Chapter 9
Summary and Conclusions

This research provides an interesting indepth pioneering analysis of demand for and economic impact of ICT from the demand perspective and from public-private perspectives in public and private Sudanese universities. The aims of this research is three fold: first, to examine the status, pattern, structure, trend and determinants of the demand for ICT in public and private Sudanese universities; second to investigate the economic impacts of the uses of ICT, the potential opportunities and challenges that ICT is expected to create for public and private Sudanese universities; and finally to explain the role of ICT in facilitating the production, creation and transfer of knowledge in Sudanese universities.

We fill the gap in the literature, since we examine the demand for ICT from public-private perspective in Sudanese universities. Different from earlier studies in the literature that focuses on ICT from the supply perspective, we provide a new and perhaps the first study focused on ICT from the demand perspective, since we examine both the uses and impacts of ICT in public and private Sudanese universities. One advantage and interesting element in our analysis is that we present a more comprehensive analysis from the demand perspective concerning the use and impacts of ICT at the micro level and we compare between public and private universities. Another advantage is that we examine from the demand perspective, the use and economic impacts of ICT after integrating three different perspectives of academic teaching staff, support staff and students. A novel element in our analysis is that we use a new primary survey data at the micro level, which we obtained from the University Survey (2009) which we distributed randomly amongst 131 individuals in 10 public and private Sudanese universities located in Khartoum.

Chapter 1 gives a background and a brief general overview of the research problem and briefly shows the importance, relevance, objectives, hypotheses, and the general structure of the research project. Chapter 2 presents an introduction and background to motivate the research and explains some stylised facts, the research problem along with other strategic problems confronting economic development in Sudan. This chapter presents an overview of Sudanese economy and the trend and

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status of ICT in Sudan. Section 2.2 explains some stylised facts along with other strategic problems confronting economic development in Sudan that, it explains that Sudan's economy has been characterised by low GDP per capita income, presence of high rates of poverty, unemployment and inequalities in resources sharing. Section 2.3 explains the trend and status of core ICT indicators in Sudan. We show that in the recent years, Sudan has shown growing telecommunication networks and Internet services and the diffusion of ICT in Sudan has increased significantly. We explain that recent indicators from International Telecommunication Union (ITU) (2014) show the trend of core ICT indicators and illustrate that despite recent slowdown in terms of fixed telephone, the recent average growth rate of the total online population, Internet, fixed (wired)-broadband and mobile-cellular subscribers in Sudan during the period 2000–2013 has been significant. ITU (2014) data for 2000–2013 indicates that in Sudan the growth rate of mobile-cellular telephone (1,039.71) is faster than Internet (755.67), fixed (wired)-broadband (59) and fixed telephone (−0.04) respectively. We show that the status of ICT indicators in Sudan in 2013 can be explained by regional and international standards compared to Arab countries and world regions respectively. We find that ITU (2014) data for 2000–2013 indicates that by regional and international standards the rapid increase in ICT indicators in Sudan that appear from the increasing use of Internet and mobile-cellular telephone and the increasing proportion of households with Internet and proportion of households with computer are above that of Africa but below Arab region and World region, whereas the use of fixed-telephone in Sudan is less than Africa, Arab region and World region. This implies that by regional and international standards, ICT indicators in Sudan are below compared to Arab countries and World regions. Our findings indicate that the reported increasing trend of mobile and Internet usage at the aggregate macro level in Sudan seems consistent with the observed increasing trend at the regional and international levels. We find evidences in support of the incidence of the global digital divide between Sudan and the World countries, developed countries and developing countries that appear from ICT Development Index (IDI), access sub-index, use sub-index and skills sub-index over the period (2011–2012). Our results indicate that the reported digital gap in core ICT indicators at the aggregate macro level in Sudan compared to world regions seems consistent with the observed development gap in social, economic, human development and education indicators in Sudan compared to world regions.

