SUDAN REGIONAL STAND IN KNOWLEDGE ECONOMY DEVELOPMENT

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ABSTRACT

Purpose: The main purpose of this article is to examine the existence and development of the Knowledge Economy (KE) in Sudan.

Design/methodology/approach: Evidence is gathered from different national and international sources to corroborate the country's KE story and to compare its performance to peer African and Arab countries. The performance is judged based on tacit and codified knowledge strands, quantified using several international indicators and measurements.

Findings: Evidence reveals that Sudan is lagging in many aspects of the KE, including low investments in education, R&D activities and labour, technological and skills capabilities.

Originality/value: The findings support further understanding of the mechanisms of development and functioning of the KE in Sudan and may trigger strategic reforms aimed at building a conducive environment for the use of knowledge in economic development.

Keywords: knowledge economy; KE; educational attainments; R&D; capabilities; Sudan.

INTRODUCTION

In modern economies, knowledge creation, use and innovative activities are important drivers of economic growth and wealth creation. The term *knowledge-based economy*, derives from the full adoption of knowledge and technology in economic growth (OECD, 1996). Several economies have recognised the leading role of knowledge in focusing the role of information, technology and learning in economic performance. The Singaporean and the South Korean scenarios provide valuable policy lessons and good models of successful implementation of knowledge-based development strategies that have led to a rapid and sustainable knowledge-led economic growth and diversification reforms (Wong, 2008; World Bank, 2006).Resource-based economies, on the other hand, might enjoy positive economic development given the right institutional settings (Paltseva and Roine, 2011). However, it is clearly noted that in addition to several economic and political problems, wealth generated from natural resources tend to delay diversification reforms. Natural resources, however, are best utilised by quality human resources and practical use of knowledge (Gerasymchuk and Sakalosh, 2007).

In this context, it is worthy to note that knowledge constitutes two distinct divisions, namely tacit and codified sources. The tacit aspect of knowledge describes personal knowledge and human capital and skills, acquired, for example, by learning experience or insights. Tacit knowledge is difficult to transfer or state in an explicit form. This is contrary to codified or explicit knowledge where transfer can easily take place through codification.Codification is defined as a process of transforming knowledge into a format that facilitates the storage and the transfer of knowledge as information technology and infrastructure, with the aim of making it accessible to a group of beneficiaries or users over long distances and across boundaries (Johnson and Lundvall, 2001).

The main purpose of this paper is to examine the existence and development of the Knowledge Economy (KE) in Sudan. Produced evidence is used to understand the country's KE stand and level of development and to compare its performance to peer African and some Arab countries.

The rest of the paper is organised as follows. In the next section, the methodological approach used to realise the study objectives is outlined. A brief socio-economic and background overview of Sudan is then presented. The section that follows discusses the results of the analysis. The last section provides some concluding remarks and policy implications.

METHODOLOGICAL APPROACH

Evidence is gathered from different national and international sources to corroborate the country's KE story and development and to compare its performance to peer African and Arab countries. The performance is judged based on tacit and codified knowledge strands quantified using several international indicators and measurements. The World Back international database on the Knowledge Index (KI) and the Knowledge Economy Index (KEI) is also utilised. A descriptive comparative approach is used to analyse the data.

SOCIO-ECONOMIC BACKGROUND

Sudan is located in the North-East of the continent of Africa, bordered by seven counties and the Red Sea in the east. The country occupies an area of 1.86 million square kilometres. According to the Sudan Central Bureau of Statistics' (CBS) National Baseline Household Survey (NBHS, 2010), the country's population is estimated to be around 28.7 million persons (excluding nomads, the homeless and people living in camps), with an average household size of six persons. The share of the population living in the urban areas is 36%. Sudan population is dominantly young, with 43% of its population aged less than 15 years old and 28% between 15 and less than 30 years old.

