the Indian case suggests.

Keywords: Human capital, Economic development, Software industry

1. Introduction

Software industry is seen as an opportunity for economic growth especially for developing countries (Nicholson and Sahay, 2008). The successful case of India and Ireland provide sufficient evidence of software industry role as a major economic growth engine (Baraya et.al 2008). The huge advancement in telecommunication technologies and internationalization of business process where key factors that leads to the globalization of software industry. Countries with low-cost qualified human capital, fine telecommunication infrastructure, and supporting national polices became the ones who benefited most of this globalization and thus had the impressive payback on exports and economic development (Jones 1994, Heeks 1999, Arora et.al 2001). Software industry is not a "solo industry", but rather a vehicle for industrial development. In fact, software industry is more than just "another industry- it is a central intermediate good in the new digital economy" and its function became not less important than the role played by any other production factors (Athreye 2003). As economies are turning to more knowledge-based industries, many products require embedded software and more competitive e-businesses will require more effective software (Hoch et al. 1999).

However, software industry is based intensively on Human Capital (HR) "more than any other high-tech Industry" (Arora and Bagde 2010). In fact, the existence of skilled and professional human capital in software industry is widely acknowledged as the most important element in the success of the software industry (Lakha 1994). Yet, the presence of human capital does not guarantee the quality and many other factors are needed to trigger software industry development.

For a country with limited resources (expect for human capital), Jordan had allocated notable effort to join the software industry exporters club. Although Jordan has realized a notable advancement in key factors supporting software industry development such as education, intellectual property rights (IPR) and telecommunication infrastructure, software industry outputs as are still relatively small. The slow and modest growth of software revenues and exports represent a huge challenge for a country that seeks to replicate the experience of key software exporters and raise the overall software industry contribution to the GDP.

This research seeks to investigate and differentiate roles of human capital in building and developing the software industry on the national level. In doing so, we aim to highlight the following research problems:

1. What are the key characteristics of human capital in the Jordanian software industry?

2. To what extent human resources have played in developing software industry in Jordan?

3. What challenges Jordanian software industry face in regarding human capital?

Using qualitative analysis, this research seeks to document the human capital portfolio of software industry in Jordan and highlight both its strength and weakness.

This paper is organized as following; in the next section we provide background information on country context. Section three presents literature review on the role of human capital in software industry along with the theoretical framework. In section four we present our methodology. Section five provides the case study analysis based on the theoretical framework. Section six offers the analysis and policy implications, and section seven concludes this work.

2. Background: Country Context

This section is dived into two man parts. Fist part presents the general country context whereas the second part presents the current Information and communication technology (ICT) infrastructure status in the country.

2.1 General Background

Jordan is an Arab country located in the center of Middle East with a population of six million inhabitants approximately. As many other developing countries, Jordan is facing fundamental economic development challenges that ranges from poverty, to unemployment and slow economic growth. Table 1 present key indicators of Jordan economy in comparison with selected countries in the region.

With limited natural resources, Jordan had recognized the important role of human capital in economic development. Therefore successive Jordanian government's invested heavily in human capital. This had resulted in skilled and competitive human capital renowned by most regional and international indicators. In 2003 Jordan literacy rate stood at 90.1 percent supported by a country's educational infrastructure consisting of 5,376 primary and secondary schools (including public, private, and United Nations Relief and Works Agency schools). Jordan has more than 57community colleges and 24 universities of which 10 are public and 14 private (Congress, 2006). However, the utilization and quality of this human capital has been questionable. This can be easily noted from the World Economic Forum Global Information Technology Report 2009-2010, were Jordan ranked poorly in most innovation indicators (see table 2). For instance, total number of patents granted by U.S. Patent and Trademark Office to Jordan was only 23 till 2008.

2.2 ICT infrastructure

Information and Communication Technology adoption and diffusion in Jordan have witnessed a notable growth in the last few years. With Jordan becoming a full member of the WTO in 2000 the road to fully liberalized telecommunications sector have become inevitable. Privatization and deregulation of the market resulted in substantial increased connectivity and investments in the sector.