Chapter 3 presents the conceptual and theoretical framework and theoretical and empirical literature. It provides a background for the empirical analysis in the following chapters by surveying the theoretical and empirical literature that emphasizes the positive effects of ICT in enhancing knowledge and economic growth and the negative effects of ICT through exacerbating the digital divide. In Sect. 3.2 we define the conceptual framework; the theoretical and empirical literature on the relationship between ICT, knowledge and the digital divide are presented in Sect. 3.3.Section 3.3.2 describes the relationship between ICT and economic growth; Sects. 3.3.3 and 3.3.4 discusses the relationship between ICT, education and knowledge. We explain the debate on the effects of ICT and the economic

opportunities and the challenges that ICT imposes on the production and dissemination of knowledge in the world economy. We illustrate that on the one hand, some studies provide robust results showing the various influences of ICT on enhancing economic growth and development, not only directly, but also indirectly through enhancing knowledge and through the complementary relationships between ICT, human capital and skill upgrading. We explain that on the other hand, several studies discuss the hazards ICT creates for economic development. In particular, the rapid progress in ICT will make it harder for the developing countries to bridge the already existing and widening gap and digital divide between the developed and developing countries. Based on our findings from the existing studies in the literature we highlight the need for improvement of investment in ICT to alleviate the digital divide, enhance production, creation and transfer of knowledge in higher education institutions and to enhance economic growth and sustainable development in Sudan.

Chapter 4 explains the research methodology and methods of data collection and illustrates the composition and operation of the survey in this chapter. Section 4.1 presents introduction. Section 4.2 explains the motives for performing the university survey and selection of a case study. Section 4.3 shows the selection of the sample and composition of the survey. Section 4.4 explains the structure and design of the questionnaire and Sect. 4.5 provides the conclusions, advantages and limitations of the survey.

Chapter 5 provides the empirical analysis and examines from public-private perspective the research hypotheses on the public-private differential in the demand for ICT, trend, determinants in Sudanese universities. Section 5.1 presents introduction. Section 5.2 defines the main characteristics of the respondent including academic teaching staff, support staff and students in the respondent universities. Section 5.3 presents from the demand perspective an indepth analysis of the use of ICT, pattern, trend, nature, extent, structural change and comparative advantages of the demand for the use of the different modes of ICT in public and private Sudanese universities. Section 5.4 explains and examines the income and price effects of the use of ICT in public and private Sudanese universities, and Sect. 5.5 provides the conclusions. Chapter 5 presents our findings and proves the first hypothesis in Chap. 1 on the presence of significant public-private differential between public and private universities in Sudan not only in the general characteristics but also in the demand for and impacts of ICT. For instance, our results show that the reported rapid incidence of the observed structural change in the demand for ICT, knowledge about computer and Internet, the importance, structure, trend, and income and prices effects of the demand for the four ICT modes, fixed telephone, mobile telephones, computer and Internet, seems to be more significant for private university staff compared to public university staff. This can be interpreted in relation to the observed differences in the general characteristics, which imply that monthly income and skill level are relatively higher for private university staff compared to public university staff.

Our findings prove our second hypothesis in Chap. 1 which implies that demand for the four ICT modes is characterised by considerable dynamism: it shows a

dynamic increasing trend and significant structural change over time amongst public and private university staff in Sudan. For instance, we confirm the incidence of structural change in the demand for ICT by scrutinising the historical use of the four ICT modes which implies that fixed telephone was used earlier as old or more traditional and a long-standing ICT mode, but then there is a gradual and visible shift toward using of other new more recent ICT modes such as computer, mobile and Internet respectively amongst academic teaching staff, support staff and students.

Our results present several interesting pieces of evidences in support of the hypothesis on the incidence of structural change in the demand for the four ICT modes from the demand perspective. For instance, we find that one important piece of evidence on the incidence of structural change in the demand for ICT can be elaborated from our result which indicates that for the majority of all respondents the personal use of mobile telephone, Internet and computer shows an increasing trends, while the personal use of fixed telephone shows an opposite decreasing trend. For the majority the personal use of mobile telephone is growing faster than Internet, computer and fixed telephone respectively. This result seems consistent with the reported increasing trend of the use of mobile and Internet at the aggregate macro level in Sudan and also consistent with the observed increasing trend at the regional and international levels.