The Labour force participation rate is reported at 48% for the population aged 15 years and above. Almost three quarters of the labour force are males, females accounted for only 23%, NBHS (2010). According to the NBHS 2010 report, total unemployment rate in the country is estimated at 13% with a share of 9% among males and 23% among females. The share of the Sudan population below the poverty rate, derived from the 2009 NBHS survey, reached 46%. According to this survey, poverty is defined as persons with the value of monthly total consumption below SDG 114.

Table 1 display's Sudan's standing with respect to a number of health and socio-economic indicators, compared to neighbouring African and Arab countries, including the Gulf Cooperation Council (GCC) countries. The country's standards of living and economic development (measured by a GDP per capita of 2162.1 PPP current international US dollars) seem to rank its economy among the lower medium-income countries, in a better performance compared to peer African countries in the table, but lower than Egypt and Tunisia. The gap is huge compared to the oil producing GCC countries. Strikingly, the country has recently suffered negative economic growth manifested in a GDP per capita reaching an annual figure of -10.1 in 2012. The recent decline in economic growth had been preceded by a positive growth during the period from 1999 to 2010, reaching a maximum GDP per capita of 11.5 in 2007, thanks to increased oil revenues due to increased oil production and exports. The decline in economic growth is mainly caused by the loss of about 75% of the oil wealth following the secession of southern Sudan. The high percentage of the Sudanese population in poverty, with an income of less than 2 US dollars per day, is problematic and is impacting the social and economic well-being of the population as a whole. Evidence suggests indirect effects and role of poverty in the reduction

Table 1	Socio-economic and health characteristics of the Sudan and some other countries				
Country	GDP per capita (ppp USD) (2012)	GDP Growth (annual %) (2012)	Poverty Headcount Ratio at 2 USD a Day	Human Development index (HDI) (2013)	Life Expectancy at Birth (2013)
Sudan	2162.1	−10.1	44.1 (2009)	0.473 (166)	62.1
Ethiopia	1108.8	8.5	77.6 (2005)	0.435 (173)	63.6
Kenya	1736.9	4.6	67.2 (2005)	0.535 (147)	61.7
Uganda	1329.8	3.4	64.7 (2009)	0.484 (164)	59.2
Egypt	6614.2	2.2	15.4 (2008)	0.682 (110)	71.2
Tunisia	9635.7	3.6	4.3 (2010)	0.721 (90)	75.9
GCC	41683.6	4.3	–	0.821	76.4

Source: UNESCO Institute of Statistics Database; UNDP Human Development Report 2014.