Connectivity has increase in mobile, fixed and internet telecommunication services, which resulted in ranking Jordan 44 in Networked Readiness Index and 44 in the Digital Access Index (MoICT, 2008). Figure 1 show the penetration rates of fixed, mobile and data communication technologies in Jordan between 2000 and 2006. On the other side, private sector invested substantial capital in ICT, which resulted in notable growth in employment, total revenue, exports and FDI. Table 3; provide a summary of ICT sector growth in Jordan.

Despite this growth, data technologies (Network and Hardware) are still face notable challenges. Broadband communication is limited and costly, and PC penetration rates are still modest. Therefore a national broadband project (1 gigabit per second) was launched along with national PC penetration initiatives (Please see MoICT.gov.jo).

3. Literature Review and Theoretical Framework

3.1 Software Industry and Human Capital

As any other industry, software industry requires the presence of *sufficient* supply of human resources for progress (Ashraf, 2004). Yet, "Software is different from the traditional manufacturing industries in many respects, especially in terms of the relatively greater importance of human capital relative to physical inputs" (Arora et.al 2001). Thus, it was no wonder that Prikladnicki, et.al (2003) stressed the important function that investment in recruiting and training human capital plays in minimizing the difficulties related to the non-technical dimension. As well, Seleim, et.al (2004) investigated empirically the intellectual capital (human capital, structural capital, and relational capital) in the Egyptian software firms and acknowledged the critical role of human capital in software industry development. Silvia et al. (2006) also acknowledged the importance of

human capital and human capital management in software industry and investigated the different roles of human resources in software development. In fact, weak supply and high-costs of human capital may have serious implications on the success of software industry (Arora et.al 2005, Kapur 2001).

Thus, it was no wonder that software development became global and distributed industry that seeks low cost skilled human and sufficient in any country (Prikladnicki et.al 2003). Consequently, Kapur and McHale (2003) highlighted the advantages of human capital mobility in software industry development and the role of *international* human capital in the development of software industry. Human capital had always attracted transnational corporations (TNC) investment in software industry which later leads to a positive effect on triggering externalities (spillovers) on local community.

However, competitiveness of high-tech industries such as software industry need more than the existence of large pool of human capital, other factors such as local policy, internationalization and technology infrastructure define the development these industries (Lall, 1992). Different models were studied thought-out the literature that investigated the relation between these factors, human capital and software industry. For instance, Heeks and Nicholson (2002) defined five usable success dimensions for software industry namely; 1) Demand, 2) National vision and strategy, 3) International linkages, 4) Software industry characteristics, 5) Domestic input factors and infrastructure (include human capital, telecommunications technology, and access to finance). Another comprehensive work by Carmel (2003) compared and analyzed a number of models and stressed the importance of human capital in most of them. A recent work by Minetaki and Takemurathat (2010) examine the software productivity in Japan through labor (programmer and system engineer, clerk, manager and non-technical staff) and capital stock (equipment, structure and software) and expressed the critical role of human capital.

In summary, all models used to explain the software industry growth agreed on the critical role of human capital in explaining the development and growth of software industry (Liu (2004), Silvia et al. (2006), Commander et al. (2004 a, b), Arora & Bagde (2006), Barr and Tessler (1999), Khadria(2004)).

3.2 Theoretical Research Framework

Since physical capital and human capital have been identified as the two key components of economic development analysis (Lucas 1988) and while software industry is first and foremost a human capital industry, this study analyzes the role of human capital in software industry. In doing so, following five roles were drawn from the literature and will be investigated and described:

1). Professionals and technical HR: Engineers, programmers web developers and many other technical Human capital is a primary human capital in software industry (Arora et, al 2005). Number of employees in software companies, IT work-force, the level of professional's education, and improvements in total revenues of software sector are good indicators of this role.

2). Entrepreneurs: entrepreneurship was definitely acknowledged by scholars (Hausmann and Rodrik 2002) as a key role for software industry success. Investigating number of new venture and observing the growth of these numbers in successive periods will give an indicator of entrepreneur's role in software industry.