The interpretation of the above-mentioned evidence on the incidence of structural change in the trend of the demand for the four ICT modes provides another piece of evidence in support of the hypothesis on the incidence of structural change in the demand for ICT, which can be elaborated from the demand perspective along with the respondents' assessment views on the importance of ICT for satisfaction of personal need and utility that highlight the three ICT modes, mobile telephone, Internet and computer, as highly important and value fixed telephone as moderately important. Our findings on the trend and assessment of the importance of ICT indicate different preference of the different ICT modes that can be explained in relation to preference of specific characteristics such as fashion, style and good design, ease of use, cheap price and efficiency and high quality. Our findings indicate that somewhat surprisingly despite the high poverty rate and low per capita income, the reported concern about cheap price comes next to the reported concern about efficiency and high quality. We find that for the majority of the respondents the preference of the use of different modes of ICT is most probably related to preference of specific characteristics such as efficiency and high quality. This implies that the respondents are much more concerned with efficiency and high quality, which can be interpreted probably because of high skill level and therefore increasing awareness amongst the respondents in public and private Sudanese universities. We find that from all the respondents' perspectives, the most important advantages of using fixed telephone include ease of use for people who are illiterate or have limited electronic knowledge, facilitated communication with Internet and ease of use in work. The most important advantages of using mobile telephone includes easy to carry and move from place to place, easy for waiting calls and messages from other people, facilitated social contact with family, ease of use in

work, facilitated social contact with friends, ease of use of SMS and facilitated direct contact and reach of the requested person. The most important advantages related to the use of Internet include facilitated training to improve skill for the use of computer and Internet, enhanced learning, training, skill and capacity for all society, long distance learning from international institutions, R&D skill and efforts and cheap price. In addition, Internet provides advantages such as facilitated study, research, networks and communication, job listings, participation in seminars, conferences and workshops and social and work contact. Our findings imply that because of these multiple advantages for satisfying the needs and utility in an academic setting in Sudanese universities, Internet is followed by mobile as the most important ICT mode that are popular and very widely used amongst academic staff. For the majority of the respondents mobile is preferred because of the characteristics of fashion, style and good design and ease of use, while Internet is preferred because of the characteristics of cheap price and efficiency and high quality. These multiple advantages of mobile and Internet gives further justification for the incidence of the structural change in the demand for ICT in Sudanese universities.

Further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our finding that the effect of the costs of expenditure on imposing burden in personal budget is most important for mobile telephone, which is higher than Internet and computer, but less important for fixed telephone. Additional evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our result that the effect of the costs of expenditure on ICT on competing with the expenditures on other goods and services in personal budget is most important for mobile telephone, which is higher than the moderate important effect for Internet and computer and less important effect for fixed telephone. Another piece of evidence in support of our hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our findings which implies that the effect of the increase in income on increasing the use of ICT is most important for mobile telephone, which is higher than Internet and computer and less important for fixed telephone. Somewhat surprisingly, even for both private staff and support staff the increase in income has an unimportant effect for the demand for fixed telephone; this implies that fixed telephone tends to be an inferior good and show an inelastic demand with respect to increase in income for both private staff and support staff. Our findings imply that from all the staff's perspective, for the majority the increase in income has an important effect on increasing the demand for the use of various ICT modes, fixed telephone, mobile telephone and Internet, and that the use of various ICT modes tend to be normal goods and their demand varies in the same direction as income. This finding is consistent with the conventional stylised fact on the theoretical literature on the positive income effect or the positive relationship between income and demand, i.e. that increase in income has important positive impacts on increasing the use of ICT. Additional evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our results, which indicate that the effect of the increase in prices in