of innovation capacity (Hall and Howell-Moroney, 2012).The Sudanese situation, however, is much better than that of its closest neighbours, namely Ethiopia, Kenya and Uganda, but much worse than the situation in Egypt and Tunisia.
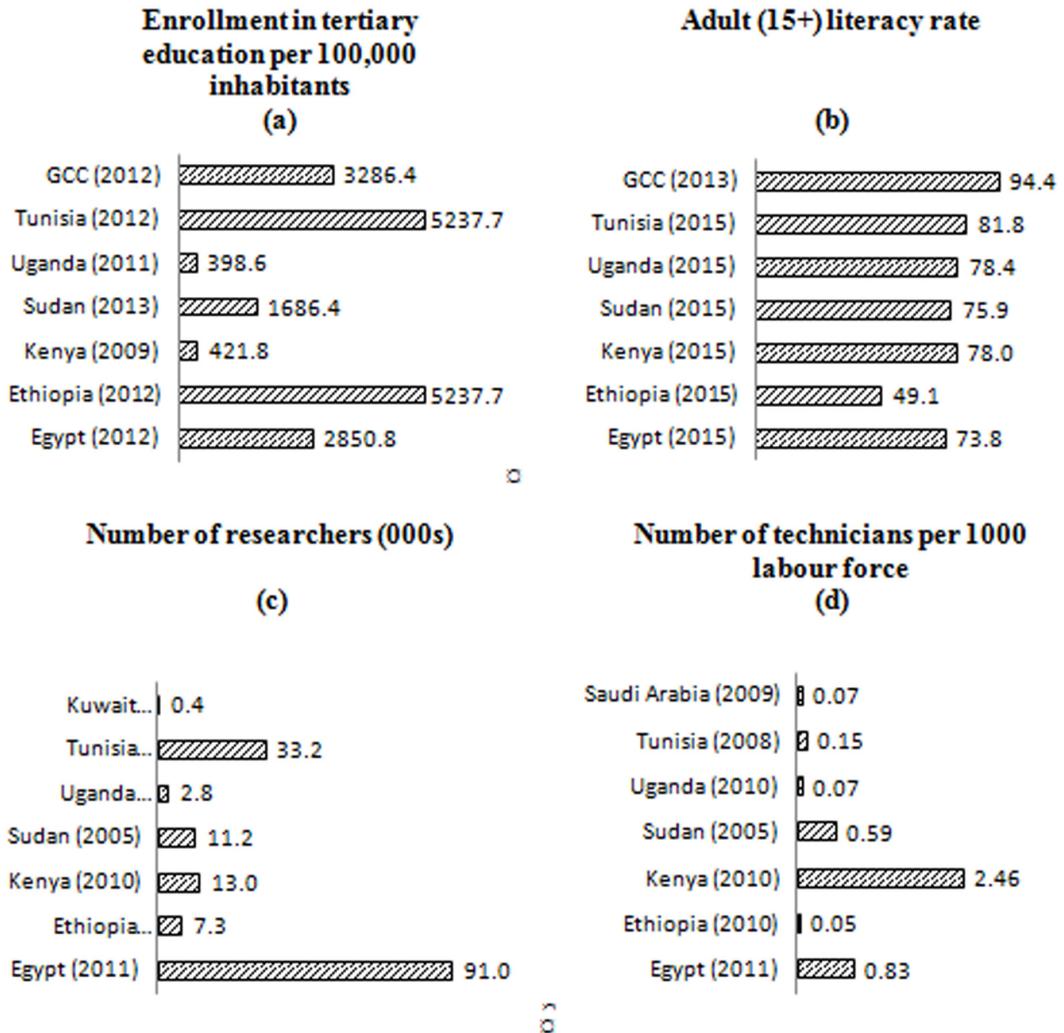
Other health and socio-economic aspects of life in Sudan are measured by the Human Development Index (HDI), a composite index that reports Sudan's progress in three dimensions, namely life expectancy, years of schooling and income, all of which are directly or indirectly related to the realisation of a KE (Hall and Howell-Moroney, 2012). The pace of progress of human development in the country remains very slow. Globally, Sudan is ranked 166 with an HDI score of 0.473, positioning itself among the low developing countries, achieving close parity with Ethiopia and Uganda (see Table 1). The country's position is worse compared to either Egypt which is ranked 110 and is classified among the medium developing countries or Tunisia with a rank of 90, positioned among the high developing countries.

ANALYSIS RESULTS

Investigating presence and development of KE in the Sudan

Presence of knowledge is assessed by introducing several indicators that might approximately quantify the tacit and codified aspects of knowledge in the country. Several indicators are used to proxy tacit knowledge, namely enrolment in tertiary education per 100,000 inhabitants, adult literacy rate among the population of age 15 years and above, and total headcounts of researchers and technicians in the country. Two indicators are used to measure codified knowledge; namely, government spending on education and spending on R&D (GERD) as a percentage of GDP.