3). Academia HR: As software industry grows, demand for software degrees also grows (Arora and Bagde 2006). Liu (2004) in his study on technology policy and human resource in Chinese software industry found that poor education and training systems is one of the major factors for the weakness of Chinese software industry. Indicators such as student's enrollment in Software related studies, numbers of IT graduates, the percent of staff to students, quality of graduates and relationship between academia and staff will capture provides a good evidence on this role in software industry development.

4). Research and Development (R&D) HR: The software industry is a knowledge intensive industries where R&D investment, patent, human capital and networking is vital (Minetaki & Takemura 2010, Balakrishnan 2006). Thus number of researchers, the quantity of researchers involved in software R&D, and patents are used to capture this role.

5). Diaspora: Diaspora played significant role in software industry development in Ireland, India and Israel (Kapur and McHale 2003, Arora et.al 2005). Heeks and Nicholson (2002) explained how the Diaspora harnessed the network and linkages between their own national industry and international parties in these countries. As well Liu (2004) addressed the important role of oversea Chinese as a source of human capital in software industry. In addition Commander et al. (2004 b) sees that "in many instances migration has been viewed as positive effect for the firm and the industry more generally". Here we investigate the role played by this Diaspora in weakening the software sector development or strengthen it by building ties and directing software investments to their original countries. Due to the unavailability of data for such investigation "Stock of emigrants by destination and by

educational attainment "provided by Docquier and Marfouk (2005) can give an indicator for quantity of brain drain in such cases. In addition "Workers' remittances, compensation of employees, and migrant transfers (US$ million)" provided by "Global Economic Prospects 2006" can be used as another indicator in such case.

4. Methodology

This research is a descriptive qualitative research that uses case study methodology. The choice to use qualitative research can be attributed to tow key reason. First, case study methodology is appropriate when tackling a non technical research issues (Creswell, 1998) such as this work. Second, the fundamental socio-economic complexity of the research makes it more sufficient to use. Finally, the absence of adequate country-level statistical data makes the quantitative research very difficult to undertake.

This research uses Jordan as a single case analysis as it represents an interesting case that symbolizes many less developed countries seeking catch up and transition to knowledge economy.

Using literature review, theoretical models, publically available data, and 14 unstructured industry interviews, we describe and analyze the different roles of human capital in software industry development while trying to profile both quantity and quality of human capital in Jordanian software industry. Finally, in the scope of this research, software represents all information goods and service that include system and application programming services, web development, hardware and telecom software development, outsourcing and consultancy. Thus, this work tried to extract and exclude hardware and communication related information.

5. Human Capital in Software Industry: The Jordanian Case

The software sector in Jordan is relatively a new emerging sector. In fact the real launch and empowerment to this sector started after king Abdullah II became in power in 1999. According to The Information Technology Association of Jordan int@j (2003) the main Jordanian software development areas are banking software services and packages, accounting packages, web-based applications, Arabization, system integration, health systems and insurance software packages.

5.1 Professionals and Technical Human Capital

In 1980's software industry in Jordan was infant. Number of professionals and technical in software industry were small and weak software industry. According to Elian (1999) estimation and judgment the overall industry was employing around 139 persons. By 1998 the number of software industry employees was doubled to reach 278 people with a gross output of nearly 22 million dollars (UESCWA 2003). This was also reported by REACH 1.0 (1999) where they estimated that both software and hardware industry employs 1250, of which 27% are in software services which matches the results of 1998.

The 2000's witnessed a notable growth in number of professionals and technical due to many factors including the increased number of software companies. According to Ministry of Information and Communication Technology (MoICT 2008), in 2001 the number of professionals and technical human capital working in software development reached 2000 employees.

Information technology association of Jordan reported that in 2003, revenues form the IT sector (excluding telecommunications services) where 296m US$, of which some US$70m was export earnings (generated mainly from Arab countries) with an employment of 3,500 people (Global technology forum). Even though, when referencing to int@j survey in 2004 and excluding hardware sector we can say that the total revenue of software industry will average in 112 million dollars.