reducing the demand for the use of ICT is most important for mobile telephone, which is higher than Internet and fixed telephone. Our results indicate that from all the staff's perspective, for the majority the effect of the increase in prices has important impacts on reducing the demand for the use of various modes of ICT: fixed telephone, mobile telephone and Internet. This result is consistent with the conventional stylised fact in the theoretical literature on the downward sloping demand curve or the negative price effect or the negative relationship between price and demand. Further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our findings which indicate an interesting cross price or substitution effect between the various modes of ICT, i.e. between fixed telephone, mobile telephone and Internet, in particular, somewhat surprising is the substitution effect between mobile telephone and fixed telephone, which is higher than the substitution effect between mobile telephone and the Internet. The relationship between fixed telephone and Internet is somewhat confusing, but for the majority the relationship is in favour or support of the complementary relationship, so this most probably indicates a complementary relationship between fixed telephone and Internet. Our findings indicate that the interesting substitution effect seems to be observed not only between the demand for the various ICT modes, but also between the supplier companies offering ICT services. For instance, our results indicate that the reduction of the prices of ICT offered by ICT competing companies has an important effect in motivating transference of the demand for ICT services offered by ICT competing companies with cheap prices and in reducing the demand for ICT services offered by the current company with high prices. This result is consistent with the conventional stylised facts in theoretical literature concerning the cross price, substitution-complementary effects and rationality of consumers.

Chapter 6 presents an overview of the use of ICT and the digital divide in Sudan and highlights the importance of bridging the digital divide to enhance equality in the use of ICT in Sudan. Section 6.2 shows the use of mobile and digital divide in Sudan. Section 6.3 discusses the use of computer and digital divide in Sudan. Section 6.4 investigates the use of Internet and digital divide in Sudan. Section 6.5 examines the determinants of the digital divide that appears from the relationships between the use of ICT (mobile, computer and Internet) and age, educational and professional levels, and the use of ICT and per capita income, poverty and urbanization. Finally, Sect. 6.6 draws conclusions and proposes policies to bridge the digital divide and enhance adequacy and equality of the use and utilization of ICT in Sudan. Our findings in Chap. 6 are consistent with the findings in the international literature on the incidence and the main reasons for the incidence of the digital divide. We provide significant contribution and fill the gap in the Sudanese literature, a novel element in our analysis is that different from the Sudanese literature we use recent secondary data at the macro level to discuss the use of ICT and the incidence of the digital divide in Sudan and we provide a more comprehensive analysis by investigating and comparing the digital divide for different modes of ICT in Sudan. Our results confirm the seventh hypothesis in Chap. 1 about the relationship between the uses of ICT (mobile, computer and

Internet) and the occurrence of the digital divide for households and individuals in terms of ownership, use, spending, awareness and knowledge and purposes of uses of mobile, computer and Internet defined by region (geographic location), mode of living, gender, age and educational level in Sudan. Our results imply that the observed disparities in the use of ICT and digital divide implies that ICT adds a new dimension to the already existing and longstanding challenges of inequalities and disparities in Sudan that has been well-documented in the literature as we explained in Chap. 2. We find that the major impediment factors that hindered the use of computer at home and the use of Internet are the lack of electricity that hindered the use of computer and the non availability of the Internet service that hindered the use of the Internet in rural areas nearly twice higher than in urban areas. We find that home is the most commonly place for using the Internet, Arabic is the most widely used language for using the Internet and mobile cellular telephone is the most widely used mean or for using the Internet. The use of mobile cellular telephone is more than fourteen times higher than fixed telephone. We find positive relationship between the use of computer and Internet and educational level, and negative relationship between the use of computer, Internet and mobile and age. Our findings imply inconclusive relationships between the use of mobile and educational level and between the use of computer, mobile and Internet and professional levels. We find positive correlations between the use of ICT and net enrolment rate in primary education, literacy rate, per capita income and rate of urbanization and negative correlation between the use of ICT and poverty gap ratio. Our results in this chapter confirms the seventh hypothesis in Chap. 1 about the relationship between the use of ICT and the incidence of the digital divide defined by age and educational level in Sudan. Our results are plausible and consistent with the findings in the literature that imply positive relationship between the uses of ICT and educational level, that particularly important for computer, since computer may require substantial levels of education for use, but telephones and the Internet may require very little.