Exploring the tacit sources of knowledge depicted in Figure 1, it is evidently clear that Sudan is lagging behind its African and Arab peers in terms of the extent of knowledge necessary for the existence of a KE. In tertiary education,the country came second after Ethiopia with an enrolment rate of 1686.4 per 100,000 population, but better than both Uganda and Kenya (see Figure 1a). Comparing tertiary enrolment rates within the Arab domain, it seems that the

Enrollment in tertiary education per 100,000 inhabitants
(a)

GCC (2012) 3286.4
Tunisia (2012) 5237.7
Uganda (2011) 398.6
Sudan (2013) 1686.4
Kenya (2009) 421.8
Ethiopia (2012) 5237.7
Egypt (2012) 2850.8

Adult (15+) literacy rate
(b)

GCC (2013) 94.4
Tunisia (2015) 81.8
Uganda (2015) 78.4
Sudan (2015) 75.9
Kenya (2015) 78.0
Ethiopia (2015) 49.1
Egypt (2015) 73.8

Number of researchers (000s)
(c)

Kuwait... 0.4
Tunisia... 33.2
Uganda... 2.8
Sudan (2005) 11.2
Kenya (2010) 13.0
Ethiopia... 7.3
Egypt (2011) 91.0

Number of technicians per 1000 labour force
(d)

Saudi Arabia (2009) 0.07
Tunisia (2008) 0.15
Uganda (2010) 0.07
Sudan (2005) 0.59
Kenya (2010) 2.46
Ethiopia (2010) 0.05
Egypt (2011) 0.83

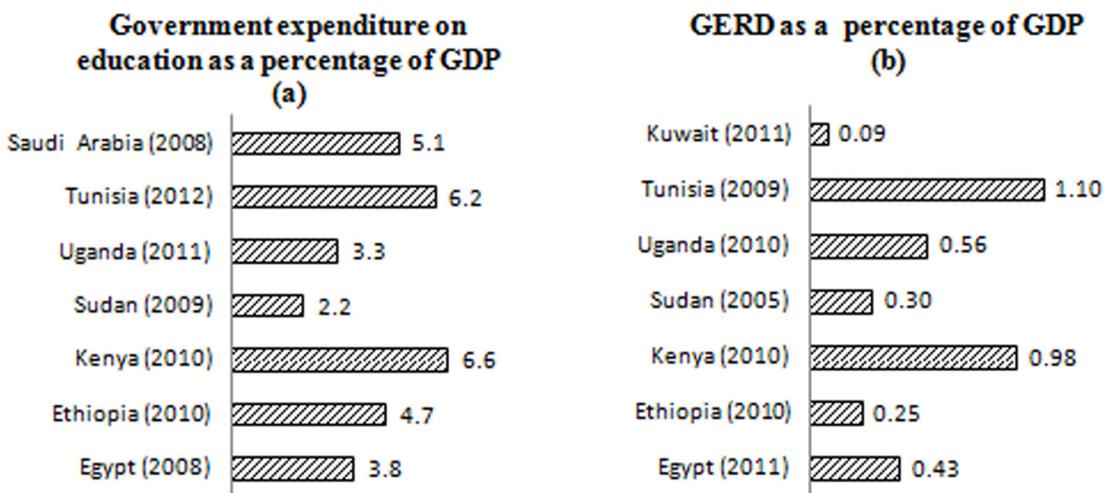*Data Sources:* UNESCO Institute for Statistics (2015).

Figure 1   Proxies of tacit knowledge

country is doing no better than any of the countries in the comparison group. The gap seems very wide between Sudan and Tunisia and between Sudan and Egypt. Futhermore, the country attains almost half the average rate of the GCC countries (Figure 1a).

The level of population literacy, in particular literacy among the workforce, significantly impacts the county's adoption and use of knowledge in economic activities (Allam and Abdalla Alfaki, 2013). According to the adult literacy rates depicted in Figure 1b, the Sudanese performance (75.9) is average, compared to its African peers (after both Kenya (78.0) and Uganda (78.4)). Compared to peers from the Arab world, the country is doing better than Egypt (73.8) but producing lower performance than Tunisia (81.8) and the GCC countries (94.4).It is important to note that the KE is essentially focused on the production and management of ideas, data and information. Human capacity building and presence of capable workers, including research teams and technical staff,to manage these processes are therefore essential.