46.9% of the professional human capital working in Jordanian software firms has at least bachelor degree (Elian 1999). This argument is consistent with REACH 1.0(1999) in which they analyzed the skills of professionals available in Jordanian market and found that 2 out 10 employees are very highly skilled, 2 medium high, and 4 medium and 2 as low medium skilled.

5.2 Entrepreneurs Human Capital

In fact there is no exact number on startups in the 80's although Elian (1999) in his study entitled "computer hardware and software business in Jordan "stated that most of the firms where established since the mid 1986 and particularly in 1992 and thereafter. In his study he reported that there exist 57 hardware and software companies in 1988. Assuming one third of them is in software industry (based on the percent of software firms from total ICT industry in 1998, and Elian (1999) statement that 30% of companies activities where in writing programs) we estimate in average there were 19-20 startups in the software sector in that period. Actually this situation remained till the end of the 1990's, since then the number of startups grows dramatically to become 33 firms in 1998 from a total of 79 ICT firms, then to triple in 1999 to become 82 firms.

The 2000's witnessed continues rise in the number of software startups and reached 100 firms in 2001 with additional 100 new startups companies. This trend grows to reach 300 firms in 2003 (int@j 2003). However, these firms where characterized by small number of employees, small investment, lack of networks, and lack of R&D capabilities.

This growth in startups was the result of Jordan government focus on providing the proper institutional environment for entrepreneurship in software industry drive by international programs such as, YEA (The Young Entrepreneurs Association established in 1998), NAFES (National Fund for Enterprise Support) and AMIR(Achievement of Market-Friendly Initiatives and Results) program in cooperation with USAID. Although, these programs where not dedicated for software sector development, they have supported the overall entrepreneurship spirit, provide funding sources for startups and encouraged service sector development. However, these efforts were scattered, unorganized on national level and has not resulted in building a one unique, successful and competitive cluster, in software or other industry.

5.3 Academia Human Capital

According to Abuashaikh (1996) in 1994/1995, 650 students were enrolled in computer science programs in 17 public collages (two-year community colleges) and 74 in private collages. In addition there was 559 studying abroad of which 74 are in master and PhD programs. Enrollment in universities (public and private) was near 6000 students. (This is by assuming only 10% of them are in computer and IT related as same as the percent in that appears in collages, this also supported by the department of statistics as reported by (int@j 2003)). The enrollment and graduates number of IT and software related studies counties to grow in the 1990's. Table 4 shows the Distribution of Students at Jordanian Universities in Computer Science Related Fields in 1997 / 1998.

By 1999, total Annual Graduates in IT-Related studies were 2,307 graduates and enrollment reached 8,000 at university level and 5,300 at two-year community colleges (REACH 1.0, 1999).

In 2001 total graduates from these undersides was more than 1600 in different degrees (BS, MS, PhD) while an enrolment in IT related fields exceeded 10,000 students in all degrees (Please see: www.ict.gov.jo). Since 2004, academia output reached almost 4,000 yearly IT and software-related graduates (int@j 2003). This is also supported by ministry of labor data which report that total number of IT and Mathematics department's graduates from universities was about 9.5% (about 3280).

IT faculty staff ratio was poor during the last decade. In 2001 there were 250 university instructors in IT and software-related studies with only 50% of them holding a PhD degree.

However, a recent work by Elshuraydeh et al. (2006) based on annual statistical report (Ministry of Higher Education & Scientific Research) 2005 showed that the computer and mathematic staff in Jordan universities reached 715 representing 12.6 % of all academic staff. The percentage of PhD also grows slowly to ready 58%. However, the overall enrolment of students in IT and software-related studies reached 22228 students counting for 12.5 of all student enrollments.

A notable gap between industry needs and the graduate's skill can be easily noted in Jordan. This can be attributed to both mismatch between the academic curricula and technological advancements (Peppers & Rogers Group. 2006), as well as the low ration of PhD. holders within IT instructors and the low ratio of academic staff to students is which was around 1:31 according to MoHE(2005). Table 5 shows the faculty to student ration in selected Jordanian public universities.