Chapter 7 provides the empirical analysis and examines from the public-private perspective the research hypotheses on the public-private differential in the supply side of ICT in Sudanese universities. Section 7.1 defines the main characteristics of the supply side of ICT in Sudan. Section 7.2 shows an indepth analysis from the demand perspective the supply side of ICT, methods and places of connection to ICT. Section 7.3 explains the difficulties on the supply and demand sides and suggestions for relevant solutions. Further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from the supply side. For instance, next to the well investigated structural change in the structure of the supply of ICT market from monopoly to monopolistic competition with more than one operating companies, we explain further structural change from the demand perspective. We find that the increasing number of operating companies has been in favour of consumers not only by increasing availability of ICT services but also by offering consumers wider options for selection from the different ICT supplier companies. For instance, our results indicate that from all the respondents' perspective, fixed telephone is mainly supplied by Sudatel and Canar, mobile

telephone is mainly supplied by Zain and Sudani and Internet services are mainly offered by Sudatel and Sudani. Our findings indicate that the above-observed structural change in the supply side from monopoly by Sudatel to monopolistic competition with many operating companies has been in favour of consumers not only by increasing availability of ICT services, but also by increasing competition between different ICT supplier companies to attract more consumers by offering ICT services with high or improved efficiency, low or cheap prices and also the introduction of price discrimination mechanisms. Our results indicate further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT from the demand perspective in relation to the supply side, for instance our findings imply shift from Sudatel as ICT pioneer company to Zain as new recent ICT supplier company. Our results imply that the justification of this shift or structural change is related to preference of certain characteristics of the supplier company. For instance, our findings imply that from all the respondents' perspective, the preference of the company offering ICT services indicates that Zain is the most preferred company and ranks first compared to other companies because of its distinguished characteristics in terms of fashion, style, good design, efficiency and high quality, ease of use and price discrimination; Zain is also ranked second next to Sudani in terms of cheap price. This result is also consistent with the conventional stylised fact in the theoretical literature concerning the rationality of consumers. Another piece of evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our findings on the methods of connection to the Internet, which indicate significant shift from connection via dial-up by telephone to connection by ADSL. For instance, our results indicate that from all the staff's perspective, for the majority, the most widely used and common way for connection with the Internet is through ADSL, which is used by near to half of all respondents, followed by connection by wireless, which is used by near to one third of all respondents and finally by fixed telephone which is used by near to one fifth of all respondents. Further evidence in support of the hypothesis on the incidence of structural change in the demand for ICT can be elaborated from our findings, which imply that from all the staff's perspective, for the majority, in both the home and office mobile telephone, computer and Internet are widely used, while fixed telephone is less often used. Our results indicate that from all the respondents' perspective ICT is often and widely accessed in both the home and office, while Internet café and telecommunication offices are less often widely used compared to both home and offices as common locations for the use of ICT. In particular, both computer and Internet are very often used in office or work place; this is probably because they are offered free of charge in the office or work place for the respondents in public and private Sudanese universities.

Apart from the above observed structural change in the demand for ICT, our findings in Chap. 5 verify the third hypothesis in Chap. 1 that the demand for the four ICT modes amongst public and private university staff in Sudan is determined by income, education attainment level, age, and gender. Our results prove the fourth hypothesis in Chap. 1 that the demand for or the use of Internet shows positive significant correlations with the use of telephone; the use of/spending on IT

(computer) shows positive significant correlations (complementary relationships) with both telecommunication and ICT training amongst public and private university staff in Sudanese universities. Our results are consistent with the findings in the theoretical and empirical endogenous growth literature on the correlation between ICT components and human capital.