Based on UNESCO data (Figure 1c and d), the Sudan's stock of qualified research and technical staff is very small.In 2005, it accounted for slightly over 11.2 thousand researchers and less than 1 technician per 1000 persons in the labour force. This is small compared to international benchmarks and knowledge-based economies (e.g., estimated number of researchers and technicians in the Republic of Korea are given as 375.2 thousands and 4.3 technicians per 1000 labour force, respectively). Despite the small number of researchers and technicians, Sudan occupied the second place after Kenya (13.0 thousands) in terms of the number of researchers, and the third place after Kenya (2.46) and Egypt (0.83)in terms of the rate of technicians per 1000 persons in the labour force.

Two commonly used indicators of transferable codified knowledge are presented in Figure 2, namely government spending on education and spending on R&D as a percentage of the GDP. It is argued that spending on education, through both private and public services or from public spending alone, is a process of human capital formation and accumulation (Blankenau and Simpson, 2004; Glomm and Ravikumar, 1992). Evidence shows significant relationships between education, knowledge and innovation (see e.g. Kamara et al., 2007). Education is perceived to enhance employability, improve income and reduce poverty (Gupta et al., 1999). On the other hand, accumulated R&D expenditures of a country or firm are often interpreted as its knowledge stock (Dirk and O'Byrnes, 2007).On this point, Dirk and O'Byrnes elaborate that economies exhibit an increase in R&D with an increase in the size of the economy, because as knowledge stock becomes more important to the economy, investments in R&D to generate new knowledge becomes imperative. In this context, Sudan has shown very low investments in both education and R&D with the magnitude of 2.2% and 0.30% of its GDP, respectively,(see Figure 2).The Sudanese government spending on education is the lowest compared to both its African and the Arab world counterparts. In the case of the GERD (spending on R&D),the country's spending is also the lowest within both the selected African and Arab world groups, excluding Ethiopia and Kuwait, respectively. Moreover, the country is showing a negative GERD

Data Sources: UNESCO Institute for Statistics (2015).

**Figure 2   Proxies of codified knowledge**

trend. The GERD value has consistently dropped from 0.53% of the GDP in 1999 to 0.3 in 2005. This declining trend questions the level of knowledge development in the country and the progress being made towards a knowledge-based economy.

It seems that the gap between Sudan and its neighbouring low-income countries in codified sources of knowledge is significant. This gap is envisaged to grow even wider when the country is compared to developed countries or knowledge-based economies. It seems that Sudan needs to improve public spending on education and different aspects of R&D.

The KI and the KEI

The KEI is an aggregate index representing a country's overall preparedness to compete in the KE, World Bank (2009). The KEI is based on a simple average of four sub-indexes, which represent the four pillars of the KE, namely, economic incentive and institutional regime (EIR), education and training, the innovation and technological adoption and Information and Communication Technology (ICT) infrastructure. The KI, on the other hand, is similar to the KEI but excludes the EIR pillar.