5.4 Research and Development (R&D) Human Capital

In general term, R&D human capital in software industry is very limited. Universities, big software companies and some R&D centers in HCST (Higher Council of Science and Technology) and RSS (Royal Scientific Society) are key stakeholders of R&D capital. In 2001 50% of the university staff in IT where involved in R&D activities in 30 labs inside universities and 6 outside (See www.ict.gov.jo). iPARK the technology incubators initiated by the Higher Council for Science and Technology in 2003, to help entrepreneurs and start-ups in developing technology applications and start their business is one key R&D center for software in Jordan ((UESCWA 2005).

According to Elshuraydeh et al.(2006) and based on annual statistical report of higher education in Jordan 2003/2004 , a total of 2122 researchers representing 13% out of 15799 researchers in public and private sector acquired their degree in computer or mathematics. 977 of them are in public sector and 1145 in private sector. Even if we assume that all of these are involved in software research, represent how poor is still the number of HR in software research.

On the other side, R&D expenditure in Jordan is still very weak in all industries up-to-date. Both, public sector

expenditure on R&D in 2010 were about 13,260,000 Euros (58% of GERD) in compared to around 8,308,000 Euros (36% of GERD) by the private sector (Erawatch 2010). Following figure (2) shows a comparison between Jordan and selected Arab and regional countries in GERD. Moreover, as we can see from the indicators presented in table 6, the overall current status of R&D is still very challenging in Jordan.

5.5 Diaspora

Diaspora have played key role in the development of India, Israel and Ireland software industry (Arora et.al 2006). Although Jordanian Diaspora has always been acknowledged as a key source of remittance, there is no studies that discuss the role of Diaspora in the development of software industry. The total number of Jordanian Diaspora to all countries where 48003 in 1990 of which 41% are reported as high skilled, resulting in 499 million dollars of remittance (Defoort& Marfouk 2005) and double in 2000 reaching 72324 Diaspora 52% of them are highly skilled with 1,845 million dollars of remittance. This number of Diaspora is increasing sharply specially for skilled workers in Jordan within the last few years. In fact, REACH 1.0 (1999) indicates that Jordan is considered a major supplier of brainpower throughout the MENA region. int@j (2003) have acknowledged the rising importance role of Diaspora and state that:

"Many Jordanians that immigrated to other countries hold powerful positions within their organizations and social statues, and are in position to generate a significant amount of "deal flows" to Jordan. In addition to generating "deal flows", influential Jordanians residing abroad are able to encourage foreign investors to consider Jordan as a destination for their ambitions. To capitalize on such individuals, int@j will develop a "Jordanian Ambassadors' Program", that is designed to equip influential Jordanians residing abroad with the necessary knowledge and support needed to effectively represent their country amongst their peers. This program includes continues updated information about Jordan's accomplishments, statistics, promotional material, and as many "tools" as possible to support Jordan's reputation and cause abroad".

However, we couldn't find information regarding such efforts or activities. In summary, we believe that Diaspora role have to be investigated and profiled specially for high-tech and software industry.

6. Analysis and Policy Implications: The role of Human Capital in Software Industry

Since 1999 software industry has witnessed some notable progress and enjoyed an exceptional support by H.M King Abdullah the Second, however software industry is still characterized by modest exports, weak progress rate, and distorted progress. Although the 1999 REACH strategic plan was unique in the region and represented a chance to achieve the development of the Jordanian software industry, after 5 years REACH 4. could not report more than 8 goals achievement from the initial plan of 51 goals to support software industry. The extremely unrealistic planning, lack of measurements, evaluation techniques, and monitoring tools has contributed this disappointment.

After reviewing the human capital profile in Jordan, we believe that Jordan software industry is promising, but not exploited. Jordanian Human capital requires marketing, utilization and development. For instance, the number of professional and technicals in software industry is growing but require training, incentives and access to other markets. Entrepreneurs should become priority in Jordan. This require a set of action to support them by providing them with financial support, tax incentives, less startups procedures, and new commercialization tools for their ideas, service and product.