Chapter 8 focuses on the impacts of ICT in connection, transformation, creation and transfer of knowledge in Sudanese universities. Section 8.1 presents an introduction. Section 8.2 shows Sudanese national ICT strategy and policy in higher education in section. Section 8.3 explains the efforts made by the Sudanese Ministry of Higher Education and Scientific Research and then the effort made by some Sudanese universities, notably, universities in Khartoum, Sudan, Juba, Ahfad and Computerman to enhance the use of ICT to meet the multiple needs for enhancing connection, creation and transfer of knowledge. Section 8.4 discuses explain from the demand perspective the effect of ICT and opportunities and challenges for the creation and transfer of knowledge in Sudanese universities. Finally, Sect. 8.5 provides the conclusions. Our results discussed in Chap. 8 verify the fifth and sixth hypotheses in Chap. 1 on the importance and impacts of ICT in facilitating the creation and transfer of knowledge in Sudanese universities. Our results are consistent with the results in the theoretical and empirical literature. We show that the use of ICT, namely Internet, facilitates connections, networks and communication inside knowledge institutions, namely Sudanese universities, facilitates connections with other institutions in Sudan, with regional and international institutions, collaboration between Sudanese universities and international universities, northern institutions and integration of Sudanese universities into the system of global knowledge production. Our findings support the hypothesis that the use of ICT introduces 'positive-negative' effects by providing opportunities for the production, creation and transfer of knowledge, but simultaneously also creating hazards to production, creation and transfer of knowledge in Sudanese universities: the positive effect is enhancing access, production and dissemination of knowledge, building connections and organisational changes; the negative transformation is building disconnections for those who do not share the knowledge and do not know how to use ICT. Our results show that the most important advantages related to the use of Internet for facilitating connections and transformations and enhancing the production, creation and transfer of knowledge, include increasing digital knowledge for academic and researchers by finding information that was earlier not available or accessible, rapid quantitative (in number) and qualitative (efficiency and speed) increase in transferring available information. In addition to development of a new model for disseminating and distributing electronic information, where the information moved towards the user and not the other way around, increased creation and transfer of knowledge and increased free access to electronic publications for academic purposes. Our findings indicate that the top problem related to the use of Internet is the lack of or inadequate regular budget for university libraries to pay for access to scientific and technical information, licenses and subscriptions. Finally, the general conclusion of this chapter is that the advantages of using ICT in Sudanese universities are more than the challenges or

difficulties. We explain that ICT introduces opportunities and challenges for the creation and transfer of knowledge. One of these challenges or difficulties is that ICT has the capacity to lead to disconnection and to marginalisation of some people. By disconnection we mean the difficulties of getting connected due to the difficulties on both the supply and demand sides. On the supply side disconnection is probably caused by poor availability, inefficiency and interruption or irregular supply of ICT services. On the demand side, disconnection means lack of ability to connect that is probably due to both poverty and therefore, inability to have access to ICT and the lack of adequate skill and knowledge to use ICT, particularly for the poor. This implies that disconnection leads to creating gaps and marginalisation of some people who are poor and lacking access and other people who are lacking skill and knowledge to use ICT. The major ethical and political implications are that ICT, by causing disconnection, has the potential to add a new form of marginalisation and therefore add to the already existing inequalities between the different social groups in Sudan. The major policy recommendation on the demand side is increasing subsidies for the poor to facilitate their access to ICT and increase literacy, skill and knowledge about ICT to improve access to ICT. The major suggestion on the supply side is increasing availability, sustainability and improving efficiency of ICT services. The findings in Chap. 7 are consistent, agree with and add a new case study to contribute to the literature on ICT, higher education institutions and universities in Africa (cf. Durrant 2004; Beebe et al. 2003; Olukoshi and Zeleza 2004), universities in Egypt (cf. (Radwan 2003: Cairo University and other Egyptian universities), Kenya (Thairu 2003: Kenya Education Network), Kenya and Nigeria (Oyeyinka and Adeya 2003), Mozambique (Massingue 2003: Eduardo Mondlane University), South Africa (Adei 2003: South Africa University), Tanzania (Mutagahywa 2003: Dar es Salaam University), and Zambia (Mwenechanya 2003: Zambia University). Our results are useful to improve understanding of the role of ICT in production, creation and transfer of knowledge in Sudan as a new case study in the literature. In addition in this research we fill the gap in the literature by focusing only in Sudan as a new case study in the literature; mainly we explain the importance of the use of ICT for facilitating connection within knowledge institutions and for introducing opportunities and challenges for the creation and transfer of knowledge.