The EIR comprises incentives that promote the efficient use of existing and new knowledge and the flourishing of entrepreneurship. An efficient innovation system is made up of firms, research centres, universities, think tanks, consultants and other organisations that can tap into the growing stock of global knowledge, adapt it to local needs and create new technological
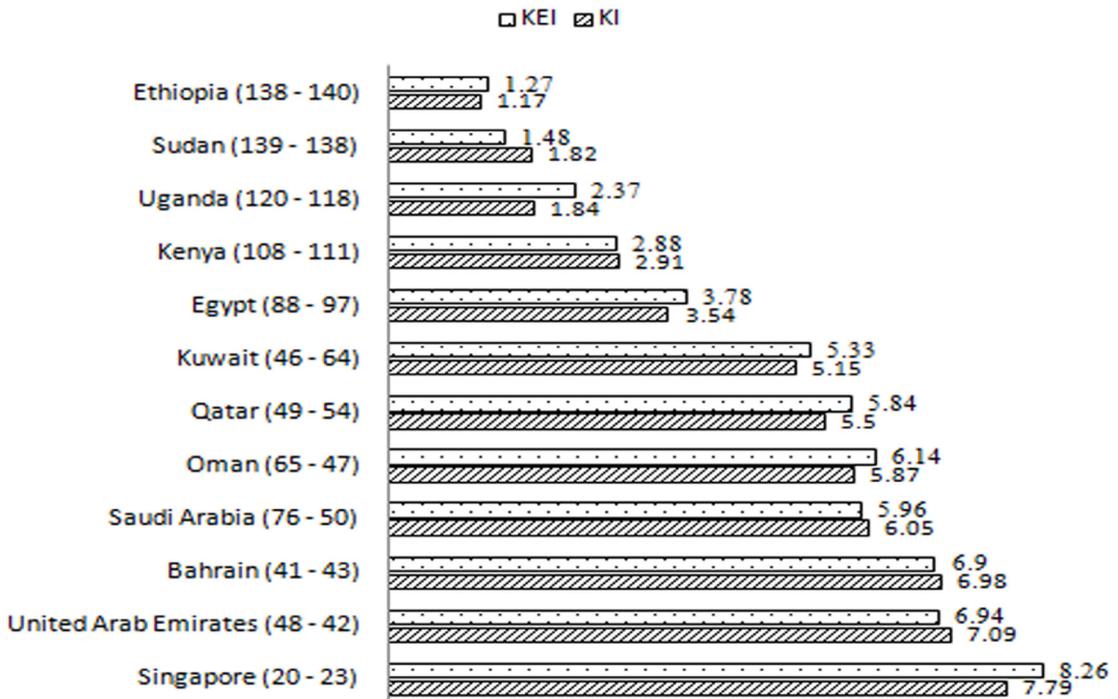
Source: KAM 2012 (www.worldbank.org/kam).

Figure 3   The KI and the KEI (numbers in brackets indicate the change in country ranking between 2000 and 2012)

solutions. An educated and appropriately trained population is capable of creating, sharing and using knowledge. A modern and accessible ICT infrastructure serves to facilitate the effective communication, dissemination and processing of information.

It appears from the KI and KEI scores depicted in Figure 3 that the Sudan is poorly performing within the African and Arab regions. Its performance is only better than that of Ethiopia. Out of 146 countries, Sudan occupied the 138th position in terms of the KEI.

CONCLUDING REMARKS

The main purpose of the paper is to examine the existence and development of the KE in Sudan. Several national and internal sources of data are employed to achieve the objectives. The existence of the level of knowledge needed to fulfil knowledge-based economy requirements is tested through the use of several indicators which represent both the tacit and codified aspects of knowledge. Further analysis employed the World Bank KI and KEI to measure the Sudanese progress and development towards the KE. Evidence reveals that Sudan is lagging in many aspects of the KE, including low investments in education and R&D activities.

The study findings may help in further understanding of mechanisms of development and functioning of the KE in Sudan and may help in trigger strategic reforms aimed at building a conducive environment for the use of knowledge in economic development. Much work is needed to improve in county's performance in many indicators of knowledge generation and human capital development, particularly in raising literacy levels in the population and increasing entry into tertiary and technical education as well as in devising policies for retention of trained human capital.

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BIOGRAPHICAL NOTES

Ibrahim M. Abdalla Alfaki is an Associate Professor in the Department of Statistics in the College of Business and Economics at the United Arab Emirates University, where he has been a faculty member since 1998. He completed his PhD at Edinburgh Napier University in Scotland and his undergraduate studies at the University of Khartoum in Sudan. His research interests lie in the area of social and economic statistics, with focus on income distribution, sustainability and human development. Lately, his interests extended to the study of global competitiveness and statistical assessment of acountry's transition into knowledge economy. Following prior work, he is still focused on safety research and risk analysis of traffic injuries and mortalities. He is a member of the World Association of Sustainable Development (WASD) and consulting editor of the World Journal of Entrepreneurship, Management and Sustainable Development (WJEMSD).