The academia output of human capital in the last few years showed an excessive output and enrollment, which need to planned and managed for developing the industry. Academia output of human capital in software industry need to be adjusted for more quality than quantity. This requires new curriculum, advanced software development systems (tools), and more private-academic ties. R&D human capital needs to be supported, technology transfer has to be enabled, linkages with global software R&D centers must be supported, and IPR laws have to be updated and enforced. Finally Diaspora has proved (in the Indian case) to be a major asset for developing the software industry. In Jordan case, Diaspora role need to be encouraged and motivated to promote software industry.

In summary, we see that Jordan has modest levels of human capital in Jordanian software sector (both quality and quantity), yet we believe that this human capital is under-utilized. Both public sector and private sector have to support and trigger this asset.

7. Conclusion

In this study we documented and analyzed the role of human capital in Jordan software industry development. We described five roles of human capital namely; professional and technical, academia, Entrepreneurs, R&D, and Diaspora HR. We found modest levels of quality and quantity of human capital in these roles. Thus

utilization and development of human capital should become a priority for both public policy maker and private sector leaders to trigger the software industry development.

Finally, future work will focus on investigating other aspects and conducting an empirical analysis to support and profile the best composition of human capital in software industry.

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Table 1. Selected Jordan Economy Indicators. Source: World Development Indicators, 2006

Country	**Jordan**	**Iran**	**Oman**
GDP Million US$ (2005)	12861	196343	24284
GDP Per Capita US$ (2005)	2377	2900	9460
Unemployment Rate % (2008)	12.9	12.5	15.0
Inflation Rate % (2008)	14.9	28.0	12.5
External Dept Million US$ (2008)	6597	21770	6120

Table 2. Selected innovation indicators-Jordan. Source: (WEF-GITR 2010)

Factor	**Rank**
Creative industries exports, 2006	46
Utility patents, 2008	90
High-tech exports, 2007	82

Table 3. ICT Sector Statistics. Source: (Int@j. 2010)

Indicator /Year	**2003**	**2004**	**2005**	**2006**	**2007**
Export Revenue (USD)	69,728,000	79,410,743	162,619,518	191,520,379	196,907,691
Growth %	74.16%	13.89%	105%	17.80%	2.81%
% of Total Revenues	24%	18%	28%	25.00%	22.30%
Domestic Revenue (USD)	226,183,000	361,103,905	418,254,125	578,554,212	686,063,063
Growth %	20.02%	59.65%	15.80%	38.33%	18.58%
% of Total Revenues	76%	82%	72%	75.00%	77.70%
Total Revenue (USD)	295,910,000	440,514,648	580,873,643	770,074,591	882,970,754
Growth %	29.51%	48.87%	31.86%	32.57%	14.66%
FDI Yearly	11,594,500	2,900,000	10,524,761	13,569,656	3,070,791
FDI (Cumulative) (USD)	79,600,000	82,500,000	93,024,761	106,594,417	109,665,208
Employment	8,117	8,523	10,032	10,712	11,034
Growth %	1.46%	5.00%	17.70%	6.78%	3.00%

Table 4. Academia numbers. Sources (int@j 2003)

Subject	**Total Admitted**	**Total Enrolled**	**Total Graduated**
Information technology	72	72	-
Information systems	132	698	183
Computer science	1215	4778	683

Table 5. Faculty/Student ratio. Source: MoHE (2005)

University	Faculty/Student ratio	Administrators/Faculty ratio
Univ. of Jordan	1:33	1:2.3
Yarmouk	1:30	1:2
JUST	1:29	1:0.9
The Hashmeite	1:43	1:1.7
Balqa'a	1:69	1:8.3
Mu'tah	1:31	1:4.7
Al Hussein	1:56	1:2.1
Aal Al Bayet	1:64	1:4
Total	1:38	1:2.8

Table 6. Selected R&F indicators-Jordan. Source: (WEF-GITR 2010).