The findings in Chap. 8 suggest that ICT is leading to significant transformation by facilitating connection, creation and transfer of knowledge in Sudanese universities. The introduction of ICT has the potential to support scientific research activities, improve the ways of acquisition of knowledge, support the restructuring of administration and modernisation of Sudanese universities and facilitate access to electronic publications and online courses and distance learning, help solve the problematic access to limited members in enrolment through distance education, help bridge the knowledge divide by improving accessibility to scientific and technical information, facilitate internal and external connections, improve collaboration between south-south and south-north and create and transfer knowledge. In the future ICT has the potential to continue playing an important role and facilitate connection, creation and transfer of knowledge in Sudanese universities provided

that they manage to overcome the difficulties on the supply and demand sides, in particular, improve skill, training and knowledge about ICT and improve availability, sustainability and efficiency of ICT infrastructure (cf. Durrant 2004). In addition to increasing government spending for the development of ICT infrastructure in higher education and for provision of subsidies to offer adequate regular budgets for university libraries to pay for having licenses or subscriptions and access to scientific and technical information. However, there are both political and ethical issues related to government spending on ICT. As for the political issue, the justification of the commitment of the Sudanese government spending on the development of ICT for the universities, is probably because the universities relate to the elite and their power-position; therefore, when the Sudanese government spends money on ICT it is then sponsoring its own elite. In addition to the political issue, there is also an ethical issue if the Sudanese government spends scarce resources (i.e. money for development) on the development of ICT for the universities, thereby reducing the amount of money it has available for addressing important issues such as poverty and health. This is probably implies a disadvantage of ICT, as government spending on ICT draws money away from other urgent targets (the poor). The major implication here is that more spending on ICT, probably implies less spending on social development such as health and poverty reduction, consequently, poverty will continue to increase and the poor will suffer more. Therefore, probably, the challenge would be how to make the right balance and trade off between allocations of government funds to different priorities. The major policy recommendation is to encourage private sector involvement on ICT and to focusing government spending on ICT more towards the beneficiaries of the poor by upgrading their skills, offering more education and employment opportunities for the poor that will also contribute towards achieving the UN Millennium Development Goal of halving the share of people living in poverty by 2015.

Our findings show that the main problems on the supply sides are the lack of government spending on ICT, lack of or inadequate investment, high costs of offering services, low quality/efficiency of the services, lack of networks, interruption/disconnection of the services, lack of R&D, slow speed of the services, interruption of electricity supply, inadequate capacity of services, lack of infrastructure, uncertainty related to investment in ICT and lack of technical skills. Whereas, the main problems on the demand side are high spread of electronic illiteracy, high cost for offering the services, lack of awareness of the importance of ICT in the new economy and high spread of poverty. Based on these results, our findings indicate that the major recommendations and policies on the supply sides include improvement and increase in R&D, improvement and increase in infrastructure, improvement and increase in efficiency and capacity of services, improvement and increase in speed of the services, introduction of policies to increase collaboration in the field of research and publication and free access to electronic publications for academic purpose in developing countries, introduction of policies to reduce the digital and scientific gap between Sudan and advanced countries in the world, improvement and increase in government spending and investment on ICT, encourage the use of preferential tariff or free access to

electronic publications for academic purpose in developing countries, treatment of problem of interruption/disconnection of services, improvement and increase in networks offering the services, treatment of interruption of electricity supply and encouragement and support of private investment to offering services. Whereas, the main recommendations and policy on the demand sides includes, improvement and increase in quality of education and electronic knowledge and eradication of electronic illiteracy, reduced cost for offering the services, improvement and increase in awareness of the importance of ICT in the new economy, improvement and increase in income and eradicate poverty. Therefore, the major policy implications from our results is that it is essential for policy making in Sudan and Sudanese universities to enhance the use and impacts of ICT, mainly by motivating the effective use of ICT for creation and transfer of knowledge, enhancing quality and accumulation of human capital and skill and offering adequate budget for enhancing ICT in Sudanese universities.

Our findings from the ICT survey indicate that the use of ICT has grown and increased in Sudan, despite many obstacles that are represented in the high cost. For instance, the academic staff confirm the importance of ICT, mobile phone, computers and the Internet, for their personal use, but the high cost of mobile negatively affects their expenses because of their high and widespread personal use of mobile. We find that the ICT technology has qualitatively affected and eased the burden of long-distance for the branches of institutions within and outside Sudan. Although, the impact of high technology may be effective over the long term, the benefit and advantages from the use of Internet services, especially in scientific research depends on the capabilities of the user and knowledge of the English language and mastery of specialisation and cooperation with international institutions to provide access to specialised sites. We find that certainly the impact of information technology is very useful if properly employed for the purposes of scientific research. But it may have negative effects if not employed properly. Our findings from the ICT survey imply several recommendations for the use of ICT in Sudan. We recommend the government to seriously address the problems hindering access and use of ICT and to facilitate the provision of ICT modes at reduced costs and free of charge provision of fixed telephone and exemption of the input related to the transfer of information technology. In view of the problem of low standard of living in Sudan that is reflected in all aspects of life, including ICT, the government needs to address technological illiteracy, the limited ability of most people even educated people to acquire computers at home, the limited access to ICT service to certain segments of society, notably, the financially able and highly educated and lack of access to ICT to poor people due to the high cost that constitutes a burden for the poor. We appeal to the responsible authorities to facilitate free of charge provision, connections and access or facilitating subsidised provision of ICT services for all members of the community in every place (school, home, workplace, etc.), especially, the poor and rural areas, in order to contribute to increasing education and raising awareness. Since the use of ICT is related to the level of development, income and knowledge, we recommend increasing income and living conditions and skill and knowledge for all Sudanese to improve their access to ICT. In addition

we recommend improving the literacy and knowledge about the English language and research strategies for information retrieval on the Internet. Moreover, we recommend reducing the official control over access to Internet and removing all obstacles in the flow of information, and easy provision of ICT in accordance with the state's general policy, principle, moral values, general regulations and sound measures. We recommend avoiding the negative impact and treatment of the problem of the seizure of the information and blocking and controlling of important academic programmes and websites, without any objective justification to withhold important useful websites that may be due to limited cultural attitudes. We recommend improving use of electronic publications. Moreover, we recommend maximising the productive use of ICT and minimising other currently widespread misuse of ICT for unproductive, unimportant and unnecessary purposes, for example, leisure, entertainment, to follow up the news of celebrities, songs, movies, etc. In addition, we recommend enhancing the direction of the use of ICT for all purposes of production and development and dissemination of knowledge in Sudan. We recommend increasing sufficient awareness of the importance of ICT and its impact on development and scientific knowledge amongst all Sudanese, not only among the highly educated people. We recommend reforming the laws and legislations for the protection of IPR related to the use of ICT. In addition, we recommend implementing other important policies in the demand side by focusing on the import of equipment with high efficiency and design, reducing the tariff imposed on it, facilitating acquisition by consumers, in addition to ensuring quality (total quality assurance (TQA)). Moreover, we recommend improving government policy towards the use of ICT and linking that to the various government strategies and provision of all necessary infrastructure and human development. In addition, we recommend the government encourage increasing investment and accelerating the diffusion of ICT, as more investment in the information technology is needed, especially given the Internet is not accessible to about 60 % of the population of Sudan, notably the rural population. In addition, we recommend the government encourage the introduction of the use of ICT at all education levels; we recommend the provision of training for all public people interested in the use of ICT means. We recommend increasing the use of ICT and its direct impacts on increasing production, by reducing the cost and increasing the efficiency and speed of the Internet and reducing the burden imposed on many families in the Sudan as a result of ICT use. Moreover, we recommend that the expansion in the use of ICT must be well thought out so that it adds to the positive development of human, social, cultural and economic development in Sudan.

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