Factor	**Rank**
Company spending on R&D	108
University-industry collaboration in R&D	68
Prevalence of foreign technology licensing	28
Firm-level technology absorption	24
Capacity for innovation	74
Quality of scientific research institutions	70
Property rights	24

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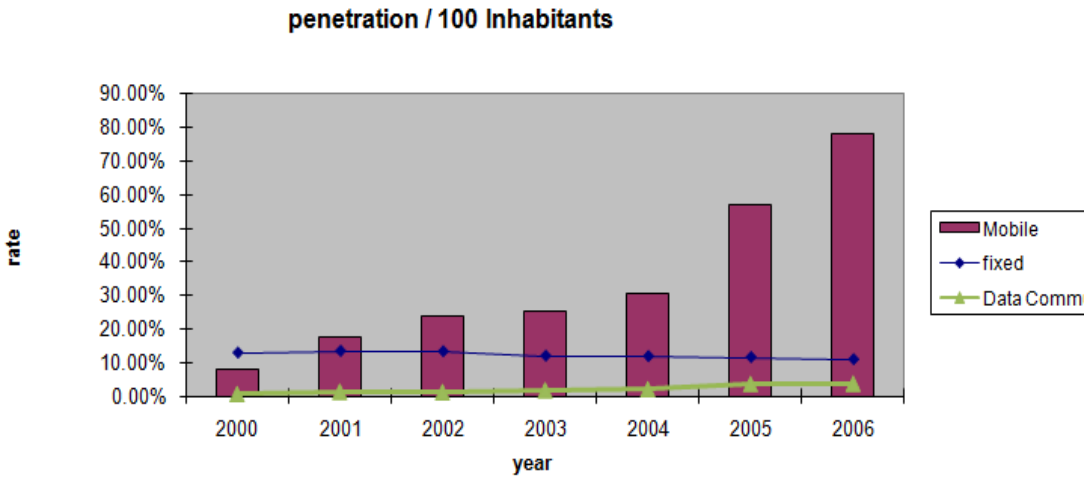

Figure 1. ICT Penetration rates. Compiled from TRC data (2009)

Compiled by Author

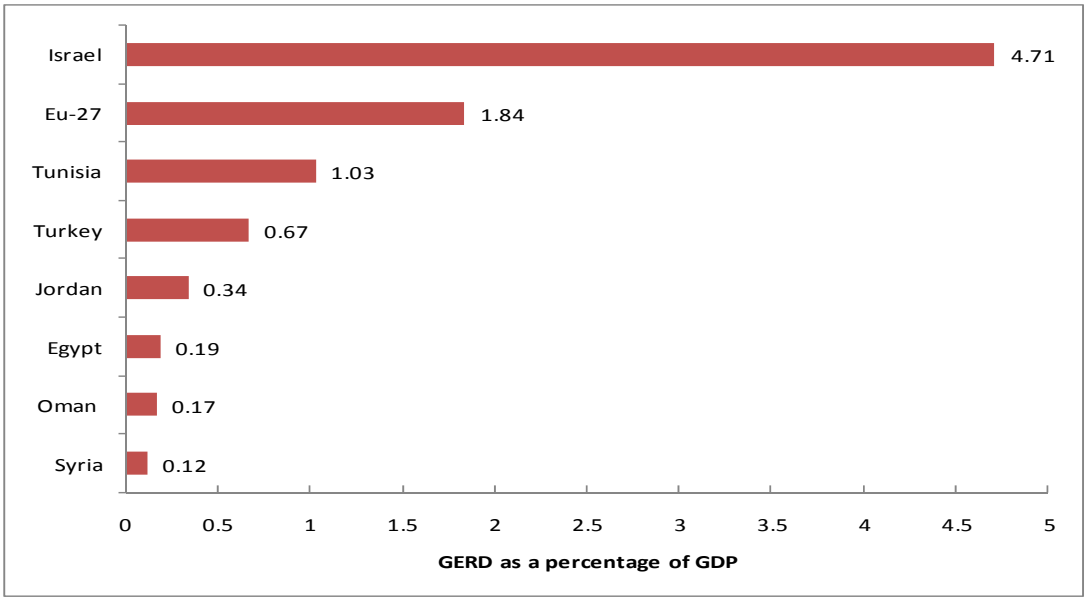

Figure 2. Jordan GERD compared to some selected countries

Source: UNDP Human Development Report (2007)